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Hunter Estuary Management Study

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Final Report

Hunter Estuary Management Study

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Title :	Hunter Estuary Management Study
Author :	Dr Philip Haines, Michelle Fletcher, Brad Snedden
Synopsis :	This report provides information on future management strategies for the Hunter estuary. It details the objectives of long-term management and discusses some of the strategies that may be adopted to meet these objectives

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FOREWORD

The estuaries of NSW represent a priceless natural resource. Collectively, they are immensely valuable from an ecological, social and economic perspective. NSW has over 130 estuaries that vary in size from small coastal creeks and lagoons to large lakes and rivers. Estuaries contain diverse ecosystems that form the foundation of the coastal food chain. They provide important habitats for a variety of marine and terrestrial plants and animals.

Estuaries have a special place in the lives of most Australians. Many people want to live near estuaries and if they can't, they want to take their holidays there. Over 75% of the NSW population live and work in towns and cities near estuaries. A high proportion of the State's commercial activity occurs near estuaries as they provide an important focus for industry, tourism and recreational activities. This high level of development pressure means that estuaries are subject to a range of direct and indirect impacts due to land use in the catchment, changes to hydrology and tidal processes, and the direct use of the estuary waterway. In recognition of the need for future sustainable use of these threatened resources, the NSW Government is implementing a number of key strategic initiatives, one of which is the Estuary Management Program.

The Hunter River is one of the largest estuaries in NSW, and arguable the most complex from a landuse and an administrative perspective. This document represents the Estuary Management Study for the Hunter River Estuary, and has been prepared by environmental consultants BMT WBM and Parsons Brinckerhoff (PB) on behalf of the Hunter Coast and Estuary Management Committee. The methods followed in preparing the report are consistent with the framework outlined in the NSW Government's Estuary Management Manual.

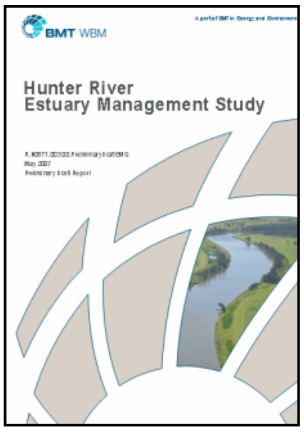
The precursor to the present study is the Hunter Estuary Processes Study (MHL, 2003), which outlines the hydraulic, sedimentation, water quality and ecological processes within the estuary, and the impacts of human activities on these processes.

The scope of the present report has been directed by input from the community, industry and relevant government agencies. In this regard, the study team gratefully acknowledges contributions from more than one hundred individuals who have assisted in preparation of this document. This level of stakeholder involvement was achieved through a comprehensive program of consultation including five open invitation community workshops, over ten industry and government agency workshops, a planning workshop (with representatives from the three relevant Councils and the NSW Department of Planning) and ongoing information dissemination through newsletters and a dedicated website (www.hunter-ems.com.au). This provided a foundation of knowledge and opinions about the estuary and is a key strength of the document.

The final step in the process is the development of a companion document, the Estuary Management Plan for the Hunter River. The Estuary Management Plan is largely based on the recommended strategies outlined in this Estuary Management Study, and aims to be a 'users guide' for future management activities around the Hunter River.

EXECUTIVE SUMMARY

Who should read this report?



An Estuary Management Plan for the Hunter Estuary has been developed on behalf of Newcastle, Maitland and Port Stephens Councils and the NSW Department of Environment and Climate Change to guide long term sustainable management of the estuary and its surrounding environments. This document, the Hunter Estuary Management Study (HEMS), is a companion document to the Estuary Management Plan. It forms the foundation for the Plan by outlining the requirements for future management, providing a comprehensive list of possible management options, and prioritising these options to give a shortlist of recommended strategies, which are described further in the Estuary Management Plan.

The HEMS is therefore of interest to all those concerned about the future condition and management of the Hunter Estuary, and provides further information and background details in support of the Estuary Management Plan.

For more information on the NSW Estuary Management framework, refer to Chapter 1.

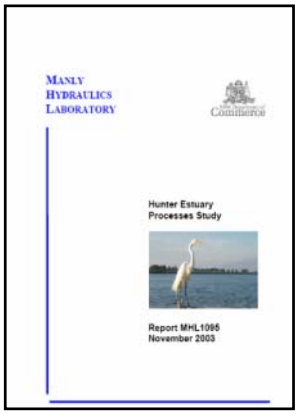
What geographic area is covered by this Study?

The Hunter Estuary includes all tidal waters of the Hunter River and its tributaries. This includes the banks and bed of the waterway from the Port of Newcastle to the tidal limits at Seaham Weir (on the Williams River), Gostwyck (on the Paterson River) and Oakhampton (on the main Hunter River).

Whilst the principle focus of the study is the tidal reaches of the river and the fringing riparian zone, considerations and recommendations have also been made that extend well into the catchment, as it is the catchment processes that are largely responsible for many of the processes within estuary, including freshwater inputs, sedimentation and water quality.

For more background information on the study area, refer to Chapter 1.

What is this study trying to achieve?



The present study brings together the latest scientific knowledge of the estuary and the aspirations of the wider community and government agencies to develop a series of strategies that will improve and protect the condition of the Hunter Estuary into the future.

The HEMS recommends a series of well founded, outcome-focussed and feasible management strategies within a framework that is acceptable and able to be funded by appropriate management organisations. In order to achieve this, a comprehensive program of community, industry and

government agency consultation has been undertaken.

Extensive scientific analysis and research into the Hunter Estuary has preceded this study, and are documented in the Hunter Estuary Processes Study.

For more information on the scientific understanding of the Hunter Estuary, refer to Chapter 2.

What are the aspects of the estuary that need protection?

The valued aspects of the Hunter Estuary include:

- ✓ Internationally significant wetlands
- ✓ Fishing (commercial, recreational) and aquaculture
- ✓ Connection to wildlife corridors
- ✓ Wetland rehabilitation works
- ✓ Economic role of Port
- ✓ Importance to agriculture
- ✓ Diversity of habitats
- ✓ The Hunter River Flood Mitigation Scheme
- ✓ Tourism and recreational uses
- ✓ Cultural / heritage significance
- ✓ Scenic value
- ✓ Groundwater dependent ecosystems

For more detailed descriptions of estuary values, refer to Chapter 5.

What are the problems with the Hunter Estuary?

The issues or problems that were identified through this study include:

- × Habitat loss
- × Bank erosion and sedimentation
- × Impacts on native flora and fauna
- × Lack of riparian vegetation
- × Mangroves and noxious weeds invasion
- × Estuary management co-ordination
- × Protecting estuary significance
- × Development pressures and land management
- × Estuary users and conflicts
- × Heritage
- × Scenic quality
- × Changes to estuarine hydraulics
- × Flood mitigation works
- × Fishing
- × Water quality
- × Agricultural inputs
- × Urban inputs
- × Industrial inputs
- × Water extraction
- × Dredging and commercial sand and gravel extraction
- × Need for foreshore reserves
- × Port operations
- × Climate change
- × Condition of sea walls

For more detailed descriptions of the issues, refer to Chapter 6.

How can we address the issues and protect the values?

Ideas for addressing the problems and protecting the values associated with the Hunter Estuary were compiled from the community, relevant government and Council representatives and other interest groups. Further options and strategies were then developed by the study team.

More than 100 options were formulated and considered. Additional community consultation and workshops with key agency staff were undertaken to refine the list of options down to a manageable and implementable number.

The top 25 recommended strategies are outlined in Chapter 9 of this report. These strategies include a range of approaches, such as on-ground works, monitoring and further research, community education and capacity building, planning controls and administration tasks.

Who will fund the implementation of the strategies?

Most strategies discussed within this document and included in the companion Hunter Estuary Management Plan are eligible for 50 / 50 funding under the NSW Estuary Management Program. Funding may also be sourced from State and Federal Government Grants, through the Hunter Central Rivers Catchment Management Authority (HCRCMA) or through Councils Programs.

In-kind contributions are also expected by stakeholders, existing land managers and land holders.

STATEMENT OF ENDORSEMENT

The success of the Hunter Estuary Management Plan will be dependent upon resources, time and enthusiasm of a range of organisations and individuals. For this reason, a significant effort has been made to ensure that anyone who wishes to contribute has had the opportunity to do so. Upon finalisation of the Estuary Management Study and Estuary Management Plan, it is intended that a Statement of Endorsement / Memorandum of Understanding will be prepared and signed by relevant agencies. The Statement of Endorsement illustrates support for the Plan and the process of developing the Plan. It also illustrates a level of commitment to implementation of the Plan, giving recognition to the multitude of issues that require consideration by the various organisations and authorities.

Proposed signatories of the Statement of Endorsement would likely include:

- Newcastle City Council
- Port Stephens Council
- Maitland City Council
- NSW Department of Environment and Climate Change (Coasts & Floodplain)
- NSW Department of Environment and Climate Change (Parks & Wildlife)
- NSW Department of Environment and Climate Change (Environmental Protection & Regulation)
- NSW Maritime Authority
- Hunter-Central Rivers Catchment Management Authority
- NSW Department of Primary Industries (Fisheries)
- NSW Department of Primary Industries (Agriculture)
- NSW Department of Planning
- NSW Department of Water and Energy
- Hunter Water Corporation
- Newcastle Ports Corporation

DEFINITIONS AND ACRONYMS

Acid Sulphate Soils (ASS)	Soils that contain iron sulphides. When the sea level rose and inundated land (see Post-glacial Marine Transgression), sulphate in the seawater mixed with land sediments containing iron oxides and organic matter. The resulting chemical reaction produced iron sulphides. When exposed to air, these sulphides oxidise to produce sulphuric acid.
Alluvial sediment	Sediment washed from the catchment and deposited via flooding / runoff processes
ANZECC guidelines	Guidelines for water and sediment quality, prepared by the Australian and New Zealand Environmental Conservation Council
Astronomical tide	Daily variations in ocean water level, driven by astronomical features, including the moon and sun
Baseflows	Ambient flows within a waterway, which are mostly derived from groundwater discharges
Bathymetry	Underwater land topography
Benthic biota	Organisms living on or in the bed of the estuary
Benthos	Collection of organisms living on or in the bed of the estuary
Biobanking	A biodiversity banking and offsets scheme. 'Biodiversity credits' are generated by landowners who commit to enhance and protect biodiversity values on their land. These credits can then be sold, generating funds for the management of the site. Credits can be used to counterbalance (or offset) the impacts on biodiversity values that are likely to occur as a result of development. The credits can also be sold to those seeking to invest in conservation outcomes, including philanthropic organisations and government.
Boat wake	Bow wave that are generated by a boat as it moves across a water surface
CAP	Catchment Action Plan (developed by the HCRCMA in 2007)
Catchment runoff	The flow of water across the ground surface within a catchment following rainfall
DCP	Development Control Plan
DECC	NSW Department of Environment and Climate Change
DoP	Department of Planning
Ebb tide	Outflowing tide (flowing seaward)
Ecological communities	Assemblages of plant and or animal populations
EIS	Environmental Impact Statement
El Nino	A weather phenomenon that occurs in the eastern and central equatorial Pacific Ocean. During an El Niño, winds weaken and sea temperatures become warmer (see also La Nina)
EMP	Estuary Management Plan
EMS	Estuary Management Study
Environmental Flows	Fresh water flow that is maintained (or not allowed to be used for other, typically anthropogenic, purposes) solely for environmental reasons, to maintain the health and biodiversity of a particular water-related entity, such as an estuary (Peirson et al 2002)
EPI	Environmental Planning Instrument (includes LEP, REP and SEPP)
EPS	Estuary Processes Study
ESD	Ecologically Sustainable Development
Flood tide	Incoming tide (flowing landward)

Half tide level	The average water level over the whole tidal cycle (half way between high and low tides)
HBOC	Hunter Bird Observers Club
HCEMC	Hunter Coast and Estuary Management Committee
HCRCMA	Hunter Central Rivers Catchment Management Authority
HENP	Hunter Estuary National Park
HRC	Healthy Rivers Commission (ceased to exist in 2004)
Hydrodynamics	The movement of water
Hydrosurvey	Survey of the underwater surface of a waterway
ISQG	Interim Sediment Quality Guidelines – see ANZECC
La Nina	A weather phenomenon that involves unusually cold ocean temperatures in the equatorial Pacific Ocean (see also El Nino).
LEP	Local Environmental Plan
LGA	Local Government Area
LHRS	Lower Hunter Regional Strategy
MCC	Maitland City Council
MHL	Manly Hydraulics Laboratory
Microalgae	Marine algae that is not visible to the naked eye (requires microscopic identification)
NCC	Newcastle City Council
MT	Management Target from the Hunter Central Rivers CMA CAP
NHT	National Heritage Trust (Money available for Environmental projects from the partial sale of Telstra)
NPWS	NSW National Parks and Wildlife Service (now included in DECC)
Nutrients	An element or simple compound necessary for the health and survival of an organism. Mostly refers to Carbon, Phosphorus, and Nitrogen.
POM	Plan of Management (within this report the abbreviation specifically refers to a POM prepared under the National Parks and Wildlife Act, 1974)
Pneumatophores	Aerial peg roots of mangroves
Propagule	A part of a vegetative body capable of independent growth if detached from the parent (eg seeds, spores)
PSC	Port Stephens Council
PVP	Property Vegetation Plan
REP	Regional Environmental Plan
Riparian vegetation	Vegetation that grows in close proximity to a waterway
Salinity	Measure of the amount of dissolved salts within water
Saltmarsh	An area that is colonised by salt-adapted ('halophytic') plants
SEPP	State Environmental Planning Policy
STP	Sewage Treatment Plant
TN	Total Nitrogen
TP	Total Phosphorus
Water Sharing Plan	A water sharing plan is a legal document prepared under the *Water Management Act 2000*. It establishes rules for sharing water between the environmental needs of the river or aquifer and water users, and also between different types of water users such as town supply, rural domestic supply, stock watering, industry and irrigation

A NOTE ON GOVERNMENT DEPARTMENTS

In recent years, and notably during the course of this project, a number of Government departments have undergone name changes, reorganisations and/or amalgamations with other departments.

With respect to Natural Resources Management, the principal agency is now the Department of Environment and Climate Change (DECC). This is an amalgamation of the previous Department of Environment and Conservation (both EPA and NPWS divisions) and some sections of the former Department of Natural Resources. This includes the functions of DNR previously responsible for Estuary Management and Coastal Management. The remainder of DNR was combined with the former Department of Energy, Utilities and Sustainability to form the current Department of Water and Energy (DWE). DWE administers tidal pool licensing, which includes some environmental conditions.

Departmental names provided in this report (the Hunter Estuary Management Study), and the accompanying Hunter Estuary Management Plan, are correct at the time of drafting (October 2008). Further changes to these departments may occur during the course of implementation (ie within the next 10 + years). Care should therefore be taken when reading these documents to ensure that due consideration is given by the appropriate government departments at the time.

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1 INTRODUCTION

1.1 The Study Area

The Hunter Estuary is a barrier estuary, meandering through Worimi, Wonnarua and Awabakal country, over millions of years. From the most inland tidal limit at Gostwyck, on the Paterson River, some 75km from the ocean, the estuary meanders through agricultural lands, some of the earliest developed townships in Australia and internationally important wetlands to the largest coal port in the world, the Port of Newcastle.

The term “Hunter Estuary” describes the waterway, bed and banks of the tidal section of the Hunter River and its tributaries (such as the Williams and Paterson Rivers, Wallis and Fishery Creeks, Ironbark Creek and Throsby, Styx and Cottage Creeks) (refer to Figure 1-1). The adopted tidal limit for the Hunter River is in the vicinity of Oakhampton, which is about 64km from the ocean.

The waterway itself is used by commercial and recreational fishers, recreational boaters, nature observers, and sand and gravel extractors. It is also a receiving water for waste water treatment plants, agriculture, industry, stormwater and catchment runoff. Additionally, it serves as a water source for agriculture and as habitat to an internationally significant menagerie of resident and migratory animals. The physical diversity and complexity of the estuary is reflected in the many interest groups that are connected to the estuary. These groups include government agencies, Aboriginal Land Councils and Aboriginal Elders groups, conservation organisations, recreational groups and industry groups.

1.2 Purpose of This Document

The Hunter Estuary Management Study seeks to bring together the current scientific understanding of how the estuary works and an understanding of the aspirations for future management of the estuary.

This document identifies and assesses a range of potential future management options that aim to protect the values of the estuary (ie those aspects of the estuary that are good), and address the issues facing the estuary (ie those aspects of the estuary that require attention).

The purpose of this Estuary Management Study is to:

- Document the aspects of the Hunter estuary valued by the human and environmental communities;
- Document and describe the issues faced by the estuary, from a scientific, community and management perspective;
- Establish and prioritise objectives for the future management of the estuary;
- Identify responses that will promote ecologically sustainable development consistent with the *NSW Coastal Policy 1997;*
- Present detailed information on potential management options for the study area, including likely costs, benefits, constraints, opportunities and impacts;

- Evaluate management options in terms of their ability to promote the adopted objectives for the study area;
- Make recommendations as to the preferred management strategy; and
- Make the above information readily accessible to the community, thereby enabling informed community participation in the selection of appropriate management options.

1.2.1 Vision for the Estuary

The Hunter Coast and Estuary Management Committee have prepared the following vision statement for the Hunter Estuary to represent the overall goal of the Estuary Management Plan.

"The community, industry and government working together towards a productive, economically viable and ecologically sustainable Hunter Estuary, recognising social, cultural and environmental values"

1.3 Why Do We Need an Estuary Management Study and Plan?

Two centuries of rapid change within the catchment and estuary have had major impacts on environmental processes, resulting in a change to the condition of the estuary. Yet, the Hunter Estuary continues to support a diverse ecosystem with many ecological, economic and social values. In order to preserve these values, and to address issues currently facing the estuary, pro-active management is required. This management is required without further delay to ensure that the condition of the estuary does not continue to decline.

The Estuary Management Study is a crucial step in developing an Estuary Management Plan. An Estuary Management Plan is a strategic and long term plan developed through a specifically designed and legislated framework. Implementation and funding of the Plan are guided through the existing process. Strategies recommended in an Estuary Management Plan developed through the NSW Estuary Management Program are eligible for funding from the State Government. Completion of the Hunter Estuary Management Plan is also required under the Hunter Central Rivers Catchment Action Plan.

The NSW Government's Estuary Management Framework is described further in Section 1.4.

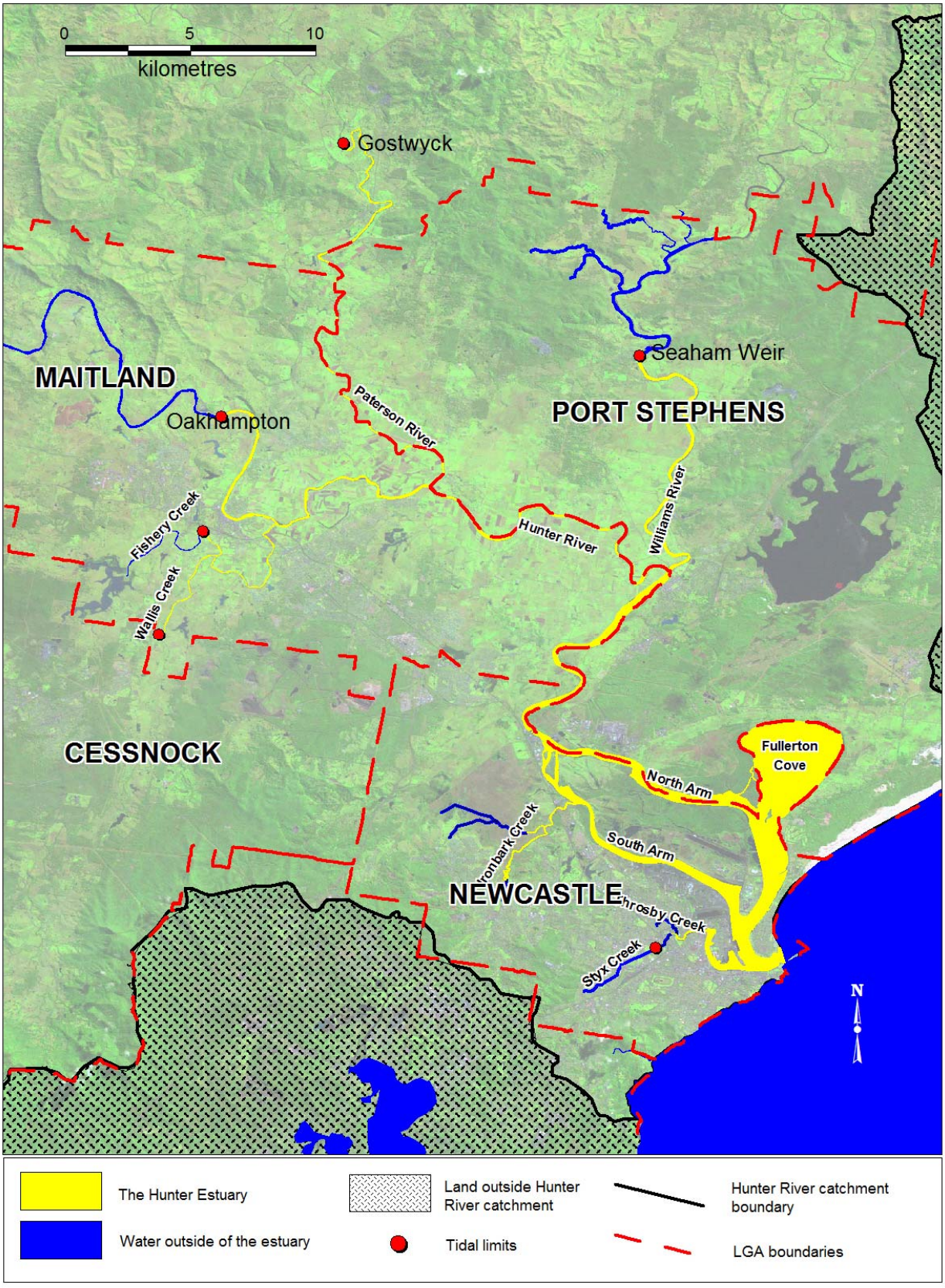


Figure 1-1 The Waterways of the Hunter Estuary

1.4 The NSW Estuary Management Program

The NSW Government's Estuary Management Manual (1992) was released to assist local councils in developing balanced management plans for their estuaries. The Manual outlines a framework of distinct steps to be followed leading to the production of an estuary management plan. Community input is a key component of this process.

The process of managing an estuary, in accordance with the Estuary Management Manual, is initiated by the establishment of an Estuary Management Committee. This Committee is then responsible for the development of an Estuary Processes Study, which outlines all the hydraulic, sedimentation, water quality and ecological processes within the estuary, and the impacts of human activities on these processes. The Hunter Estuary Processes Study was completed by Manly Hydraulics Laboratory (MHL) in 2003.

The next step is to undertake an Estuary Management Study. This study develops management objectives and considers all feasible management options that address the identified issues of concern that are affecting the estuary. From the findings of the Management Study, an Estuary Management Plan is prepared. The Plan describes how the estuary will be managed, gives recommended solutions to management problems, and details a schedule of activities for the implementation of the recommendations. Once the Plan has been accepted by both the Community and the relevant Government Departments, the Plan can be implemented through planning controls, works programs, monitoring programs, and education services. The general estuary management process, as established by the NSW Government, is shown in Figure 1-2.

1.4.1 Membership of the Hunter Coast and Estuary Management Committee

The Hunter Estuary Management Committee was convened in 1997 and amalgamated with the already established Hunter Coast Management Committee to form the Hunter Coast and Estuary Management Committee (HCEMC).

Membership in the committee, at the time of preparation of the Estuary Management Study and Plan, comprised representatives from the organisations listed in Table 1-1.

1.5 Relationship to the Hunter-Central Rivers Catchment Action Plan

The Hunter-Central Rivers Catchment Action Plan 2007 (CAP) was developed by the HCRCMA to provide a coordinated plan for all natural resource work in the region through partnerships and collaborations with government, industry, community groups and individuals. The document prioritises natural resource issues in the whole Hunter Central Rivers region, and guides rehabilitation effort where it is considered most essential. This CAP has a term of ten years, but may be modified over time as new information becomes available or priorities change.

Table 1-1 Organisations represented on the Hunter Coast and Estuary Management Committee (HCEMC)

State Government

- Dept. Environnent & Climate Change (Env Protn & Regn Group)
- Dept. Primary Industries – Fisheries (prev. NSW Fisheries)
- Dept. Environment & Climate Change (Coastal and Floodplain Prog Sect)
- Dept. of the Premier and Cabinet
- Dept. Environment & Climate Change (Parks and Wildlife Group)
- NSW Maritime Authority (prev. Waterways Authority)
- Hunter-Central Rivers Catchment Management Authority
- Dept of Planning

Councils

- NCC – Councillors (incl Committee Chair)
- NCC – Environmental Educator
- NCC – Senior Strategist – Integrated Flooding
- NCC – Strategic Planning & Development (Group Manager)
- NCC – Senior Strategist - Environment
- Maitland City Council
- Port Stephens Council
- NCC – Asset Manager – City Services
- NCC – Principal Strategist – City Direction
- NCC – Principal Strategist City Coast and Estuary

Industry Stakeholders

- Newcastle Port Corporation
- Hunter Water Corporation
- Kooragang Wetland Rehabilitation Project Manager (HCRCMA)
- Port Waratah Coal Services
- Hunter Development Corporation

Community Stakeholders / Representatives

- Commercial Fishermen's Co-operative Ltd
- Newcastle District Anglers Association (Sec)
- Hunter Surf Industry Cluster
- Oceanwatch
- Hunter Bird Observers Club (HBOC)
- Community representative (coastal management specialist)
- Community representative (Newcastle)
- Community representative (Stockton)
- University of Newcastle

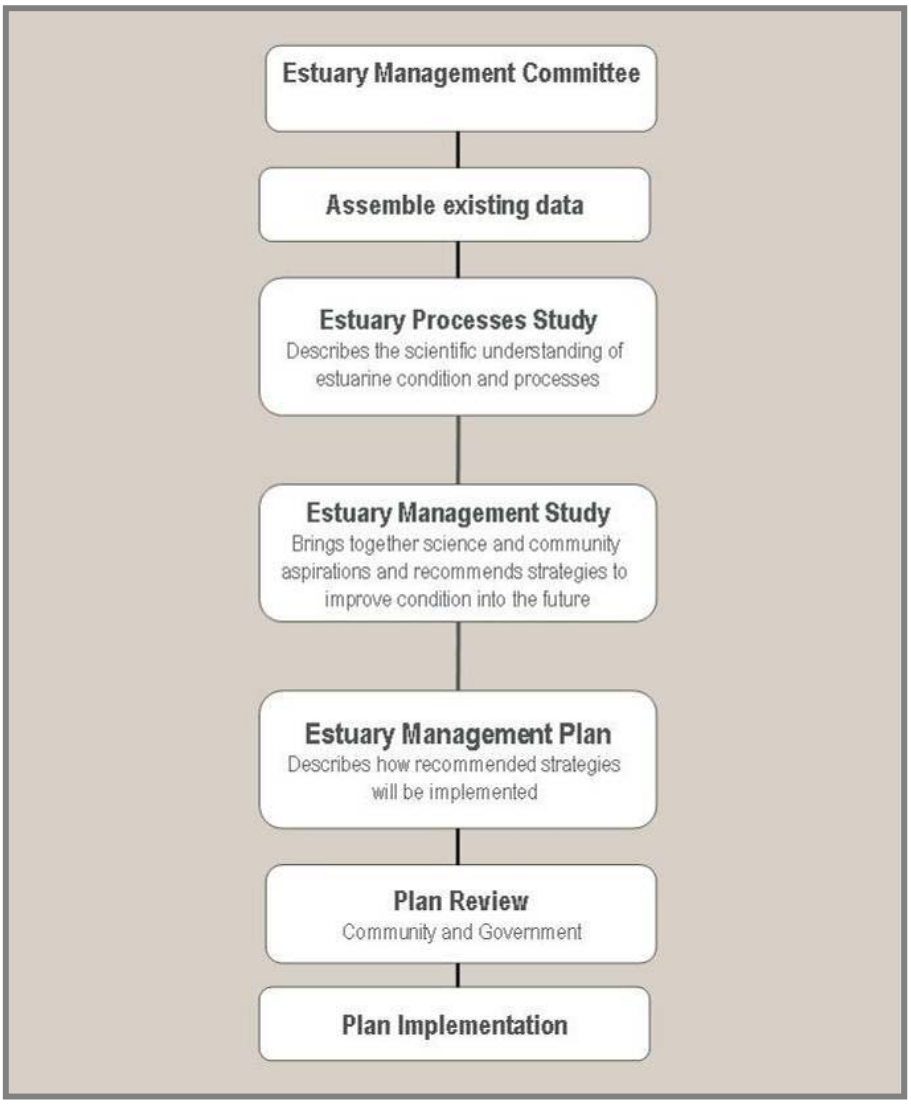


Figure 1-2 NSW Estuary Management Framework

The HCRCMA will be an important funding mechanism for strategies included in the Hunter Estuary Management Plan. For this reason, the detailed descriptions of short listed strategies included in Section 9 of this report include brief outline of the relationship to the CAP, where appropriate. Also, strategies that were considered "quick wins", namely, on-ground works with a high environmental benefit to cost ratio, have been identified. For more details on the "quick wins", refer to Section 9.26.

It is important to recognise that the CAP and associated natural resource management targets are for the whole HCRCMA area, and not just the Hunter Estuary. The HCRCMA area includes some 37,000 square kilometres, from Taree in the north, to Gosford and the coastal waterways of the Central Coast in the south, and from Newcastle in the east to the Merriwa Plateau and Great Dividing Range in the west.

1.6 Structure of this Report

This report is divided into nine key chapters, each of which represents a stage in the development of a series of short-listed strategies for the Hunter Estuary.

Chapter 1 sets the scene, describes the NSW Estuary Management Framework and outlines what is trying to be achieved.

Chapter 2 summarises the scientific understanding of how the estuary functions.

Chapter 3 describes the consultation undertaken in the development of the HEMS.

Chapter 4 describes the planning framework relevant to the estuary.

Chapter 5 summarises the valued aspects of the estuary.

Chapter 6 discusses the key issues that need to be addressed.

Chapter 7 documents the adopted Estuary Management objectives.

Chapter 8 outlines the process of short listing options.

Chapter 9 describes each of the recommended strategies.

The report structure beyond this introduction is shown in Figure 1-3.

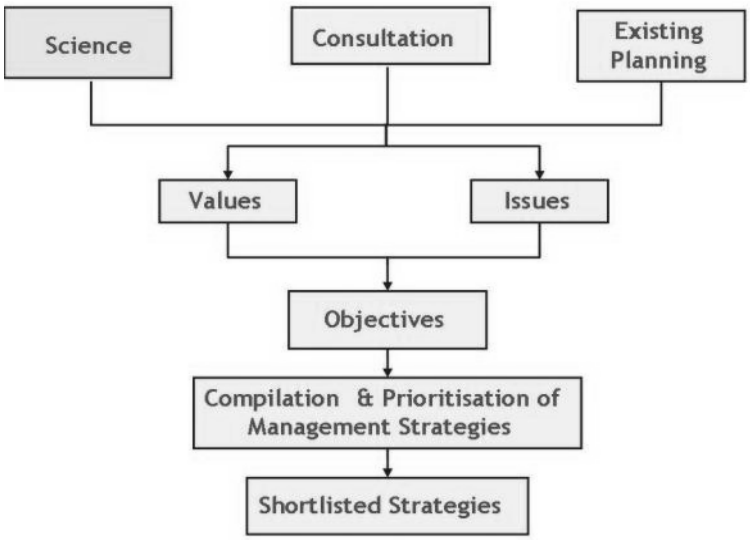
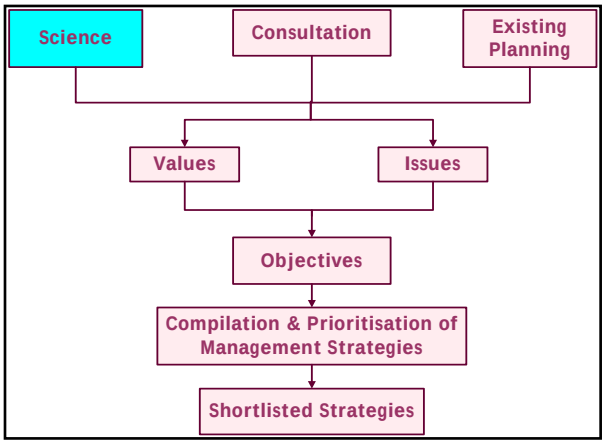


Figure 1-3 Structure of this Report

2 OVERVIEW OF ESTUARINE PROCESSES



The information in the following sections is adapted from MHL (2003), unless otherwise referenced.

2.1 Catchment

The Hunter River Catchment is one of the largest in NSW covering an area of approximately 22,000km^2. This catchment was once covered in thick rainforest, largely unvegetated natural floodways, alluvial cedar brush forest, tall eucalypts and melaleuca and Casuarina swamps. Most of this natural bushland was cleared by early Europeans. MHL (2003) describe land management practices by early agriculturalists as “ruthless”.

Present day landuses along the estuary are predominantly agricultural upstream of Hexham, interspersed by a number of urban centres including Maitland and Morpeth. Riparian vegetation is mostly absent for this section. Downstream of Hexham, landuses are more varied and include the urban areas of Newcastle, Newcastle Port Development and associated infrastructure, industrial areas and the Kooragang Nature Reserve.

The Hunter Estuary Management Study and Plan will consider land uses and activities throughout the catchment for the Hunter Estuary, as these have significant consequences for estuary condition. As well as the estuary side landuses described above, wider catchment landuses include mining and bushland.

2.2 Hydraulics

2.2.1 Channel Bathymetry and Morphology

The dynamic nature of estuaries is such that bathymetry and morphology is in a state of constant change. This is in response to the processes including flood, wind, ocean waves and tides. Over and above this natural variation, the bathymetry and channel morphology of the Hunter Estuary has changed significantly in the past 200 years as a result of human activities. These activities have included direct modification of the estuary bed levels through port dredging and removal of sand and gravel for use in building materials from the upper estuary. Changes to bathymetry have also manifested as a result of the construction of floodgates, drainage channels and groynes, catchment and riparian zone clearing and bank stabilisation works.

MHL (2003) describe the bathymetry of the Hunter Estuary, based on modelling completed by Hunter Water in 1990 and more recent hydrosurveys undertaken by Newcastle Port Corporation. This description includes maintained depths of 14 to 16 metres in the Port, rapidly decreasing to about 4 metres upstream in the South Arm to about 1 metre at the Junction with the North Arm at Hexham. The majority of tidal flows are conveyed through the North Arm, where depths are generally greater than 5 metres and up to 9 metres on the outside of bends. Fullerton Cove is mostly very shallow, with depths of less than two metres.

Bathymetric and morphologic change is typically initiated by flooding in the river. The Hunter River Geomorphology Study (PBP, 1993 – cited in MHL 2003) states that between 1879 and 1959, the length of river between Maitland and Morpeth has reduced from 24km down to just 9.6 km. This is in response to large floods creating new 'short-cuts' across old meanders. It is expected that the cleared condition of the catchment has prompted such drastic morphological change, through increased flood volumes, velocities and sediment transport loads.

Dredging has also been carried out in the Hunter River since 1845. Annual maintenance dredging of the Port of Newcastle removes around 300,000 m^3/year of sand and silt. Most of this material is dumped off shore.

Further upriver, sand and gravel are extracted from the bed and banks for use in the construction industry. This occurs at various locations, particularly around Maitland.

2.2.2 Tides

Ocean tides move through the estuary approximately twice daily. The distance travelled by each tide (tidal excursion) varies, however the tidal limits for the Hunter, Paterson and Williams River are considered to be approximately 64km, 75km and 46km from the ocean, respectively. The tidal inflow is estimated at 18,250GL per annum. Tidal inflows are the largest contributor of water to the Hunter Estuary (exceeding average freshwater flows). Further upstream the significance of tidal waters diminishes and freshwater flows become more important.

Throughout the community consultation for the current project, the issue of an anthropogenic increase in tidal range was raised. The issue was considered in the Estuary Processes Study (MHL 2003) where available tidal planes from 1955 were compared to those of 2000. The results suggest an increase on the high water components of the tidal planes, indicating a local influence such as floodgates installation rather than harbour dredging. A detailed numerical model covering the whole estuary and low-lying tidal areas would be required to assess the relative importance of each dredging and floodgate installation.

2.2.3 Freshwater Flows

The average daily freshwater flow from the catchment is 0.7GL, while the annual catchment runoff is estimated at approximately 1,800 GL (MHL, 2003). In comparison, approximately 3,000 GL (or 2 million Olympic-sized swimming pools) of runoff occurred during the June 2007 flood event. A freshwater event of 200 GL/day is capable of completely flushing the salt out of the estuary.

Discharges from underground aquifers form the baseflow of the Hunter River during dry times. The annual input of groundwater to the estuary is estimated to be about 183GL (MHL, 2003).

The largest flood on record occurred in 1955. After this event, which claimed 14 lives, the NSW Government introduced the "Hunter Valley Flood Mitigation Scheme". The scheme reportedly includes 160km of levees, 3.8km of spillways, 40km of control banks, 245 floodgates and 120km of drainage canals (DNR, 2007). Large floods are a natural event, which provide water to aquifers and replenish the layers of rich topsoil on floodplains. Many Australian plant species are dependent on these large events to trigger aspects of their life cycle. Flood mitigation works have had significant impacts on wetlands throughout the Hunter River catchment.

Up to 300 land holders extract water from the estuarine area for irrigation primarily under Basic Landholder rights (Pers. comm., David Hoey, DNR, 2007). This extraction has historically been unmonitored and free of charge. MHL (2003) estimated that Landholders were extracting about 10.7 GL/year (based on an unpublished report referred to in DLWC 1999).

A draft Water Sharing Plan for the Hunter River has been prepared under the NSW Water Management Act 2000 (DWE, 2008). All water users extracting water for domestic and stock use or for commercial activities require a licence (or other approval) from the Department of Water and Energy. Landholders over an aquifer or with river or lake frontage can access water for domestic purposes or to water stock without a licence (this is known as Basic Landholder rights). Ensuring adequate freshwater flows to satisfy estuarine requirements of the Hunter Estuary will require ongoing research and adaptive management, and has not been addressed in detail within the draft Water Sharing Plan. Investigations to date have shown little evidence of extraction stress in the Hunter estuary (Pers. comm., G Carter, 2008). Further work is necessary to clarify the issue of water extraction within the catchment and preserving environmental flows and associated ecosystem values.

2.2.4 Water Budget

Estimations of water inflows and outflows were made for the Hunter Estuary by MHL (2003), and is summarised in Table 2-1.

Table 2-1 Average Annual Contributions to the Water Budget of the Hunter Estuary

Contribution	Annual Average (GL)
Tides	± 18, 250
Catchment Runoff	1,800
Groundwater inflow	183
Rainfall (direct)	30
Evaporation	-26

2.2.5 Interactions Between Saltwater and Freshwater

Exchange and mixing processes are of importance to the distribution of salinity and pollutants in an estuary. Salinity variability is determined by a balance between the freshwater inflows (catchment runoff, groundwater flows, direct rainfall and human sources) and saltwater entering at each tide from the ocean. During floods, freshwater flows completely displace the saltwater in the estuary. Salt intrusion through tidal propagation and diffusion then follows after the floods, returning salt to the estuary. It can take up to 3 months for pre-flood saline conditions to return to the upper reaches of the estuary (MHL 2003). Investigations undertaken by Sanderson and Redden (2001) indicate that vertical salinity stratification in the Hunter Estuary is generally weak and occurs for periods of a few days to a week after flood events. It is noted that in backwater areas such as wetlands in the upper reaches where tidal currents are weaker, stratification is likely to last for longer periods, however, there is insufficient data available to confirm or quantify this (Sanderson et al 2001).

2.3 Ecology

Estuarine vegetation types in the Hunter Estuary include mangroves, saltmarsh, a variety of wetlands, Casuarinas and Melaleuca (paperbark) stands. Human impacts on estuarine vegetation include land clearing, cattle grazing, and change to flow regimes of the river. The vegetation mapping presented in the Estuary Processes Study was primarily based on broad vegetation modelling undertaken as a part of the Lower Hunter Central Coast Regional Biodiversity Conservation Strategy (LHCCREMS, 2000). A separate locally focused vegetation mapping project was undertaken in the Maitland LGA by Lisa Hill in 2003 which involved groundtruthing of the project. Targeted, systematic vegetation surveys are currently being undertaken throughout the region, focussing on previously poorly sampled environments, as an input to developing a regional revegetation community classification scheme and vegetation community maps.

The fauna that depend on estuarine habitats include fish, crustaceans (eg prawns), benthic invertebrates, amphibians, reptiles, mammals and a variety of birds. The birds include a diverse community of residential, seasonal and migratory species. The destruction of habitats and the introduction of new species have significantly negatively impacted on native fauna. The amphibians, reptiles and mammals now have relatively low diversity.

The Lower Hunter Green and Golden Bell Frog Management Plan has recently been completed for the two populations located at Kooragang/Ash Island and Sandgate/Hexham Swamp (DECC, 2007).

The Hunter Estuary and wetlands are of international significance, being listed under the Ramsar wetland convention, and utilised by 38 of the 66 migratory species protected by the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA).

The HBOC recently compiled data and individual members' records for the Hunter Estuary (HBOC, 2007). Statistical assessment of the data has not been undertaken, however seasonal and longer term fluctuations in observed abundance for a particular species at a particular wetland can be observed from data plots. The HBOC adopt the definition of significant species to include those species that are listed as vulnerable or endangered, included in the CAMBA and JAMBA agreements or present in sufficient numbers to qualify the estuary as an important bird area. A total of sixty six species meet these criteria for the Hunter Estuary. These significant species utilise some fifty wetland locations (HBOC, 2007). Many of the sites with the highest recorded bird species diversity were artificial or highly modified wetlands, including the Kooragang Dykes and Stockton Sandspit. As this study was completed subsequent to the Estuary Processes Study, the identified significant sites are presented in Figure 2-1.

2.4 History and Heritage

The Awabakal, Worimi and Wanarua people were the first to inhabit the area now known as the Hunter Valley. The diversity of the landscape would have provided for an abundance of food and other resources. Tribal groups maintained a sustainable lifestyle in the area for at least 30,000 years. Today there are about 2,000 recorded Aboriginal sites throughout the study area.

European arrival saw the introduction of large-scale exploitation of cedar trees and coal deposits. After this came the draining and filling of wetlands for agriculture, dredging of the river to enhance navigation and flood mitigation works to alter natural flow patterns. The Newcastle region was one of

the first areas to be settled by Europeans and the study area contains many structures, buildings and towns that are considered historically significant.

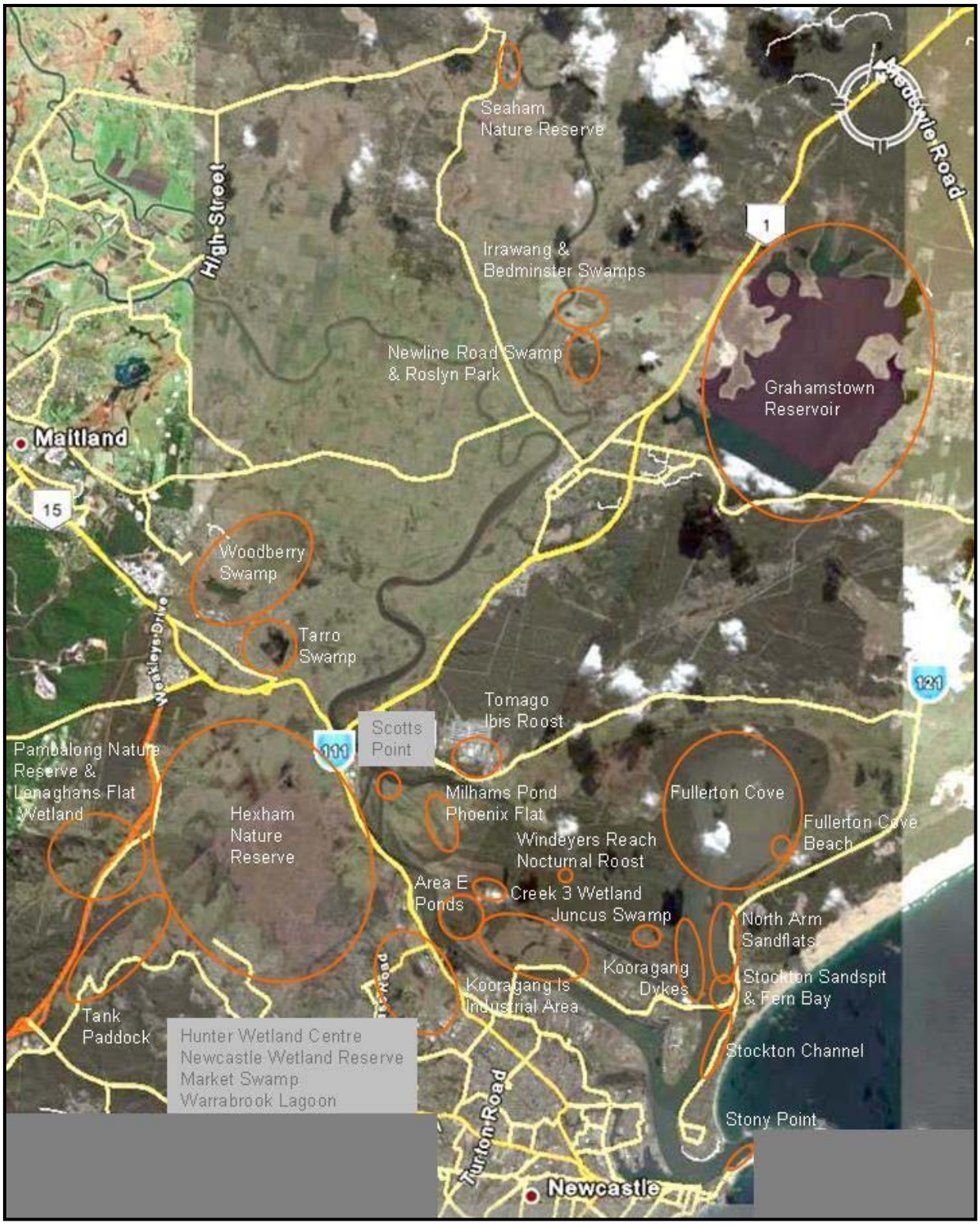


Figure 2-1 Wetlands identified as significant by the Hunter Bird Observers Club

2.5 Recreational Use

There are many recreational activities undertaken within and around the Hunter Estuary, including for example fishing, boating, water skiing, rowing, bird watching, picnicking, walking, cycling and sightseeing (to name just a few). Recreational facilities are located throughout the estuary, in particular, in the vicinity of Newcastle, Raymond Terrace, Morpeth and Maitland. Impacts of these activities include bank erosion from boat wake, foreshore vegetation destruction and potential impacts to fish populations.

2.6 Water Quality

Water quality is a broad term that generally describes the suitability of the water for its natural and human based uses. Water quality processes of estuarine systems are complex and vary considerably with time depending on freshwater flows, tidal dynamics, human influences and seasonal and longer term trends.

Water quality is integrally linked to the level of pollutants that are discharged to the river and the capacity of the estuary to evacuate these pollutants before they become problematic. The biggest influence on the water quality in the Hunter Estuary is the land uses within the catchment.

Nutrient levels within the estuary sometimes exceed recommended guidelines. This is a result of general catchment runoff and discharges from wastewater treatment works and other industries.

Monitoring of nutrients within the estuary suggests that algal blooms are probably common, but the high turbidity means that they are often not noticed, or the growth of the algae is retarded by the limited light penetration into the water. The Hunter Regional Algal Co-ordinating Committee coordinates the dissemination of algal alerts within the Hunter Region (primarily blue-green algae), but this is restricted to the freshwater creeks and pools within the catchment, rather than the estuarine reaches (Pers. comm., G Carter, DWE, 2008).

Bacteriological monitoring suggests that after rainfall there are parts of the estuary that do not meet standards for primary human contact. This is most pronounced in the Paterson River and in the Hunter River upstream of the Paterson Junction.

2.7 Acid Sulfate Soils (ASS)

Some areas around the Hunter estuary and the bed of the Hunter River have been classed as having a high probability of ASS occurrence. While the effects of acid runoff in the rural areas and the immediate drainage channels have been documented there has not been much research into the impacts of ASS on the estuary.

2.8 Erosion and Sedimentation

There are large amounts of sediment being washed into the upper estuary due to deforestation, overgrazing and bank erosion. Changes to flood patterns, together with the clearance of riparian vegetation have led to riverbank destabilisation and substantial bank erosion. Cattle access is a major factor in erosion for much of the estuary. Boat wake from recreational boaters is also a cause of erosion in the estuary.

An investigation into bank erosion in the estuarine reach of the Williams River has been undertaken by GHD (2006). The study involved a literature review, community consultation, bank condition assessment and monitoring. The monitoring was undertaken at approximately 3 monthly intervals, between January 2005 and October 2005. During this period, one of the fourteen sites (Site 10) monitored exhibited measurable erosion of the bank profile between the January and April surveys. Site 10 had already been the subject of erosion control / rehabilitation measures, including cattle exclusion, revegetation and wave baffles.

The study confirmed that the following processes contribute to bank erosion in the Williams River, however, the relative contributions of these processes could not be quantified:

- Boat wake from water-skiers and wake boarders;
- Land and river management practices (including removal of riparian vegetation, cattle access, past bank protection works)
- Natural processes and river characteristics (such as floods, wind waves, catchment runoff, soil type, tidal influence)
- Seaham Weir (through reducing the volume of sediment entering the tidal reaches)

The study recommends site specific rehabilitation works at four of the monitoring sites and the following general management strategies:

- Development and implementation of a riparian management plan (including regeneration of riparian vegetation and cattle exclusion)
- Development and implementation of a Boating Management Plan (including a trial “no wash zone for three years)

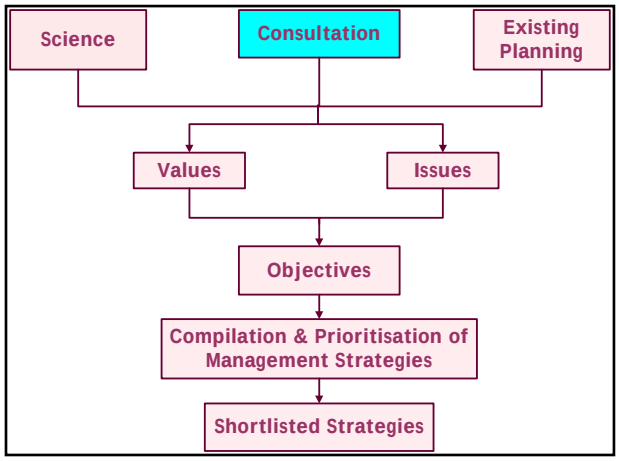
The recommendations highlight the need for broadscale overarching strategies. Site specific strategies could only be developed for sites included in the monitoring program.

Catchment erosion and riverbank/streambank erosion has lead to sedimentation within the estuary. Large sediment ‘slugs’ have developed, notably between Maitland and Raymond Terrace, slowly transported downstream under the influence of large flood events.

Fine sediment also accumulates within the deeper sections of the Port of Newcastle, necessitating the continuous dredging of the Port to maintain navigable depths for visiting ships. Approximately 300,000m^3 of fine material is dredged from the Port of Newcastle annually by Newcastle Ports Corporation, with most of this disposed offshore.

3 CONSULTATION

3.1 Community



Community input is essential to ensure the management plan reflects community priorities and incorporates the wealth of local knowledge of people who live and work with the estuary. The consultation process to date has included several methods to ensure adequate opportunity for interested parties to be involved in the project. Further, it has taken place within two distinct phases. The first phase was conducted at the initial stage of the Plan's preparation, with the second phase taking place once draft management strategies had been developed.

3.1.1 Phase 1 Community Consultation

1. **Advertisement –** Community workshops were advertised in the following local newspapers in lead up to the workshops.
    - Newcastle Herald on Wednesday 10th November 2004. Editorial in the Maitland City Council pages.
    - Newcastle Herald on Saturday 13th November 2004. Advertisement in the council pages.
    - Port Stephens Examiner on Thursday 11th November 2004. Editorial article and photo.
    - Maitland Mercury Thursday 11th November 2004. Editorial and advertisement in the business section.

2. **Letters and Fact sheet -** The consultation process involved a mail out to 182 organisations and individuals considered likely to have an interest in the estuary. Many of those were identified through their involvement in existing interest groups. The mail out included a covering letter outlining the objectives of the study and a fact sheet outlining the steps in the estuary management process. A second mail out was sent to the previous recipients informing them of details for community workshops subsequently held at Maitland, Raymond Terrace and Newcastle.

3. **Website –** A dedicated project website was established for the study (www.hunter-ems.com.au). The website includes a summary of the project objectives, program, opportunities for involvement and feedback contact. Advertisements for the workshops, fact sheets and workshop notes were posted on the website.

4. **Community Workshops** - Three community workshops were held:
    - Maitland Senior Citizens Centre – 6 - 9pm Monday 15th November 2004

- Port Stephens Council Administration Centre – 6 - 9pm Wednesday 17th November 2004
- Harbourview Function Centre, Newcastle – 6 - 9pm Thursday 18th November 2004

The three initial workshops generally introduced the project to the wider community, providing a background on the project objectives and information obtained to date. Workshops involved attendees forming groups where values, issues, concerns and strategies for the estuary were recorded (refer Figure 3-1).

Feedback from the community has comprised:

- 32 phone calls
- 9 letters
- 9 emails
- 20 attendees at Maitland workshop
- 40 attendees at Port Stephens workshop
- 30 attendees at Newcastle workshop.

Figure 3-1 Group Work at the Newcastle Community Workshop, November 2004

A summary of all feedback received was entered into an Access database. In total **over 500** issues were raised during the workshops and in submissions made to the study team. Every issue raised was considered in conjunction with the technical information (refer Section 1) to provide a listing of the *key* issues (refer Section 3.1.3) that forms the basis of the Hunter Estuary Management Plan.

Table 3-1 outlines a summary of the key values (positives), issues (negatives) and strategies (opportunities) that were repeatedly raised in the community feedback. This feedback represents the perspectives of the community and not necessarily the study team.

Table 3-1 Summary of Key Values and Issues of the Hunter Estuary

Positives/ Values		
▪ Water quality is currently improving	▪ RAMSAR site – environmental assets.	▪ Revegetation of buffer zones
▪ Estuary recreation and tourism	▪ High biodiversity	▪ Flood gates opening
▪ Control of salinity through trading scheme	▪ Kooragang Wetlands Rehabilitation Project	▪ Jobs from fishing industry (prawns, oyster)
▪ Bird life, especially migrating waders and shore bird habitat	▪ Levees and floodgates reducing sedimentation of the estuary	▪ Rich social history and active community groups
		▪ Estuary views and access
Negatives/Issues/ Concerns		
▪ Urban / mining / industrial / farming inputs (affecting recreational, environmental and commercial uses)	▪ Habitat loss (prawns, waders, birds)	▪ Estuary Management Plan will not include larger LGAs upstream
▪ Bank erosion from cattle access to river banks, dredging, boat wake, carp, wind and lack of riparian vegetation	▪ Water pollution (blue-green algae)	▪ General community apathy and government inaction
▪ Filling of natural waterways	▪ Green corridor not protected	▪ Litter interfering with recreational uses
▪ Mangrove and noxious weed invasion	▪ Hexham and Tomago floodgates closed – reducing prawn habitat	
Opportunities/Strategies		
▪ Education of the public regarding the value of the estuary through local experience and science.	▪ Restrict wake boarding	▪ Improve public access along river
▪ Marketing to promote ‘eco-tourism’	▪ Stabilise river banks / erosion control.	▪ Recycle dredged sediment – bioremediate and treat
▪ Cash re-imbursements / rate relief, to encourage rehabilitation and fencing of riparian zones on private land	▪ Public ownership of key ecological areas (such as Wentworth Swamp)	▪ Establish a ‘Lower Hunter Estuary National Park’. Hexham Swamp and Kooragang Wetlands rehabilitation
▪ Increase policing and accountability of pollution and water use.	▪ Carp control, weed management	▪ Energy dissipation systems for boat wash/waves (e.g. floating barrier)
▪ Reforestation of upper catchment to filter runoff	▪ Control stormwater runoff with water sensitive urban design (W.S.U.D.) & treatment	▪ Identify and protect sites of aboriginal heritage
▪ Ramsar, CAMBA and JAMBA nature reserve sites should be state significant	▪ Repeal SEPP 74 transport corridor	

3.1.2 Key Values

The attendees at the workshops emphasised the importance of the estuary as an internationally significant environmental asset. In particular, a healthy environment was stressed including diverse flora and fauna habitats.

A rich social history and active community groups are also considered valuable including the importance of the estuary for job creation through fishing, commercial shipping and tourism.

3.1.3 Key Issues

The workshops highlighted negative impacts on the estuary resulting from erosion, agricultural and industrial land uses, noxious weeds, flood mitigation measures, pollution and loss of habitat. Key concerns included a lack of government action towards rehabilitation and control of development.

The industrial development permitted for Kooragang Island under SEPP 74 was seen as a major threat to the estuary, as was the impact of upstream development activities.

3.1.4 Key Strategies

Numerous strategies were raised within the groups including education, modifications to the flood mitigation scheme, incentive schemes for changes in agricultural practices, increased government action and the implementation of conservation plans. Pollution control measures were a high priority, as was erosion control.

3.1.5 Phase 2 Community Consultation

Following the initial project workshops, held in November 2004, draft management objectives were developed for the Study, which were subsequently discussed with Council staff and industry representatives. To achieve broad-scale acceptance of these objectives, Council sought community input regarding the draft objectives, as well as potential options to address them, at a public workshop on Wednesday, 19 July 2006, at the Hexham Bowling Club. The workshop was well attended by over 40 people and was a key step in the development of the Plan.

The attendees were divided into groups, where detailed discussion of potential management options took place. The result was a large range of suggested management options, which are listed in a Appendix A. These suggestions were incorporated into the final draft list of management options that include options raised by the projects consultants and government bodies.

General acceptance of the draft management objectives was agreed upon by the workshop attendees, with the addition of some minor rewording. In addition to the broad-scale acceptance of the objectives and discussion of management options, the workshop attendees provided further feedback on issues and other matters, which were also considered in the development of the draft Management Study.

3.2 Government Agency

Similar to the broad community consultation process, the consultation process with the government agencies has included several methods to ensure adequate opportunity for interested parties to be

involved in the project. Again, the consultation has taken place within two distinct phases. The first phase was conducted at the initial stage of the Plan's preparation, with the second phase taking place once draft management strategies had been developed.

3.2.1 Phase 1 Agency Consultation

A technical sub-committee of the Hunter Coast and Estuary Management Committee coordinates the preparation of the study and plan. As of October 2008, the technical sub-committee comprises representatives from:

- Newcastle City Council
- Maitland City Council
- Port Stephens Council
- Department of Environment and Climate Change (Coasts and Floodplain; Environmental Protection and Regulation; Parks & Wildlife)
- Industry representatives (Port Waratah Coal Service)
- Maritime Authority
- Newcastle Port Corporation
- Hunter Water Corporation
- HCRCMA (Kooragang Wetland Rehabilitation Project)
- NSW Fisheries
- Hunter Development Corporation (formerly Regional Land Management Corporation)

In addition to government input via the technical sub-committee, agencies were included in a letter mail out and were invited to community and industry workshops in 2004/5. Other agencies also contacted included:

- State Emergency Service
- Roads and Traffic Authority
- Rural Lands Board
- Defence Estate
- Agility
- Transgrid
- Energy Australia
- Australian Rail Track Corporation
- State Transit Authority of NSW
- Telstra
- Department of Transport and Regional Services
- Department of Lands

A summary of the feedback received from government agencies is provided below.

3.2.1.1 Newcastle City Council

Positives / Values

- Waterfront amenity and tourist opportunities must be maintained while still allowing continued industrial development.
- Identify opportunities for recovery of key habitats lost through incremental and cumulative impacts

Issues / Concerns

- Need to manage the cumulative impacts of catchment developments on flooding, water quality and estuary hydrodynamics.
- The Plan must consider climate change implications.
- Enhancement and protection of water quality required.
- Management strategies should consider the extent and implications of the effects of surface and groundwater extraction.
- Protection of known areas of high conservation value, in particular including migratory shorebirds and associated habitats, listed threatened species and ecological communities (eg. saltmarsh, freshwater wetlands and coastal floodplain communities and significant locations of habitat for more common species eg. Shortland Wetlands, Kooragang Island, Tomago Wetlands and Seaham Swamp).
- Sedimentation and bank erosion and stability require improved management.
- User conflicts exist in the mid estuary (Raymond Terrace).
- Management of contamination issues (eg. Incitec groundwater plume, South Arm sediments, Throsby Basin & Throsby Ck, possibly lower Ironbark Ck from metal slag dumping).
- Management of diffuse sources impacting on water quality and other opportunities to reduce pollutant loads.
- Impact of potential leachate sites.
- Management opportunities for identified significant cultural heritage issues or locations (eg. Morpeth area).
- Weed management.
- Implications of SEPP 74 need to be determined and planned for.

Opportunities / Strategies

- Improved coordination required for dealing with estuary issues and implementation of the Plan (eg. memorandum of understanding, statutory control). Plan recommendations need to be linked to broader planning and investment decisions.

- Integration of relevant Estuary Management Study and Plan matters in Catchment Management Authority Catchment Action Plan (CAP) and delivery of recommendations through CAP investment strategy.
- Ownership and responsibility for implementation of the Plan required by governments, agencies, councils, community and industry.
- Adoption of Healthy Rivers Commission's recommendations by governments, agencies, councils and operators required.
- Forward planning and coordination of utilities, services and associated infrastructure provision (roads rail, gas, electricity, water, wastewater, telecommunications) to allow continued industrial/urban growth while minimising environmental impact.
- Consider re-use options for sediments from harbour maintenance dredging.
- Identification of future user group needs.

3.2.1.2 Port Stephens Council

Issues / Concerns

- Diminishing foreshore vegetation, especially *Phragmites australis*, at various locations.
- Need for protection and rehabilitation of endangered ecological communities, especially saltmarsh and freshwater wetlands (including fens) along Newline Road north of Raymond Terrace.
- Inappropriate and excessive boating on the Williams.
- Discharge of effluent from the Raymond Terrace sewerage treatment plant into Windeyers Creek.
- Impacts of increasing urban development (runoff, onsite sewer, farming, industrial effluent).
- Release of freshwater from the Seaham weir pool into the estuarine reach of the Williams River (Hunter Water is currently carrying out a study of changes in water quality downstream of the weir as a result of the weirs operation).
- Alligator Weed along the foreshore of the estuarine reach of the Williams River.

Opportunities / Strategies

- Identification of opportunities for future foreshore recreational facilities, including boat ramps and cycleways and determination of whether the current level of access & locations are appropriate.

3.2.1.3 Maitland City Council

Issues / Concerns

- Implications of Water Sharing Plans and other upstream issues, including mining impacts, water extraction, water quality, salt release, agricultural impacts & pollution from point sources, on environmental flows and the health of the estuary.
- Enforcement arrangements for any new regulation proposals.

Opportunities/ Strategies

- Opportunities for integration of the Maitland Greening Plan.
- Acquisition opportunities for nature conservation objectives and associated management arrangements.
- Consultation with drainage unions on flood mitigation issues.
- Opportunities to inform and integrate with the Catchment Action Plan and associated investment program.

3.2.1.4 Hunter-Central Rivers Catchment Management Authority

Positives / Values

- Hexham Swamp and Kooragang Wetland Rehabilitation Projects.

Issues / Concerns

- River and creek bank stability/erosion.
- Vegetation loss.
- Water quality.
- Excessive wash from recreational boating causing accelerated streambank erosion
- Difficultly in re-establishing aquatic vegetation in areas subject to excessive wash from recreational boating activities
- Management of migratory birds, other significant species & communities and their habitats – bioregional significance of the Hunter Estuary.
- Sustainable fishery management.

3.2.1.5 Department of Primary Industries - Fisheries

Issues / Concerns

- Using the Hunter River prawn catch as a performance indicator for river health in State of Environment reporting.
- Risks to the river environment and fish stocks.

Opportunities / Strategies

- Prohibition of oyster and shellfish harvesting in Hunter River South Arm related to industrial pollution.
- Closure to prawn harvesting in Ironbark Creek.
- Consultation with Newcastle District Anglers Association and professional fishers is recommended.

3.2.1.6 NSW Maritime Authority

Positives / Values

- No complaints relating to conflicts with rowers on the river are known.

Issues / Concerns

- Standards, maintenance and upgrading of official boat ramps and associated facilities.
- Safety of boat ramp on Kooragang Island near Stockton Bridge.
- Illegal boat ramp issues at Hexham Bridge, under Stockton Bridge, Ferry Rd Sandgate, and possibly other locations.
- Perception of bank erosion being caused by only boating activities. Uncontrolled cattle access and other poor farming practices are major contributors.
- Management of boating conflicts between wakeboard vessels and water skiers in the Williams River.

Opportunities / Strategies

- Management of boating activities can be controlled and balanced through local Boating Plans of Management developed in consultation with local communities. These can include bank stabilisation works and planting programs.

3.2.1.7 Department of Environment and Conservation – National Parks

Now known as the Department of Environment and Climate Change (Parks & Wildlife Division)

Positives / Values

- Management of conservation reserves in the National Park Estate, as outlined in respective Plans of Management.

Opportunities / Strategies

- Rehabilitation of natural processes in the estuary, in particular the management of migratory shore birds and provision of suitable foraging and roosting habitat; and rehabilitation of freshwater wetlands and related ecological functions in Hexham Swamp.

3.2.1.8 Department of Environment and Conservation - Environment Protection Authority

Now known as the Department of Environment and Climate Change (Environmental Protection and Regulation Division)

Issues / Concerns

- Licensed pollution discharges to the river.
- Port expansion proposals and related development.
- Contaminated sites management.
- Flood gates.

- Water extraction from the tidal pool.
- Discharges to waters upstream of the estuary limits.
- Effluent reuse options and strategies.

3.2.1.9 Department of Natural Resources

Now known as the Department of Environment and Climate Change (Coasts and Floodplains Division).

Issues / Concerns

- Water flows, in particular in relation to the Seaham Weir pool.
- Water quality.
- Bank erosion.
- Flood management, in particular in relation to cumulative impacts from recent developments and future development proposals.
- Sustainability of natural physical and biological processes.
- Matters related to port expansion proposals.
- Conservation of Aboriginal heritage.

3.2.1.10 Department of Lands

Positives / Values

- Crown land is a valuable resource that satisfies a wide variety of community needs including conservation, development and reservation for public purposes.

Issues / Concerns

- Dept of Lands is required to be consulted prior to any proposed activity on, use or occupation of Crown land.
- status of land ownership, including land title and tenure, allocation of land for public use, lawful use and occupation (compliance),
- assessment of appropriate use,
- sustainable and commercial management and public competition,
- environmental care, control and management,
- access to waterways and foreshores;
- management of Crown roads and reserves.

3.2.1.11 Transgrid

Issues / Options

- Scenic quality enhancement in the estuary should accommodate operation and maintenance of Transgrid's infrastructure requirements.

- All weather 4WD access to Transgrid assets and easements should be maintained.
- Transgrid access tracks should be protected from tidal inundation.

3.2.1.12 Hunter Water Corporation

Positives / Values

- Hunter Water strategies to minimise potential sewage system impacts on water quality within the estuary system.
- Hunter Water initiatives to either reduce stormwater volumes or reduce pollution within the stormwater system.
- Hunter Water sponsorship within the estuary (eg. Landcare, The Wetland Centre, Clean Streets – Clean Creeks) to heighten community awareness of water issues.

Issues / Concerns

- Water quality within the Williams River Catchment.
- Influence of freshwater on estuary and extraction.

Opportunities / Strategies

- Surface access rules will be determined by Department of Natural Resources and Hunter Water for inclusion in the estuary management process.

3.2.1.13 Aboriginal Community

Positives / Values

- The entire estuarine zone is considered significant to Aboriginal people.

3.2.1.14 Australian Rail Track Corporation

Issues / Concerns

- Need to forecast infrastructure requirements before determining areas for conservation.

3.2.1.15 Energy Australia

Positives / Values

- Plan for the provision of the new 132kV feeder at Kooragang Island.
- Access to existing infrastructure must be maintained.
- Conservation strategies should not restrict the provision of additional infrastructure.
- Kooragang Wetland Rehabilitation Project

Issues / Concerns

- Impact of changing salinity on biology of estuary

3.2.2 Phase 2 Agency Consultation

Following the initial agency consultation in 2004/05, and once draft management objectives were developed for the Study, informal meetings/workshops were held with the majority of the key agencies detailed in the above section (Section 3.2.1), during late 2006 and early 2007, which included:

- Newcastle City Council (5/12/06)
- Maitland City Council (7/12/06)
- Port Stephens Council (6/12/06)
- Department of Natural Resources, now the Department of Environment and Climate Change (C&F) and Department of Water and Energy (15/3/07)
- Newcastle Port Corporation / Maritime Authority (combined workshop) (20/2/07)
- Hunter Water Corporation (16/2/07)
- Hunter-Central Rivers Catchment Management Authority (16/2/07)
- Regional Land Management Corporation (21/2/07)
- National Parks and Wildlife Service, now the Department of Environment and Climate Change (P&W) (20/3/07)
- Department of Primary Industries – Agriculture (27/2/07)
- Combined Town Planning Strategies workshop that included representatives from Newcastle, Port Stephens and Maitland Councils, as well as the Department of Planning (23/2/07).

A summary of the feedback received from government agencies regarding potential management strategies is provided below.

3.2.2.1 Newcastle City Council

Issues / Concerns

- funding opportunities were viewed as critical in HEMP implementation
- links with the HCRCMA was viewed as necessary, due to their policy, resources and funds available for landowners, particularly in riparian vegetation management

Strategy Opportunities

- explore opportunities for development 'off-sets', possibly included into a DCP. State Government has policies and process that may be transferable to Local Government, which is the level of government responsible for the implementation of estuary planning and management
- capacity building with the community and community groups/volunteers. Also, commercial business has expressed willingness to be involved in environmental works through either sponsorship, investment.
- Links / cross-reference to existing strategies should be a requirement of the HEMP

- Funding opportunities must be investigated, with potentially joint funding across all Councils
- Community education/involvement to raise awareness before works are undertaken
- The HEMP needs unified Councillor support from each Council

3.2.2.2 Maitland City Council

Issues / Concerns

- The rural issues in Maitland are considerably different compare to the issues within Port Stephens and Newcastle LGAs.

3.2.2.3 Port Stephens Council

Issues / Concerns

- Council is preparing a Foreshore Management Plan, due early 2008, which have some links with the HEMP
- There is a wetland mapping project underway that would also be beneficial to the HEMP when completed
- Bank erosion is viewed as a big estuary issue in the Port Stephens LGA

Strategy Opportunities

- The Williams River Erosion Study also has recommendations that are compatible with estuary management and would require integration with the HEMP

3.2.2.4 Department of Natural Resources

Issues / Concerns

- When planning rehabilitation works –flood mitigation implications need to be considered (e.g. levees should not be vegetated)
- Liability issues if DNR (now DECC) were to stop clearing drains on private properties
- Revegetation should focus on 'natural' creeks rather than private drains
- Revegetation works need to have ongoing funding
- The flood mitigation works are owned by the Minister, yet they are on private property
- DNR (now DWE) currently developing water sharing plan – complexity in establishing appropriate environmental flows
- Complexities of measuring water use

Strategy Opportunities

- Manage river based on function (eg snags)
- Fullerton Cove levee
- All named creeks that are currently flood gated should be seen as rehabilitation opportunities
- Irrawang Swamp

- Where landuses have changed, there will be opportunities to modify floodgate management

3.2.2.5 Newcastle Port Corporation (NPC) / Maritime Authority (MA) (a combined workshop)

Issues / Concerns

- MA has its own planners that undertake self-determination of projects. These staff are as yet unaware of the HEMP and should be made aware and potentially included in the future
- Capital works and maintenance dredging within the port requires clear distinction within the HEMP
- Additional levies on the port users was not favoured by the NPC or current port users, but it was acknowledged that such a levy may become a political decision
- NPC is currently updating its Environmental Management System (EMS) regarding its land and land leased areas
- It was not agreed that seeking a benchmark water level of the estuary/port is a realistic strategy

Strategy Opportunities

- While AQUIS control the world's ballast water disposal, there is currently a review program for domestic ballast water in Australia , which would potentially benefit the estuary/port – due in mid 2008

3.2.2.6 Hunter Water Corporation (HWC)

Issues / Concerns

- Current HWC facility upgrades and overflow abatement schemes are considered positive for the estuary, and are taking place regardless of the HEMP

Strategy Opportunities

- HWC currently has a sponsorship program that can include estuary-positive initiatives/works
- HWC water quality monitoring could be incorporated into an "estuary-based" database to increase technical data levels for future management of the estuary

3.2.2.7 Hunter-Central Rivers Catchment Management Authority (HCRCMA)

Issues / Concerns

- HCRCMA has numerous projects currently underway, as well as funding for many more into the near future, which may potentially benefit the estuary. Creating a link to the goals and implementation of the HEMP will require considerable effort
- HCRCMA also has a range of scientific tools that should be linked to estuary management e.g. Tools 2, LiDAR and other biometric tools.

- Market based tools used to allocate funds to ensure maximum environmental benefit for CMA dollar – funding applications developed for HEMP actions will need to demonstrate high ratio of environmental benefit
- Important that HEMP is not too focussed on further research

Strategy Opportunities

- Strong links between the Catchment Action Plan (CAP) and the HEMP considered critical
- Opportunities exist whereby the reporting and monitoring mechanisms by the HCRCMA could be linked to the State of Environment (SoE) reporting by Council, thus potentially including HEMP reporting as well
- Development of property plans

3.2.2.8 Department of Primary Industries – Agriculture

Issues / Concerns

- DPI – Ag.still undertakes landholder education programs in best practice land management, which is estuary-positive
- DPI is the determining authority for the Fisheries Management Act. An issue is development consent from HCRCMA under the Native Vegetation Management Act
- Issue of ongoing management – HCRCMA build fence but then what?
- HCRCMA does not look at productivity (Ag = productivity + NRM). DPI are getting some funding from the CMA to run programs
- Landholders will have veg (biodiversity) credits. Like for like compensation is not always achievable

Strategy Opportunities

- Bio-banking is perhaps one of the best mechanisms for implementation of the HEMP
- LEP Standard Zone – E3 Intensive Agriculture will require Development Consent, where previously such land use did not. As a result the impacts of intensive agriculture will be assessed, and this assessment will need to consider estuary impacts
- The proposed Williams River accreditation scheme, linked to the Water Sharing Plan, would potential benefit the estuary

3.2.2.9 Regional Land Management Corporation

Issues / Concerns

- There is a need to distinguish between the large-scale port development projects and development that is controlled more by LEPs/DCPs
- RLMC is currently undertaking estuary-positive land rehabilitation through “land-swaps” that require rehabilitation or re-inundation by the estuary

Strategy Opportunities

- The need to align the LHRS and Regional Conservation Strategy with the HEMP was considered key to the success of the HEMP
- Delivery mechanisms were also considered central to the ultimate success of the HEMP
- All stakeholders must be involved
- Suggest that you may need to precede voluntary levy with major education strategy

3.2.2.10 National Parks and Wildlife Service

Issues / Concerns

- NPWS are already a large manager in the estuary and this will increase over the next 5 years due to expected handover of land. A National Parks Plan of Management (POM) will need to be prepared soon and this will be difficult to develop due to complexities of the newly dedicated Hunter Estuary National Park.
- Transfer from nature reserve to national park will mean increased community expectation for recreational opportunities. 1st July 2007 becomes National Park.
- NPWS recognises that port expansion presents opportunities to achieve rehabilitation outcomes. Land needs to be rehabilitated before it becomes valuable.
- NPWS aim to increase biodiversity- would like to maintain some freshwater wetlands and not rehabilitate all to estuarine. Most freshwater wetlands are on private lands.
- Plans need to be mindful of recurrent funding demands not just primary- need to lock in long term funding. The best conservation sites are those that don't require active management
- Wader bird habitat is critical – particularly known feeding and roosting sites
- There is some conflict between Endangered Ecological Communities and threatened species eg. Green and Golden Bell Frog / waders etc
- Different LGAs classification of weeds
- NPWS land is not eligible for CMA grants
- RLMC handover subject to Memorandum of Understanding – hangs on rezoning for private development 500 ha east of freeway on Coal and Allied Land (tank paddock)

Strategy Opportunities

- Ensure that the Hunter EMP is consistent with the National Parks POM..
- Where possible it would be good to have common corridors for utilities
- Prioritise biodiversity values

3.2.3 Combined Town Planning Strategies workshop (Newcastle / Port Stephens / Maitland Councils and DoP)

Issues / Concerns

- It may not be appropriate to have environmental protection zones in some areas. Nevertheless, it may prove necessary for the protection of the Estuary to place environmental protection zones in certain areas.

- Community consultation in each LGA need to be considered when developing planning options for the implementation of the HEMP
- The Standard LEP does not have a provision for Estuary Management. Councils may have to create a new specific clause to address the issue
- State Government do not encourage the inclusion of numerical controls within LEP documents, these should be outlined within DCP documents
- DCP documents do not have statutory force, however the Land and Environment Court generally uphold Council DCP controls if Councils are consistent in the application of the DCP. As such, DCP controls may be a sufficient planning tool to implement the Estuary Management Plan
- Because Councils have to consider issues other than those concerning Estuary Management, there may be situations in which such issues have higher priority than estuary management and/or conflict with estuary management objectives
- The Standard LEP gives Councils some flexibility to alter objectives and add additional land uses to each zone. As such using the same zonings across the three Councils does not necessarily ensure consistency between Council.
- The Minister of Planning has the power to insert clauses into any LEP document under the Standard LEP. Additionally all new LEPs require Ministerial approval. Should the Department of Planning disagree with Councils resolve to place Estuary Management principles within their LEP documents the Department has the authority to alter/refuse the LEP.
- There are some distinctly different needs of each Council:
  - Maitland - Agricultural / cattle access
  - Newcastle – Highly development, urban development, industrial land use
  - Port Stephens – Tourism
- Implementation could prove controversial.
- HEMP is vital in achieving ecological sustainable water objectives
- Schemes such as bio-banking may be instrumental for the HEMP. All three Councils were interested in finding out where the DECC stood in terms of the plan
- Estuary Policy may conflict with other council policies, such as Floodplain policies or agricultural land policy
- The Hunter HEMP may well be the most complicated Estuary Management Plan in NSW due to the complexity of land use issues (rural/industrial) along with environmental concerns and economic considerations (i.e. port) which will need to be taken into account

Strategy Opportunities

- A need for consistency in the approach to Estuary Management within planning instruments and development controls between three local councils and the State Government
- Realistic options that Councils will support is needed
- Implementation of the EMP through planning tools is crucial to the Plan's ultimate success

3.3 Industry

In addition to the broader community consultation activities described above, the following was also undertaken to target industry interests:

Industry workshop - was held with local estuary-based industries at the Hunter Business Chamber on Thursday 22nd September 2005. Approximately 48 companies were invited to attend the workshop, with 8 providing representation. Follow up phone calls were also made to all invitees to heighten awareness and encourage participation / alternative feedback. The presentation and format of the workshop was the same as the community workshops.

Letters and fact sheets – distributed to industry representatives, as described previously.

3.3.1 Key Values

The key values of the Hunter Estuary expressed by industry was the functional role it has in facilitating industrial operations, with access for ships and ability to discharge.

Additionally, industry acknowledged the unique ability of the estuary to successfully operate as an industrial precinct whilst maintaining tourist and recreational values (cycleways, parks, visual amenity).

3.3.2 Key Issues

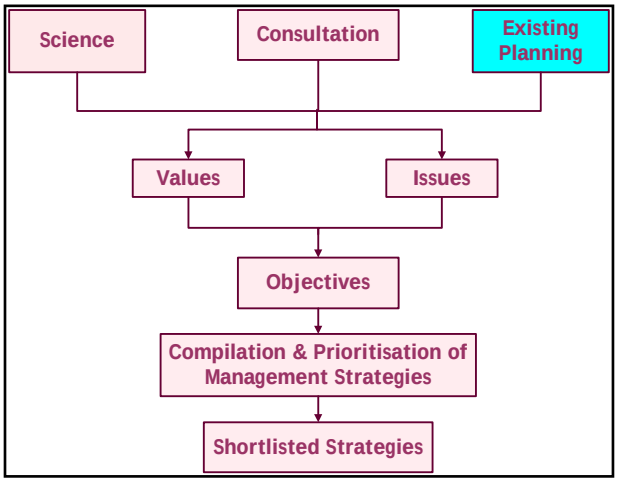
The key issue of concern related to the disjointed management of the estuary with conflicting government decisions in relation to development, conservation and strategic planning.

3.3.3 Key Strategies

Industry representatives suggested the key strategy for improved estuary management is the preparation of a *strategic land use plan* to establish an agreed balance between industry and conservation. This would provide certainty for the community and industry as the strategic direction for the area whilst maintaining the values and viability of the estuary's commercial function.

Industry also consider community education to be a key opportunity to improve estuary management by giving the community an understanding of the true industrial impacts (positive and negative) and provide a better understanding of the government approved strategies for the area. It is hoped this would relieve community pressure placed on individual industrial operations.

4 ESTUARY MANAGEMENT PLANNING CONTEXT



An understanding of the strategic environment of the estuary will assist in developing and delivering appropriate management strategies. The following legislation and planning policies are relevant to the Hunter Estuary Management Plan (HEMP).

4.1 Regional Scale Strategic Environment

There are a number of planning instruments that apply to the study area. These include strategic documents that have been developed to guide future development and conservation within the Hunter Estuary. The following plans have been adopted and need to be assessed when considering management options for the Hunter Estuary.

4.1.1 Lower Hunter Regional Strategy, 2006

The Lower Hunter Regional Strategy (LHRS) is the principal regional environmental planning instrument. The primary purpose of the LHRS is to ensure that adequate land is available and development is appropriately located to sustainably accommodate the projected housing, employment and environmental needs of the region's population over the next 25 years. This strategy contains strategies for priority areas of residential and employment development. The strategy includes:

- provision of 115,000 new dwellings, half in existing zoned areas
- 160,000 more people
- conservation of high quality agricultural land
- development of existing zoned employment land
- protection of drinking water aquifers
- minimum loss of natural resources (sand, gravel, clay)

Relevance to Hunter Estuary Management Plan

Department of Planning should be consulted and informed of the key issues and strategies being developed in this plan, to allow incorporation of strategies for reinforcement of responsibilities and priorities. The impact of the proposed areas of urbanisation should be considered in developing strategies for estuary protection.

4.1.2 Regional Conservation Plan 2009

The Regional Conservation Plan (RCP), which forms part of the regional planning for the Hunter, has been developed:

- to assess the extent of the biodiversity impacts of the LHRS and recommend priority areas for investment in biodiversity conservation and environmental repair and restoration to offset these impacts
- with the recognition that development certainty and conservation outcomes are best achieved by good strategic planning at a regional scale, rather than at the development application stage
- to assist with the implementation of the recent amendments to the Threatened Species Conservation Act 1995, including biodiversity certification of environmental planning instruments and biobanking
- to be consistent with, and promote the principles of Ecologically Sustainable Development.

Relevance to Hunter Estuary Management Plan

The Regional Conservation Plan has been developed to support the Regional Strategy, and thus has provided guidance on future strategic development of the Hunter area with respect to Regional Conservation. The RCP identifies areas of conservation significance. These areas and their existing conservation values will need to be considered when developing strategies for the HEMP.

4.1.3 Hunter Regional Environmental Plan, 1989

The Hunter Regional Environmental Plan, 1989, is superseded by the LHRS, however, until revoked by the government it remains in force. The plan aims to promote balanced development of the Hunter Region, to encourage orderly and economic development and to bring about optimum use of land and other resources consistent with the needs and aspirations of the local community.

The Hunter Regional Environmental Plan, 1989 provides principles and policies for the preparation of local environmental plans within the Hunter region. The plan is divided into nine parts including:

- social development
- economic development
- land use and settlement
- transport
- natural resources
- environment protection
- conservation and recreation.

Relevance to Hunter Estuary Management Plan

The Hunter Estuary Management Plan will need to consider the principles reflected under these parts when implementing management options and strategies.

Specifically in relation to environmental protection, the policy requires consideration of: cumulative impact on water quality and sedimentation, controlled recreational access to conservation areas, protection of natural areas, prevention of reduction in the extent of important habitat areas including wetlands and preservation existing amenity.

4.1.4 Thornton-Killingworth Sub-Regional Conservation and Development Strategy, 2003

The Thornton to Killingworth Conservation and Development Strategy covers sections of Maitland, Cessnock, Lake Macquarie and Newcastle LGA's. The strategy covers part of the Hunter estuary study area. The strategy includes recommendations to:

- conserve Hexham Swamp
- establish a vegetation corridor connecting the Stockton sand dunes and Mount Sugarloaf
- consolidate main urban areas
- separate urban areas with green corridors
- protect key conservation areas of Hexham Swamp, Black Hill and Mount Sugarloaf.

The strategy has been adopted by Newcastle, Cessnock, Maitland and Lake Macquarie Council's. Council's are committed to considering the conservation and development recommendations of the strategy when planning development in the study area. The Department of Planning (formerly DIPNR) has endorsed the study which was expected to form the basis of the upcoming Lower Hunter Regional Strategy. Whilst not directly affecting estuary uses, the conservation and development recommendations provide a strategic direction for Councils dealing with land use issues within the estuary catchment.

Relevance to Hunter Estuary Management Plan

The HEMP should lever off the government commitment to the Thornton to Killingworth Conservation and Development Strategy, by incorporating and prioritising management measures consistent with its recommendations.

4.1.5 Hunter-Central Rivers Catchment Action Plan

The Hunter-Central Rivers CAP is a guide to protecting and improving the region's natural resources over the next 10 years. The CAP for the HCRCMA region applies to the area from Taree in the north to Gosford and the coastal waterways of the Central Coast in the south, and from the Merriwa Plateau and Great Dividing Range in the west to Newcastle in the east. It will build on the work of the Catchment Blueprints for the Central Coast, Hunter and Lower North Coast, which were endorsed by the NSW Government in February 2003 and have guided natural resource management in these areas since that time (HCRCMA, 2007).

Relevance to Hunter Estuary Management Plan

Part three of the CAP outlines the guiding principles of the HCRCMA. These guiding principles provide direction for all natural resource managers to achieve ESD and ensure that the whole community (including government) can work towards the same goal. Each set of guiding principles provides an overview of the relevant issues and systematically numbered statements that guide land managers. The CAP also outlines how and how much natural resource management will be funded through the HCRCMA.

4.1.6 Healthy Rivers Commission Inquiry into the Hunter River

In May 2002, the Healthy Rivers Commission (HRC) released its final Inquiry into the Hunter River System. In preparing the report, the HRC aimed to understand how the entire river system is being managed. This included undertaking a comprehensive program of community consultation and review. Eight key recommendations were developed and are considered by the HRC as essential. The eight key recommendations can be summarised as:

- Review of the Flood Mitigation Scheme to ensure that future decisions regarding floodplain management are guided by contemporary understandings of catchment and floodplain processes, community values and expectations and changing land uses within the catchment.
- Amendment of the Blueprint to include a River Corridor Plan, which is based on geomorphology, riparian vegetation, biodiversity assessments, Aboriginal heritage assessments and a system for determining rehabilitation priorities.
- Development of incentive mechanisms to promote and facilitate the adoption of sustainable agricultural practices that generate a commercial and environmental benefit (NB: study undertaken by UNE as part of the HRC report indicates economic benefits of crop rotation and other sustainable practices).
- New regional planning strategies should cover the entire catchment and should explicitly state the inter-relationships between the regional strategy and other resource-specific plans for the region.
- Preparation of a development and environmental management plan for Newcastle Harbour- this should interlink with an Estuary Management Plan.
- A strategic environmental assessment at a sub regional scale should help guide planning in the mining industry. This should provide for recognition of cumulative impacts that can be considered for individual mine approvals.
- The coordination required for integrated management of the river and catchment should be provided by the Blueprint (now the CAP) and the Trust (now the HCRCMA). A conflict resolution process should be specified to refer difficult decisions to a regular, independently chaired meeting of state agency regional managers with links back to central decision making processes.
- The last recommendation refers to subsequent audits by the HRC of the implementation of actions.

Relevance to Hunter Estuary Management Plan

Recommendations have been directly incorporated into this Estuary Management Study.

4.2 Local Government Planning Framework

The Hunter Estuary study area incorporates three local government areas: Newcastle, Maitland and Port Stephens. Each local council has a number of planning policies that assist in the development and conservation of the area. The following is a brief description of the most relevant policies and plans.

4.2.1 Local Environmental Plans (LEPs)

LEPs are planning instruments produced by local councils to direct the type of development in local government areas. LEPs aim to conserve the natural environment, whilst creating attractive living areas and ensuring development complies with ecologically sustainable principles. Through zoning and development controls, they allow councils to supervise the ways in which land is used.

LEPs assist in guiding the preparation of more detailed non-statutory planning documents known as Development Control Plans (described in more detail below).

Landuse zonings across the lower Hunter are presented in Figure 4-1.

Relevance to Hunter Estuary Management Plan

The HEMP needs to consider existing landuse zonings, and recognise the permissibilities and restrictions already placed on these lands. All Councils are required to prepare new LEPs in accordance with the Standard Instrument LEP Order by 2011. A review of Council's LEP provides an ideal opportunity to modify landuse zonings to ensure an appropriate balance between development and conservation, as an outcome of the HEMP.

4.2.2 Development Control Plans (DCPs)

Development Control Plans (DCPs) provide specific, more comprehensive guidelines for types of development, or specific areas within a local government area. DCPs contain a specific range of conditions (including visual amenity, drainage, access, pollution control, vegetation etc.) aimed at optimising land use in an environmentally sustainable manner.

Relevance to Hunter Estuary Management Plan

The following list identifies the range of issues covered by DCPs that relate to management opportunities applied in the estuary management plan:

- industrial development
- floodplain management
- conservation
- port development
- stormwater control.

The measures contained within all Council DCPs should be updated to reflect the recommendations of the Estuary Management Plan to minimise the impact of development on the catchment.

4.2.3 Section 94 Contribution Plans

Section 94 of the Environmental Planning and Assessment Act 1979 enables Local Government to levy contributions from development for the provision of public services and amenities, required as a consequence of that development. Contributions may be in the form of cash payments, dedication of land, provision of a material Public Benefit or a combination of some, or all, of the above.

For a Council to levy contributions under Section 94, there must be a clear nexus between the proposed development and the need for the public service or amenity for which the levy is being required and a contributions plan in force that authorises the Council to do so. Where new facilities satisfy demands beyond those of the contributing development only the portion of demand created by new development can be charged.

Under the current legislation, Section 94 can only be applied to the capital funding of facilities. Schedule 3 of The Environmental Planning and Assessment Amendment Bill 2008 currently awaiting gazettal, however will prevent a Council from requiring a Section 94 contribution for infrastructure other than;

- Local roads
- Local bus facilities
- Local parks
- Local sporting, recreational and cultural facilities and local social facilities
- Local car parking facilities
- Drainage and stormwater management works
- Land for any community infrastructure (except land for riparian corridors)
- District infrastructure of the kind referred to above but only if there is a direct connection with the development to which a contribution relates.

Relevance to Hunter Estuary Management Plan

Whilst Newcastle, Maitland and Port Stephens Council all have Contributions Plans in place for the collection of contributions for public infrastructure there is limited opportunity for the collection of funds through section 94 contributions for strategies relating to improved public access, including foreshore land purchase, public jetties, playgrounds and facilities.

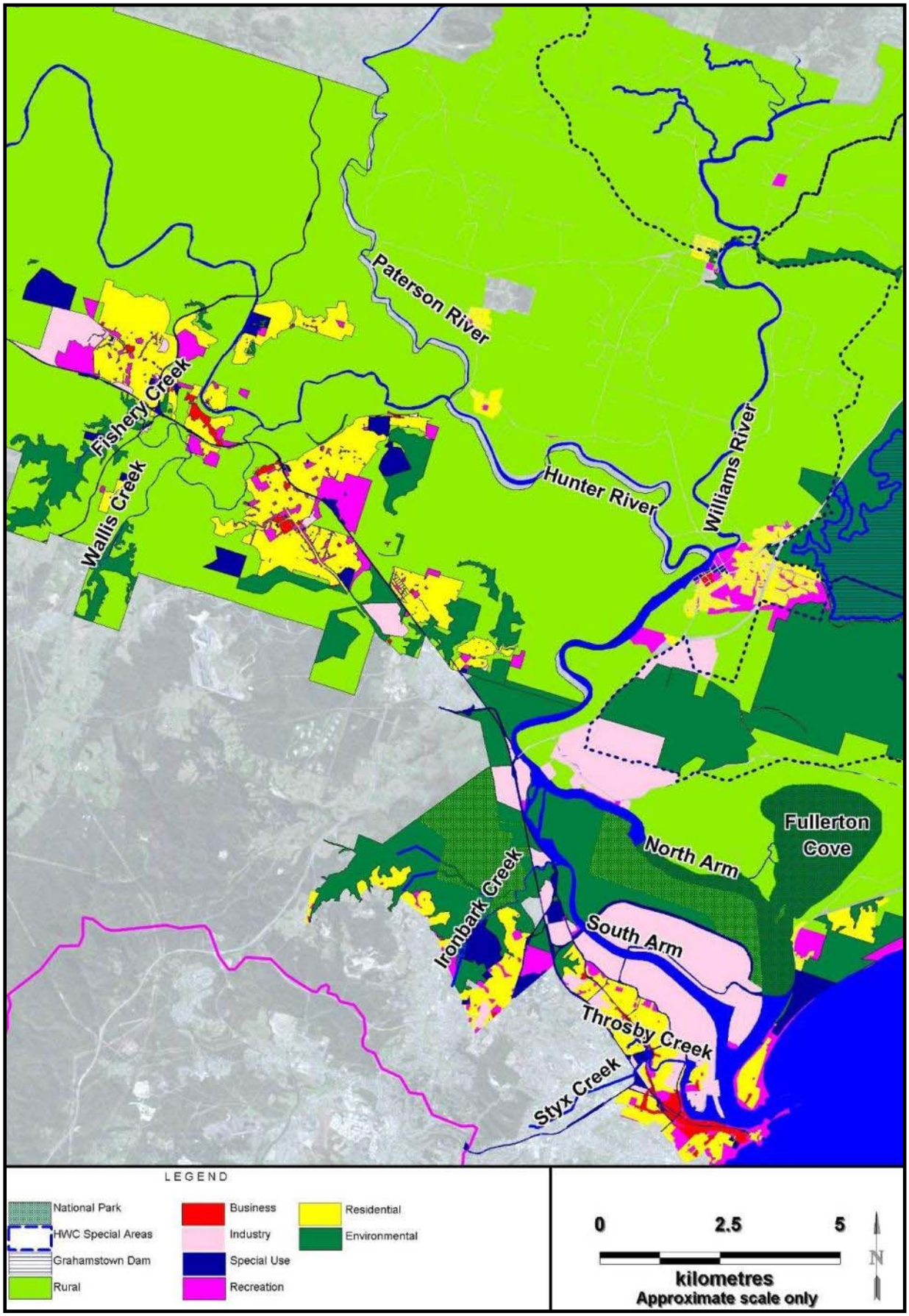


Figure 4-1 Land Use Zonings in the Vicinity of the Estuary

4.3 Relevant Policies and Legislation

4.3.1 State Policies

4.3.1.1 NSW Estuary Management Policy 1992

The *NSW Estuary Management Policy*, established in 1992, is one of a suite of catchment management based policies under the umbrella *NSW State Rivers and Estuaries Policy*. The Estuary Management Policy was developed in recognition of the environmental, social and economic importance of estuaries. It provides for the assessment of all estuarine uses, the resolution of conflicts and the production of a unified and sustainable management plan for each estuary, including remedial works and the redirection of activities, where appropriate. The specified general goal of the policy is "to achieve an integrated, balanced, responsible and ecologically sustainable use of the State estuaries, which form a key component of coastal catchments" (NSW Government, 1992, p27).

Specific objectives of the *NSW Estuary Management Policy* are:

- Protection of estuarine habitats and eco-systems in the long term, including maintenance in each estuary of the necessary hydraulic regime;
- Preparation and implementation of a balanced long term management plan for the sustainable use of each estuary and its catchment so that all values and uses are considered and which defines management strategies for;
    - Conservation of aquatic and other wildlife habitats;
    - Conservation of aesthetic values;
    - Prevention of further estuary degradation;
    - Repair of damage to the estuarine environment; and
    - Sustainable use of estuarine resources, including commercial and recreational uses as appropriate.

The Policy is implemented through the development and adoption of specific Estuary Management Plans, prepared under the Estuary Management Program (refer Section 1.4). Policy implementation is facilitated through the *Estuary Management Manual* (NSW Government, 1992).

The NSW Estuary Management Policy has been usurped to some degree by the NSW Coastal Policy 1997 (refer Section 4.3.1.2). The continuance of the NSW Government's Estuary Management Program is listed in the NSW Coastal Policy as Action 1.4.6, while preparation of Estuary Management Plans (such as this Hunter Estuary Management Plan) is identified as Actions 1.4.3 and 2.1.1 of the Policy. Also, future development within and adjacent to estuaries is addressed through Action 1.4.7 of the NSW Coastal Policy.

Relevance to Hunter Estuary Management Plan

The Hunter Estuary Management Plan has been prepared to specifically fulfil the aims and objectives of the Estuary Management Policy in respect to the Hunter River. The Hunter Estuary Management

Plan has been prepared in accordance with the Estuary Management Manual, which supports implementation of the Policy.

4.3.1.2 NSW Coastal Policy 1997

The NSW Coastal Policy responds to the fundamental challenge to provide for population growth and economic development without placing the natural, cultural, spiritual and heritage values of the coastal environment at risk. To achieve this, the Policy has a strong integrating philosophy based on the principles of ecologically sustainable development (ESD).

The Policy addresses a number of key coastal themes including:

- Population growth in terms of physical locations and absolute limits;
- Coastal water quality issues, especially in estuaries;
- Disturbance of acid sulfate soils;
- Establishing an adequate, comprehensive and representative system of reserves;
- Better integration of the range of government agencies and community organisations involved in coastal planning and management;
- Indigenous and European cultural heritage; and integration of the principles of ESD into coastal zone management and decision making.

The management of the coastal zone is the responsibility of a range of government agencies, local councils and the community. The Policy provides a framework for the balanced and coordinated management of the coast's unique physical, ecological, cultural and economic attributes.

Relevance to Hunter Estuary Management Plan

The Hunter River and its foreshores falls within the defined coastal zone, therefore the Coastal Policy needs to be considered in the preparation of the Hunter Estuary Management Plan. Councils are required to implement the policy when making local environment plans applying to land within the coastal zone and to take the provisions of the policy into consideration when determining development applications in the coastal zone.

The Policy specifically recommends that detailed management plans for estuaries be prepared and implemented in accordance with the NSW Government's Estuary Management Manual.

4.3.1.3 NSW State Groundwater Policy Framework Document

The purpose of this Groundwater Framework Policy document is to provide a clear NSW government policy direction on the ecologically sustainable management of the State's groundwater resources for the people of NSW. The focus of the Policy is on water below the ground surface in a geological structure or formation, and on the ecosystems from which these waters are recharged or into which they discharge (Department of Water and Energy, 2008).

A set of three component policies will be developed to identify management needs and opportunities. The NSW Groundwater Dependent Ecosystem Policy and Groundwater Quality Protection Policy

have been developed. The NSW Groundwater Quantity Management Policy is the third component policy to be developed (Department of Water and Energy, 2008).

Relevance to Hunter Estuary Management Plan

Groundwater ecosystems throughout the estuary have a significant role to play in estuary management. Ongoing management of groundwater and groundwater dependent ecosystems is an important aspect of the overall management of the estuary.

4.3.1.4 SEPP 14 – Coastal Wetlands

State Environmental Planning Policy 14 (SEPP 14) – Coastal Wetlands aims to ensure coastal wetlands are preserved and protected in the environmental and economic interests of the State.

SEPP 14 outlines restrictions on the development of certain lands within the area, as well as restrictions on carrying out restoration works.

Relevance to Hunter Estuary Management Plan

There are a number of areas in the Hunter Estuary that are defined as coastal wetlands under this SEPP. Protection of these areas under the HEMP is supported by this SEPP, and should be prioritised. SEPP-14 Wetlands around the Hunter Estuary are shown in Figure 4-2.

4.3.1.5 SEPP 44 – Koala Habitat Protection

State Environmental Planning Policy 44 – Koala Habitat Protection aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of population decline.

SEPP 44 requires that consent authorities must not issue a development approval without prior investigation of potential and core koala habitat.

This SEPP applies to the whole Hunter Estuary study area except for land dedicated or reserved under the *National Parks and Wildlife Act 1974* or to land dedicated under the *Forestry Act 1916* as a State forest or flora reserve.

Relevance to Hunter Estuary Management Plan

Restoration and protection of selected foreshore and catchment land under the HEMP may be supported by the provisions of this SEPP.

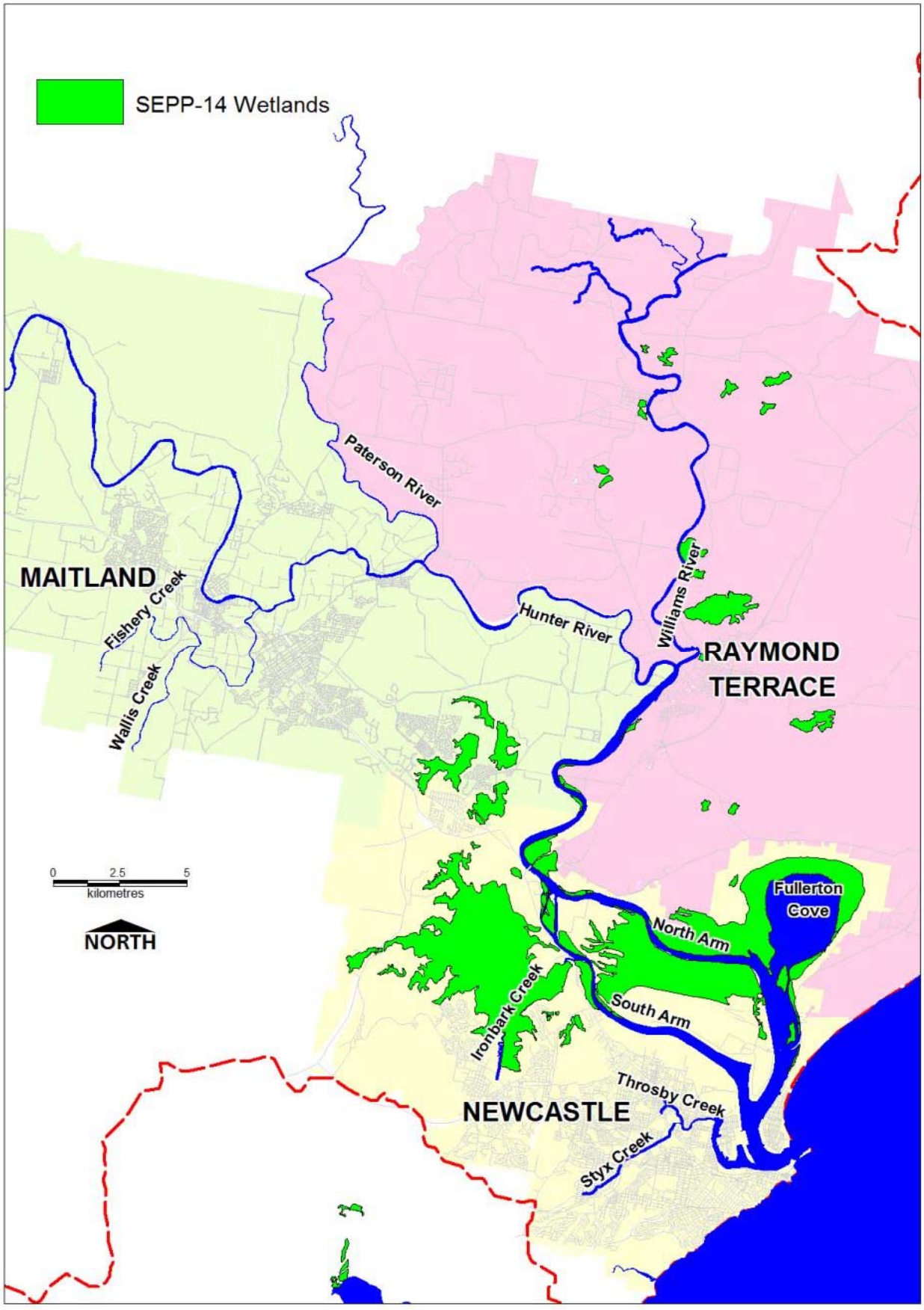


Figure 4-2 SEPP-14 Wetlands around the Hunter Estuary

4.3.1.6 SEPP 71 – Coastal Protection

This policy seeks to ensure that the development within the coastal zone is appropriate and suitably located and is consistent with the principles of ecologically sustainable development. Under this policy the Minister for Planning becomes the consent authority for state significant development, significant coastal development and development in sensitive coastal locations.

A Sensitive Coastal Location is described in the Policy as:

- a coastal Lake (as listed in Schedule 1)
- land within 100m above mean high water mark of the sea, a bay or an estuary
- land within 100m of the waters edge of a coastal lake, a declared Ramsar Wetland, a World Heritage property, an aquatic reserve, a marine park, a national park, a nature reserve, or a wetland subject to SEPP14
- residential land within 100m of land identified under SEPP26.

Relevance to Hunter Estuary Management Plan

The coastal zone (as defined in section 4A of the Coastal Protection Act 1979) between Wollongong and Port Stephens has recently been mapped and gazetted by the Minister for Planning. As such SEPP-71 is applicable to the Hunter Estuary, and will need to be considered during development of management options and during implementation, as appropriate. The area applicable to SEPP-71 within the Hunter Estuary is shown in Figure 4-3.

4.3.1.7 SEPP (Major Projects) 2005

The SEPP provides for the Minister to be the approval authority for major projects as identified within the SEPP and schedules, subject to Part 3A of the EP&A Act. Part 3A of the EP&A Act prescribes the assessment methodology to be utilised for major projects and generally excludes involvement of local government, albeit council may be involved in consultation activities as part of the assessment.

Relevance to Hunter Estuary Management Plan

The Minister may determine applications under Part 3A of the Act that are identified in the SEPP as a major project. Part 3A approvals have the potential to be detrimental to the intent of the HEMS, however, the purpose of a major project assessment is to consider the state significance of a proposal.

Amendments to SEPP (Major Projects) is proposed to incorporate the major ports at Port Kembla, Newcastle and Port Botany as being of State significance and included within the precincts identified in the SEPP (known as the Three Ports State Significant Site Proposal, draft May 2008). The area of Newcastle proposed to be included in the SEPP covers existing Port and Industry zoned land (zone 4b) as well as the Steel River industrial land (zone 4c), and the Open Space / Recreation land at the end of Walsh Point (refer Figure 4-4). Inclusion within the SEPP is designed to provide certainty in delivering port-related industrial lands to the region.

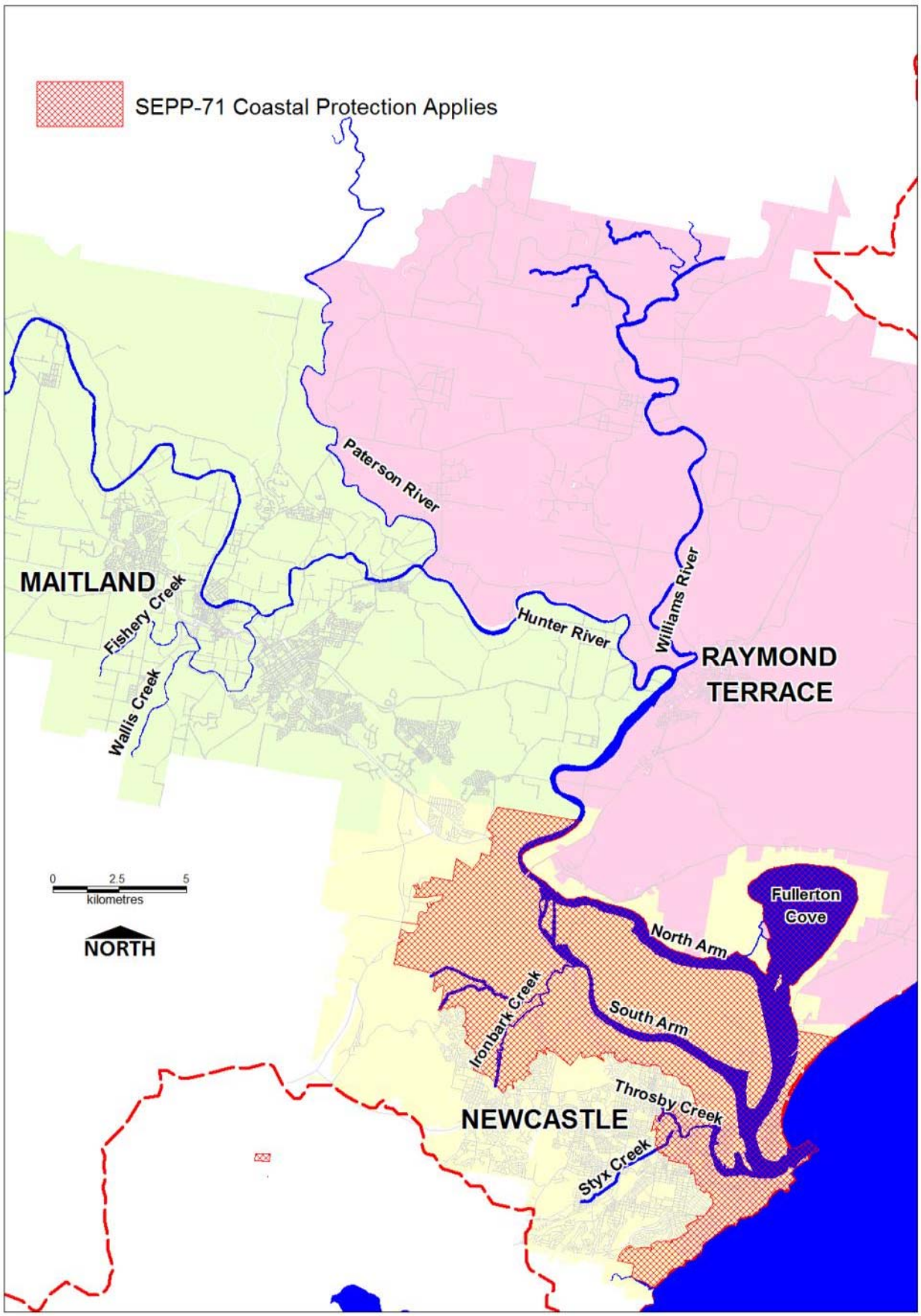


Figure 4-3 SEPP-71 Coastal Protection Areas around the Hunter Estuary

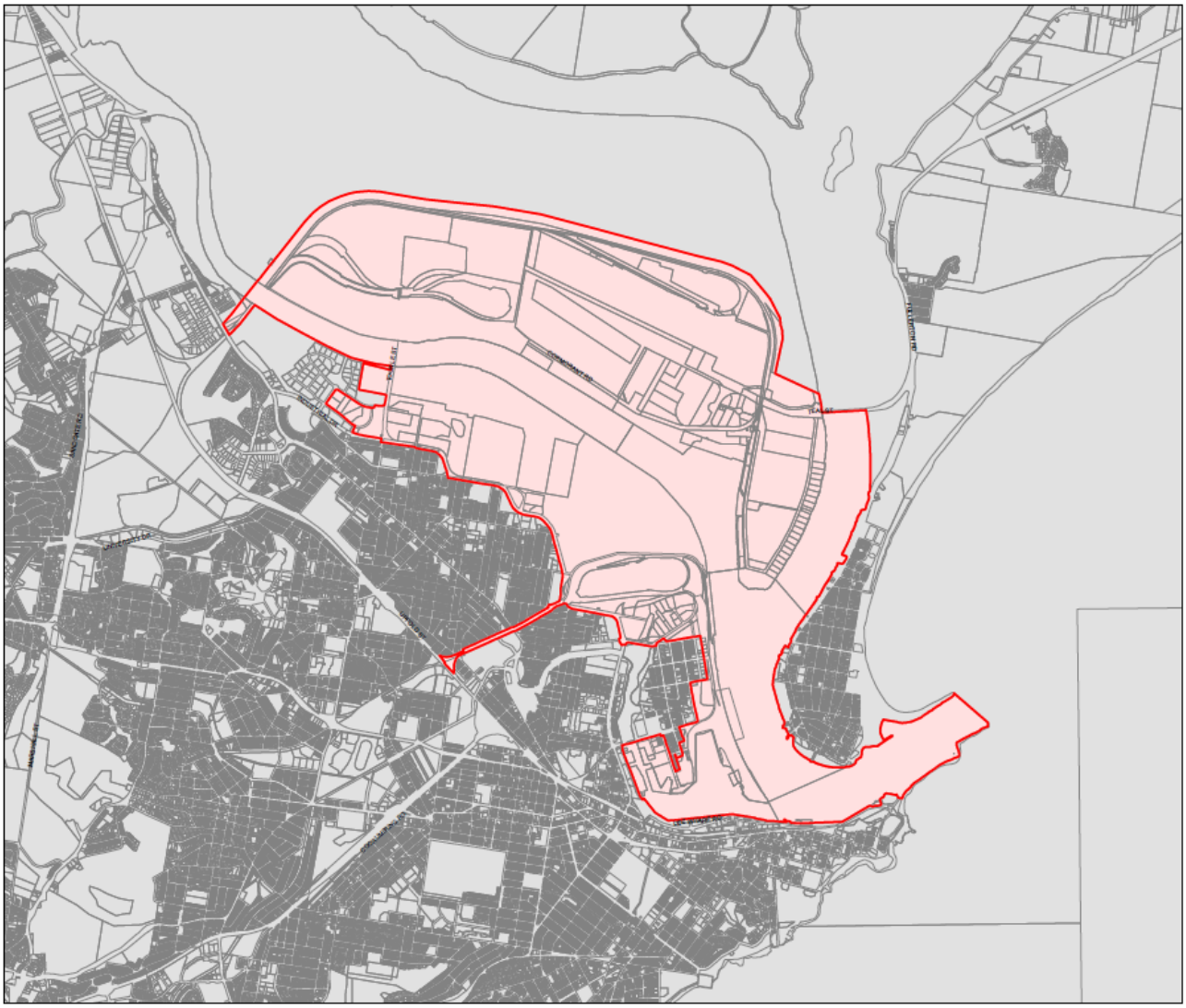


Figure 4-4 Three Ports State Significant Site Proposal Amendment to SEPP (Major Projects)

4.3.1.8 SEPP (Infrastructure) 2007

SEPP (Infrastructure) 2007 was gazetted on the 1 January 2008 and was prepared to consolidate and update planning provisions relating to infrastructure and government land. The SEPP provides a consistent planning regime for infrastructure and the provision of services across NSW, along with providing for consultation with relevant public authorities during the assessment process. The intent of the SEPP is to support greater flexibility in the location of infrastructure and service facilities along with improved regulatory certainty and efficiency for the State.

The SEPP:

- outlines planning processes for considering classes of public infrastructure and particular infrastructure projects
- exempts some minor public infrastructure from the need for an approval

- clarifies where new infrastructure can be located and provides for additional permissible uses on government land
- requires State agencies constructing infrastructure to consult local councils when a new infrastructure development is likely to affect existing local infrastructure or services.

Relevance to Hunter Estuary Management Plan

Division 25 of the SEPP relates to waterway or foreshore management activities. Section 129 of the SEPP identifies development which is permitted without consent and includes development for the purposes of waterway or foreshore management activities, which may be carried out by or on behalf of a public authority without consent on any land. These activities include:

- construction works;
- routine maintenance works;
- emergency works, including works required as a result of flooding, storms or coastal erosion;
- environmental management works.

The clause also relates to development for the purpose of temporary works associated with drought relief which maybe be carried out by on behalf of a public authority without consent subject to certain criteria.

The provisions afforded by this SEPP need to be considered by the HEMP.

4.3.2 Relevant Legislation

4.3.2.1 NSW Coastal Protection Act 1979

In 2002, amendments were made to the Coastal Protection Act 1979 that requires Coastal Zone Management Plans to be prepared for parts of the NSW coastal zone. Under provisions of the Act, Coastal Zone Management Plans are required to be approved by the Minister prior to being Gazetted by Councils. In order to comply with the provisions of the Act, Coastal Zone Management Plans need to address the following matters before they would be approved by the Minister:

a. protecting and preserving beach environments and beach amenity, and

b. emergency actions of the kind that may be carried out under the *State Emergency and Rescue Management Act 1989*, or otherwise, during periods of beach erosion, including the carrying out of related works, such as works for the protection of property affected or likely to be affected by beach erosion, where beach erosion occurs through storm activity or an extreme or irregular event, and

c. ensuring continuing and undiminished public access to beaches, headlands and waterways, particularly where public access is threatened or affected by accretion.

Once published in the Government Gazette, a Coastal Zone Management Plan becomes a statutory instrument under NSW legislation. In accordance with Section 55L of the Coastal Protection Act, 1979, a breach of (eg failure to comply with) the Plan may result in the Minister or a council bringing proceedings in the Land and Environment Court to remedy or restrain the breach.

Relevance to Hunter Estuary Management Plan

At the time of writing the Coastal Protection Act (1979) is to be reviewed, and therefore any additional future requirements of the Act are not known. The plan is unable to be gazetted in accordance with the Act until stakeholders have a clear understanding of the requirements of the Act. Therefore, at this time, MCC, PSC and MCC will endorse the plan as a non-statutory document and will review the gazettal process, in consultation with the stakeholders responsible for implementation, once the Coastal Protection Act has been reviewed and finalised.

4.3.2.2 NSW Local Government Act 1993

The *Local Government Act 1993* provides the legal framework for an effective, efficient, environmentally responsible and open system of local government in NSW. Council's charter is outlined by the Act and includes 'to properly manage, develop, protect, restore, enhance and conserve the environment of the area for which it is responsible, in a manner that is consistent with and promotes the principles of ecologically sustainable development'.

Under the provisions of the Act, Councils have numerous functions. Chapter 6 of the Act requires that all land vested in Councils must be classified as either Community or Operational land. Community land is land which should be kept for use by the general public (e.g. a public park). Councils must prepare Plans of Management to guide the use and management of Community land. Core objectives are defined in the Act for the management of different types of Community land. Plans of Management prepared for Community land within the study area should be generally consistent with the principles of this plan.

Relevance to Hunter Estuary Management Plan

Under Chapter 13 of the Act, Councils are required to prepare Management Plans each year. The Management Plan details the Council's activities and budget for the next financial year. Subject to the competing demands and priorities, NCC, PSC and MCC will identify funding for the implementation of various elements of the HEMP through the relevant program areas.

4.3.2.3 NSW Crown Lands Act 1989

The Crown Lands Act is administered by the Crown Lands Division of the Department of Lands to provide for the administration and management of Crown land in the Eastern and Central Division of the State. Crown land shall not be occupied, used, sold, leased, licensed, dedicated or reserved or otherwise dealt with unless the occupation, use, sale, lease, licence, reservation or dedication or other dealing is authorised by this Act.

Crown Lands provides a property management service for the Department of Lands where they are the custodian of Crown land status information and administer Crown land held under lease, licence or permit under the Crown Lands Act. The Division also manages vacant Crown land, land retained in public ownership for environmental protection purposes and the lands of the Crown public roads network. Crown land is allocated for public uses, including schools, hospitals, sports grounds,

community recreation and housing development. Crown reserves are managed in partnership with both councils and local community groups. The goal of Crown land management is to optimise environmental, economic and social outcomes for the benefit of the people of NSW.

Relevance to the Hunter Estuary Management Plan

Within the Hunter estuary, the major part of the Crown estate includes the beds of the Hunter, Paterson and Williams Rivers and their tributaries to the tidal limits excluding the Port of Newcastle and a section of the Hunter River included in the Kooragang Nature Reserve. Any activity that will impact on Crown land must be referred to the Crown Lands Division of the Department of Lands for assessment of impacts and the consideration of approval of the activity by way of appropriate authorisation subject also to any Environmental Planning requirements.

4.3.2.4 NSW National Parks and Wildlife Act 1974

The NP&W Act is administered by the Department of Environment and Climate Change, and addresses the protection of Aboriginal items and certain native flora and fauna.

Under the NP&W Act it is an offence to harm threatened species; buy, sell or possess threatened species; damage critical habitat; or damage the habitat of a threatened species without the issuing of a Section 120 licence.

If any identified archaeological sites or remains need to be removed or destroyed, prior to commencement of works in the area, an approval is required from the Department of Environment and Climate Change (DECC) for a section 87 or 90 permit.

Relevance to Hunter Estuary Management Plan

The Hunter Estuary study area could potentially contain a number of significant aboriginal heritage sites. Conservation of key estuary areas identified in the HEMP may be supported by the protection of flora, fauna or Aboriginal heritage under this Act.

The Hunter Estuary National Park has been established recently, largely incorporating the former Kooragang and Hexham Swamp Nature Reserves. A Plan of Management for the Hunter Estuary National Park will be prepared by DECC in accordance with requirements of the NP&W Act.

4.3.2.5 NSW Fisheries Management Act 1997

The *FM Act* has as part of its objectives the protection of threatened species and their habitats. Under the FM Act removal or damage to seagrass and mangroves requires a permit to be obtained from DPI (NSW Fisheries).

Relevance to Hunter Estuary Management Plan

The Hunter Estuary has an abundance of mangroves. Any work proposed in the Hunter Estuary will require an approval from NSW Fisheries if the work is to affect threatened species or their habitats, including mangroves.

4.3.2.6 Maritime Legislation

The NSW Maritime Authority is the State Government's maritime regulator responsible for providing safe and sustainable ports and waterways. NSW Maritime, formerly the Waterways Authority, came into effect on 1 September 2004.

The NSW Maritime Authority administers or operates under the following New South Wales legislation:

- Maritime Services Act 1935
- Commercial Vessels Act, 1979
- Navigation Act, 1901
- Marine Pilotage Licensing Act, 1971
- Marine Pollution Act, 1987
- Marine (Boating Safety – Alcohol and Drugs) Act, 1991
- Ports Corporatisation and Waterways Management Act, 1995

It also has responsibilities to the marine environment under:

- Water Management Act 2000 (formerly provisions held within the Rivers and Foreshores Improvements Act 1948)
- Environmental Planning and Assessment Act 1979
- Protection of the Environment Operations Act 1997

A safe boating handbook is accessible from the NSW Maritime Authority website. It outlines all the essential boating information including licensing and offences.

Other information that can be found on the website includes information on:

- kite surfing
- boating licenses and miscellaneous fees
- boat ‘wash’ and ‘no wash’ zones
- sewage, garbage and noise
- moorings
- waterskiing
- personal watercraft
- yachts.

The Maritime Services Act governs activities in any waters vested in NSW Maritime. Section 13D of the MS Act outlines the control of construction of certain works in the Hunter River. It states that a person must need consent from the Maritime Authority to:

- construct or authorise the construction of any structure
- carry out any dredging operations.

This section does not apply to works or dredging undertaken or authorised by the Crown under the Newcastle Harbour Improvements Act 1953, or otherwise undertaken by the Crown for the purpose of flood control in the Hunter River.

Relevance to Hunter Estuary Management Plan

Through their legislation, the NSW Maritime may be able to assist in implementing strategies aimed at recreational and commercial watercraft. Measures such as controlled boating access areas, speed controls and waste management should be assessed against the existing controls currently administered by the NSW Maritime.

This Maritime Services Act applies to the Hunter Estuary Management Plan as any future structures or dredging operations within the designated areas stated in the Act require approval from the NSW Maritime.

4.3.2.7 NSW Ports Corporatisation and Waterways Management Act 1995

The PC&WM Act established statutory state-owned corporations to operate the state's port facilities in the major ports and transfer waterways management and other marine safety functions to the Minister. The Act also established the Maritime Authority (formerly Waterways Authority) and provides for port charges, pilotage and other marine matters.

The principal functions of each Port Corporation are to establish, manage and operate port facilities and services in its ports and to exercise the port safety functions for which it is licensed in accordance with its operating licence.

The State owned Newcastle Port Corporation, is constructed by this Act.

Relevance to Hunter Estuary Management Plan

The Newcastle Port Corporation is a significant organisation in regard to the Hunter Estuary Management Plan as they, along with the Maritime Authority, manage the charges that apply to vessels entering and exiting the Port. Implications of proposed management strategies on port operations must be considered and discussed with the Port Authority. Consideration should be given to the possibility of utilising revenue from these charges to implement some of the recommended mitigation measures, particularly in respect to degradation attributed to past and present port works and activities. As revenue raised through port operations is directed to Treasury, significant community and political will shall be required to source additional funds from Treasury, or to increase Port charges to cover environmental works within the estuary.

4.3.2.8 NSW Threatened Species Conservation Act 1995

If a proposed development is likely to significantly affect critical habitat of a threatened species, population or ecological community, or is within critical habitat, as defined by the Act, a Species Impact Statement (SIS) must be prepared. The test of significance is defined by an eight point test that is required for potentially affected threatened species under Section 5A of the Environmental Planning and Assessment Act 1979.

A licence under the Act is generally required for the harming or picking of listed threatened plants or animals.

The NSW Biobanking Offsets Scheme has been established under the provisions of the TSC Act. Biobanking enables 'biodiversity credits' to be generated by landowners who commit to enhance and protect biodiversity values on their land through a Biobanking agreement. These credits can then be sold, generating funds for the management of the site. Credits can be used to counterbalance (or offset) the impacts on biodiversity values that are likely to occur as a result of development. The credits can also be sold to those seeking to invest in conservation outcomes, including philanthropic organisations and government.

Relevance to Hunter Estuary Management Plan

The TSC Act applies to the Hunter Estuary Management Plan as many threatened species listed under the TSC Act are present in the study area. This Act will assist in implementing strategies to ensure habitat protection and conservation within the Hunter Estuary catchment. Also, Biobanking provides significant opportunity for conservation of existing valued lands within the catchment.

4.3.2.9 NSW Native Vegetation Act 2003

The *NV Act* aims to promote the management of native vegetation as well as prevent broad scale clearing unless it improves or maintains environmental outcomes. It states that native vegetation must not be cleared except in accordance with:

- a development consent granted in accordance with this Act, or
- a property vegetation plan.

Land to which this Act does not apply:

- SEPP 14 – coastal wetlands
- SEPP 26 – littoral rainforests
- Land reserved under National Parks and Wildlife Act.

Relevance to Hunter Estuary Management Plan

Vegetation clearing would not normally be recommended under an Estuary Management Plan (except possibly for the roost sites). Existing NV Act approaches to vegetation management (such as property vegetation plans) in the HEMP should be adopted to assist in implementation. Approaches to developing conservation tradeoffs for landowners under the Act should be investigated and discussed with DECC.

4.3.2.10 NSW Heritage Act 1977

The Heritage Act 1977 protects heritage items, sites, and relics and is administered by the NSW Heritage Office.

A relic is defined as any item relating to European settlement that is older than 50 years. Under Section 139 an excavation permit must be obtained from the NSW Heritage Office for the excavation or disturbance of a relic.

Relevance to Hunter Estuary Management Plan

The Estuary Processes Study recognised that there are 684 heritage items listed on the State Heritage Inventory (SHI) with 77 being of state significance.

HEMP management strategies must ensure they do not detrimentally impact on heritage items listed under this Act.

4.3.2.11 NSW Protection of the Environment Operations Act 1997

The POEO Act lists activities requiring environmental protection licences from the Department of Environment and Climate Change (DECC), and details pollution offences and penalties.

Relevance to Hunter Estuary Management Plan

The Hunter Estuary and its tributaries are subject to scheduled activities (such as mines and industry), and other forms of pollution (commercial and recreational boats, industrial development, urban development etc) that are administered under the POEO Act. Improved compliance with licence requirements may be necessary.

4.3.2.12 NSW Noxious Weeds Act 1993

The Noxious Weeds Act 1993 identifies noxious weeds and specifies control measures and duties of public and private landholders. The Act provides a framework for the state-wide control of noxious weeds by the Minister and local control authorities.

Relevance to Hunter Estuary Management Plan

The HEMP can support the management of weeds through incorporating the management strategies contained within the Act for the categories of noxious weeds listed.

4.3.2.13 NSW Environmental Planning and Assessment Act 1979

The Environmental Planning and Assessment Act 1979 (EP&A Act) establishes a state-wide system of environmental planning and assessment. All proposed development or activities (as defined by the Act) must be assessed in relation to their environmental impact and compliance with planning instruments (such as REPs, LEPs and SEPPs).

Relevance to Hunter Estuary Management Plan

This Act provides an additional avenue to control development within the Hunter Estuary catchment through the LEP process. Future development control can be achieved with local Council support through amendments to permissible land uses, development consent conditions and strategic conservation.

4.3.2.14 Commonwealth Environmental Protection and Biodiversity Conservation Act 1999

The EPBC Act requires approval by the Commonwealth Minister for the Environment for actions that may have a significant impact on matters of national environmental significance. The EPBC Act also requires Commonwealth approval for certain actions on Commonwealth land.

The EPBC Act defines matters of national environmental significance as Ramsar wetlands, listed threatened species and communities, World Heritage properties, listed migratory species, the Commonwealth marine environment and nuclear actions (including uranium mining).

Relevance to Hunter Estuary Management Plan

The Hunter Estuary Wetlands Ramsar sites (Kooragang Nature Reserve and Shortland Wetlands) are protected under this Act.

Protection measures contained in this Act should be incorporated into management strategies of the HEMP to reinforce its implementation.

4.3.2.15 NSW Water Management Act 2000

A controlled activity approval is required for certain types of developments and activities that are carried out in or near a river, lake or estuary. Under the Water Management Act 2000 (WMA) a controlled activity means:

- the erection of a building or the carrying out of a work (within the meaning of the Environmental Planning and Assessment Act 1979), or
- the removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise, or
- the deposition of material (whether or not extractive material) on land, whether by way of landfill operations or otherwise, or
- the carrying out of any other activity that affects the quantity or flow of water in a water source.

The WMA also governs the issue of new water licences and the trade of water licences and allocations for those water sources (rivers, lakes and groundwater) in NSW where water sharing plans have commenced. The Water Act 1912 is being progressively phased out and replaced by the WMA but some provisions are still in force.

Relevance to Hunter Estuary Management Plan

The provisions of the WM Act require a permit from the Department of Environment and Climate Change for:

- Any works on or adjacent to existing levees; and
- 'Flood works' within a declared floodplain.

This will need to be considered when assessing management strategies for the Hunter Estuary. Furthermore, any work by a non-public authority and Landcom will require a controlled activity approval.

4.3.2.16 NSW Rivers and Foreshores Improvement Act 1948

This Act has now been repealed, with all relevant provisions captured within the Water Management Act 2000 (refer Section 4.3.2.15).

The R&FI Act was administered by the Department of Water and Energy (DWE). This Act established a regime for the protection and improvement of certain rivers and foreshores and the prevention of erosion of lands by non-tidal and tidal waters.

Under Part 3A of the former R&FI Act, excavation works within 40 metres of a waterway required a permit from DWE. This requirement has been passed to the Water Management Act.

Relevance to Hunter Estuary Management Plan

Any work by non-public authorities that involves excavation (eg. construction of jetties, weirs etc) within the Hunter Estuary study area will require a permit from DWE, under the provision of the WMA. This will need to be taken into consideration if excavation is a necessary management strategy.

4.3.2.17 Hunter Water (Special Areas) Regulation 2003

The Hunter Water (Special Areas) Regulation 2003 replaces the Hunter Water (Special Areas) Regulation 1997. The Regulation identifies key land areas within each of Hunter Water's catchments that are protected from development and reserved for water extraction.

Land uses that are controlled under the Regulation include:

- Intensive agriculture;
- On-site sewage facilities;
- Pollution of waters;
- Water activities; and
- Extractive industries.

Relevance to Hunter Estuary Management Plan

Development in the identified Special Area should be adequately assessed and controlled to prevent any impact on the aquifer's use. The HEMP should support DWE and HWC under this Regulation to restrict development in this area for the long term protection of this resource.

4.3.2.18 NSW Native Title Act 1994

The Native Title Act 1994 focuses on continuity of links with an area. Where this can be demonstrated, Aborigines of local derivation and specific ancestry will have a case for making claims for land interest arising from it.

Relevance to Hunter Estuary Management Plan

Measures proposed in the HEMP on Crown land must be reviewed to determine if a Native Title Claim exists.

4.3.3 Williams River (Seaham Weir Pool) Boating Management Plan 2000

The Healthy Rivers Commission of NSW published a report that identified a set of goals and recommendations directed towards the management of the river. The Waterways Authority (now NSW Maritime Authority) produced the Williams River Boating Management Plan to be monitored by independent experts in the relevant areas of engineering, the environment and ecology.

Key Performance Indicators (KPI's) were used to monitor the success of the plan. Bank erosion monitoring, vegetation monitoring, noise and near-shore turbidity were all used as environment KPI's. Incidents were monitored for safety KPI's and boat behaviour was reported to monitor compliance KPI's.

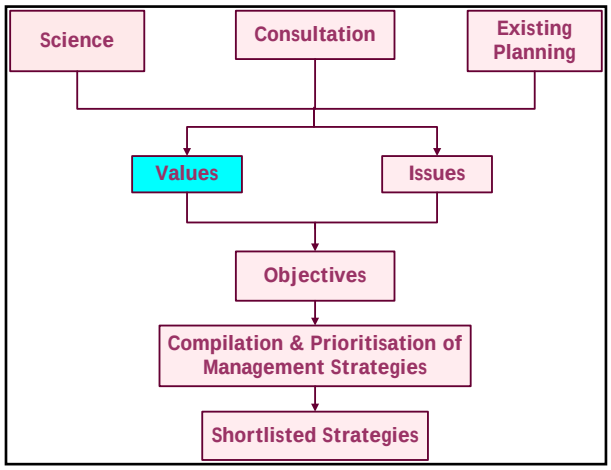
Actions to complete the KPI's successfully included:

- video recording to monitor areas with low to high cattle access
- parameters to assess maximum and minimum water levels for effective bank revegetation
- conducting environment protection "Regulation Compliance and Incident Reporting" seminars to general public users
- investigate the use of "Wave Barriers" to reduce bank degradation
- introduce program to inspect powerboats to ensure noise emissions comply with noise control limits.

Relevance to Hunter Estuary Management Plan

The HEMP should support the Boat Management Plan by incorporating the successful traffic management strategies of the Plan. The inclusion of action plans that were successful within the Williams River will help to determine management options and strategies for the wider estuary area. It is understood that wave baffles and revegetation trials were largely unsuccessful, while education and traffic management initiatives showed some success (Cal Cotter, pers. Comm.. 2008).

5 ESTUARY MANAGEMENT VALUES



A series of statements about the significance and value of the estuary has been developed, based on the Estuary Processes Study and the outcome of the community and stakeholder consultation. These considerations have been accommodated in the development of all management objectives, management strategies and options. The considerations are described below under the headings of economic, social and ecological values.

5.1 Economic

- The deep water access and port-side activities of the Port of Newcastle act as a significant driver for local, regional and state economies.
- Agriculture around the Hunter Estuary contributes to local and regional economies.
- Fishing (commercial and recreational) and aquaculture within the Hunter Estuary contribute to the regional and local economies.
- The Hunter River Flood Mitigation Scheme has been developed to minimise damage, economic losses and risks to life during times of flood.
- The lower Hunter Estuary is considered a key attraction for tourists and recreational users to the area, with associated economic benefits.
- Wetlands within the Hunter Estuary provide habitat for prawns and fish, and thus are important to regional and local economics.
- Wetland rehabilitation works contribute to the local economy.

5.2 Social

- The Hunter Estuary, wetlands and environs are of cultural significance to Aboriginal People.
- Newcastle and surrounds were one of the first sites of European settlement and the Hunter Estuary study area includes a unique variety of historical structures and sites of significance.
- The estuary is a significant landscape feature that determines the identity of regional communities and contributes to the amenity of the region.
- The Hunter Estuary is a focus for recreational activities in the region, including fishing, boating, water skiing, bird watching, swimming, cycling, sightseeing and walking.
- It is important to the local community that they continue to be consulted in management and protection of the Hunter Estuary.

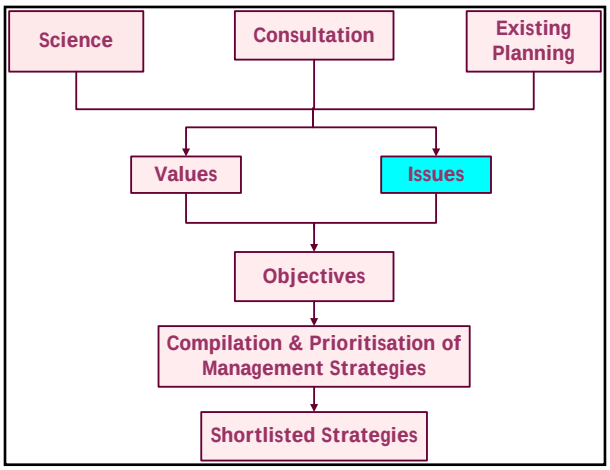
5.3 Ecological

- The Hunter Estuary and wetlands are of international significance, being listed under the Ramsar wetland convention, and utilised by 38 of the 66 migratory species protected by the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA).
- The Hunter Estuary and wetlands are also of state and national significance, being utilised by a range of species protected under the NSW *Threatened Species Conservation Act 1995* and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999.*
- The Hunter Estuary encompasses a diversity of habitats, including several Endangered Ecological Communities listed under the NSW *Threatened Species Conservation Act 1995*, as well as habitats critical to migratory birds.
- Estuarine vegetation communities of the Hunter Estuary play an important role in providing wildlife corridors of a landscape scale.
- Wetland rehabilitation works around the Hunter Estuary (such as Kooragang, Shortland and Hexham Projects) are widely regarded and have produced notable positive results.

6 ESTUARY MANAGEMENT ISSUES

This section describes the key issues of concern affecting the estuary. These key issues were derived with consideration of issues raised during the consultation phase and those identified as having scientific significance in the Estuary Processes Study (MHL, 2003).

The issues are listed and discussed below in no particular order.



6.1 Estuary Management Coordination

Development within the estuary catchment is a major threat to estuary health. Urban development contributes to erosion, runoff and pollution through increased hardstand areas, tree clearing, industrial discharges, detergents etc. Strategies that engage local planning controls to manage these impacts upstream will result in demonstrable improvements in downstream water quality.

Similarly, portside development and use has the potential for serious estuary impacts. Strategic conservation of key ecological areas within the estuary is urgent, as pressure mounts for redevelopment of this area. The competing interests of tourism, commercial fishing and industrial development pose difficulties in prescribing and implementing estuary management strategies. The broader goal of ecological integrity must be paramount in balancing competing priorities, as the implications of poor estuarine health are more far reaching than any immediate industrial benefit.

A range of environmental legislation and policies exist to protect identified ecological assets (refer Section 4.3), however the nature of the development assessment process does not adequately account for the cumulative impact of individual proposals, and therefore fails in achieving true ecological sustainability. Broader protection policies and strategies are needed with multi-governmental support and implementation to accurately assess and control the impact of development.

The division of responsibility for various activities affecting the estuary may be counterproductive in achieving the common goals. Reshuffling of government departments at the state level has added to complication in this regard in recent times.

Through the creation of Catchment Management Authorities and strategic planning documents (eg. Thornton-Killingworth Conservation and Development Sub-regional Strategy, Newcastle Port Environs, Lower Hunter Regional Strategy and SEPP 71), attempts have been made to consider development and conservation on a broader scale. However, a greater level of cooperation and coordination is required to achieve ecologically sustainable development.

6.2 Protecting Estuary Significance

Protecting the economic, social and environmental significance of the estuary is an important issue for the community. The feedback during consultation has identified the following key features of the estuary as factors increasing its value and importance:

- largest coal port
- new port opportunities with the closure of BHP
- Ramsar wetlands
- growing Hunter tourism (cycleways, parks, boating, visual amenity)
- substantial fishing industry
- riverside farming
- increasing development pressure in the catchments.

All these factors add to the significance of the estuary and the importance of developing strategies for its protection.

Habitat provision, good water quality and the remaining natural aspects of the estuary were highly valued by participants in the community consultation. The ecological integrity of the estuary is recognised as a paramount value, having diverse implications on estuary use. Ecological integrity affects the recreational usage, fishing capability, community pride and tourism opportunities.

6.3 Development Pressures and Land Management

The study area covers parts of the local government areas of Newcastle, Maitland and Port Stephens. These areas have experienced particularly strong population growth in recent years, with Councils facing pressure to release additional land for urban development. This pressure is evidenced by the large number of urban investigation areas identified within the estuary's catchment.

As well as residential development, the catchment is a good location for industrial/commercial uses that can take advantage of the existing and future transport corridors and proximity to Sydney, the North Coast and the Port of Newcastle. Pressure for this type of land use is likely to continue with the planned construction of the National F3 Highway extension. The area's advantages are already seen in the recent concentration of industrial/commercial uses to the west of Newcastle (Tomago, Thornton and Beresfield) and around the Port of Newcastle (Kooragang Island and Mayfield). The growing importance of Port Stephens as a tourist area, and the expansion of services from Newcastle Airport, also illustrates the pressure of increased development.

Contrasting with these pressures are the natural attributes of many parts of the estuary and its catchment, with tracts of bushland, large wetland areas and rural landscapes. Within these natural areas are vegetation and fauna species that have been identified as important, and are protected under various legislative controls. Other natural resources include known and potential mineral resources, with coal and mining activities prevalent in the study area. The urban development pressures and strategic location mean that these environmental resources and values need to be balanced against competing issues.

Traditional approaches to agricultural land management continue to contribute to the degradation of the estuary. Land clearing and agriculture contribute to water quality and bank erosion problems.

Current Land Use

The upper reaches of the estuary are dominated by agricultural land use in the immediate river zone. *Figure 3.2* of the Hunter Estuary Processes Study (EPS) identifies land uses within the Hunter Estuary. There is very little bushland or wetlands along the river banks (MHL, 2003 p. 25). Urban settlements such as Maitland, Morpeth, and Raymond Terrace have developed very close to the river and tributaries, creating a high flood hazard and pollution risk.

The lower part of the estuary is characterised by protected areas of the Kooragang Nature Reserve, industrial development at Tomago, Kooragang Island, Newcastle Harbour, Throsby Creek, and urban development at Stockton and surrounding areas of Newcastle. Surrounding land uses include further urban areas, bushland and mining/quarrying (MHL, 2003 p. 26). The Port of Newcastle (lower estuary) has extensive wharfing, boating and docking facilities. The main locations of these facilities are identified in *Figure 3.5* of the EPS, (MHL, 2003).

Impacts associated with land uses are further discussed under various headings in this section.

Land Ownership

The majority of riverside land is privately owned. Portside land is owned by a number of large corporations (Newcastle Port Corporation, Hunter Development Corporation [formerly RLMC], Honeysuckle Development Corporation, NSW Government, State Rail Authority and Grain Corp). These areas are shown in *Figure 3.4* of the EPS (MHL, 2003). There is currently little council owned land within the estuary area (MHL, 2003 p. 27).

Within the Hunter estuary, the beds of the Hunter, Paterson and Williams Rivers and their tributaries to the tidal limits, excluding the Port of Newcastle and a section of the Hunter River included in the Kooragang Nature Reserve, are generally part of the Crown estate. It is accepted that the river has moved over time and parts of the river may no longer be considered within the Crown estate. In addition, Crown land includes some tenured lands, reserves and Crown roads in the vicinity of the estuary.

The diversity of land ownership throughout the estuary catchment makes implementing management measures difficult. Strategies affecting riverside land must consider the implications on the land owners as well the estuary's health and estuary users. Broad-reaching policies are required to necessitate action by all affected parties. Implementation of strategies requires commitment and enforcement by governing bodies (local councils, Department of Planning, Department of Primary Industries: DPI-Fisheries, Department of Environment and Conservation, NSW Maritime Authority) and Department of Lands.

Proposed F3 to Raymond Terrace Upgrade

The proposed upgrade of the F3 to Raymond Terrace will have consequences on the HEMP as the project is likely to include an additional crossing over the Hunter River. The main study area for the upgrade is located to the north of the existing highway crossing adjacent to the estuary.

The proposed upgrade will require privately owned land to be purchased by the State Government which may provide opportunity to repair riparian vegetation and restore important habitat areas.

Considerations and Opportunities

Land use changes in the future should be seen as opportunities to improve the natural and social values of the estuary. Examples of such potential improvements are:

- *Important natural areas* – identify and protect their attributes through clear guidelines and priorities in the EMP;
- *New urban development adjacent to river* – such as new industrial areas could require land use improvements like the rehabilitation of native vegetation and the river edge, provision for public foreshore/waterway access and park dedication;
- *Inland rural areas* - increased buffers to the river and rehabilitation of riverbanks;
- *Other urban development* – could require the reinforcement and rehabilitation of watercourses and catchment areas, as well as key habitat areas and corridors, within their development areas;
- *Areas seen from river* – all new development should be assessed in terms of visual impact from the river itself.

Various mechanisms can be used to reinforce these land use improvements such as LEPs, requiring strict provisions for any rezonings and other more specific legislation related to pollution and natural environment protection.

6.4 Estuary Users and Conflicts

Conflicts frequently exist between different estuary uses. These conflicts need to be understood so management measures do not disproportionately favour or affect portions of the community.

A large number of people use the estuary for recreational purposes. *Figure 3.9* of the EPS (MHL, 2003) maps recreational activities carried out within the study area. These activities (and conflicts between them) are described below. Note that fishing is addressed separately (refer Section 6.7).

6.4.1 Water-Based Users

Speed boats/wakeboarding/waterskiing

The EPS identifies the Williams River as the general area for waterskiing between Seaham and Raymond Terrace. The main waterskiing area is identified as 1 – 2 km upstream from Fitzgerald Bridge.

The impacts of wakeboarding and waterskiing on the riverbanks of the estuary have contributed to erosion and destabilisation of the river banks adding to the siltation of the estuary. This was highlighted as an issue at the community workshops.

The issue of erosion within the Hunter Estuary is described elsewhere in this document. Specifically, investigations undertaken by GHD are summarised in Section **Error! Reference source not found.**.

Powerboats/Rowing

Rowing in the Hunter Estuary is predominantly carried out in the Swan Reach of the Hunter River, and within Throsby Creek upstream of Cowper St Bridge. There is potential for conflicts to occur between rowers and users of speedboats, such as for waterskiing, however, this is presently uncommon. The spatial distances of these activities within the estuary have provided a buffer, reducing potential conflicts.

Boating and Commercial Shipping

Boating activities are popular within the estuary. *Figure 3.9* of the EPS identifies the location of numerous boating facilities available within the estuary, including jetties, boat ramps and marinas. These facilities are used regularly around the estuary. Recognised boating facilities in the EPS include:

- major boat ramps at: Carrington, Stockton, Raymond Terrace (Fitzgerald Bridge), Kooragang Island, Tomago and Morpeth
- a marina at Throsby Creek (MHL, 2003).

Illegal facilities also exist along the estuary foreshore in some locations and these require management controls.

Recreational boating can obstruct commercial shipping activities in the port, creating conflict between both uses. This is currently well managed with few conflicts arising.

6.4.2 Shore-Based Users

Picnic areas and foreshore reserves are predominantly located around urban areas including: Morpeth, Newcastle, Raymond Terrace and Paterson (MHL, 2003). Most areas are used for recreational shore-based fishing and leisure activities such as picnics.

Bird watching is predominantly conducted at locations such as Stockton Sandspit, Ash Island, The Wetlands Centre and within Hexham Swamp (MHL, 2003). Concerns were raised during the community consultation about recreational boating disturbing the roosting and feeding patterns of birds.

The adequacy of recreational facilities within the estuary are considered overall to be satisfactory. The provision of walking tracks, boat ramps, river side parks and playgrounds appears to meet the communities' needs. However, the potential reduction of public access to waterways and foreshores with continued foreshore development is a concern among the community and demands may change with future population growth.

Considerations and Opportunities

- Dredging of the river to allow commercial ship access has economic advantages for tourism and selected industry, however, dredging has a negative effect on the fishing industry, and alters fauna habitat.

- A major impact of water sports in the estuary is the exacerbation of bank erosion. The Maritime Authority regulates points of access, speed and distance to the shorelines to minimise bank erosion.
- Management of boating activities through local Boating Plans of Management developed by NSW Maritime through community consultation and programs of replanting and stabilization are a positive way of addressing these issues and ensure a balanced approach to the enjoyment of these natural assets.
- Mitigation measures for bank erosion may include review of the location of low speed zones and increased enforcement of access limitations.
- The appropriateness of current fishing restrictions should be considered within the HEMP.
- Boating facilities and foreshore amenity could be enhanced by landscaping treatments and illegal facilities require management controls.

6.5 Social and Cultural Issues

6.5.1 Heritage

European Heritage

Several heritage sites exist within the estuary including the eastern side of Fullerton Cove, registered as the Hunter Estuary Landscape Conservation Area by the National Trust (MHL, 2003 p. 23). Some sites are listed under the State Heritage Register (SHR) and afford protection under the NSW Heritage Act 1977. Several heritage sites adjoin the river and could be affected by strategies proposed in the EMP through increased flood levels, erosion or riverbank works.

Aboriginal Heritage

The EPS (MHL, 2003 p. 22) identified around 2,000 Aboriginal sites throughout the study area. However, many of these have been disturbed or destroyed over the years by river works, reclamation and urban development. Aboriginal sites are considered high priority for conservation.

The EMP needs to incorporate protection of identified heritage items and areas of spiritual significance. Liaison with Aboriginal representatives is needed to determine priority areas, possible artefact areas and preferred management actions. Depending on the sensitivity of sites, some may be targeted for protection and educational uses.

Opportunities and Considerations

- There is opportunity for conserving areas of cultural importance in existing or new foreshore reserves.
- Riverbank works including jetties and replanting may disturb unregistered or buried Aboriginal sites.

6.5.2 Scenic Quality

Visually sensitive areas are those most exposed to public viewing, either by water craft, residential or commercial land development, from nearby roads and bridges, foreshore areas and recreational uses.

Areas of poor scenic quality along the estuary include unattractive land uses (eg. industrial, major roads), degraded river infrastructure (eg. ramps, jetties and park lands) and areas of pollution (eg. litter, outfalls). Quality scenic areas include dense vegetation, clean water, bird life, clean and plentiful fish stock, and quality recreation facilities.

Management options evaluated for the next phase should be assessed in terms of their potential visual impact.

Opportunities and Considerations

Methods to reduce impact on the river itself may include establishing vegetation buffers and parks along some foreshore areas, setting taller and generally unattractive structures (such as industrial areas) well back from the water front, sensitive design of any new structures in the river and removal of obsolete structures and ensuring infrastructure corridors and road crossings are minimised and screened where possible.

Priority should be given to enhancing existing areas of remnant vegetation and habitat corridors, and screening undesirable views from the river.

6.6 Flood Mitigation Works

Figure 3.8 of the EPS, (MHL, 2003) identifies the locations of all the flood mitigation structures within the Hunter Estuary. The existence of flood mitigation structures and their significance was a key issue raised by the community.

Whilst weirs and floodgates provide flood protection for farmers and riverside residents, they limit the tidal flushing of wetland areas, effectively reducing aquatic fauna habitat, salt marsh and wetland areas, interrupt fish passage, alter water chemistry, degrade the quality of floodplain soils and often result in conversion to a fresh water system. These competing objectives pose a challenge in managing their use.

A key focus of the Hunter Estuary Management Plan will be identifying opportunities to modify the flood mitigation scheme, resulting in increased habitat areas. One such project for restoring habitat behind floodgates is the Hexham Swamp Rehabilitation Project. This project involves the progressive opening of floodgates on Ironbark Creek. Some 750ha of wetland are expected to be returned to saline wetland habitat. Works associated with the project commenced in 2007, while the first floodgate was officially opened on 19th December 2008. Subsequent floodgates are expected to be opened progressively over the coming years, subject to monitoring outcomes.

Considerations and Opportunities

Through the community consultation, a number of opportunities to rehabilitate former prawn habitat areas were identified. These include:

- Mosquito Creek, where reclamation has closed off the confluence with the South Arm of the Hunter River
- the saltmarsh and tidal flats of Fullerton cove, impacted by a ring drain
- Gates at Purgatory Creek
- Gates at Ironbark Creek (Hexham Swamp)
- Gates at Greenways Creek
- Gate at Wallis Creek (Wentworth Swamp)
- the swamp and saltmarsh areas in the north west corner of Kooragang Island, which have been impacted by reclamation works (Ash Island) – not part of the flood mitigation scheme
- Tomago

Barriers to prawn and fish passage should also be identified and where possible, removed. Examples of barriers to fish passage raised through the community consultation were gross pollutant traps (GPT) used in stormwater management.

6.7 Fishing

Recreational Fishing

The Hunter Estuary is a popular area for both boat and shore-based recreational fishing. An angling survey carried out by NSW Fisheries suggested that catches from the Hunter River are in the vicinity of 114,000 fish per annum, with approximately 40% returned to the water (MHL, 2003).

The EPS (MHL, 2003) identified three areas with some restricted recreational fishing activities. These include Throsby Creek upstream of Cowper Street bridge, south arm of the Hunter River and upstream of Hunter and Williams Rivers from Raymond Terrace, and mostly relate to netting and trapping restrictions, and the taking of shellfish (see http://www.dpi.nsw.gov.au/fisheries/closures/location/hunter-river).

The northern breakwater of Newcastle Harbour has been identified as the most popular area within the estuary for shore-based fishing (MHL, 2003). Shore-based fishing also occurs along the southern breakwater, Throsby Creek, Carrington Basin, Stockton, Tomago and Kooragang Island. Further north of the river, the south arm from Ironbark Creek to Hexham is used for shore fishing as well as from the foreshore reserve at Raymond Terrace (MHL, 2003).

Shore fishing in the upper estuary is not as common with a small number of people fishing on the Paterson River and around the Morpeth area. A number of jetties are located in this area, suggesting these areas could be used as fishing spots (MHL, 2003). Fishing in the Williams River is infrequent.

Recreational fishing by boat predominantly occurs in the lower parts of the estuary and has been discussed previously (see Section 6.4.1).

Commercial Fishing

Commercial fishing within the estuary is primarily prawn trawling. In an effort to regulate prawn trawling, the Hunter River is divided into six sub-divisions (MHL, 2003). The majority of prawn trawling

is conducted in the north arm, however, DPI Fisheries checks the size and number of prawns in each sub-division (MHL, 2003). There is no limit to the amount of trawlers working within a sub-division at any time (MHL, 2003).

Opportunities and Considerations

The yield of recreational fishing can potentially reduce the viability of commercial activities and vice versa. Restrictions to operating areas, times and catch numbers can assist in reducing this conflict.

6.8 Water Quality

Water quality is a major issue for government authorities, environmental groups and the general community. The most significant influence on the water quality of the Hunter Estuary are the land uses within the catchment.

6.8.1 Agricultural activities

Agricultural development of the Hunter River Catchment has involved broad scale clearing, overgrazing, use of pesticides and fertilizers and compaction of soil by hoofed animals. These types of activities have lead to increased sediment, nutrients, pesticide and fertiliser loads to the estuary. Further impacts to water quality from agricultural practices include changes to the flow regime due to extraction.

Opportunities and Considerations

Opportunities to mitigate the impacts of agricultural landuse on the Hunter Estuary could include:

- Development of incentive mechanisms to promote and facilitate the adoption of sustainable agricultural practices that generate a commercial and environmental benefit, as recommended by the Healthy Rivers Commission Inquiry into the Hunter River (HRC, 2002).
- Algal blooms should be monitored, including the identification of species, mapping of extents and impacts on water quality parameters.
- Incentives for land/river bank/riparian conservation and alternative watering strategies for cattle.
- When agricultural land is subdivided for urban development, allow for a riparian buffer to be transferred to council and rehabilitated through a possible ‘contributions’ scheme and ensure that Water Sensitive Urban Design (WSUD) principles are being embraced. It should be noted, however, that Councils have finite resources and ongoing maintenance of riparian buffers may be difficult.

6.8.2 Urban Inputs

Urban inputs include sewerage discharges and stormwater runoff. These increase nutrient, sediment and contaminant loads to the estuary.

Opportunities and considerations

- Stormwater management techniques, including purpose designed wetlands and detention basins, engineered devices and Water Sensitive Urban Design (WSUD) principles, should be considered in the Estuary Management Plan.
- Target monitoring (including wet weather monitoring) should be undertaken at stormwater outlets to estimate relative impacts and to prioritise stormwater management works.

6.8.3 Industrial

DECC licensed inputs into the Hunter Estuary include oil and grease, suspended solids, saline water and a range of metals and halogens. Sediment contamination from industry is of particular concern in the South Arm.

Concerns about ballast water impacts on the Estuary were raised during the community consultation. While ballast is legally discharged offshore and unlikely to be an issue for the estuary, foreign marine organisms may be directly introduced into the Hunter Estuary through general shipping activity.

Opportunities and Considerations

- A significant opportunity for the improvement of water quality and industrial discharge standards is available with the closing of BHP operations in the estuary. New industries may be able to exist in balance with the natural estuary.
- The Salinity Trading Scheme was introduced to mitigate the impacts of electricity production and mining on agriculture and the environment. The scheme involves a program of continuous monitoring to allow scheduling of saline discharges for periods of high river flow rates and low background salinity levels. The scheme is based on the sharing of total allowable discharge according to dischargers' holdings of tradable salinity credits (MHL 2003). The impacts of the scheme were raised as a concern.

6.9 Bank Erosion and Sedimentation

Changes to flood patterns, together with the clearance of riparian vegetation, have led to riverbank destabilisation and substantial bank erosion. Once banks are vulnerable, wind induced erosion also becomes an issue. Sand and gravel extraction may also be exacerbating the erosion by widening channels and starving downstream sections of sediment. Cattle access is also a major factor in erosion for much of the estuary, particularly upstream of Hexham. Cattle access damages the banks through trampling and through eating germinating plants in the riparian zone. In some areas speedboats may also be a contributing factor.

Sedimentation is a natural process that is highly variable depending on rainfall and subsequent runoff. Human induced increases in sedimentation in the Hunter Catchment are significant. Large volumes of sediment have been washed into the estuary due to deforestation, overgrazing and bank erosion. This may have slowed in recent times due to a slowing in the rate of deforestation. Major floods deliver large amounts of sediment from the catchment, to the river. During the largest flood on record, in 1955, major deposition occurred between Oakhampton and Morpeth. This material is gradually being reworked, by natural river processes being progressively removed from the outside of

meander bends and deposited on the inside of bends. Through the community consultation, sedimentation was identified as an issue for recreational opportunities and water quality.

Opportunities and Considerations

- Port Stephens Council is currently undertaking an erosion study on the Williams River. This study will provide an opportunity to understand the processes that are causing erosion on the Williams River and to identify strategies to address them.
- The use of "No Wash" boat zones instead of speed-limited zones and user pays options were discussed in the community workshops
- A co-ordinated approach to erosion and sedimentation controls across Councils
- Opportunities to co-ordinate sand and gravel extraction to assist in the management of sedimentation issues were discussed in community workshops
- Remediation of riparian vegetation should be undertaken to improve bank stability and decrease sediment input to the estuary.
- The Department of Lands (Crown Lands Division) must be consulted prior to any works to stabilise river banks or remediate eroding banks where the bed of the river is Crown land. Sedimentation control measures and particularly plans for the removal of sediment should also be referred to the Department at an early stage to prevent unnecessary delays. Where Crown land is affected by any proposed works that may require approval via the environmental planning process, it is also a legal requirement to have the consent of the land owner prior to the lodgement of the application for approval.
- Other government departments that may need to be contacted prior to works to stabilise river banks include DECC and DPI Fisheries, depending on the nature of the site and the proposed works.
- Consider the findings of the current Comparative Analysis of Boat Wake Waves study commissioned by NSW Maritime Authority to assist informed management decisions in relation to boating activities within estuaries.

6.10 Impacts on Native Flora and Fauna

6.10.1 Lack of Riparian Vegetation

The landuse information presented in the Estuary Processes Study (MHL, 2003) reports that riparian vegetation along the banks of the north arm, Fullerton Cove and the south arm north of the port area is generally good.

The remainder of the estuary is characterised by riparian vegetation that is generally sparse and degraded. This includes:

- the port (non existent)
- the Hunter River north of Hexham
- the north-western section of Kooragang Island
- upstream areas of Ironbark Creek

- Williams River
- Paterson River
- Wallis and Fishery Creeks.

Cattle access, historical and current agricultural practices, and flood mitigation works are the major causes of the decline in the condition of riparian vegetation.

Opportunities and Considerations

MHL (2003, *Figure 4.23*) has categorised riparian vegetation as:

- in good condition with a diversity of native species
- either sparse or exotic- areas where community effort could move the area into the above category
- missing or bare, trees falling in channel and cover is less than 25%

Aerial reconnaissance has confirmed that this layer is a reasonable representation of broad scale riparian habitats. This will be a useful tool in developing management options for the Estuary Management Plan.

6.10.2 Mangroves and Noxious Weeds Invasion

Mangrove incursion into saltmarsh and tidal flat areas is an issue throughout NSW. Reasons for the phenomena may include sea level rise, increased sedimentation and changes to environmental flows. Saltmarsh is recognised as an endangered ecological community and is a key habitat for a range of nationally and internationally significant bird species. General weed invasion is an issue through the Hunter Estuary and the catchment.

Opportunities and Considerations

- A co-ordinated approach to weed management across council areas should be considered in the Estuary Management Plan.
- A co-ordinated approach to decreasing sediment input to the estuary across council areas may limit mangrove incursion to saltmarsh areas.
- Opportunities for funding will be available through Caring for our Country, Envirofund and other existing programs.
- Investigate opportunities for adaptive management of existing flow control structures and installation of new flow control structures to influence tides and exclude mangrove propogules.

6.10.3 Habitat Loss

The habitats of the Hunter Estuary have been recognised as significant on a regional, national and international scale. Habitats have been lost to land clearing, reclamation, fragmentation, illegal land filling and flood mitigation activities.

The large variety of migratory and resident bird species depend on a diversity of habitats including: open saline and fresh water bodies, tidal mudflats, saltmarsh, mangroves, sand spits, Casuarina and Melaleuca swamp and an overall high diversity of freshwater and brackish wetlands. The loss of riparian vegetation has impacted on the diversity of native amphibians, reptiles and mammals inhabiting this area.

Opportunities and Considerations

- The Estuary Processes Study has a strong focus on the vegetation of the lower estuary and further nature conservation opportunities in the upper reaches.
- The Estuary Processes Study notes that there is a lack of information regarding groundwater influence on wetlands
- The Healthy Rivers Commission Inquiry recommendations related to ecological integrity and resilience.
- Modifications to hydraulics (including tidal range increase) has lead to changes in vegetation communities and habitat loss.

The catchment is highly modified, however, significant opportunities for habitat rehabilitation remain, including:

- Ash Island
- Mosquito Creek
- the saltmarsh and tidal flats of Fullerton Cove
- the north eastern end of Kooragang Island and the east bank of the north arm of the Hunter River (above Stockton Bridge), including the Kooragang Dykes area
- opening of gates at Purgatory Creek, Ironbark Creek, Greenways Creek, Wallis Creek
- removal of barriers to fish passage such as stormwater gross pollutant traps on Throsby and Styx Creeks.
- removal/partial removal of Fullerton Cove ring levee and /or floodgates
- patches of remnant Melaleuca stands throughout the western part of Kooragang Island (Ash Island) and around the perimeter and upland areas of Tomago and Fullerton Cove, within Hexham Swamp, the Shortland Wetlands and Ironbark Creek
- green corridor areas including the east Maitland Hills Area, the corridor through Irrawang Swamps that links the wetland to the State Forest in the North and the Tomago Coastal Plain which links the Hunter Estuary to Port Stephens
- vegetation around Bolwarra spillway (without compromising structural integrity or functionality)

Constraints to habitat rehabilitation in the Hunter Estuary, include:

- the large portion of riverside land in private ownership
- development pressure from the expansion of the greater Sydney metropolitan region
- state government policies (eg SEPP (Major Projects) 2005 and SEPP (Infrastructure) 2007)

- the estuaries economic role as a major coal port.

6.11 Water Extraction

Discharges from underground aquifers form the base flow of the Hunter River during dry times. The annual input of groundwater to the estuary is estimated to be about 183GL/year. By comparison, landholders extract about 10.7 GL of water per year. However, this estimate is likely to be low, compared to the actual (and unknown) extraction rate (MHL, 2003). A significant volume of water is also extracted from the Williams River at Seaham Weir to supply potable water to the Lower Hunter. This activity has implications for management of the Williams River below the weir.

Through the community consultation, concerns were raised about reduced environmental flows, cold water releases from dams and recent discussions about supplying parts of the Central Coast with drinking water.

Opportunities and Considerations

- Improved monitoring of water extraction rates from the Hunter River.

6.12 Dredging and Commercial Sand and Gravel Extraction

Sand and gravel extracting operations have occurred in and around the upper estuary (ie on adjacent floodplains). Quantities of extracted material were not available from the Estuary Processes Study (MHL, 2003). Historical sand and gravel extraction may still contribute to localised bank erosion by generating wider channels and starving downstream sections of sediment. Localised impacts on ecology are also expected to have occurred, but are not well documented.

Opportunities and Considerations

Monitoring of impacts of previous (and possibly future) sand and gravel extraction on the estuary should be considered in the Estuary Management Plan. Opportunities to utilise commercial operators for sediment removal in hot spot areas of accelerated sedimentation should also be investigated.

6.13 Need for Foreshore Reserves

The issue of the quality and quantity of foreshore reserves was raised during community workshops. The EPS (MHL 2003, p. 34) identified potential 'opportunity' areas for tourism recreational potential within the estuary, such as Throsby Creek and Newcastle Harbour, Paterson River, Hexham Swamp and Morpeth.

Opportunities and Considerations

It is recommended that foreshore reserve areas be identified where there is also an opportunity for dual benefits, such as where native vegetation, wetlands or attractive views are nearby. Other areas may be identified for rehabilitation which could improve water quality and bank erosion, and provide visual, cultural heritage protection and/or native fauna benefits.

6.14 Port Operations

Port operations and related industrial development is of major economic benefit to the Hunter region. It also has a major influence on lower estuary function. Future port growth is planned and opportunities exist for industry to grow in conjunction with the estuary and assist in its future protection.

Dredging of Newcastle Harbour is required to maintain adequate depths for commercial shipping. The Estuary Processes Study (MHL, 2003) reports that there has been no detailed monitoring to quantify the impacts of dredging on the ecology of the estuary. The spoil from maintenance dredging is currently disposed at a designated and approved offshore spoil ground.

The operation of the Port of Newcastle has potential implications for estuary management which must be recognised and addressed in management strategies.

Potential impacts of dredging include:

- habitat modification for estuarine biota, including commercial fish species
- mobilisation of contaminants
- modification of estuary hydrodynamics (with flow on effects for estuarine vegetation)

Potential impacts of increased shipping traffic include:

- increasing water pollution through fuel discharges and introduction of foreign marine life through ballast water
- reduced scenic amenity with an expansion of industrial operations in the estuary
- reduced accessibility and appeal for tourist boating and portside development
- bank erosion from increased ship wakes and/or tug thrust.

Port developments include industrial uses which can conflict with the community vision for the social and environmental management of the estuary.

Opportunities and Considerations

- the feasibility of reusing dredged material from planned capital works should be considered further
- further studies should be undertaken to determine the extent of impacts of planned capital works dredging on the hydraulics and ecology of the estuary and possible measures to mitigate these
- the Healthy Rivers Commission recommends the preparation of a development and environmental management plan for Newcastle Harbour
- adequate planning for the strategic growth of the port and related industries provides an opportunity to achieve an improved balance between the natural, social and economic values of the estuary and the long term protection of these
- increasing community involvement in planning for future port & related activities would reduce conflicts and allow a more strategic approach to estuary management.

6.15 Climate Change

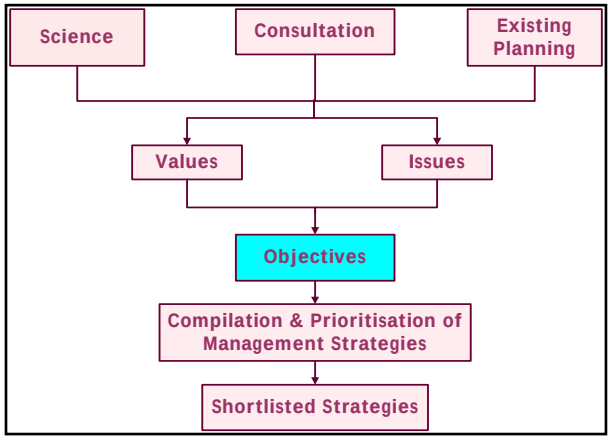
Climate change is now accepted as occurring, with estuarine environments being recognised as particularly vulnerable to sea level rise. Planning for future development and management of the estuary must accommodate predicted future climate change factors.

In general terms, climate change is likely to modify the hydrodynamics of the Hunter Estuary through an elevated half tide level, altered rainfall and flooding patterns, tidal penetration, wind waves and ocean wave energy. This will have flow on impacts to wetlands, shoaling patterns, channel alignment and water levels. Temperature and hydrology changes may also impact on lifecycles of native flora and fauna. The range of implications is large and it is difficult to plan for specific outcomes.

Opportunities and Considerations

- Estuary management and planning needs to accommodate predicted sea level rise from climate change, where appropriate following research.
- Consideration has been given to developing a flexible and adaptable plan that can cater to future changes.

7 ESTUARY MANAGEMENT OBJECTIVES



The **objectives** define the specific aims of the Estuary Management Plan, essentially defining the "goal posts" for which future management of the estuary should be targeted towards. The objectives have been established giving consideration to the values of the estuary as well as the key management issues. The objectives have been prioritised (ranked from most important to least important) by representatives of the Hunter Coast and Estuary Management Committee. Prioritisation of the objectives is used in the assessment of potential management options. The most important objectives are essentially the first to be addressed by short-listed management strategies presented in the Final Hunter Estuary Management Plan. A table demonstrating the relationship between values, issues and management objectives is presented in Table 7-1, under the key themes of **Environmental**, **Economic**, **Social** and **Governance**.

7.1 Prioritised Management Objectives

1. To protect and enhance estuarine biodiversity, particularly Endangered Ecological Communities (as listed under the *NSW Threatened Species and Conservation Act 1995*) and other key habitats

2. To increase appropriate native riparian vegetation along the Hunter Estuary

3. To prevent catchment and point source pollutants from compromising social, environmental and economic values of the Hunter Estuary

4. To optimise management of flood mitigation works and other flow control structures to enhance environmental values without compromising intended function

5. To minimise further bank erosion throughout the Hunter Estuary and remediate existing erosion sites, where appropriate

6. To provide opportunity for effective and inclusive stakeholder involvement in the management of the Hunter Estuary environment.

7. To acquire knowledge relevant to environmental management about the Hunter Estuary, on a priority basis

8. To achieve consistency and integration between the Hunter Estuary Management Plan and other strategic environmental planning and Natural Resource Management instruments and programs

9. To adopt catchment wide development assessment practices that consider and address cumulative impacts on the Hunter Estuary

10. To ascertain the impacts of past works and activities on the tidal hydraulics of the Hunter Estuary

11. To encourage development that maintains and enhances landscape values and ecological functions of the Hunter Estuary

12. To prevent mobilisation of contaminated sediment and groundwater contamination from impacting on environmental processes within the Hunter Estuary

13. To reduce the catchment sediment load to the Hunter Estuary

14. To fulfil all requirements of international environmental management treaties and relevant conservation legislation in regard to the Hunter Estuary

15. To prevent environmental weeds and pests from compromising the social, ecological and economic values of the Hunter Estuary

16. To facilitate the adaptation of estuarine communities to projected climate change

17. To adopt a consistent approach to foreshore land rehabilitation and conservation along the Hunter Estuary

18. To minimise environmental consequences of changes to flow and salinity regimes from upstream activities

19. To reduce the environmental impacts of the accumulation and migration of recent sediments within the Hunter Estuary

20. To prevent further exposure of Potential Acid Sulfate Soils and to reduce the extents of Actual Acid Sulfate Soils around the Hunter Estuary

21. To increase appropriate public access and amenity to the Hunter Estuary and wetlands, recognising sensitive habitats

22. To enhance the scenic quality of the Hunter Estuary

23. To facilitate appropriate reuse of sediment dredged from the Port of Newcastle

24. To minimise the environmental impacts of commercial sand and gravel extraction on the Hunter Estuary

25. [1]To protect and conserve Aboriginal and European heritage objects, places and landscapes

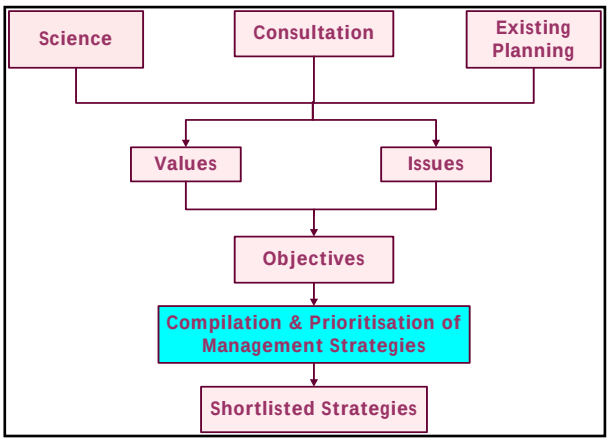
[1] This objective was added during the review process because heritage principles and strategies were included in the plan, however, there was not a corresponding objective The objective has not been prioritised in relation to the other objectives, and its number (25) does not reflect the relative importance given to this objective.

Table 7-1 Relationship between Values, Issues and Objectives

Values	Issues	Objectives
Environmental		
✓ Internationally significant wetlands ✓ Connection to wildlife corridors ✓ Wetland rehabilitation works ✓ Diversity of habitats ✓ Groundwater dependent ecosystems	× Habitat loss × Bank erosion and sedimentation × Impacts on native flora and fauna × Lack of riparian vegetation × Mangroves and noxious weeds invasion × Changes to estuarine hydraulics × Water quality × Climate change	1. To protect and enhance estuarine biodiversity, particularly Endangered Ecological Communities (as listed under the *NSW Threatened Species and Conservation Act 1995*) and other key habitats 2. To increase appropriate native riparian vegetation along the Hunter Estuary 5. To minimise further bank erosion throughout the Hunter Estuary and remediate existing erosion sites, where appropriate 7. To acquire knowledge relevant to environmental management about the Hunter Estuary, on a priority basis 10. To ascertain the impacts of past works and activities on the tidal hydraulics of the Hunter Estuary 12. To prevent mobilisation of contaminated sediment and groundwater contamination from impacting on environmental processes within the Hunter Estuary 13. To reduce the catchment sediment load to the Hunter Estuary 14. To fulfil all requirements of international environmental management treaties and relevant conservation legislation in regard to the Hunter Estuary 15. To prevent environmental weeds and pests from compromising the social, ecological and economic values of the Hunter Estuary 16. To facilitate the adaptation of estuarine communities to projected climate change 19. To reduce the environmental impacts of the accumulation and migration of recent sediments within the Hunter Estuary 20. To prevent further exposure of Potential Acid Sulfate Soils and to reduce the extents of Actual Acid Sulfate Soils around the Hunter Estuary
Economic		
✓ Internationally significant wetlands ✓ Commercial fishing and aquaculture ✓ Wetland rehabilitation works	× Estuary users and conflicts × Flood mitigation works × Fishing	3. To prevent catchment and point source pollutants from compromising social, environmental and economic values of the Hunter Estuary 4. To optimise management of flood mitigation works and other flow control structures to enhance environmental values without compromising intended function 18. To minimise environmental consequences of changes to flow and salinity regimes from upstream activities

Values	Issues	Objectives
✓ Economic role of Port ✓ Importance to agriculture ✓ The Hunter River Flood Mitigation Scheme ✓ Tourism and recreational uses	× Agricultural inputs × Urban inputs × Industrial inputs × Water extraction × Dredging and commercial sand and gravel extraction × Port operations	23. To facilitate appropriate reuse of sediment dredged from the Port of Newcastle 24. To minimise the environmental impacts of commercial sand and gravel extraction on the Hunter Estuary
Social		
✓ Recreational fishing ✓ Tourism and recreational uses ✓ Cultural / heritage significance ✓ Scenic value	× Protecting estuary significance × Estuary users and conflicts × Heritage × Scenic quality × Fishing × Need for foreshore reserves × Condition of sea walls	6. To provide opportunity for effective and inclusive stakeholder involvement in the management of the Hunter Estuary environment 21. To increase appropriate public access and amenity to the Hunter Estuary and wetlands, recognising sensitive habitats 22. To enhance the scenic quality of the Hunter Estuary 25. To protect and conserve Aboriginal and European heritage objects, places and landscapes
Governance		
	× Estuary management co-ordination × Development pressures and land management	8. To achieve consistency and integration between the Hunter Estuary Management Plan and other strategic environmental planning and Natural Resource Management instruments and programs 9. To adopt catchment wide development assessment practices that consider and address cumulative impacts on the Hunter Estuary 11. To encourage development that maintains and enhances landscape values and ecological functions of the Hunter Estuary 17. To adopt a consistent approach to foreshore land rehabilitation and conservation along the Hunter Estuary

8 POTENTIAL ESTUARY MANAGEMENT OPTIONS



8.1 Compilation of Management Options

Well over 100 individual potential management options for the Hunter Estuary were formulated through the community and stakeholder consultation and by the study team. A complete list of these options is provided in Appendix A of this report.

8.2 Assessment and Prioritisation of options

The strategies were prioritised and short listed by the study team according to the following criteria:

- The degree to which they address the agreed Estuary Management Plan objectives (represented by a "management objectives score")
- The benefit of the strategy (represented by a "benefit score")
- The implementation costs (represented by a "cost score")

These three criteria, and their associated scores, are discussed further below.

Management Objectives Score (O)

A matrix was used to assess each of the management strategies against the objectives. Within the matrix, a symbol was used to indicate where the strategies directly contributed (▲), indirectly contributed (△) or conflicted (✪) with each of the management objectives. Weighted scores were then calculated for each strategy, according to the priority level of the objective(s) it contributed to or conflicted with, and the contribution of the strategy to meeting the objective.

The management objective score is a final value out of 5 and is broadly categorised as high, medium or low. A "high" category is allocated to scores > 3.5, "medium" is given to scores between 2.0 and 3.5, and "low" to scores < 2.0.

The Management Objectives vs Options Matrix and details of the scoring are presented in Appendix B.

Benefit Score (B)

This score was assigned for each of the 100 plus strategies by the study team during a two day internal workshop in April 2007, which included representatives from Newcastle City Council and the co-ordinator of the Hunter Coast and Estuary Management Committee.

The score is illustrated in Table 8-1. The scores were assigned based on an understanding of agency directions and status established through a series of individual workshops held in late 2006 and early 2007, and an understanding of estuarine processes.

		Outcome for the estuary		
		Likely to result in observable positive change for the estuary	Will contribute to some positive change to the estuary	Unlikely to contribute to observable benefit for the estuary
Likelihood of implementation / acceptability by agencies	Consistent with agency directions as, programs / funding already in place	3	2	1.5
	Consistent with agency directions	2	1.5	1
	Inconsistent with current agency thinking / programs	1.5	1	0

Table 8-1 Matrix Used by the Study Team to Assign the Benefit Score

Cost Score (C)

An indicative cost was assigned to each of the proposed strategies. The cost was categorised as High (>$110, 000), Medium ($11,000 - $110, 000), Low (<$11,000) or minimal (requiring no specific funding, as works can be completed by existing staff). Corresponding cost scores of 3, 2, 1.5 and 1 were then applied, respectively.

Overall Benefit / Cost Ratio (BCR)

The overall cost benefit ratio was calculated according to the following formula:

BCR = O x (B / C)

Where *O = Management Objectives Score*
B = Benefit Score
C = Cost Score

The calculated scores range from -1 to 8.5, and are detailed fully in Appendix A. The scores were plotted to determine the distribution of results (refer Figure 8-1). From this plot, two clear clusters of data were observed. These were categorised as the “Very High” and “High” scores. The remaining scores are not clustered so there is not such an obvious cut off point for the “Medium” priority strategies. Selection of “short-listed” strategies includes all options with a BCR of very high and high, as well as a number of medium options to ensure that all higher priority objectives were to be addressed by at least one strategy.

Many of the options included in the complete list in Appendix A, but not short listed, still have potential to improve the condition of the estuary. Therefore the full list of options should be reviewed from time to time as part of an adaptive approach to estuary management.

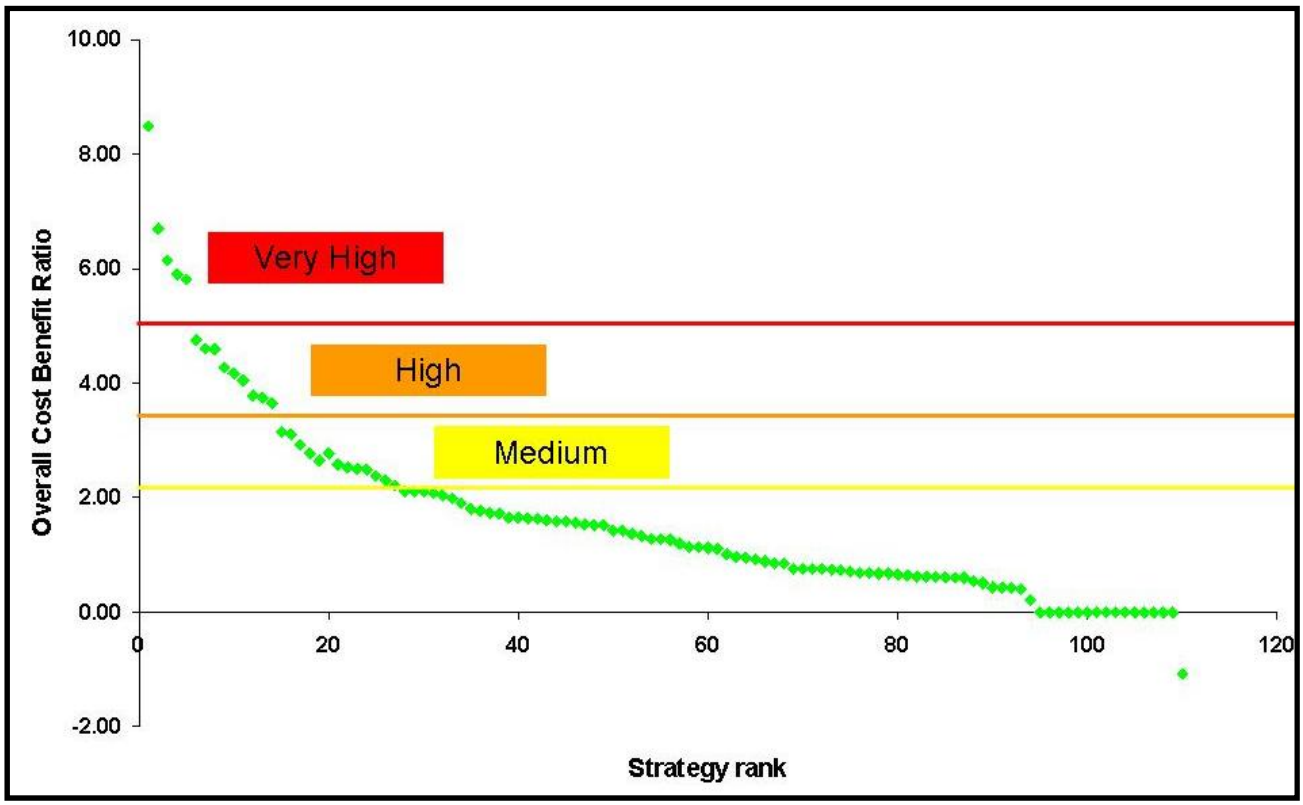
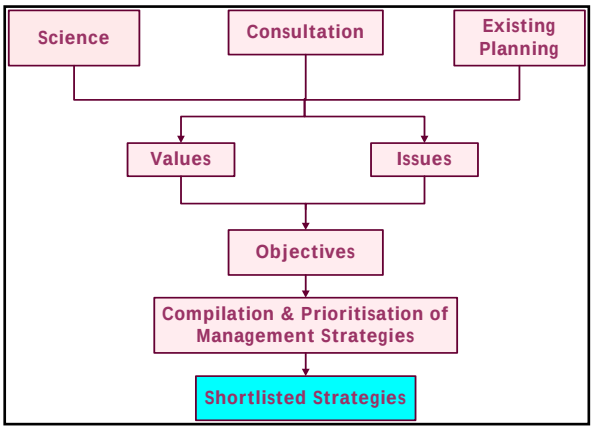


Figure 8-1 Distribution of Overall Benefit Cost Ratios for the Different Options

9 SHORTLISTED STRATEGIES FOR THE HUNTER ESTUARY



This chapter provides descriptions of the top 25 strategies that were ranked as the best options for addressing future conservation and management of the Hunter Estuary. A summary of these strategies is provided in Table 9-2.

The scope of these 25 strategies encompasses all 25 management objectives. There are a number of short-listed strategies that cover multiple objectives. Indeed, those strategies that do address more than one objective have been ranked higher through the 'Objective Score'. Every objective has at least one strategy that is applicable.

Strategy Score Indicator

Within the following descriptions, for each of the short listed strategies, an indicator table is presented to show the overall benefit / cost ratio for the option, and the scores that contribute to this.

A key to the strategy score indicator tables is shown in Table 9-1.

Table 9-1 Key to the Strategy Score Indicators

Overall benefit/ cost ratio of strategy (red is very high, orange is high and yellow is medium)		
Objective Score	Benefit Score	Cost Score
red is high	red is very high	red is very high
orange is medium	orange is high	orange is high
yellow is low	yellow is medium	yellow is medium
	cream is low	cream is low

Table 9-2 Summary of Short-Listed Strategies, ranked according to overall benefit/cost

Rank	Strategy Reference	Strategy description	Overall benefit/cost	Page Number
1	1.7 8.1 8.3	Establish and/or modify local planning guidelines and controls to allow appropriate assessment and consideration of estuarine habitats and biodiversity as a part of any future development within the estuary and its surrounds **Referenced as Strategy 1 in the HEMP**	Very High	86
2	1.1 1.2 1.3	Map estuarine and riparian vegetation to determine habitat potential, health and location and extent of estuary-related Endangered Ecological Communities **Referenced as Strategy 3 in the HEMP**	Very High	88
3	1.5	Identify all structures within the estuary that are interfering with fish passage and then replace and rehabilitate on a priority basis **Referenced as Strategy 5 in the HEMP**	Very High	92
4	3.6	Introduce an environmental planning requirement for all new development to achieve no net increase in pollutant runoff loads, through best practice stormwater management **Referenced as Strategy 11 in the HEMP**	Very High	94
5	2.3 2.5	Conservation of key habitat and significant vegetation should be undertaken through the Biobanking scheme or through preparation and implementation of individual Property Vegetation Plans **Referenced as Strategy 16 in the HEMP**	Very High	95
6	1.4	Undertake estuarine and related habitat restoration through physical works, revegetation and or alternative management practices of assets and infrastructure **Referenced as Strategy 17 in the HEMP**	High	97
7	5.4 5.5 5.3	Prioritise bank erosion sites with consideration to assets (built and natural), infrastructure, RiverStyles condition and recovery potential, rates of recession, land tenure / use and vegetation, and implement strategies to redress erosion, on a priority basis **Referenced as Strategy 8 in the HEMP**	High	101
9	1.3	Investigate opportunities to protect key habitats and significant existing vegetation stands through rezoning to a more appropriate conservation zone **Referenced as Strategy 2 in the HEMP**	High	104
10	JS2	Incorporate the objectives of the EMP into the Plan of Management for the newly created Hunter Wetlands National Park (incorporating the former Hexham Swamp and Kooragang Nature Reserves) **Referenced as Strategy 7 in the HEMP**	High	105
11	1.8 17.3	Raise public awareness of the values of the Hunter Estuary and sustainable use of the estuary through targeted community education **Referenced as Strategy 13 in the HEMP**	High	106
14	2.4	Support volunteers and environmental group participation, including Indigenous Green Teams, in revegetation of riparian zones-where appropriate include opportunities to improve public	High	108

Rank	Strategy Reference	Strategy description	Overall benefit/cost	Page Number
		access. **Referenced as Strategy 9 in the HEMP**		
16	16.3	Introduce planning controls for climate change impacts **Referenced as Strategy 20 in the HEMP**	Medium	110
17	C3	Support and participate in research programs and run these programs in partnership with major stakeholders on a case by case basis **Referenced as Strategy 19 in the HEMP**	Medium	112
18	JS3 2.1 JS1	Develop an estuary wide conservation Masterplan that provides clear priorities for future conservation and rehabilitation, and should be considered as part of future land rezoning and PVPs **Referenced as Strategy 6 in the HEMP**	Medium	113
21	2.2	Build on existing riparian vegetation guidelines to encourage consistency across the estuary landscape and differing land tenures **Referenced as Strategy 10 in the HEMP**	Medium	116
22	6.3 6.7	Through the Hunter Coast and Estuary Management Committee (or similar), host a periodic inter-governmental panel / forum with senior administrators and agency staff to stream-line co-ordinated and integrated decision-making **Referenced as Strategy 12 in the HEMP**	Medium	117
24	13.2	Improve land use practices throughout the catchment to minimise soil erosion **Referenced as Strategy 14 in the HEMP**	Medium	118
25	21.4	Develop a plan of all public access points along the Hunter Estuary, relocating those which coincide with sensitive habitats, and formalising those with highest recreational usage / value (where appropriate), to provide on-going and undiminished access to the river **Referenced as Strategy 18 in the HEMP**	Medium	119
26	10.2 10.4 10.1 19.2	Develop an integrated predictive numerical model of the Hunter Estuary, incorporating hydrodynamics, water quality and sediment transport processes, as necessary **Referenced as Strategy 4 in the HEMP**	Medium	120
29	3.5	Develop incentive mechanisms to promote and facilitate the adoption of sustainable agricultural practices that generate a commercial and environmental benefit. **Referenced as Strategy 15 in the HEMP**	Medium	121
34	19.1 19.2 19.4	Review the impact of the accumulation of sediments within the Hunter Estuary **Referenced as Strategy 25 in the HEMP**	Medium	122
52	12.3	Undertake a risk assessment for contaminated sediments in the Lower Hunter Estuary **Referenced as Strategy 22 in the HEMP**	Medium	123
63	18.1 19.2	Undertake a critical review of the salinity trading scheme, the Hunter River Water Sharing Plan and upstream activities in terms of environmental consequences of water discharges and offtakes	Medium	124

Rank	Strategy Reference	Strategy description	Overall benefit/cost	Page Number
		Referenced as Strategy 21 in the HEMP		
83	23.1	Where appropriate, reuse sediment dredged from the Port of Newcastle **Referenced as Strategy 23 in the HEMP**	Medium	126
-	-	To identify and conserve objects, places and landscapes in the Hunter Estuary[2] **Referenced as Strategy 24 in the HEMP**	-	127

[2] This is a new strategy that was introduced during the review process. It was not developed or assessed by the multi-criteria analysis as described in this HEMS.

9.1 Rank 1: Strategy 1.7 +

Establish and/or modify local planning guidelines and controls to allow appropriate assessment and consideration of estuarine habitats and biodiversity as a part of any future development within the estuary and its surrounds (Combination of original Strategies 1.7, 8.1 and 8.3, refer Appendix A)

Referenced as **Strategy 1** in the Hunter Estuary Management Plan

Strategy Score Indicator

Very High		
O	B	C

Existing Situation

The *Standard Instrument (Local Environmental Plans) Order 2006*, has introduced standard zonings which must be adopted by Council during the preparation of their New Local Environmental Plans. This limits the opportunity for Councils to create a special 'common' zone relating to the Hunter Estuary. All Local Environmental Plans (LEP) require ministerial approval , and it is unlikely that the introduction of a specific Hunter Estuary zone, or the inclusion of estuary management principles, within Councils' new LEP documents would be supported or approved.

Strategy Description

There are several planning mechanisms that could be introduced to ensure that impacts of future developments upon estuarine habitats, and associated biodiversity, are appropriately assessed and considered.

Ideally an environmental protection zone, specifically relating to the Hunter Estuary area, and its surrounds, could be established and implemented within the Newcastle, Port Stephens and Maitland Local Government Areas. The establishment of such a zone would ensure specific objectives relating to the protection of estuarine habitats and could be used as a buffer around the Hunter Estuary. Successful adoption of such a zone would ensure appropriate and consistent assessment of development across all three Council areas.

Councils will have to adopt the Environmental Protection zones identified within the Standard Instrument, including Zone E2 (Environmental Conservation) and Zone E3 (Environmental Management), to achieve appropriate consideration and assessment of future developments within the estuary and its surrounds. The Standard Instrument does enable Councils to add specific objectives and permissible land uses to the standard zonings, and a unified approach to estuary management could be achieved by adopting unified zoning objectives and permissible land use within the given standard zones. A generic clause relating to the protection of the estuary, and implementation of the Estuary Management Plan (EMP) could potentially be introduced within Councils' new LEP documents, though the development of such a clause is likely to require consultation between Council and the Department of Planning. Note that individual Councils may apply these zones to other areas of the LGA beyond the estuary.

Development Control Plans (DCP) could be prepared by Councils to introduce site specific, or estuary specific controls to restrict or control development within the areas of the estuary and its surrounds. DCP documents should incorporate buffers, offsets and considerations and numerical controls, such as boundary set-backs and density controls, that could effectively minimise impact upon key habitats and biodiversity by restricting development. Whilst DCP controls do not have statutory force they guide development and would ensure that impacts of future developments are adequately considered and assessed.

In addition to the above, Council could create an internal estuary checklist for development to ensure that all critical impacts are considered by assessing officers. Appropriate in-house monitoring, benchmarking and quality assurance mechanisms could also be introduced to facilitate the proper assessment of future development occurring within the estuarine habitat and its surrounds. Ideally, each of the councils should establish the same zoning or DCP requirements to allow for uniformity between the LGAs, however, it is recognised that this is not easily achieved in reality due to the many other considerations that are given when establishing zonings and development controls. Where uniformity is not considered appropriate site specific DCPs may be developed.

Alternatively, to ensure that development within sensitive ecological habitats does not occur upon privately owned or leased land, Councils (possibly in collaboration with DECC and the HCRCMA) could explore a range of planning options, including the establishment of covenants (restrictive or positive), acquisition, conservation agreements, economic incentives, and interim protection orders over areas of land that has natural, scientific or cultural significance (under the TSC Act 1995).

Furthermore, sites within the coastal zone are subject to the *Coastal Protection Act 1979* and, in the case of draft LEPs and development applications, certain work within the coastal zone may require approval by the Minister. Matters for consideration under Clause 8 of SEPP 71 must be considered when council assesses a development application or develops a draft LEP.

Consistency with CAP

The strategy provides for overall consideration of the CAP by encouraging planning mechanisms and administrative arrangements to consider the overall impact of development on the estuary.

9.2 Rank 2: Strategy 1.1+

Map estuarine vegetation to determine habitat potential, health and location and extent of estuary-related Endangered Ecological Communities (Combination of strategies 1.1, 1.2, and 1.3, refer Appendix A)

Referenced as **Strategy 3** in the Hunter Estuary Management Plan

Strategy Score Indicator

Very High		
O	B	C

Existing situation

The vegetation mapping presented in the Estuary Processes Study (refer Figure 9-1) was primarily based on broad vegetation modelling undertaken as a part of the Lower Hunter Central Coast Regional Biodiversity Conservation Strategy (LHCCREMS, 2000). The modelling was based on GIS mapping of variables such as slope, aspect, solar radiation, mean annual climate figures, soil landscapes and distance from features including streams, geological features and the coastline. This mapping is not considered reliable enough to be used as a basis for conservation and remediation strategies.

A separate groundtruthed vegetation mapping project was undertaken in the Maitland LGA (Hill 2003), and more detailed mapping is also available for Hexham Swamp and parts of Kooragang Island. This strategy will be assisted by the targeted, systematic vegetation surveys currently being undertaken throughout the region as an input to developing regional vegetation community classification scheme with vegetation community maps (on behalf of the Hunter Councils and CMA).

Newcastle City Council's Biodiversity Strategy (2006) includes a GIS based map of threatened species and EEC's that are relevant also to this Strategy.

Strategy Description

The present strategy would involve a mapping and ground truthing exercise for all estuarine vegetation. As part of the ground truthing work, aspects such as habitat potential, community health and threats would also be documented. The key output would be vegetation maps, in GIS format. This can then be overlayed with existing zoning and ownership layers to determine opportunities for conservation and rehabilitation. Where possible, it would also be helpful to identify groundwater dependent ecosystems.

In implementing this strategy the Council's should work closely with Hunter Councils and the CMA to maximise the benefit to all parties of the vegetation mapping undertaken as part of the Lower Hunter Central Coast Regional Biodiversity Conservation Strategy.

Areas of mapped vegetation should be compared with other mapping recommended by the HEMP (including recreation sites and bank erosion sites) to identify areas of potential conflict, and to help prioritise rehabilitation works.

Consistency with CAP

This strategy relates directly to the following CAP Management Targets:

- MT01 By 2016, protect an additional 31,000 ha of native vegetation.
- MT 06 By 2016, protect an additional 4,600 ha of wetlands.

Actions to be supported by the CAP include gathering knowledge and data to improve the delivery of the target.

Relevant Mapping

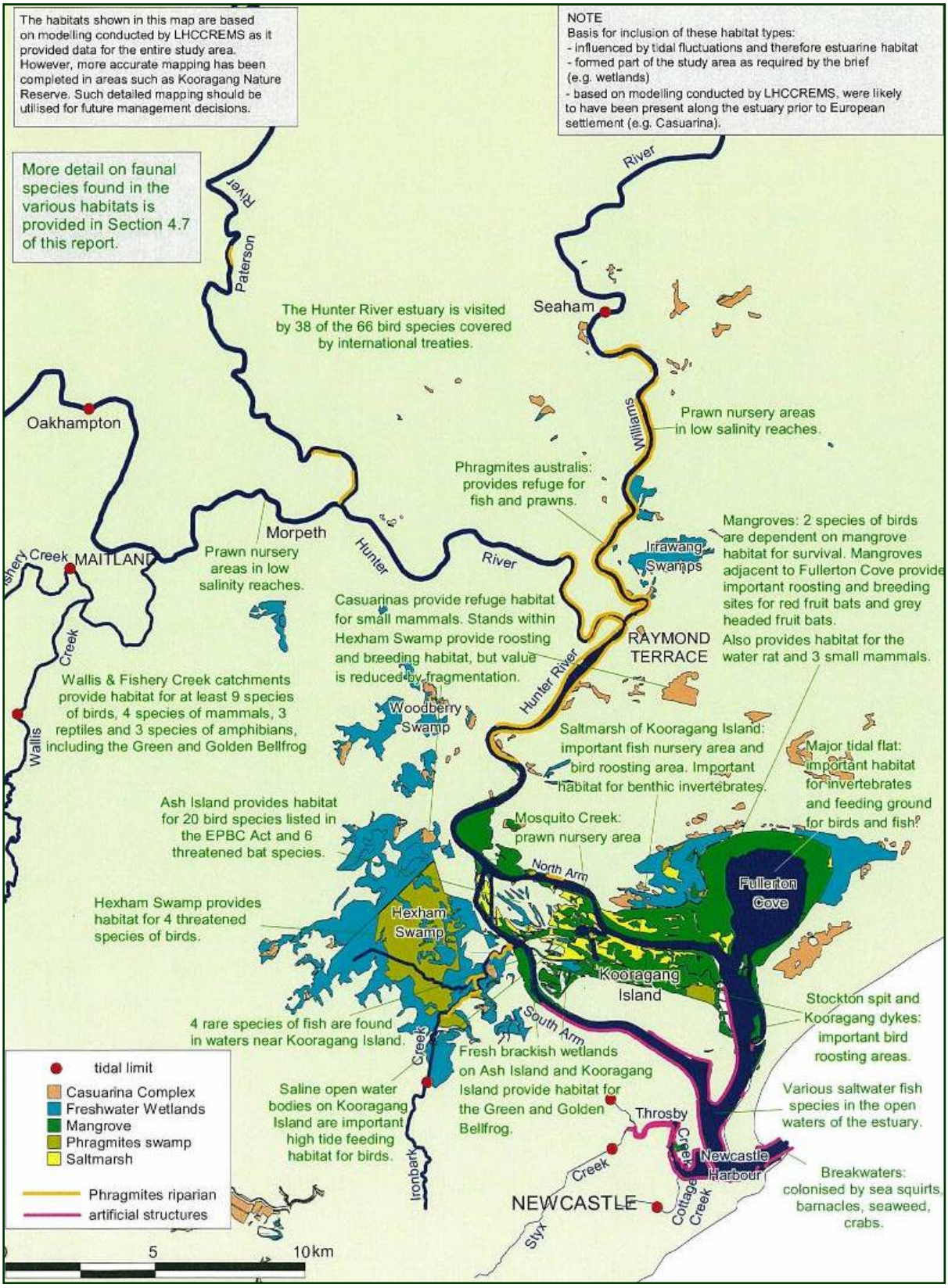


Figure 9-1 Habitat Mapping Based on Modelling Conducted by LHCCREMS – the mapping is not detailed enough to be used as a basis for management planning (Source MHL 2003)

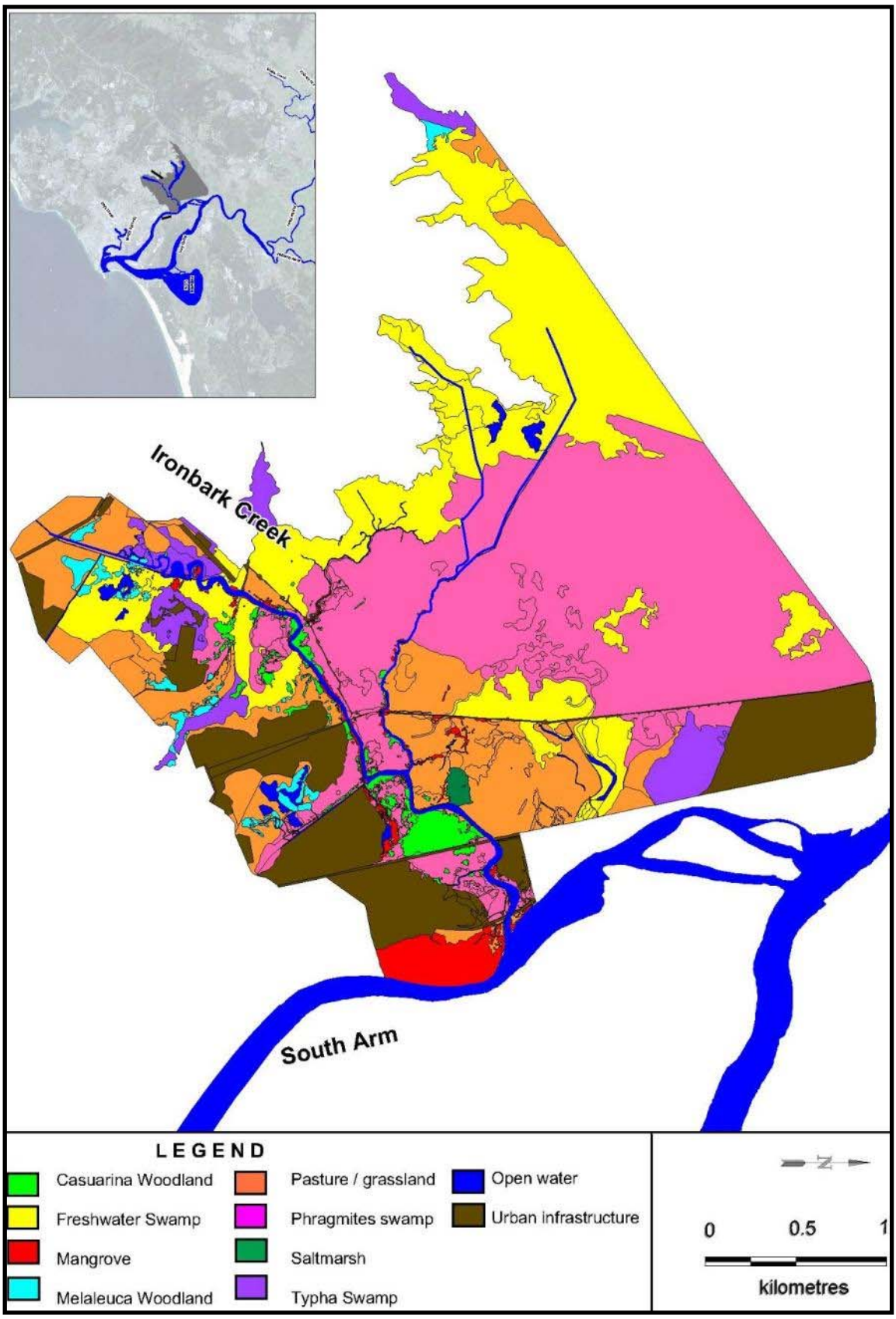


Figure 9-2 Vegetation Mapping for Hexham Swamp (Source: Danielle Morrison)

9.3 Rank 3: Strategy 1.5

Identify all structures within the estuary that are interfering with fish passage, and then replace and rehabilitate on a priority basis (Strategy 1.5, refer Appendix A)

Referenced as **Strategy 5** in the Hunter Estuary Management Plan

Strategy Score Indicator

Very High		
O	B	C

Note: cost score relates to identifying, analysing and prioritising fish passage obstructions across the Hunter.

Existing Situation

Barriers to fish passage in the Hunter Estuary include the extensive flood mitigation works, reclamation (e.g. Mosquito Creek), stormwater gross pollutant traps (e.g. Throsby and Styx Creeks) and numerous low level road crossings and culverts.

Strategy Description

This strategy would involve the removal or modification of these barriers to allow fish passage. The NSW Department of Primary Industries, with funding from the Hunter Central Rivers CMA, is currently undertaking a project aimed at restoring stream connectivity through the removal / modification of in-stream barriers. The project is known as “Bring Back the Fish” and spans the entire NSW Coast. A preliminary audit of floodgate structures has been undertaken for the Hunter River. There are some funds already available through the CMA and Fisheries for remediation of high priority structures. Structures already identified are indicated on Figure 9-3 and listed in Appendix C.

The implementing of this strategy would also provide much wider ecological benefits that will support the overall health of the estuary.

Consistency with CAP

This strategy is consistent with Management Target 25 of the Hunter Central Rivers CMA Catchment Action Plan, “By 2016, manage 75 estuarine floodgates to increase tidal movement”. The strategy would therefore be eligible for funding through the CMA. As priority barriers have already been identified, it is recommended that the HCEMC consider applying for further funding through the CMA on an opportunity basis (prior to the completion of the EMP).

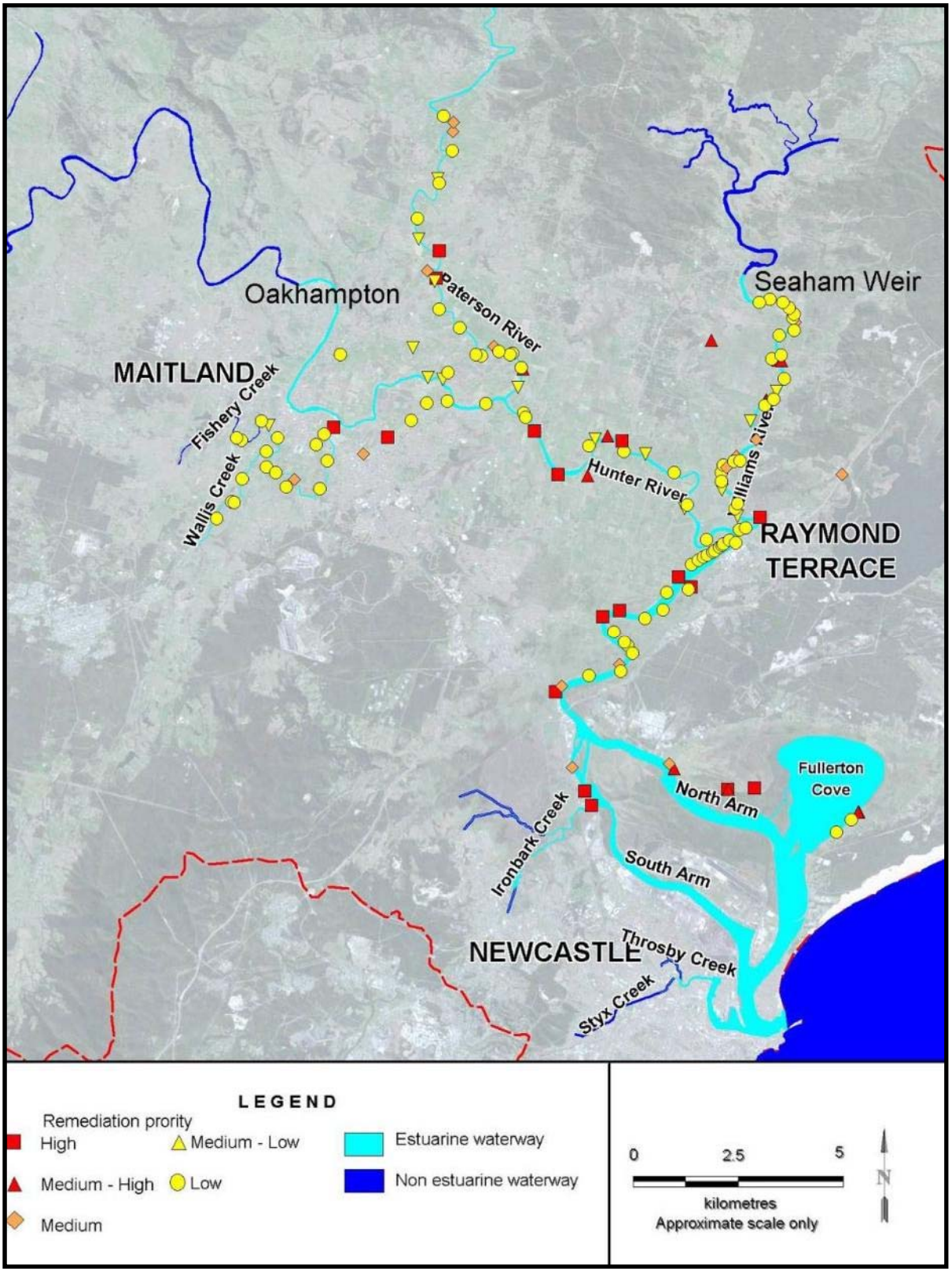


Figure 9-3 Floodgate Remediation Priorities Identified by the 'Bring Back the Fish' Project. The Project is a joint venture between DPI Fisheries and the HCRCMA

9.4 Rank 4: Strategy 3.6

Introduce an environmental planning requirement for all new development to achieve no net increase in pollutant runoff loads, through best practice stormwater management (previously Strategy 3.6, refer Appendix A)

Referenced as **Strategy 11** in the Hunter Estuary Management Plan

Strategy Score Indicator

Very High		
O	B	C

Existing Situation

Councils have policies and development controls in place that will support the implementation of this strategy.

Strategy

This strategy would be applicable to any new residential subdivision exceeding 4 lots as well as general development on lots exceeding 4,000m^2.

A Council Policy or DCP could be prepared that provides guidance and targets for best practice stormwater quality control. Preliminary stormwater design could be reviewed at the development application stage to determine the potential for adverse impact on pollutant loads. A recommended target is new development should achieve either no net increase in pollutant loads, or a reduction in TSS / TP / TN of 80% / 60% / 45%, whichever is the more stringent, compared to existing development conditions. This would be assisted through modelling (eg using MUSIC or similar).

The guiding principles for the Pollutant Control Policy or DCP could be:

- To facilitate the installation and use of best management practices to improve water quality discharging from development sites of varying densities and scale within the City.
- To retain nutrients on site and/or to filter stormwater flows to remove nutrients prior to discharging of stormwater from development sites into any constructed drains or local waterways.
- The maintenance and use of vegetation on development sites be used to its best advantage in minimising pollutant generation and managing nutrients on site.

Consistency with CAP

There are no specific provisions provided within the CAP that relate to planning controls for pollutant reduction.

9.5 Rank 5: Strategy 2.3 +

Conservation of key habitat and significant vegetation should be undertaken through the Biobanking scheme or through preparation and implementation of individual Property Vegetation Plans (Combination of strategies 2.3 and 2.5, refer Appendix A)

Referenced as **Strategy 16** in the Hunter Estuary Management Plan

Strategy Score Indicator

Very High		
O	B	C

Existing Situation

Upstream of Hexham Swamp, and to the north of the North Arm (including Fullerton Cove), the Hunter Estuary is predominantly fronted by privately owned land. Most of the remnant patches of vegetation are therefore on private land. In recognition of this a key focus of the Estuary Management Plan should be incentives for landholders to protect this habitat to prevent further degradation or clearing. Cattle access is considered a key issue (refer to Figure 9-5).

Strategy Description

The Native Vegetation Act 2003 introduced a new approach to the management of native vegetation across NSW. The HCRCMA has been given the role of applying the regulations of the new act and supporting landowners in managing native vegetation on their properties through the development of PVPs. A PVP is a long-term plan which identifies actions for the protection and enhancement of native vegetation on a particular property, including offset actions for any proposed clearing.

Biobanking allows for offsets to counterbalance the impact of development on biodiversity. Biobanking provides a consistent, robust and transparent approach for offsets. It is intended that Biobanking offsets will be measurable, consistent, secure, transparent and strategic.

Both PVPs and Biobanking allow for retention of significant conservation and habitat sites in perpetuity; whilst, allowing appropriate development to occur.

The introduction of planning agreements that permit particular governance arrangements, which suit particular cases and foster the provision of infrastructure in an efficient, co-operative and co-ordinated way (Department of Planning, 2005).

Other incentives for private conservation may include rate exemptions, CMA grants (for fencing etc), conservation agreements, and Environmental Stewardship schemes.

A number of Environmental Stewardship Schemes have been set-up between government (State and Federal) and the private sector throughout Australia. The National Farmers Federation has shown a proactive interest in the development of Environmental Stewardship Schemes, which they report provide positive outcomes for farmers, the community and the environment (NFF, 2006). An example of successful application of a wetland-based Environmental Stewardship approach is the Little

Broadwater Swamp in the Clarence River Catchment. Historically, Little Broadwater Swamp was an important habitat for both juvenile and adult fish and was a significant contributor to the fisheries of the Clarence River. The project involved assistance in the form of stewardship payments to landholders to cease grazing and to allow the reintroduction of tidal inundation onto the wetland. The floodgates are operated to return tidal inundation to 100 ha of former wetland. Stewardship payments made by DPI (Fisheries) to the Clarence landholders were between $60 and $130/ha/yr (*pers. comm*., S. Fairfull, DPI, 2005).

Consistency with the CAP

Biobanking and PVPs are considered to be two of the major platforms for the HCRCMA to achieve CAP targets relating to private vegetation retention and conservation.

This strategy is consistent with Management Target 06 of the CAP, which states "*By 2016, protect an additional 4,600 ha of wetlands*". The Hunter Estuary is in the top five priorities for conservation from about sixty identified wetland complexes.

Mechanisms to achieve wetland protection, outlined in the CAP include:

- Management through Property Vegetation Plans, Voluntary Conservation Agreements, National Parks gazetting etc.
- Rehabilitation work, including fencing, managing weeds and pests, engineering work and managing water flows.

9.6 Rank 6: Strategy 1.4

Undertake estuarine and related habitat restoration through physical works, revegetation and or alternative management practices of assets and infrastructure (Strategy 1.4, refer Appendix A)

Referenced as **Strategy 17** in the Hunter Estuary Management Plan

Strategy Score Indicator

High		
O	B	C

Existing Situation

The Hunter estuarine wetlands have been recognised as significant on a regional, national and international scale. Much of the estuarine habitat has been modified, however, significant opportunities for nature conservation remain.

There are a number of volunteer based programs making significant contributions to habitat restoration throughout the estuary. The organisations identified to date are listed in Table 9-3. This existing volunteer, skills and knowledge base will be a strong asset for future works.

The existing wetland rehabilitation works around the Hunter Estuary (such as Kooragang, Shortland and Hexham Projects) are widely regarded and have produced notable positive results.

Strategy Description

This strategy would involve further consideration and implementation of habitat restoration through physical works, revegetation and or alternative management practices of assets and infrastructure. Based on a review of the Estuary Processes Study and the information provided through the consultation processes, a number of opportunities have been identified. These opportunities have been categorised as are either:

(a) Specific areas identified as having significant conservation/rehabilitation potential; or

(b) Specific species, communities or habitats identified as being subject to significant pressure/s.

Specific areas identified as having significant conservation potential include:

- The swamp and saltmarsh areas in the North West corner of Kooragang Island (Ash Island).
- Mosquito Creek (the reclamation of Kooragang Island closed off the confluence with the South Arm of the Hunter River).
- The saltmarsh and tidal flats of Fullerton Cove,
- The north eastern end of Kooragang Island and the west bank of the north arm of the Hunter River (above Stockton Bridge), including the Kooragang Dykes area.

- Modification of operating procedures for gates at Purgatory Creek, Ironbark Creek, Greenways Creek, Wallis Creek; stormwater gross pollutant traps on Throsby and Styx Creeks and Seaham Weir.
- Tomago
- Green Corridor areas across the valley landscape, including the East Maitland Hills Area, the corridor through Irrawang Swamps that links the wetland to the State Forest in the North and the Tomago Coastal Plain which links the Hunter Estuary to Port Stephens. This will connect Stockton Bight to the Watagan Mountains and will protect the conservation values of key sites such as the Hexham Swamp, Kooragang Island, Mt Sugarloaf and the Tank Paddock as well as the mix of salt and freshwater wetlands and forested mountains in the proposed corridor. The corridor will also create a permanent green buffer between Newcastle and adjoining cities.
- Hexham Swamp
- Hunter Water owned land at Bolwarra

Note that the Estuary Processes Study has a strong focus on the vegetation of the lower estuary and further nature conservation opportunities in the upper reaches of the estuary may be being overlooked.

Specific species, communities or habitats identified as being subject to significant pressure/s include:

- Salt marsh areas at Kooragang Island (already partially protected by the nature reserve), Tomago and Fullerton Cove. These are now recognised as a threatened community and are diminishing on a state wide basis due to mangrove incursion, human disturbance and possibly sea level rise.
- *Casuarina glauca* and *Melaleuca spp*. stands and remnant forests which used to be prolific around the estuary are now found in patches throughout the western part of Kooragang Island (Ash Island) and around the perimeter and upland areas of Tomago and Fullerton cove, within Hexham Swamp, the Shortland Wetlands and Ironbark Creek. (*C. glauca* is moving into dead mangrove areas in response to tidal exclusion in some areas).
- A low diversity of native amphibians, reptiles and mammals is described in the Estuary Processes Study. The opportunity to identify habitat areas for remediation to conserve and enhance this diversity could be taken up but would be dependent on further studies.
- The large variety of migratory and resident bird species and the open saline water bodies, tidal mudflats, saltmarsh, open freshwater bodies and high diversity freshwater and brackish wetlands that support them. Information to assist this is presented in HBOC(2007). This data is discussed in Section 2.3 and some data is presented in Figure 2-1.
- The Estuary Processes Study has a strong focus on the vegetation of the lower estuary and further nature conservation opportunities in the upper reaches of the estuary may be being overlooked. In particular riparian and estuarine vegetation is not discussed.
- Areas of shallow, saline water surrounded by sparsely vegetated saltmarsh and salt scolds are often used as high tide diurnal and night time roosts by wading birds.
- Ash Island habitats are too easily accessible to 4WD vehicles.

- Noise disturbance of roosting sites of waterbirds was raised as an issue during the community consultation. This was also mentioned in the Estuary Processes Study.

There are a number of challenges to habitat restoration in the Hunter Estuary, including:

- The large portion of riverside land in private ownership
- Development pressure from the expansion of the greater Sydney metropolitan region
- State Government policies, including SEPP (Major Projects) and SEPP (Infrastructure)
- The estuary's economic role as a major coal port
- Selecting the appropriate species and planting regime for the site (as well as historical vegetation assemblages, consideration also needs to be given to changes to the hydrology and catchment influences to the particular site)
- Restricting stock access and returning tidal inundation to the site without pro-active regeneration may result in dominance by colonising species. For example, *Phragmites australis* may simply form a monoculture across the wetland, which may be undesirable, thus necessitating vegetation control strategies.

An important aspect of designing rehabilitation works will be the development of specific and measurable ecological objectives. These objectives will determine the approach taken, expenditure and ultimately how the results of rehabilitation are measured. The dynamic nature of wetlands and expected timeframes for rehabilitation should be acknowledged in setting wetland objectives. The relationship between hydraulic regime and ecological processes will also need to be considered. Nearby wetlands that are in a sound environmental condition could be used as an indication of the potential of the wetlands in terms of biodiversity and habitat.

In designing and implementing rehabilitation projects, it should be noted that DECC National Parks Service aim to increase biodiversity, and would therefore like to maintain some freshwater wetlands (pers. comm. 2007). It has also been advised that in planning to rehabilitate, it is essential to consider recurrent funding demands. The best sites will be those that do not require long term active management.

Consistency with CAP

The CAP recognises the Hunter Estuary Wetlands as a priority area for rehabilitation works.

This strategy is eligible for CMA funding as it is consistent with the management target "*By 2016, protect an additional 4,600 ha of wetlands*" (MT06). Incentives may be offered by the CMA to meet this target using mechanisms such as:

- Management through Property Vegetation Plans, Voluntary Conservation Agreements, National Parks Gazettal etc
- Rehabilitation work, including fencing, managing weeds and pests, engineering works and managing flows
- Protection of roost sites for migratory birds including revegetation, habitat rehabilitation, pest and weed management, appropriate planning and hydrologic management if required (e.g. keeping an area flooded for pest management)

- Implement Management Plans to minimise any negative outcomes from rehabilitation such as an increase in mosquito numbers.

9.7 Rank 7: Strategy 5.4 +

Prioritise bank erosion sites with consideration to assets (built and natural), infrastructure, RiverStyles conditions and recovery potential, rates of recession, land tenure / use and vegetation, and implement strategies to redress erosion on a priority basis (Combination of strategies 5.4, 5.5 and 5.3, refer Appendix A)

Referenced as **Strategy 8** in the Hunter Estuary Management Plan

Strategy Score Indicator

High		
O	B	C

Note: cost score relates to identifying, analysing and prioritising bank erosion sites across the Hunter.

Existing situation

The causes of modern day bank erosion on the Hunter Estuary include changes to flood patterns, clearing of riparian vegetation, cattle access and boat wake. The erosion assessment undertaken by MHL in the EPS (refer Figure 9-4, Figure 9-5) indicates that much of the river has unstable banks with cattle access identified as a major factor – particularly upstream of Hexham. It is worth noting that following the floods of June 2007, it would be an opportune time to reassess bank condition.

An investigation into bank erosion in the estuarine reach of the Williams River has been undertaken by GHD (2006). The study involved a literature review, community consultation, bank condition assessment and monitoring. This is discussed in more detail in Section 2.8.

Strategy Description

The present strategy would involve extending the Williams River approach (GHD, 2006) to the remaining reaches of the estuary. Erosion "hotspots" could be identified from the mapping undertaken by MHL, and further mapping currently planned by the HCEMC.

Consistency with CAP

This strategy is eligible for CMA funding as it is directly relevant to Management Target 20. '*By 2016, stabilise 125 km of unstable or degraded stream channels and estuarine shorelines*'. The priority areas included in the CAP list the Hunter Estuary.

Relevant Mapping

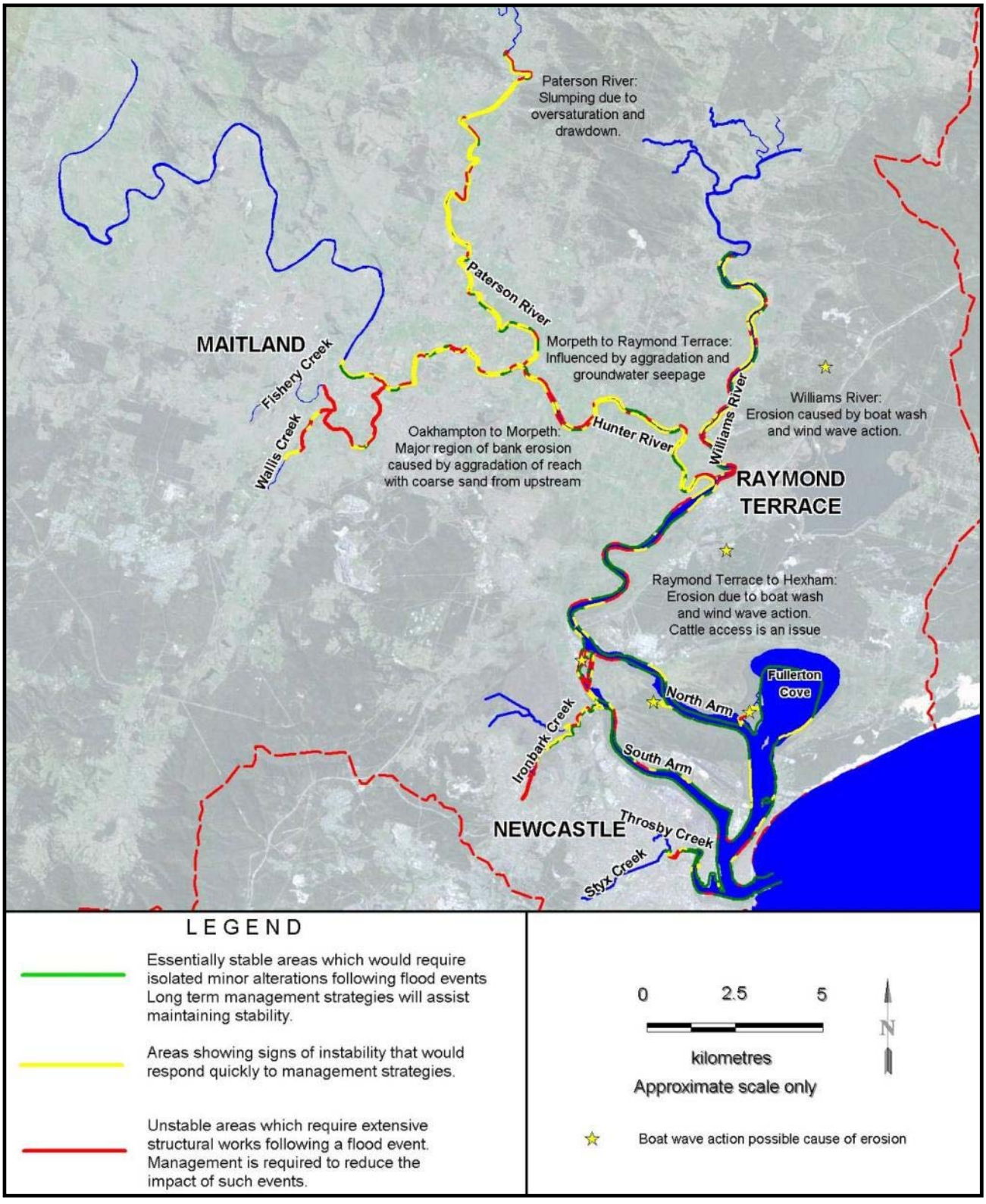


Figure 9-4 Rapid Assessment of Bank Erosion by MHL 2003

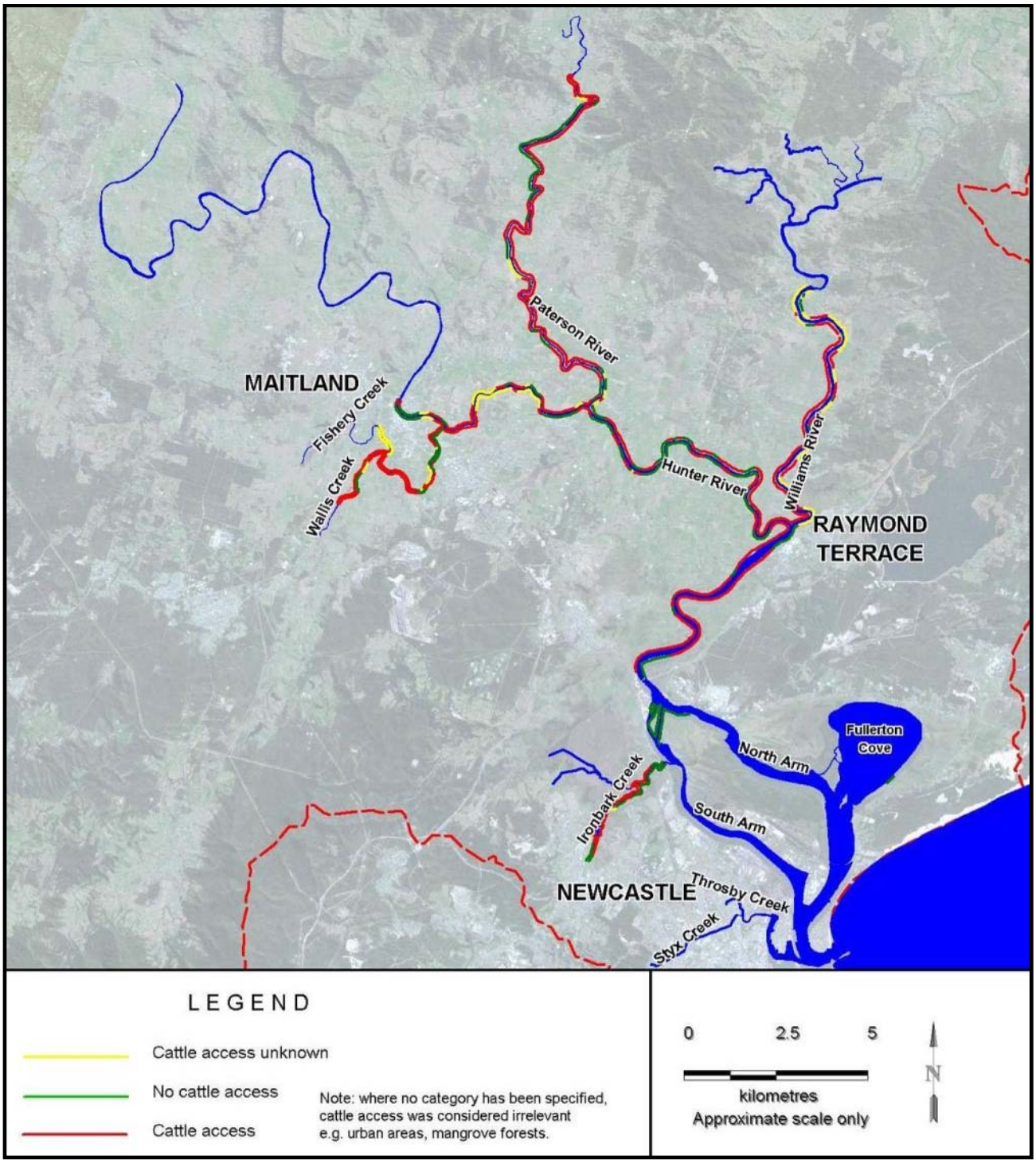


Figure 9-5 Rapid Assessment of Cattle Access by MHL 2003

9.8 Rank 9: Strategy 1.3

Investigate opportunities to protect key habitats and significant existing vegetation stands through rezoning to a more appropriate conservation zone (modification of strategy 1.3, refer Appendix A)

Referenced as **Strategy 2** in the Hunter Estuary Management Plan

Strategy Score Indicator

High		
O	**B**	**C**

Existing Situation

Many areas of conservation significance are zoned appropriately, however, it is possible that some areas of significant habitat are zoned rural or urban (particularly on privately owned lands). Areas of conservation significance would first need to be identified at a landscape level. Mapping by HCCREMS and Hunter Councils has gone some way identifying these areas. Further mapping is necessary, and is recommended by the HEMP.

Strategy Description

Zoning and ownership of key habitats are an important consideration in their protection. This strategy involves a review of zoning with the view to modifying these where they are considered inadequate for conservation and rehabilitation purposes.

Now is an opportune time for reviewing landuse zonings, as all NSW councils are currently in the process of preparing new Local Environmental Plans consistent with templates introduced by the Department of Planning in 2006. The new template has standard definitions across NSW.

Consistency with CAP

This strategy relates to a number of the management targets set by the HRCCMA in the CAP, such as:

- MT01 - By 2016, protect an additional 31,000 ha of native vegetation.
- MT02 - By 2016, regenerate 25,500 ha of native vegetation.

9.9 Rank 10: Strategy JS2

Incorporate the objectives of the EMP into the Park Plan of Management for the newly created Hunter Wetlands National Park (incorporating the former Hexham Swamp and Kooragang Nature Reserves) (Strategy JS2, refer to Appendix A)

Referenced as **Strategy 7** in the Hunter Estuary Management Plan

Strategy Score Indicator

High		
O	B	C

Existing Situation

The NSW Department of Environment and Climate Change (Parks and Wildlife) already manages land around the estuary, within the former Kooragang and Hexham Swamp Nature Reserves. The role of DECC will increase over the next 5 years as additional land is dedicated to Hunter Wetlands National Park (HWNP) (declared July 1st 2007). The HWNP includes the land previously included in Kooragang and Hexham Swamp Nature Reserves, as well as additional land now dedicated to National Park. The change from Nature Reserve to National Park is likely to result in increased demand for recreational opportunities.

The National Parks and Wildlife Act (1974) requires that a Plan of Management (POM) be prepared for each National Park. A POM is a legal document, which outlines how a National Park will be managed in the years ahead. Once a POM has been adopted by the Minister, no operations may be undertaken within the National Park except in accordance with the plan.

Strategy Description

The Hunter Estuary Management Plan should be referred to in the development of a POM for the HWNP. The Estuary Processes Study and Estuary Management Study should also be referred to for more detailed information on environmental processes and social and economic considerations.

Consistency with CAP

This strategy relates to a number of the management targets set by the HCRCMA in the CAP, such as:

- MT01 - By 2016, protect an additional 31,000 ha of native vegetation.
- MT05 - By 2016, manage an additional 52,000ha of landscapes having physical, cultural or spiritual significance to Aboriginal people.
- MT06 - By 2016, protect an additional 4,600 ha of wetlands
- MT17 - Protect an additional 1,100 km of native riparian vegetation by 2016

9.10 Rank 11: Strategy 1.8

Raise public awareness of the values of the Hunter Estuary and sustainable use of the estuary through targeted community education (Combination of strategy 1.8 and 17.3, refer Appendix A)

Referenced as **Strategy 13** in the Hunter Estuary Management Plan

Strategy Score Indicator

High		
O	B	C

Existing Situation

There are a number of existing educational programs that should be further supported. This includes initiatives of Councils, Hunter Wetland Centre, DECC (Parks and Wildlife) and the HCRCMA.

An example of existing initiative is the educational aspects of the Kooragang Wetland Rehabilitation Project (KWRP), a collaborative project of all levels of Government, community and industry administered by the HCRCMA. This includes guided tours for various community and tourist groups and resources and guidance for school groups (*'Wet and Dry Environment' syllabus for primary and 'Ecosystems at Risk,' 'A Local Ecosystem' and 'Biophysical Interactions' syllabus for senior school students as well as various HISE subjects for the middle secondary students*).

Information about the rehabilitation project, the Hunter Estuary and estuarine ecosystems in general is provided through a series of interpretive signs, maps and brochures for walkers, cyclists, fishers, bird observers, picnickers and other casual visitors. KWRP has restored an historic 1890's Schoolmaster's House which holds display and library material; this facility has become a clearing house for historical and technical information about the Hunter Estuary. A website provides an overview of the rehabilitation of Kooragang Wetlands (www.hcr.cma.nsw.gov.au/kooragang). Kooragang City Farm is a demonstration site on how to manage agriculture to benefit wetlands. The KWRP education program, also dovetails with Newcastle's annual Coastcare summer festival.

Hunter Wetlands Centre at Shortland has a regular activities program of day and night time guided walks and canoeing, which promote estuary functions and values to the general public and specialist groups. The Wetlands Centre also includes a field studies centre operated by the NSW Department of Education that teaches environmental education to about 10,000 school children from the region annually.

Councils also undertake some educational and capacity building activities. Examples from Port Stephens Council include monthly water quality monitoring programs in Windeyers Creek and Waterwatch initiatives in the Williams River.

Strategy Description

This strategy calls for the support of educational projects or programs that develop or widen the community's knowledge of, skills in, and commitment to, protecting the Hunter Estuary and its wide and varied values.

Public awareness campaigns regarding the estuary should include information on all values, not just environmental values, to ensure that public use of the estuary is undertaken in appropriate and sustainable ways.

Consistency with CAP

The CAP recommends providing capacity building and education as an action for meeting many relevant targets. Therefore the implementation of this strategy will be eligible for funding from the HCRCMA. The HCRCMA are currently revising their education strategy to align with CAP targets. Once finalised, the HCRCMA Education Strategy should be referred to in the implementation of the current strategy to avoid duplication and ensure optimal benefit.

9.11 Rank 14: Strategy 2.4

Support volunteers and environmental group participation, including Indigenous Green Teams, in revegetation of riparian zones-where appropriate include opportunities to improve public access (previously Strategy 2.4, refer Appendix A)

Referenced as **Strategy 9** in the Hunter Estuary Management Plan

Strategy Score Indicator

High		
O	**B**	**C**

Existing Situation

The existing volunteer effort directed toward rehabilitation for the Hunter Estuary is significant. Existing groups known to the study team are listed in Table 9-3. Support for these groups is provided by the HCRCMA, Councils and other small environmental grants.

Table 9-3 Existing Volunteer Rehabilitation Groups

Group	Focus	Other details
Kooragang Landcare Group	Ash Island (780ha) and Stockton Sandspit (10ha). Work concentrates on revegetating floodplain rainforest and riparian areas on Ash Island and riparian and shelter plantings at Stockton Sandspit, also weeding, including removal of mangrove seedlings from key areas of shorebird habitat	about 100 members & will have provided approximately 18,000hrs of volunteer labour for 2006/2007
Hunter Bird Observers Club (HBOC)	weeding shorebird habitat and planting around the carpark at Stockton Sandspit	also conducts monthly bird surveys in the estuary (Ash Island, Tomago Wetlands, Stockton Dykes, Stockton Sandspit and foreshore
Hunter Wetlands Centre landcare program	Wetlands Centre Site	50,000 plants planted since 1985
CMA sponsored work	Wentworth Ck on the southern side of Hexham Swamp	
Stockton Dunecare	weeding and planting work on the river side at Stockton in association with Stockton Historical Society	also involve students from Stockton Public School
Throsby Landcare	Lower Throsby Creek	
Juvenile Justice	rubbish removal program in Lower Throsby Ck in association with Council's coastal zone management program	

Group	Focus	Other details
Linwood Groups	maintain parklands and environmental amenity in the Honeysuckle precinct	
Carrington Landcare	environmental rehabilitation work	
Shortland-Wallsend and Warabrook landcare groups	Upper catchment rehabilitation	
Raymond Terrace Tidy Towns group	works along Windeyers Creek mainly undertaking weed removal	
Windeyers Creek Committee	a collection of community and industry reps that oversee the management of the creek, with particular interest in water quality and related issues	
Williams River bank erosion project	landholders to fence off the river banks, etc	

In addition, there are approximately 5 – 6 Indigenous Green Teams that operate within and throughout the Hunter Region (Pers. comm., C Aspinell, HCRCMA, 2008).

Strategy Description

These groups should be supported and encouraged. Rehabilitation works should be consistent with the conservation and erosion control priorities determined through implementation of other HEMP strategies.

Consistency with CAP

The CAP advises the following guiding principles for riparian rehabilitation:

- Good quality riparian vegetation of an appropriate width should be protected to maintain or improve a stream's natural resource values.
- Degraded riparian vegetation should be rehabilitated and weeds controlled.
- Riparian vegetation should cover land over the entire waterfront to sustain and improve riverine processes.
- Information should be provided to land managers about the importance of riparian vegetation.
- Riparian rehabilitation should use native, locally sourced (provenance) species.

9.12 Rank 16: Strategy 16.3

Introduce planning controls for climate change impacts (Strategy 16.3, refer Appendix A)

Referenced as **Strategy 20** in the Hunter Estuary Management Plan

Strategy Score Indicator

Medium		
O	**B**	**C**

Existing Situation

The impacts of climate change are uncertain. Predictions are available for some climate variables such as sea level rise and changes to storm and drought intensity and frequency. Planning mechanisms to mitigate the environmental impacts of climate change (eg. loss of saltmarsh to rising sea levels) are currently limited.

Strategy Description

As a priority, better information on the impacts of climate change on the estuary should be established, recognising the varying impacts along the estuary (ie impacts at Maitland will be different to the impacts at Newcastle). In the absence of complete information, however, existing broadbrush estimates of climate change impacts and the adoption of a 'conservative approach' should be used as the basis for future strategic planning and development controls such as:

- land title restrictions
- establishing larger riparian setbacks (eg to ensure that saltmarsh can respond to sea level rise)
- changes to infrastructure design to ensure that the ecological response to climate change can be accommodated (eg. culverts under roads to allow saltmarsh to migrate and re-colonise elsewhere)

Biobanking and PVPs are appropriate tools to utilise in retaining land. The schemes allow for appropriate development of sites in tandem with retention of significant land that may be affected by climate change in the future.

Covenants on land title may be used to control the use of land in perpetuity, thus enabling a land use control that is inter-generational, which could be used to plan for long term climate change impacts. Restrictive covenants can restrict the use to which the land can be put even when bought by a subsequent purchaser. A covenant could therefore be placed to control any future development or land clearing to occur upon the site to preserve key habitat and significant biodiversity, to plan for predicted climate change impacts.

Positive covenants, on the other hand, require a landholder to 'do something' on their land and thus could be used to ensure private landowners continue to carry out conservation management. Unlike restrictive covenants, positive covenants are not enforceable in Court.

Financial incentives could be utilised to encourage land owners to place a covenant upon their land. Although it is considered unlikely that this measure would be affective as such restrictions upon land could potentially impact the market value of the property.

Further, provisions under the Conveyancing Act (Section 88d and 88E) enable government departments, authorities and local councils to enter into agreements with land holders to attach covenants to land; these covenants can be enforced against subsequent landowners. This type of covenant is usually part of an agreement under which Council will let a development go ahead. It may be possible that 'public positive covenants' be utilised as part of the EMP, however, it should be noted that they are usually enforced to reflect the development of land rather than the conservation of the environment.

Outright purchase of private land is a potential option to protect and enhance the estuarine biodiversity and establish setbacks to ensure the sustainability of certain communities (eg the response of the endangered saltmarsh community to future sea level rise). Purchased land could be dedicated as public land and thus protected from future development. Furthermore, as more detailed knowledge of climate change impacts becomes available, governments may need to consider compulsory acquisition, such as the "planned retreat" approach used in coastline management.

A DCP could be prepared by Council to introduce site specific, or estuary specific, control plans to restrict development within the areas of the estuary and its surrounds, to establish appropriate setbacks.

There are several forms of conservation agreements that could also be utilised to establish a protection mechanism for estuarine biodiversity and climate change impacts. Protection could possibly be achieved via the negotiation of a conservation agreement with the owner or leaseholder. These agreements are generally voluntary, and as such, sufficient and attractive terms of an agreement would be required to persuade a landowner to enter a conservation agreement.

Council's, possibly with the assistance of State Government, could establish a policy or framework to initiate such agreements with local land owners.

Consistency with CAP

The CAP incorporates a number of guiding principles that aim to plan for climate change impacts and adaptation. This strategy therefore is considered to be wholly consistent with the intent and goals of the CAP.

9.13 Rank 17: Strategy C3

Support and participate in research programs and run these programs in partnership with major stakeholders on a case by case basis (Strategy C3, refer Appendix A)

Referenced as **Strategy 19** in the Hunter Estuary Management Plan

Strategy Score Indicator

Medium		
O	B	C

Existing Situation

Supporting research programs (for example through universities) is a useful way of increasing the understanding of how the estuary works, getting future professionals interested in the estuary and increasing community interest.

An example of such a project is the *Lower Throsby Creek Biophysical Condition (Contamination) Assessment*. This study is a university honours project with support from Newcastle City Council, Hunter Water Corporation, HCRCMA & DPI – Fisheries. Essentially, the project is about characterising the current condition of the creek between Islington & Carrington, in particular considering heavy metal and allied pollutants/contaminants in sediments and biota. The key output was a University of Newcastle Honours Thesis. Project partners contributed around $2000 each.

Strategy Description

This strategy involves supporting university research programs related to increasing our knowledge and understanding of the Hunter Estuary environment. Projects should be prioritised according to the data gaps identified in the Estuary Processes Study and the Objectives outlined in the present Estuary Management Study.

Consistency with CAP

For each of the management targets presented in the CAP, an action suggested for meeting the target is '*Gathering knowledge and data to improve the delivery of the target*'.

9.14 Rank 18: Strategy JS3 +

Develop an estuary wide conservation Masterplan that provides clear priorities for future conservation and rehabilitation, and should be considered as part of future land rezoning and PVPs (Combined strategies JS3, 2.1, JS1, refer Appendix A)

Referenced as **Strategy 6** in the Hunter Estuary Management Plan

Strategy Score Indicator

Medium		
O	B	C

Existing situation

At present, conservation of the estuary is somewhat fragmented between different land owners, management agencies and initiatives. Conservation under this arrangement does not recognise and preserve the holistic and inter-related nature of ecological processes. This arrangement may also be at the risk of concealing cumulative environmental degradation.

Strategy Description

This strategy would involve the development and implementation of a Conservation Masterplan for the Hunter Estuary. The Plan would bring together existing relevant plans and data as well as data collected and analysed in response to the Estuary Management Plan, including:

- Management Plan for the Green and Golden Bell Frog Key Populations in the Lower Hunter (DECC, 2007)
- Compiled data from the Hunter Bird Observers Club (HBOC, 2007)
- Green corridors
- Maps of estuarine vegetation

The key output of the Conservation Masterplan would be a series of GIS maps that would be readily available to managers and the community.

As part of the "Masterplanning" process, riparian "Green zones" should be identified based on the available information such as the riparian vegetation assessment from the EPS (MHL, 2003), the River Styles assessment, existing and potential ecological corridors and up to date estuarine vegetation mapping undertaken as part of the HEMP.

The Masterplan should aim to identify and prioritise areas that should be protected and rehabilitated for the purpose of habitat restoration, conservation and connectivity. It is crucial that connections are established between riparian vegetation and native remnants.

The impacts of revegetating riparian areas on overall flood behaviour will need to be considered.

Consistency with CAP

This strategy relates to a number of the management targets set by the HCRCMA in the CAP, such as:

- MT 18 "*By 2016, regenerate 550 km of degraded native riparian vegetation*"; and
- MT 17 "*Protect an additional 1,100 km of native riparian vegetation by 2016*".

Relevant Mapping

The River Styles assessment is based on an approach developed by Macquarie University and the former NSW DLWC. River Styles provides baseline geomorphic assessment of river character, behaviour and condition, suited to the structure and function of Australian rivers. The key outputs of the assessment are an assessment of the geomorphic condition, recovery **potential and likely future condition of each reach in the catchment**. This information is then used to determine target conditions for river rehabilitation programs, framed within a catchment-based vision. The mapping is, however, undertaken at a catchment scale, and more detailed consideration will need to be undertaken. The rehabilitation potential for the estuary is mapped in Figure 9-6.

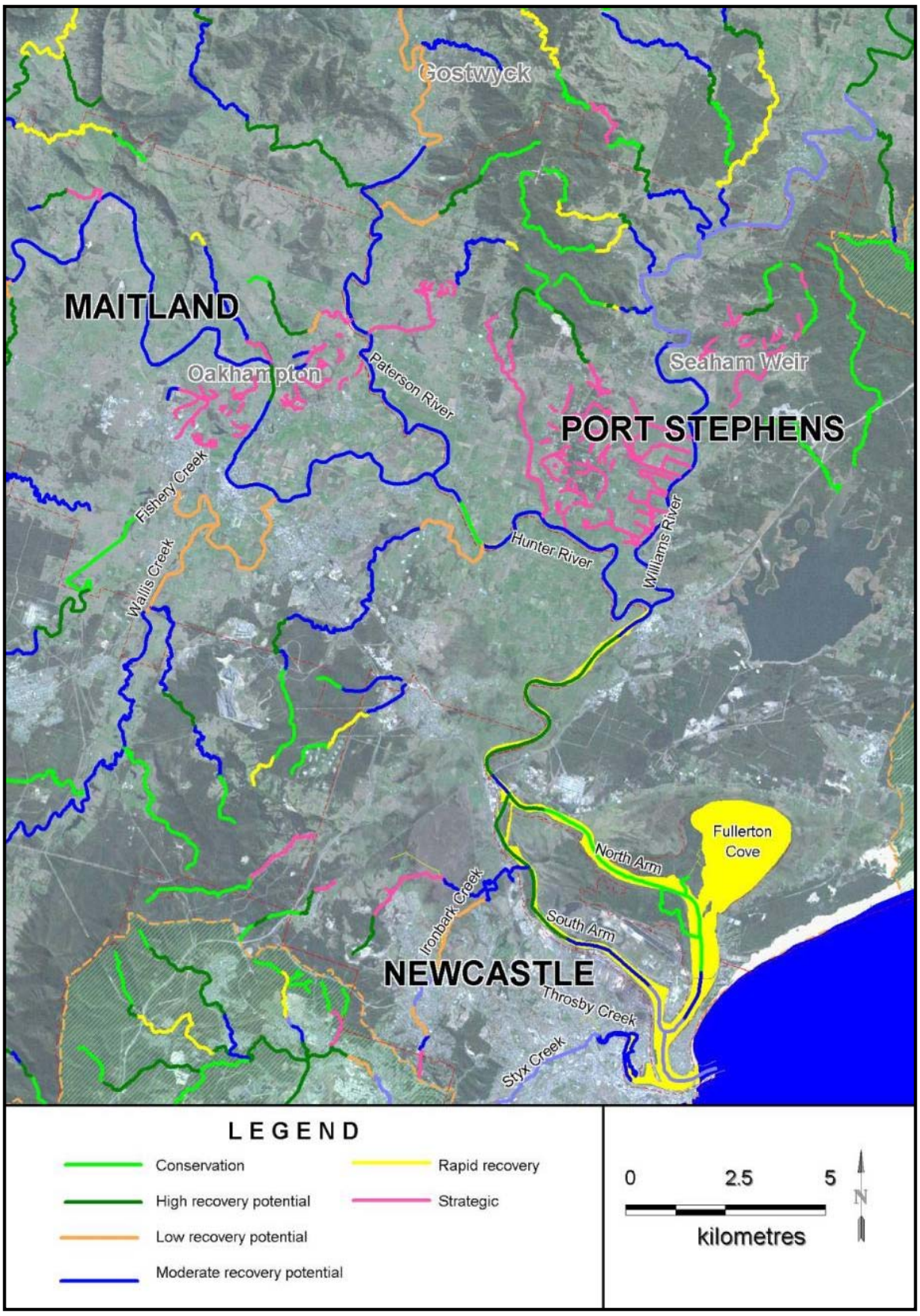


Figure 9-6 Geomorphic Categorisation of Recovery Potential (Source DNR 2007)

9.15 Rank 21: Strategy 2.2

Build on existing riparian vegetation guidelines to encourage consistency across the estuary landscape and differing land tenures (Strategy 2.2, refer Appendix A)

Referenced as **Strategy 10** in the Hunter Estuary Management Plan

Strategy Score Indicator

Medium		
O	B	C

Existing Situation

Two relevant guideline documents have recently been released. These are *Principles for riparian lands management* (LWA 2007), and *Where Land Meets Water - Resource Kit* (HCRCMA 2007). A challenge of riparian rehabilitation is the diversity of morphological, physiological and life history adaptations which enable plant species to persist in these variable and dynamic habitats. This highlights the need for a considered approach to rehabilitation across the estuary. The dynamic nature of vegetation communities in riparian habitats as a result of fluvial disturbance also needs to be considered. An overall strategy will better consider more holistic aspects, for example, the degree of shade created by riparian vegetation can influence the growth and development of aquatic plants and animals, implications for flood velocities (due to possible increases in roughness and flow resistance).

Strategy Description

Riparian revegetation plans specific to the Hunter Estuary should be prepared and implemented to promote optimum habitat, ecological corridor, erosion control and scenic amenity benefits through rehabilitation of riparian areas. Environmental weeds and pests should be considered as part of the guidelines.

An integral component of planning rehabilitation works in the riparian zone will be monitoring and evaluation.

Consistency with CAP

The CAP advises the following guiding principles for riparian rehabilitation:

- Good quality riparian vegetation of an appropriate width should be protected to maintain or improve a stream's natural resource values.
- Degraded riparian vegetation should be rehabilitated and weeds controlled.
- Riparian vegetation should cover land over the entire waterfront to sustain and improve riverine processes.

9.16 Rank 22: Strategy 6.3 +

Through the Hunter Coast and Estuary Management Committee (or similar), host a periodic inter-governmental panel / forum with senior administrators and agency staff to stream-line co-ordinated and integrated decision-making. (Combined strategies 6.3 and 6.7, refer Appendix A).

Referenced as **Strategy 12** in the Hunter Estuary Management Plan

Strategy Score Indicator

Medium		
O	**B**	**C**

Existing Situation

The first step of the NSW Government Estuary Management Framework (refer to Section 1.4) calls for the establishment of an Estuary Management Committee. The Hunter Estuary Management Committee was convened in 1997 and amalgamated with the already established Hunter Coast Management Committee to form the Hunter Coast and Estuary Management Committee (HCEMC). The HCEMC has successfully managed the preparation of the Estuary Processes Study, Estuary Management Study and Estuary Management Plan. The efficiency and representativeness of the committee would be greatly improved by consistent attendance by all key agencies.

Strategy Description

This strategy involves encouraging improved attendance of the existing Estuary Management Committee, and the establishment of a working sub-group or sub-committee that has representatives at higher levels within agencies. A local example of high level state government departments actively participating in estuary management is the Lake Macquarie Project Management Committee. The Lake Macquarie Project Management Committee consists of community representatives, Regional Directors of the relevant State Government Departments and one councillor from both Wyong Shire Council and Lake Macquarie City Council. The committee oversees the work of the Lake and Catchment Coordinator in the implementation of an action plan for the improvement of Lake Macquarie.

Consistency with CAP

Implementation of the CAP will require collaboration between the CMA and many other entities, ranging from individual landholders and communities through to State and Federal Governments. It is considered that the collaborative arrangements established in implementing the CAP can be fostered and extended to also consider the Hunter Estuary, as appropriate.

9.17 Rank 24: Strategy 13.2

Improve land use practices throughout the catchment to minimise soil erosion (Strategy 13.2, refer Appendix A)

Referenced as **Strategy 14** in the Hunter Estuary Management Plan

Strategy Score Indicator

Medium		
O	**B**	**C**

Existing Situation

There is some information available on sheet erosion within the catchment (refer erodible soils layers from DECC / CMA). The information is based on aspects such as soil type, geology, rainfall, and slope classes. This data is useful in determining broadscale locations likely to experience erosion.

Strategy Description

Actions to reduce creek and gully erosion throughout the catchment will include improved stock management practices, filter strips around water courses, contour farming etc.

Erosion in areas that are affected by on-going recreational activities should also be targeted, particularly along riverbanks.

Consistency with CAP

Some funding may be available for this strategy from the CMA as the strategy relates directly to the following CAP Management Targets:

- MT 10 "*By 2016, revegetate 8,400 ha of highly erodible soils*".
- MT 11 "*By 2016, stabilise 800 ha of actively eroding soils*".
- MT 15 "*By 2016, implement sustainable grazing management practices on an additional 19,000 ha of grazing land*"

Note that the areas above relate to the entire HCRCMA area.

9.18 Rank 25: Strategy 21.4

Develop a plan of all public access points along the Hunter Estuary, relocating those which coincide with sensitive habitats, and formalising those with highest recreational usage / value (where appropriate), to provide on-going and undiminished access to the river (previously strategy 21.4, refer Appendix A)

Referenced as **Strategy 18** in the Hunter Estuary Management Plan

Strategy Score Indicator

Medium		
O	**B**	**C**

Existing Situation

Sensitive habitats in the Hunter Estuary include, for example:

- mangroves adjacent to Fullerton Cove which provide roosting and breeding sites for red fruit bats and grey headed fruit bats, or
- the Kooragang Dykes and Stockton Sandspit which provide roosting and feeding sites for a variety of birds.

The Hunter Estuary Processes Study reports that recreational activities may be disturbing birds from their roosts in some key habitat areas.

Strategy Description

This strategy would involve a review of public access points throughout the Hunter Estuary, and identifying those access points that coincide / threaten sensitive habitats. A starting point would be the recently mapped roosting and breeding sites by the Hunter Bird Observers Club.

This strategy aims to relocate existing access points to alternative sites where access is affecting ecological communities, and formalises existing high usage locations that are not already formalised, providing that any environmental and social issues can be addressed.

Consistency with CAP

Access management (including pedestrian and 4WD vehicular access) is considered an important component in meeting CAP management targets:

- MT01 - By 2016, protect an additional 31,000 ha of native vegetation
- MT02 - By 2016, regenerate 25,500 ha of native vegetation
- MT17 - Protect an additional 1,100 km of native riparian vegetation by 2016
- MT27 - By 2016, revegetate 240 ha of degraded dune systems with native species (although there is a limited number of dunes within the HEMP study area)
- MT31 - By 2016, enhance 250 km of marine shorelines

9.19 Rank 26: Strategy 10.1 +

Develop an integrated predictive numerical model of the Hunter Estuary, incorporating hydrodynamics, water quality and sediment transport processes, as necessary (Combination of previous strategies, 10.1, 10.2, 10.4 and 19.2)

Referenced as **Strategy 4** in the Hunter Estuary Management Plan

Strategy Score Indicator

Medium		
O	B	C

Existing Situation

There are currently a number of computer models simulating the Hunter River, however, most of these are limited in their functionality, depending on the intent for their development. Broadscale ecological models of the region are also likely to exist with DECC (P&W) and LHCCREMS, however, these again are likely to be limited in their application.

Strategy Description

This strategy involves the development of a detailed hydrodynamic model of the estuary that is capable of simulating flood and tidal conditions for a range of existing and future climate change scenarios. The model should be used in a predictive manner to ascertain the likely changes to estuarine hydrodynamics associated with a range of potential management strategies (eg, opening of floodgates, removal of fish passage barriers, future climate change scenarios etc).

The results of the hydrodynamic model should be integrated with a predictive ecological model to determine structure and function of ecological communities. Changes to ecological communities can thence be predicted in response to altered hydrodynamic conditions (either through physical works or future climate change).

The models can also be used retrospectively to determine the likely structure and function of estuarine communities in the Hunter River at time in the past (eg, at European settlement, prior to and following major flood mitigation works, prior to and following major Port of Newcastle dredging). This could, for example, model likely changes in tidal range and subsequent results in vegetation and fauna communities.

Consistency with CAP

Modelling is identified in the CAP as a means of assisting with Monitoring, Evaluation and Reporting (MER). It is considered, however, that the information obtained from the modelling would be advantageous to the implementation of many of the CAP initiatives, particularly in terms of prioritising works across the whole of the Hunter region.

9.20 Rank 29: Strategy 3.5

Develop incentive mechanisms to promote and facilitate the adoption of sustainable agricultural practices that generate a commercial and environmental benefit (Strategy 3.5, refer Appendix A)

Referenced as **Strategy 15** in the Hunter Estuary Management Plan

Strategy Score Indicator

Medium		
O	**B**	**C**

Existing Situation

In May 2002, the Healthy Rivers Commission released its final Inquiry into the Hunter River System. In preparing the report the HRC aimed to understand how the entire river system is being managed. This included undertaking a comprehensive program of community consultation and review. Eight key recommendations were developed. One of these essential recommendations was "Development of incentive mechanisms to promote and facilitate the adoption of sustainable agricultural practices that generate a commercial and environmental benefit (for example the study undertaken by UNE as part of the HRC report indicates economic benefits of crop rotation and other sustainable practices).

In the five years since the HRC report was released there have been changes in the way the Hunter River is managed. One change has been the formation of the Hunter Central Rivers Catchment Management Authority and development and implementation of the CAP (refer to Section 1.5).

The CMA are introducing a property planning accreditation program to assist in ensuring that agricultural land is managed within its capability and that more landholders consider and understand the impacts from farm management practices (through planning) on the immediate on-farm natural resources and also the surrounding natural resources.

Strategy Description

This strategy would involve promoting existing incentive schemes such as the CMA Property Planning accreditation program. It could also involve opportunistic development of new incentive mechanisms through rate rebates etc.

Consistency with CAP

The HCRCMA CAP suggests that this can be achieved through the preparation of Property Plans. This is based on the belief that property planning increases a landholder's understanding of the soil, water and vegetation on their land and their awareness of their land capability as well as presenting opportunities to review land management practices that will benefit both farm productivity and sustainability in the long-term. In this regard, there may be some assistance available for the implementation of this strategy from the CMA for plans that meet the CMA's accreditation criteria.

9.21 Rank 34: Strategy 19.1+

Review the impact of the accumulation of sediments within the Hunter Estuary (combination of Strategies 19.1, 19.2 and 19.4, refer Appendix A)

Referenced as **Strategy 25** in the Hunter Estuary Management Plan

Strategy Score Indicator

Medium		
O	B	C

Note: This strategy has been recommended (in preference to other strategies that have a higher benefit/cost score) to ensure that Objective 19 is addressed.

Existing Situation

Sediment is being transported through the Hunter Estuary in response to significant high flow/flood events. A geomorphology study of the Hunter River was prepared by Patterson Britton & Partners on behalf of the then Hunter Catchment Management Trust, however, this report was never finalised.

The 1955 Hunter River flood delivered a significant quantity of sediment to the river, which is being reworked through the system. At present there is a significant sediment 'slug' between Morpeth and Raymond Terrace. Changes to bed profile resulting from the migration of the slug have consequences on river bank as the channel attempts to adjust to the reduced conveyance capacity.

Strategy Description

This strategy would involve assessing the environmental implications of sediment accumulation within the estuary, including for example pressures placed on adjacent riverbanks. For areas considered vulnerable, options for minimising potential future impacts should be identified and assessed.

Opportunities could be sought for commercial extraction of sediment from the river that would relive environmental pressures resulting from accumulation of excess sediment.

Consistency with CAP

The CAP does not directly address the issue of excess sediment accumulation within the waterway. The CAP focuses on reducing soil erosion within the catchment, and thus reducing the future accumulation of the sediment, and also on stabilisation of riverbanks, including protection of riparian revegetation and re-establishing riparian vegetation lost in the past.

9.22 Rank 52: Strategy 12.3

Undertake a risk assessment for contaminated sediments in the Lower Hunter Estuary (Strategy 12.3, refer Appendix A)

Referenced as **Strategy 22** in the Hunter Estuary Management Plan

Strategy Score Indicator

Medium		
O	B	C

Note: This strategy has been recommended (in preference to other strategies that have a higher benefit/cost score) to ensure that Objective 12 is addressed.

Existing Situation

The Estuary Process Study reports that there has been extensive sediment sampling undertaken on the South Arm of the Hunter River and more limited sampling elsewhere in the estuary. The available data indicates that the South Arm is contaminated with metals and PAHs. These values exceed ISQG guidelines, indicating a high risk to benthic biota. However, a more detailed investigation would be required to understand the ecologic risks and feasible remediation options. It is understood that proposals to deepen the south arm would involve removal of these contaminated sediments from the estuary.

BHP Billiton's Hunter River Remediation Project (HRRP) aims to clean up areas of the Hunter River bed that have been affected by BMP's former steelmaking industry. Full-scale remediation works, including treatment activities, are currently scheduled to commence in 2010.

Strategy Description

The risk assessment, which should cover the whole of the estuary, should include consideration of the available sediment data, as well as additional investigations to determine background concentrations, bioavailability and toxicity. Sources of information available since the preparation of the Estuary Processes Study include:

- EIS Study by URS for BHP site on the south arm
- Lower Throsby Creek Honours Study

Consistency with CAP

The CAP does not directly consider contaminated sediments.

9.23 Rank 63: Strategy 18.1 +

Undertake a critical review of the salinity trading scheme, the Hunter River Water Sharing Plan and upstream activities in terms of environmental consequences of water discharges and offtakes (Combination of previous strategies 18.1 and 19.2, refer Appendix A)

Referenced as **Strategy 21** in the Hunter Estuary Management Plan

Strategy Score Indicator

Medium		
O	B	C

Note: This strategy has been recommended (in preference to other strategies that have a higher benefit/cost score) to ensure that objective 18 was addressed.

Existing Situation

The Salinity Trading Scheme was introduced to mitigate the impacts of electricity production and mining on agriculture and the environment. The scheme involves a program of continuous monitoring to allow scheduling of saline discharges for periods of high river flow rates and low background salinity levels. The scheme is based on the understanding that when the flow in the river increases, salinity initially increases as the river picks up salt from riverbanks and pools, but then falls as freshwater run-off diluted the salt concentration (EPA, 2007). This is illustrated in Figure 9-7.

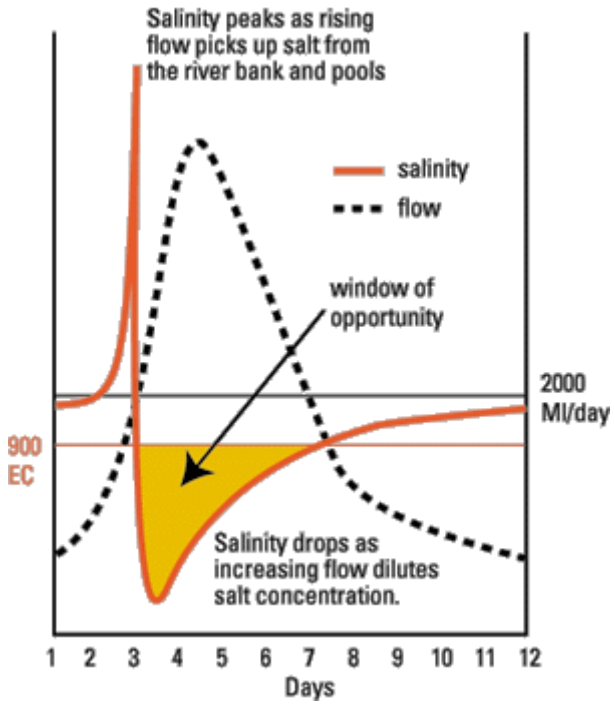


Figure 9-7 Processes related to the Salinity Trading Scheme (Source: EPA 2007)

During these times of very low salinity levels, licensees are allowed to discharge into the river. The scheme is based on the sharing of total allowable discharge according to dischargers' holdings of tradable salinity credits (MHL 2003). There was some concern amongst the community that this is impacting on the environment.

As discussed in Section 2.2.3, Water Sharing Plans are currently being developed for the Hunter River under the NSW Water Management Act 2000. A draft Water Sharing Plan has been prepared for the unregulated reaches of the Hunter River (March 2008), however, there is minimal consideration given to maintaining environmental flows to the estuary for estuary function purposes.

A key challenge is establishing what an appropriate or sustainable environmental flow would be for the estuary. The issue of environmental flows is complex. Aspects including seasonal and longer term variation in flows are important. Peirson et al, (2002) present a risk-assessment methodology capable of determining appropriate levels of fresh water flow to estuarine systems either to avoid damage or to maintain or rehabilitate the in stream ecology (including biodiversity).

Strategy Description

The critical review should start with a comprehensive assessment of relevant scientific literature as well as available data. It is understood that determination of environmental flows for estuaries has been considered in other Australian states (notably Victoria), as well as overseas (notably South Africa). The strategy should include the monitoring of extraction rates and consider the impacts on groundwater dependent ecosystems.

Consistency with CAP

The CAP states that the cost of environmental flows must reflect the value of the limited resource and the cost of managing it. All those who benefit from the extraction of water from the river, both directly and indirectly, should meet these costs.

9.24 Rank 83: Strategy 23.1

Where appropriate, reuse sediment dredged from the Port of Newcastle (Strategy 23.1, refer Appendix A)

Referenced as **Strategy 23** in the Hunter Estuary Management Plan

Strategy Score Indicator

Medium		
O	**B**	**C**

Note: This strategy has been recommended (in preference to other strategies that have a higher benefit/cost score) to ensure that objective 23 was addressed.

Existing Situation

Dredging of the Newcastle Port commenced in 1859. The Newcastle Port Corporation (NPC) undertakes maintenance dredging to maintain shipping channels. NPC'S the dredge, the 'David Allan' is licenced to remove 500,000 m^3 of material annually from the Port.

In 2005, NSW Maritime was granted development consent (DA-134-3-2003-i) to dredge the South Arm of the Hunter River to facilitate the extension of shipping channels in the Port of Newcastle. Organisations (e.g. Newcastle Coal Infrastructure Group) undertake capital dredging on behalf of NSW Maritime in accordance with DA-134-3-2003-i.

Strategy Description

There is potential to reuse sediments removed from Newcastle Port either through maintenance dredging operations, or through capital works programs. Therefore, this strategy involves undertaking appropriate studies to determine the feasibility of material reuse, and identifying potential avenues for reuse.

Salt levels within the sediment, once removed, are expected to be a significant barrier to potential reuse options, unless considerable effort is made to flush and clean the sediment of residual salts.

Consistency with CAP

The CAP does not address the potential reuse of sediments dredged from Newcastle Harbour.

9.25 New heritage strategy

To identify and conserve objects, places and landscapes in the Hunter Estuary

Referenced as **Strategy 24** in the Hunter Estuary Management Plan

Note: This strategy has been recommended (in preference to other strategies that have a higher benefit/cost score) to ensure that objective 25 was addressed.

Existing Situation

The Hunter Estuary has a long history of Aboriginal occupation, with tribal groups believed to be living in the area for at least 30,000 years. Approximately 2000 Aboriginal sites have been recorded throughout the study area, including sites along the valley floors of the major tributaries, rock shelter sites in the sandstone areas and shell middens around the estuary. However due to large scale river works, land reclamation and urbanisation, many of the remnants of Aboriginal occupation in the Hunter Estuary may have been destroyed.

From a non-Aboriginal perspective, the Newcastle region was one of the first areas settled by Europeans and the study area contains many structures, buildings and towns that are considered historically significant. The Hunter Regional Environmental Plan 1989 (Heritage) has identified approximately 800 items of heritage significance to be conserved for future generations.

Strategy Description

This strategy involves identifying all objects, places and landscapes around the Hunter Estuary that are of cultural heritage significance. An overarching Heritage Management Plan for the area should then be prepared and implemented that targets the long term preservation and conservation of heritage features. Preparation and implementation of such a plan would involve significant input and consultation with various Aboriginal groups, as well as local historical societies, historians and the general community.

Consistency with CAP

One of the guiding principles of the CAP is to “Maintain and improve the culture and heritage values of culturally significant landscapes”, and relates to both places of European significance and Aboriginal cultural values and landscapes within the natural resources of the region. This guiding principle is supported by:

- Management Target MT-05: By 2016, manage an additional 52,000 ha of landscapes having physical, cultural or spiritual significance to Aboriginal people

9.26 Recommended on ground 'quick wins'

"Quick Win" strategies have been identified as those which require on ground works without significant further research, and have a high environmental benefit to economic cost ratio. HCRCMA funding is currently allocated through a competitive process that selects high environmental value for money projects. Other funding opportunities, including the Federal Government programs may also be a source of funding for quick win strategies.

Strategies consistent with the CAP and ready for immediate implementation with high environmental benefit for the estuary include:

- Identify all structures within the estuary that are interfering with fish passage - replace and rehabilitate on a priority basis (Rank 3, Strategy 1.5, refer Section 9.3);
- Conservation of key habitat and significant vegetation should be undertaken through the Biobanking scheme or through preparation and implementation of individual Property Vegetation Plans (Rank 5, Strategy 2.3 +, refer Section 9.5);
- Undertake estuarine and related habitat restoration through physical works, revegetation and/or alternative management practices of assets and infrastructure (Rank 6, Strategy 1.4, refer Section 9.6);
- Develop incentive mechanisms to promote and facilitate the adoption of sustainable agricultural practices that generate a commercial and environmental benefit (Rank 29, Strategy 3.5, refer Section 9.20);
- Identify and conserve heritage objects, places and landscapes in the Hunter Estuary (refer Section 9.25).

This approach is consistent with the intentions of the Precautionary Principle, which is a component of the NSW Coastal Policy.

9.27 Concurrent Initiatives

In parallel to the preparation and Implementation of the Hunter Estuary Management Plan, a number of relevant initiatives are being pursued by others. It is important that the Hunter Coast and Estuary Management Committee remain informed of these initiatives. Pertinent examples highlighted through the consultation undertaken for the HEMS include:

- The strategy currently being developed by the National Introduced Marine Pests Coordination Group (NIMPCG). (Note that AQIS (Australian Quarantine and Inspection Service) is the regulator for international vessels but there is currently no system for managing domestic sources)
- Threatened species recovery plans
- Regional conservation strategy
- Hexham Swamp Rehabilitation Project
- Regional Biodiversity strategy
- Hunter Central Rivers Catchment Management Authority CAP

- Urban Creek Deformalisation projects (e.g. Lower Throsby and Lambton Creeks)
- Bank stabilisation works at Hexham undertaken by Newcastle City Council
- Development of a Plan of Management for the Hunter Wetlands National Park
- Implementation of the Williams River Erosion Study, including a 3 year no wake zone that is being trialled within Reach 2 (roughly Irrawang Swamp to the wooden revetment along Newline Rd) to combat erosion.
- Acid Sulfate Soils projects being undertaken by the Department of Primary Industries.
- National Coastal Vulnerability Assessment Case Study (Hunter Estuary, Lake Macquarie and Tuggerah Lakes) being undertaken by Federal Department of Climate Change to assess impacts of climate drivers (eg sea level rise, rainfall) on estuary processes, infrastructure and land use planning.
- Lower Hunter Estuary Cultural Management Plan, covering Hexham and Kooragang, and being undertaken by Awabakal Local Aboriginal Lands Council

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APPENDIX A: LONG LIST OF POTENTIAL MANAGEMENT STRATEGIES

Rank	Ref.*	Strategy	Considerations	Objective Score	Benefit Score	Cost Score	Priority
1	1.7	Modify planning framework to all appropriate assessment and consideration of estuarine habitats and biodiversity as a part of any future development within the estuary and its surrounds (DMF)	Common "Environment Protection" LEP zones throughout the relevant LGAs Common "Environment Protection" DCP guidelines and principles throughout the relevant LGAs Achieve through zoning- not through additional "Heads of Consideration" Interim protection orders could be used for the protection of biodiversity around Hunter Estuary Restrictive or Positive Covenants	4.2	2	1	VH
2	1.1	Undertake mapping of existing estuarine vegetation communities, including habitat potential and health	Vegetation mapping to community level is currently being undertaken by the Hunter Councils and CMA. HCEMC habitat, vegetation, bank condition and birds	4.5	3	2	VH
3	1.5	Identify all structures within the estuary that are interfering with fish passage - replace and rehabilitate on a priority basis	An inventory has recently been completed through the "Bring Back the Fish" Program. This identifies crossings and weirs interfering with fish passage in the Hunter Estuary. Costs refer to analysing this info as it relates to the estuary.	3.1	3	1.5	VH
4	3.6	Environmental planning mechanism for new development to have no net increase in pollutant loads for up to 1 in five year event		3.6	1.5	1	VH
5	2.5	Foster opportunities for rehabilitation and / or dedication as part of development consent with the aim of getting key habitat land back into public ownership	Section 94 used less for land dedication. Will require changes to contributions plan	2.9	2	1	VH

Rank	Ref.*	Strategy	Considerations	Objective Score	Benefit Score	Cost Score	Priority
6	1.4	Identify, prioritise and undertake opportunities for estuarine and related habitat restoration through physical works, revegetation and or alternative management practices of assets and infrastructure	Within the prioritisation, reference should be made to the River Styles determined by DECC. Include consideration of measures to protect EEC's from mangrove pneumatophores/ propagules Conservation Agreements - e.g. voluntary, negotiated, under the NPW Act 1974 or Nature Conservation Trust Act 2 1Economic Incentives - Such as Transferable Development Rights or Purchase of Development Rights, Density Bonuses Acquisition - Purchase of private land to protect and enhance the estuarine biodiversity and ECC	4.8	3	3	H
7	5.4	Develop strategies to minimise future erosion including modifying recreational speed zones, temporary wake baffles and limiting activities		2.3	3	1.5	H
8	2.3	For private lands implement agreements and incentives for rehabilitation / conservation (rate exemptions, CMA grants for fencing etc, conservation agreements with CMA and DECC).	TOOLS 2 is currently being developed as a decision support system to consider water quality, aquatic habitat and biodiversity at catchment scales. A site by site assessment will be required to assess width and revegetation requirements. Recommend alternative incentives to encourage better uptake.	4.8	2	2	H
9	1.3	Review zoning/ownership of existing key habitats and areas identified for potential rehabilitation	Hunter Councils are currently looking at Pilot Projects to scope the use of biometric tools with the new LEP templates, Establishment of Lower Hunter Estuary National Park	2.1	2	1	H

Rank	Ref.*	Strategy	Considerations	Objective Score	Benefit Score	Cost Score	Priority
10	JS2	Incorporate the objectives of the EMP into the Lower Hunter National Park POM		1.0	3	1	H
11	1.8	Raise public awareness of the environmental values of the Hunter Estuary through targeted community education		2.7	3	2	H
12	2.1	Using the riparian vegetation assessment from the EPS (MHL, 2004), the river styles assessment and that currently being undertaken on behalf of the Hunter Coast and Estuary Management Committee as a first pass, identify "Green Zones" as key habitat and feed into strategies for objective 1		1.9	3	1.5	H
13	17.3	Undertake targeted consultation and capacity building with affected stakeholders, including field days to foster a consistent approach		1.9	2	1	H
14	2.4	For public land- support volunteers and environmental group participation in revegetation of riparian zones-where appropriate include opportunities to improve public access		2.7	2	1.5	H
15	8.3	Use the Guidelines referred to in 8.1 as a reference for relevant landuse zonings and development controls in the preparation of the new standard LEP for each of the Local Government Areas.	See 1.7 and 8.1 (combine for EMP)	1.6	2	1	M
16	16.3	Introduce planning controls to plan for climate change impacts (eg. establishing larger setbacks to ensure that saltmarsh can respond to sea level rise). For example, changes to infrastructure design to ensure that the ecological response to climate change can be	Broaden to include considerations for infrastructure and assets , feed into conservation masterplan, for development controls incorporate into guidelines referred to in 8.1	1.6	2	1	M

Rank	Ref.*	Strategy	Considerations	Objective Score	Benefit Score	Cost Score	Priority
		accommodated (eg. Culverts under roads to all saltmarsh to re-colonise)					
17	C3	Fund university research programs, run these programs in partnership with major stakeholders		2.2	2	1.5	M
18	JS1	Incorporate the objectives of the EMP into the Regional Conservation Plan		1.0	2	1	M
19	JS3	Following on from 1.4 develop an Estuary Wide conservation Masterplan	Climate change impacts would be considered here also	3.0	2	2	M
20		Not used					
21	2.2	Apply existing riparian vegetation guidelines to encourage consistency across the landscape and differing land tenures	Catchment scale guidelines have been developed by the CMA, we would build on these	2.6	1.5	1.5	M
22	6.3	Continue the work of the Estuary Management Committee. Develop strategies to encourage better participation – target higher levels of key agencies.		1.7	1.5	1	M
23	8.1	Prepare Development assessment and control guidelines that address issues presented by all stakeholders and can be applied for future development assessment (this could potentially be implemented in the form of 3 LGA specific place based DCPs).	Guidelines for planners, points for inclusion, checklist for assessment planners, see 1.7 and 8.3 (combine for EMP) This one refers to the DCP and 8.3 refers to the LEP	1.7	3	2	M
24	13.2	Improve land use practices within the catchment by addressing creek and gully erosion within the catchments, improved stock management practices, and other catchment management practices including filter strips around water courses, contour farming etc		1.7	1.5	1	M
25	21.4	Discontinue the access through formal access routes where these coincide with sensitive	Relates to development of POM for HENP, ensure that access is appropriate	1.6	1.5	1	M

Rank	Ref.*	Strategy	Considerations	Objective Score	Benefit Score	Cost Score	Priority
		habitats					
26	10.2	Construct ecological models to simulate the estuarine habitats and communities at various stages through time		2.3	2	2	M
27	13.1	Undertake a catchment wide investigation of erosion looking at different mechanisms such as sheet erosion of land surfaces, gully erosion, creek bank erosion and runoff from development or industrial sites	CMA soil con service	1.7	2	1.5	M
28	4.5	Opportunistically undertake aerial observation of response of flood mitigation works to identify structures that are not operating as anticipated		1.6	2	1.5	M
29	3.5	Development of incentive mechanisms to promote and facilitate the adoption of sustainable agricultural practices that generate a commercial and environmental benefit, as recommended by the Healthy Rivers commission inquiry into the Hunter River	eg. Minimum buffer offsets to waterways, zero tillage	2.1	2	2	M
30	10.4	Use model for assessing future development scenarios such as impacts of climate change and feasibility of options to assist with climate change adaptation		2.1	2	2	M
31	6.9	For all information being collected through other strategies, ensure that new information is being synthesised and interpreted and applied to everyday management as appropriate as well as influencing longer term strategic actions, particularly during the plan review process	Adaptive management in action. Coordinator role-ensuring that any outcomes are being implemented. Centralised data base.	1.6	2	1.5	M

Rank	Ref.*	Strategy	Considerations	Objective Score	Benefit Score	Cost Score	Priority
32	17.4	Condition environmental grants based on consistency with guidelines documented (facilitated through CMA)	Ensure that estuarine values are being considered in the market based consideration for environmental grants. Re-evaluate implementability based on discussion with Cal	1.0	2	1	M
33	5.3	Determine foreshore erosion recession rates for hotspots	Hotspot areas to be informed by work to be undertaken for HCEMC	2.0	2	2	M
34	19.2	Assess detrimental environmental impacts on estuarine processes		1.0	2	1	M
35	6.6	Organise "field days" for community groups and landholders to improve practices- tie in with CMA initiatives	Part of 17.3	1.4	2	1.5	M
36	10.1	Develop a hydrodynamic model of the Hunter Estuary. Use the model to simulate stages during European history (e.g. dredging, flood mitigation, channel realignments - where available use historic hydrosurveys) and assess changes and impacts to hydraulic regime of the estuary	This one should just be model development (delete red text and create separate action (1,2))	1.8	2	2	M
37	4.4	Develop operating procedures for floodgates (and other control structures), including reporting mechanisms and review on a five yearly basis		1.3	2	1.5	M
38	5.5	Prioritise bank erosion sites with consideration to assets (built and natural), infrastructure, rates of recession, land tenure and use, vegetation		0.9	3	1.5	M
39	5.2	Introduce improved stock management practices to limit cattle access to banks including fencing/alternate water supply		1.7	2	2	M
40	6.7	Establish a regional multi agency taskforce to facilitate decision making and bureaucratic process associated with implementation of plan -		1.1	1.5	1	M

Rank	Ref.*	Strategy	Considerations	Objective Score	Benefit Score	Cost Score	Priority
		e.g. LMC Project Management Committee					
41	3.2	Liaison with licensed polluters regarding short and long term reductions in pollutant discharges to the Hunter River		1.1	1.5	1	M
42	9.1	Prepare a guideline document to be used by all Councils regarding particular development within the catchment for supplementary consideration to local planning provisions	Impacts of specific development types for the estuary. This would help with applying development types for LEP zonings. Together with 8.1 forms a "planning pack" - use with landholders, planners	1.1	1.5	1	M
43	1.6	Carry out a risk based sustainability assessment associated with all threats including climate change (using recognised techniques such as Bayesian networks)	(ecological, social and economic), implemented through state based system more likely	2.4	2	3	M
44	10.3	Use the hydraulic and ecological models to assess the benefits and impacts of development assessment and strategy assessment	For example modifications to control structures	1.6	2	2	M
45	C2	Create an established role of a 'River Keeper'- an identified person		2.4	2	3	M
46	C7	Ensure obligations are not usurped when inappropriate development are given 'state significance' and control is passes to government agencies who have failed to demonstrate an understanding of treaty obligations.	State to consider EMP in decision making? SEPP? (State significance in this strategy includes part 3a)	1.0	1.5	1	M
47	3.1	Conduct an inventory of point and diffuse sources pollutants entering the HRE (throughout the whole catchment)	Non point source sources would be modelled	2.0	1.5	2	M
48	14.2	Based on the audit, develop recommendations for future management and protection of habitats protected by treaties to ensure the values are maintained and enhanced		0.8	2	1	M

Rank	Ref.*	Strategy	Considerations	Objective Score	Benefit Score	Cost Score	Priority
		into the future					
49	16.2	Using the hydraulic model and EEC mapping undertake an extensive mapping exercise showing constraints of adaptation to the 2m AHD mark including areas beyond artificial impediments (consider use of aerial surveying techniques)	Outcome to inform conservation masterplan	0.8	2	1	M
50	19.1	Identify locations where recently deposited sediments are accumulating and migrating	Mostly completed through previous investigations (PBP study, riverstyles report)	1.0	3	2	M
51	7.1	Where issues associated with implementation are experienced that relate to a lack of data, these should be flagged and prioritised by the HCEMC technical subcommittee		0.7	2	1	M
52	12.3	Undertake a risk assessment to the environment and the community	For the Port and the South Arm this work is already being undertaken (BHP south arm, Port Corp in Port itself, HW some stormwater, Throsby Ck work)	1.0	2	1.5	M
53	C4	Create a task force to target illegal dumping and stockpiling of used tyres in the 'inter tidal' areas within the estuary.		1.3	1	1	M
54	6.4	Tie actions to budgetary and timeframe commitments.		0.9	1.5	1	M
55	6.5	Maintain the project website (move onto Council pages?) and update regularly with plan progress and latest events and happenings		0.9	1.5	1	M
56	3.7	Undertake an inventory to assess sources of groundwater and leachate pollutants discharging into the HRE	Volume and quality of base flow - limited information	1.7	1.5	2	M
57	13.5	Review existing sediment and erosion controls and enforcement of these controls		0.8	1.5	1	M

Rank	Ref.*	Strategy	Considerations	Objective Score	Benefit Score	Cost Score	Priority
58	4.1	Critically review and assess the hydraulic performance and management of the flood mitigation works during flood time and non flood time	Consider drain clearing, tree planting policies etc (check costing)	1.1	2	2	M
59	5.1	Implement recommendations of the Williams River Bank Erosion Study		1.1	2	2	M
60	18.3	If appropriate implement changes to the trading scheme and other activities not associated with the scheme		0.8	1.5	1	M
61	19.4	If yes - assess feasibility of commercial extraction of material - as part of feasibility assess commercial viability of material if it is to be sold commercially to fund the project		0.7	1.5	1	M
62	20.2	Undertake a risk based assessment of ASS on soils and the infrastructure/ drainage that has been constructed around the estuary		0.7	3	2	M
63	18.1	Undertake a critical review of the salinity trading scheme and other upstream activities in terms of environmental consequences (particularly changes to environmental flows)		1.0	2	2	M
64	20.4	Identify opportunities to mitigate ASS through re-inundation of tidal wetlands (for example through filling deep drains)		1.0	2	2	M
65	24.2	Where adverse impacts are identified, negotiate with extractors to modify operations or lease areas (potentially swapping for a more appropriate lease areas to remove troubled shoals -link to previous objective)		0.6	1.5	1	M

Rank	Ref.*	Strategy	Considerations	Objective Score	Benefit Score	Cost Score	Priority
66	3.4	Improve stormwater management techniques, including purpose designed wetlands and detention basins, engineered devices and Water Sensitive Urban Design (WSUD) principles, through the development and implementation of stormwater management plans and development approval	Retrofit for existing development	1.3	2	3	M
67	6.2	Maintain and expand existing community contacts database and provide periodic newsletters / updates on estuary related issues and plan implementation and progress		0.9	1.5	1.5	M
68	6.8	Establish a community interest email group with regular liaison, forums for questions with a full record of all postings on issues related to the Hunter Estuary		0.9	1	1	M
69	15.1	Review and assess current ballast water management practices and if considered warranted carry out a risk assessment using best practice techniques (e.g. Bayesian)	Ballast water, AQIS (Australian quarantine and inspection service) is the regulator for international vessels but no system for managing domestic sources at present. National Introduced Marine Pests Coordination Group (NIMPCG) currently developing strategy	0.8	2	2	M
70	15.2	Develop and implement an integrated weed management strategy for the estuary including Land holder incentive schemes, works programs (eg. those run through CMA) revegetation options to expand existing vegetation stands providing buffers between new developments and remaining pockets of bushland	DPI (Ag) focus on noxious weeds while the CMA focus on L level noxious weeds and environmental weeds (ie. Those that farmers are not obliged to remove)	0.8	2	2	M

Rank	Ref.*	Strategy	Considerations	Objective Score	Benefit Score	Cost Score	Priority
71	15.3	Improved fire management practices to minimise increasing weed density, sediment control etc	National Parks POM, Big land holders	0.8	1	1	M
72	16.1	Investigate opportunities to facilitate adaptation to climate change (pilot studies and experimental plots, physical works		0.8	2	2	M
73	18.2	Where impacts are identified, identify opportunities to change the scheme and or changes to activities not associated with the scheme and determine the economic or commercial consequences of these changes		0.8	2	2	M
74	14.1	Undertake an audit of the present condition of habitats covered by treaties, audit past and present development with respect to how obligations have been met		1,0	1.5	2	M
75	7.3	Carry out routine monitoring of environmental processes to determine health and long term trends and impacts of strategies, as they are being implemented	Consider opportunities to share costs for real time monitoring with irrigators	0.7	3	3	M
76	6.1	Establish a community forum regarding the Estuary and implementation of the EMP and instate a member of this forum onto the HCEMC		1.0	1	1.5	M
77	22.2	Detailed scenic quality assessment to identify areas of remediation potential		0.9	1.5	2	M
78	20.1	Review ASS policies for Councils within the catchment to assess consistency and adequacy and modify as necessary	Check new approach to ASS	0.7	2	2	M
79	20.3	Consider options for modifying drainage systems in order to reduce risk		0.7	2	2	M

Rank	Ref.*	Strategy	Considerations	Objective Score	Benefit Score	Cost Score	Priority
80	11.1	Prepare Hunter Estuary SEPP		1.3	1	2	M
81	21.1	Overlay ownership to assess where additional access could be provided	Note that social benefits are considered in the objectives score hence the L estuary health score -possible performance measure	0.7	1	1	M
82	8.2	Incorporate the EMP within the Lower Hunter Regional Strategy as a mechanism to give the plan force of law and ensure consistency across all three local government areas		0.8	1.5	2	M
83	23.1	As part of all future capital dredging in the port ensure that consideration is given to reuse of material as opposed to offshore disposal		0.6	1	1	M
84	24.1	Undertake an environmental assessment of the ecological and physical impacts of the extractive industry and future impacts given current material reserves and lease boundaries		0.8	1.5	2	M
85	12.1	Undertake a detailed and comprehensive assessment of chemical properties within estuary sediments and tributaries		0.8	1.5	2	M
86	13.3	Identify and investigate opportunities for the extractive removal of sediment slugs within fluvial reaches (eg tributaries such as Wollombi Brooke and the Oakhampton to Morpeth stretch)		0.8	1.5	2	M
87	13.4	For point source inputs or locations of sediment input development appropriate strategies such as sediment traps and sediment filters		0.8	1.5	2	M
88	3.3	Develop trading scheme similar to the STS to cap the amount of pollutants entering the estuary based on environmental		1.1	1.5	3	M

Rank	Ref.*	Strategy	Considerations	Objective Score	Benefit Score	Cost Score	Priority
		capacity					
89	C9	Encourage the Department Natural Resources to make real time data available, so that interested parties are able to monitor fresh and salt levels in Hunter River.	social/economic benefit	0.5	1.5	1.5	M
90	21.3	Discourage inappropriate access from informal locations around the estuary		0.7	1	1.5	M
91	C8	Identify levy banks that could be appropriately utilised as walking/cycling trails.	Ownership would be a consideration. Social issue so lower estuary health score	0.7	1	1.5	M
92	5.6	Reduce risks through relocation of assets and infrastructure or if not feasible within the lifetime of the asset, then stabilise foreshores with appropriate engineering works	Newcastle Council are currently undertaking asset protection / erosion control measures (Hexham Bridge)	0.9	1.5	3	M
93	12.4	Develop and implement appropriate strategies for minimising risk, if considered warranted		0.8	1	2	M
94	21.2	Provide additional public facilities at appropriate locations around the estuary (eg toilets, picnic facilities, boat ramps etc)		0.7	1	3	M
95	1.2	Ground truthing /Floristic surveys to determine location and extent of EECs	considered with strategy above	3.5	0	1	L
96	4.2	Identify redundancies in the scheme during flood times and non flood times	part of review in 4.1	1.4	0	1	L
97	4.3	Identify opportunities for areas to be managed for environmental benefit during non flood times	part of review in 4.1	2.3	0	1	L
98	7.2	Compile a central database of data already being collected in the estuary (for example, Hunter Water, CMA, Council, Wetland Australia, Hunter Bird Observers Club, DECC). Use data to prepare quarterly / annual reports?	Refer to 6.9 and combine so that both strategies are covered	1.0	0	1	L

Rank	Ref.*	Strategy	Considerations	Objective Score	Benefit Score	Cost Score	Priority
99	11.2	Identify Hunter Estuary significant development -	This may already be underway through the conservation strategy etc.. .for this you need to develop a master plan to demonstrate that your development wont have a significant impact on estuary. Refer to new conservation masterplan strategy	1.4	0	1.5	L
100	12.2	Identify sources of contamination to sediments	Refer to pollution identification study	1.0	0	2	L
101	17.1	Expand the guideline document introduced for 2 to cover foreshore rehabilitation and conservation	Guideline document refers to riparian vegetation. Identification of structure / condition, would also be included in conservation masterplan strategy (section on riparian zones) see above strategy 2.1	1.0	0	1.5	L
102	17.2	Refer to the Foreshore Rehabilitation Recommendations in Guideline discussed in 8.1	Dot point in guidelines	1.5	0	1	L
103	19.3	If no impact - do nothing	COMBINE	0.7	0	1	L
104	19.5	If not commercially feasible then remove under the Estuary Management Plan - using whatever material can be sold to offset cost of capital dredging		0.7	0	1	L
105	22.1	Refer to riparian veg options		0.6	0	1	L
106	22.3	Develop a decision making framework (DMF) that addresses issues presented by all stakeholders and can be applied for future development assessment (this could potentially be implemented in the form of 3 LGA specific place based DCPs). Framework for DCPs to be prepared as part of DCP, include mapping of buffers, offsets, considerations etc.	REFER to 8.1	0.6	0	1	L

Rank	Ref.*	Strategy	Considerations	Objective Score	Benefit Score	Cost Score	Priority
107	24.3	Assessment could be linked to bank erosion assessment	Delete -comment only	0.9	0	1	L
108	C5	Within the development approvals framework establish a means to assess developments upon environmental outcomes rather than environmental impacts	This is already being addressed through existing processes. Within DCP give specifics on outcomes.	0.3	0	1	L
109	C6	Isolate area of contaminated sediments with impermeable wall and remove by dredging; evaporate water and then use remaining contaminated sediment to make some sort of 'synroc' that will permanently lock up contaminants	Contaminated land is being addressed through BHP south arm remediation	0.0	1	3	L
110	C1	Install flow control structures on some creeks to enable control of tidal inundation and extent of mangrove encroachment, to protect salt marsh- particularly in the Kooragang wetland rehabilitation project areas.		-2.2	1	2	L

*Reference number referring to original source of suggested options

APPENDIX B: OBJECTIVES – OPTIONS MATRIX (OBJECTIVES: HORIZONTAL AXIS ; OPTIONS: VERTICAL AXIS)

Strategy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
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Objective Score = sum (*f1**Obj1+*f2**Obj2+……+*f24**Obj24) / 5 (refer Appendix A for values).

Where f1 = 1.0 if the option *directly contributes* to objective 1; = 0.3 if the option *indirectly contributes* to objective 1; = -1.0 if the option *conflicts* with objective 1

Obj1 = relative value of objective, as determined through objectives ranking/prioritisation process (see below for details).

and so on.

Objective values

1	To protect and enhance estuarine biodiversity, particularly Endangered Ecological Communities (as listed under the *NSW Threatened Species and Conservation Act 1995*) and other key habitats	4.6875
2	To increase appropriate native riparian vegetation along the Hunter Estuary	4.5625
3	To prevent catchment and point source pollutants from compromising social, environmental and economic values of the Hunter Estuary	4.375
4	To optimise management of flood mitigation works and other flow control structures to enhance environmental values without compromising intended function	4.3125
5	To prevent further bank erosion throughout the Hunter Estuary and remediate existing erosion sites, where appropriate	4.3125
6	To provide opportunity for effective and inclusive stakeholder involvement in the management of the Hunter Estuary environment.	4.25
7	To acquire knowledge relevant to environmental management about the Hunter Estuary, on a priority basis	3.5625
8	To achieve consistency and integration between the Hunter Estuary Management Plan and other strategic environmental planning and Natural Resource Management instruments and programs	4.1875
9	To adopt catchment wide development assessment practices that consider and address cumulative impacts on the Hunter Estuary	4.1875
10	To ascertain the impacts of past works and activities on the tidal hydraulics of the Hunter Estuary	4.15625
11	To encourage development that maintains and enhances landscape values and ecological functions of the Hunter Estuary	4.125
12	To prevent mobilisation of contaminated sediment and groundwater contamination from impacting on environmental processes within the Hunter Estuary	4.0625
13	To reduce the catchment sediment load to the Hunter Estuary	4
14	To fulfil all requirements of international environmental management treaties and relevant conservation legislation in regard to the Hunter Estuary	3.8125
15	To prevent environmental weeds and pests from compromising the social, ecological and economic values of the Hunter Estuary	3.8125
16	To facilitate the adaptation of estuarine communities to projected climate change	3.8125
17	To adopt a consistent approach to foreshore land rehabilitation and conservation along the Hunter Estuary	3.75
18	To minimise environmental consequences of changes to flow and salinity regimes from upstream activities	3.75
19	To reduce the environmental impacts of the accumulation and migration of recent sediments within the Hunter Estuary	3.6875
20	To prevent further exposure of Potential Acid Sulfate Soils and to reduce the extents of Actual Acid Sulfate Soils around the Hunter Estuary	3.375
21	To increase appropriate public access and amenity to the Hunter Estuary and wetlands, recognising sensitive habitats	3.25
22	To enhance the scenic quality of the Hunter Estuary	3.1875
23	To facilitate appropriate reuse of sediment dredged from the Port of Newcastle	3.125
24	To minimise the environmental impacts of commercial sand and gravel extraction on the Hunter Estuary	3.0625

APPENDIX C: PRIORITY SITES FOR THE REMOVAL OF BARRIERS TO FISH PASSAGE

Code	Final Priority	Stream	Nearest road	Type	Riparian Condition	Latitude	Longitude
HUNT 001	H	Ironbark Creek	off Pacific Highway	Hinged Flap	Good	-32.854695	151.700913
HUNT 004	H	off Dunns Creek		Hinged Flap	Fair	-32.840677	151.766028
HUNT 002	H	off Hunter River		Hinged Flap	Fair	-32.842488	151.755318
HUNT 070	H	Greenways Creek	off Woodberry Road	Winch and auto	Fair	-32.788942	151.694400
HUNT 182	H	Barties Creek off Hunter R	off Hinton Road	Winch	Poor	-32.727600	151.692200
HUNT 033	H	Wallis Creek	off Carrington Street	Winch	Fair	-32.736900	151.574300
HUNT 061	H	Purgatory Creek off Hunter R	off Pacific Highway	Hinged Flap	Fair	-32.817345	151.679633
HUNT 215	H	off Paterson River	off Clarence Town Road	Winch	Poor	-32.680723	151.607313
HUNT 071	H	Scotch Creek	off Woodberry Road	Winch	Poor	-32.786015	151.700828
HUNT 186	H	off Hunter River	off Duckenfield Road	Winch	Poor	-32.742177	151.667977
HUNT 217	H	off Paterson River	off Paterson Road	Winch	Poor	-32.671167	151.606890
HUNT 080	H	Windeyers Creek	off Kinross Park	Winch and auto	Fair	-32.774347	151.728628
HUNT 081	H	Nalleys Creek	off Nalleys Creek Road	Winch	Poor	-32.771623	151.723047
HUNT 189	H	off Hunter River	off Duckenfield Road	Winch	Poor	-32.728405	151.655905
HUNT 057	H	Howes Lagoon	off Morpeth Road	Winch	Fair	-32.737673	151.596628
HUNT 103	H	off Williams River	off Seaham Road	Winch	Fair	-32.747260	151.752565
HUNT 237	H	off Hunter River	off Pacific Highway	Hinged Flap	Fair	-32.850048	151.697357
HUNT 125	M-H	off Williams River	off Seaham Road	Winch	Fair	-32.692286	151.750852
HUNT 003	M-H	off Hunter River		Hinged Flap	Poor	-32.842332	151.755502
HUNT 138	M-H	off Williams R (Eskdale Swamp)	off Seaham Road ('Eskdale')	Hinged Flap	Poor	-32.688610	151.722787
HUNT 233	M-H	off Fullerton Cove	off Fullerton Cove Road	Winch	Poor	-32.843690	151.809842
HUNT 234	M-H	off Fullerton Cove	off Fullerton Cove Road	Winch	Poor	-32.843873	151.809565
HUNT 119	M-H	off Williams River	off Seaham Road	Winch	Fair	-32.706906	151.748137
HUNT 120	M-H	off Williams River	off Seaham Road	Winch	Fair	-32.706572	151.748738
HUNT 230	M-H	Saltwater Gully	off Duckenfield Wharf Road	Winch	Fair	-32.741152	151.680160
HUNT 059	M-H	off Hunter River	off Tomago Road	Hinged Flap	Poor	-32.838098	151.732332
HUNT 183	M-H	off Hunter River	off Hinton Road	Winch	Poor	-32.726662	151.686103
HUNT 127	M-H	off Williams River	off Newline Road	Winch	Poor	-32.692242	151.752454
HUNT 202	M-H	off Paterson River	off High Street	Winch	Poor	-32.707707	151.647938

Code	Final Priority	Stream	Nearest road	Type	Riparian Condition	Latitude	Longitude
HUNT 020	M	off Wallis Creek	off Louth Park Road	Winch	Poor	-32.756700	151.561200
HUNT 058	M	off Hunter River	off Tomago Road	Hinged Flap	Poor	-32.836528	151.729982
HUNT 062	M	off Hunter River	off Pacific Highway	Winch	Poor	-32.815112	151.681870
HUNT 131	M	off Williams River	off Newline Road	Winch	Poor	-32.678290	151.755859
HUNT 207	M	off Paterson River	off Wallalong Road	Winch	Poor	-32.701353	151.634803
HUNT 238	M	off Hunter River	off Pacific Highway	Hinged Flap	Poor	-32.842437	151.690772
HUNT 116	M	off Williams River	off Seaham Road	Winch	Fair	-32.727450	151.739472
HUNT 065	M	off Hunter River	off Pacific Highway	Winch	Poor	-32.804798	151.704048
HUNT 225	M	off Paterson River	off Paterson Road	Winch	Fair	-32.629598	151.605778
HUNT 031	M	off Hunter River	off John Street	Hinged Flap	Fair	-32.744600	151.587900
HUNT 117	M	off Williams River	off Seaham Road	Winch	Fair	-32.720647	151.746553
HUNT 226	M	Duns Creek	off Paterson Road	Hinged Flap	Poor	-32.626365	151.605337
HUNT 111	M	off Williams River	off Seaham Road	Winch	Poor	-32.731827	151.736028
HUNT 216	M	off Paterson River	off Clarence Town Road	Winch	Poor	-32.678662	151.603460
HUNT 232	M	off Grahamstown Lake	off Pacific Highway	Winch	Poor	-32.728315	151.783577

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