



Pittwater Estuary Management Plan

FINAL REPORT
November 2010

Pittwater Estuary Management Plan

Prepared For: Pittwater Council

Prepared By: BMT WBM Pty Ltd (Member of the BMT group of companies)

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Title :	Pittwater Estuary Management Plan
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Synopsis :	This Estuary Management Plan provides for the ecologically sustainable use of Pittwater Estuary and outlines strategies and actions to maintain or improve the environmental, community and economic values of Pittwater Estuary over the immediate, short and medium term.

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PITTWATER ESTUARY MANAGEMENT PLAN: EXECUTIVE SUMMARY

<i>Purpose</i>	The Pittwater Estuary Management Plan is a guide for the short and long term sustainable management of the Pittwater waterway, its surrounding foreshore lands, its tributaries and its catchment. The Plan has particular focus on maintaining or improving the environmental qualities of Pittwater Estuary.
<i>Context</i>	<p>This Estuary Management Plan has been developed in accordance with the NSW Government's Estuary Management Program, to satisfy the objectives of the NSW Estuary Management Policy 1992 and the NSW Coastal Policy 1997. It shall also address the Hawkesbury Nepean Catchment Management Authority's River Health condition target RH5 Estuary/marine condition, which aims to improve and maintain estuarine condition (HNCAP, 2006). This Plan is considered to be a Coastal Zone Management Plan under the provisions of Part 4A of the Coastal Protection Act 1979.</p> <p>The Plan is supported by an Estuary Processes Study (Lawson and Treloar, 2002), which describes the environmental processes of the estuary and their interactions, and an Estuary Management Study (WBM, 2006), which details a range of potential management options for the estuary.</p>
<i>Status</i>	This is a draft document and therefore has yet to be adopted by Pittwater Council.
<i>Relationship to other plans</i>	This Plan is to be read in conjunction with other relevant strategic environmental management plans, including the HNCMA's Catchment Action Plan, and Sydney Regional Environmental Plan No. 20 – Hawkesbury/Nepean River. This Plan should also be consulted when reviewing and amending Pittwater Council's Local Environmental Plan (LEP), Development Control Plans (DCPs), and other Council Plans of Management.
<i>Overarching Aim</i>	The overarching aim of this Estuary Management Plan is to protect and maintain or improve the environmental values of Pittwater Estuary, as the environment provides the basis of the social, commercial and recreational values enjoyed by users of Pittwater Estuary.
<i>Management Areas</i>	<p>Management of the Pittwater Estuary was separated into eight management categories to address the issues and values of the estuary.</p> <ul style="list-style-type: none"> • Water Quality; • Sedimentation and Erosion; • Ecology; • Waterway Usage; • Foreshore Usage; • Heritage; • Future Development; and • Climate Change.
<i>Objectives</i>	<p>A total of 25 objectives for estuary management were compiled and arranged under their relevant management category.</p> <p>Water Quality Objectives</p> <p>1.0 Water quality of Pittwater to be suitable for maintaining healthy aquatic ecosystems and all recreational and commercial activities currently undertaken.</p> <p>1.1 Water quality objectives specified in the Independent Inquiry into the Hawkesbury-Nepean River system (NSW Healthy Rivers Commission, 1998) to be met for more than 90% of the time at locations that are both close to the foreshore and in the middle of the waterway, including sites adjacent to Scotland Island and the western foreshore</p>

communities.

1.2 Faecal coliforms and enterococci levels at designated bathing areas to comply with recommendations specified within the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (revised 2004).

1.3 Concentrations of toxicants within all parts of the estuary, including around marinas and within poorly flushed embayments, to meet the ANZECC (2000) guidelines for 95% level of species protection

Sedimentation and Erosion Objectives

2.0 On-going sedimentation is not to compromise the ecological value of existing habitats or the social amenity currently afforded to all estuary users.

2.1 Foreshore erosion processes to be mitigated at all high priority areas by 2015.

2.2 Sediment runoff rates from the Pittwater catchment to be 50% of 2002 levels by 2015.

2.3 The quality of all Pittwater sediments to be below the low trigger values specified in the ANZECC (2000) Interim Sediment Quality Guidelines (ISQG), to minimise impacts on benthic or aquatic ecosystems.

Ecology Objectives

3.0 Maintain and where practical, restore a healthy and diverse mix of terrestrial, fringing, intertidal and aquatic habitats that will promote visitation by a wide range of species, including migratory birds that have been displaced in recent years.

3.1 Re-establish a native vegetation foreshore corridor around public natural foreshore areas of Pittwater.

3.2 Bring under control aquatic and terrestrial noxious weed species (including *Caulerpa taxifolia*) from within and around the Pittwater estuary by 2025.

3.3 Areas of ecological significance to be properly identified and conserved for future generations. Conservation to consider appropriate adaptive management strategies to deal with the natural resource impacts of long term climate change.

Waterway Usage Objectives

4.0 Recreational, commercial and commuter users to access and utilise the estuary in an equitable and safe manner.

4.1 Improve and/or develop arrangements, for the co-operative management of waterway activities, between the relevant State Government Authorities and between State Authorities and Council.

4.2 Minimise the disturbance from waterway activities to the natural environment, as well as other estuary users.

Foreshore Usage Objectives

5.0 Re-establish wherever practical public access to and around the entire foreshores of the Pittwater estuary by 2025.

5.1 Improve public facilities and access along sections of foreshore in public ownership.

5.2 Minimise traffic and parking congestion at foreshore access points.

5.3 Foreshore recreational and commercial activities to be consistent with the other objectives of this Estuary Management Plan.

Heritage Objectives

6.0 Aboriginal and non-indigenous heritage areas fringing the Pittwater estuary are not to be damaged or destroyed through inappropriate or poorly planned activities.

6.1 Sites of Aboriginal heritage significance around Pittwater are to be properly identified, recorded and protected under the applicable State and Federal legislation.

6.2 Sites of non-indigenous heritage are to be identified and registered under the relevant state and/or local planning instruments.

	<p>6.3 Increase the awareness of the community regarding the significance of the Pittwater estuary to the local Aboriginal people and also to the early European settlers in the area.</p> <p>Development Objectives</p> <p>7.0 Future development, including redevelopment or infill development, is not to compromise the principles of natural resources sustainability as they relate to the Pittwater estuary, as espoused by this Estuary Management Plan.</p> <p>7.1 Minimise the impacts of future development on the existing scenic quality, recreational amenity and ecological values of the Pittwater estuary through appropriate land use zoning and development controls.</p> <p>Climate Change Objectives</p> <p>8.0 Potential climate change impacts for Pittwater are to be acknowledged and adequately addressed in Council's strategic planning and management plans</p>
<i>Strategies for Estuary management</i>	<p>41 strategies have been developed to achieve the management objectives and particularly to meet the aim of maintaining and improving the environmental condition of Pittwater Estuary (and its catchment and tributaries). The strategies have been developed through consultation with the study team (Council, DECCW and BMT WBM) and with community.</p> <p>The strategies have been grouped according to the types of activity the strategy involves, rather than issue based as per the management categories, to assist Council in organising the implementation of the strategies. Groupings include land management controls, planning controls, development controls, activity controls, new and improved services / assets, environmental rehabilitation, pollution reduction measures, community education and compliance.</p> <p>Strategies have been prioritised according to their ability to address management objectives and effectiveness particularly in improving the environmental quality of the estuary. Priorities for the strategy range between High, Medium and Low. Relative timeframes for the strategies to be implemented have also been assigned.</p> <p>A summary of the highest priority strategies and associated details is provided in Table A. The full list of management strategies is given in Section 6.</p>
<i>Implementing the Strategies</i>	<p>Implementation details for each strategy have been compiled and are listed in the Pittwater Estuary Management Action Table, in Section 7.1 of this Plan.</p> <p>Implementation details for each strategy include detailed actions, priority, timeframe (< 4 years or > 10 years), responsibilities, costs, measures of performance for implementation, mapping and locations to which the strategy applies, relevant best practice guidelines and the objectives addressed by each strategy, outlined in the Action Table.</p> <p>An 'Excel' spreadsheet version of the Pittwater Estuary Management Action Table has been compiled, for use within Pittwater Council.</p>
<i>Key responsibilities</i>	<p>Responsibilities for implementation have been defined and listed in the Pittwater Estuary Management Action Table. For many strategies, the primary responsibility for implementation rests with Pittwater Council. In other strategies, Council is partly responsible. However for a few strategies, the primary responsibility for implementation rests with other government agencies. In these circumstances, Council may still assist with implementation by lobbying for funding.</p> <p>Assistance to Council, and implementation of some ancillary strategies and tasks, is to be provided by key stakeholders and relevant government agencies including: DECCW, HNCMA, DII (Fisheries), NSW Maritime, Dept. of Lands and DP. Implementation is also to be facilitated through the assistance of landholders and local community groups / volunteer organisations.</p>

<i>Estuary Sub-plan Maps</i>	<p>Eight estuary management sub-plans have been developed, which are 'stand-alone' packages of strategies according to the eight management areas. The sub-plans provide a clear indication of management strategies that need to be implemented to address the management objectives and issues for the estuary, within each management category.</p> <p>All of the strategies have been mapped and sub-plan maps illustrating each strategy relevant to that management category have been created. A GIS 'workspace' (in the MapInfo GIS Platform) for each sub-plan has also been created which maps the strategies and management issues for each sub-plan.</p>
<i>Best Practice Guidelines</i>	<p>To support implementation of the strategies and achievement of objectives, 13 Best Practice Guidelines (BPGs) have been developed. These are 'fact sheet' style papers that provide advice for activities within the estuary. The BPGs are variously aimed at catchment residents, users and Council staff, and provide practical advice on ways to preserve key features of the estuary. Categories for the BPGs include stormwater outlet design, foreshore and inter-tidal access, companion animal management, seawall and jetty design for aquatic habitat, recreational fishing and boating use.</p>
<i>Costs and funding</i>	<p>Indicative costs have been provided in the Pittwater Estuary Management Action Table. Costs to Council and other stakeholders will depend on prioritised requirements for funding of individual strategies against significant existing stakeholder activities. Significant in-kind contributions are required by all responsible authorities. A range of external funding opportunities will also be available to support the implementation of this Plan. Potential funding sources are discussed in Section 7.2.</p>
<i>Indicators for success</i>	<p>The ultimate success of this Plan will be gauged by how well the Plan objectives have been met. Given that the objectives are broad and likely to be measurable over long timescales only, a series of Performance Measures have been incorporated into the Pittwater Estuary Management Action Table for each strategy, to facilitate short term successes.</p>
<i>Consultation</i>	<p>Community and stakeholder consultation has underpinned the development of this Plan. The community have been involved in the development and prioritisation of management objectives and strategies. The community will be invited to review this Plan during a public exhibition period.</p>
<i>Review and amendment provisions</i>	<p>This Plan has an indicative 5 year timeframe. Progress with implementation should be formally reviewed annually, with a thorough audit of implementation after 5 years. Contingency measures should be activated if progress is slow. A complete review and amendment of the Plan should be considered after 5 years, and should redress outstanding issues, new environmental management practices, new scientific data, and changed governance and administrative arrangements.</p>

Summary Table A Highest Priority Strategies

Strategy	Priority	Time-frame	Responsibility	Strategy Mapping	Relevant BPGs ***	Objectives Addressed
1 a) Prepare and implement Plans of Management to define land management for Church Pt, Palm Beach Wharf / Pittwater Park, Scotland Island and western offshore communities (Note: Church Point PoM already complete)	HIGH	By 2014	Council & Dept. Lands to prepare Input from key stakeholders and state agencies for PoM development Implementation by Council	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 1a.TAB This strategy is applicable to ALL Estuary Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan workspaces in Council's GIS Network	2, 3, 4, 6, 7, 8, 10, 11, 13	1.0, 1.1, 1.2, 1.3, 2.0, 2.2, 3.0, 3.1, 3.3, 4.0, 4.2, 5.0, 5.1, 5.2, 6.0, 7.0, 7.1, 8.0
8 f) Community Education - General environmental values of estuary	HIGH	By 2014	Council, DECCW, HNCMA	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 8f.TAB This strategy is applicable to the Water Quality, Sediment & Erosion, Ecology, Waterway Usage, Foreshore Usage and Heritage Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	6, 10, 11, 12, 13	1.0, 1.1, 1.3, 2.0, 2.2, 2.3, 3.0, 3.2, 3.3, 4.2, 6.3, 7.1, 8.0
3 d) Developments not to incorporate pollution and/or sediment discharges to the waterways	HIGH	By 2014	Council	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 3d.TAB This strategy is applicable to the Water Quality, Sediment. & Erosion, and Future Development Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	1, 9, 12	1.0, 1.1, 1.2, 1.3, 2.0, 2.2, 2.3, 3.0, 3.1, 3.3, 4.0, 7.0, 7.1
3 h) Require all new marina developments (> 9 berths) to have pump-out services	HIGH	By 2014	Council DP	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 3h.TAB (ie, all foreshore regions where marina developments are permitted). This strategy is applicable to the Water Quality, Waterway Usage, and Future Development Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	10	1.0, 1.1, 1.2, 1.3, 3.0, 4.0, 4.2, 7.0, 7.1
9 e) Compliance: Water pollution from boats and waterway businesses (eg marinas)	HIGH	By 2014	NSW Maritime, Council	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 9e.TAB This strategy is applicable to the Water Quality, Sediment & Erosion, Waterway Usage and Foreshore Usage Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	10, 11	1.0, 1.1, 1.2, 1.3, 2.3, 3.0, 4.0, 4.2,

1 c) Prepare and implement Plans of Management for areas of significant habitat (eg EECs) on public and private lands ensuring preservation and enhancement of key environmental values	HIGH	By 2014	Council Assistance by DECCW, DII (Fisheries), HNCMA	Known locations of significant habitat are mapped in MapInfo table 1c.TAB. Further mapping required to better identify significant habitat areas This strategy is applicable to the Ecology, Waterway Usage, Foreshore Usage, Future Development and Climate Change Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan workspaces in Council's GIS Network	1, 4, 5, 6, 7, 8	2.0, 3.0, 3.1, 3.3, 4.0, 4.2, 6.0, 7.0, 7.1, 8.0
7 a) Targeted measures for reducing marina operations waste	HIGH	By 2014	Council DECCW (EPA), DII (Fisheries), NSW Maritime	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 7a.TAB This strategy is applicable to the Water Quality, Sediment & Erosion and Waterway Usage Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	10	1.0, 1.1, 1.2, 1.3, 2.3, 3.0, 4.2,
3 b) WSUD principles to be added to all development controls (draft DECC DCP)	HIGH	By 2014	Council	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 3b.TAB This strategy is applicable to the Water Quality, Sediment & Erosion and Future Development Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	12	1.0, 1.1, 1.3, 2.0, 2.2, 2.3, 3.0, 3.3, 7.0, 7.1
1 b) Update and implement Plan of Management for Careel Bay wetlands, ensuring maintenance of habitat mix / diversity (which may include selective removal of mangrove seedlings that have encroached onto saltmarsh areas from time to time)	HIGH	By 2014	Council Assistance by DECCW, DII (Fisheries), HNCMA	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 1b.TAB This strategy is applicable to the Ecology, Waterway Usage and Foreshore Usage Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan workspaces in Council's GIS Network	1, 4, 5, 6, 7, 8	2.0, 3.0, 3.3, 4.0, 4.2, 6.0, 7.0, 7.1, 8.0
7 b) Targeted catchment management measures, following catchment-wide urban pollution and sediment runoff audit (esp. areas discharging to poorly flushed embayments)	HIGH	By 2014	Council DECCW Landowners of identified sites will be responsible for implementing mitigative measures	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 7b.TAB This strategy is applicable to the Water Quality and Sediment & Erosion Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	1, 5, 8, 12	1.0, 1.1, 1.2, 1.3, 2.0, 2.2, 2.3, 3.0

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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.

The Pittwater Estuary is one of only a handful of estuaries in the Sydney region and as such, requires special protection to conserve its natural values. This document represents the Estuary Management Study and Plan for the Pittwater Estuary, and has been prepared by environmental consultants BMT WBM, with assistance from SJB Planning, on behalf of Pittwater Council and the Department of Environment, Climate Change and Water. The methods followed in preparing the report are consistent with the framework outlined in the NSW Government's Estuary Management Manual (1992).

The Estuary Management Plan aims to balance the pressures and demands placed on the Pittwater Estuary, both from a human perspective and from an environmental perspective, in particular, the pressures imposed by surrounding urban development. Existing values of the estuary have been considered, along with issues that have been identified through consultation with the community and through a technical appraisal of the current condition of the estuarine environment.

The Estuary Management Plan comprises a suite of short and long term strategies, which address the needs for future sustainable management of the Pittwater Estuary. State government agencies and other stakeholders have been designated responsibility and authority, and have agreed to implement these strategies to the best of their abilities.

Our knowledge of the Pittwater Estuary and estuaries in general will continue to improve in the future. It is therefore essential that this Estuary Management Plan be reviewed and amended periodically to account for our expanding knowledge as well as to adapt to changing environmental conditions, and to varying management directions.



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Members of the Pittwater Estuary Working Group and Pittwater Council staff are gratefully acknowledged for input into this Estuary Management Plan.

Appreciation is also extended to all members of the community who participated in the community consultation process, through attendance of the drop in sessions, workshops and meetings, or in providing responses to requests for input from the brochures, and/or provided feedback on the draft Plan and preceding documents.

DEFINITIONS

PC	Pittwater Council
DNR	Department of Natural Resources (now DECCW)
DP	Department of Planning
DEC	Department of Environment and Conservation (now DECCW)
DECCW	Department of Environment, Climate Change & Water (amalgamation of former National Parks and Wildlife Service, Environment Protection Authority, Department of Natural Resources, Department of Water, plus others)
DII	Department of Industry & Investment (amalgamation of former Departments of Fisheries, Agriculture, Mineral Resources, State Forests and others)
HNCMA	Hawkesbury Nepean Catchment Management Authority
LW&CPC	Pittwater Land, Water and Coastal Portfolio Committee
EWG	Pittwater Estuary Working Group

AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment Conservation Council
BPG	Best Practice Guideline
CAP	Catchment Action Plan
DA	Development Application
DCP	Development Control Plan
EMP	Estuary Management Plan
EPI	Environmental Planning Instrument (e.g., REP, LEP, DCP, SEPP)
ESD	Ecologically Sustainable Development
GPT	Gross Pollutant Trap
IPCC	Intergovernmental Panel on Climate Change
IWCM	Integrated Water Cycle Management
LEP	Local Environmental Plan
LGA	Local Government Area
OSM	Onsite Sewage Management
PEMS	Pittwater Estuary Management Study
REP	Regional Environmental Plan
RL	Reduced Level
SEPP	State Environmental Planning Policy
STP	Sewage Treatment Plant
WSUD	Water Sensitive Urban Design

1 INTRODUCTION AND STRATEGIC CONTEXT OF PLAN

1.1 Purpose of this Estuary Management Plan

The Pittwater Estuary Management Plan has been prepared on behalf of Pittwater Council (Council) and the NSW Departments of Environment, Climate Change and Water (DECCW). Its preparation has been overseen by the Pittwater Estuary Working Group (EWG), which contains representation from various government agencies as well as stakeholder groups and community individuals.

The Estuary Management Plan has been developed in accordance with the NSW Government's Estuary Management Program (refer Section 1.6) to satisfy the objectives of the NSW Estuary Management Policy 1992 and the NSW Coastal Policy 1997. It also helps to satisfy the Hawkesbury Nepean Catchment Management Authority's River Health condition target RH5 Estuary/marine condition, which aims for improving and maintaining estuarine condition (HNCAP, 2006).

The primary purpose of this plan is to guide future Council actions. Any actions, including project funding, noted in this plan for completion by or contribution from the NSW Government, its Departments or Agencies should be considered as requests for funding or action. The NSW Government will consider these requests when determining its state-wide priorities relating to coastal zone management. If any such actions are not completed in accordance with the plan, this is not to be considered a breach of Section 55L of the *Coastal Protection Act 1979*.

Ministerial approval of this plan for gazettal under Section 55G of the Act is to be considered to be a Ministerial statement that the plan is consistent with the requirements of the Act and suitable for gazettal. Ministerial approval does not necessarily represent endorsement of the contents of the plan.

Actions in this plan may require approval under the *Environmental Planning and Assessment Act 1979* and other legislation and should be considered as intended actions subject to these approvals. In the event of any inconsistency between a statutory instrument or development consent issued under the EP&A Act and this plan, the statutory instrument or development consent applies to the extent of the inconsistency.

The Pittwater Estuary Management Plan provides strategic direction and specific focus for the short and long term sustainable management of the Pittwater waterway, its tributaries, its surrounding foreshore lands, and its catchment insofar as catchment activities impact on the condition of the estuary. The Plan has particular focus on maintaining or improving the environmental qualities and attributes of Pittwater Estuary. The Plan is designed as a 'user manual' for undertaking activities and implementing strategies that will result in improved environmental conditions and balancing both human and ecological demands on the estuary.

The Plan has been designed with integrated GIS map based tools, which show the location of issues and values and the location where strategy actions apply around the estuary. Implementation tables are contained in this Plan that correlate with the strategy mapping, to provide a powerful management tool that will assist Council's planners and environmental and infrastructure officers to determine where and how to undertake activities and implement the strategies contained in this plan.

The Plan and its GIS based mapping tools shall be used to inform other strategic documents that aim to manage and rationalise human activities and development within the catchment, such as Regional Strategies, Urban Structure Plans, Development Control Plans (DCPs) and the proposed review of the Pittwater Local Environmental Plan (LEP).

The Plan aims to fulfil Council's requirement for applying the principles of Ecologically Sustainable Development (ESD) to Pittwater Estuary and its catchment. The Plan also provides an opportunity for future climate change to be considered in the strategic management and planning of the estuary and surrounding sensitive coastal lands.

1.2 The Pittwater Estuary

The Pittwater Estuary, located near the mouth of the Hawkesbury-Nepean River system, is a drowned river valley of approximately 10 km in length and 1 km in width, and has a maximum depth of the order of 20 m. Pittwater has a catchment of 51 km² which extends from Mona Vale and Warriewood in the south, along the eastern ridge of the Peninsula leading to Palm Beach and along the western ridge leading to West Head. The eastern parts of the catchment are heavily urbanised whilst the western parts are primarily National Park (Ku-ring-gai Chase). A locality map of the study area is shown in Figure 1.1.

The waterway is intensively used for recreational purposes. A number of commercial enterprises are dependent upon the estuary, including several marinas, while the estuary also holds intrinsic ecological values.

A long term management plan is required for the Pittwater estuary to ensure that ecological sustainability of the estuary is given the highest priority when planning for and managing all the anthropogenic demands on the waterway.

There are key eight management areas considered to be of relevance to the management and sustainability of the Pittwater Estuary. The Estuary Management Plan has been divided into these categories to facilitate future management strategies and directions. The management categories are:

- Water Quality;
- Sedimentation and Erosion;
- Ecology;
- Waterway Usage;
- Foreshore Usage;
- Heritage;
- Development; and
- Climate Change.

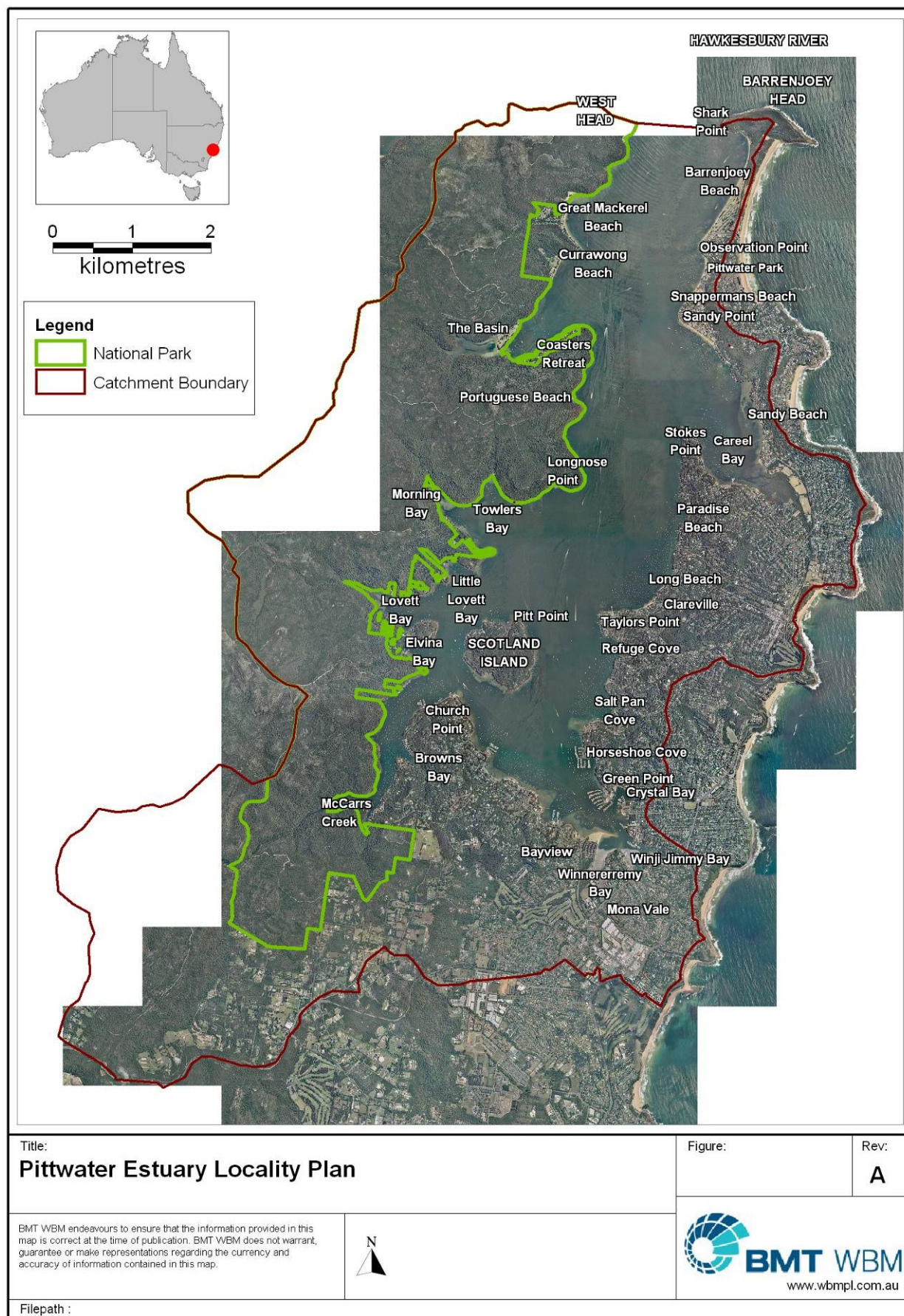


Figure 1-1 Pittwater Estuary Locality Plan

1.3 Objectives of the Plan

The objectives of the Pittwater Estuary Management Plan are as follows:

- To identify and discuss the planning framework relevant to management of the estuary;
- To prioritise the management objectives;
- To assess the management options and select strategies to achieve the objectives;
- To detail a schedule of activities for the implementation of the management strategies; and
- To indicate responsibilities and sources of funding for the strategies.

Once the Plan has been endorsed by the community, DECCW and by Council, the recommended management strategies and actions can start to be implemented, in accordance with the framework presented in the Plan.

This Plan has been prepared by BMT WBM with assistance from SJB Planning on behalf of the Pittwater EWG, Pittwater Council and DECCW. It builds on the Pittwater Estuary Management Study (WBM, 2006) and the Pittwater Estuary Processes Study (Lawson & Treloar, 2002), which were undertaken as preceding steps to the development of this Plan.

1.4 Existing Management and Strategic Planning Framework

Pittwater Estuary and its catchment are subject to a myriad of environmental planning legislation, policies and management programs. A thorough review of all environmental planning legislation relevant to the Pittwater Estuary has been compiled by SJB Planning, refer Appendix A. The major planning instruments of relevance to the Pittwater Estuary are:

- *Environmental Planning and Assessment Act 1979*
- State Environmental Planning Policies 19, 44, 71, (Major Projects) 2005, and (Infrastructure) 2007.
- Sydney Regional Environmental Plan No. 20 – Hawkesbury/Nepean River
- Pittwater Local Environmental Plan 1993
- Pittwater 21 DCP

It is noted that the new Hawkesbury Nepean River Act 2009 only applied upstream of Brooklyn Bridge, and as such, is not applicable to the Pittwater Estuary or its catchment.

A brief summary of these main instruments and how they are most applicable to the Pittwater Estuary, as taken from SJB's review is included in Appendix A.

1.5 Land Tenure

A small proportion of the Pittwater catchment (~ 9 km²) lies outside of the Pittwater LGA. This land is largely forested, with a small proportion of urban residential development.

The remainder of the catchment is separated as follows:

- About 43% (22 km²) of the catchment is within Ku-ring-gai Chase National Park, and managed by DECCW NPWS
- Pittwater Council manages 2.0 km² of land within various Council reserves, and some Crown trustee lands.
- Department of Lands technically controls 2.4 km² of land within Crown Land, Crown Lease Land, Crown Trustee Land and other mixed property types.
- Department of Lands are also the consent authority for the entire waterway of Pittwater below the mean high water mark, covering 18.8 km², which includes Careel Bay wetlands.
- The various other government departments and authorities (eg, DP, Education department, Sydney Water, Energy Australia, Telstra, RTA and so on) own and manage approximately 0.7 km² of land within the Pittwater Catchment.
- The remaining land area of 23.4 km² is privately owned and managed.

The Metropolitan Aboriginal Land Council (MALC) lodged a native title claim over the Pittwater Estuary. In preliminary stages of the preceding it was rejected, however appeals may be made. The MALC has stated that the native title claim is on hold indefinitely due to funding resources.

1.6 NSW Government's Estuary Management Program

In 1992, the NSW State Government introduced its Estuary Management Policy, aimed at managing the growing pressures on estuarine ecosystems. The Policy is implemented through an Estuary Management Program, which is co-ordinated by DECCW, in co-operation with local government and the community.

The Estuary Management Program also implements actions of the Coastal Policy 1997 insofar as they relate to the estuarine components of the NSW Coastal Zone. The NSW Coastal Policy 1997 sets the strategic framework for coordinated, integrated and ecologically sustainable development of the coast, which includes estuaries such as Pittwater.

The process of managing an estuary is documented in the Estuary Management Manual (NSW Government, 1992). The general estuary management process as established by the NSW Government is shown in Figure 1-2, along with the stage of this project in relation to the estuary management process, namely, to produce and implement an estuary management plan for Pittwater.

Within the context of the Pittwater Estuary, the Pittwater Estuary Processes Study was completed in 2002, while the Pittwater Estuary Management Study was completed in 2006.

The NSW Government has begun the process of revising the estuary management planning process, which shall involve combining coastal and estuary planning into a single coastal zone program. The revised program is due to be released in June 2010. It is also noted that the NSW Government has begun to roll estuary management plans into coastal zone management plans. Under the *Coastal Protection Act 1979* (and 2002 Amendments of this Act), such coastal zone management plans may be formally gazetted, providing statutory weight to the implementation of the document. However, until such time as the estuary program is formally revised, the Estuary Management Manual (1992) remains the guiding document for the current estuary planning process.

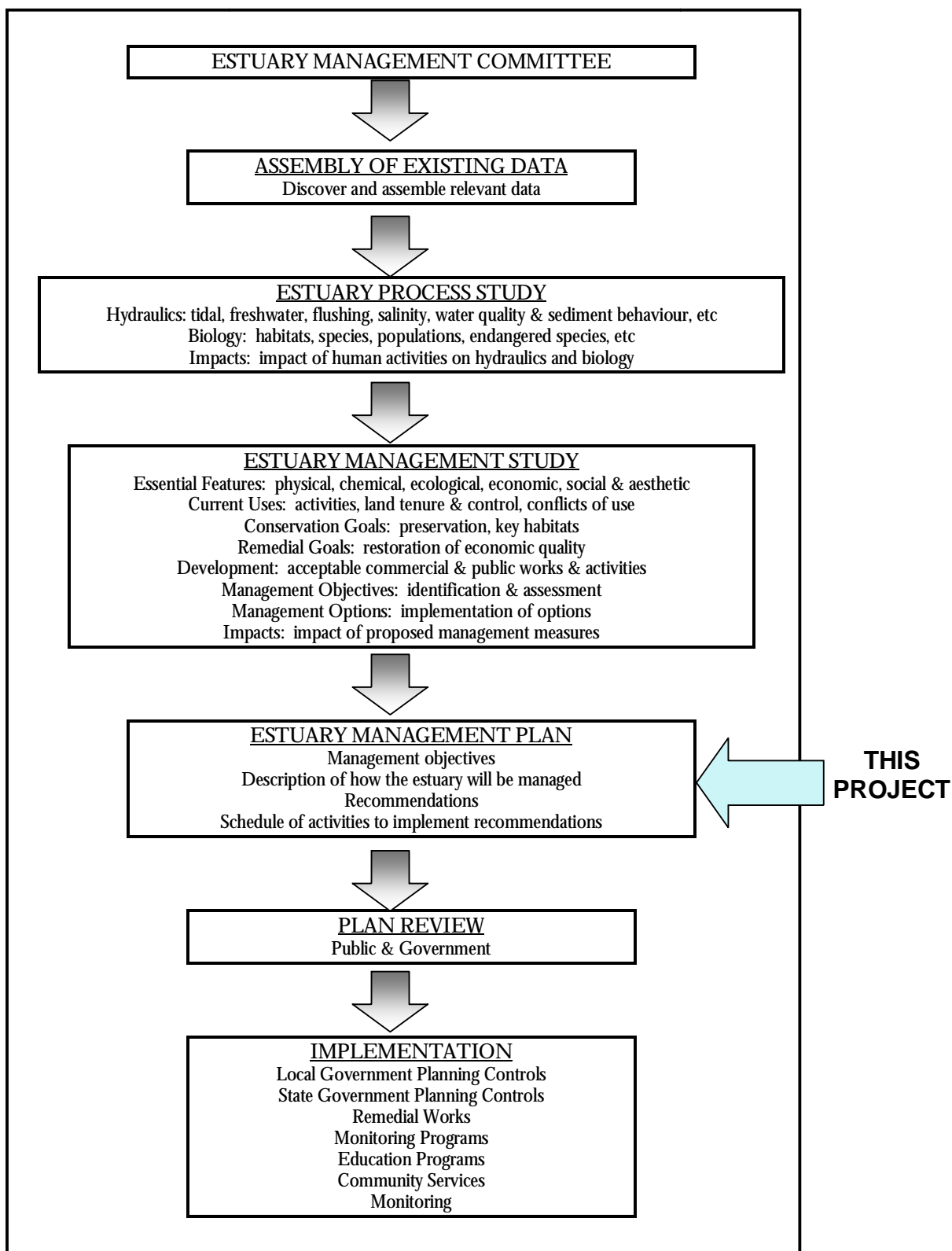


Figure 1-2 The NSW Estuary Management Process (NSW Government, 1992)

1.7 Development and Structure of the Pittwater Estuary Management Plan

The structure of this Pittwater Estuary Management Plan is presented in Figure 1-3 and described below.

Values, Issues and Objectives were defined in the Pittwater Estuary Management Study (WBM, 2006). The objectives aim to protect the values and to address the issues derived for the Pittwater Estuary (refer Chapter 4 & 5).

Management Strategies: are a series of proposed initiatives aimed primarily at improving the existing environmental condition of the estuary and its catchment, or as a minimum, to prevent it from degrading further. The strategies describe methods to meet the Plan's objectives (refer Chapter 6).

Implementation Actions: provide specific detail to the initiatives described by the management strategies. These are prescribed within an Actions Table, which outlines tasks, responsibilities, costs, and proposed timeframes for implementation (refer Chapter 7).

Sub-Plans: provide a snap-shot overview of proposed works and actions as they relate to specific issues / areas of management. These include: Water Quality; Sedimentation and Erosion; Ecology; Waterway Use; Foreshore Use; Heritage; Future Development; and Climate Change (refer Chapter 8).

Best Practice Guidelines: aim to provide practical, best practice guidance and knowledge to Council, the community, developers and any other organisations/authorities on a range of activities within the estuary, particularly on-ground works, and ways in which associated environmental outcomes can be maximised (refer Chapter 9).

Standard Conditions of Consent: recommends changes to Council's Standard Conditions of Consent, to ensure that the intent of all estuary management objectives and strategies are represented within Council's database of Standard Conditions of Consent provided with approval of development applications (refer Chapter 10).

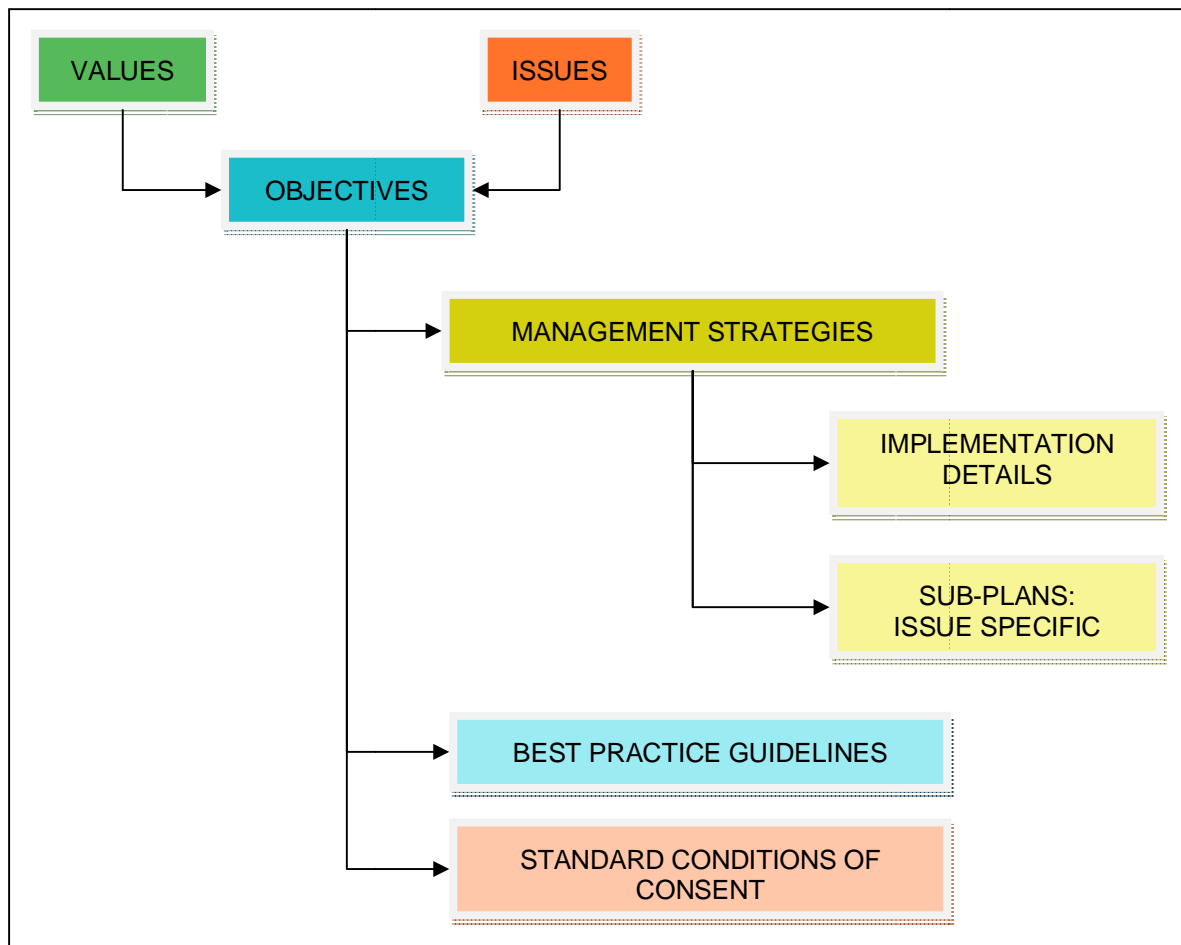


Figure 1-3 Structure of the Pittwater Estuary Management Plan

2 COMMUNITY CONSULTATION

Various stages of the development of the Pittwater EMP have involved consultation and collaboration with the community. For the final stage, that is the development of the Pittwater EMP, it was necessary to revisit components of the PEMS with the community, due to the length of time between the EMS and this EMP stage of the project. Community consultation conducted in developing this EMP document and tools, is outlined below.

2.1 Community Consultation during the Estuary Management Study

The local communities surrounding the Pittwater estuary were invited to contribute to the development of the Estuary Management Study phase of the EMP process. The wider Pittwater community was invited to a special workshop (the EMS Workshop) held at the Coastal Environment Centre on Saturday 23 August 2003, to give their personal accounts of the values of the estuary and the areas or issues that need to be rectified as part of the Estuary Management Plan.

A summary of the outcomes of the EMS Workshop are presented below. Specific issues and questions raised during this workshop are detailed in Appendix B. The major issues of concern were:

- Ecologically Sustainable Development (ESD) should be the overall goal of the management of the estuary. ESD must provide the framework for developing actions to be incorporated into the Estuary Management Study (EMS).
- Ecology, particularly foreshore vegetation communities (including the Endangered Ecological Community Pittwater Spotted Gum Forest) seagrass beds, saltmarsh areas and birds need to be conserved.
- Adequate protection for ecologically sensitive areas through appropriate measures/actions.
- Poor water quality, particularly as a result of effluent that is discharged from boats.
- Over-use of the waterway by boats, and associated foreshore and waterway congestion and public safety issues.
- Limited public access to the foreshore.

2.2 Workshop 1 – Issues, Objectives & Management Options

The aim of this workshop was to determine the relevance of the issues and objectives outlined within the PEMS in 2006. In addition, the workshop aimed to select a set of preferred management options from the full list of management options presented in the PEMS. The workshop was held on 27 March 2008 at the Coastal Environment Centre, with 13 people attending.

The workshop commenced with a presentation to re-familiarise the community with the project, and to outline the issues, management objectives and management options for Pittwater Estuary. The community was then asked for their involvement in prioritising the management options, and selecting their preferred management options.

An A1 display listing each of the management objectives was displayed at the workshop location. Attendees were asked to indicate their top five (5) most important objectives for the estuary, by attaching orange “post-it” notes they had been given.

A set of A1 maps for each of the management categories (plan of management, water quality, sedimentation & erosion, ecology, waterway usage, foreshore usage, heritage, development) that illustrated the issues and described the management options relevant to the category were also displayed around the workshop location, as reproduced in Appendix C. Attendees were then invited to make comment upon the issues, via yellow “post-it” notes placed upon the maps. The attendees were again asked to indicate their top five (5) options they felt would be most effective/relevant to managing the Pittwater Estuary, with pink “post-it” notes. The group was advised that the options chosen did not have to relate to the objectives that they had chosen.

The A1 map displays remained at the Coastal Environment Centre for a number of weeks following the workshop to allow community members who had been unable to attend the workshop to make comment at an alternative time. In this way, the community was able to decisively and anonymously make comment upon the issues, objectives and options, as they felt appropriate to Pittwater Estuary. The outcomes of the workshop have been used to prioritise the management objectives, and to assist in the selection of a set of management options for which strategies and actions for the EMP have been developed.

2.3 Consultation with the Estuary Working Group

In June 2009, the Pittwater EWG was established to provide opportunities for community input into the development of the Pittwater Estuary Management Plan and to meet the statutory requirements expected by the Department of Environment, Climate Change and Water (DECCW). The EWG was developed as a sub-group of the Natural Environment Reference Group (and replaces the former Pittwater Land & Water Portfolio Committee in administering estuary management).

Members of this group are active in the community, some are involved with the Pittwater Natural Environment Trust, West Pittwater Community Association, Careel Bay Pittwater Protection Association or Church Point Residents Association.

A Pittwater EWG Meeting was held on Monday 17 August 2009 at the Avalon Community Centre to discuss the terms of reference and what Council would like to achieve from this Working Group. At this meeting members were given a background of processes involved in the development of the Pittwater Estuary Management Plan. The group was advised of the importance of their involvement in decision-making. This group will continue for the life of the management plan for input into grant funded projects as they arise.

2.4 Presentation of Draft EMP to Key Users

At the completion of the Draft Pittwater EMP a presentation was given to key users, during a Key Users Briefing on 27th January, 2010 at the Coastal Environment Centre. Key Users included Council officers (from various Council Departments), councillors, members of the EWG and other key community interest groups.

The presentation was aimed at providing an overview of the prior stages to and details of the EMP to key users, to accompany their review of the draft document. The presentation outlined the background to the EMP, including the prior stages of the EMP process including the Estuary Processes Study and Estuary Management Study. An overview of the strategies and actions contained within the draft EMP, the accompanying implementation tables, the estuary sub-plan maps, and remaining components of the EMP were also detailed in the presentation to key users.

Following the presentation, attendees were encouraged to raise questions regarding the content of the EMP, and a group discussion of answers, and comments upon the EMP draft was conducted. Notes were taken about discussions and comments, for inclusion in the revised draft EMP.

2.5 Workshop 2 – Public Exhibition of Draft EMP

A half day workshop is to be conducted to present the Draft EMP and Estuary Master Plan (including maps, master plan and sub plan figures) to the community, and will coincide with the public exhibition of the Draft EMP. The Draft EMP will remain on public exhibition for a period of four weeks (28 days).

A summary of the project and the estuary management planning process will be presented, along with a brief discussion of issues, objectives and initial list of management options, and then an outline of the management strategies and implementation will be given at the workshop. This will be supplemented with a handout (1-2 pages) which briefly describes the key aspects of the presentation.

In a similar style to Workshop 1, the community will be encouraged to inspect the maps and master plans, which will be on display on large posters around the workshop location. Comments made on the plan will be documented, to be included in the review of the Draft EMP and master plan.

3 SUMMARY OF ESTUARY PROCESSES

An Estuary Processes Study for Pittwater was completed in late 2002 (Lawson and Treloar, 2002). This chapter provides a summary of the Estuary Processes Study report. The report concluded that, "Overall, the Pittwater estuary is functioning reasonably well given the level of urbanisation that has occurred within the catchment and along the foreshores. The preservation of estuarine function is largely related to the wide entrance, good tidal flushing and the preservation of the National Park within the western portion of the catchment".

3.1 Overview

Pittwater estuary, located near the mouth of the Hawkesbury Nepean River system, is a drowned river valley of approximately 10 km in length and 1 km in width and has a maximum depth of the order of 22 m (refer Table 3-1). Pittwater connects to the southern side of Broken Bay, a major estuary junction that also drains Brisbane Water to the north and the Hawkesbury-Nepean River and its tributaries to the west. Pittwater has a catchment of 5100 ha, which extends from Mona Vale and Warriewood in the south to along the eastern ridge of the Peninsula leading to Palm Beach and then along the western ridge leading to West Head. The eastern parts of the catchment are heavily urbanised whilst the western parts are primarily National Park (Ku-ring-gai Chase). Key characteristics for the estuary are outlined in Table 3-1.

Complex interactions occur within the waterway. They are governed by the large entrance and the estuary's capacity for exchange with ocean water. The waterway is intensively used for recreational purposes. A schematic detail of key processes is shown as Figure 3-1.

The main findings of this investigation have been categorised under the following process headings:

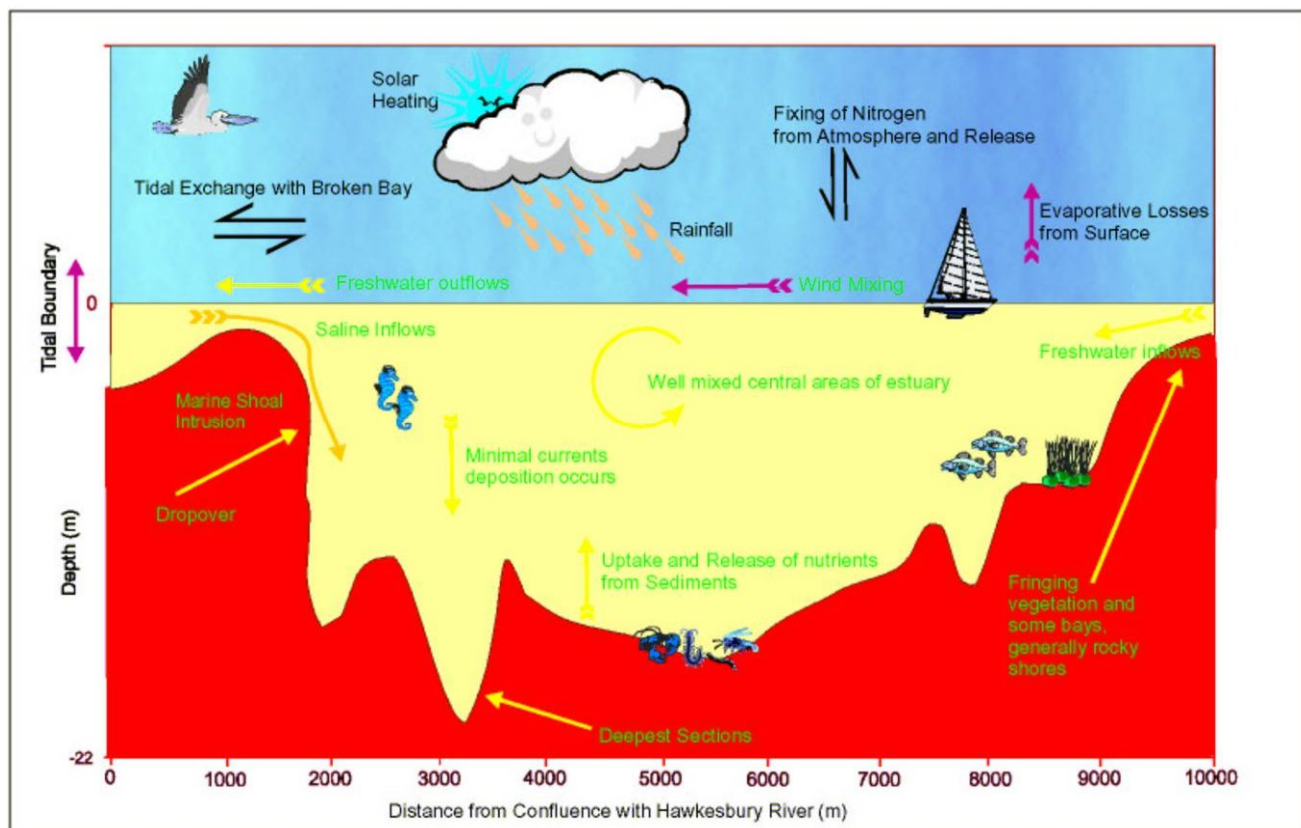
- hydraulic processes;
- water quality processes;
- sedimentary processes;
- ecological processes;
- human user processes.

Key aspects of these processes are described in the following sections.

Table 3-1 Key Characteristics of Pittwater*

Characteristic	Detail
Condition	Modified
Classification	Tide dominated
Catchment area	5100 ha
Intertidal flats	0.11 km ²
Saltmarsh/saltflat	0.02 km ²
Mangrove area	0.12 km ²
Seagrass area	1.934 km ²
Bedrock perimeter	0.67 km
Surface area	18,100,000 m ²
Estuary Volume (below 0 m AHD)	183,084,000 m ³
Maximum depth	22 m
Entrance width	1.1 km
Perimeter	52.05 km
Perimeter	52.05 km
Maximum length	10.94 km
Maximum width	2.06 km
Mean wave height	1.4 m
Mean wave period	7 sec
Maximum wave period	13.3 sec
Tidal range at Entrance	1 m (typical)
Tidal Range at southern estuary areas (Crystal Bay)	1 m (typical)
Tidal period	Semi Diurnal
Tidal prism	32 x 10 ⁶ m ³

(*base data from OzEstuaries Database, 2001 - updated where additional information available from the EPS)

**Figure 3-1 Schematic Representation of Key Estuarine Processes in Pittwater**

3.2 Hydraulic Processes

The principal hydraulic forcing function is the astronomical tide that propagates into Broken Bay and then to Brisbane Water, the Hawkesbury-Nepean River and Pittwater. Ocean wave energy is generally low except at the northern end. At the southern end of the estuary wind driven circulation is important for flushing and mixing, but is limited. Catchment flows to the estuary have only minor, local impacts on hydraulic processes and stratification is generally minimal.

3.3 Water Quality Processes

Water quality processes in Pittwater are governed by a wide variety of catchment, marine and estuarine processes. Overall, the estuary is dominated by tidal inflows and outflows, as well as inputs within the catchment from both diffuse and point sources. Data indicate that the water quality in wet weather conditions appears to be an issue for beaches and embayments, particularly from a human health perspective. Litter was commonly observed along the length of the foreshore. Major areas of litter include parts of the southern shore and Careel Bay.

3.4 Sediment and Erosion Processes

Key aspects of the sediment and erosion processes within Pittwater estuary include:

- The flood tide delta at the entrance to Pittwater is slowly prograding into the waterway;
- Sediment from the delta is moving onshore to the western foreshores, and is then transported south along the foreshore to accumulate on the barrier at the entrance to The Basin;
- A large number of the natural fluvial deltas around the southern shores of Pittwater have been dredged to improve navigability and deepwater frontages, resulting in the loss of a significant amount of wetlands. Given the incised nature of the estuary, wetlands can only form on low-lying fluvial deltas;
- It is expected that there has been a significant increase in the sediment load delivered to the estuary due to urbanisation of the catchment. However, significant progradation of fluvial delta fronts has not been observed during contemporary times. Nonetheless, fine sediments would be accumulating in the deeper parts of the estuary, as well as within areas that have been artificially deepened (e.g. Horseshoe Bay, Crystal Bay, Winji Jimmi Bay, Winnererremy Bay);
- Some reclamation of foreshores has occurred, mostly associated with the construction of marinas.

Assessment of the causes of erosion and their relative severity indicates that boat wash is one of the main causes of erosion within Pittwater. Other significant causes of foreshore erosion include wind-generated waves, high velocity discharges associated with stormwater outlets, and uncontrolled riparian access to the foreshore.

At the time of the Estuary Processes Study, 26 erosion locations were identified around Pittwater (L&T, 2002). Investigations by DECCW (Pers comm., Danny Wiecek, DECCW, 2008) suggested there were three (3) primary high priority erosion sites outside the National Park. More recently, investigations by Council have indicated that seven sites of high priority erosion are currently active along the shoreline (refer Section 4.2.2).

The literature consistently indicates recreational boating and marina operations as the primary cause of poor sediment quality in certain areas of Pittwater. These areas are located towards the south of Pittwater, where the majority of recreational boating, mooring and commercial boating activity occurs, and coincides with the area where tidal flushing is least effective at removing contaminants. In particular, the sediments in the south-east of the estuary are notably polluted. It should be realised that the quality of those sediments is a result of years of accumulation due to the persistence of these contaminants in the sediments, rather than an indication of current marina practices. Nonetheless, resuspension and interaction of these sediments with the overlying water column needs to be addressed, particularly given the potential for re-suspension by recreational vessels.

3.5 Ecological Processes

Processes identified in the Pittwater estuary that threaten its ecological sustainability are outlined below:

- historical clearing of vegetation and urban development in the surrounding catchment has resulted in elevated sediment loads to the estuary, causing detrimental impacts to estuarine biota such as seagrass. The areas between Mona Vale and Careel Bay have the greatest impact on sedimentation within Pittwater. Sedimentation has also influenced wetland habitats in Careel Bay, where it has caused mangroves to displace saltmarsh;
- stormwater runoff (point and diffuse sources) inputs also impact on water quality and estuarine ecosystems. Seagrass cover has declined within the study area, possibly reflecting an overall decline in water quality;
- the foreshore has been extensively modified throughout the estuary. Rock/concrete retaining walls now line most of the south-eastern shoreline. This area has a large number of wharves and other foreshore structures. Foreshore development has resulted in the loss of most of the original habitat and associated estuarine communities;
- the invasive macroalgae *Caulerpa taxifolia* has been recorded in Pittwater (Careel Bay), and has been declared a 'noxious marine vegetation' by the NSW Government. This species is highly invasive and can out-compete and displace seagrass communities. The actual impact on seagrass within Careel Bay is unknown, but based on case-studies in Europe, the impacts can be major if left unchecked; and
- recreational angling pressure is high in the embayment areas, as a consequence of Pittwater's close proximity to major urban centres. The impacts on fish stocks have not been quantified, but may be substantial.

3.6 Human Usage Interactions

The waterway supports a high level of water usage including a diverse range of passive recreational activities, a wide range of boating activities and a commercial and recreational fishery. Twenty five percent of the waterway is occupied by swing moorings, mostly concentrated along the eastern, southern and south-western shores. There is competition among user groups for the waterway resource and as a result, some conflict exists between these groups.

4 SUMMARY OF ESTUARY VALUES AND MANAGEMENT ISSUES

4.1 Estuary Values

The values of the Pittwater estuary are wide and varied, covering a range of aspects from natural heritage to regional economics. Values differ from one stakeholder / user to the next, and are dependent on the context of the estuary to each individual (including recreation, commerce, transportation, etc).

A brief summary of the main values of the estuary are provided below. These values have been identified through consultation with the community and through the scientific appraisal of the estuary (i.e., the Estuary Processes Study – refer Section 3).

4.1.1 Ecological Values

Pittwater estuary and surrounding lands contain a wide range of estuary habitats. These include rocky shores, mangroves, seagrasses, saltmarsh, sandy shoals (as both fluvial deltas and a flood tide marine shoal) and deep open water environments. Added to this is the extensive remnant eucalypt bushland along the western shoreline within Ku-ring-gai Chase National Park, which occupies more than 50% of the estuary's catchment.

Riparian and fringing urban bushland is present along the eastern foreshores of Pittwater, and contains remnants of the Endangered Ecological Communities of Pittwater Spotted Gum Forest, Littoral Rainforest and Coastal Saltmarsh. Dune habitat also fringes the estuary along Station Beach on the western side of the Barrenjoey tombolo.

Migratory wader bird habitat is present within the wetlands and shallow shoals of Careel Bay. Saltmarsh wetlands (Endangered Ecological Community) are locally rare, given the incised and drowned valley nature of the Hawkesbury-Nepean River system and those that exist are in decline. Over 70% of commercially harvested fish, crustacean and shellfish species spend at least part of their life cycle in an estuarine ecosystem.

Mapping of various estuarine habitats, including estuarine macrophytes, estuarine foreshores, subtidal rocky reefs, sand / mud flats, and human installations such as jetties and marinas, oyster leases and navigational aids, moorings and boat ramps was undertaken by West *et al.*, in 2009.

4.1.2 Scenic Values

The estuary holds intrinsic scenic values given that the vast majority of the western foreshore is within National Park and is densely vegetated with remnant bushland. Areas that hold specific scenic value include:

- Barrenjoey Head (and Barrenjoey lighthouse);
- Western foreshores and embayments, generally;
- Perry's Lookout; and
- West Head and Commodore Heights.

4.1.3 Heritage Values

4.1.3.1 *Aboriginal Heritage*

The Pittwater Council area contains numerous items of important Aboriginal historical, cultural and spiritual significance. Aboriginal archaeological sites themselves are merely the most identifiable physical signposts of Australia's ancient civilizations within the Pittwater estuary. The landscape itself is an artefact of traditional Aboriginal land management techniques. The continued development of these areas, over thousands of years, is an importance factor in Aboriginal culture and to many in the existing community.

There are a significant number of identified sites within Pittwater's estuary (excluding National Park land) including more than 35 shell middens, numerous rock shelters, engravings and a burial site (refer to the Aboriginal Heritage Office Pittwater Report 2008). Items which have been identified are kept in a separate confidential list held by the NSW Aboriginal Heritage Office. There are likely to be many more sites that have yet to be identified and, notwithstanding significant modification and development, the estuarine area still holds great potential for the disclosure of future archaeological evidence and greater conservation of Aboriginal sites.

There exists an opportunity for Pittwater Council to ensure that the Aboriginal heritage potential of the estuary is further investigated and conserved where new developments and/or activities are proposed in:

- areas of bushland, recreation, open space;
- areas containing sandstone outcrops, and areas adjacent to known sites;
- land with little previous development;
- waterfronts and foreshore areas;
- parks and open spaces; or
- where disturbance has been minimal.

Residents and community members should be educated as to the significance of all Aboriginal sites and places, whether identified or not, and that they are legally protected under the *NSW National Parks and Wildlife Act 1974*. It is an offence to destroy, damage or deface Aboriginal sites without the prior consent of the National Parks Service Director-General. Other relevant legislation includes the *NSW Environmental Planning and Assessment Act 1979*, *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*, *Commonwealth Aboriginal and Torres Strait Islander (Heritage Protection) Act 1984*, *Commonwealth Australian Heritage Commission Act 1975*, *NSW Heritage Act 1977* and the *NSW Local Government Act 1993*.

4.1.3.2 *Non-Indigenous Heritage*

European heritage of Pittwater dates back to 1788. Much of the early settlement of the area occurred along the western shoreline, so these areas have intrinsic heritage value. Cottages at Currawong and some of the western foreshore wharves are icons of our past activities in this area. Currawong Beach cottages are listed on the NSW State heritage register. Other areas of significant non-indigenous heritage include:

- Lovett Bay;
- Parts of Careel Bay;
- Parts of Newport;
- Bayview baths; and
- Coasters Retreat and The Basin.

Heritage items within the Pittwater Local Government Area (LGA) are scheduled in the Pittwater Local Environmental Plan 1993 (Pittwater LEP). The Pittwater LEP already contains a large number (130) of European heritage items around Pittwater, including items such as ocean rock pools, stone bath remnants, timber jetties, wharves and wharf remnants, drainage and bridge structures, midget submarines and tidal swimming pools. However, the local historical societies indicate the potential for many more sites to be included. Council advises that should members of the community be aware of items that they believe should be added to the schedule, they should advise Council in writing.

Coasters Retreat and the Basin located on the western shores of the estuary are also highly valued for their heritage and scenic values. These areas have a long history of preservation due to their natural and scenic beauty and provision of a sheltered anchorage. The areas have been highly popular with visiting boats, excursionists and holidaymakers from the 1860s to the present day (pers. comm., Susan Gould, Coasters Retreat).

For more information regarding heritage listings within the Pittwater LGA, refer to the following Council link:

http://www.pittwater.nsw.gov.au/building_and_development/heritage/heritage_listings

4.1.4 Recreational Values

The Pittwater estuary is a prized recreational resource. Its deep protected waters are very attractive to the boating community, while its proximity makes it popular with not only the northern beaches community, but the entire Sydney Basin population. It is reported that there are more boats in Pittwater than in Sydney Harbour, and it is the most intensively used waterway in NSW.

The attraction of Pittwater is enhanced by its generally good water quality (particularly in comparison to most other Sydney waterways). This results in numerous primary and secondary contact recreational pursuits, including swimming, sailing, kayaking, fishing, sailboarding, kite-surfing, water skiing and boat and shore fishing.

There are a number of public baths located along the shoreline of Pittwater, including Catherine Park, Bayview Baths Reserve, Taylor's Point Reserve and Paradise Beach. Whilst the water quality at these locations is suitable for swimming most of the time, there are periods (mostly following rainfall events) when the risk of waterborne disease is higher, due primarily to leakage from the reticulated sewerage system and runoff of (dog) faeces from the catchment.

The foreshores around Pittwater are also used for numerous recreational pursuits, including walking / jogging, dog exercise, birdwatching, scenic enjoyment / nature appreciation and picnicking.

4.1.5 Economic Values

There are numerous economic values of Pittwater, which are important to a range of stakeholders, ranging from local bait and tackle shops to commercial fishers and cruise operators. Also of significance from an economic perspective are the various commercial marinas located within the Pittwater estuary and the waterway infrastructure that is used by recreational and commercial operators.

A detailed economic analysis of the values of Pittwater estuary has not been carried out at this stage. Nonetheless, it is regarded that the estuary supports economically significant and sustainable industries, including marina operations, boating chandleries (sales, maintenance, supplies etc), and fishing. There are also a range of other industries that would indirectly benefit from the estuary, including hotels, restaurants and other tourist-related enterprises.

With regards to commercial fishers, the Hawkesbury River (which includes Pittwater) has provided, on average, 420 tonnes of catch per year, at an average value of approximately \$1.8 million. The bulk of the catch generally comprises Sea Mullet, School Prawns and Squid.

Overall, most economic values are derived from the fact that the system is a relatively clean, healthy and biologically active environment, which in Sydney terms, is quite rare. Admittedly there are still problems with pollution following rainfall, and the waterway is intensively used by boats and other watercraft. However, given its scenic beauty, the estuary is still attractive and people want to be near it, look at it, or be on it. For these reasons, recreational visitation and use of the waterway is extremely high with significant “flow on” effects for the local and regional economies.

NSW Fisheries has carried out a recreational fishing survey of NSW (NSW Fisheries, 2002), which indicates that there are almost half a million recreational fishers in Sydney, many of which would utilise Pittwater from time to time. Total expenditure of Sydney recreational fishers could be in the order of \$150 - \$250 million per year.

4.1.6 Educational Values

The Pittwater estuary provides excellent opportunities to study and appreciate numerous aspects of the natural and modified environment, given the local diversity in habitats, its response to human influences, and its general proximity to the populous. In particular, the National Park along the western foreshores of the estuary provides a good example of pre-European and early-European conditions, which contrasts with the eastern and southern foreshores, which is mostly heavily developed.

School groups in particular benefit from the educational values of the estuary, as the diversity of habitats and examples of human impacts all occur within a relatively small geographical space (especially at Careel Bay). Environmental education programs have been conducted in the estuary for over 10 years by Council's Coastal Environment Centre (CEC). Guided walks and field excursions conducted by the CEC help to promote the conservation of fragile estuarine habitats as well as raising awareness of the many threatened species of flora and fauna that are still found around the Pittwater estuary.

4.2 Management Issues

Management issues were identified for the original Estuary Management Study during a focus meeting on 6 February 2003 with the Study Team, Council and the then Department of Infrastructure, Planning and Natural Resources (the role of which is now played by DECCW with respect to Estuary Management Plans) and also, a community workshop held on 23 August 2003. Additional community consultation since that period, as discussed in Chapter 2, has assisted to confirm the management issues. A summary of issues requiring future management and accompanying issues maps are given herein.

4.2.1 Water Quality

Water quality issues have been linked to marinas and yacht clubs, boat discharges, catchment runoff and on-site sewage treatment systems runoff. These may affect both estuarine ecosystem health and human health (as regards bathing requirements). An illustration of the water quality issues and their location / source in Pittwater is given in Figure C-2, Appendix C.

Marinas and Yacht clubs

Marinas and yacht clubs represent notable sources of pollutants to the estuary. The only EPA pollutant licences in Pittwater are held by yacht clubs and marinas, and cover activities such as boat cleaning, antifouling, re-painting, boat repairs, vessel construction, mooring and boat storage.

Yacht clubs and marinas also provide services such as refuelling and sewage pump-out, which represent a risk of pollution to the environment if not conducted properly.

Boat Discharges

Boats, generally, have the potential to pollute the water, particularly older boats that do not have holding tank facilities. For these older boats, all sanitary discharges are directed into the waterway untreated. Pittwater estuary is essentially a 'No Discharge' zone, meaning that waste cannot be released from any boat. Unfortunately, it is very difficult to enforce this policy, and it is expected that boats do discharge within the estuary. Boat discharges can be particularly problematic in areas where tidal flushing is not great. Within Pittwater, this includes all of the southern section of the estuary as well as some of the fringing sheltered bays, including The Basin and Coasters Retreat.

Emissions from boat engines are also a source of pollutants into the waterway. Older style two-stroke motors have been estimated to lose up to 30% of the fuel/oil mixture directly into the water (although newer two-stroke motors are believed to be less polluting). Fuel emissions from all outboard motors (two-stroke, four-stroke etc) and jet skis contain volatile organic carbon compounds which contribute to air pollution and are known carcinogens. For example, it is estimated that 5 % of benzene (a known carcinogen) emissions nationally are sourced from outboard marine engines and jet skis.

Catchment Runoff

A significant source of pollutants to the Pittwater estuary is associated with runoff from the catchment, particularly the heavily urbanised sections of the catchment located to the east and south of the estuary (refer Pittwater Estuary Processes Study, L&T, 2002). Urban runoff (from roads and pavements) can deliver a range of pollutants to the estuary including sediment, nutrients, metals,

hydrocarbons, industrial compounds and litter. The industrial / commercial region of Mona Vale represents a potentially significant source of pollutants to Pittwater, where runoff is not controlled or treated prior to entering the stormwater network.

Within the wider expanses of the Pittwater estuary, water is relatively well flushed by the tides. However, close to the shores and within the southern bays of the estuary (eg Winnererremy Bay), poor tidal exchange means that inputs from the catchment cannot be readily assimilated, and elevated concentrations of pollutants generally result. This is more pronounced immediately following rainfall events when runoff from the catchment is discharged into these fringing estuarine receiving waters.

Specific sites within the Pittwater catchment may also be providing excessive pollutants to the waterway, either through direct runoff or via leachate through the groundwater system. Examples of possible locations where this might be happening include golf courses and playing grounds, and former landfill sites (such as adjacent to Careel Bay wetlands).

The use of groundwater for irrigation and other nonpotable purposes can be problematic as a result of water quality impacts from adjacent land uses as well as potential environmental impacts that may be caused by the extraction of the groundwater itself, particularly upon groundwater dependent ecosystems.

It is believed that groundwater is increasingly being tapped in order to balance surface water deficiencies, particularly for irrigation purposes. The use of this resource will need to be properly monitored and controlled to avoid contamination or over-exploitation. There are a number of NSW legislation and policies governing the use and extraction of groundwater (refer DECCW).

On-site / septic systems

While the majority of the urban area around Pittwater is serviced by a reticulated sewerage system (which then treats effluent and discharges to the ocean via a deep ocean outfall), some of the more remote settlements still rely on on-site or septic systems for sewage treatment and disposal. In particular, development on Scotland Island and along the western foreshores remains serviced by these non-reticulated systems.

On-site and septic systems mostly involve discharge of effluent into the soil profile, with infiltration to the groundwater. In areas of relatively low permeability soils, the systems can become inefficient, resulting in surface runoff of effluent. In more permeable soils, the groundwater can become contaminated with nutrients, organics and viruses, which can be harmful to humans. Water quality around Scotland Island is reportedly quite poor immediately following rainfall due to the release of effluent from the on-site systems.

Public Bathing Requirements

There are a number of designated bathing areas within the Pittwater estuary, including baths and sandy beaches. As these sites are mostly located adjacent to urbanised foreshore areas, water quality can be poor following rainfall events, characterised by high levels of bacteria (an indicator of viruses and pathogens). The NSW Government's Beachwatch program confirms that faecal coliform and Enterococci densities generally increased with increasing rainfall. Enterococci levels occasionally exceed the median ANZECC guideline limit after ten millimetres of rain or more, and

often exceeding the median guideline limit after 20 millimetres of rain or more in the previous 24 hours.

The poor water quality is a result of contaminant runoff from the catchment (eg dog faeces) and contamination of the stormwater system by sewage (from either illegal connections to the stormwater or exfiltration from the sewerage system).

4.2.2 Sedimentation and Erosion

Sedimentation issues are discussed in relation to shoaling, siltation of former areas of dredging, and sediments delivered in catchment runoff. Foreshore erosion is due primarily to boat wash, wind waves, stormwater runoff and trampling by foreshore users. An illustration of the sedimentation and erosion issues in Pittwater is given as part of Figure C-4, Appendix C.

Shoaling

Shoaling refers to the migration and accumulation of coarser-grained sediment. There are a few locations around Pittwater where shoaling is occurring, including The Basin and Bayview. At The Basin, sediment is transported southward along the shoreline due to a combination of swell waves and wind waves. The sand has prograded into the mouth of The Basin, which now forms a considerable barrier to navigation. At Bayview, wind waves impact on the reclaimed Rowlands Reserve, pushing sand eastward towards the main Winnererremy Bay navigation channel. An elongated sand spit has formed with material that has eroded from the northern shoreline of the Reserve.

It is unclear whether the marine flood tide shoal at the entrance of Pittwater is migrating landward or not. Anecdotal reports of shallowing at Mackerel Beach suggest that there is some transport of material around the landward edge of the shoal (even though there might not be a net change over the long term). Any further migration of the shoal towards Mackerel Beach would significantly limit navigability in this area.

A map of routes frequently used by boat traffic and also by public ferries has been included in the strategy maps for Waterway use, Section 8.4.

Siltation in Former Dredged Areas

There have been a number of areas dredged around the foreshores of Pittwater, with the aim of improving navigability and deepwater access to foreshore properties. The former dredging removed natural fluvial deposits around the periphery of the drowned ancient river valleys. General catchment runoff has resulted in the natural infilling of these dredged areas as the estuary has a tendency to return to its former geomorphically 'stable' condition, particularly within McCarrs Creek (lower reaches of Cicada Glen Creek), Winnererremy Bay, Winji Jimmi Bay and Crystal Bay. Concern has been expressed by local community members that these areas need to be re-dredged in order to maintain safe navigable access to the deep draught vessels that now occupy these sections of the waterway.

It is likely that the rate of siltation of these waterways was exacerbated during the period of widespread urban development within the catchment. However, it is possible that the reduced amount of development, along with stricter controls on sediment control at development sites, has slowed the infilling of these bays in recent years.

Catchment Runoff

Sediment from within the catchment is disturbed by rainfall and runoff processes, and is transported into the estuary during storm events. Coarser-grained sediment (i.e. sands) are deposited within the estuary relatively close to the discharge locations (usually stormwater outlets), generally in the form of an alluvial fan. Finer-grained sediment (i.e. silts and clays) stay in suspension for longer and are transported into the middle of Pittwater before settling in the deeper mud basin of the estuary.

Catchment runoff has caused exacerbated siltation at Browns Bay, McCarrs Creek, Winnererremy Bay, Winji Jimmi Bay, Crystal Bay, Salt Pan Cove, Careel Bay and around Scotland Island. These areas are mostly backwater areas that are naturally susceptible to siltation, however, urbanisation of the catchment has exacerbated the rate of sediment runoff in contemporary times.

Within Careel Bay, the siltation has caused notable change to the delicate mangrove / saltmarsh balance within the wetlands that occupy the fluvial delta. Seaward progradation of the delta has been shadowed by expansion of the mangroves, while the existing saltmarsh areas are becoming invaded by juvenile mangroves (refer Pittwater Estuary Processes Study, L&T 2002). Despite the expansion of mangroves, on an estuary-wide basis, the area of mangroves has been reduced due to dredging of fluvial deltas elsewhere (eg McCarrs Creek).

Sediment runoff from Scotland Island is a particular concern as the roadways on the island are all unsealed. Considerable sedimentation is evident around the island, while local turbidity plumes also occur following storm events.

Contaminated Sediments

Some of the bed sediments within Pittwater contain elevated concentrations of arsenic, tributyltin (TBT), lead, zinc, copper, chromium and mercury. These sediments are generally located in the southern sections of the estuary, particularly around the marina precinct. Recreational boating and marina operations have historically been identified as the primary sources of pollutants within the sediments of Pittwater. However, the sediments in this area have accumulated over long timescales, and as such, can still reflect historical pollutant input conditions.

Advancements in boat and marina management over recent years has minimised the amount of pollutants that now enter the water. Nonetheless, disturbance of the sediments may re-release some of the contaminants into the water, which could then have wider implications to the estuarine ecology of Pittwater. TBT is particularly toxic to aquatic species. Concentrations of TBT around the slipways and marinas of Pittwater are considered to be highly toxic. Also, other contaminants in the sediments (eg metals) can migrate along the food chain through bioaccumulation.

Not all contaminants within the sediments are the result of boating. Some metals, including manganese and nickel, are elevated due to general urbanisation of the catchment, although these contaminants are not generally above guideline values.

A contaminant model covering complex estuaries is currently in development by Associate Professor Gavin Birch of the School of Geosciences at the University of Sydney. This research should be further investigated as it may assist in determining the location and movement of toxic sediments in the estuarine environment. Professor Birch is developing cheap but reliable indicators for particle-

bound toxicants which may also be useful in determining stormwater borne metal loads to the Pittwater estuary.

Foreshore Erosion

Foreshore erosion in Pittwater has typically been found to result from boat wash, wind-generated waves, high velocity discharges from stormwater outlets and uncontrolled riparian access to the foreshore. Foreshore erosion was identified at 26 locations around Pittwater during the EPS (Lawson and Treloar, 2002).

DECCW conducted a site assessment of all public land accessible by foot along the foreshore of Pittwater Estuary in December 2008. The key sites of concern were:

- Two locations within McCarrs Creek Reserve, one fronting Cicada Glen Creek and one fronting McCarrs Creek (and which is currently subject of an application for funding for rehabilitation under the Estuary Program).
- Erosion at Rowland Reserve Foreshore adjoining Bayview Park, which, following foreshore stabilisation work in 2009, no longer presents an erosion issue.

More recent investigations by Council have determined the following sites of erosion to be of concern, in addition to the two sites at McCarrs Creek noted above:

- Yachtsmans Paradise Reserve foreshore in Newport;
- Station Beach foreshore adjoining Palm Beach Golf Course;
- Careel Bay, at the fill batters adjoining Careel Bay Playing Fields;
- Along the northern, eastern and southern shorelines of Crystal Bay in Newport.

The high priority erosion sites are illustrated in Figure 4-1, along with the medium and low priority sites listed in the EPS (L&T, 2002).

It should be noted that the erosion sites listed above were assessed by DECCW in 2008. At the time of inspection that these areas were noted to have either stabilised or to have been natural fluctuations (pers.comm., Daniel Wiecek, DECCW). However, Council has recently confirmed that, while natural fluctuations may have occurred, erosion issues remain at these sites.

Other sites of lower priority erosion noted during the EPS (L&T, 2002) located within (and under the management of) Ku-ring-gai Chase National Park are located at Great Mackerel Beach, Currawong Beach and The Basin. Work has been completed at the Basin, but requires ongoing monitoring.

4.2.3 Ecology

Foreshore vegetation

Foreshore vegetation is extensive along the western shoreline, however, it is narrow to non-existent along the eastern and southern shorelines of Pittwater. Given the steep and incised nature of the estuary, true riparian vegetation is rare, and predominantly terrestrial eucalypts extend right to the water's edge. The extent of riparian vegetation, along with core bushland areas (outside the National Park), are shown within Figure C-5, Appendix C.

The western foreshore areas, along with some of the core bushland areas within the urbanised parts of the catchment contain the Endangered Ecological Community Pittwater Spotted Gum Forest. Some of this community type occurs around the small pockets of development along the western foreshores. Recent changes to state legislation and policy regarding bushfire hazard management places significant areas of these vegetation types at a greater risk of being cleared.

It is essential that the extents of all Endangered Ecological Communities are accurately mapped in order to plan for and manage the long term survival of these valuable natural resources. To this end it will also be important to ensure that appropriate information and assistance is provided to landowners where an Endangered Ecological Community occurs on their properties.

Generally, vegetation clearing within the catchment represents a potential degrading influence on the values of the estuary as a habitat resource. Aspects and recommendations of the floodplain risk management studies and plans for tributaries to the Pittwater Estuary (e.g. Mona Vale Creek, Careel Creek) are consistent with addressing management issues relating to vegetation along tributaries, such as outlined above. Greater details of the environmental actions associated with Floodplain risk management of Pittwater Catchment are outlined in Appendix D.

Wetlands

The largest areas of mangroves in Pittwater occur in Careel Bay and McCarrs Creek, while smaller areas are also located at the head of several embayments. The extent of existing mangroves and saltmarsh habitats is illustrated in Figure C-5, Appendix C. At Careel Bay, the area of mangroves has nearly trebled over the past 50 years (refer Pittwater Estuary Processes Study, L&T 2002). This has coincided with a substantial decline in saltmarshes (due to encroachment by mangroves, land reclamation and inappropriate access and recreational activities). Both mangroves and saltmarsh are valuable habitats, and a balance between the two needs to be maintained in order to maximise local biodiversity.

McCarrs Creek was formerly an extensive wetland. However, following rutile mining, dredging and land reclamation, only a narrow fringe of mangroves remain in this area. There has also been a substantial loss of mangroves from the Bayview area (Winnererremy Bay) as a result of dredging and reclamation undertaken during the 1960's and 70's. Only small isolated mangrove stands occur in the south-eastern section of Pittwater. Some of these stands have experienced burial of mangrove peg roots by urban sediments.

Saltmarsh, (both natural and recreated) is still found at Winnererremy Bay. Saltmarsh re-colonisation work undertaken by Council, with the assistance of community volunteers, has been slow to establish due mainly to the susceptibility of saltmarsh to damage and disturbance, particularly as a result of uncontrolled public access and inappropriate recreational activities.

The steeply incised foreshores and lack of extensive fluvial deltas along the western foreshores of Pittwater mean that there are few mangroves and areas of coastal saltmarsh in this part of the estuary, as the steep foreshores provide limited area for colonisation by these species, except for some areas within localised embayments.

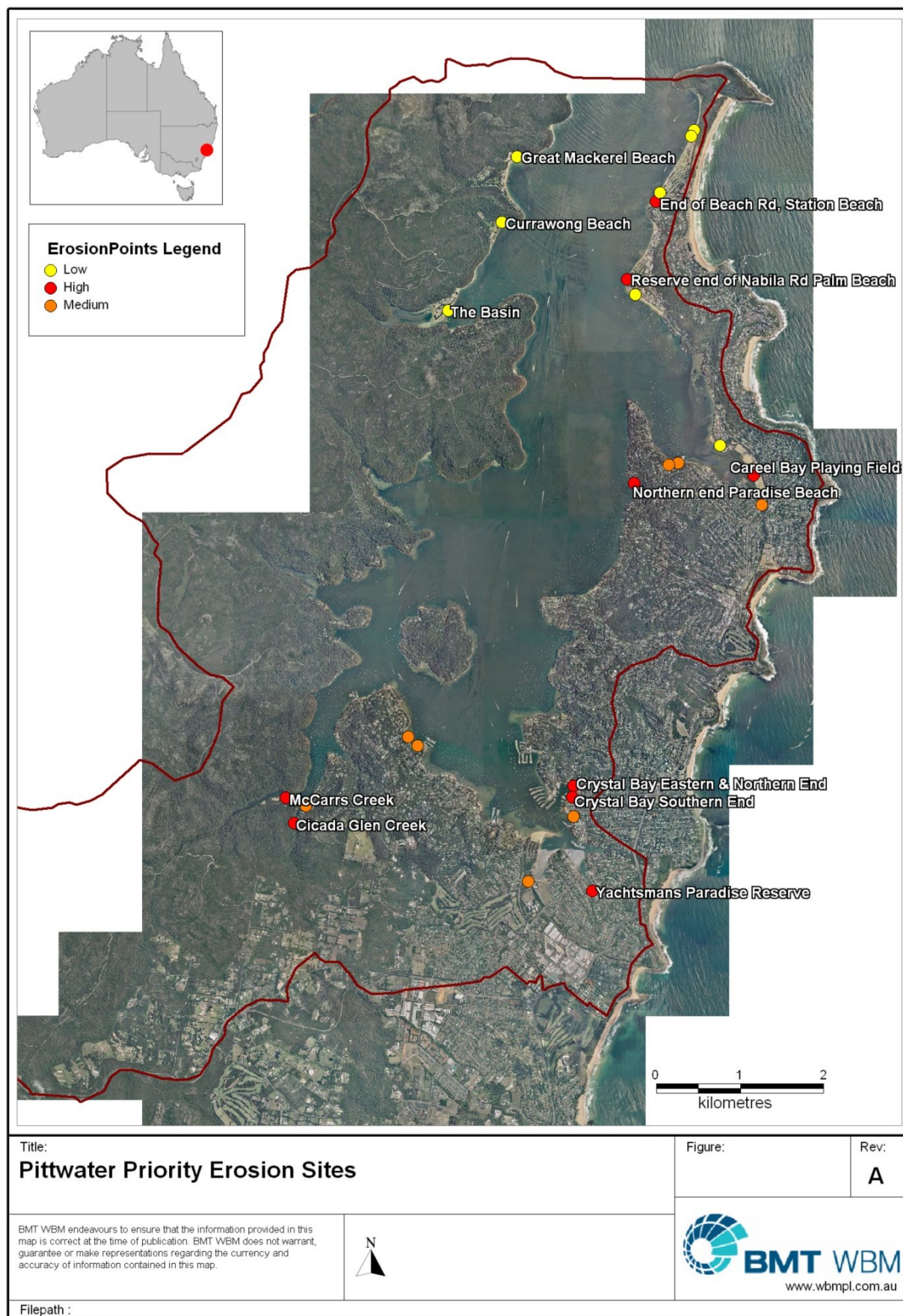


Figure 4-1 Locations of Priority Foreshore Erosion Sites

Seagrasses

Three species of seagrass occur within Pittwater, including the sensitive *Posidonia australis* (strapweed). *Posidonia australis* is often found growing in association with *Zostera capricorni* (eelgrass), but at slightly greater water depths. *Halophila ovalis* (paddleweed) is commonly found in mixed beds with both *Zostera capricorni* and *Posidonia australis*. *Posidonia australis* is listed as an endangered population on Part 7A of the *Fisheries Management Act 1994*.

The most extensive areas of seagrass are located in Careel Bay and in front of Station Beach, although narrow beds of seagrass (mostly *Posidonia* and *Zostera*) have been recorded around Clareville, Bayview, Church Point, Scotland Island, Elvina / Lovetts Bay and the north west shoreline of Pittwater (adjacent to and south of Great Mackerel Beach). Existing seagrass extents are illustrated in Figure C-5, Appendix C. The NSW Department of Industry and Investment (DII) Fisheries has recently completed another estuarine habitat mapping exercise of the Lower Hawkesbury River, including Pittwater (refer West *et al.*, 2009).

Moorings within seagrass beds is a recognised problem, as the mooring chains can physically remove seagrass shoots within a radius of the mooring anchor. Trials with seagrass friendly moorings have recently begun, as part of the HNCMA's "bringing back the fish" project (funded through NHT programs). The trial has involved the replacement of 32 moorings with seagrass friendly moorings (during 2008-9). The moorings will be monitored for 3 years, to assess the environmental benefit in terms of the recovery of seagrass, the acceptability of the moorings to users and the capacity of the moorings to withstand various weather conditions (pers. comm. Ruth Williams, HNCMA, 2009).

Some community members are also concerned about commercial fishing over seagrass beds. General assessments by NSW Fisheries have shown that most commercial practices are not harmful to seagrasses providing they are conducted correctly and the seagrass meadows are free from infestations of pest species such as *Caulerpa taxifolia*. In this regard, monitoring of commercial fishing activities, especially haul netting, in Pittwater should be undertaken by DII (Fisheries) where possible, to ensure that commercial fishing practices do not cause long term damage to native seagrass meadows or the depletion of populations of target and by-catch species in the estuary.

Fisheries

In May 2001, the NSW Government bought out all commercial fishing licences at numerous estuaries along the NSW coast to create a series of recreational fishing havens. Pittwater was not one of these estuaries, so commercial fishing is still permitted within the estuary. The impact of commercial fishing on local fish stock is unknown. However, given its high recreational usage, it is possible that recreational fishing could have an equal or even a greater impact than commercial fishing.

Pittwater, with its protected waters and close proximity to the open ocean, would act as a nursery and feeding ground for many different marine species. It has been estimated that 70% of all fish caught commercially in NSW spend some of their life cycle within estuaries such as Pittwater.

Fauna and Human Disturbance

The fauna of Pittwater, particularly shorebirds and wading birds including migratory species could be disturbed by the physical presence of human activities within and around the estuaries, or by the

noise associated with these activities. Of particular concern are power boats (especially large-engine ski boats) and Personal Watercraft (PWC).

Unleashed dogs have also been identified as an issue along the foreshores, particularly disturbing shorebird populations. A number of off-leash dog exercising areas are located around the estuary. A trial dog swimming area was established at Careel Bay within the 7(a1) Environment Protection Zone. Council resolved at its meeting of 12 May 2003 to stop the trial and not include the waterway within the designated Careel Bay Unleashed Dog Exercise Area (UDEA) due to its importance as habitat for migratory wader birds. In addition to the other dog swimming areas available within Pittwater, an alternative dog swimming area is now being investigated north of Bilgola Bends.

Given the high rate of dog ownership in Pittwater, mitigating the impacts of unleashed dog exercise areas (particularly on adjoining valuable environmental areas) as well as catering for the needs of dogs and their owners is an important issue for Council.

Pittwater is currently one of the few remaining known habitats of the Bush Stone-curlew (an Endangered Species) in the Sydney Region. Bush Stone-curlews rely upon estuarine habitats, particularly the intertidal zone of saltmarshes and mangrove fringes, for feeding, roosting and breeding.

These habitats are generally in decline or threatened by the impact of development within the Sydney Metropolitan Region. In the Pittwater estuary, where Bush Stone-curlew habitat interfaces with private property, appropriate development controls may be required to maintain sufficient areas of suitable habitat for the species and to specify adequate building setbacks from Bush Stone-curlew habitat, saltmarshes and other estuarine vegetation.

Pest and Exotic Species:

Pittwater is one of a number of estuaries in NSW that contains the noxious macroalgae *Caulerpa taxifolia* (Caulerpa). Known outbreaks of Caulerpa are illustrated in Figure C-5, Appendix C. Caulerpa spreads rapidly by regrowth from dislodged fronds, and has the potential to impact native seagrasses (by invasion and encroachments), and thereby affect fish stocks. Caulerpa can grow from just fragments of one plant and, due to its long fronds and creepers, is easily entangled on anchors, fishing and diving equipment and other recreational waterway gear and transported to new locations. Swing moorings have also been implicated as a vector in the fragmentation and spread of Caulerpa. Once established, Caulerpa is very difficult to remove.

DII (Fisheries) is actively managing the outbreaks of Caulerpa in NSW through its Caulerpa Control Plan. Although a number of techniques have been trialled (including smothering with jute matting), the most effective approach at present is smothering the Caulerpa beds with about 10 – 15cm of salt. The salt dissolves in the water within about 2 – 3 hours, however, this is long enough for the Caulerpa to exhibit osmotic stress and die-off over the following fortnight. Seagrasses also dieback from osmotic stress, however, they recover relatively quickly (within 6 – 8 weeks), although more recent trials suggest *Posidonia australis* may be more sensitive to osmotic stress than first thought. The Caulerpa beds will generally slowly re-establish over the months following treatment, meaning that on-going management is required, such as yearly treatment at Careel Bay by DII (Fisheries). However, treatment with salt is said to be most effective on small infestations only. Large outbreaks are very difficult to destroy.

The Caulerpa beds slowly re-establish over the months following treatment (particularly in summer when growth is maximised), meaning that on-going management of the pest species will be required. Salt treatment at Careel Bay has typically been carried out annually by DII (Fisheries) however, the infestation has not been eradicated and has in fact increased in area. There are now thought to be numerous outbreaks throughout the estuary (pers. comm., NSW Maritime, 2009).

DII (Fisheries) control program for Caulerpa also includes providing signage at estuaries with major outbreaks, providing information to recreational fishers, boaters and other waterway users about minimising the spread of Caulerpa, restricting the use of fishing nets in existing infested areas, and removing the sale of Caulerpa from the aquarium trade. Research and monitoring to better understand the effect of Caulerpa on native seagrasses and fish stocks, and new methods of eradication are also being undertaken.

Other exotic species also threaten the value of the estuarine environment. These mostly include terrestrial plants, such as lantana and garden escapees, which can overrun native species and restrict habitat diversity.

4.2.4 Heritage

Aboriginal Heritage

While it has been noted that there are already a number of identified Aboriginal heritage sites (both at Council and on National Parks lands), the primary issue of concern is that the record of identified sites may not yet be complete or accurate. As noted previously, there are likely to be many more sites that have yet to be identified and, notwithstanding significant modification and development, the estuarine area still holds great potential for the disclosure of future archaeological evidence and greater conservation of Aboriginal sites.

Items which have been identified in the Pittwater Council area are kept in a separate confidential list held by the NSW Aboriginal Heritage Office, and Council is able to refer to this list when reviewing development applications, undertaking maintenance work and so on. All Aboriginal places and Aboriginal objects are protected under the *National Parks and Wildlife Act 1974*, and it is an offence to destroy, damage or deface them without the prior consent of the Director-General of DECCW.

As many of the places and items of Aboriginal heritage may have special values or secret/sacred significance to Aboriginal people, information about places and items of Aboriginal heritage should never be made public without the consent and guidance of the appropriate Aboriginal communities.

Nevertheless, there is a real need for increased public recognition and understanding of the importance of the Pittwater Estuary to past, present and future Aboriginal communities. Public education, through a variety of media, will be a key element in the management of the Aboriginal landscape of the Pittwater estuary.

Non-indigenous Heritage

There are a number of sites of European-based heritage around Pittwater, mostly associated with early colonisation of the area. While it is worth noting that Council already has a large number of items listed (130 listed in the Pittwater LEP 1993, at last count), as well as heritage controls (e.g. in Pittwater 21 DCP), the main issue of concern for heritage is that redevelopment of the area poses a

risk particularly to those sites that have not been formally recognised or listed within Council planning instruments. A range of non-indigenous sites which have been identified are shown in Figure C-8, Appendix C, including archaeological items, built items, heritage conservation areas and sites of scenic and landscape value.

4.2.5 Future Development

Greenfield development

Most of the non-urban land within Pittwater is designated National Park. The main area of potential greenfield development is at Ingleside. The Department of Planning (DP) has included the land as a part of the subregional planning strategy under the Sydney Metropolitan Strategy. Council has recently been directed by the NSW Government to investigate the land for future land release. Whilst it is currently not known when an urban land release in the Ingleside area is likely to occur, interest from land owners continues to mount as to when the State Government is likely to undertake the necessary planning and provision of utilities that will enable further subdivision and residential development to proceed. Zoning and issues related to development are illustrated within Figure C-9, Appendix C.

Infill development / redevelopment

Urban development within the Pittwater estuary has essentially occupied all available areas. Therefore, future development within the catchment will be limited to either redevelopment of existing sites or small scale infill development.

Redevelopment is also the only future development potential for the western foreshore settlements and Scotland Island. However, for these latter two areas, substantial redevelopment is likely to increase the population of the communities, and therefore increase the demand on services and infrastructure (at present, many of the properties are weekenders or holiday shacks). As there is no reticulated water or sewerage, an increase in resident population is likely to increase the amount of effluent being discharged through on-site systems, and thus is likely to increase pollutant loads to the estuary during periods of heavy rainfall.

An increase in offshore community population is also likely to exacerbate the existing problems associated with commuter access and storage of private vessels at onshore transportation nodes (eg Church Point, Pittwater Park), as well as offshore community parking at these locations.

Aspects and recommendations of the floodplain risk management studies and plans for tributaries to the Pittwater Estuary (e.g. Mona Vale Creek, Careel Creek) are consistent with addressing management issues relating to infill and redevelopment outlined above, such as stormwater management. Greater details of the environmental actions associated with Floodplain Risk Management of Pittwater Catchment are outlined in Appendix D.

4.2.6 Waterway Usage

Waterway capacity

Moorings within Pittwater were capped in 1994 to a limit of 3641. A breakdown of the different areas within Pittwater of the mooring cap is contained in Pittwater 21 DCP. It is understood that there is a

waiting list for moorings in Pittwater totalling about 266 (pers. comm. Steven Black, NSW Maritime). Council works in conjunction with NSW Maritime to administer the mooring cap. NSW Maritime is responsible for issuing mooring leases and locating moorings within the waterway. Following the gazettal of State Environmental Planning Policy (Infrastructure) 2007, NSW Maritime mooring installations are no longer subject to the development application and assessment requirements of Pittwater LEP (1993) and Pittwater 21 DCP.

In recent years, due to private jetty construction and commercial marina redevelopment there has been a significant increase in wet berth numbers. NSW Maritime has interpreted the mooring number cap as applying only to swing mooring numbers and has therefore not relinquished swing moorings as new wet berths have been created. Consequently, there has been a net increase in the number of vessels moored in Pittwater.

The Pittwater waterway is used for a range of water-based activities, including recreational, commercial and commuter uses. It has been suggested by several members of the community that the boating capacity of Pittwater has been reached. This is evident based on the increasing number of conflicts between the different user types, and the concerns for public safety, particularly at the onshore facilities. An illustration of some of the waterways uses in Pittwater Estuary is given in Figure C-6, Appendix C.

Commuter and commercial vessels

The offshore communities of Scotland Island and the western foreshores (e.g. Elvina Bay, Lovett Bay, Mackerel Beach, Coasters Retreat) rely on a commuter boat service to access the mainland. Commuter boats are either commercially run ferries, which pick up and drop off at public wharfs, or individually owned tinnies, which need to be stored at the onshore transportation node (typically Church Point and Pittwater Park).

Safety concerns have been raised regarding the high number of moorings within the 'commuter boat highway', particularly in the lower reaches of McCarrs Creek (adjacent to Church Point).

There is also significant concern regarding the storage of private commuter boats at the mainland node. At present, boats are often stored two or three deep from public wharfs. As the offshore areas are redeveloped in the future, the number of people relying on commercial or individual commuter services is likely to increase.

A commercial ferry service also operates between Palm Beach (Pittwater Park) and Ettalong on the Central Coast. During the devastating bushfires of summer 2002, this service was the only link between Sydney and the Central Coast, as both the main northern road and rail lines were closed. An increasing number of commuters from the Central Coast are using this service, and are even leaving vehicles at Palm Beach for subsequent transportation in Sydney. The existing and expected future demands on the Palm Beach Wharf and associated reserve areas need to be addressed.

A further commercial activity that operates within Pittwater is the seaplane service. This service mostly operates between Palm Beach and Rose Bay on Sydney Harbour.

Recreational vessels

Recreational usage of Pittwater is also wide and varied, and includes sailing, kayaking, kite surfing and power boating. The popularity of the waterway inevitably leads to competition for limited resources and infrastructure and may result in conflicts over space and access especially with the increased numbers of larger vessels in the waterway. Of particular concern is the inappropriate use of Personal Watercraft (PWC) and other powered vessels in Pittwater. The use of PWC in Pittwater is likely to have increased following the ban of these vessels from Sydney Harbour.

Congestion is not restricted to the Pittwater waterway. Boating access points (e.g. boat ramps, yacht clubs, dinghy storage) and associated car parking facilities are also limited and heavily used, especially on weekends and public holidays. The general increase in traffic during these times is an issue to the local resident community around the estuary.

Dredging within shallow embayments of Pittwater (e.g. Cicada Glen Creek, Winji Jimmi Bay, Crystal Bay) has permitted access to these areas by larger (deep draught) recreational vessels. These dredged areas have become natural sediment traps for catchment runoff, and as they silt up, navigation by the larger boats becomes compromised. A program of on-going dredging will be required if deep water access at these sites is to be maintained.

4.2.7 Foreshore Access

Like the waterway, foreshore areas around Pittwater are also used extensively for a range of activities. However, much of the Pittwater foreshore is in private ownership, so access is restricted to a series of defined locations only (with little or no linkages between them). The wider community of Pittwater has expressed concern that access around the foreshores of Pittwater should be improved.

Foreshore activities can also have significant impacts on the ecological health of the waterway. Every piece of litter damages the environment, especially plastic bags that make their way into the water, which can be mistaken by turtles, whales and birds for jellyfish and other potential food sources. Also, dog exercise areas adjacent to waterways have the potential to pollute the estuary if faeces are not removed, while adjacent playing fields and golf courses need to manage the application of fertilisers and herbicides and collect grass clippings to ensure that impacts on the environment are minimised. Foreshore usage issues are shown in Figure C-7 of Appendix C.

4.2.8 Climate Change

Climate change is a highly important issue for future sustainability of Pittwater Estuary. In recent years, the impact of climate change upon environmental systems has become an important consideration when planning for the maintenance of environments into the future. In terms of estuary processes, climate change may impact upon estuary water levels, ecosystem assemblages, bushfire risks and storm damage, as explained below.

Recent projections from IPCC (2007), CSIRO (2007) and others illustrate that in addition to projected sea level rise, changes to climate are likely to include temperature, rainfall, wind patterns and more, all of which will impact upon estuary processes and their interactions. Pittwater Council has recently developed a Climate Change Adaptation Framework to assist in managing this important issue.

Sea Level Rise

For sea level rise, the most up to date global projections are given within the Fourth Assessment Report (AR4) by the IPCC (2007), and regional projections for Australia are given by CSIRO (2007). The NSW Government finalised its Sea Level Rise Policy Statement in October 2009, which establishes 'benchmark' for sea level rise projections for NSW of 0.4 m by 2050 and 0.9 m by 2100. The Sea Level Rise Policy statement is derived from the IPCC (2007) and CSIRO (2007) global and regional projections. Council has adopted the NSW policy benchmarks.

Sea level rise is highly pertinent to foreshore (riparian) ecosystems, such as mangroves and saltmarsh, which will need to migrate upslope to remain within the water level ranges to which they are adapted. Seagrass may also be affected, as it is also adapted to a certain range in water depth. These species will be sustained at higher water levels where foreshore land is available to migrate into, such as within Ku-ring-gai National Park. However, where the foreshore region is already developed, there may be a loss of these ecological communities if they cannot migrate.

Shallow wetland areas, particularly the Careel Bay wetlands, will face increasing competition for space within surrounding urban areas, as saltmarsh and mangrove species attempt to migrate upslope to remain within their tidal limits. The Careel Bay wetlands are of particular focus given its high ecological significance, and suitable foreshore set back arrangements will need to be considered to sustain this environment into the future.

In addition to enabling the migration of foreshore ecosystems, future development and redevelopment of Pittwater's foreshores will need to consider the impact of future sea levels upon the developments, and upon maintaining public foreshore access. Sea level rise is also pertinent to the construction or reconstruction of foreshore structures such as seawalls, marinas, fixed jetties and boat ramps.

Until such time as Council's Standard Instrument: Principal Local Environmental Plan is enacted, careful consideration and diligent application of the requirements of State Environmental Planning Policy No. 71 - Coastal Protection should apply when assessing development in the coastal zone of the Pittwater local government area.

5 MANAGEMENT OBJECTIVES

5.1 Overview

The overarching aim of this Estuary Management Plan is to protect and maintain or improve the environmental values of Pittwater Estuary, as the environment provides the basis of the social, commercial and recreational values enjoyed by users of Pittwater Estuary.

The Estuary Management Plan is seen by the community as a tool for integrating the needs and values of the environment within the development-based planning framework of local and state government. The focus of this Plan is on addressing environmental concerns through a series of actions that are both effective and easy to implement.

The basis for an Estuary Management Plan, according to the Estuary Management Policy 1992, should be Ecologically Sustainable Development (ESD). Put simply, ESD is development that aims to meet the needs of the present, while conserving our ecosystems for the benefit of future generations. By following the principles of ESD, we should be able to reduce the likelihood of serious environmental impacts arising from our present day economic activities.

There are four basic principles of Ecologically Sustainable Development (ESD):

- Conservation of biological diversity and ecological integrity;
- Social equity, including inter-generational equity;
- Improved valuation, pricing and incentive mechanisms; and
- The precautionary principle.

These principles form the basis of matters to be considered in deciding whether projects are consistent with ecologically sustainable objectives.

5.2 Formulation of Management Objectives

Management Objectives provide the 'goal posts' towards which future management of Pittwater should be directed. In short, the objectives aim to rectify the problems or issues facing the estuary, whilst preserving and enhancing its inherent values.

A total of 25 objectives for estuary management were compiled. The objectives are arranged under their relevant management category, as follows:

- Water Quality;
- Sedimentation and Erosion;
- Ecology;
- Waterway Usage;
- Foreshore Usage;
- Heritage;
- Future Development; and

- Climate Change

Within each category, a broader, or root, objective is defined first (identified by a # after the objective number), then more specific objectives relating to particular topics, locations or issues are defined.

5.3 Water Quality Objectives

- 1.0#** Water quality of Pittwater to be suitable for maintaining healthy aquatic ecosystems and all recreational and commercial activities currently undertaken.
- 1.1** Water quality objectives specified in the Independent Inquiry into the Hawkesbury-Nepean River system (NSW Healthy Rivers Commission, 1998) to be met for more than 90% of the time at locations that are both close to the foreshore and in the middle of the waterway, including sites adjacent to Scotland Island and the western foreshore communities.
- 1.2** Faecal coliforms and enterococci levels at designated bathing areas to comply with recommendations specified within the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (revised 2004).
- 1.3** Concentrations of toxicants within all parts of the estuary, including around marinas and within poorly flushed embayments, to meet the ANZECC (2000) guidelines for 95% level of species protection

5.4 Sedimentation and Erosion Objectives

- 2.0#** On-going sedimentation is not to compromise the ecological value of existing habitats or the social amenity currently afforded to all estuary users.
- 2.1** Foreshore erosion processes to be mitigated at all high priority areas by 2015.
- 2.2** Sediment runoff rates from the Pittwater catchment to be 50% of 2002 levels by 2015.
- 2.3** The quality of all Pittwater sediments to be below the low trigger values specified in the ANZECC (2000) Interim Sediment Quality Guidelines (ISQG), to minimise impacts on benthic or aquatic ecosystems.

5.5 Ecology Objectives

- 3.0#** Maintain and where practical, restore a healthy and diverse mix of terrestrial, fringing, intertidal and aquatic habitats that will promote visitation by a wide range of species, including migratory birds that have been displaced in recent years.
- 3.1** Re-establish a native vegetation foreshore corridor around public natural foreshore areas of Pittwater.
- 3.2** Bring under control aquatic and terrestrial noxious weed species (including *Caulerpa taxifolia*) from within and around the Pittwater estuary by 2025.

- 3.3** Areas of ecological significance to be properly identified and conserved for future generations. Conservation to consider appropriate adaptive management strategies to deal with the natural resource impacts of long term climate change.

5.6 Waterway Usage Objectives

- 4.0#** Recreational, commercial and commuter users to access and utilise the estuary in an equitable and safe manner.
- 4.1** Improve and/or develop arrangements, for the co-operative management of waterway activities, between the relevant State Government Authorities and between State Authorities and Council.
- 4.2** Minimise the disturbance from waterway activities to the natural environment, as well as other estuary users.

5.7 Foreshore Usage Objectives

- 5.0#** Re-establish wherever practical public access to and around the entire foreshores of the Pittwater estuary by 2025.
- 5.1** Improve public facilities and access along sections of foreshore in public ownership.
- 5.2** Minimise traffic and parking congestion at foreshore access points.
- 5.3** Foreshore recreational and commercial activities to be consistent with the other objectives of this Estuary Management Plan.

5.8 Heritage Objectives

- 6.0#** Aboriginal and non-indigenous heritage areas fringing the Pittwater estuary are not to be damaged or destroyed through inappropriate or poorly planned activities.
- 6.1** Sites of Aboriginal heritage significance around Pittwater are to be properly identified, recorded and protected under the applicable State and Federal legislation.
- 6.2** Sites of non-indigenous heritage are to be identified and registered under the relevant state and/or local planning instruments
- 6.3** Increase the awareness of the community regarding the significance of the Pittwater estuary to the local Aboriginal people and also to the early European settlers in the area.

5.9 Development Objectives

- 7.0#** Future development, including redevelopment or infill development, is not to compromise the principles of natural resources sustainability as they relate to the Pittwater estuary, as espoused by this Estuary Management Plan

- 7.1** Minimise the impacts of future development on the existing scenic quality, recreational amenity and ecological values of the Pittwater estuary through appropriate land use zoning and development controls

5.10 Climate Change Objectives

- 8.0#** Potential climate change impacts for Pittwater are to be acknowledged and adequately addressed in Council's strategic planning and management plans

5.11 Prioritisation of Management Objectives

The management objectives were prioritised based upon community feedback during Workshop 1 (refer Section 2.2). Community members were asked to indicate the top five (5) objectives they believed to be most important to Pittwater Estuary. The votes by the community have been used to rank the objectives, and this is detailed in Table 5-1. Prioritisation of the management objectives is used to assist in the assessment of management strategies detailed in the subsequent Section.

Table 5-1 Prioritised Management Objectives

Rank	Objective	Number of Votes
1	(1.0#) Water quality of Pittwater to be suitable for maintaining healthy aquatic ecosystems and all recreational and commercial activities currently undertaken	6
2	(3.0#) Maintain and where practical, restore a healthy and diverse mix of terrestrial, fringing, intertidal and aquatic habitats that will promote visitation by a wide range of species, including migratory birds that have been displaced in recent years	5
2	(3.2) Bring under control aquatic and terrestrial noxious weed species (including <i>Caulerpa taxifolia</i>) from within and around the Pittwater estuary by 2025.	5
2	(5.0#) Re-establish wherever practical public access to and around the entire foreshores of the Pittwater estuary by 2025.	5
5	(4.2) Minimise the disturbance from waterway activities to the natural environment, as well as other estuary users.	4
6	(1.1) Water quality objectives specified in the Independent Inquiry into the Hawkesbury-Nepean River system (NSW Healthy Rivers Commission, 1998) to be met for more than 90% of the time at locations that are both close to the foreshore and in the middle of the waterway, including sites adjacent to Scotland Island and the western foreshore communities.	3
6	(4.1) Improve and/or develop arrangements, for the co-operative management of waterway activities, between the relevant State Government Authorities and between State Authorities and Council.	3
6	(8.0#) Potential climate change impacts for Pittwater are to be acknowledged and adequately addressed in Council's strategic planning and management plans.	3
9	(1.2) Faecal coliforms and enterococci levels at designated bathing areas to comply with recommendations specified within the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (revised 2004).	2

9	(1.3) Concentrations of toxicants within all parts of the estuary, including around marinas and within poorly flushed embayments, to meet the ANZECC (2000) guidelines for 95% level of species protection	2
9	(7.0#) Future development, including redevelopment or infill development, is not to compromise the principles of natural resources sustainability as they relate to the Pittwater estuary, as espoused by this Estuary Management Plan.	2
12	(2.0#) On-going sedimentation is not to compromise the ecological value of existing habitats or the social amenity currently afforded to all estuary users.	1
12	(2.2) Sediment runoff rates from the Pittwater catchment to be 50% of 2002 levels by 2015	1
12	(2.3) The quality of all Pittwater sediments to be below the low trigger values specified in the ANZECC (2000) Interim Sediment Quality Guidelines (ISQG), to minimise impacts on benthic or aquatic ecosystems.	1
12	(3.3) Areas of ecological significance to be properly identified and conserved for future generations. Conservation to consider appropriate adaptive management strategies to deal with the natural resource impacts of long term climate change	1
12	(6.1) Sites of Aboriginal heritage significance around Pittwater are to be properly identified, recorded and protected under the applicable State and Federal legislation.	1
12	(7.1) Minimise the impacts of future development on the existing scenic quality, recreational amenity and ecological values of the Pittwater estuary through appropriate land use zoning and development controls.	1
19	(2.1) Foreshore erosion processes to be mitigated at all high priority areas by 20	0
19	(3.1) Re-establish a native vegetation foreshore corridor around public natural foreshore areas of Pittwater	0
19	(4.0#) Recreational, commercial and commuter users to access and utilise the estuary in an equitable and safe manner.	0
19	(5.1) Improve public facilities and access along sections of foreshore in public ownership	0
19	(5.2) Minimise traffic and parking congestion at foreshore access points.	0
19	(6.0#) Aboriginal and non-indigenous heritage areas fringing the Pittwater estuary are not to be damaged or destroyed through inappropriate or poorly planned activities	0
19	(6.2) Sites of non-indigenous heritage are to be identified and registered under the relevant state and/or local planning instruments	0
19	(6.3) Increase the awareness of the community regarding the significance of the Pittwater estuary to the local Aboriginal people and also to the early European settlers in the area.	0

6 STRATEGIES FOR ESTUARY MANAGEMENT

6.1 Management Strategies

Management strategies have been derived based upon consideration of the objectives for Pittwater estuary, in particular, the aim of maintaining and improving the environmental condition of Pittwater Estuary and its catchment and tributaries. The strategies have been developed through consultation with the study team (Council, DECCW and BMT WBM) and with the EWG.

The strategies have been grouped according to the types of activity the strategy involves, for example, planning controls. The strategy groups are activity based, rather than issue based (as for the management categories). The management strategies for Pittwater are listed below. A full description of each of the strategies listed below is given in Appendix F.

The Strategies presented in this Plan represent actions primarily for Pittwater Council, although in some instances, Council will require assistance by, or collaboration with, other Government Agencies. For some strategies, the primary responsibility may actually reside with another Agency, and Council is only to provide an assisting role. As this Plan has been developed by Council in partnership with the NSW Government, strategies and actions are not restricted to the exclusive responsibility of Council.

There are nine (9) basic strategies that have been developed, which target different aspects of future conservation, management, compliance, and works. These are:

1. Preparation and implementation of appropriate land management controls,
2. Preparation and adoption of planning controls,
3. Prepare and enforce development controls,
4. Undertake activity controls and/or activity modifications,
5. Construct new or improved services and/or assets,
6. Undertake environmental and heritage-based rehabilitation works,
7. Initiate pollution reduction measures,
8. Undertake community education, and
9. Increase compliance with existing regulations.

For each of these basic strategies, a range of specific actions have been considered, which relate specifically to application to the Pittwater estuary. The specific actions are presented below.

1 Prepare and Implement Land Management Controls, specifically:

- a) *Prepare and implement Plans of Management to define land management for Church Pt, Palm Beach Wharf / Pittwater Park, Scotland Island and western offshore communities*
- b) *Update and implement Plan of Management for Careel Bay wetlands, ensuring maintenance of habitat mix / diversity (which may include selective removal of mangrove seedlings that have encroached onto saltmarsh areas from time to time)*
- c) *Prepare and implement Plans of Management for areas of significant habitat (eg EECs) on public and private lands ensuring preservation and enhancement of key environmental values*

2 Prepare and Incorporate Planning controls, specifically:

- a) *Significant environmental values are to be identified and adequately protected within appropriate planning instruments (including foreshore areas, EECs, vegetation stands). Eg, modify SEPP-14 wetland boundaries, TPOs.*
- b) *Areas of significant heritage value (Aboriginal and early-European) are to be identified and adequately protected within appropriate planning instruments, such as Council's LEP (first requires assessment of Aboriginal and early-European sites)*
- c) *Extend public conservation area lands (eg State Park), to include parts of Currawong and Mackerel Beach for example*
- d) *Allow small scale maintenance dredging for navigational safety, providing it does not conflict with or compromise existing or future environmental values.*

3 Prepare and Enforce Development controls, specifically:

- a) *Climate change impacts for development are to be considered and addressed, with the development of relevant risk management plans for adoption into Council's DCP*
- b) *WSUD principles to be added to all development controls (draft DECC DCP)*
- c) *Appropriate on-site sewage systems to be adopted, suitable for soils, topography etc*
- d) *Developments not to incorporate pollution and/or sediment discharges to the waterways*
- e) *Developments not to degrade scenic amenity of the Pittwater estuary and surrounds*
- f) *Public amenity and existing foreshore values to be retained / improved for foreshore developments*
- g) *Make stricter sediment & erosion controls for developments*
- h) *Require all new marina developments (> 9 berths) to have pump-out services*

4 Undertake Activity Controls / Modifications, specifically:

- a) *Limit proximity of boating activities to environmentally significant areas and other sensitive areas (eg infested areas), incl. no anchoring*

- b) *Replace existing moorings with seagrass friendly moorings in areas close to existing seagrass beds*
- c) *If necessary, reduce boating speed limits in areas of high waterway use / traffic (eg western side of Scotland Island)*
- d) *If necessary, relocate existing moorings away from areas of high environment significance and/or high vessel traffic*
- e) *Remove significant impediments to fish passage*
- f) *Encourage all existing large marinas (> 30 berths) to install pump-out services*
- g) *If necessary, reduce the total number of moorings within Pittwater to a more appropriate capacity / mooring limit, through opportunistic relinquishment and offsets through new marina developments.*

5 Construct New or Improved Services / Assets, specifically:

- a) *Install new and/or upgrade and repair existing waterway access locations / points, and foreshore access and facilities*

6 Undertake Environmental and Heritage Rehabilitation, specifically:

- a) *Repairs / rehabilitation of significant heritage sites (Aboriginal and/or early European)*
- b) *Redress erosion along Pittwater foreshores and along catchment streams / tributaries*
- c) *Re-vegetation along estuary foreshores and along riparian zones within catchment (on both public and private lands) to connect habitats, provide shade and enhance ecological communities (esp. EECs)*
- d) *Weed and exotic species control, including *Caleurpa taxifolia*.*

7 Initiate Pollution Reduction Measures, specifically:

- a) *Targeted measures for reducing marina operations waste*
- b) *Targeted catchment management measures, following catchment-wide urban pollution and sediment runoff audit (esp. areas discharging to poorly flushed embayments)*
- c) *Minimise overflows from the reticulated sewerage system (through Sydney Water consultation)*

- 8 Undertake Community Education**, involving a review existing programs and develop with stakeholders and education program promoting estuary values, catchment management and opportunities for action by community and business.

The education program should incorporate strategies specific to different audiences and actions that target specific issues and short term needs. Specifically, consider different combinations as outlined in Table 6-1.

Table 6-1 Topics, Approaches and Audiences for Community Education

Topics	Approaches	Audiences
General <ul style="list-style-type: none"> - Environmental values of the estuary - Appreciation of indigenous culture and heritage - Catchment management for waterway health and biodiversity (e.g. impacts of fertilisers, pesticides, etc) 	<ul style="list-style-type: none"> - Signage - Public displays - Brochures - Expert advice and mentoring - Printed and electronic resources - Home action (e.g. gardens for wildlife, controlling weeds, using native plants etc) - Market Days / Fair - School Excursions 	Pittwater LGA including community groups, schools, business (commercial and non-commercial), and recreational users (visitors) in: <ul style="list-style-type: none"> - The catchment, - The waterway, - The foreshore
Specific <ul style="list-style-type: none"> - No discharge status of Pittwater - Discouragement of use of high-pollution older-style 2 stroke outboard motors - Appropriate foreshore use (including education of foreshore landowners) 	<ul style="list-style-type: none"> - Eco walks - Workshops and guest speakers - Volunteering (e.g. bushcare, catchment monitoring) - Joint projects with schools, community and Council - Development of environmental and sustainability management plans that including activity reviews, audits and action planning for the built and natural environment 	

9 Increase Compliance with Existing Regulations (through additional resources /officers) covering:

- a) *Permanent occupancies on boats*
- b) *Boating regulations re: speeds, dangerous behaviour, Caeurpa controls / washdown*
- c) *Sediment and erosion controls, as well as other development controls / conditions*
- d) *On-site sewage systems operation*
- e) *Water pollution from boats and waterway businesses (eg marinas)*

6.2 Prioritisation of Management Strategies

The prioritisation of Management strategies considered two main criteria. The Pittwater Estuary Management Plan aims to maintain or improve the environmental condition of the estuary, and the management objectives have been derived to achieve this overarching goal (refer Section 5.1). Thus, the effectiveness of the strategies in meeting the Plan objectives has been used as the first criterion

for prioritising the management strategies. The perceived environmental benefit of each of the strategies was used as the second criterion for prioritisation.

Aspects such as cost and timeframe have been estimated as part of the implementation details for each strategy, but were not used as criteria for assessing the strategies. In this way, all actions were considered for their environmental benefit to Pittwater Estuary only.

The acceptability of the management strategies to the broader Pittwater community was also considered by the study team (BMT WBM, Council staff and the EWG) and the community (through the workshops), insofar as whether the actions were or were not acceptable to community.

The outcomes of effectiveness and environmental benefit assessments and the final prioritised list of management strategy actions are described herein.

6.2.1 Effectiveness in meeting Management Objectives

An 'Association Matrix' between the management strategies and objectives has been generated, as shown in Appendix E. This matrix identifies how each of the strategies relates to each of the management objectives. Within the matrix, the association between strategies and objectives has been separated into: 'direct association' (defined by a solid star ★); and 'indirect association' (defined by a hollow star ☆). Direct association means that by implementing the strategy, the specific objective will be addressed (to some degree at least). Indirect association means that the action does not specifically target that objective, but the implementation of the action will still provide some benefit in terms of addressing the objective.

The action that addressed the most number of objectives (directly and indirectly) was 1a - Prepare and Implement Plans of Management for Church Pt, Palm Beach Wharf / Pittwater Park, Scotland Island and the western offshore communities. This option addresses many of the water quality, sedimentation, ecology, heritage and future development issues raised by the Committee, the general community and as part of the EPS.

The second most applicable action in terms of objectives met directly and indirectly was 8 – Community Education, particularly general education regarding the environmental values of the estuary.

6.2.2 Environmental Benefit of Management Strategies

The environmental benefit achieved through implementation of the strategies was assessed by the Study Team, in terms of a 'high', 'medium', and 'low' environmental benefit. That is:

- actions considered likely to **greatly improve** the environment of the estuary were classed as 'high';
- actions considered likely to **marginally improve** the environment of the estuary were classed as 'medium'; and
- actions considered to result in **no improvement or maintenance** of the estuarine environment were classed as 'low'.

The environmental benefit assessment for each strategy was based on the assumption that the strategy actions are largely implemented. The environmental benefit assessment for each strategy action is given in Table E-2, Appendix E.

As outlined previously, fundamental social and economic benefits relating to the Pittwater estuary are dependent on a healthy and sustainable natural environment. As such, rather than considering social and economic benefits of each management strategy separately, the focus of this Estuary Management Plan is maximising environmental benefits, which will then have flow-on effects to the wider community.

6.2.3 Acceptability

The acceptability of management options has been canvassed with the community through prior consultation processes. For example, during Workshop 1, community members were asked to indicate the five management strategies they deemed most important to the estuary's management.

The outcome of community consultation indicated that none of the management strategies were negatively viewed by the community. Actions the community deemed particularly important for estuary management included:

- **3f)** Ensure public amenity and existing foreshore values are retained / improved for foreshore developments
- **7b)** Targeted catchment management measures, following catchment-wide urban pollution and sediment runoff audit (esp. areas discharging to poorly flushed embayments)
- **4a)** Limit proximity of boating activities to environmentally significant areas and other sensitive areas (eg infested areas), incl. no anchoring
- **6c)** Re-vegetation along estuary foreshores and along riparian zones within catchment (on both public and private lands) to connect habitats, provide shade and enhance ecological communities (esp. EECs)

6.2.4 Prioritised Order of Management Strategies

By combining the assessments of effectiveness in addressing Plan objectives and environmental benefit, a prioritised order of environmental importance for the strategies was obtained. The prioritised list is given in Table 6-2 and represents a relative preferred order for implementation, to achieve the greatest environmental benefit to the estuary (note that some strategies are equally ranked, and are therefore numbered the same). The prioritisation of the management strategies is included in the implementation details for each strategy, in Chapter 7.

The strategies were determined to be High, Medium or Low Relative Priority, according to the following definition.

- High: indicating that implementation of these particular strategies must generally take precedence over other strategies within existing funding and resource limitations;
- Medium: indicating that these strategies are not as crucial as the high strategies. These strategies should still be implemented when funding and resources become available; and

- Low: indicating that these strategies have the least potential to make significant difference to the Pittwater Estuary environment. These strategies will, however, still benefit many aspects of the estuary, and as such, should be implemented when funding and resources becomes available.

Prioritisation of the strategies is subject to periodic statutory and corporate reviews.

As noted in Table 6-2, the highest ranked strategy was 1a) - Preparation of PoMs for Church Point, Scotland Island and the Western Offshore communities. Community education (Strategy 8), particularly promoting the environmental values of Pittwater was also ranked highly. Both of these strategies are considered to be of highest priority. The next three highest ranked strategies related to reducing inputs of pollution to the estuary from developments (3d) and from marinas (3h) and boats (9e).

6.2.5 Timeframes and Indicative Cost

Timeframes for implementation were determined for each of the strategy actions, and are given in the Implementation Tables listed in Section 7.1. Timeframes are independent of the strategy ranking.

Timeframes are based on Council's Corporate Management Planning horizons:

- Short: within 4 years (ie by 2014); and
- Medium: within 10 years (ie by 2020);

It should be noted a review of this Plan is required after 5 years, to ensure that appropriate attention and focus is being provided to the areas of most concern. Timeframes are provided subject to the availability of necessary funding and resources.

Indicative costs for implementation were estimated for each of the strategy actions, and are listed in the Implementation Tables, Section 7.1.

Table 6-2 Prioritised Order for Management Strategies

Rank	Strategy	Relative Priority
1	1 a) Prepare and implement Plans of Management to define land management for Church Pt, Palm Beach Wharf / Pittwater Park, Scotland Island and western offshore communities	HIGH
2	8 f) Community Education - General environmental values of estuary	HIGH
3	3 d) Developments not to incorporate pollution and/or sediment discharges to the waterways	HIGH
4	3 h) Require all new marina developments (> 9 berths) to have pump-out services	HIGH
5	9 e) Compliance: Water pollution from boats and waterway businesses (eg marinas)	HIGH
6	1 c) Prepare and implement Plans of Management for areas of significant habitat (eg EECs) on public and private lands ensuring preservation and enhancement of key environmental values	HIGH
7	7 a) Targeted measures for reducing marina operations waste	HIGH
8	3 b) WSUD principles to be added to all development controls (draft DECC DCP)	HIGH
9	1 b) Update and implement Plan of Management for Careel Bay wetlands, ensuring maintenance of habitat mix / diversity (which may include selective removal of mangrove seedlings that have encroached onto saltmarsh areas from time to time)	HIGH
9	7 b) Targeted catchment management measures, following catchment-wide urban pollution and sediment runoff audit (esp. areas discharging to poorly flushed embayments)	HIGH
11	9 c) Compliance: Sediment and erosion controls, as well as other development controls / conditions	MEDIUM
12	2 a) Significant environmental values are to be identified and are adequately protected within appropriate planning instruments (including foreshore areas, EECs, vegetation stands). Eg, modify SEPP-14 wetland boundaries, TPOs.	MEDIUM
13	4 f) Encourage all existing large marinas (> 30 berths) to install pump-out services	MEDIUM
14	8 c) Community Education - Catchment management, including use of fertilisers, pesticides etc	MEDIUM
15	3 c) Appropriate on-site sewage systems to be adopted, suitable for soils, topography etc	MEDIUM
16	8 a) Community Education - No discharge status of Pittwater	MEDIUM
17	9 d) Compliance: On-site sewage systems operation	MEDIUM
18	4 a) Limit proximity of boating activities to environmentally significant areas and other sensitive areas (eg infested areas), incl. no anchoring	MEDIUM
19	6 b) Redress erosion along Pittwater foreshores and along catchment streams / tributaries	MEDIUM
20	7 c) Minimise overflows from the reticulated sewerage system (through Sydney Water consultation)	MEDIUM
21	3 f) Public amenity and existing foreshore values to be retained / improved for foreshore developments	MEDIUM
22	9 b) Compliance: Boating regulations, ie speeds, dangerous behaviour, caleurpa controls / washdown	MEDIUM
23	8 d) Community Education - Appropriate foreshore use (including education of foreshore landowners)	MEDIUM
24	3 a) Climate change impacts for development are to be considered and addressed, with the development of relevant risk management plans for adoption into Council's DCP	MEDIUM
25	3 e) Developments not to degrade scenic amenity of the Pittwater estuary and surrounds	MEDIUM
26	6 c) Re-vegetation along estuary foreshores and along riparian zones within catchment (on both public and private lands) to connect habitats, provide shade and enhance ecological communities (esp. EECs)	MEDIUM
26	6 d) Weed and exotic species control, including <i>Caleurpa taxifolia</i> .	MEDIUM
28	4 b) Replace existing moorings with seagrass friendly moorings in areas close to existing seagrass beds	MEDIUM
29	9 a) Compliance: Permanent occupancies on boats	MEDIUM
30	3 g) Make stricter sediment & erosion controls for developments	MEDIUM
31	8 b) Community Education - Discouragement of use of high-pollution older-style 2 stroke outboard motors	MEDIUM
32	4 g) If necessary, reduce the total number of moorings within Pittwater to a more appropriate capacity / mooring limit, through opportunistic relinquishment and offsets through new marina developments.	MEDIUM
33	2 c) Extend Ku-ring-gai Chase NP, to include parts of Currawong and Mackerel Beach for example	MEDIUM
34	4 e) Remove significant impediments to fish passage	LOW
35	2 b) Areas of significant heritage value (Aboriginal and early-European) are to be identified and are adequately protected within appropriate planning instruments, such as Council's LEP (first requires assessment of Aboriginal and early-European sites)	LOW
36	4 d) If necessary, relocate existing moorings away from areas of high environment significance and/or high vessel traffic	LOW
37	6 a) Repairs / rehabilitation of significant heritage sites (Aboriginal and/or early European)	LOW
38	5 a) Install new and/or upgrade and repair existing waterway access locations / points, and foreshore access and facilities	LOW
39	4 c) If necessary, reduce boating speed limits in areas of high waterway use / traffic (eg western side of Scotland Island)	LOW
40	2 d) Allow small scale maintenance dredging for navigational safety, providing it does not conflict with or compromise existing or future environmental values.	LOW
41	8 e) Community Education - Aboriginal values	LOW

7 IMPLEMENTATION, FUNDING AND PLAN REVIEW

7.1 Pittwater Estuary Management Action Table

Implementation details outlining the actions required to implement each of the management strategies, as well as the agency(s) responsible for implementation, timeframe, cost and measurables have been compiled to form the Pittwater Estuary Management Action Table. This table also outlines the mapping which has been completed for each management strategy, and sub-plans to which the strategy applies. The Action table also details the best practise guidelines (refer Chapter 9) which apply to each strategy, and the management objectives met by that strategy.

The complete Pittwater Estuary Management Action Table has been provided to Council in the form of a Microsoft Excel spreadsheet, for use and reference within Council. Further, the implementation details given in the Action Table have also been included in the mapping tables for each strategy, as provided in MapInfo at Council. These tools provides a valuable, interactive GIS and database resource, which various council officers may access to interrogate management strategies, enabling them to view where the management strategy applies, and the information on how to implement the strategy. It is hoped that such interactive tools will better enable the Pittwater Estuary Management Plan to be understood, accessed and implemented across all departments within Council.

For the purpose of this estuary management plan report, the Pittwater Estuary Management Action Table has been split into respective strategy groups, and reproduced below.

It should be noted that for many strategies, the primary responsibility for implementation rests with Pittwater Council. In other strategies, Council is partly responsible. However for a few strategies, the primary responsibility for implementation rests with other government agencies. In these circumstances, Council may still assist with implementation by lobbying for funding.

Strategy 1 – Prepare and Implement LAND MANAGEMENT CONTROLS

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
1 a) Prepare and implement Plans of Management to define land management for Church Pt, Palm Beach Wharf / Pittwater Park, Scotland Island and western offshore communities (Note: Church Point PoM already complete)	<ul style="list-style-type: none"> Complete PoM for Palm Beach Wharf / Pittwater Park. Complete PoM for Scotland Island and western offshore communities. PoMs to cover: <ul style="list-style-type: none"> environmental protection, including foreshore buffers and rationalisation of impacts to aquatic environments from boating and foreshore usage recreational amenity, parking, access & transport, commerce, boating facilities, future development potential, and climate change, including foreshore land provision for habitat migration. Completed PoMs to be implemented. 	HIGH	By 2014	Council & Dept. Lands to prepare Input from key stakeholders and state agencies for PoM development Implementation by Council	Staff time to prepare. Unknown costs to implement PoMs	<ul style="list-style-type: none"> Completion of all PoMs Implementation of PoMs 	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 1a.TAB This strategy is applicable to ALL Estuary Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan workspaces in Council's GIS Network	2, 3, 4, 6, 7, 8, 10, 11, 13	1.0, 1.1 , 1.2, 1.3 , 2.0, 2.2, 3.0, 3.1 , 3.3 , 4.0, 4.2 , 5.0, 5.1, 5.2, 6.0, 7.0, 7.1, 8.0
1 b) Update and implement Plan of Management for Careel Bay wetlands, ensuring maintenance of habitat mix / diversity (which may include selective removal of mangrove seedlings that have encroached onto saltmarsh areas from time to time)	<ul style="list-style-type: none"> PoM to include a program for the selective removal of mangrove seedlings from saltmarsh areas from time to time to maintain habitat mix. PoM to stipulate controls on access to the wetlands. PoM to stipulate the legal works or activities permissible. 	HIGH	By 2014	Council Assistance by DECCW, DII (Fisheries), HNCMA	Staff time to review and update PoM. Costs to implement approx. \$20,000/yr	<ul style="list-style-type: none"> Balanced mix of habitat types, particularly saltmarsh and sandflats relative to mangrove growth Adequate controls upon recreational and other activities, to protect important habitats 	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 1b.TAB This strategy is applicable to the Ecology, Waterway Usage and Foreshore Usage Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan workspaces in Council's GIS Network	1, 4, 5, 6, 7, 8	2.0, 3.0, 3.3, 4.0 , 4.2, 6.0, 7.0, 7.1 , 8.0
1 c) Prepare and implement Plans of Management for areas of significant habitat (eg EECs) on public land and DCPs for private lands ensuring preservation and enhancement of key environmental values	<ul style="list-style-type: none"> Undertake mapping in waterway and catchment to identify areas of significant habitat. Mapping could be co-ordinated with existing vegetation mapping projects. Determine potential threats and values to areas of significant habitat areas. Prioritise areas for preparation of management plans, based on values and potential threats. Compile and implement PoMs for significant habitat areas. 	HIGH	By 2014	Council Assistance by DECCW, DII (Fisheries), HNCMA	Staff time to prepare PoMs. Unknown costs to implement PoMs. Mapping and planning actions in this strategy could be linked with Strategy 2a	<ul style="list-style-type: none"> Areas of significant habitat have been adequately mapped Areas of significant habitat have been prioritised for protection PoMs have been prepared PoMs have been implemented 	Known locations of significant habitat are mapped in MapInfo table 1c.TAB . Further mapping required to better identify significant habitat areas This strategy is applicable to the Ecology, Waterway Usage, Foreshore Usage, Future Development and Climate Change Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan workspaces in Council's GIS Network	1, 4, 5, 6, 7, 8	2.0, 3.0, 3.1 , 3.3, 4.0 , 4.2, 6.0, 7.0, 7.1 , 8.0

Strategy 2 – Prepare and Incorporate PLANNING CONTROLS

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
2 a) Significant environmental values are to be identified and are adequately protected within appropriate planning instruments (including foreshore areas, EECs, vegetation stands). Eg, modify SEPP-14 wetland boundaries, TPOs.	<ul style="list-style-type: none"> Conduct detailed habitat mapping of EECs on land and in water, particularly sandflats, mudflats, saltmarsh, mangroves, hollow trees etc. Utilise the Estuarine Habitat Mapping and Geomorphic Categorisation of Lower Hawkesbury & Pittwater Estuaries report (DII, Oct. 2009), as a starting point for groundtruthing known EECs and significant habitat. Cross reference mapping against Federal, State and Local legislation, to determine existing level of protection for significant habitat value. Amend Local planning instruments (LEP, DCP etc) to ensure adequate protection of habitats Apply to the State Government for inclusion of Careel Bay and other significant areas as a SEPP14 Coastal Wetland. Apply to DII (Fisheries) for Aquatic Reserve or Critical Habitat declaration of important aquatic habitats under the Fisheries Management Act, 1994 (eg, mudflat habitats for Bush Stone-curlew). 	MEDIUM	By 2014	Council DECCW, DII (Fisheries), HNCMA, and DP	~\$50,000 for mapping. Staff time for planning input. Actions in this strategy could be linked with Strategy 1c	<ul style="list-style-type: none"> Significant habitat value areas have been adequately mapped & identified Local planning instruments provide highest level of protection to significant habitat areas State and Federal legislation provides highest level of protection to significant habitat areas 	<p>Known locations of significant habitat are mapped in MapInfo table 2a.TAB. Further mapping required to better identify significant habitat areas</p> <p>This strategy is applicable to the Ecology, Waterway Usage, Foreshore Usage, Future Development and Climate Change Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-Plan Workspaces in Council's GIS Network</p>	5, 6, 7, 8	3.0, 3.1 , 3.3, 4.1 , 4.2, 6.0 , 7.1, 8.0
2 b) Areas of significant heritage value (Aboriginal and early-European) are to be identified and to be adequately protected within appropriate planning instruments, such as Council's LEP (first requires assessment of Aboriginal and early-European sites)	<ul style="list-style-type: none"> Conduct detailed mapping to identify sites of Aboriginal and European heritage significance around Pittwater. Compile a detailed formal record/database of heritage sites. Heritage sites (Aboriginal as permissible, and European) to be registered on planning instruments, to ensure protection from development. 	LOW	By 2020	Council & DECCW (NPWS) HNCMA assistance sought from Historical Societies, NSW Heritage Council	~\$30,000 for identification and mapping. Staff time for planning input	<ul style="list-style-type: none"> Aboriginal and European heritage sites have been mapped and identified A detailed register of Aboriginal and European Heritage Sites has been compiled 	<p>Known heritage locations in Pittwater are mapped in MapInfo table 2b.TAB. Further mapping of unidentified sites is required, and GIS should be updated accordingly</p> <p>This strategy is applicable to the Heritage and Future Development Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	12	6.0, 6.1, 6.2, 6.3 , 7.0

Strategy 2 – Prepare and Incorporate PLANNING CONTROLS

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
2 c) Extend public conservation area lands (eg State Park), to include parts of Currawong and Mackerel Beach for example	<ul style="list-style-type: none"> Determine which parts of western foreshore land (e.g., Currawong, Mackerel Beaches, foreshore land at Coasters Retreat and The Basin) are appropriate for inclusion into Kuring-gai Chase National Park, due to significance for ecological or heritage reasons. Alternatives should also be explored for creating an independent State Conservation Area, State Park or Regional Park. Determine most appropriate method of management of these protected lands, for example: <ul style="list-style-type: none"> rezoning of publicly owned land (and which could be undertaken as part of new Pittwater LEP) exchange or dedication of lands in private / public ownership purchase of land for dedication to park, if considered viable. 	MEDIUM	By 2014	Council, DECCW (NPWS), DP and Dept of Lands.	Staff time for planning requirements / assessment Unknown cost of purchase of land if chosen	<ul style="list-style-type: none"> Areas of Currawong Beach, Mackerel Beach or other western foreshore regions are being managed by NPWS or similar 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 2c.TAB</p> <p>This strategy is applicable to the Ecology, Foreshore Usage, Heritage and Future Development Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>		3.0, 3.3 , 4.2 , 5.0 , 6.0, 6.1 , 6.2 , 6.3 , 7.0
2 d) Allow small scale maintenance dredging for navigational safety, providing it does not conflict with or compromise existing or future environmental values.	<ul style="list-style-type: none"> Undertake detailed environmental investigations for locations requiring dredging for navigations purposes, including: <ul style="list-style-type: none"> State government approvals (SEPP (Major Projects) 2005) detailed hydrographic surveys detailed ecological assessments detailed assessment of boating usage. Proposed dredging to not compromise the environmental values of the estuary. 	LOW	By 2020	Individual boat owners who will benefit from dredging and NSW Maritime	Depends upon scale of dredging required (typically > \$0.5 million)	<ul style="list-style-type: none"> Dredging for navigation has been limited to areas of high boat usage and low environmental significance 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 2d.TAB</p> <p>This strategy is applicable to the Sediment. & Erosion, Waterway Usage and Future Development Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>		2.0 , 4.0 , 7.1

Strategy 3 – Prepare and Enforce DEVELOPMENT CONTROLS

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
3 a) Climate change impacts for development are to be considered and addressed, with the development of relevant risk management plans for adoption into Council's DCP	<ul style="list-style-type: none"> Council's Climate Action Plan to consider implications of climate change (including sea level rise) on the Pittwater estuary. Implementation of Council's Climate Action Plan. On-going assessment of current best practice regarding climate change management for local government. 	MEDIUM	By 2014	Council with assistance from State (DECCW, HNCMA) and / or Federal (DCC) Government programs	Staff time	<ul style="list-style-type: none"> The Climate Action Plan has been integrated into Council's strategic planning activities Standards to improve the adaptive capacity of future developments has been developed and implemented Council DCP to include consideration of climate change impacts on Pittwater estuary 	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 3a.TAB . This strategy is applicable to the Ecology, Future Development and Climate Change Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	12, 13	3.0, 3.3, 5.0, 7.0, 7.1, 8.0
3 b) WSUD principles to be added to all development controls (draft DECC DCP)	<ul style="list-style-type: none"> Pittwater Water Management Plans to be consistent with the principles of Water Sensitive Urban Design (WSUD). Enforce WSUD principles for all new developments (including re-development). Utilise the DECCW (EPA) example WSUD DCP and determine Pittwater specific DCP requirements for WSUD principles. Require WSUD details to be submitted with Development Applications. This would involve an amendment to Pittwater DCP / new DCP. Investigate opportunities to combine aims and implementation of this strategy with implementation of FM11, FM15 from Draft Mona Vale /Bayview Floodplain Risk Management Plan, and similar actions from the Careel Creek Floodplain Risk Management Plan. Combine implementation with education to existing homes / business on best practice information and expert advice on WSUD (such as via consultation, phone, hard copy and web based resource materials). 	HIGH	By 2014	Council	Staff time	<ul style="list-style-type: none"> Amendments to Pittwater DCP or new WSUD DCP, which outlines WSUD principles to be implemented, and requires WSUD details to be submitted with development applications 	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 3b.TAB . This strategy is applicable to the Water Quality, Sediment & Erosion and Future Development Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	12	1.0, 1.1, 1.3, 2.0, 2.2, 2.3, 3.0, 3.3, 7.0, 7.1
3 c) Appropriate on-site sewage systems to be adopted, suitable for soils, topography etc	<ul style="list-style-type: none"> Conduct regular audits of existing on-site systems, to ensure adequate function, and that system is appropriate to site constraints. Recommendations from audits (eg, maintenance, replacement) to be implemented Appropriate conditions of consent to enable new systems for new developments are appropriate to site constraints, and will not contribute pollutants to nearby waterways. Consider implementing development controls for new developments in sensitive land areas that require connection to the reticulated sewerage network in return for permission to connect to the potable water supply network. 	MEDIUM	By 2014	Council Sydney Water	Staff time	<ul style="list-style-type: none"> Audit outcomes indicate all on-site sewage systems are appropriate to the site constraints and are operating correctly New developments either utilise the correct on-site system for the site constraints, or are connected to the reticulated sewage network 	Existing locations which utilise on-site sewage systems are mapped in MapInfo table 3c.TAB . Any new on-site systems should be added to this map, and areas converted to reticulated sewage network removed. This strategy is applicable to the Water Quality and Future Development Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network		1.0, 1.1, 1.2, 1.3, 3.0, 4.0, 7.0, 7.1

Strategy 3 – Prepare and Enforce DEVELOPMENT CONTROLS

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
3 d) Developments not to incorporate pollution and/or sediment discharges to the waterways	<ul style="list-style-type: none"> Review and amend development controls (eg LEP, DCP) to ensure that best practise WSUD and other treatment controls / measures are implemented for all new developments (including redevelopments), to reduce pollutant & sediment discharges. 	HIGH	By 2014	Council	Staff time. Action could be combined with Strategy 3b & 3g	<ul style="list-style-type: none"> Planning instruments include requirements for new developments to maintain or reduce sediment and pollutant discharges from the development 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 3d.TAB</p> <p>This strategy is applicable to the Water Quality, Sediment. & Erosion, and Future Development Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	1, 9, 12	1.0, 1.1, 1.2 , 1.3 , 2.0, 2.2, 2.3 , 3.0 , 3.1 , 3.3 , 4.0 , 7.0, 7.1
3 e) Developments not to degrade scenic amenity of the Pittwater estuary and surrounds	<ul style="list-style-type: none"> Review and update planning instruments to provide adequate protection to scenic amenity and values, in all areas of Pittwater. Scenic values include: <ul style="list-style-type: none"> vistas, views natural bushland expanses healthy riparian habitats Amendments may include design standards for re-developments which ensure the development is in keeping with surrounding natural aesthetics. 	MEDIUM	By 2014	Council	Staff time	<ul style="list-style-type: none"> Planning instruments include standards for re-development/ new development which ensures they are in keeping with aesthetics of Pittwater, and which protect the scenic amenity of Pittwater for all users 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 3e.TAB. This includes known areas that provide significant views or vistas.</p> <p>This strategy is applicable to the Ecology, Waterway Usage, Foreshore Usage, and Future Development Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	12	1.0 , 2.0 , 3.0, 3.1 , 3.3 , 4.0, 5.0, 7.0, 7.1
3 f) Public amenity and existing foreshore values to be retained / improved for foreshore developments	<ul style="list-style-type: none"> Review and amend existing development controls (eg LEP, DCP) to require new developments on foreshore land to improve foreshore habitats as a requirement of development approval. Improvements may include rehabilitation and maintenance of foreshore habitats. Review and amend development controls for commercial foreshore developments (eg, marinas) to ensure maximisation of public foreshore access, in addition to maintenance / improvement of foreshore habitats. Amend development controls to require demonstrated need for proposed seawalls, and construction of proposed seawalls to be conducted according to DECCW (2009) Environmentally Friendly Seawalls best practice guidelines. Amend development controls to guide the construction of appropriate seawalls in all locations around Pittwater. Amend development controls to guide the construction of appropriate wharves / jetties around Pittwater, including opportunities for shared new facilities and sharing of existing facilities instead of new facilities. 	MEDIUM	By 2014	Council DP	Staff time. Action could be combined with Strategy 3e & 3h	<ul style="list-style-type: none"> Planning instruments provide for ongoing public access to foreshores, including consideration for sea level rise. Planning instruments for foreshore public land apply to redevelopment of existing lands, in addition to new foreshore developments 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 3f.TAB</p> <p>This strategy is applicable to the Ecology, Waterway Usage, Foreshore Usage and Future Development Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	2, 3, 4, 5, 13	3.0, 3.3, 4.0, 4.2, 5.0, 5.1, 5.2 , 7.0, 7.1

Strategy 3 – Prepare and Enforce DEVELOPMENT CONTROLS

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
3 g) Make stricter sediment & erosion controls for developments	<ul style="list-style-type: none"> Review and amend existing development controls to ensure sedimentation and erosion controls (eg, via a formal Sediment & Erosion Control Plan) are implemented for all construction activities. Amendments shall reflect current best practise for sediment and erosion control on construction sites. 	MEDIUM	By 2014	Council	Staff time. Action could be combined with Strategy 3d	<ul style="list-style-type: none"> Sediment and Erosion controls are implemented for all for construction activities, via the appropriate planning instruments 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 3g.TAB</p> <p>This strategy is applicable to the Water Quality, Sediment & Erosion and Future Development Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	12	1.0, 1.1, 2.0, 2.2, 3.0, 7.0 , 7.1
3 h) Require all new marina developments (> 9 berths) to have pump-out services	<ul style="list-style-type: none"> Modify planning instruments (LEP, other statutory regulation) to require all new marinas or redevelopment/modification to existing marinas with more than 9 berths to install sewage pump-out facilities. For example, a clause stating this intent could be included in the new Pittwater LEP, inserted under Part 5 Miscellaneous Provisions (refer the Standard LEP template). To enable this strategy to also be implemented for Marina developments classed as "Designated Development" under Part 3A of the EPA Act, Council shall request DP to modify or develop specific statutory regulations for Pittwater, such that pump-out facilities are mandatory for marina developments (> 9 berths) in the Pittwater Estuary (similar controls have been implemented for Sydney Harbour). 	HIGH	By 2014	Council DP	Staff time	<ul style="list-style-type: none"> All planning instruments (local and state) are updated to require pump-out facility installation for new marina developments (ie new marina or redevelopment of existing marina) > 9 berths 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 3h.TAB (ie, all foreshore regions where marina developments are permitted).</p> <p>This strategy is applicable to the Water Quality, Waterway Usage, and Future Development Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	10	1.0, 1.1, 1.2, 1.3, 3.0, 4.0 , 4.2, 7.0, 7.1

Strategy 4 – Undertake ACTIVITY CONTROLS / MODIFICATIONS

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
4 a) Limit proximity of boating activities to environmentally significant areas and other sensitive areas (eg infested areas), incl. no anchoring	<ul style="list-style-type: none"> Assess environmentally significant areas to determine which areas require lower speed limits, 'no wake' zones, 'no anchoring' zones, and / or the installation of floating buoys (such as to mark seagrass areas) to discourage boating activity. Careel Bay and Barrenjoey (Station Beach) are two areas that should be considered. Consider buoy markers and 'no anchoring' restrictions for areas of <i>Caulerpa taxifolia</i>, to minimise the spread of this weed. Enter a request with NSW Maritime for areas requiring lower speed limits, 'no anchoring' zones and floating buoy markers to discourage boating in sensitive areas. Future proposed public pumpout services to be sited away from areas of high environmental sensitivity. 	MEDIUM	By 2014	NSW Maritime Council and DII (Fisheries)	Staff time to assess + \$10,000 for installation of buoys / signs	<ul style="list-style-type: none"> Environmentally significant areas have been assessed, and appropriate restrictions installed, to minimise damage from boating 	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 4a.TAB This strategy is applicable to the Ecology and Waterway Usage Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	6, 10, 11	1.0, 2.1, 3.0, 3.2, 3.3, 4.1, 4.2
4 b) Replace existing moorings with seagrass friendly moorings in areas close to existing seagrass beds	<ul style="list-style-type: none"> Determine remaining moorings within seagrass beds (ie, those not already replaced as part of the Bringing Back the Fish program with NHT and HNCMA), and apply for funding for their replacement with appropriate seagrass friendly moorings. Following outcomes of the trial of seagrass friendly moorings, include use of recommended, appropriate seagrass friendly moorings within the appropriate planning instruments (e.g. Pittwater 21 DCP). 	MEDIUM	By 2014	HNCMA, Maritime, with assistance from DII (Fisheries) and Council	\$1500 to \$5000 per mooring, depending on mooring type	<ul style="list-style-type: none"> All moorings within seagrass beds have been replaced with a seagrass friendly moorings 	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 4b.TAB This strategy is applicable to the Ecology and Waterway Usage Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	10	3.0, 3.3, 4.1, 4.2
4 c) If necessary, reduce boating speed limits in areas of high waterway use / traffic (eg western side of Scotland Island)	<ul style="list-style-type: none"> Undertake review of current speed restrictions in all areas that are known commuter and heavy boat traffic routes (refer to strategy map for relevant locations). 	LOW	By 2020	NSW Maritime	Staff time to review, up to \$5000 to replace boating signage	<ul style="list-style-type: none"> All areas of high boat traffic have appropriate speed restrictions to improve the safety for boat users, particularly regular commuters 	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 4c.TAB This strategy is applicable to the Waterway Usage Sub-plan Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	10	4.0, 4.1, 4.2
4 d) If necessary, relocate existing moorings away from areas of high environment significance and/or high vessel traffic	<ul style="list-style-type: none"> Undertake review of mooring locations compared with areas of high boat traffic. Relocate moorings which pose a hazard to boating safety, ensuring the new location will not harm the aquatic environment. 	LOW	By 2020	NSW Maritime, with assistance from DII (Fisheries) for suitable new mooring locations	Staff time to assess + \$500 to relocate an existing mooring	<ul style="list-style-type: none"> No moorings pose a threat to the safety of boat users along high boat traffic routes 	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 4d.TAB This strategy is applicable to the Waterway Usage Sub-plan Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	10	3.0, 4.0, 4.1, 4.2

Strategy 4 – Undertake ACTIVITY CONTROLS / MODIFICATIONS

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
4 e) Remove significant impediments to fish passage	<ul style="list-style-type: none"> Hold discussions with the flood gate owner, DII (Fisheries), Council, DECCW and HNCMA, to arrange for the removal (or changed management, where removal is not possible) of the flood gate on Cahill Creek, upstream of Pittwater Road and adjacent to Bayview Golf Club. Investigate combined implementation of this strategy with Action FM3 of the Draft Mona Vale / Bayview Floodplain Risk Management Plan. 	LOW	By 2014	DII (Fisheries), HNCMA, Council and DECCW	\$5000 approx. for the removal of the structure + staff time to coordinate	<ul style="list-style-type: none"> The flood gate on Cahill Creek (upstream of Pittwater Road and adjacent to Bayview Golf Club) has been removed, or is being managed to allow fish passage 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 4e.TAB</p> <p>It should be noted that HNCMA has investigated road crossings and weirs across the Hawkesbury Nepean, and found no other obstructions from these structures in Pittwater.</p> <p>This strategy is applicable to the Ecology Sub-plan</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	4	3.0, 3.3
4 f) Encourage all existing large marinas (> 30 berths) to install pump-out services	<ul style="list-style-type: none"> Install a voluntary charter with marina operators, for the installation of pump-out services at marinas with > 30 berths. Investigate opportunities to link ongoing EPA licences with a requirement for the installation of pump-outs at marinas with > 30 berths. Add a clause to the new Pittwater LEP (under Part 5 Miscellaneous Provisions of the Standard LEP template) that requires the provision of pump-out facilities to be considered for the future development/modifications of existing marinas. 	MEDIUM	By 2014	Council, DECCW (EPA) and NSW Maritime, with assistance from other state agencies (DP) as required	Staff time	<ul style="list-style-type: none"> Existing marinas > 30 berths to have installed pump-out facilities 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 4f.TAB</p> <p>This strategy is applicable to the Water Quality and Waterway Usage Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	10	1.0, 1.1, 1.2, 1.3, 3.0, 4.1, 4.2,
4 g) If necessary, reduce the total number of moorings within Pittwater to a more appropriate capacity / mooring limit, through opportunistic relinquishment and offsets through new marina developments.	<ul style="list-style-type: none"> Review the appropriateness of the existing Pittwater mooring cap, to consider environmental values, existing facilities, waterway activities, and physical space available. As recommended by the review, reduce the mooring cap and remove moorings on an opportunistic basis (such as when mooring licences are not renewed). Investigate extending the cap to berthed vessels (ie, within marinas, on private jetties), to limit the number of vessels in the waterway. If the cap is extended to include berthed as well as moored vessels, when new wet berths are created, a corresponding number of swing moorings must be relinquished and cancelled to allow for the additional wet berths. 	MEDIUM	By 2020	NSW Maritime, with assistance from Council, DECCW and DII (Fisheries) as required	Staff time	<ul style="list-style-type: none"> The mooring cap in Pittwater reflects the constraints of the environment Inclusion of wet berths in the Pittwater cap has been investigated, and if possible, implemented 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 4g.TAB</p> <p>This strategy is applicable to the Ecology and Waterway Usage Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	2	3.0, 3.3, 4.0, 4.2

Strategy 5 – Construct NEW OR IMPROVED SERVICES / ASSETS

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
5 a) Install new and/or upgrade and repair existing waterway access locations / points, and foreshore access and facilities, giving consideration to the environment	<ul style="list-style-type: none"> Undertake a review of the level and type of waterway infrastructure (eg, public wharves, jetties, boat ramps, tie-up pontoons, fuelling and pump-out facilities etc) and foreshore access and recreation facilities. Determine the ability of existing structures to protect the foreshore and aquatic environment in addition to serving the demands of foreshore and waterway users. Compile a program of works to rationalise existing facilities (including removal of poor facilities) and provide new facilities in appropriate locations, to enhance the protection of the environment from damage due to waterway and foreshore recreational use. Public foreshore accessways are to be confined to areas of low environmental significance (ie, away from wetlands, saltmarsh and mangroves, riparian habitat). Formalise accessways where there is strong demand for access in areas of high environmental significance, to minimise impacts and discourage informal tracks. Arrange for removal of encroachments from private property onto public foreshore land. 	LOW	By 2020	Council DECCW, DII (Fisheries), HNCMA, and NSW Maritime	Staff time to undertake review of facilities. Unknown cost for construction of facilities	<ul style="list-style-type: none"> All foreshore and waterway facilities are located or designed to minimise the impact upon foreshore and aquatic habitats 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 5a.TAB</p> <p>This strategy is applicable to the Ecology, Waterway Usage and Foreshore Usage Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	2, 3, 4, 5, 6, 7, 8, 10, 11	3.3, 4.0, 4.2 , 5.1,

Strategy 6 – Undertake ENVIRONMENTAL AND HERITAGE REHABILITATION

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
6 a) Repairs / rehabilitation of significant heritage sites (Aboriginal and/or early European)	<ul style="list-style-type: none"> Investigate the condition of known Aboriginal and European heritage sites. Carry out repairs to structures to ensure their integrity, or restore degraded structures / sites as show-pieces of former usage and estuary based activities. Rehabilitation of sites of natural heritage (primarily Aboriginal sites) should include erosion stabilisation, revegetation and protective measures to conserve the sites. 	LOW	By 2020	Council DECCW, Dept of Lands, HNCMA	Staff time.	<ul style="list-style-type: none"> All sites of Aboriginal or European heritage significance have been repaired or rehabilitated to ensure their preservation 	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 6a.TAB This strategy is applicable to the Heritage Sub-plan Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	3, 4, 8	6.0, 6.1, 6.2 , 6.3
6 b) Redress erosion along Pittwater foreshores and along catchment streams / tributaries (Rowland Reserve remediation works were completed in 2009)	<ul style="list-style-type: none"> Undertake foreshore erosion stabilisation works at Cicada Glen Creek and McCarrs Creek Reserve (refer to strategy map for location). These works are permitted to be completed by Council without development consent under SEPP (Infrastructure) 2007. Undertake foreshore erosion works at Yachtsmans Paradise, Station Beach, and Careel Bay playing fields. Assess all stormwater outlets to the estuary for erosion, and complete remediation works to redress erosion found (refer to BPG 1). Small scale remediation for environmental management is permitted by Council without development consent under SEPP (Infrastructure) 2007. 	MEDIUM	By 2014	Council DECCW, HNCMA may provide assistance	Proposed stabilisation works at McCarrs Creek and Cicada Glen Creek ~ \$10,000 each. > \$100,000 (typ) for other sites	<ul style="list-style-type: none"> Remediation works have been completed at McCarrs Creek, Cicada Glen Creek, Yachtsmans Paradise, Station Beach, and Careel Bay playing fields Erosion has been redressed at stormwater outlets to the estuary and its tributaries The remediation works have successfully mitigated erosion 	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 6b.TAB This strategy is applicable to the Sediment & Erosion Sub-plan Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	1, 3, 4	1.0 , 1.1 , 2.0, 2.1, 2.2 , 3.0, 3.1, 3.2

Strategy 6 – Undertake ENVIRONMENTAL AND HERITAGE REHABILITATION

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
6 c) Re-vegetation along estuary foreshores and along riparian zones within catchment (on both public and private lands) to connect habitats, provide shade and enhance ecological communities (esp. EECs)	<ul style="list-style-type: none"> On unvegetated public foreshores, undertake planting of indigenous species. Encourage voluntary revegetation on privately owned lands through education, assistance and incentives (eg, through HNCMA programs or similar). Replace existing concrete lined drains with natural vegetation and meanders. Where the ability to do works is limited by space, land ownership issues or potential flood impacts, attempts to revegetate available areas should be maximised. Priority locations for creek rehabilitation or removal of concrete channels include: <ul style="list-style-type: none"> Careel Creek (particularly upstream from Barrenjoey Road) Mona Vale Main Drain (open drain through light industrial area at Mona Vale) Cahill Creek (upstream of Bayview Golf Course) Bayview Golf Course channels and watercourses Bayview Golf Course floodgates (in conjunction with Strategy 4e). Under new SEPP (Infrastructure) 2007 provisions, Councils works teams are permitted to undertake these environmental management activities without the need for development consent. Refer to BPG for further guidance. Investigate combined implementation of this strategy with Action FM12 of the Draft Mona Vale / Bayview Floodplain Risk Management Plan. 	MEDIUM	By 2014	Council HNCMA	Costs will depend upon the extent of works undertaken.	<ul style="list-style-type: none"> Concrete channels and formalised drains have been removed, and rehabilitated to the greatest extent possible (given land ownership, flooding and other possible constraints) Vegetation on public foreshore land has been maximised to the greatest possible extent Private foreshore land is being managed by private owners to maximise foreshore vegetation and maintain foreshore habitat 	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 6c.TAB This strategy is applicable to the Sediment & Erosion, Ecology and Climate Change Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	4, 5, 6	1.0, 2.1, 2.2, 3.0, 3.1, 3.3
6 d) Weed and exotic species control, including <i>Caulerpa taxifolia</i>.	<ul style="list-style-type: none"> Prioritise areas of known weed invasion on public land (refer to strategy mapping for known areas of riparian habitat and creeks requiring rehabilitation). Develop a prioritised program of works for public land, and systematically undertake on-ground works to remove weeds and exotic species from riparian and foreshore habitats, including tributary streams. Investigate and undertake methods to maximise the removal of <i>Caulerpa taxifolia</i> from the waterway (refer to strategy mapping for known areas of <i>Caulerpa</i> outbreak). For private land, undertake education of landowners and targeted incentive programs to encourage weed removal. 	MEDIUM	By 2014	Council, HNCMA, DII (Fisheries)	Costs will depend upon the extent of works undertaken.	<ul style="list-style-type: none"> Foreshore habitats are being effectively managed, with effective and ongoing weed removal and reduction Aquatic weeds (<i>Caulerpa taxifolia</i>) is being managed to the highest standard, with reduction in weed extents 	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 6d.TAB This strategy is applicable to the Ecology Sub-plan Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	8, 10, 11	3.0, 3.1, 3.2, 3.3

Strategy 7 – Initiate POLLUTION REDUCTION MEASURES

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
7 a) Targeted measures for reducing marina operations waste	<ul style="list-style-type: none"> Hold discussions with individual marina operators, to identify ways to minimise pollutants to the waterway, particular from boat maintenance activities (eg, using slipways for anti-fouling works). Consider a voluntary marina waste charter, to encourage best practise waste reduction and control at marinas. As required, link voluntary charter requirements with EPA licence requirements (at present, 4 marinas hold EPA licences). As required, measures from the voluntary charter could be included as requirements for future development at marinas. 	HIGH	By 2014	Council DECCW (EPA), DII (Fisheries), NSW Maritime	Staff time. Actions could be combined with Strategy 4f.	<ul style="list-style-type: none"> All marinas are operating at best practise standard, to capture and correctly dispose of all site runoff from boat maintenance and other activities. 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 7a.TAB</p> <p>This strategy is applicable to the Water Quality, Sediment & Erosion and Waterway Usage Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	10	1.0, 1.1, 1.2, 1.3, 2.3, 3.0, 4.2,
7 b) Targeted catchment management measures, following catchment-wide urban pollution and sediment runoff audit (esp. areas discharging to poorly flushed embayments)	<ul style="list-style-type: none"> Conduct a catchment wide urban pollution and sediment run off audit. This will include assessing activities and land uses which constitute a potential source of pollutants to watercourse, including upper catchment areas. Consider incorporating update and review of Pittwater Stormwater Management Plan (1999) as part of catchment wide audit. The audit shall include water quality monitoring, detailed mapping and site inspection particularly at suspected pollutant contributors, eg landfill sites, golf courses, industrial sites, service stations, landscaping businesses, nurseries. Areas draining to poorly flushed embayments shall be assessed as a priority, namely: <ul style="list-style-type: none"> Mona Vale Main Drain Careel Creek Cicada Glen Creek Winji Jimmy Bay Scotland Island, Catherine Park. Prioritise areas of greatest impact, and systematically undertake mitigative measures to reduce sediment and pollutant discharges. Potential mitigative actions may include - vegetating and sealing exposed ground and unsealed roads; runoff diversions to filter strips. Catchment wide audit is to be consistent within the context of the Pittwater Water Management Plans. 	HIGH	By 2014	Council DECCW Landowners of identified sites will be responsible for implementing mitigative measures	\$50,000 for audit, cost for implementing measures will depend on extent of works undertaken	<ul style="list-style-type: none"> Catchment wide audit of pollutant and sediment discharge has been conducted for Pittwater catchment Priority actions and mitigative measures have been implemented by Council and private landowners 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 7b.TAB</p> <p>This strategy is applicable to the Water Quality and Sediment & Erosion Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	1, 5, 8, 12	1.0, 1.1, 1.2, 1.3, 2.0, 2.2, 2.3, 3.0

Strategy 7 – Initiate POLLUTION REDUCTION MEASURES									
Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
7 c) Minimise overflows from the reticulated sewerage system (through Sydney Water consultation)	<ul style="list-style-type: none">Completion of the SewerFix Wet Weather Abatement Program in Pittwater, which involves improvements to pipes, storage facilities and design overflow points.	MEDIUM	By 2020	Sydney Water Council, DECCW (EPA), Department of Health	Costs will depend upon the extent of works undertaken.	<ul style="list-style-type: none">Overflows from pipes, storage facilities, design overflow points, and pumping stations have been eliminated in Pittwater catchment	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 7c.TAB This strategy is applicable to the Water Quality Sub-plan Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network		1.0, 1.1, 1.2, 1.3, 2.3, 3.0, 4.0

Strategy 8 – Undertake COMMUNITY EDUCATION

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
8 a) Community Education - No discharge status of Pittwater	<ul style="list-style-type: none"> Educate waterway users that Pittwater estuary is a "no discharge" zone, which means effluent from boats is prohibited from being discharged into the water in all areas of the estuary. <u>Preferred education methods</u> include: <ul style="list-style-type: none"> Signage Public displays Brochures (including existing NSW Maritime resources) Face to face discussions, eg with boat owners at marinas. <p><u>Target audience:</u></p> <ul style="list-style-type: none"> Waterway users, particularly recreational boaters and fishers (educating all types of waterway users will assist to disseminate this message between the waterway community). Waterway commercial operators and businesses, including marinas and commercial boat operators (and who may also assist educating others of the boating public). 	MEDIUM	By 2014	NSW Maritime, Council	Staff time + \$10,000 approx. for education materials and activities	<ul style="list-style-type: none"> All waterway users (recreational and commercial) understand and observe the status of Pittwater as a "No Discharge Zone" 	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 8a.TAB This strategy is applicable to the Water Quality and Waterway Usage Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	10	1.0, 1.1, 1.2, 1.3, 3.0, 4.0, 4.2
8 b) Community Education - Discouragement of use of high-pollution older-style 2 stroke outboard motors	<ul style="list-style-type: none"> Undertake education to discourage use of older style 2-stroke outboards because they exhaust up to 30% of the fuel/oil mix directly into the waterway. <u>Preferred education methods</u> include: <ul style="list-style-type: none"> Signage / Public displays Brochures Demonstrations Face to Face discussions. <p><u>Target audience:</u></p> <ul style="list-style-type: none"> Waterway users Waterway commercial operators/businesses, such as marinas (who may assist educating others of the boating public). 	MEDIUM	By 2014	NSW Maritime, Council	Staff time + \$10,000 approx. for education materials and activities	<ul style="list-style-type: none"> All boaters use newer style engines, to prevent fuel and oil discharge to the waterway 	Locations to which this strategy applies in Pittwater are mapped in MapInfo table 8b.TAB This strategy is applicable to the Water Quality, Ecology and Waterway Usage Sub-plans Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network	10	1.0, 1.1, 1.3, 2.3, 3.0, 4.2

Strategy 8 – Undertake COMMUNITY EDUCATION

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
8 c) Community Education - Catchment management for waterway health and biodiversity (e.g. use of fertilisers, pesticides etc)	<ul style="list-style-type: none"> Review existing programs, develop and undertake education about catchment management, including: <ul style="list-style-type: none"> stormwater management control and reducing flow velocities and flow to groundwater systems minimising the use of fertilisers and pesticides properly managing water usage Gardens for wildlife and planting native species, and how to recognise and remove environmental weeds. <u>Preferred education methods</u> include: <ul style="list-style-type: none"> Environmental and sustainability Management plans for community, schools, business Volunteering including bushcare and catchment monitoring School excursions Joint projects between schools, community and Council Expert advice and mentoring Printed and electronic resources Eco walks and street events. <p><u>Target audience:</u></p> <ul style="list-style-type: none"> Community groups and schools Catchment businesses (e.g.golf courses, sporting grounds etc) Catchment residents. 	MEDIUM	By 2014	Council HNCMA, DECCW	Staff time FTE/s required + \$10,000 approx. for education materials and activities	<ul style="list-style-type: none"> All large scale landowners are implementing best practise for fertiliser and pesticide usage and water management Small scale residential landowners are aware of correct methods of fertiliser and pesticide usage and water conservation 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 8c.TAB</p> <p>This strategy is applicable to the Water Quality, Sediment & Erosion and Ecology Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	8, 9	1.0, 1.1, 1.2, 1.3, 2.0, 2.2, 2.3, 3.0

Strategy 8 – Undertake COMMUNITY EDUCATION

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
8 d) Community Education - Appropriate foreshore use (including education of foreshore landowners)	<ul style="list-style-type: none"> Review existing programs, develop and provide education regarding: <ul style="list-style-type: none"> the importance of foreshore habitats, intertidal zone, and aquatic habitats such as seagrass beds use of these habitats by migratory birds for feeding and roosting the impacts of disturbance by humans, dogs & other companion animals, through trampling, noise, litter and dog faeces the location of sensitive foreshore and aquatic habitats, and other more suitable foreshore access and waterway areas, for bathing and boating etc responsible bait collection and compliance with Fisheries Bag Limits. <u>Preferred education methods</u> include: <ul style="list-style-type: none"> Expert advice and mentoring Printed and electronic resources Gardens for wildlife – controlling invasive weeds, using local native plants, less water and less fertilisers and chemicals Eco walks and street events Workshops and guest speakers Joint projects with schools, community and Council Volunteering including bushcare and catchment monitoring. <p><u>Target audience:</u></p> <ul style="list-style-type: none"> Residents of the foreshore and catchment Businesses on the foreshore, waterway and catchment (commercial and non-commercial). 	MEDIUM	By 2014	Council, HNCMA, DII (Fisheries), NSW Maritime	Staff time + \$10,000 approx. for education materials and activities	<ul style="list-style-type: none"> All foreshore and waterway users are educated as to the value of foreshore and aquatic habitats All foreshore and waterway users are educated about ways to minimise the disturbance and protect foreshore and aquatic habitats 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 8d.TAB</p> <p>This strategy is applicable to the Ecology, Waterway Usage and Foreshore Usage Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	3, 5, 6, 7, 10, 11	1.0, 2.1, 3.0, 3.1, 3.3, 4.0, 4.2, 5.0, 5.1, 6.0, 7.1,
8 e) Community Education - Aboriginal values	<ul style="list-style-type: none"> Review existing programs, develop and undertake education regarding Pittwater's important Aboriginal heritage and values, including public sites of significance. <u>Preferred education methods</u> for this subject include: <ul style="list-style-type: none"> School excursions Workshops and guest speakers Printed and electronic resources Eco walks Community fair. <p><u>Target audience:</u></p> <ul style="list-style-type: none"> Catchment residents, community groups and schools Catchment users. 	LOW	By 2020	Council, HNCMA	Staff time + \$10,000 approx. for education materials and activities	<ul style="list-style-type: none"> Catchment users (including visitors and residents) are made aware of the history of Aboriginal culture at Pittwater and its value 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 8e.TAB</p> <p>This strategy is applicable to the Waterway Usage, Foreshore Usage and Heritage Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>		6.0, 6.1, 6.3

Strategy 8 – Undertake COMMUNITY EDUCATION

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
8 f) Community Education - General environmental values of estuary	<ul style="list-style-type: none"> Review existing programs, develop and undertake education outlining: <ul style="list-style-type: none"> the importance of Pittwater as an estuary of local to national significance; the diverse environments and environmental values; local ecology and the impact of day to day human activities; sensitive areas such as Careel Bay; and solutions to issues and opportunities for personal action to make a difference. Preferred education methods for this subject include: <ul style="list-style-type: none"> Printed and electronic resources Sustainable Living – good for the family and good for the environment Market Days School excursions Eco walks Gardens for wildlife – controlling invasive weeds, using local native plants, less water and less fertilisers and chemicals Expert advice Workshops and guest speakers Volunteering (e.g. bushcare, catchment monitoring). <p><u>Target audiences</u></p> <ul style="list-style-type: none"> Catchment residents Community groups, schools Catchment businesses. 	HIGH	By 2014	Council, DECCW, HNCMA	Staff time + \$10,000 approx. for education materials and activities	<ul style="list-style-type: none"> Catchment users and residents are aware of and have available access to education regarding the environmental values of Pittwater estuary 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 8f.TAB</p> <p>This strategy is applicable to the Water Quality, Sediment & Erosion, Ecology, Waterway Usage, Foreshore Usage and Heritage Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	6, 10, 11, 12, 13	1.0, 1.1 , 1.3 , 2.0, 2.2 , 2.3 , 3.0 , 3.2 , 3.3 , 4.2, 6.3, 7.1, 8.0

Strategy 9 – Increase COMPLIANCE WITH EXISTING REGULATIONS

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
9 a) Compliance: Permanent occupancies on boats	<ul style="list-style-type: none"> Obtain additional resources and / or compliance officers. Enforce regulations prohibiting the permanent occupation of boats. 	MEDIUM	By 2020	NSW Maritime, Council	Additional officer required	<ul style="list-style-type: none"> There is no permanent occupancy on boats in Pittwater 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 9a.TAB</p> <p>This strategy is applicable to the Water Quality and Waterway Usage Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	10	1.0, 1.1, 1.2, 1.3, 3.0, 4.2
9 b) Compliance: Boating regulations, ie speeds, dangerous behaviour, Caulerpa controls / washdown	<ul style="list-style-type: none"> Obtain additional resources and / or compliance officers. Enforce boating and waterway regulations, such as speed limits, "no discharge" zones, Caulerpa control and washdown, littering, dangerous behaviour etc. 	MEDIUM	By 2014	NSW Maritime, Council	Additional officer required	<ul style="list-style-type: none"> Boating regulations are adhered to by waterway users 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 9b.TAB</p> <p>This strategy is applicable to the Water Quality, Sediment & Erosion, Ecology and Waterway Usage Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	10	1.0, 2.1, 3.0, 4.0, 4.1, 4.2, 6.0,
9 c) Compliance: Sediment and erosion controls, as well as other development controls / conditions	<ul style="list-style-type: none"> Obtain additional resources and / or compliance officers. Enforce sediment and erosion controls on construction sites. Enforce development controls and conditions. 	MEDIUM	By 2014	Council	Additional officer required	<ul style="list-style-type: none"> Sediment and erosion controls are properly implemented on all construction sites Development conditions and controls are properly and fully implemented at all development sites 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 9c.TAB</p> <p>This strategy is applicable to the Water Quality, Sediment & Erosion and Future Development Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	3, 4, 5, 12	1.0, 1.1, 1.3, 2.0, 2.2, 2.3, 3.0, 4.2, 7.0, 7.1
9 d) Compliance: On-site sewage systems operation	<ul style="list-style-type: none"> Obtain additional resources and / or compliance officers. Conduct regular audits of on-site sewage disposal systems, to determine if systems are functioning adequately, are appropriate to soil types and depth, site slopes, topography and other site constraints, and systems capacity. Provide recommendations on maintenance and/or replacement of systems, based on audit outcome. Ensure recommendations are implemented. 	MEDIUM	By 2014	Council	Additional officer required	<ul style="list-style-type: none"> All on-site sewage systems are operating properly, maintained, and suitable to site constraints 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 9d.TAB</p> <p>This strategy is applicable to the Water Quality and Future Development Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>		1.0, 1.1, 1.2, 1.3, 3.0, 7.0, 7.1

Strategy 9 – Increase COMPLIANCE WITH EXISTING REGULATIONS

Strategy	Actions for Implementation	Priority	Timeframe	Responsibility	Cost Estimate	Measurable	Strategy Mapping	Relevant BPGs	Objectives Addressed
9 e) Compliance: Water pollution from boats and waterway businesses (e.g. marinas)	<ul style="list-style-type: none"> Obtain additional resources and / or compliance officers. Conduct regular audits of waterway businesses (eg marinas), to ensure waste from maintenance activities is correctly disposed of, and pollutants in run off is minimised. Other locations of boat maintenance are to dispose of waste correctly, and minimise pollutant run off to the estuary. Provide recommendations on maintenance. Ensure recommendations are implemented. 	HIGH	By 2014	NSW Maritime, Council	Additional officer required	<ul style="list-style-type: none"> All marinas and other boat maintenance facilities are implementing controls to capture and correctly dispose of all site runoff from boat maintenance and other activities. 	<p>Locations to which this strategy applies in Pittwater are mapped in MapInfo table 9e.TAB</p> <p>This strategy is applicable to the Water Quality, Sediment & Erosion, Waterway Usage and Foreshore Usage Sub-plans</p> <p>Refer to indicative Sub-plan Maps in Chapter 8, and Sub-plan Workspaces in Council's GIS Network</p>	10, 11	1.0, 1.1, 1.2, 1.3, 2.3, 3.0 , 4.0 , 4.2,

7.2 Funding Opportunities

7.2.1 Estuary Management Program

A proportion of the required funds may be sourced from the NSW Estuary Management Program. The program provides dollar for dollar funding for strategies included in an adopted Estuary Management Plan prepared according to the NSW Estuary Management Manual (ie, this Plan).

7.2.2 HNCMA

The Hawkesbury Nepean Catchment Management Authority (HNCMA) is a statutory body with the key purpose of coordinating natural resource management in the Hawkesbury – Nepean catchment. The HNCMA's Hawkesbury Nepean Catchment Action Plan (HNCAP) sets out management targets specific to the Hawkesbury Nepean catchment to achieve state-wide and specific conditions targets for the Hawkesbury-Nepean. The HNCAP provides the mechanism and strategy for HNCMA to direct the investment from state and federal governments into natural resource management in the Hawkesbury Nepean catchment.

The HNCMA has outlined the following target and aim which relates specifically to the PEMP, namely River Health Management Target RH5-1 Estuary, coastal and marine management plans:

- Implement or assist with implementation of relevant, high priority actions that are identified in **estuary management plans** or other management plans that have been cooperatively developed through a formalised process with all stakeholders, including community, councils and agencies (eg, the PEMP).

The HNCMA action for this target is to identify strategies within estuary management plans which are suitable for and/or of high priority to HNCMA to assist in implementing. Additional actions outlined by the HNCMA are to assist with education regarding *Caulerpa taxifolia* and the value of seagrass beds, and to instigate a Wetlands Program and a Local Governments Partnership Program.

There are a range of management targets outlined in the HNCAP which relate to fulfilling the Target RH5-1 stated above. In the description of management strategies given in Appendix E, management targets from the HNCAP which align with the strategies have been stated, and provide a guide when seeking funding for the management options of this Plan.

7.2.3 Recreational Fishing Trusts

All revenue raised by the NSW recreational fishing fee is placed into two Trust Funds dedicated to improving recreational fishing:

- the Recreational Fishing (Freshwater) Trust Fund; and
- the Recreational Fishing (Saltwater) Trust Fund.

Anyone can apply for funding from the Recreational Fishing Trusts, including fishing clubs and organisations, universities, councils, community groups, individuals and so on. Joint applications are also encouraged.

Grants are determined by The Minister for Primary Industries who receives advice on Trust Fund expenditure from the Advisory Council on Recreational Fishing, which consists of people with expertise in all aspects of recreational fishing. Two sub-committees of the Advisory Council, the Recreational Fishing Saltwater and Freshwater Trust Expenditure Committees assess funding applications and then the Advisory Council makes recommendations for funding priorities to the Minister.

Funding applications must relate to the improvement of recreational fishing. Successful projects are usually funded for one year, however, funding may be provided for up to a maximum of three years from the initial grant.

Priorities for funding from the Trust Funds include:

- recreational fisheries enhancement;
- angler education, information and training;
- research on popular recreational species;
- recreational fisheries access and facilities;
- recreational fisheries sustainability;
- maximising the benefits to geographic areas or numbers of recreational fishers;
- leverage off other projects; and
- incorporating matched funding or in-kind contribution by the applicant.

7.2.4 Caring for Our Country

Caring for our Country commenced on 1 July 2008 bringing together delivery of a raft of Commonwealth natural resource management funding programs into an integrated package. The programs consolidated under this program included the Natural Heritage Trust, the National Landcare Program, the Environmental Stewardship Program, and elements of the Working on Country program. *Caring for Our Country* provides \$2.25 billion in funding over five years from 1 July 2008 to June 2013. The program will focus on achieving strategic results and invest in six national priority areas:

1. a national reserve system,
2. biodiversity and natural icons,
3. coastal environments and critical aquatic habitats,
4. sustainable farm practices,
5. natural resource management in remote and northern Australia, and
6. community skills, knowledge and engagement.

The program allows for non-government organisations, regional bodies, Local Government and State, Territory and Australian Government agencies to apply for program funds to help achieve these national priorities. Pittwater management strategies may be able to apply for funding grants in relation to priorities 1, 2, 3, and 6 listed above.

7.2.5 Coordination with Neighbouring Councils

Neighbouring councils Hornsby Shire Council and Gosford City Council are managers of the waters of the Lower Hawkesbury, which Pittwater is part of, and Brisbane Waters, which also flows into the Lower Hawkesbury. As these waterways are linked, their management would also benefit from coordination across the three councils.

Pittwater Council should endeavour to undertake joint projects where this is mutually beneficial to the Pittwater waterway and to implementing the management strategies and to achieving the objectives of the Pittwater EMP. Additional advantages of this include:

- encouraging consistency in estuary management approach and standards across the three peer councils, which shall inevitably benefit the waterways;
- application for grants by the three councils in a coordinated and consistent manner, which may prove more attractive to funding bodies, particularly for undertaking studies to fill data gaps and preparing a database of environmental information, where there may be significant financial and environmental advantages in coordinating such studies;
- ability to apply economies of scale to use of grant funding; and
- assisting all councils to demonstrate commitment to achieving state-wide and Hawkesbury Nepean CAP targets.

8 ESTUARY MANAGEMENT SUB-PLANS

8.1 Introduction

The estuary management sub-plans are 'stand-alone' packages of strategies that focus on specific issues within Pittwater, namely:

- Water Quality;
- Sedimentation and Erosion;
- Ecology;
- Waterway Use;
- Foreshore Use;
- Heritage;
- Future Development; and
- Climate Change.

The sub-plan categories correspond to the different 'areas' of management objectives, as development during the Estuary Management Study.

Each management strategy that relates to the different management categories above have been compiled to form separate Sub-Plans. Table 8-1 presents the applicability of each strategy to the different management categories, to form the Sub-Plans.

8.2 Sub-plan Mapping and GIS resource

A MapInfo workspace has been compiled for each sub-plan category. The GIS workspace contains layers for the various issues and values relating to the sub-plan, for example, the Ecology Sub-plan contains layers for mangroves, saltmarsh, seagrass, endangered ecological communities, and so on. The workspace also contains the strategy layer for each of the strategies that apply to each sub-plan, as given in Table 8-1. That is, Table 8-1 demonstrates which of the strategies are included on each of the sub-plan maps (with a separate GIS layer for each strategy within the sub-plan workspaces).

Each of the sub-plan workspaces are available through Council's GIS system (which adapts the MapInfo Platform). As noted for the strategies in Chapter 7, the strategy layers within MapInfo contain all of the implementation details for that strategy. Thus, the sub-plan workspaces provide a powerful, interactive tool which illustrates all of the issues and values associated with each sub-plan category, and the strategies and implementation details that shall mitigate such issues and maintain / improve the values.

For the purpose of this Estuary Management Plan document, sub-plan maps have been compiled for each sub-plan category. Because the issues are already illustrated within this document (Appendix C), to clearly illustrate the strategies associated with each sub-plan, the Sub-plan maps only show the strategies associated with each category, and not issues or values. As noted above, mapping of issues and values is contained within the MapInfo workspaces, at Council.

The figures illustrating the sub-plan maps are low resolution for inclusion in this plan document. Full resolution high quality copies of the Sub-plan maps can be accessed at Council.

8.2.1 Review and Update of Mapping Resources

In order to ensure that the GIS resources developed for this project remain current and of usable quality, regular updates to the associated workspaces and mapping layers should be undertaken. The update would involve:

- amending the maps as new information on locations relevant to the strategies are identified, for example, additional EEC extents from vegetation mapping being conducted at present or new erosion sites are identified; and
- amending the maps as strategies are implemented and locations relevant to the strategies are remediated, for example, where erosion sites are treated, stormwater outlets are upgraded, and sewer overflows are repaired.

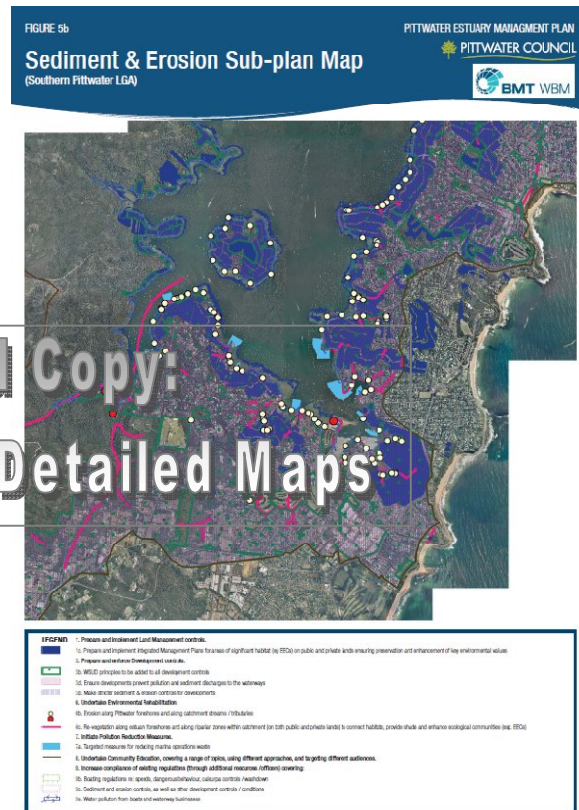
Updates to mapping layers and workspaces should be coordinated to occur as part of the annual plan review, as detailed in Section 11.2 of this plan.

Table 8-1 Applicability of Strategies to the Estuary Sub-plans

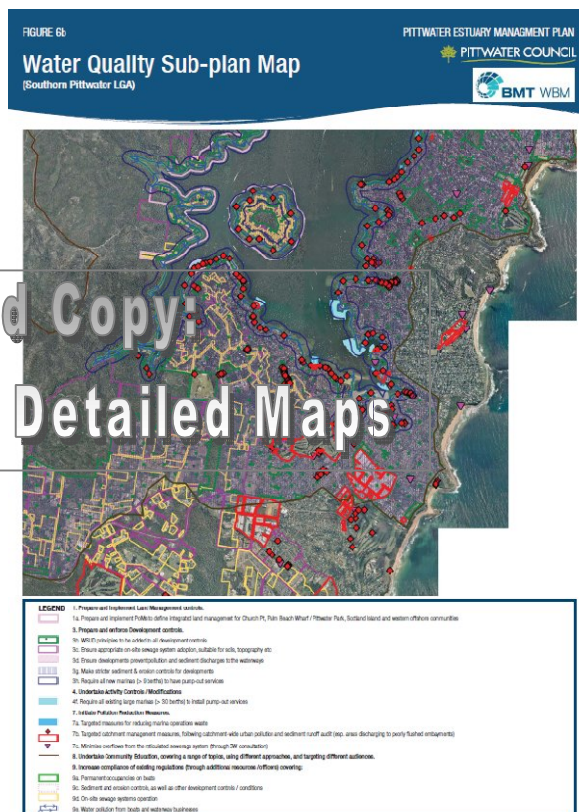
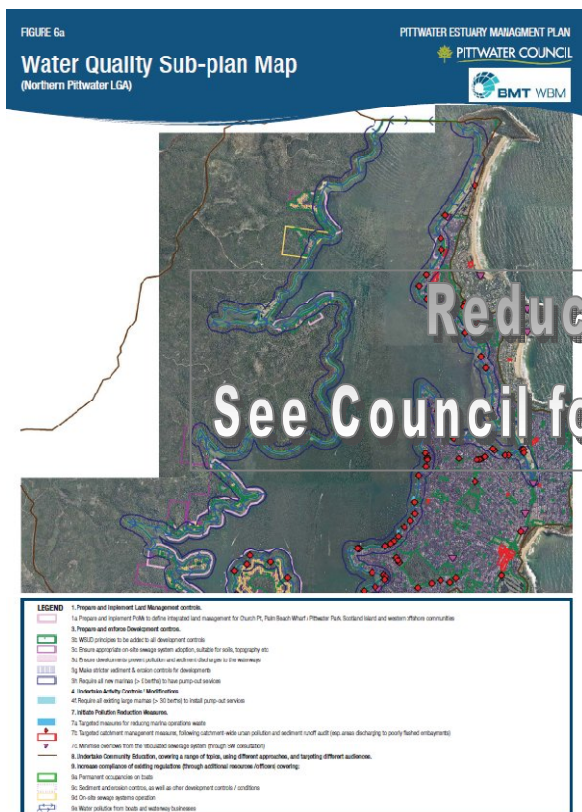
Strategies / Actions	Water Quality Sub-plan Map	Sediment. & Erosion Sub-plan Map	Ecology Sub-plan Map	Waterway Usage Sub-plan Map	Foreshore Usage Sub-plan Map	Heritage Sub-plan Map	Future Development Sub-plan Map	Climate Change Sub-plan Map
1. Prepare and implement Land Management controls.								
1 a) Prepare and implement Plans of Management to define land management for Church Pt, Palm Beach Wharf / Pittwater Park, Scotland Island and western offshore communities	✓	✓	✓	✓	✓	✓	✓	✓
1 b) Update and implement Plan of Management for Careel Bay wetlands, ensuring maintenance of habitat mix / diversity (which may include selective removal of mangrove seedlings that have encroached onto saltmarsh areas from time to time)		✓	✓	✓	✓	✓	✓	✓
1 c) Prepare and implement Plans of Management for areas of significant habitat (eg EECs) on public and private lands ensuring preservation and enhancement of key environmental values			✓	✓	✓	✓	✓	✓
2. Prepare and incorporate Planning controls.								
2 a) Significant environmental values are to be identified and are adequately protected within appropriate planning instruments (including foreshore areas, EECs, vegetation stands). Eg, modify SEPP-14 wetland boundaries, TPOs.			✓	✓	✓		✓	✓
2 b) Areas of significant heritage value (Aboriginal and early-European) are to be identified and are adequately protected within appropriate planning instruments, such as Council's LEP (first requires assessment of Aboriginal and early-European sites)						✓	✓	
2 c) Extend public conservation area lands (eg State Park), to include parts of Currawong and Mackerel Beach for example			✓		✓	✓	✓	
2 d) Allow small scale maintenance dredging for navigational safety, providing it does not conflict with or compromise existing or future environmental values.		✓		✓			✓	
3. Prepare and enforce Development controls.								
3 a) Climate change impacts for development are to be considered and addressed, with the development of relevant risk management plans for adoption into Council's DCP			✓				✓	✓
3 b) WSUD principles to be added to all development controls (draft DECC DCP)	✓	✓					✓	
3 c) Appropriate on-site sewage systems to be adopted, suitable for soils, topography etc	✓						✓	
3 d) Developments not to incorporate pollution and/or sediment discharges to the waterways	✓	✓					✓	
3 e) Developments not to degrade scenic amenity of the Pittwater estuary and surrounds			✓	✓	✓		✓	
3 f) Public amenity and existing foreshore values to be retained / improved for foreshore developments			✓	✓	✓		✓	
3 g) Make stricter sediment & erosion controls for developments	✓	✓					✓	
3 h) Require all new marina developments (> 9 berths) to have pump-out services	✓			✓			✓	
4. Undertake Activity Controls / Modifications								
4 a) Limit proximity of boating activities to environmentally significant areas and other sensitive areas (eg infested areas), incl. no anchoring			✓	✓				
4 b) Replace existing moorings with seagrass friendly moorings in areas close to existing seagrass beds			✓	✓				
4 c) If necessary, reduce boating speed limits in areas of high waterway use / traffic (eg western side of Scotland Island)				✓				
4 d) If necessary, relocate existing moorings away from areas of high environment significance and/or high vessel traffic				✓				
4 e) Remove significant impediments to fish passage			✓					

Strategies / Actions	Water Quality Sub-plan Map	Sediment. & Erosion Sub-plan Map	Ecology Sub-plan Map	Waterway Usage Sub-plan Map	Foreshore Usage Sub-plan Map	Heritage Sub-plan Map	Future Development Sub-plan Map	Climate Change Sub-plan Map
4 f) Encourage all existing large marinas (> 30 berths) to install pump-out services	✓			✓				
4 g) If necessary, reduce the total number of moorings within Pittwater to a more appropriate capacity / mooring limit, through opportunistic relinquishment and offsets through new marina developments.			✓	✓				
5. Construct new or improved services / assets.								
5 a) Install new and/or upgrade and repair existing waterway access locations / points, and foreshore access and facilities			✓	✓	✓			
6. Undertake Environmental Rehabilitation.								
6 a) Repairs / rehabilitation of significant heritage sites (Aboriginal and/or early European)						✓		
6 b) Redress erosion along Pittwater foreshores and along catchment streams / tributaries		✓						
6 c) Re-vegetation along estuary foreshores and along riparian zones within catchment (on both public and private lands) to connect habitats, provide shade and enhance ecological communities (esp. EECs)		✓	✓		✓			✓
6 d) Weed and exotic species control, including <i>Caleurpa taxifolia</i> .			✓					
7. Initiate Pollution Reduction Measures.								
7 a) Targeted measures for reducing marina operations waste	✓	✓		✓				
7 b) Targeted catchment management measures, following catchment-wide urban pollution and sediment runoff audit (esp. areas discharging to poorly flushed embayments)	✓	✓						
7 c) Minimise overflows from the reticulated sewerage system (through Sydney Water consultation)	✓							
8. Undertake Community Education, covering a range of topics, using different approaches, and targeting different audiences.	✓	✓	✓	✓	✓	✓	✓	✓
9. Increase compliance of existing regulations (through additional resources /officers) covering:								
9 a) Compliance: Permanent occupancies on boats	✓			✓				
9 b) Compliance: Boating regulations, ie speeds, dangerous behaviour, <i>Caleurpa</i> controls / washdown		✓	✓	✓				
9 c) Compliance: Sediment and erosion controls, as well as other development controls / conditions	✓	✓					✓	
9 d) Compliance: On-site sewage systems operation	✓						✓	
9 e) Compliance: Water pollution from boats and waterway businesses (eg marinas)	✓	✓		✓	✓			

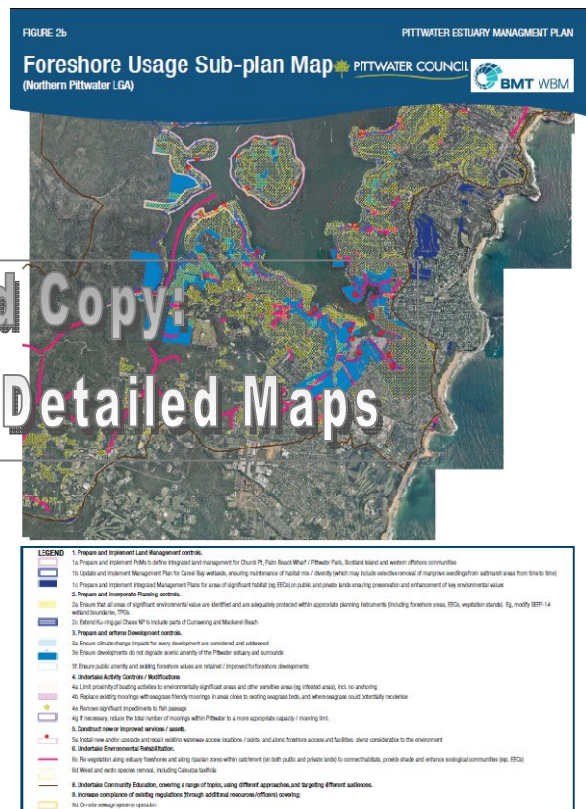
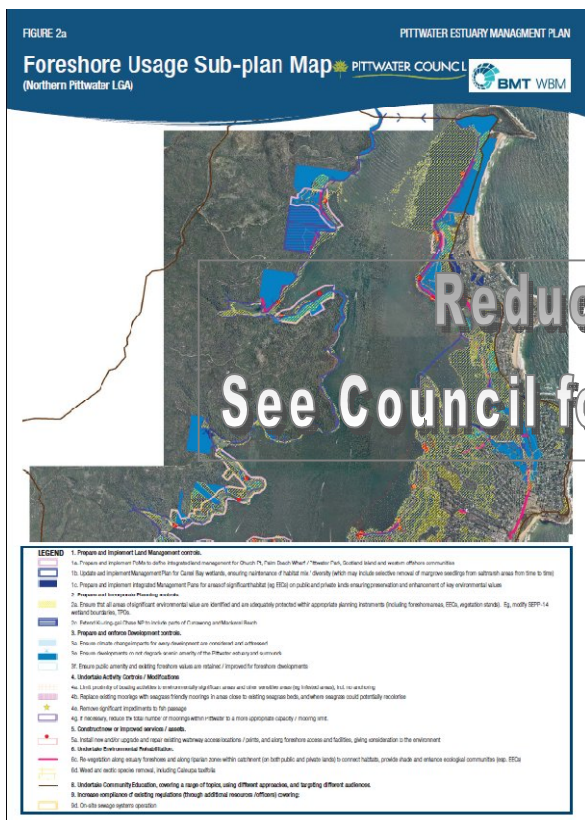
8.5 Sedimentation and Erosion Sub-plan



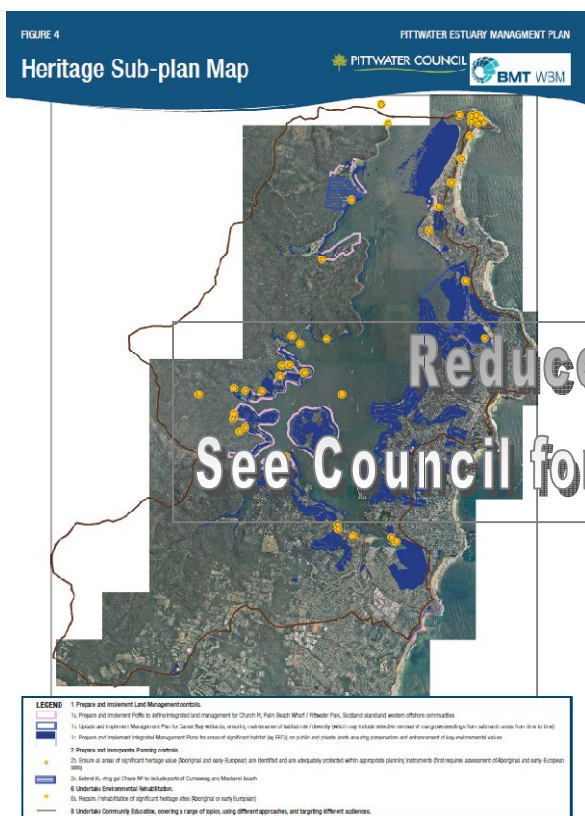
8.6 Water Quality Sub-plan



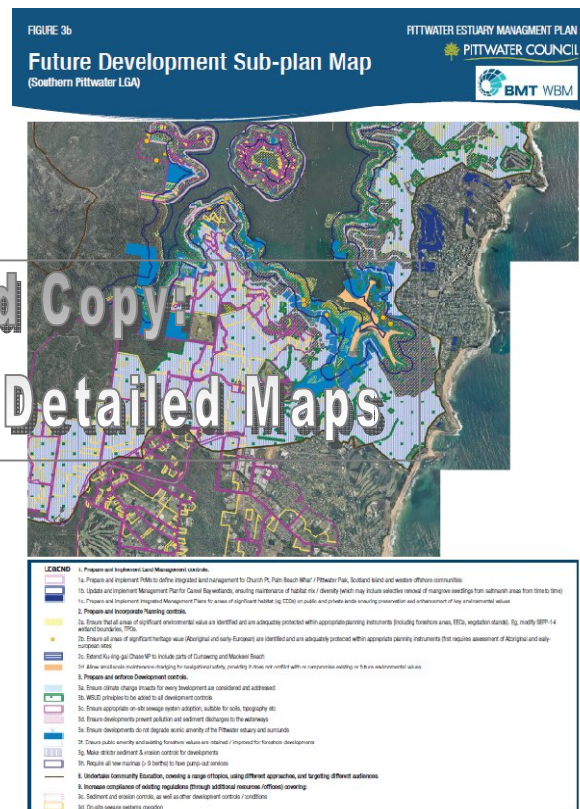
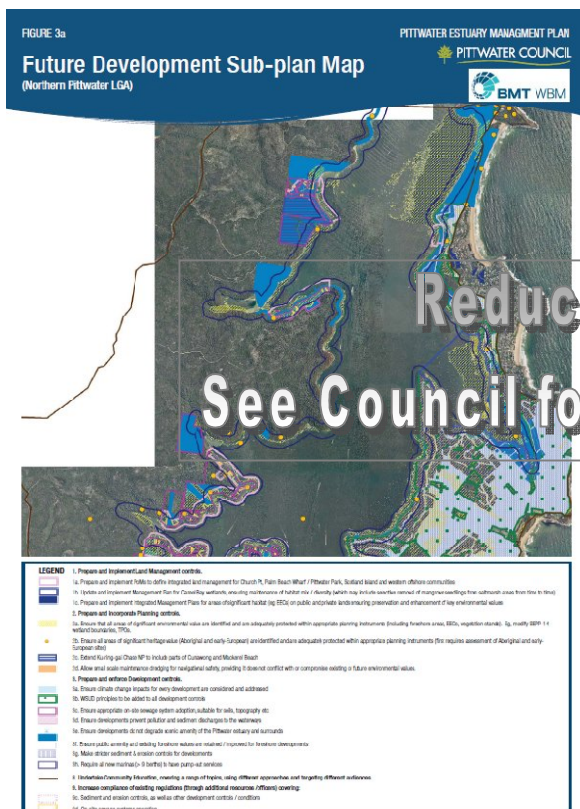
8.7 Foreshore Use Sub-plan



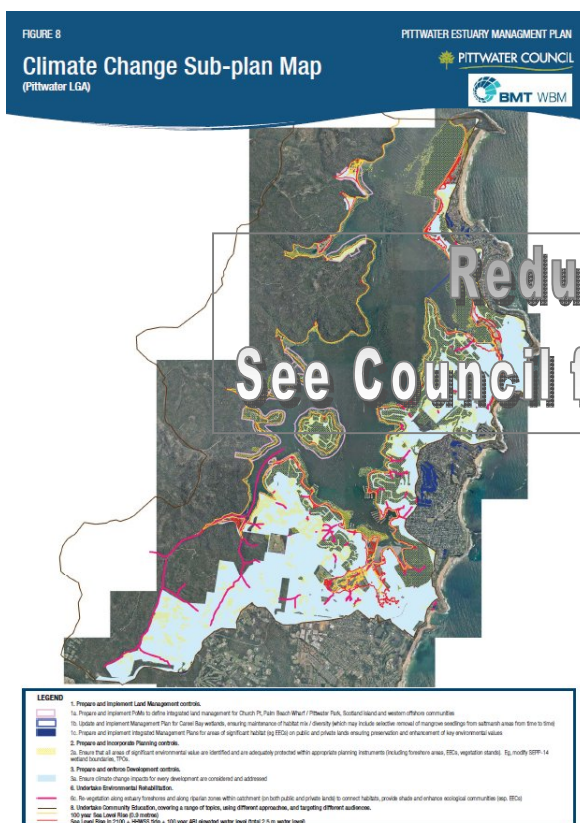
8.8 Heritage Sub-plan



8.9 Future Development Sub-plan



8.10 Climate Change Sub-plan



9 BEST PRACTICE GUIDELINES

Best Practice Guidelines (BPGs) for activities undertaken within Pittwater Estuary by Council, the Community, developers and other authorities have been developed. These have been cross-referenced with the EMP strategy actions, as listed in the implementation tables. BPGs have been prepared for the following works / activities:

- 1 Stormwater Outlets**
- 2 Wharfs, Jetties & Other Foreshore Structures**
- 3 Seawalls**
- 4 Foreshore Stabilisation & Protection**
- 5 Foreshore Property Interfaces & Landscaping**
- 6 Foreshore & Inter-Tidal Access & Recreation**
- 7 Companion Animal Management**
- 8 Reserve Management**
- 9 Groundwater Use**
- 10 Boating And Waterway Use**
- 11 Recreational Fishing**
- 12 Building And Associated Activities**
- 13 Climate Change And Development And Associated Activities**

The Best Practice Guidelines developed by BMT WBM were provided to Council (in an unformatted version), including a compendium of all of the Best Practice Guidelines, their associated additional information and an Excel spreadsheet with a brief description of each BPG, provided in electronic format (on CD) with this Plan. The final, formatted Best Practice Guidelines can be accessed from Council's website.

10 RECOMMENDATIONS FOR STANDARD CONDITIONS OF CONSENT

A review of Council's existing Standard Conditions of Consent relating to the environment was conducted, to determine where changes could be made to better reflect the objectives and incorporate the strategies of this Estuary Management Plan. It was apparent through the process of review that many of the strategy actions in this EMP require implementation within Council's planning controls, particularly LEP and DCPs. This will ensure that best practise environmental management (for example, assessment of potential heritage sites, jetty designs which protect foreshore habitat etc) is incorporated as part of formulation development plans, at the pre-approval stage.

The outcomes of this review and recommended changes to be incorporated in Council's Standard Conditions of Consent database are listed herein.

B3 HAZARD CONTROLS

B3.7, 3.8, 3.9, 3.10 – Estuarine Hazard

- Structures below the EPL shall be designed to be stable during high water levels, such that they are not washed away to pose a risk to other habitats/development.
- Structures below the EPL shall be designed to be easily modified/removed to accommodate sea level rise in the future.
- B7 (as per B3.7 to B3.8, 3.10) should apply to B3.9 also.

B4 CONTROLS RELATING TO THE NATURAL ENVIRONMENT

- B4 Control of Noxious Weeds should be consistently applied across all subsets of the B4 CONTROLS section.
- G1 Retention of EEC and/or Threatened Species Habitat should be updated to include species on the EPBC Act, and species protected by the *Fisheries Management Act 1994* (ie, mangroves and seagrass). The change to G1 should apply to all subsets of the B4 Controls relating to the Natural Environment, in particular, B4.12 Mangrove Conservation, B4.14 Development in the Vicinity of Wetlands, B4.16 Seagrass Conservation and B4.19 Estuarine Habitat.

B4.20 Protection of Estuarine Water Quality

- Condition C1 from subset B8.2 Construction and Demolition which requires Erosion and Sediment Management should be included within this subset.
- Conditions from stormwater and sewage controls should be included here, such as:
 - Stormwater treatment measures are installed and operating effectively.
 - Assessment or certificate to state that proposed on-site sewage treatment measures are appropriate to site constraints (soils, topography, etc), and installed according to manufacturers specifications.

- Stormwater treatment measures or sewage treatment measures are not to be installed within any areas of protected habitat (e.g. national parks land, EECs), including bushland or riparian habitat buffer zones.

B4.21 – Bushstone Curlew Habitat

- At present there are no conditions in this subset. At the least, conditions G1 from the other Natural Environment subsets (eg, B4.1 Flora and Fauna Conservation Category 1 Land) should be applied here.

B5 WATER MANAGEMENT

B5.2 Wastewater Disposal

- Sewage treatment measures are not to be installed within any areas of protected habitat, including bushland or riparian habitat buffer zones.

B5.3 Greywater Reuse

- Greywater treatment measures are not to be installed within any areas of protected habitat, including bushland or riparian habitat buffer zones.

B5.7 to B5.9 Stormwater Management

- Stormwater treatment measures are not to be installed within any areas of protected habitat, including bushland or riparian habitat buffer zones.

B5.12 Stormwater Drainage Systems and Natural Watercourses

- B1 – should be modified or amended to require the installation of a treatment measure that is consistent with WSUD principles. The intent of this should be reflected within the objectives and controls of the Pittwater DCP.

11 MONITORING, EVALUATION AND AMENDMENTS

11.1 Monitoring of Plan Success

Performance measures to evaluate the performance and gauge a better appreciation of the relative success of this Plan have been developed. The evaluation measures can be assessed on a periodic basis. A series of performance measures applicable to the Plan outcomes are discussed below.

11.1.1 Primary Performance Measures

The first set of evaluation measures should ascertain whether the strategies are being implemented within the timeframe designated in the Plan. As such, the primary performance measures are simply a *measure of implementation*.

Organisations responsible for implementation will need to review the Plan carefully and ensure that adequate resources are allocated to the various strategies to ensure that the timeframe for implementation is achieved.

Clearly, a high degree of co-ordination will be required to manage the successful implementation of all the strategies within the designated timeframe. This co-ordination should be facilitated by Council's or a designated Council Committee (eg LW&CPC), who would be required to meet regularly to discuss and manage the implementation of the estuary management strategies.

Specific questions to be answered are:

- What strategies have actually been implemented (regardless of outcome – see Secondary performance measure)?
- What strategies are outstanding, and should have been implemented within this nominated timeframe?

If it is determined that the strategies are not being implemented to the nominated timeframe then one or both of the following *contingencies* should be adopted:

- Determine the cause for the delay in implementation. If delays are funding based, then seek alternative sources of funding. If delays are resource-based, seek additional assistance from stakeholder agencies and/or consider using an external consultancy to coordinate implementation of the Plan; and
- Modify and update the Estuary Management Plan to reflect a timeframe for implementation that is more achievable. The revised Plan would need to be endorsed by all relevant stakeholders and agencies responsible for implementation.

11.1.2 Secondary Evaluation Measures

The second set of evaluation measures relate to *measuring specific performance outputs* from the individual strategies, as appropriate. The specific outputs from each strategy, are provided within the Pittwater Estuary Management Action Table (refer Chapter 7) under “**Measureable**”. These measureables define what the specific outcome from each strategy should be. If these outputs are delivered as defined, then the strategy is considered to have been successful.

The specific question to be asked here is:

- Of the strategies that have been implemented, has the nominated “measurable” been achieved?

If specific outputs, as defined by the “measurables”, are not generated from implementation of the Plan then the following *contingencies* need to be adopted:

- Determine the reason for not producing the specified output. If the reason involves a lack of funding or resources, then similar contingency measures to those described for the primary performance measures should be adopted. If the reason is of a technical nature, then expertise in the area should be consulted to overcome the technical problem. DECCW, HNCMA and other government agencies should have the necessary in-house expertise to assist in most cases; and
- Review the appropriateness of the specific output of the management strategy, and if necessary, modify the output described in the Plan to define a more achievable product.

11.1.3 Tertiary Performance Measures

The third set of performance measures are aimed at *measuring the overall outcomes of the Plan*, and as such relate to the specific management objectives of the Plan (refer Section 5), and how implementation of the Plan has made a difference to the ecological and social environments of Pittwater Estuary (eg reduction in pollutant loads, improved biodiversity etc). The main mechanism for gauging whether these objectives have been achieved or not, is environmental monitoring. Therefore, **monitoring of various elements of the physical, biological and social environment is an essential component of assessing the overall success of the Estuary Management Plan.**

The specific question to be asked here is:

- Have the objectives been satisfied?

If, after a reasonable period of time, the specific objectives of the Plan are not being achieved by the strategies being implemented, then the following contingencies should be adopted:

- Carry out a formal review of the implemented management strategies, identifying possible avenues for increasing the effectiveness of the strategy in meeting the Plan objectives;
- Commence implementation of additional management strategies that may assist in meeting Plan objectives (possibly ‘fast-track’ some longer term strategies as necessary);
- Reconsider the objectives of the Plan to determine if they set impossible targets for future estuary conditions, and adjust the Plan, as necessary. Any such changes to the Plan would need to be endorsed by the stakeholders and relevant government agencies, as well as the public.

11.2 Plan Review and Amendments

Periodic reviews and amendments of this Estuary Management Plan are necessary to ensure that it remains current and relevant to the environmental management and planning framework in which it operates.

It is proposed that the Pittwater Estuary Management Plan is reviewed on a regular basis, and completely updated within a period of about 5 years (ie by end 2014). A regular review of the Plan

(which may occur annually, for example) is necessary to allow modifications / alterations to the management of the estuary, on an as-needed basis, within the context of an adaptive management framework.

It should also be noted that regular review and update of the mapping and other resources (ie, Sub-plan workspaces in MapInfo; Pittwater Estuary Management Action Table) compiled to complement this Plan also be updated in concurrence with modifications and alterations conducted as part of the review process for this plan.

The periodic Estuary Management Plan reviews should cover the topics described in Table 11-1. This table also outlines who is responsible for conducting the periodic reviews.

It is possible that the NSW Government's Estuary Management Program, under which this Plan has been prepared and will be implemented, may change in the future. For example, the Coastal Zone Management Manual, which reached draft stage in 2006, will combine and replace the existing Estuary Management Manual (1992) and the Coastline Management Manual (1990), and may at some stage be adopted in the future. Therefore, on-going liaison between Council, DECCW and the HNCMA is necessary to ensure that the aims and objectives of the Pittwater Estuary Management Plan continue to be achieved in the future.

As the Pittwater EMP was being finalised, in August 2010 DECCW released Draft *Guidelines for Preparing Coastal Zone Management Plans* (CZMP Guidelines). When adopted in the future, the CZMP Guidelines will replace the Estuary Management Manual (1992) and Coastline Management Manual (1990). The CZMP Guidelines prescribe a risk-based management approach to preparing actions to protect estuary health.

A joint approach to review this Pittwater EMP in combination with the Lower Hawkesbury EMP (Hornsby Shire Council) and / or the Brisbane Water EMP (Gosford City Council) has been suggested. A joint review of the plans offers Council the opportunity to update the Pittwater EMP using the prescribed risk-based format to comply with the CZMP Guidelines, in advance of the intended review period of 2014.

Table 11-1 Framework for Future Estuary Management Plan Review

Review Period	Review tasks	Responsibility
Annual	<ul style="list-style-type: none"> Assess primary, secondary and tertiary evaluation measures, and determine appropriate contingencies if performance measures do not meet targets Review funding arrangements and allocations for current and future management strategies Review resourcing and staffing allocations for current and future management strategies Provide report on progress of Estuary Management Plan implementation, results of annual review, and any modifications required to the Plan coming out of the review 	<p>Council, Estuary Management Committee (ie, LW&CPC) or appointed external consultant*</p> <p>To be coordinated through Council and reported to Council, relevant stakeholders and government agencies</p>
5 Yearly <i>(first review to be completed by end 2015)</i>	<ul style="list-style-type: none"> Assess the overall effectiveness of each management strategy implemented to date For strategies requiring on-going commitment, assess the value in maintaining implementation of those strategies Reconsider the management options that were not short-listed and included in the original Plan Provide implementation details of additional strategies that are to be included in the subsequent 5 year Plan Update the Estuary Management Plan document to reflect proposed strategies for implementation over the next 5 year period, and seek endorsement by stakeholders, government agencies and the community. 	<p>Council, Estuary Management Committee (ie, LW&CPC) or appointed external consultant*</p> <p>To be coordinated through Council and reported to Council, relevant stakeholders government agencies and the general community</p>

** It would be advantageous for the same consultant responsible for initially preparing the Estuary Management Plan to be involved in the annual review and 5-yearly update, given their appreciation of the study area and the details of the Plan and associated strategies.*

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APPENDIX A: ENVIRONMENTAL PLANNING INSTRUMENTS AND RELATED DOCUMENTS

The Environmental Planning and Assessment Act, 1979

The *Environmental Planning and Assessment Act, 1979* (EPA Act) is the principle legislation that establishes the NSW planning framework, and was intended as a system of land use control. This is essentially the overarching document which determines land use and planning in Pittwater. Those Parts of the EPA Act of particular relevance to the Pittwater Estuary are outlined herein.

Part 3A of the EPA Act – Major Infrastructure and Other Projects

Part 3A of the EPA Act, which came into effect in August 2005, may be declared applicable to two types of development projects:

- Major infrastructure or development that the Minister for planning decides is of state or regional environmental significance
- Former Part 5 activity approvals, where the proponent is the determining authority and an Environmental Impact Statement (EIS) would formerly have been required.

Within the Pittwater Estuary catchment, the redevelopment of former Labour Party holiday lodgings at Currawong Beach is an example of development to which Part 3A approval applies.

Other development in Pittwater to which Part 3A applies is discussed with respect to SEPP (Major Projects) 2005 on page A-2 overleaf.

Part 4 of the EPA Act – Development Assessment

Part 4 applies to the standard lodgement and consideration process for development applications, where the local council is the consent authority. In this case, the Local Environment Plan (LEP) determines the permissibility of the development, with controls for particular sites found in the LEP and any applicable development control plan (DCP). Part 4 applies to the majority of development on land within the study area.

In addition, Section 79BA of Part 4 is also likely to be applicable to the majority of land based development in the study area. Section 79BA requires developments within bushfire prone areas to comply with the *Planning for Bushfire Protection* document and consultation with the NSW Rural Fire Services. Certain integrated developments, such as a subdivision may additionally require approvals under the *Rural Fire Act 1997*.

Part 4 also stipulates the need for a Controlled Activity Approval (CAA) for works on 'Waterfront Land', in accordance with Part 3 of Chapter 3 of the *Water Management Act 2000* (WM Act). 'Waterfront Land' broadly refers to land within 40 m of the highest bank of a river, and equivalent location for lakes, estuaries and coastal waters. Activities for which a CAA is required include erection of buildings, removal of material or vegetation, deposition of material, and carrying out any other activity that affects the quantity or flow of water. A large amount of development within the study area may lie within 'Waterfront Land' as defined by the WM Act and will require a CAA, unless it can be

shown to meet an exemption to the WM Act, as defined in Clause 39A of the *Water Management (General) Regulation 2004* (refer Appendix A for details).

Part 5 of the EPA Act – Development by the Crown

Part 5 of the EPA Act applies to those “activities” which do not require development consent under Part 4, but do require approval from a Minister or Public Authority, or are proposed to be carried out by a Minister or Public Authority.

State Environmental Planning Policies (SEPPs)

The State Environment Planning Policies (SEPPs) relevant to the study area are listed below, with further description of each policy provided in Appendix A:

- SEPP 14 – Coastal Wetlands. While no SEPP 14 wetlands are identified within the study area, there may be wetland areas which may require recommendation for inclusion in SEPP14
- SEPP 19 – Bushland in Urban Areas
- SEPP 44 – Koala Habitat Protection
- SEPP 50 – Canal Estate Development
- SEPP 71 – Coastal Protection
- SEPP (Major Projects) 2005
- SEPP (Infrastructure) 2007

SEPP (Major Projects) 2005 aims to identify development to which Part 3A of the EPA Act applies, and outlines specific sites in Schedule 2. Of particular relevance to Pittwater is specific site No.1 – Coastal Areas, which affects the entire land-water interface of the Pittwater Estuary. Schedule 2 outlines the types of developments within specific site No. 1 which are subject to a Part 3A approval, as summarised in Appendix A. However, of particular note for Pittwater, certain marina developments, subdivisions of land not connected to sewerage works, and subdivisions of more than 25 lots within sensitive coastal locations of the coastal zone would require approval under Part 3A of the EPA Act.

Not all marinas fall within Part 3A of the EPA Act (for which the Department of Planning is the consent authority). Only those marinas are classified as “Designated Development” under the EPA Act *and* located within the coastal zone (which covers the entire Pittwater study area), fall within Schedule 2 of the SEPP (Major Projects) 2005 and therefore, Part 3A of the EPA Act. That is, those marinas:

- a) that have an intended capacity of 15 or more boats with a length of 20m or more;
- b) that have an intended capacity of 30 or more vessels of any length and
 - i) are located in non-tidal waters or within 100m of a wetland or aquatic reserve
 - ii) require the construction of a groyne or annual maintenance dredging;
 - iii) the ratio of car park spaces to vessels is less
- c) that have an intended capacity of 80 or more vessels of any size

Marina proposals that fall below such thresholds fall within Part 4 of the Act and Council remains the consent authority.

Division 25 of SEPP (Infrastructure) 2007 refers to waterway and foreshore environmental management activities, including riparian corridor management, bank stabilisation, weed management, revegetation activities, and the creation of foreshore accessways. In this regard, Pittwater Council is deemed to be the public authority, and as such, does not require development consent to undertake waterway and foreshore environmental management activities. SEPP (Infrastructure) 2007 formally repeals SEPP 35 – Maintenance Dredging of Tidal Waterways (among others), and allows Pittwater Council to undertake dredging for environmental purposes only (ie aquatic rehabilitation).

It is important to note the different application of SEPP (Major Projects) 2005 and SEPP (Infrastructure) 2007 with respect to dredging activities. With the exception of dredging undertaken by a public authority for aquatic rehabilitation, all other dredging activities within the coastal zone (i.e. the whole of the EMP study area) fall within Schedule 2 of the SEPP (Major Projects) 2005. In particular, this applies to dredging for navigational purposes.

If such (non-environmental) dredging is proposed by a public authority, the proposal would fall within Part 5 of the EPA Act. Dredging proposing the removal of greater than 1,000 cubic metres falls within “Designated Development” under Clause 77A of the EPA Act and therefore requires the preparation of an Environmental Impact Statement (EIS). The only dredging that can be undertaken under the SEPP (Infrastructure) 2007 is for aquatic rehabilitation, not for navigational purposes.

Sydney Regional Environmental Plan No. 20 – Hawkesbury/Nepean River

The Regional Environmental Plan (REP) applicable to the entire Pittwater Estuary is Sydney Regional Environmental Plan No. 20 – Hawkesbury/Nepean River (SREP 20). It aims to protect the Hawkesbury/Nepean River system by ensuring the impacts of future land uses are considered in a regional context. A range of broad strategies for consideration in future development and planning are given in Clause 6 of SREP 20.

SREP 20 also outlines development controls for certain works/uses of land and waterways. Of most relevance are controls relating to maintenance dredging and extractive operations, filling of land (including submerged aquatic land), marinas, and all works in or near the waterway. For such activities the SREP reconfirms the need for development consent and outlines specific matters for consideration which address environmental impact and protection of aquatic flora and fauna.

Pittwater Local Environmental Plan 1993

The Pittwater Local Environmental Plan 1993 (PLEP) provides the zoning framework and statutory controls on land use and development within the Pittwater Estuary and its catchment. Zoning of the catchment as per the PLEP is illustrated in Figure A-1. Zoning of the catchment includes:

- Residential (including the riverside settlements accessible only by water on the western foreshore and Scotland Island)
- National Parks and Nature Reserves (Zone 6(d)), which dominantly comprises the Ku-ring-gai National Park

- Environment Protection (typically Zone 7 (a1) Environment Protection 'A' and Environment Protection – Waterways zones)
- Open Space (such as Zone 6A Existing Recreation, which a number of settlements on the western foreshore abut with)
- Reservations
- Waterways

The entire western foreshore is considered to be Bushfire Prone Land, and the immediate waterfront is classed as Vegetation buffer and Vegetation 2 Category, while the remainder is classed as Vegetation 1 Category land.

The LEP outlines the kinds of development Council can grant approval for within each zone. Clauses and schedules within the LEP provide additional guidance for granting development consent in exceptional circumstances, and some of those relevant to the Pittwater EMP are outlined below.

- Schedule 11 of the LEP states the zoning objectives for each of those zones that are within or adjoining to Pittwater waterway.
- Clause 50 and 51 of the LEP provide certain restrictions to land within the water, but allow Council to grant development consent for purposes incidental or subsidiary to waterfront business or boat service, and, the case of Clause 51 (specific to Governor Phillip Park) to seaplane transport services.
- Clause 49 enables council to grant development consent to land within 10 m of a boundary of Environment Protection 'A' zoned land, so long as the objectives of the environment protection zoning will be satisfied.

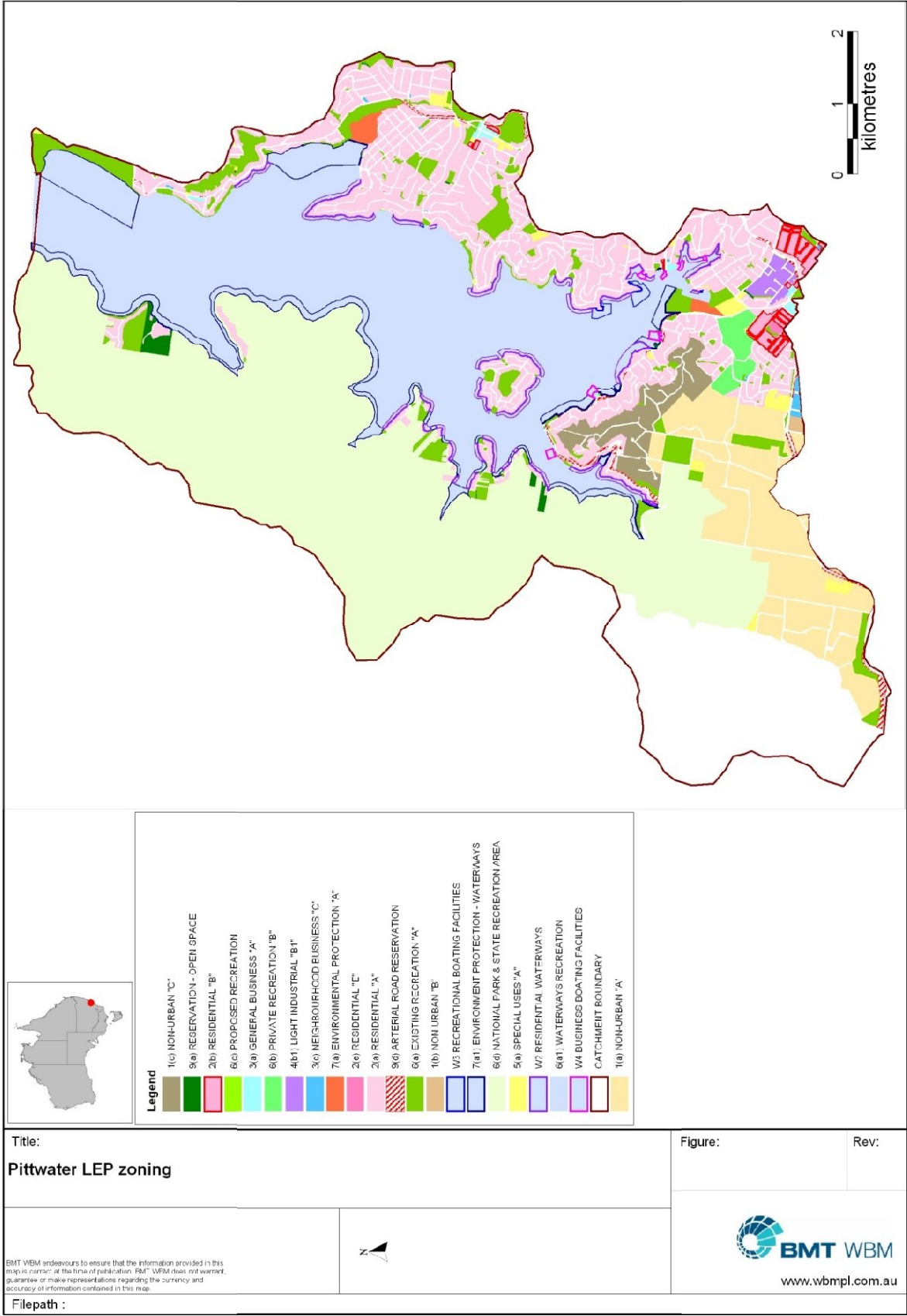


Figure A-1 Pittwater Local Environment Plan 1993 Zoning

The Standard Instrument (Local Environment Plans) Order 2006

On March 31, 2006, the Standard Instrument (LEPs) Order 2006 was gazetted. It aims to reduce the number of planning documents and improve the consistency in documents across local councils. The Standard Instrument provides for 34 standard zones for LEPs, for use by Councils when preparing their new LEPs according to the Standard Instrument. There are a number of new zones relevant to the study area, including W1 Natural Waterways, W2 Recreational Waterways, W3 Working Waterways, E1 National Parks and Nature Reserves, E2 Environment Conservation, E3 Environmental Management, and E4 Environmental Living.

Pittwater Development Control Plans

Pittwater Council has two Development Control Plan (DCPs) for Pittwater LGA, the comprehensive Pittwater 21 DCP, and DCP 22 – Exempt and Complying. Sections within the Pittwater 21 DCP are a mixture of zone based, issue based, land use or locality based controls. The sections of most relevance to the Pittwater EMP are:

- B3 Hazard Controls, which includes controls and outcomes related to landslip, bushfire, acid sulfate soils, contaminated land, coasts and beach, coastal bluffs, estuaries and flooding. Estuarine hazard controls may be related to wave action, tidal inundation mitigation works and circumstances for variations from such controls;
- B4 Controls relating to the Natural Environment, which are related to flora and fauna, protection of biodiversity, wildlife corridors, endangered ecological communities, mangrove conservation, development within wetlands and the protection of estuarine water quality;
- B5 Water Management which regards wastewater management, stormwater discharge to waterways and coasts, and stormwater management; and
- Locality Plans within Part D of which there are 15 localities in Pittwater, and two additional specific controls for land adjoining or within the vicinity of the foreshore which stipulate a foreshore building line and scenic protection areas.

The aim of DCP 22 is to identify development standards, requirements and conditions for exempt and complying development, and facilitate processing of small scale, safe, low impact development, within the statutory requirements of the EPA Act. There are said to be no development types permissible under Complying Development which are relevant to the Study Area.

State and Commonwealth Legislation and Policies

There are a number of NSW Parliamentary Acts that are relevant to the management of the Pittwater estuary and catchment. The key Acts are listed below.

- Environmental Protection and Biodiversity Conservation Act 1999 (Federal Legislation)
- Water Management Act 2000;
- National Parks and Wildlife Act 1974;
- Coastal Protection Act 1979;
- Local Government Act 1993;
- Fisheries Management Act 1994;

- Threatened Species Conservation Act 1995;
- Protection of the Environment Operations Act 1997;
- Catchment Management Authorities Act 2003;
- Natural Resource Commission Act 2003;
- Native Vegetation Act 2003;
- Crown Lands Act 1989;
- Marine Pollution Act 1987; and
- Marine Safety Act 1988.

Other Relevant Planning and Management Documentation

The following planning and management documents and reports are relevant to the future management of Pittwater Estuary and catchment.

- Estuary Management Policy 1992
- Hawkesbury-Nepean Catchment Action Plan 2007 – 2016 (HNCAP)
- NSW Coastal Policy 1997
- Planning for Bushfire Protection (2001)
- Metropolitan Strategy – City of Cities, A Plan for Sydney's Future
- Coastal Design Guidelines 2003
- Pittwater 2020 Strategic Plan
- Pittwater Public Wharves Plan of Management

Hawkesbury-Nepean Catchment Action Plan 2007 – 2016.

The Hawkesbury Nepean Catchment Management Authority (HNCMA) is a statutory body established under the Catchment Management Authorities Act 2003 (NSW) (CMA Act), to coordinate natural resource management in the Hawkesbury – Nepean catchment. The HNCMA has produced the Hawkesbury Nepean Catchment Action Plan (HNCAP), which incorporates the state-wide conditions targets for river catchments endorsed by the NSW State Government (as per recommendations of the Natural Resource Commission), and sets out management targets specific to the Hawkesbury Nepean catchment to achieve the state-wide aims.

The HNCAP provides the mechanism and strategy for HNCMA to direct the investment from state and federal governments into natural resource management in the Hawkesbury Nepean catchment. The HNCAP identifies targeted activities to improve environmental outcomes, and help land managers improve and restore the natural resources of the Hawkesbury Nepean Catchment.

Within the HNCAP, the most relevant condition target to the Pittwater Estuary is as follows (p79):

“River Health condition target CT RH5 Estuary/marine condition

Aim: By 2016, there will be no decline, and where appropriate an improvement, in estuarine and marine ecosystem functioning as reflected in a range of indicators, potentially including the following.

For estuarine: extent and condition of estuarine vegetation, freshwater inflows, algal blooms, water quality, soil condition

For marine: rocky reef species, sewage discharges, industry groups implementing environmental management systems, marine debris, extent of marine protected areas.”

From this, a management target has been outlined which is particularly relevant to the implementation of the Pittwater EMP, namely River Health Management Target MT RH5-1 Estuary, coastal and marine management plans, for which the aim is stated to be:

- Implement or assist with implementation of relevant, high priority actions that are identified in estuary management plans or other management plans that have been cooperatively developed through a formalised process with all stakeholders, including community, councils and agencies.

Within this target, the HNCMA action is to identify strategies within estuary management plans which are suitable for and/or of high priority to HNCMA to assist with implementing. Additional actions outlined by the HNCMA are to assist with education regarding *Caulerpa taxifolia* and the value of seagrass beds, and to instigate a Wetlands Program and a Local Governments Partnership Program.

The management targets of the HNCAP are presented under four themes: Community and Partnerships; River Health; Biodiversity; and Soil and Land. Of these, a number of management targets are stated to specifically relate to estuary, coastal and marine issues, as shown in Table reproduced from the HNCAP. Those management targets of most relevance to the Pittwater EMP, as shown in Table, are stated in full below:

- River Health Target 1: Riparian Lands - MT RH1-1 Riparian conservation

Aim: By 2016, there is an increase in the length of river and stream banks identified as being in the riparian land management category of focus on conservation being managed primarily for conservation so that 23% or 150 km of reaches in this category are being managed with a focus on conservation.

- River Health Target 1: Riparian Lands - MT RH1-2 Riparian vegetation regeneration

Aim: By 2016, there is an increase in the length of river and stream banks undergoing assisted regeneration in reaches identified as being in the management category of focus on assisted regeneration so that 18% or 260 km of riverbank in this category has improved riparian vegetation and streambank condition.

- River Health Target 1: Riparian Lands - MT RH1-3 Riparian vegetation rehabilitation

Aim: By 2016, 600 000 plants established through revegetation on stream/river banks and restoration of 20% or 140 km of reaches that have an identified management focus on revegetation.

- River Health Target 1: Riparian Lands - MT RH1-4 Best practice for public river access recreation areas

Aim: By 2016, 10 existing public passive recreation river access areas (one per year currently high pressure/low management areas) are managed under an endorsed management plan

using current recommended/best practice riparian lands management principles with associated strategies for implementation.

- River Health Target 2: Aquatic biodiversity - MT RH2-1 Restoration of in-stream habitat

Aim: By 2016, there is an increase in the length of in-stream habitat that is improved by appropriate instream works such as re-instatement of large woody debris and removal of barriers to fish passage in priority reaches.

- River Health Target 3: Wetlands - MT RH3-1 Important wetlands

Aim: By 2016, there is an increase in the area of important wetlands with recovery potential that are protected and/or appropriately managed through arrangements that prevent damaging access and/or disturbance.

- Biodiversity Target 3: Threatened Species – MT B3-1 Threatening Processes Management

Aim: By 2016 activities classified as 'threatening processes' are identified and included in HNCMA management plans and agreements with landholders and other partners (see Table 17 for a list of threatening processes).

- Biodiversity Target 3: Threatened Species – MT B3-2 Threatened species action

Aim: By 2016, the conservation of threatened species, endangered populations and EECs outside national parks and reserved lands and protected marine vegetation (under s.204 of the FM Act) is supported through implementation of actions in PASs and recovery plans.

- Biodiversity Target 4: Invasive Species – MT B4-1 Weed control

Aim: By 2016, there has been a 5% reduction in coverage of target weeds identified in the Hawkesbury- Nepean Weed Strategy (DPI 2006) through primary weed control measures and effective processes are in place to eradicate new weed outbreaks and emerging weed threats.

- Biodiversity Target 4: Invasive Species – B4-2 Maintenance of Weed Control

Aim: By 2016, 50% of areas treated for invasive plant control (under projects supported by HNCMA) since 2006/7 report sustained success.

- Biodiversity Target 4: Invasive Species – B4-3 Threatening Processes – Pest Animals

Aim: By 2016, populations of invasive pest animal species identified as key threatening processes under state threatened species legislation (in 2005 feral pigs, deer, rabbits, goats, honeybees, cats and foxes), are included in TAPs, and managed according to the priorities in those plans.

- Community Target 1: Community – MT C1-4 – Indigenous Land Management

Aim: By 2016, aspects of the landscape related to NRM that have Indigenous cultural significance will be identified in accordance with cultural protocol. As culturally significant sites, places, landscapes and species significant to Aboriginal people are identified, they will be protected, enhanced and rehabilitated.

- Community Target 1: Community – MT C1-1 – Social Connectivity

Aim: By 2016, people are encouraged and supported in understanding their rights and responsibilities in relation to their place in the catchment. This is reflected in:

- an understanding of the catchment boundaries and the place of the individual within the catchment
 - spiritual connection and sense of belonging to this catchment
 - understanding of the duty of care and how to apply this especially by land managers implementation of current recommended practices (CRPs)
 - development of locally relevant programs by local groups
 - higher rates of individual action that support catchment health and the achievement of the targets
 - increase in Indigenous land management and incorporation of Indigenous beliefs/customs/knowledge into management programs
 - increasing participation in and membership of Landcare.
- Community Target 1: Community – MT C1-2 – Incentives

Aim: By 2007, appropriate incentive programs are in place to support achievement of the targets, and by 2011, these incentive programs have been evaluated and reviewed to improve their ability to meet the targets, and appropriate partnerships are in place to support achievement of the targets in the CAP.

- Community Target 1: Community – MT C1-3 – Education and Training

Aim: Appropriate education and training opportunities are fostered, brokered and developed to support achievement of the targets.

Table A-1 Links from HNCAP to Estuary Issues, sourced p 82 HNCAP (2006).

Table 16: Links to Estuary, Coastal and Marine issues.

Condition target	Management target	Examples of estuary, coastal, marine issue
Riparian lands RH1	Riparian conservation, vegetation regeneration and rehabilitation RH1-1, 1-2, 1-3	Foreshore vegetation, including dune vegetation
	Best practice for public recreation areas RH1-4	Damage to foreshores, including dunes, caused by high levels of recreational use
Aquatic biodiversity RH2	Restoration of in-stream habitat RH2-1	Floodgates, fish passage
Wetlands RH3	Important wetlands RH3-1	Impacts on estuarine wetlands extent and condition
Groundwater RH4	n/a	Groundwater provides base flows for many estuarine tributaries and wetland areas
Native vegetation extent B1	Conservation of native vegetation B1-2	
	Remnant buffers B2-1	Direct impacts on significant native vegetation remnants including estuarine wetlands and dune vegetation
Threatened species B3 and invasive species B4	Threatening processes management: threatening processes – pest animals B3-1, B4-3	Relevant threatening processes such as invasion by bitou bush, climate change, native vegetation clearing, introduction of non-indigenous fish and marine vegetation Reduce impact of (e.g. fox predation on shorebird populations)
	Threatened species action B3-2	Implementation of recovery plans and priority action statements for threatened species and EECs (e.g. saltmarsh EEC)
Invasive species B4	Weed control B4-1 and maintenance of weed control B4-2	Control of priority weeds in priority landscapes
Soil condition SL1	Acid sulphate soils SL1-4	Raise awareness of risk levels and prevent disturbance
Rural land capability SL2	Large/commercial farm management SL2-2	Support for best management practices (BMPs) in horticulture industries (e.g. in Mangrove Mountain area)
	Small/non-commercial farm management SL2-3	Support for improved management of rural residential and small landholdings
Community C1	Social connectivity C1-1, Education and training C1-3, Communication C1-6	Support for ongoing estuary and coastal landcare through designated community support staff
	Incentives C1-2	Best practice management for estuary and marine based industries Support for private landholders to manage natural resource issues
	Indigenous land management C1-4	Protection of cultural heritage values

APPENDIX B: EMS WORKSHOP SPECIFIC ISSUES

Specific Issues or Questions Raised

Water Quality

General

- Do marinas significantly impact the water quality of the estuary?
- Boat washing at marinas is a concern. This must be strictly regulated.
- The tip site at Careel Bay is a concern. Is the site leaking? What impacts is the site having on water quality and aquatic life?
- How were faecal coliforms measured in the Estuary Process Study?

Effluent from boats

- Certain areas within the estuary (ie. areas that are environmentally sensitive or are not well flushed) should be zoned to disallow effluent release from boats into the waterway.
- Effluent is released from boats where people live as well as at marinas. This is a concern and must be strictly regulated.
- Should we insist that boats must pump-out effluent at designated locations, rather than into the waterway?
- People should not be allowed to live on boats at McCarrs Creek because of associated effluent pump-out and a lack of flushing there.

Stormwater runoff

- Stormwater is the largest pollutant in the estuary and is therefore the greatest issue in relation to water quality. The impacts of stormwater require addressing as a priority.
- Mona Vale main drain is a concern because of the industrial and commercial land uses in the catchment. Oils slicks have been seen regularly. Mona Vale main drain is especially a concern because there is very little flushing of the receiving bay (Winnererremy Bay).
- The greatest point source polluters within the estuary's catchment need to be identified.
- There needs to be an audit of all septic systems within the catchment. There also needs to be a review of regulations regarding the upgrading of septic systems, which currently discourage upgrading.
- Was there a comparison done in the Estuary Process Study between storm events and water pollution? Is there a correlation?

Sedimentation and Erosion

- The local community is generally concerned that the estuary is silting up, particularly at Mackerel Beach. There are calls to dredge certain areas, including at Mackerel Beach.
- The EMS needs to identify where sedimentation is occurring within the estuary.

- Sedimentation at Crystal Bay is of great concern. It impacts significantly on the use of boats there. Dredging is required at this location.
- Major sedimentation problems at the estuary include impacts as a result of the unsealed roads at Scotland Island, and the proposed development at Ingleside and associated impacts on McCarrs Creek.
- Beach erosion at the Basin is a major concern.
- Making full use of existing data contained in previous management plans and other studies is important and should be undertaken for the EMS.

Ecology

General

- Potential increase in use of the Currawong area is a concern. No change or increase in the intensity of use should be permitted. The area should become part of Ku-ring-gai Chase National Park.
- The estuary has too many boats, and has reached its mooring limit.
- What is the carrying capacity of the estuary in relation to boating? There are too many boats currently. What are their impacts on the ecology of the estuary?

Seagrasses

- Seagrass conservation is a major issue. Seagrasses must be conserved. Impacts on seagrasses occur particularly as a result of the use of boats, mooring areas, etc.
- The EMS should consider moving mooring areas to better protect seagrasses, and zoning areas where mooring cannot occur.

Mangroves

- Mangroves also occur in the creeks near Lovett Bay and many other places within the estuary, not just where they are shown on the maps provided in the presentation.
- There are more mangroves in the estuary now than there were 20 years ago.
- Is sedimentation likely to be increasing mangrove habitat in the estuary?

Saltmarsh

- Is the EMS going to address the mangrove/saltmarsh balance? Mangroves can be a problem in the estuary and are probably increasing because of increased sedimentation.
- Loss of saltmarsh in the estuary is a huge concern because it is likely to result in a loss of birdlife.

Birds

- Whimbrels (*Numenius phaeopus*) used to use the Careel Bay area, but they have not been seen there for years. This could be a result of a reduction in numbers of soldier crabs (there are very few there now), which may have occurred as a result of impacts on water quality, nutrient levels and sedimentation.

- There is a significant loss of birdlife at Careel Bay and other areas in the estuary.

Heritage

- The western foreshores (particularly around Lovett Bay) have much heritage significance because it is these areas that were settled first. Orchards were planted in these areas (eg. at Woody Point). The wharves on the western foreshores have heritage value.
- Parts of Careel Bay have heritage significance.
- Parts of Newport have heritage significance.
- The Currawong area contains Aboriginal sites and is also likely to be of cultural significance to local Aborigines because Aboriginal women used to come to this area to give birth.
- The cottages at Currawong have non-indigenous heritage significance.
- Bayview Baths have non-indigenous heritage significance.
- What is the status of the Native Title claim on the estuary?

Future Development

- Further development of the western foreshores is not really a concern because there are no more areas to develop.
- Commuter boat travel from the western foreshores and Scotland Island is a concern. Of particular concern is congestion of the waterway and boat storage areas and associated public safety issues, and pollution by use of two-stroke motors. At Church Point, boats are moored double or even triple at times. It is important to note that these impacts are not a result of recreational boating use. What action can Council take to manage these problems?
- The development at Ingleside is of concern, particularly in regard to water management, stormwater runoff, erosion and sedimentation. Stringent controls are needed to mitigate/minimise impacts of the Ingleside development on the estuary.
- The term 'future development' should be changed or should at least reflect the term ESD. ESD should be the overall framework within which management actions for the EMS should be developed. The EMS should consider management actions such as zoning for environmental protection, banning of commuter use of motor boats, environmental education etc.
- Activities within the Hawkesbury River upstream of the estuary are a concern in relation to their impacts on the estuary (eg. the proposed Sewerage Treatment Plant at Brooklyn).

Water-Based Recreation

- Public safety is a concern in regard to use of the 'commuter boat highway' from the western foreshores and Scotland Island to Church Point. The primary concerns are congestion and the large numbers of moorings on the 'highway'. The use and storage of commuter boats as well as the number of moorings in the area needs to be regulated.
- Revenue collected as a result of the use of the estuary (eg. from moorings, licences, car parks etc) should be put back into the sustainable management of the estuary.

- Council would like to see funding to address regional and State issues in the estuary come from State Government rather than Council. In general, Council should fund actions that address local issues only.
- There are more boats in Pittwater than in Sydney Harbour - facilities associated with boating should be funded by State Government.

Foreshore Access

- Impacts of recreational developments on the rocky shore and natural shoreline features are a concern.
- Public access to the foreshore is a big issue and of concern. Public access is very limited and needs to be improved.
- Public access to the estuary foreshore should be a prime consideration in the approval of all new foreshore developments.
- Foreshore activities need to be regulated to ensure the health of the estuary is not impacted (eg. hygiene issues and potential water quality impacts of dog exercise areas, impacts of fertiliser and grass clippings as a result of the use of football fields). Council needs a collection system for grass clippings to prevent them from entering the waterway.

Other Issues

- ESD should be the overarching framework for the management of the estuary. New and innovative ideas are required to make the estuary more sustainable.
- The focus of the study should be on environmental outcomes. Therefore, the study should focus on developing effective on-ground actions that are easy to implement.
- Management actions should be based on science. Regulation will be more easily accepted by the community if it is scientifically based.
- Council should require that all marinas should have effluent pump-out facilities.
- What is the impact of commercial fishing on seagrass beds?
- Is the drop over area getting shallower?
- Not all foreshore dwellings should be able to have their own wharf. Dwellings should be required to share wharfs.
- The estuary provides an excellent educational resource, particularly at Careel Bay.
- Dogs must be kept out of certain areas and must be kept on a leash in other areas to minimise impacts on water quality and birds.
- Climate change is a concern. All new seawalls should be properly designed in consultation with NSW Fisheries to ensure potential impacts on foreshore erosion and fish habitat are minimised - see Chapman study (Sydney University).

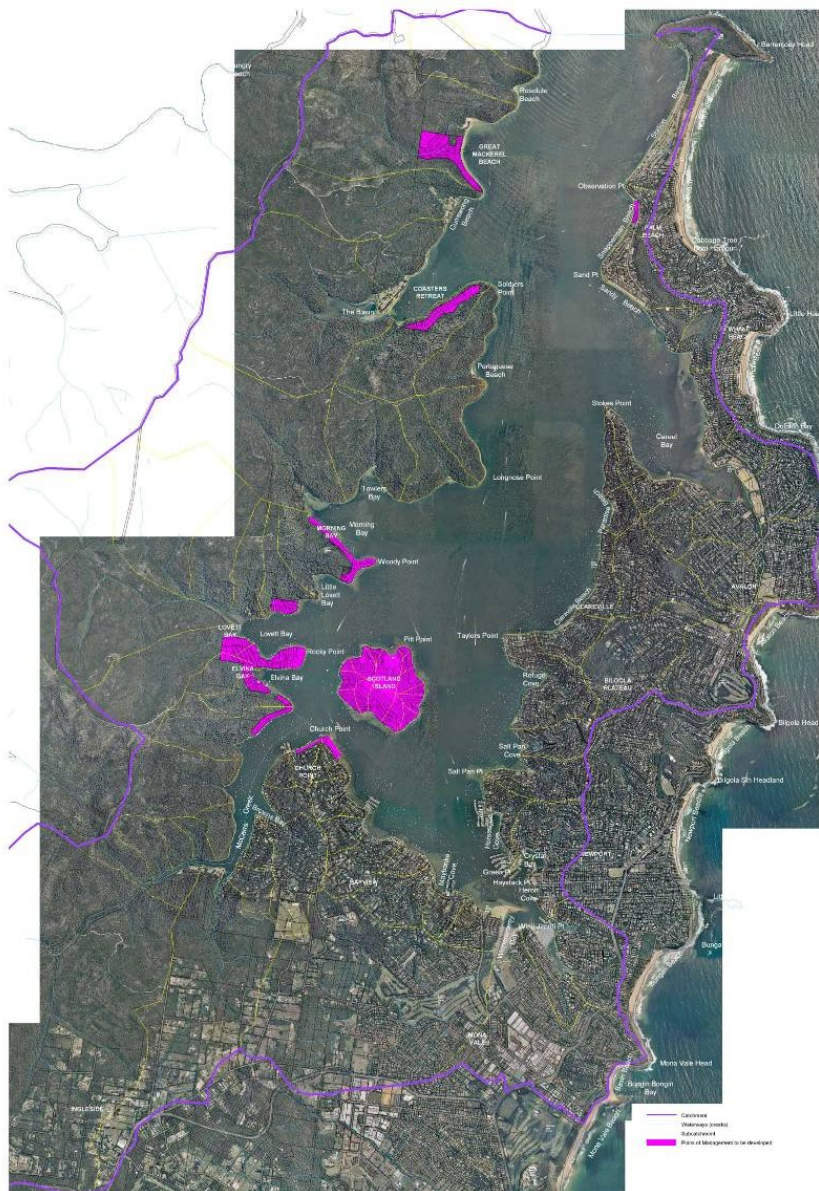
How serious is the consultant and Council in addressing all the issues raised today?

APPENDIX C: WORKSHOP 1 MAPS AND FIGURES

MAP 1

PITTWATER ESTUARY MANAGEMENT PLAN WORKSHOP 1

Plan of Management Options



1. Develop a specific Plan of Management for the Church Point Foreshore Precinct

The preparation of a Church Point Plan of Management (PoM) for Church Point Crown Land is currently in progress, and aims to address issues associated with: environmental protection and requirements; pedestrian access and safety; traffic flow, vehicle access and vehicle parking for offshore residents, tourists and day trippers, patrons of the shops, restaurants, Pasadena, and other users of Church Point Reserve and waterway; commuter boat access, traffic flow and facilities; accommodating increased demand for all facilities with future redevelopment of offshore settlements (eg. Pasadena); future wharf replacement; cargo and goods handling; and recreational and environmental amenity.



Photo 1, Church Point Foreshore

2. Develop a specific Plan of Management for Palm Beach Wharf/Pittwater Park and associated facilities

Similar to the Church Point PoM, the preparation of a Palm Beach Wharf / Pittwater Park PoM would aim to address issues regarding parking, access, transport, commerce, commuter boat facilities, future development, and recreational and environmental amenity. In addition to a potential increase in offshore resident population, increasing numbers of commuters from the Central Coast (Etterangi) need to be also accommodated.



Photos 2 & 3, Palm Beach Wharf

3. Develop a specific Plan of Management for Scotland Island and the other offshore communities along the western foreshore of Pittwater

This option involves the development of a PoM for Scotland Island and the western foreshore communities to address the issues related to the isolation of these areas, including:

- Water only access to properties; and associated demand upon public infrastructure for commuter moorings, carparking, and other transport and commuter requirements
- Water supply and waste water disposal
- Emergency response;
- Solid waste management and disposal;
- Appropriateness of future development and redevelopment of existing dwellings (and how this changes the demands on existing services);
- Vegetation clearing and requirements under recently amended bushfire legislation.



Photo 4, Cargo Wharf, Scotland Island

For each of the above PoMs, specific amendments to Pittwater 21 DCP, and/or the forthcoming standard LEP will be required to integrate the PoMs into Council's planning framework.

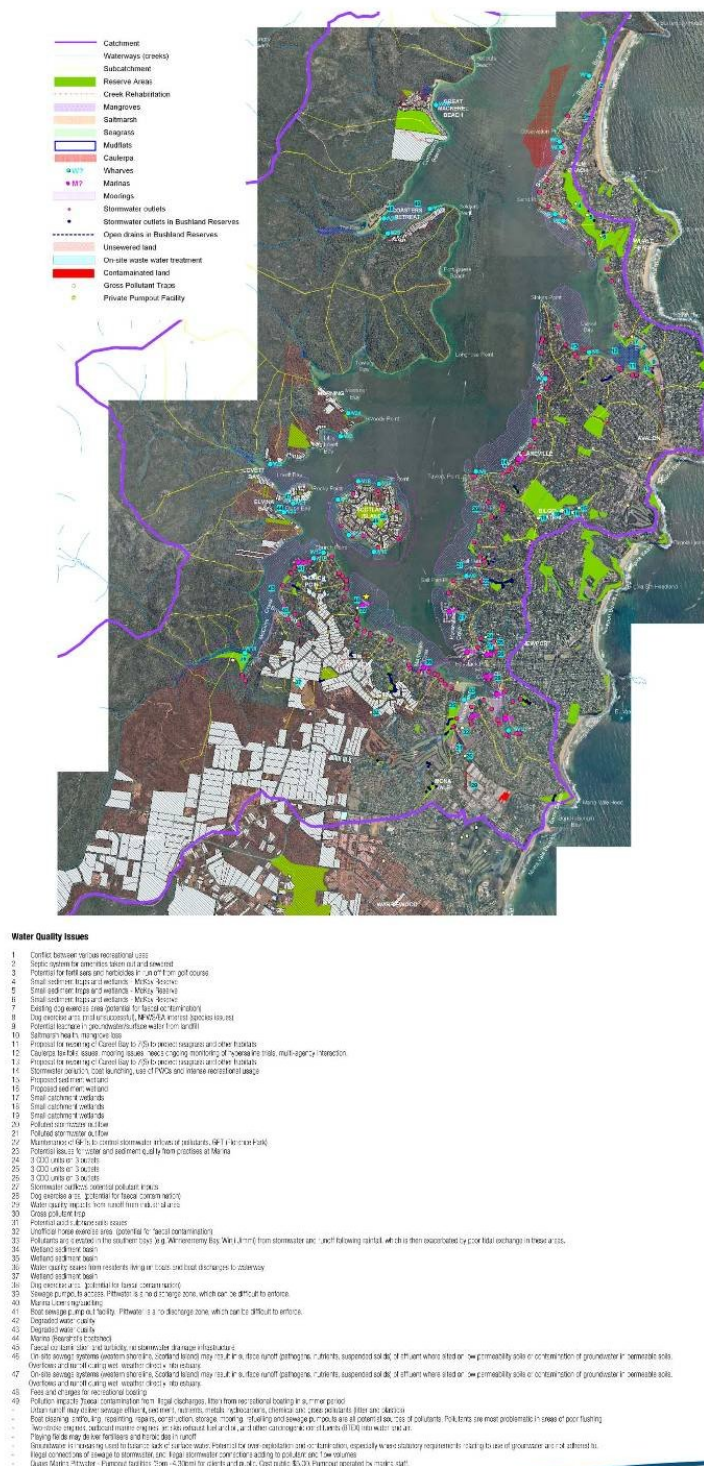
Responsibility: All three PoMs would be prepared by Council and Department of Lands, with input from the stakeholder communities (from the areas of commerce, residency, recreation, commuting etc.) relevant to the areas covered by the PoMs (ie. Church Point, Palm Beach/Pittwater Park, and Scotland Island and the foreshore communities respectively). Once adopted, Council would be responsible for implementing the Plan in close co-operation with the relevant State Government Agencies. In order to facilitate the proper integration of each of the three PoMs, it would be useful for consistency to prepare all three PoMs at the same time.

Figure C-1 Plan of Management Options Map

MAP 2

PITTWATER ESTUARY MANAGEMENT PLAN WORKSHOP 1

Water Quality Management Options



1. Discuss with marina operators ways of minimising future inputs of heavy metals and other pollutants

This option involves holding discussions with individual marina operators to identify ways to minimise the input of pollutants to the waterway, with a view to having all marinas operating voluntarily to best practice standards for the boating industry. Four marinas hold discharge licences with DECC (formerly EPA). The negotiations could include DECC making amendments to existing licensing arrangements to encourage a reduction in pollutant discharges by marinas.

Responsibility: Council would carry out negotiations, with the assistance of DECC and DPI Fisheries as required.

2. Seek to introduce Emissions Standards for Small Engines, particularly two stroke engines, in Pittwater

Two-stroke engines particularly, are known to exhaust up to 30% of the fuel/oil mix directly to the waterway. This option will involve assisting DECC to develop and promote a national approach for voluntary and regulatory actions which limit the emission of pollutants to the air and the waterway from the use of marine outboard engines.

National benchmark emissions limits could be readily developed on the basis of existing US and European standards and guidelines, and would be applicable to all small engines, both two and four stroke.

Responsibility: Implementation would be through DECC (EPA) and NSW Maritime Authority (NSW Maritime) with support from Council and the boating industry.

3. Prohibit people permanently living on-board boats unless they use holding tanks and pump-out facilities

Pittwater contains a high density of moored and berthed vessels within poorly flushed embayments (eg McCarrs Creek, Wirri Jimmi Bay, Crystal Bay). Permanent residents on vessels in these areas have the potential to degrade water quality unless they use shore-based toilet and laundering services, or they discharge to holding tanks which they regularly pump out to the reticulated sewerage system. NSW Maritime regulations prohibit the permanent occupation of boats, however, policing of this issue is difficult. Further, recreational boats are not required by law to contain holding tanks. Assistance from marinas in reporting incidents (ie, permanent occupancy) and recording additional information (eg as to holding tanks) may assist NSW Maritime achieve compliance with regulations.

Responsibility: Enforcement would be arranged through NSW Maritime with assistance by individual marina operators.

4. Education of boat owners regarding the 'no discharge' status of Pittwater

Pittwater estuary is a designated 'no discharge' zone, thus effluent from boats is not allowed to be discharged within any part of the estuary. Discharges can only be made at designated pump-out facilities, or offshore. In spite of this, it is expected that effluent is being discharged directly to the estuary from time to time, particularly by older boats that do not have holding tanks. Further, while holding tanks are required by law for commercial vessels, such legalities do not apply to recreational vessels.

Educational material (leaflets/brochures such as "leave nothing in your wake") regarding this issue have already been developed by NSW Maritime. A targeted campaign utilising existing material to raise awareness of Pittwater as a 'no discharge zone' and the repercussions of effluent discharges (eg poor water quality, algal blooms, release of pathogens) would be undertaken. Attention should initially focus high usage locations and on vessels that moor in embayments overnight or for extended periods of time, such as at The Basin.

Responsibility: NSW Maritime with the assistance of Council and the co-operation of the Hawkesbury Nepean Catchment Management Authority (HNCMA).

5. Prioritise treatment of urban runoff in areas that discharge to poorly flushed regions of the estuary as a part of the Pittwater Water Management Strategy

The southern sections of Pittwater are naturally susceptible to pollutant inputs due to their low capacity to dissipate and dilute inputs. Therefore, priority should be given to reducing pollutant discharges into these poorly flushed sections of the estuary.

The Pittwater Stormwater Management Plan (PBP 1999) identified a series of actions that should be implemented to reduce pollutant runoff from the catchment. A review of this Plan is needed to consider the natural susceptibility of some parts of the estuary and re-prioritise some of the works/actions to address inputs directed to the poorly flushed areas first.

Responsibility: Council would be required to update and modify the Stormwater Management Plan in the context of preparing the Pittwater Integrated Water Cycle Management Plan.

Figure C-2 Water Quality Management Options Map Part 1

MAP 2

PITTWATER ESTUARY MANAGEMENT PLAN WORKSHOP 1

Water Quality Management Options

continued...

6. Require the use of appropriate on-site sewage treatment and disposal technology for all new development unable to connect to a reticulated sewerage system and carry out regular audits of all existing septic systems

Residential developments on Scotland Island and the western foreshore rely on on-site effluent disposal. These systems are typically problematic and may contribute pollutants to the waterway even when working efficiently and sited correctly (based on soil types and depths, site slope and system capacity).

Every existing on-site effluent disposal system should be audited on a recurrent basis to determine if it is functioning adequately, appropriate to the site, and to ensure that excessive pollutants are not being directed to the environment. Recommendations should be given as to maintenance and/or replacement. In particular, Scotland Island has been earmarked for connection to the reticulated sewerage network, as part of Stage 2 of Sydney Water's Priority Sewerage Program (PSP). If it is found that the majority of systems along the Western Foreshores also require replacement, consideration should be given to adding these areas onto the PSP, as part of the Scotland Island connection.

For new developments, development controls should be reviewed to ensure the use effective effluent disposal systems based on site characteristics. Waterless and "hightech" composting toilets should be considered for all new installations or to replace failing systems. Potential for greywater reuse treatment and disposal systems should be considered in conjunction with NSW Govt standards, eg to ensure the land does not become saturated.

Council controls should be set such that the reticulated potable water supply will not be connected to these communities until connection to the reticulated sewerage network or an alternative means of "off-site" disposal is arranged.

Responsibility: Council would be required to conduct audits of all of the on-site and septic systems around Pittwater, although assistance could be sought from Sydney Water. Audit results should be provided to Sydney Water to assess the priority and timeframe for connecting areas to the reticulated sewerage network.

7. Require that all marinas larger than 30 berths have sewage pump-out facilities

This option involves changes to existing statutes and regulations, or the development of new controls, which require larger marinas to install sewage pump-out facilities. Controls were recently implemented for Sydney Harbour that require new marinas or redevelopment of existing marinas larger than 9 berths to include pump-out facilities.

Responsibility: Department of Lands, Department of Planning and NSW Maritime would be mainly responsible, with assistance from Council and other state agencies, as required.

8. Conduct a catchment audit to identify pollutant sources and to target future catchment management works

This option involves assessing activities and land uses that constitute potential sources of pollutants within the Pittwater catchment. Water quality monitoring, detailed mapping and site inspections would be undertaken (particularly of suspected pollutant contributors, eg landfill sites, golf courses, playing fields, industrial sites, and even individual developments). Once the major pollutant sources are identified, mitigative measures can be implemented in order to reduce pollutant discharges.

Pollutant identification would be carried out on a sub-catchment basis, with areas draining to the poorly flushed parts of the estuary being assessed first (eg Mona Vale Main Drain, Careel Creek, Cicada Glen Creek and Winji Jimmi Bay).

In the interim, community education targeting the major activities and practises in the catchment that pollute the waterway should be developed and implemented.

Responsibility: Council would be responsible for identifying pollutant sources, and for some pollutant mitigation, with assistance and advice from the EPA, particularly in cases where landowners of identified sites will be responsible for mitigation.



Photo 1. Boats on Pittwater requiring sewage pump-out facilities.



Photo 2. Gross Pollutant Trap at Kitchener Park.



Photo 3. Stormwater outlet in Algona Reserve



Photo 4. Students undertaking water quality testing

9. Hold discussions with Sydney Water regarding improving the sewerage system to prevent sewage overflows

There are 23 identified designed sewerage overflow locations around the Pittwater estuary. A survey of all known overflow locations undertaken by Council staff in 1993 listed a total of 60 overflow locations within the Pittwater LGA, 38 of which discharged to Pittwater. Sydney Water has estimated that sewage from overflows contributed about 18% of the average annual bacterial load to stormwater within the Pittwater catchment (Sydney Water, 1998), and a relatively minor contribution to total nutrient load. High bacterial loads to the estuary, particularly during rainfall events, are currently compromising the safety of the public who bathe within Pittwater (even at designated bathing locations, eg Bayview baths).

Sydney Water is currently undertaking its SewerFix Wet Weather Abatement Program, which involves improvements to pipes, storage facilities and design overflow, in areas across Sydney including Pittwater. The work is required as part of licensing agreements with DECC. In addition, upgrades to the Warriewood STP are underway and Warriewood has also been targeted for assessment and repair of sewerage components under the SewerFix program.

This option would involve starting dialogue with Sydney Water to prioritise sewer improvements (under the SewerFix program) within the Pittwater catchment, to substantially reduce overflows into the stormwater and Pittwater estuary.

Responsibility: Dialogue with Sydney Water should be initiated by Council, and supported by other government agencies, such as DECC (EPA) and Department of Health, as required.

10. Make the community aware of potential water contamination issues associated with the use of fertiliser and pesticides, as well as statutory requirements to protect the groundwater resource

This option involves a widespread community education program to ensure the appropriate use of fertilisers and pesticides, and minimise runoff to surface water and groundwater systems, for both large scale operators and smaller private landowners. In addition, the campaign would educate as to the appropriate use and protection of groundwater resources.

Management of surface runoff, such as by establishment of buffers for creek lines, should be reinforced through appropriate development controls and the Pittwater 21 DCP. Development applications involving construction that may interfere with groundwater systems, or proposals to extract groundwater should be discussed with DECC. Council Planning and Development staff should also be conversant with the State Government's requirements for groundwater bore licensing. Pittwater 21 DCP should be amended to specifically include requirements for groundwater extraction as well as desalination activities.

To further monitor the use and quality of groundwater resources, Council should update its GIS database to include all known groundwater boreholes and spearpoints (as well as private desalination devices if applicable) within the Pittwater LGA.

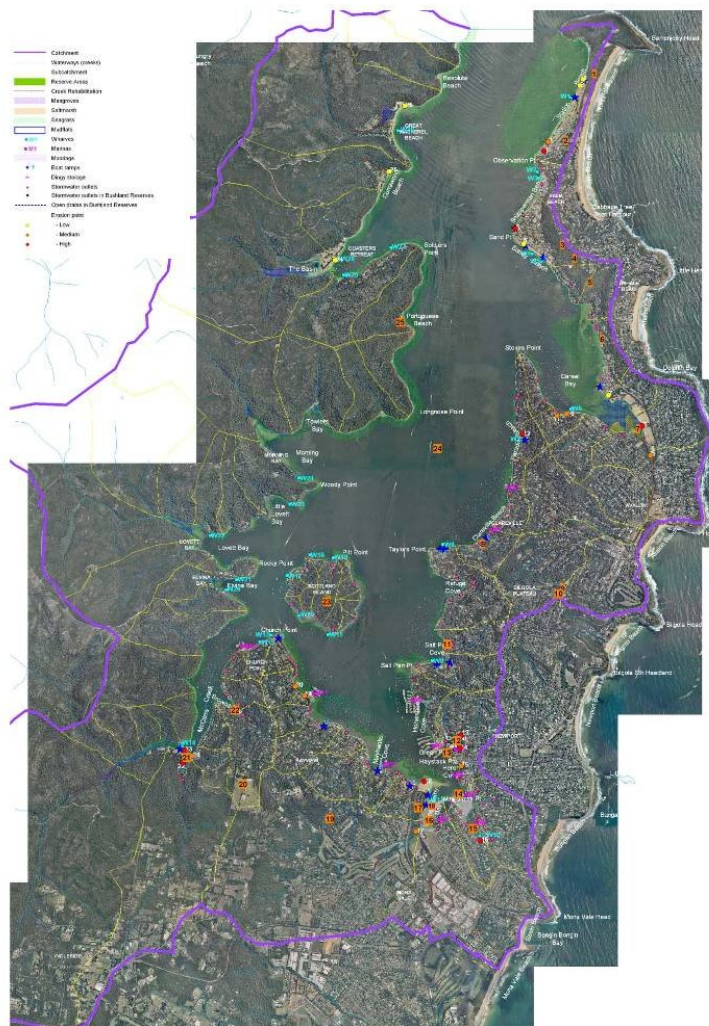
Responsibility: The education program would be initiated by Council, although assistance by DECC should be provided, particularly in relation to compliance with relevant legislation (e.g. Protection of the Environment Operations Act, Water Management Act).

Figure C-3 Water Quality Management Options Map Part 2

MAP 2

PITTWATER ESTUARY MANAGEMENT PLAN WORKSHOP 1

Sedimentation and Erosion Management Options



Sedimentation Issues

1. Re-establishment with native plantings
2. Soil cover over exposed soil
3. Seal sediment from the catchment (McKay Estate)
4. Seal sediment from the catchment (McKay Estate)
5. Seal sediment from the catchment (McKay Estate)
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21. Seal sediment from the catchment (McKay Estate)
22. Seal sediment from the catchment (McKay Estate)
23. Seal sediment from the catchment (McKay Estate)
24. Seal sediment from the catchment (McKay Estate)
25. Seal sediment from the catchment (McKay Estate)
26. Seal sediment from the catchment (McKay Estate)

1. Sandpoint Beach Boat Ramp	Uncontrolled runoff from ramp is likely to erode access to waterline. Runoff from car park onto beach is low	Low
2. Sandpoint Beach Boat Ramp	Non-formatted public access. Local access causes runoff to concentrate at public	Low
3. End of Beach Road adjacent to Boat Course	Front edge of cliff is eroded by waves but appears to be subject to erosion due to sand and sea action	Medium
4. Erosion Properties at End of Beach Road	Wind waves action. The protection of this erosion is subject to erosion due to sand and sea action	Medium
5. Reserve at End of Beach Rd	Wind waves action. The protection of this erosion is subject to erosion due to sand and sea action	Medium
6. Reserve at End of Beach Rd	Wind waves action. The protection of this erosion is subject to erosion due to sand and sea action	Medium
7. Reserve at End of Beach Rd	Wind waves action. The protection of this erosion is subject to erosion due to sand and sea action	Medium
8. Reserve at End of Beach Rd	Wind waves action. The protection of this erosion is subject to erosion due to sand and sea action	Medium
9. Reserve at End of Beach Rd	Wind waves action. The protection of this erosion is subject to erosion due to sand and sea action	Medium
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15. Reserve at End of Beach Rd	Wind waves action. The protection of this erosion is subject to erosion due to sand and sea action	Medium
16. Reserve at End of Beach Rd	Wind waves action. The protection of this erosion is subject to erosion due to sand and sea action	Medium
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23. Reserve at End of Beach Rd	Wind waves action. The protection of this erosion is subject to erosion due to sand and sea action	Medium
24. Reserve at End of Beach Rd	Wind waves action. The protection of this erosion is subject to erosion due to sand and sea action	Medium
25. Reserve at End of Beach Rd	Wind waves action. The protection of this erosion is subject to erosion due to sand and sea action	Medium
26. Reserve at End of Beach Rd	Wind waves action. The protection of this erosion is subject to erosion due to sand and sea action	Medium

1. Implement catchment management actions for urbanised tributaries as outlined in the Stormwater Management Plan to control turbidity and sediment wash-off

Some of the actions recommended in the Pitwater Stormwater Management Plan (PSMP) (PBP, 1999) address erosion and turbidity generation in the estuary, particularly due to areas of unvegetated, exposed ground surface and unsealed roads (especially on Scotland Island). This option involves ensuring such recommended actions, plus the Scotland Island Erosion and Sediment Control Plan (Witheridge 2004) are adequately incorporated into the Pitwater Integrated Water Cycle Management Plan and implemented as priority actions. Work by Council and the community to address erosion and sediment problems on Scotland Island has commenced.

Responsibility: Council is responsible for incorporating the PSMP into the Pitwater Integrated Water Cycle Management Plan.

2. Carry out major rehabilitation in areas of degraded creeklines and tributaries, or at least riparian plantings to shade the creek / drain and prevent super-heating of inflowing water

Many of the natural tributaries draining to Pitwater have been replaced with formalised 'hydraulically efficient' channels, culverts and pipes. This has tended to increase velocities within waterways, as evident by erosion at the downstream end of drains and channels. Formalised drains also provide little habitat value and can super-heat the water, particularly during summer.

This option proposes 'deformalising' some tributaries by replacing existing concrete lined drains with more natural meandering vegetated channels. Where the ability to do works is limited by space and land ownership issues, or potential flood impacts channels should be revegetated for shade and to prevent water heating as a minimum. Priority locations for creek rehabilitation or enhancement would include:

- Cereel Creek (particularly upstream from Barrenjoey Road)
- Mona Vale Main Drain (open drain through light industrial area at Mona Vale)
- Cahill Creek (upstream of Bayview Golf Course)
- Bayview Golf Course channels and watercourses (restoration of environmental flows and habitat enhancement).
- Bayview Golf Course floodgates (investigation of the operation and impacts of Pitwater Road floodgates on flooding, water quality and fish movement).

Responsibility: This option would be implemented by Council (in co-operation with private property owners as necessary) although assistance / approvals should be sought from HMC MA and DECC.

3. Review and ensure compliance with Council regulations regarding sediment and erosion control on building sites in the catchment

This option involves reviewing current sediment and erosion control requirements for new urban developments. If the requirements do not reflect current best practice, the requirements should be amended to ensure that all possible action is taken to reduce sediment loads to the estuary. Second, this option involves auditing to ensure sediment and erosion control requirements and all related conditions of consent for developments are adhered to by builders and developers.

Responsibility: Council compliance officers and approvals staff will perform assessment and policing/enforcement of this option.

4. As necessary, remediate areas that experience erosion, ensuring that the process will not continue to cause problems in the future

The 26 areas of foreshore erosion identified in the Pitwater EPS should be remediated. Preference should be given to soft-engineering for remediation works, such as shoreline re-grading and revegetation and modifying the erosion mechanism, rather than construction of additional rock walls around the foreshore. Detailed investigation of bank erosion mechanisms and remediation options (as at Rowland Reserve) for each site would need to be conducted prior to implementing works.

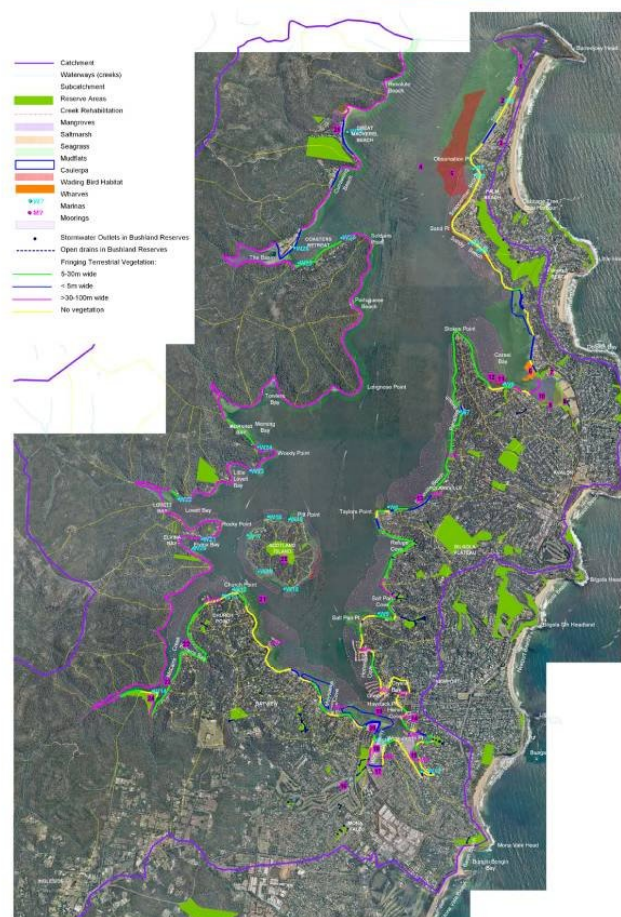
Responsibility: Investigations and remediation works would be carried out by Council, with the assistance of DECC, plus property owners if on private land.

Figure C-4 Sedimentation and Erosion Management Options Map

MAP 4

PITTWATER ESTUARY MANAGEMENT PLAN WORKSHOP 1

Ecology Management Options



Ecological Issues

1. Impact from recreational use upon habitats (particularly seagrass).
2. Commercial and recreational fishing, potential for depletion of target and bycatch species stocks.
3. Run off from golf course use of fertilisers and pesticides may impact upon ecology.
4. Commercial fishing (eg haul netting) around Pittwater Point may damage seagrass where best practice methods not used.
5. Increase in area of *Caulerpa taxifolia* in spite of ongoing management (herbicide treatment).
6. Powerboats, PWC, use and other human recreational activities may disturb migratory shorebirds and waders. Pittwater is one of few remaining known habitats in the Sydney Region for the Bush Stone-curlew, which frequent intertidal zone of saltmarsh and mangroves.
7. Dog exercise areas - potential disturbance of migratory shorebirds/waders, and other native fauna/flora.
8. Loss of saltmarsh due to increased sedimentation and replacement by mangroves.
9. Loss of mangroves and saltmarsh due to land reclamation. High clearing, inappropriate access and recreational activities.
10. Proposal for recovery of Caneel Bay to 75% to protect seagrass and other habitats.
11. *Caulerpa taxifolia* issue: mooring issue, needs ongoing monitoring of hypersaline trials, multi-agency interaction.
12. Proposal for recovery of Caneel Bay to 75% to protect seagrass and other habitats.
13. Intense recreational usage - stormwater pollution, boat launching ramps, seagrass offshore, inappropriate use of PWCs.
14. Dog exercise areas - potential disturbance of migratory shorebirds/waders, and other native fauna/flora.
15. Pressure for dredging for navigation access.
16. Problems for fish passage caused by flood gates for tidal restriction to allow water extraction for irrigation.
17. Unofficial horse exercise areas - potential disturbance of migratory shorebirds/waders, and other native fauna/flora.
18. Loss of wetlands in Willemerong Bay due to dredging and land reclamation in the 1960s and 1970s. Small isolated stands of mangroves remain. Saltmarsh replaced by Rehabilitation Program in Willemerong Bay is struggling to become established due to the sensitivity of saltmarsh, uncontrolled public access and inappropriate recreational activities.
19. Areas of active siltation (eg Dorens Bay) are also exhibiting a loss of seagrass area.
20. Seagrass recovery evident in some areas of prior dredging (eg Bayview Park).
21. Commercial runabouts damaging seagrass beds due to motors and increased turbidity which smothers beds.
22. Potential for unlicensed dog (eg within designated dog exercise area) to disturb migratory shorebirds and waders.
23. Loss of wetlands in McCarrs Creek due to milk mixing, dredging and land reclamation.
24. Dog exercise areas - potential disturbance of migratory shorebirds/waders, and other native fauna/flora.
25. Development on island - impacts on vegetation, vehicle use impacts.
26. Potential redevelopment may require control to ensure no encroachment onto valuable mangrove and saltmarsh habitat.
27. Seagrass moorings cause physical damage and removal of seagrass beds. Seagrass friendly moorings are used infrequently due to large expense and lack of appropriate mandates to require their use. Dog moorings required as a 'vector' for hyperparasitism and spread of *Caulerpa taxifolia*.
28. There is currently a cap on swing moorings in Pittwater. At 3041 Jolly and marina construction/redevelopment has continued, but without requiring replacement/removal of existing moorings in return for allowing of the hyperparasitism developments.
29. Other construction in some locations has involved backfilling and land reclamation, degrading wetland habitats.

7. Conserve and improve existing and potential habitat for native fauna, particularly avifauna

In concert with the habitat protection measures already mentioned, additional actions to enhance habitat values and protect native fauna remaining in Pittwater include:

- retention of habitat trees, fallen timber, bush rocks and wrack;
- installation of properly designed nesting structures for target species;
- creation of artificial roosts or protected roosting areas for wading and shore birds; and
- control of feral, pest and domestic animals.

Responsibility: The option would be co-ordinated by Council with substantial input from DECC and DPI. Both Council and the Pittwater community need to become involved in the implementation of applicable Species Recovery Plans (eg Bush Stone-curlew Recovery Plan) and DECC should become more involved in "off-park" conservation projects and programs.

1. Review of adequacy of existing environment protection measures (eg waterway zoning) and if inadequate, make appropriate changes to existing instruments, or introduce new habitat protection tools (eg SEPP-14 declaration)

This option involves detailed mapping of areas of environmental significance, such as Endangered Ecological Communities (EECs), sandflats and mudflats utilised by migratory wader birds, areas of native seagrass (particularly *Posidonia*), saltmarsh, mangrove forests, hollow trees etc. The maps will then be cross-referenced against local, state and federal planning instruments to determine the required versus current protection of these habitats. Amendments will be made to Council's planning instruments to ensure adequate protection for habitats against degradation due to inappropriate activities or future development (eg 7(a1) Environmental Protection Waterways for native seagrasses).

In addition, an application to DoP would be made requesting suitable areas within Pittwater, such as Caneel Bay wetlands, be specifically included under SEPP-14. (Council is already incorporating the Model DCP - Protecting Sydney's Wetlands (SCCG 2001) into Pittwater 21 DCP). Opportunities through the Fisheries Management Act 1994 to have certain areas within the estuary protected by an Aquatic Reserve declaration or certain habitats declared as Critical Habitat of endangered species, populations or ecological communities need also be investigated, eg, for mudflats that provide habitat for the endangered Bush Stone-curlew and several other threatened species of migratory wading birds.

Responsibility: Investigated by Council in conjunction with the DPI and DECC.

2. Move existing moorings away from seagrass beds and establish 'no anchoring' zones over substantial seagrass beds and *Caulerpa taxifolia* infestations

Moorings may have a significant impact on seagrass beds, particularly "scalping" circles where slackened mooring chains during the low tide have dragged and damaged seagrass beds. Moorings should be relocated away from seagrass beds. Where relocation is not feasible, seagrass friendly moorings should be mandated for use in all areas of seagrass. It is recognised that a mooring cap has been applied within Pittwater, and that suitable locations for relocated moorings may be limited.

'No anchoring' zones should also be established in areas that contain substantial beds of seagrass to prevent damage to the beds as well as in areas of *Caulerpa taxifolia* infestation to prevent spread of the weed. The areas in front of Barrenjoey (Station) Beach and within Caneel Bay are two such areas that should be considered for 'no anchoring'.

Responsibility: Council should liaise with NSW Maritime and the DPI Fisheries in considering relocation of relevant moorings and establishing 'no anchoring' zones.

3. Provide general environmental education regarding the estuary and its diverse habitats through signage, school kits and public displays

Providing education to the community regarding the estuary, its values and the potential impacts of humans is the aim of this option, to increase awareness about the estuary in the community's day-to-day life. This option also involves the continued expansion of school and community education courses run by the Coastal Environment Centre. The education program would focus on sensitive areas of the estuary such as Caneel Bay, and also on particular issues, such as reducing nutrients in runoff and the spread of environmental weeds. Signage and public displays, and a schools program would also be part of the delivery of environmental education.

Responsibility: Council would be responsible for design and implementation.

4. Remove weeds and exotic species from the foreshores and within the estuary itself, including the noxious species *Caulerpa taxifolia*

The option involves considerable on-ground works to systematically remove weeds and exotic species from the estuary and its surrounding areas. For private lands, removal of weeds would be thought education of landowners, targeted weed grants and enforcement of Noxious Weed Act provisions (as necessary).

DPI Fisheries, with support from the HNCMA and Council, should continue to manage *Caulerpa taxifolia* outbreaks (using salt treatment or other new methods) and implement the NSW *Caulerpa* Control Plan. Community education should also target ways to reduce the spread of *C. taxifolia*.

Responsibility: Weed removal from foreshores and bushland areas could be organised through local landscape co-ordinator or Council's Natural Resources staff.

5. Pro-actively manage the Caneel Bay wetlands to maintain a mix of habitat types (which may include selective removal of mangrove seedlings from saltmarsh areas from time to time)

The most valuable environments from a species diversity perspective are those that have a wide range of habitat types. Within Caneel Bay, the habitat diversity is being compromised by the prolific growth of mangroves. Both saltmarsh and sandflat areas have been affected by this relatively recent overgrowth. To maintain a healthy mix of habitat types it may be necessary to control the spread of mangroves into these other areas via selective removal of juvenile stock. This would need to be carried out by or in a manner approved by DPI Fisheries. The work should include measures to control access to and within the various wetland habitats.

Responsibility: Council and DPI Fisheries for implementation of this option

6. Plant native vegetation along both public and private foreshores to re-establish a riparian vegetated corridor around the estuary

This option involves planting indigenous species along the foreshores of the estuary to improve the habitat potential and scenic amenity of the waterway. Appropriate plantings could be carried out in the intertidal zone (eg with mangrove seedlings), the upper-tidal zone (eg with saltmarsh and salt tolerant species such as sedges and rushes) and the upper riparian zone (eg with casuarinas, acacia and eucalypts). Voluntary revegetation on privately owned lands would be encouraged through education, assistance and incentives, such as through HNCMA programs or similar.

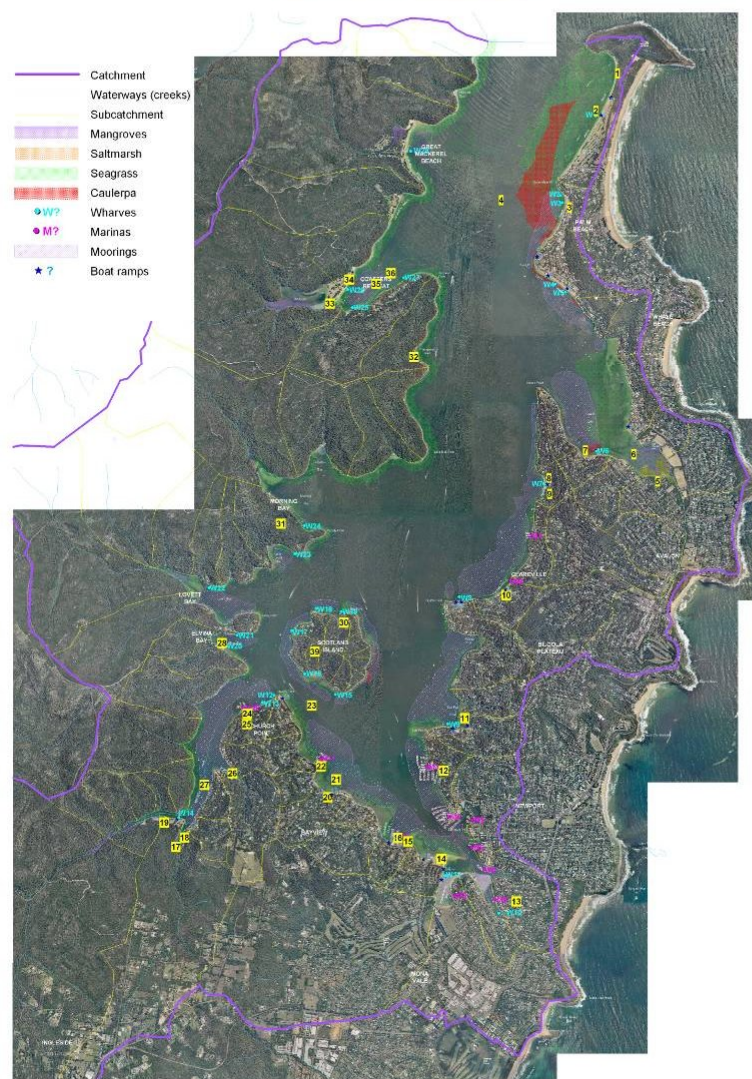
Responsibility: Council's bushcare co-ordinator with assistance from HNCMA programs could manage the implementation of this option.

Figure C-5 Ecology Management Options Map

MAP 5

PITTWATER ESTUARY MANAGEMENT PLAN WORKSHOP 1

Waterway Usage Management Options



25. Minimise proximity of some waterway activities to areas of environmental significance (eg Careel Bay) through speed restrictions and 'no anchoring' zones

To further protect areas of significant environmental value (such as Careel Bay wetlands and migratory bird habitat and extensive seagrass beds), waterway activities would be minimised in the general proximity of such areas. This may include lower speed limits and 'no anchoring' zones, to discourage inappropriate usage and frequent visitation by vessels.

Responsibility: Controlling the movement of vessels around Pittwater through speed and anchoring restrictions is the responsibility of NSW Maritime Authority.

26. Review the need for speed limits in areas of high vessel traffic, e.g. on western side of Scotland Island

The area west of Scotland Island between Church Point and the western foreshores communities is used as a 'commuter highway'. Given the high vessel traffic utilising this section of the estuary, and in the interests of public safety (particularly when travelling at night), NSW Maritime Authority should review current speed restrictions in all areas that are known commuter routes.

Responsibility: NSW Maritime

27. Enforce compliance with speed restrictions and discourage inappropriate boating behaviour

For the small element of the boating community that continues to disobey restrictions and behave inappropriately, NSW Maritime Authority, with assistance of the Water Police and other regulatory agencies, should consider ways that they can increase patrols of the estuary to enforce compliance with the boating rules and regulations.

Responsibility: NSW Maritime with the assistance of regulatory authorities.

28. Relocate existing moorings away from areas that contain considerable vessel traffic, such as near the Church Point commuter wharf and other public wharfs and determine a maximum number of vessels to be moored/berthed on the waterway

Relocation of a small number of moorings within areas heavily trafficked by boats should be considered, such as those in front of public wharfs, or adjacent to popular traffic routes. Given the current cap on moorings, consideration should be given to surrendering the mooring, possibly with compensation to the lessee, where suitable relocation is not feasible.

A total number of vessels able to be moored and berthed in the Pittwater estuary should be determined and regulated. In particular, where new wet berths are created, a corresponding number of swing moorings should be relinquished and cancelled to ensure there is no net increase in the number of vessels 'stored' in the waterway. The long term aim should be to restore, as much as possible, navigable waterway for the use and enjoyment of the boating public.

Responsibility: NSW Maritime is responsible for reviewing existing mooring locations and potential caps on boat storage.

29. Carry out on-going maintenance dredging at select locations within the estuary to maintain safe navigation for existing vessels

Some areas have been dredged in the past to permit navigation of large or deep draught vessels. Natural deposition of sediment in these areas has meant safe navigation for larger vessels has been or will be compromised at some time in the future. A program of on-going dredging will be required if deep water access in these areas is proposed to be maintained.

Responsibility: The responsibility for maintaining access essentially resides with the individual boat owners who stand to benefit from the dredging. Anyone proposing to dredge will need to gain the necessary approvals, provide detailed hydrographic surveys of the area, assessment of boating requirements, and consult with DPI, Department of Lands, foreshore landowners and boat owners. As the dredging works are likely to be expensive, joint funding between the beneficiaries of dredging works and the State Government (through NSW Maritime) may be required.

30. Improve facilities at existing waterway access locations, and provide for additional access locations on a needs basis

This option involves reviewing the existing waterway infrastructure, such as public wharves and jetties, boat ramps, tie-up pontoons, fueling and pump-out facilities etc, and identifying what additional public facilities are required within the estuary and where. A program of works can then be developed aimed at addressing identified shortfalls and rationalising under-utilised infrastructure, which can be implemented on a prioritised basis when funding becomes available. This should involve input from the boating community of Pittwater, Department of Lands and NSW Maritime.

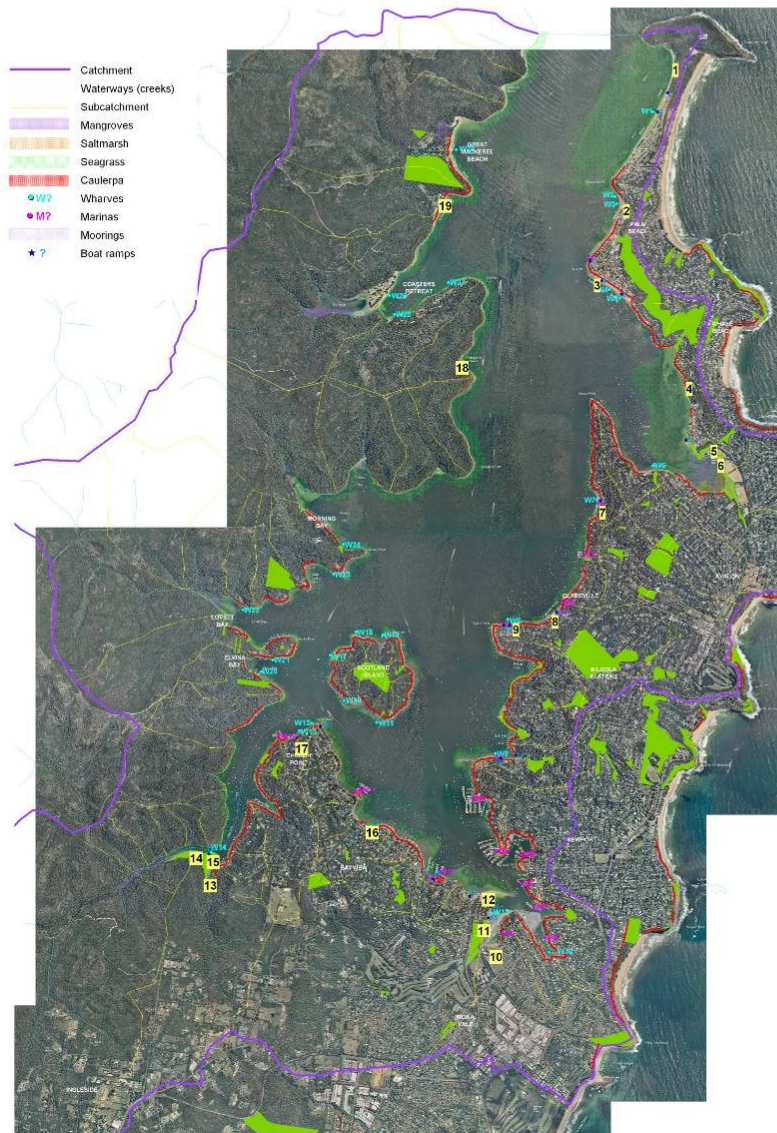
Responsibility: Council, with assistance from NSW Maritime, would be best placed to carry out the initial audit and prepare a prioritised list of necessary waterway facilities.

Figure C-6 Waterway Usage Management Options Map

MAP 6

PITTWATER ESTUARY MANAGEMENT PLAN WORKSHOP 1

Foreshore Usage Management Options



Foreshore Usage Issues

- Conflict between various recreational uses and access and existing areas of environment and heritage value
- Conflicts for commercial parking, recreational access (Link with Pittwater Park P&I model)
- Opportunities to improve foreshore access and reduce computer for structures
- Loss of foreshore access
- Day exercise area
- Day exercise area
- Conflicts between parking access, storage of bicycles and access to moored vessels
- Area of informal recreational usage
- Informal access difficulties
- Unofficial horse exercise area
- High usage area for dog walking
- Issues of access and storage for contractors at this site, provision of infrastructure requested. Council currently attempting resolution
- Relatively good car parking access
- Simply storage, no person access
- Day exercise area
- Dog walking
- High demand for 'cappuccino at Church Point' for commuters, visitors, other local users
- Use and keep use in order due to recreational usage
- Possible redevelopment for holiday resort

The foreshore building line illustrates the loss of foreshore access to private property at locations throughout Pittwater estuary

Boat Ramps

- General Phillip Park - Beach Road
- General Phillip Park - Beach Road
- Lucinda Park - Nallala Road
- Sandy Beach - Milla Road
- Sandy Beach - Milla Road
- Cambridge Reserve - Camell Bay
- Paradise Beach - Paradise Road
- Chimbley Beach
- Topper's Point
- Topper's Point
- Polytechnic Reserve - Salt Pine Cove
- Boomerang Park
- Powell Reserve (south)
- Powell Reserve (north)
- Boomerang Park
- Boomerang Park
- Boomerang Park
- Boomerang Park
- Boomerang Park

31. Develop Specific Controls for the Pittwater Foreshore

Pittwater 21 DCP should be amended to include foreshore development controls which make specific provisions for:

- The dedication of land to Council when redeveloping foreshore properties, to re-establish foreshore public access via an easement or other suitable means;
- Appropriate design and siting of foreshore structures such as jetties, sea walls, boatsheds, tidal pools, etc;
- Restriction on the number of private foreshore structures and occupancies (eg jetties), with neighbours or groups of neighbours required to share facilities;
- Prohibit the establishment of seawalls along natural foreshore areas;
- Appropriate natural foreshore protection, conservation and re-vegetation requirements.

Responsibility: Council planning department.

32. Provide education of foreshore users through signage and other campaigns regarding appropriate foreshore activities

This option involves education of users as to appropriate and considerate use of foreshore areas. Signage would be placed at key access points, and follow-up education would be carried out through specific or general mail-outs (eg with general Council rates notices). Education would include:

- Litter collection
- Picking up dog faeces (with bins provided);
- Conservation of foreshore habitats and the ecology of the inter-tidal zone;
- Areas unsuitable for swimming (eg at the heads of embayments that receive considerable stormwater input);
- Consideration of wading or roosting migratory birds (and the potential disturbance by humans, dogs and noisy activities);
- Responsible bait collection and compliance with Fisheries Bag Limits.

Responsibility: Council education officers



Photo 1: 10/10/10 Photo of Pittwater foreshore at Carter Bay



Photo 2: Complete view of Pittwater foreshore at Carter Bay

33. Improve public access and existing public facilities along the foreshore, and install additional facilities as required

To improve foreshore public access and increase opportunities for use of foreshore reserves, facilities may require upgrade, including provision of defined visitor car parks (to avoid over-parking and congestion in residential streets), seats, lighting, picnic tables, barbecue facilities, landscaping and walking tracks (either formal or informal, and enabling disabled access). Focus should also be given to removing private encroachments that obstruct access or inhibit enjoyment of public foreshore open space.

Public accessways should be confined to areas of low conservation significance wherever possible. Where there is a strong demand for public access to foreshore areas of high conservation significance, such access should be formalised and closely controlled to minimise environmental damage. Foreshore restoration or rehabilitation works should be undertaken as part of access improvement works.

Responsibility: Council would be responsible for managing public access and constructing additional facilities and services around the foreshores of Pittwater.



Photo 3: The view of the Pittwater foreshore at Carter Bay showing the location of the proposed car park



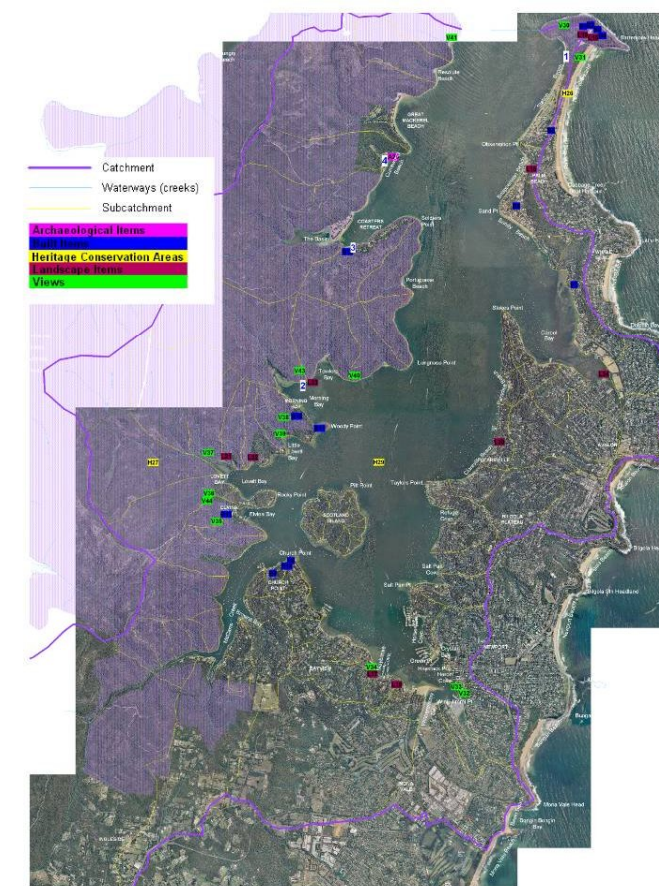
Photo 4: View of the Pittwater foreshore at Carter Bay showing the location of the proposed car park

Figure C-7 Foreshore Usage Management Options Map

MAP 7

PITTWATER ESTUARY MANAGEMENT PLAN WORKSHOP 1

Heritage Management Options



Heritage Issues

1. House Buildings - investigate heritage value and list on register as appropriate
 2. Possible Historic listing of wharf structures at 125
 3. Boonie Down Wharf - Heritage listed. The wharf has been recognised as culturally significant, associated with early recreational and residential development of the area in the period 1860-1930
 4. Historic Buildings - heritage value to be protected in case of development
- Additional issues:
- Lack of complete and accurate record of sites of Aboriginal heritage and cultural significance
 - Need for increased public recognition and understanding of Aboriginal heritage and importance of Pittwater to past, present and future Aboriginal communities
 - Indigenous and non-Indigenous heritage sites are at risk of damage/loss during redevelopment, especially where sites are not listed in state, Council or other planning instruments

Archaeological Items	Heritage Conservation Areas	Views
AC1	Archaeological site of former "Shifting Sands"	North end of Little Mackerel Beach
B1	Remnants of light house and 2 cottages	Part Lot 1, DP 54426, Berrangery Head
B2	Wharf	Part Lot 1, DP 54426, Berrangery Head
B3	Remnants of light house	Part Lot 1, DP 54426, Berrangery Head
B4	Remnants of light house	Part Lot 1, DP 54426, Berrangery Head
B5	Remnants of light house	Part Lot 1, DP 54426, Berrangery Head
B6	Remnants of light house	Part Lot 1, DP 54426, Berrangery Head
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B100	Remnants of light house	Part Lot 1, DP 54426, Berrangery Head

1. Investigate opportunities to extend Ku-ring-gai Chase National Park to include parts of Currawong and Mackerel Beach in order to protect sites of Aboriginal and early European cultural significance

This option involves DECC (NPWS) considering the inclusion of certain parts of the western foreshore (eg Currawong, parts of Mackerel Beach) into Ku-ring-gai Chase National Park. Areas considered for inclusion would have special significance from an indigenous or early European cultural viewpoint. This would include land zoned for Existing Recreation and Reservation County Open Space and areas considered by the local Aboriginal people as special women's places.

Responsibility: It is not intended to purchase land as part of this option, but for existing public land owners (Council, State) to exchange and/or dedicate the land to maximise the area of National Park and thereby afford the highest level of protection to the natural environment as well as items/areas of heritage significance.

2. Raise community awareness regarding former land occupation by the Aboriginal peoples and the importance of the estuary to the contemporary Aboriginal community

The Pittwater estuary, within the Gu-ring-gah homelands, holds intrinsic heritage and resource values for the Indigenous people who occupied the lands. This option involves increasing awareness of the general community about the former land occupation by these people, through interpretative signage around the estuary and catchment, periodic education displays and other communication techniques. For example, Council signs could display words reflecting connection to the local Aboriginal landowners (eg "part of the Guringah homelands").

Responsibility: Council would implement this option, however extensive consultation with the local Aboriginal communities would need to be conducted first to ensure their input and support of the content and methods of delivery.

3. Conduct a formal Aboriginal sites assessment of areas around Pittwater to identify and record areas that are significant to the local Aboriginal people

A detailed formal record of Aboriginal sites of heritage significance around the Pittwater estuary should be prepared. All Aboriginal sites are protected under the provisions of the National Parks and Wildlife Act, 1974, however, unless these sites are properly identified and recorded, protection is difficult.

Responsibility: DECC (NPWS) is responsible for collating information regarding Aboriginal heritage sites, and should work with the local Aboriginal people and Council to develop and update the sites register.

4. Assess further the historical significance of non-indigenous sites around the waterway to ensure that future development does not destroy valuable pieces of history

It is reported that not all of Pittwater's numerous sites of non-indigenous heritage are identified on Council planning instruments or protected by Council's development controls. All sites of significance to European heritage should be identified, assessed and registered with Council so that they are considered when assessing future development applications and broad scale planning options.

Responsibility: Council would implement this option, and assistance could be sought from local historical societies and/or NSW Heritage Council.



Photo: V. Dorey (Council) - Heritage site

5. Carry out regular repairs / rehabilitation of historic items to preserve them in perpetuity

It is likely that many sites of historical significance (primarily European heritage) have become degraded with time. Some of these sites are still used on a regular basis (eg wharves and seawalls) and in some cases, may represent a public risk. This option involves Council carrying out repairs to these structures to ensure their integrity, or restoring currently degraded structures / sites as show-places of former usage and estuary based activities.

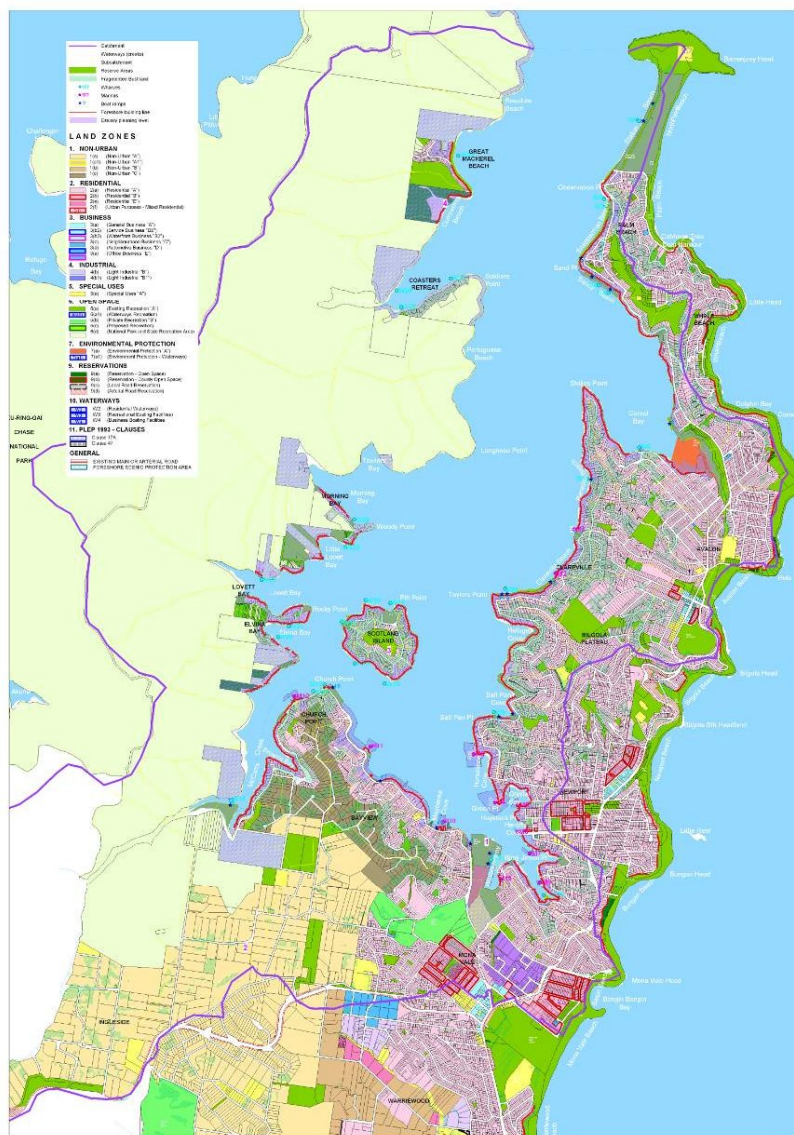
Responsibility: Council would primarily be responsible for repairs and restoration of historical items / structures, with DECC and Department of Lands also partially responsible for structures below the high water mark (ie on Crown Land).

Figure C-8 Heritage Management Options Map

MAP 8

PITTWATER ESTUARY MANAGEMENT PLAN WORKSHOP 1

Development Management Options



Development Issues

- Issues of access and storage for contractors at this site; provision of infrastructure requested. Council currently attempting resolution.
- Greenfield Development - potential urban land release for residential development.
- Potential development on Scotland Island.
- Potential development for holiday resort.
- Redevelopment of Scotland Island in other western foreshore areas may lead to an increased offshore population. These areas are serviced by on-shore sewage systems. Increased population may result in increased pressure upon on-shore sewage treatment, and thus increased effluent discharges to Pittwater, particularly during wet weather. The additional population may also increase demand for commuter services and parking at transport nodes (eg. Church Point).
- Loss of scenic values (views) and/or loss of natural habitats where developments are too high/over used.

1. Review, and if necessary amend, existing development controls to ensure appropriateness regarding pollutant and sediment discharges, scenic amenity and vegetation clearing

Council has a range of development controls (eg LEP, DCPs) that restrict types of development within certain sections of the Local Government Area (LGA). This option involves carrying out a comprehensive review of these development controls (some of which were prepared many years ago) in light of the needs of the Pittwater estuary, particularly in regards to minimisation of pollutant inputs, protection of significant habitats and maintenance of its high scenic amenity. This review could be incorporated with the development of the standard LEP template.

Responsibility: Council planning officers.



Photo 1: Development of foreshore scenery.

2. Consider incorporation of Water Sensitive Urban Design (WSUD) principles into existing development controls for both Greenfield development and infill / redevelopment by integrating WSUD principles into the Pittwater Water Management Policy and Specification

Council should enforce Water Sensitive Urban Design (WSUD) principles for all new developments and redevelopments within the Pittwater estuary catchment. WSUD involves minimising the flow and pollutant load discharge of stormwater on a site by site basis, using rainwater tanks, stormwater re-use, infiltration, bioretention, swales, porous pavers etc. DECC (EPA) is currently developing guidelines for the implementation of WSUD by local government authorities, and has already developed guidelines for the harvesting and re-use of urban water. The Pittwater Integrated Water Cycle Management Plan (in preparation) should be consistent with WSUD principles and all relevant DECC guidelines.

Responsibility: Council planners will be responsible for ensuring appropriate WSUD and stormwater controls are specified in conditions of consent for new developments.

3. Ensure that any future commercial use of foreshores (eg marina developments) allows for public access to the water

This involves modifying existing planning instruments (and possibly, Department of Lands occupancy agreements) that address the development of commercial premises on the Pittwater foreshore (eg marinas) to ensure that public access to the foreshore is maximised as a condition of consent for any future (re) development.

This action could be incorporated with the amendments proposed for Pittwater 21 DCP outlined in the Foreshore Management Option: "Develop Specific Controls for the Pittwater Foreshore".

Responsibility: Council planning officers and Department of Lands as required.

4. Ensure that potential climate change impacts on existing and future development are adequately addressed by Council's planning activities and risk management practices

An opportunity exists to introduce prioritised and achievable adaptation measures to address the potential impacts of climate change in the Pittwater LGA. Appropriate outcomes could be best achieved by integrating a risk management strategy into the existing strategic planning activities and risk management practices of Council. The process should be undertaken in accordance with the guidelines provided by the Australian Greenhouse Office in its publication - Climate Change Impacts and Risk Management - A Guide for Business and Government. The State Govt "Climate Action Plan" and studies in preparation by DECC into the parameters of climate change effects in NSW should also be consulted in developing adaptation measures for Pittwater.

Responsibility: Council with assistance from State government agencies. Existing funding (through the NSW Climate Change Fund) and new initiatives from DECC may be useful in the development of and financial assistance for actions by Council.

Figure C-9 Development Management Options Map

APPENDIX D: ENVIRONMENTAL ACTIONS ASSOCIATED WITH FLOODPLAIN RISK MANAGEMENT OF PITTWATER CATCHMENT

Three primary floodplain catchments drain into the Pittwater Estuary, namely:

- Mona Vale / Bayview — including Cahill Creek (Bayview Golf Course catchment) and Mona Vale Main Drain (Mona Vale industrial area);
- Careel Creek — including Avalon Shopping Centre and much of Avalon residential area;
- Great Mackerel Beach — located on the western foreshore of Pittwater.

A Flood Study has been completed for each of these primary floodplain areas. The Careel Creek Floodplain Management Study was completed in 2000 and the Careel Creek Floodplain Management Plan was completed in 2002. Both have been adopted by Council. Floodplain Risk Management Studies for Mona Vale / Bayview and Great Mackerel Beach are currently at the Draft Final Report stage. It is proposed to put the Great Mackerel Beach Floodplain Risk Management Study and plan on public exhibition in May 2010, with the Mona Vale / Bayview Floodplain Risk Management Study and Plan to go on public exhibition towards the end of 2010.

While the primary objective for floodplain risk management studies is to identify works and measures that reduce flood risk to the community, these studies often identify works and measures with a more environmental focus than a flood mitigation focus. Often works and measures have both a flood mitigation focus as well as an environmental focus. Therefore it is important to identify those options that have an environmental focus and include them in an equivalent Estuary Management Plan.

Outlined below are extracts from each of the Floodplain Risk Management Studies and Plans for the three catchments that drain into the Pittwater Estuary, providing details of projects that have been identified as having an environmental focus. Some projects, but not all, also have a flood mitigation focus. More information about the options can be found in the relevant floodplain risk management studies and plans.

1. Mona Vale / Bayview Catchment

The draft Mona Vale / Bayview Floodplain Risk Management Study and Plan (Cardno, November 2008) listed the following actions (as Flood Modification (FM) measures) with significant environmental considerations. As this is a draft, these actions have not been subjected to public exhibition and have not been adopted by council.

1.1. Removal of Flood Gates at Pittwater Road (FM3)

The draft Plan recommends removing the Flood Gates at Pittwater Road. Currently the gates are used to limit saltwater intrusion into Bayview Golf Course, however during floods the pressure of the flood water from the golf course pushes the flood gates open. In 2009, the NSW Fisheries installed an auto-tidal gate within the existing floodgate structure on a trial basis. The auto-tidal gate allows some tidal flushing of the watercourses within the golf course and allows the regular passage of fish upstream and downstream of the floodgate structure. Removing the flood gates altogether will allow

the water bodies upstream to experience environmental flows more frequently (instead of only getting flushed out when significant flow events occur), and remove the barrier to fish passage which the NSW Fisheries have identified as a 'High Priority' structure in their 'Bringing back the Fish Project.'

1.2. Review of On-Site Detention Policy (FM11)

Pittwater Council currently requires all developments resulting in additional hard (impervious) surface area of greater than 50m² (on a cumulative basis since February 1996) on certain land to incorporate on-site detention (OSD) facilities.

Given the existing flood issues identified in the floodplain, the following recommendations have been made with regard to further studies and review of OSD in the catchment:

- Pittwater 21 Development Control Plan (DCP) provides requirements for size and allowable discharge from on-site detention systems. Rather than adopting this site or lot based approach, a catchment based approach could be utilised for calculating allowable peak discharges and the consideration of a full range of return interval frequencies and a full range of storm durations (the Flood Study could be used as a guide to appropriate return intervals and appropriate storm durations). This could be included in Pittwater 21 DCP in a format similar to Appendix A of the Warriewood Valley Urban Land Release Water Management Specification (Pittwater Council, 2001).
- Due to the large storage areas in the lower Bayview Catchment, it may be appropriate to exempt those developments within the floodplain from OSD requirements. That is, it may be beneficial to allow the floodwater in the lower part of the catchment to be discharged from the systems prior to the peak flows from the upper catchment reaching the floodplain. This could be tested using a drainage model that incorporates all of the pits and pipes within Council's stormwater system (e.g. The Drains software). This assessment may identify areas (other than the floodplain) which may not be suitable for the implementation of OSD facilities.
- Due to the fact that any large scale future developments within the catchment are likely to occur in the upper Bayview Catchment, it may be appropriate to consider regional OSD for these developments. That is, it can be more cost effective and provide a better outcome for flooding to combine OSD facilities for a number of developments into one or several locations (e.g. regional detention basins in parks or reserves).
- Pittwater 21 DCP currently requires that developments exceeding 1,000m² of additional hard (impervious) surface area must demonstrate that stormwater flows discharged from the site are to be no greater than what would have occurred predevelopment. It may be appropriate to require these developments to ensure a zero net increase in peak discharges from natural conditions (i.e. Pre-European conditions).
- On-site reuse of stormwater should be mandatory for Greenfield and Brownfield subdivisions to maintain water balance of site to natural conditions (i.e. Pre-European conditions).
- Where a large scale development is proposed in the catchment; the developer should be required to submit a flood study to ensure that the proposed development will not have adverse impact on downstream properties. The extent of the modelling should be governed by the hydraulic controls within the floodplain and therefore should extend sufficiently downstream to evaluate all possible impacts on flood levels. This may necessitate the inclusion of an extensive

floodplain area within the model to achieve this objective. A range of design events should be considered, along with a range of event durations.

1.3. Creek Rehabilitation and Debris Control Structures on the Siobhan Place Branch (FM12)

This option looks at a combination of implementing debris control structures at the culvert inlets at the downstream ends of the open channels, and rehabilitation of the creeks themselves to improve the ecological condition of the channels and to reduce the incidence of weed growth. The locations it addresses are a small tributary flowing from the region of Suzanne Road to the Bayview Golf Course, a channel directed into a culvert which passes underneath Siobhan Place at the downstream end of Whitney Reserve, the open channel from Siobhan Place to Parkland Road, and Parkland Road via a culvert into the Golf Course

Field inspections and observations by residents note that the culverts do not always operate efficiently due to blockage from debris (possibly sourced from a build up of sediment and vegetation in the open channel sections), the channels have dense weed growth and the channel downstream of Siobhan Place has a significant build up of scrub-like vegetation and accumulated vegetation debris.

The plan makes the following recommendations:

- Selective rock work to stabilise the channel banks and increase flow conveyance, where appropriate;
- Removal of weeds;
- Planting of native plant species;
- Creation of a buffer to limit access to the creek within Whitney Reserve (this may be achieved using strategic planting or placement of logs);
- Debris Deflector structures placed at the culvert inlet or upstream of bridges to deflect the major portion of the debris away from the culvert entrance or bridge. They are normally "V"-shaped in plan with the apex upstream;
- Debris Rack structures placed across the stream channel to collect the debris before it reaches the culvert entrance. Debris racks are usually vertical and at right angles to the stream flow, but they may be skewed with the flow or inclined with the vertical; and
- Debris Fin walls built in the stream channel upstream of the culvert or bridge. Their purpose is to align the debris with the culvert or bridge so that the debris would pass through without accumulating at the inlet.

The proposed creek works are likely to have an environmental benefit due to:

- Increased ecological value in the channels due to increased presence of native vegetation species providing habitat to native fauna species; and
- Improved water quality in the receiving waters (the channels within the golf course and ultimately Pittwater) due to improved filtration of flows by vegetation and a reduction in the build up of decaying vegetation matter and anthropogenic litter.

1.4. Rainwater Tanks and Infiltration Systems for Residential Dwellings (FM15)

Pittwater 21 DCP currently requires that all development creating an additional hard (impervious) roof area of greater than 50m² must provide a rainwater tank for non-potable use connected to external taps for the purpose of landscape watering and car washing and a functional water reuse system including water supply for toilet flushing and other uses as permissible under NSW Government's Building Sustainability Index (BASIX).

In addition to the implementation of rainwater tanks, Council also requires the installation of stormwater quality improvement measures for development that result in an additional impervious area of more the 50m². Pittwater 21 requires the installation of primary treatment devices only to collect leaf litter and coarse sediments. However, the DCP also encourages the use of secondary stormwater quality treatment devices some of which may provide detention of stormwater. Examples of stormwater treatment devices that provide secondary treatment include filter strips, grass swales, extended detention basins, porous pavers, infiltration trenches, infiltration basins and sand filters.

The installation of rainwater tanks will result in a reduction in potable water demand in the catchment and the infiltration systems will result in improved water quality discharging from the properties into the receiving waters. This option would be in addition to any rainwater tanks and infiltration systems implemented as part of development controls.

2. Careel Creek (Avalon)

The adopted Careel Creek Floodplain Risk Management Study (Lawson and Treloar Pty Ltd, Nov 2000) and Careel Creek Floodplain Risk Management Plan (Lawson and Treloar Pty Ltd, Dec 2002) list the following actions with significant environmental considerations.

2.1. Overland Flow Path Improvements

The Plan recommends the area affected by the overland flow paths on the southern side of Avalon Bowling Club at the rear of the properties of Avalon Parade be cleared and restored with a grassed swale. Detailed investigations and design are required and various approvals to be obtained.

2.2. Clearing of Toongari Reserve Flowpath

The plan recommends Toongari Reserve flowpath be cleared of woodchips, and the trees/plants to be transferred out of the main flowpath with the main flowpath consisting primarily of grassed swale. This needs to consider any impacts on significant vegetation in this reserve.

2.3. On site Detention

The plan recommends an investigation into OSD to determine storage and discharge requirements, impact on the use of rainwater tanks in the catchment, impact on environmental flows, and associated Policy Review. This is similar to the recommendations made in the more recent Mona Vale / Bayview study.

2.4. Channel Maintenance

The Plan recommends maintenance of the channel between Barrenjoey High School and Barrenjoey Road in particular attention to the removal of shopping trolleys and debris (maybe an option in the Careel Creek Rehabilitation Plan). There may be ownership issues along sections of the creek as they pass through private property.

3. Great Mackerel Beach

The draft Great Mackerel Beach Floodplain Risk Management Study and Plan (WMAwater, Nov 2009) makes the following recommendations with environmental considerations:

3.1. Preparation of a Draft Entrance Management Policy

The Plan recommends the preparation of a Draft Entrance Management Policy, as a result of the entrance management workshop, that will clearly establish the future management of the entrance. As part of this policy a monitoring/inspection program is recommended to provide additional data to make sound decisions. The suggested inspection program is based on the use of "sight poles" and digital photography to record berm levels and entrance conditions at regular time intervals. The scheme should be implemented with the assistance of local residents, promoting a sense of "ownership" of the issues, outcomes and management. The results from the study will hopefully identify the rate and extent of any changes to the beach berm and assist in evaluating any changes to the entrance due to climate change (requires at least 10 years of data). It is important to note that the associated equipment and signage is not obtrusive as residents are concerned about the number of signs already.

The policy can be developed over time as data becomes available however should not wait for data from the sight poles. An interim approach whilst the data is being collected could include studies into possible environmental issues that would need to be evaluated if any works at the entrance are proposed, this may include modifications to the creek entrance particularly it's opening and closing regime.

Furthermore the policy would also address such issues as climate change impacts including sea level rise and increased rainfall, the roles and responsibilities of various government organisations, impact of developments on the ecology of the system and scouring of the dunes, and the importance of the entrance in impacting flood levels upstream,

3.2. Water Quality/Ecosystem Enhancement

The plan indicates that this study supports measures that promote water sensitive urban design. It is important that the outcomes of the Pittwater Estuary Management Plan (currently in the review phase with completion expected by June 2010) and the Great Mackerel Beach Creek Rehabilitation Plan which has been included as a recommended option in the draft Pittwater Estuary Management Plan and is eligible for grant funding through the State Government's Estuary Management Program, are consistent with and supported by the Great Mackerel Beach floodplain management strategy.

The water quality related issues discussed include contamination from septic tanks in times of flood. To eliminate this risk, council's development control policies should ensure that the design of new tanks adequately address this issue. Residents have voiced concern about the lack of vegetation clearing of the creek, the need to upgrade the creek banks and revegetate and enhance the quality of the aquatic ecosystem. The creek is mostly on private land therefore the council has no control within these areas. Possibly these could be addressed in the Great Mackerel Beach Rehabilitation Plan and a key aim would be to assist residents with appropriate treatment of the creek on their property.

APPENDIX E: PRIORITISATION OF MANAGEMENT STRATEGIES

Table E-1 Association Matrix between Management Objectives and Management Strategy Actions

	Management Objectives	Water Quality				Sediment. & Eros.				Ecology				Waterway			Foreshore usage			Heritage				Developmt		CC	
	Management Options	1.0	1.1	1.2	1.3	2.0	2.1	2.2	2.3	3.0	3.1	3.2	3.3	4.0	4.1	4.2	5.0	5.1	5.2	6.0	6.1	6.2	6.3	7.0	7.1	8.0	
1. Land Management Controls	1a) Prepare and implement Plans of Management to define integrated land management for Church Pt, Palm Beach Wharf / Pittwater Park, and Scotland Island and western offshore communities	\$	*	\$	*	\$		\$		\$	*		*	\$		*	\$	\$	\$	\$				\$	\$	\$	
	1b) Update and implement Plan of Management for Careel Bay wetlands, ensuring maintenance of habitat mix / diversity (which may include selective removal of mangrove seedlings from saltmarsh areas from time to time)					\$				\$			\$	*		\$				\$				\$	*	\$	
	1c) Prepare and implement integrated Plans of Management for areas of significant habitat (eg EECs) on public and private lands ensuring preservation and enhancement of key environmental values					\$					\$	*		\$	*		\$				\$				\$	*	\$
2. Planning Controls	2a) Significant environmental value are to be identified and are adequately protected within appropriate planning instruments (including foreshore areas, EECs, vegetation stands).									\$	*		\$		*	\$				*					\$	\$	
	2b) Areas of significant heritage value (Aboriginal and early-European) are to be identified and are adequately protected within appropriate planning instruments (first requires assessment of Aboriginal and early-European sites)																			\$	\$	\$	*	*			
	2c) Extend public conservation area lands (eg State Park) to include parts of Currawong and Mackerel Beach for example										\$		*			*	*			\$	*	*	*	\$			
	2d) Allow small scale maintenance dredging for navigational safety, providing it does not conflict with or compromise existing or future environmental values.					\$								\$											\$		
3. Development Controls	3a) Climate change impacts for development are to be considered and addressed, with the development of relevant risk management plans for adoption into Council's DCP									*			\$				*								\$	\$	\$
	3b) WSUD principles to be added to all development controls	\$	\$		*	\$		\$	*	*			*												\$	\$	
	3c) Appropriate on-site sewage systems to be adopted, suitable for soils, topography etc	\$	\$	\$	*					*			*	*											\$	\$	
	3d) Developments not to incorporate pollution and/or sediment discharges to the waterways	\$	\$	*	*	\$		\$	*	*	*	*	*	*											\$	\$	
	3e) Developments not to degrade scenic amenity of the Pittwater estuary and surrounds	*				*				\$	*		*	\$											\$	\$	
	3f) Public amenity and existing foreshore values to be retained / improved for foreshore developments									\$	*		\$	\$		\$	\$	\$	*						\$	\$	
	3g) Make stricter sediment & erosion controls for developments	\$	*			\$		\$		*															*	\$	\$
4. Activity Controls / Modifications	3h) Require all new marina developments (> 9 berths) to have pump-out services	\$	\$	\$	*					*			*	*		\$									\$	\$	
	4a) Limit proximity of boating activities to environmentally significant areas and other sensitive areas (eg weed infested areas), incl. no anchoring	*					*			\$	*		\$		\$	\$											
	4b) Replace existing moorings with seagrass friendly moorings in areas close to existing seagrass beds									\$			\$		*	\$											
	4c) If necessary, reduce boating speed limits in areas of high waterway use / traffic													\$	*	\$											
	4d) If necessary, relocate existing moorings away from areas of higher environmental significance and/or high vessel traffic									*				\$	\$	\$											
	4e) Remove significant impediments to fish passage									\$			\$														
	4f) Encourage all existing large marinas (> 30 berths) to install pump-out services	\$	\$	\$	*					*					*	\$											
5. Improved Services / Assets	4g) If necessary, reduce the total number of moorings within Pittwater to a more appropriate capacity / mooring limit, through opportunistic relinquishment and offsets through new marina developments									\$			\$	*	\$												
	5a) Install new and/or upgrade and repair existing waterway access locations / points, and along foreshore access and facilities												\$	\$	*		\$										
6. Environmental Rehabilitation	6a) Repairs / rehabilitation of significant heritage sites (Aboriginal or early European)																			\$	\$	*	*				
	6b) Redress erosion along Pittwater foreshores and along catchment streams / tributaries	*	*			\$	\$	*		\$	\$	*															
	6c) Re-vegetation along estuary foreshores and along riparian zones within catchment (on both public and private lands) to connect habitats, provide shade and enhance ecological communities (esp. EECs)	*				\$	\$			\$	\$	*	*														
	6d) Weed and exotic species control, including Caulerpa taxifolia.									\$	\$	\$	\$														
7. Pollution Reduction Measures	7a) Targeted measures for reducing marina operations waste	\$	\$	\$	\$				\$	*						\$											
	7b) Targeted catchment management measures, following catchment-wide urban pollution and sediment runoff audit (especially areas discharging to poorly flushed embayments)	\$	\$	\$	\$	\$		\$	\$	*																	
	7c) Minimise overflows from the reticulated sewerage system (through Sydney Water consultations)	\$	\$	\$	*				*	*			*	*													
8. Community Education	8a) Community Education - No discharge status of Pittwater	\$	\$	\$	*					*				*			\$										
	8b) Community Education - Discouragement of use of high-pollution older-style 2 stroke outboard motors	\$	*	\$	\$				*	*							\$										
	8c) Community Education - Catchment management, including use of fertilisers, pesticides etc	\$	\$	\$	\$	\$		*	*	*																	
	8d) Community Education - Appropriate foreshore use (including education of foreshore landowners)	*					\$			\$	*		\$	\$		\$	\$	*		*				*			
	8e) Community Education - Aboriginal values																							\$			
	8f) Community Education - General environmental values of estuary	\$	*		*	\$		*	*	\$		*	*				\$							\$		\$	
9. Compliance	9a) Compliance: Permanent occupancies on boats	\$	*	\$	*					*						\$											
	9b) Compliance: Boating regulations, ie speeds, dangerous behaviour, Caulerpa controls / washdown	\$				\$				*				\$	*				*								
	9c) Compliance: Sediment and erosion controls, as well as other development controls / conditions	\$	*		*	\$		\$	*	*						*								*		\$	
	9d) Compliance: On-site sewage systems operation	\$	\$	\$	*					*														*		\$	
	9e) Compliance: Water pollution from boats and waterway businesses (eg marinas)	\$	\$	\$	\$					\$	*			*	*		\$										

★ Direct Association

☆ Indirect Association

Table E-2 Environmental Benefit Ranking of Strategy Actions

Management Options	Environmental Benefit**
1 a) Prepare and implement Plans of Management to define land management for Church Pt, Palm Beach Wharf / Pittwater Park, Scotland Island and western offshore communities	High
1 b) Update and implement Plan of Management for Careel Bay wetlands, ensuring maintenance of habitat mix / diversity (which may include selective removal of mangrove seedlings that have encroached onto saltmarsh areas from time to time)	High
1 c) Prepare and implement Plans of Management for areas of significant habitat (eg EECs) on public and private lands ensuring preservation and enhancement of key environmental values	High
2 a) Significant environmental values are to be identified and are adequately protected within appropriate planning instruments (including foreshore areas, EECs, vegetation stands). Eg, modify SEPP-14 wetland boundaries, TPOs.	High
2 b) Areas of significant heritage value (Aboriginal and early-European) are to be identified and are adequately protected within appropriate planning instruments, such as Council's LEP (first requires assessment of Aboriginal and early-European sites)	Medium
2 c) Extend Ku-ring-gai Chase NP, to include parts of Currawong and Mackerel Beach for example	Medium
2 d) Allow small scale maintenance dredging for navigational safety, providing it does not conflict with or compromise existing or future environmental values.	Low
3 a) Climate change impacts for development are to be considered and addressed, with the development of relevant risk management plans for adoption into Council's DCP	High
3 b) WSUD principles to be added to all development controls (draft DECC DCP)	High
3 c) Appropriate on-site sewage systems to be adopted, suitable for soils, topography etc	High
3 d) Developments not to incorporate pollution and/or sediment discharges to the waterways	High
3 e) Developments not to degrade scenic amenity of the Pittwater estuary and surrounds	Medium
3 f) Public amenity and existing foreshore values to be retained / improved for foreshore developments	Medium
3 g) Make stricter sediment & erosion controls for developments	Medium
3 h) Require all new marina developments (> 9 berths) to have pump-out services	High
4 a) Limit proximity of boating activities to environmentally significant areas and other sensitive areas (eg infested areas), incl. no anchoring	High
4 b) Replace existing moorings with seagrass friendly moorings in areas close to existing seagrass beds	High
4 c) If necessary, reduce boating speed limits in areas of high waterway use / traffic (eg western side of Scotland Island)	Low
4 d) If necessary, relocate existing moorings away from areas of high environment significance and/or high vessel traffic	Low
4 e) Remove significant impediments to fish passage	High
4 f) Encourage all existing large marinas (> 30 berths) to install pump-out services	High
4 g) If necessary, reduce the total number of moorings within Pittwater to a more appropriate capacity / mooring limit, through opportunistic relinquishment and offsets through new marina developments.	High
5 a) Install new and/or upgrade and repair existing waterway access locations / points, and foreshore access and facilities	Low
6 a) Repairs / rehabilitation of significant heritage sites (Aboriginal and/or early European)	Medium
6 b) Redress erosion along Pittwater foreshores and along catchment streams / tributaries	High
6 c) Re-vegetation along estuary foreshores and along riparian zones within catchment (on both public and private lands) to connect habitats, provide shade and enhance ecological communities (esp. EECs)	High
6 d) Weed and exotic species control, including <i>Caleurpa taxifolia</i> .	High
7 a) Targeted measures for reducing marina operations waste	High
7 b) Targeted catchment management measures, following catchment-wide urban pollution and sediment runoff audit (esp. areas discharging to poorly flushed embayments)	High
7 c) Minimise overflows from the reticulated sewerage system (through Sydney Water consultation)	High
8 a) Community Education - No discharge status of Pittwater	High
8 b) Community Education - Discouragement of use of high-pollution older-style 2 stroke outboard motors	Medium
8 c) Community Education - Catchment management, including use of fertilisers, pesticides etc	High
8 d) Community Education - Appropriate foreshore use (including education of foreshore landowners)	Medium
8 e) Community Education - Aboriginal values	Medium
8 f) Community Education - General environmental values of estuary	High
9 a) Compliance: Permanent occupancies on boats	Medium
9 b) Compliance: Boating regulations, ie speeds, dangerous behaviour, caleurpa controls / washdown	High
9 c) Compliance: Sediment and erosion controls, as well as other development controls / conditions	High
9 d) Compliance: On-site sewage systems operation	High
9 e) Compliance: Water pollution from boats and waterway businesses (eg marinas)	High

**benefit rank based on:

High = action considered likely to **greatly improve** the environment of the estuary

Medium = action considered likely to **marginally improve** the environment of the estuary

Low = action considered to result in **no improvement or maintenance** of the estuarine environment

The environmental benefit assessment is based on the assumption that the actions are implemented fully

APPENDIX F: SUPPORTING DETAILS FOR MANAGEMENT STRATEGIES

1 Prepare and Implement Land Management controls

1a) *Prepare and implement Plans of Management to define land management for Church Pt, Palm Beach Wharf / Pittwater Park, Scotland Island and western offshore communities*

The preparation of a Church Point Plan of Management (PoM) for Church Point Crown Land is currently in progress, and aims to address issues associated with: environmental protection and requirements; pedestrian access and safety; traffic flow, vehicle access and vehicle parking for offshore residents, tourists and day trippers, patrons of the shops, restaurants, Pasadena, and other users of Church Point Reserve and waterway; commuter boat access, traffic flow and facilities; accommodating increased demand for all facilities with future redevelopment of offshore settlements (eg, Pasadena); future wharf replacement; cargo and goods handling; recreational and environmental amenity; adaptive capacity of Church Point Foreshore Precinct to issues associated with climate change, such as sea level rise.

Similar to the Church Point PoM, the preparation of a Palm Beach Wharf / Pittwater Park PoM would aim to address issues regarding environmental and recreational amenity, parking, access, transport, commerce, commuter boat facilities, future development, and adaptive capacity for habitat and other issues for climate change impacts. In addition to a potential increase in offshore resident population, increasing numbers of commuters from the Central Coast (Ettalong) need to also be accommodated. An existing Draft Pittwater Park PoM was completed in August 2002. Given the draft Pittwater Park PoM was completed some time ago (and was not formally adopted), it is likely to require significant updating to ensure the issues outlined above are adequately addressed. However, the draft PoM does provide a solid starting point for the development of a final Pittwater Park POM.

The development of a PoM for Scotland Island and the Western Foreshore communities would address issues related to development in these isolated areas. The Plan of Management should direct council to consider the appropriateness of future developments and re-developments of existing developments in regards to the following aspects:

- Waste water disposal methods which reduce the impacts upon water quality for ecological and human health;
- Solid waste management and disposal that reduces the impact upon surrounding environments;
- Provision and maintenance of foreshore buffers, which includes a provision for the migration of habitats (particularly saltmarsh) with sea level rise;
- Climate variability impacts, particularly storm surge, upon surrounding habitats and the development itself;
- Vegetation clearing and requirements as per the Scotland Island Bushfire Management Plan (adopted in 2007) and rural bushfire legislation;
- A reduction in the impacts on adjacent aquatic habitats from boat movements, etc;

- Water only access to properties and its associated demands upon public infrastructure such as commuter moorings, car parking and other transport and commuter provisions;
- Emergency response, including issues associated with climate change, and in keeping with current development of a road reserve master plan for the Island.

For each of the above PoMs, specific amendments to Pittwater 21 DCP, and/or the forthcoming standard LEP will be required to integrate the PoM's into Council's planning framework.

Responsibility: All three PoMs would be prepared by Council and Department of Lands, with input from the stakeholder communities (from the areas of environmental protection, commerce, residency, recreation, commuting etc) relevant to the areas covered by the PoMs (ie, Church Point, Palm Beach/Pittwater Park, and Scotland Island and the foreshore communities respectively). Once adopted, Council would be responsible for implementing the PoMs in close co-operation with the relevant State Government Agencies. In order to facilitate the proper integration and consistency between each of the three PoMs, it would be useful to prepare all three PoM's at the same time.

1b) Update and implement Plan of Management for Careel Bay wetlands, ensuring maintenance of habitat mix / diversity (which may include selective removal of mangrove seedlings that have encroached onto saltmarsh areas from time to time)

The most valuable environments from a species diversity perspective are those that have a wide range of habitat types. Within Careel Bay, the habitat diversity is being compromised by the prolific growth of mangroves. Both saltmarsh and sandflat areas have been affected by this relatively recent overgrowth. To maintain a healthy mix of habitat types it may be necessary to control the spread of mangroves into these other areas via selective removal of juvenile stock. This would need to be carried out by or in a manner approved by DPI Fisheries and the HNCMA. The work should include measures to control access to and within the various wetland habitats.

Responsibility: Council, DPI Fisheries and DECC for implementation of this option. Assistance could be sought also from HNCMA under targets RH1-1 Riparian Vegetation Conservation and RH3-1 Important Wetlands.

1c) Prepare and implement Plans of Management for areas of significant habitat (eg EECs) on public and private lands ensuring preservation and enhancement of key environmental values

Similar to Careel Bay Wetlands Plan of Management, but for other key areas. Such areas need first to be identified, mapped, surveyed and assessed.

2 Prepare and Incorporate Planning Controls.

2a) Significant environmental values are to be identified and adequately protected within appropriate planning instruments (including foreshore areas, EECs, vegetation stands). Eg, modify SEPP-14 wetland boundaries, TPOs

Williams and Thiebaud estimate that, between 1977 and 2000 there has been a 31% loss in Mangrove habitat and at least a 15% loss of saltmarsh habitat in Pittwater. Such a loss of vital habitat for fish as well as birds and invertebrate species requires specific attention to mitigate further losses.

This option involves detailed habitat mapping where existing mapping is inconclusive or outdated, particularly focussing on Endangered Ecological Communities (EECs) (including sandflats and mudflats utilised by migratory wader birds, areas of native seagrass (particularly *P.australis*), saltmarsh, mangrove forests, hollow trees etc) in terrestrial, riparian and aquatic environments. Estuarine macrophyte mapping (mangrove, saltmarsh and seagrass communities) has recently compiled by DPI Fisheries for Pittwater (2008), and efforts may be constrained to groundtruthing for these EECs.

In addition, DPI Fisheries is currently completing a Estuarine Habitat Mapping and Geomorphic Categorisation of the Lower Hawkesbury and Pittwater Estuaries, due for completion in the second half of 2009. The report will add to the previous macrophyte mapping and including rocky intertidal habitats. The report has been jointly funded by HNCMA, Hornsby Shire Council and DPI.

The updated maps should then be cross-referenced against local, state and federal planning instruments to determine the required level versus the current level of protection of significant habitats. The changes to planning instruments should also allow for the adaptation of habitats to the impacts of climate change, particularly an allowance in foreshore setbacks for the migration of species in response to sea level rise.

At the local level, amendments shall be made to land use zoning and development controls in Council's planning instruments (LEP, DCP) to ensure that habitats are adequately protected against degradation from inappropriate activities or future development. The amendments may be made as part of compiling the new Pittwater LEP with the Standard Instrument, which Council is required to complete within 12-18 months. Zonings under the new Standard Instrument appropriate to sensitive habitats include W1 Natural Waterways, E2 Environmental Conservation or E3 Environmental Management. Council is already in the process of incorporating the Model DCP – Protecting Sydney's Wetlands (SCCG 2001) into Pittwater 21 DCP.

At the state level, an application to DP would be made requesting suitable areas within Pittwater, particularly the Careel Bay wetlands, to be specifically included in SEPP 14 – Coastal Wetlands. Assistance may be sought from other state agencies such as DECC and HNCMA in this application, as this action complies with HNCAP strategies B3-2 (threatened species action) and RH3-1 (important wetlands).

There may also be opportunities through the *Fisheries Management Act 1994* to have certain areas within Pittwater estuary protected by an Aquatic Reserve declaration or certain habitats declared as Critical Habitat of endangered species, populations or ecological communities. An example would be the mudflats that provide habitat for the endangered Bush Stone-curlew and other threatened species of migratory wading birds, or seagrass beds at Careel Bay and off Governor Phillip Park/Palm Beach Reserve. Critical habitat declarations would be consistent with the Fishery Management Strategies for the NSW Estuary Prawn Trawl Fishery and Estuary General Fishery (NSW Fisheries, 2003a, b) who utilise the Hawkesbury estuary for commercial fishing. These plans outline the desire to identify and establish closure of areas that are important habitats for juvenile fish and other endangered species, particularly seagrass beds.

This strategy is in agreement with Strategy 2m of the Lower Hawkesbury EMP, which aims for the protection of seagrass beds; and Strategy 2b, which stipulates the inclusion of foreshore setbacks to allow for species migration due to sea level rise.

Responsibility: Investigated by Council in conjunction with the DP, DPI, DECC and HNCMA.

- 2b) *Areas of significant heritage value (Aboriginal and early-European) are to be identified and adequately protected within appropriate planning instruments, such as Council's LEP (first requires assessment of Aboriginal and early-European sites)*

Aboriginal sites

A detailed formal record of Aboriginal sites of heritage significance around the Pittwater estuary should be prepared. All Aboriginal sites are protected under the provisions of the *National Parks and Wildlife Act 1974* however, unless those sites are properly identified and recorded, protection is difficult.

This management option fits with the HNCAP Management Target MT C1-4, which involves identifying aspects of the landscape with indigenous cultural significance, and protecting, enhancing and rehabilitating such sites. This management option also aligns with Strategy 2t of the Lower Hawkesbury EMP, and coordination between the plans may assist in funding to achieve the strategies.

Responsibility: DECC (NPWS) is responsible for collating information regarding Aboriginal heritage sites, and should work with the local Aboriginal people and Council to develop and update the sites register. Assistance should be sought from the HNCMA in identifying and protecting sites of significance as per target C1-4 Indigenous Land Management.

Early European sites

It is reported that not all of Pittwater's numerous sites of non-indigenous heritage are identified on Council planning instruments or protected by Council's development controls. All sites of significance to European heritage should be identified, assessed and registered with Council so that they are considered when assessing future development applications and broad scale planning options.

Responsibility: Council would implement this option, and assistance could be sought from local historical societies and/or NSW Heritage Council. A similar management strategy, strategy 2u, is given in the Lower Hawkesbury EMP, and opportunities for coordination of activities between the two plans may exist.

- 2c) *Extend public conservation area lands (eg State Park, to include parts of Currawong and Mackerel Beach for example)*

Significant management and heritage protection is provided to the land within Ku-ring-gai Chase NP through the NPWS Plan of Management for the park. This option would allow for similar quality management to be extended to land parcels at Currawong and Mackerel Beach through existing Ku-ring-gai NP programs.

This option involves DECC (NPWS) considering the inclusion of certain parts of the western foreshore (eg parts of Currawong and Mackerel Beaches) into Ku-ring-gai Chase National Park. Areas considered for inclusion would have special significance from an indigenous or early European cultural viewpoint, as well as from a vegetation / biodiversity perspective. Inclusion within the National Park would thereby afford the highest level of protection to the natural environment as well as items of heritage significance.

It is the intention of this strategy to achieve management of these lands by DECC (NPWS) through whatever means deemed appropriate. This could involve:

- Rezoning of publicly owned land as agreed with National parks, and which could be undertaken as part of the new Pittwater LEP (currently under development by Council).
- Exchange and/or dedication of land under private or public ownership to National Parks,
- Depending on the viability of the option, purchase of private land for dedication to National parks could be considered.

There are a number of possible issues relating to this land at present, as described below, and which would need to be taken into consideration when choosing the most appropriate method of implementing this strategy.

A Part 3A Development Application of the 9(b) County Open Space Reservation zoned land at Currawong (within Lot 10 DP 1092275) has recently been refused by DP.

The application involved development of 25 residential lots on flood prone land. The site lies below the one in 100 year flood level and is subject to inundation from the creek and shoreline recession from Pittwater itself. The application was refused upon the grounds of unacceptable visual impact, unacceptable impact upon Aboriginal archaeological sites and historic workers cottages, inadequate parking and site access and questionable viability of the proposed on-site wastewater reclamation plant. Furthermore, DP also declared the entire site to be State Heritage listed. Any future proposals for the site have been stated will go before Pittwater Council. (DP, 2009).

Under the current 9(b) zoning of this land, there is an acquisition requirement for DP upon the owner's request. However, until such time as the land is acquired by DP, the planning controls under the 9(b) zoning permit development of this land to the highest and best use. The land, is thought to still be in the ownership of Unions NSW, while private developers Eco Villages Australia owned an option to develop the land, for which approval has been refused, as noted above.

The ownership and origin of the large parcel of 6(a) Existing Recreation land (Lot 1 DP 119168) needs to be clarified. If this land is in the care, control and management of Council, further consideration needs to be given before it is decided to hand it over to National Parks as this was not the original intention of the zoning of such land.

These issues would need to be considered, and the most appropriate action taken to implement the intent of this strategy.

Responsibility: Council, DECC (NPWS), DP and Dept of Lands.

- 2d) *Allow small scale maintenance dredging for navigational safety, providing it does not conflict with or compromise existing or future environmental values.*

Some areas have been dredged in the past to permit navigation of large or deep draught vessels. Natural deposition of sediment in these areas has meant safe navigation for larger vessels has been or will be compromised at some time in the future. A program of on-going dredging will be required if deep water access in these areas is proposed to be maintained.

Responsibility: The responsibility for maintaining access essentially resides with the individual boat owners who stand to benefit from the dredging. Anyone proposing to dredge will need to gain the necessary state government approvals, provide detailed hydrographic surveys of the area, assessment of boating requirements, and consult with DPI, Department of Lands, and other agencies as specified in the SEPP (Major Projects) 2005. As the dredging works are likely to be expensive, joint funding between the beneficiaries of dredging works and the State Government (through NSW Maritime) is likely.

3 Prepare and Enforce Development controls.

- 3a) *Climate change impacts for development are to be considered and addressed, with the development of relevant risk management plans for adoption into Council's DCP*

A recent report by the Sydney Coastal Councils Group (2008) has mapped the relative vulnerability of councils including Pittwater to the impacts of climate change. The impacts shown in the report to be relevant to the Pittwater Estuary were sea level rise, bushfire, extreme rainfall and stormwater management, and effects on ecosystems and natural resources. An important finding of this report was that vulnerability to climate change impacts could be significantly reduced where the adaptive capacity of an area/location was improved.

Within the limits of Councils ability, Council planners should consider in their review of development controls the ability to improve the adaptive capacity to climate change impacts, in particular, impacts from rainfall upon stormwater volumes, impacts on ecosystems and scenic amenity from vegetation clearing and loss of foreshore setbacks in relation to sea level rise.

An opportunity exists to introduce prioritised and achievable adaptation measures to address the potential impacts of climate change in the Pittwater LGA. Appropriate outcomes could be best achieved by integrating a risk management strategy into the existing strategic planning activities and risk management practices of Council. The process should be undertaken in accordance with the guidelines provided by the Australian Greenhouse Office in its publication - Climate Change Impacts and Risk Management – A Guide for Business and Government. The State Govt "Climate Action Plan" and studies in preparation by DECC into the parameters of climate change effects in NSW should also be consulted in developing adaptation measures for Pittwater.

Responsibility: Council with assistance from State government agencies. Existing funding (through the NSW Climate Change Fund) and new initiatives from DECC may be useful in the development of and financial assistance for actions by Council. Climate change is listed as a threatening process in the HCNAP (refer Target B3-1 Threatening Process Management), and assistance from HNCMA for this strategy may also be applicable. A similar strategy for mitigating climate change has been ranked

as a high priority in the Lower Hawkesbury EMP (Strategy 10a), thus coordination in conducting this strategy from both plans is likely to achieve a consistent and robust outcome for both Pittwater and the Lower Hawkesbury.

3b) WSUD principles to be added to all development controls (draft DECCW DCP)

Council should enforce Water Sensitive Urban Design (WSUD) principles for all new developments and redevelopments within the Pittwater estuary catchment. WSUD involves minimising the flow and pollutant load discharge of stormwater on a site by site basis, using rainwater tanks, stormwater reuse, infiltration, bioretention, swales, porous pavers etc. DECC (EPA) is currently developing guidelines and an example Development Control Plan (DCP) for the implementation of WSUD by local government authorities, and has already developed guidelines for the harvesting and re-use of urban water. The Pittwater Water Management Plans (in preparation) should be consistent with WSUD principles and all relevant DECC guidelines.

Further, the recommended WSUD controls should be integrated with the aims and implementation actions from the Draft Mona Vale / Bayview Floodplain Risk Management Study and Plan (Cardno, 200), namely: Action FM11, which relates to on-site detention of stormwater for developments (greater than particular sizes) to ensure water flowing from the sites does not exceed existing or pre-European levels; and Action FM15 of the same plan, which relates the use of rainwater tanks and infiltration systems for on-site water retention. The Careel Creek (Avalon) Floodplain Risk Management Plan (L&T, 2002) also recommends the use of rainwater tanks for on-site retention of stormwater.

To ensure appropriate WSUD and stormwater controls are included in all developments, amendments to the existing Pittwater DCP (or a new DCP) should require WSUD details to be submitted with development applications.

Responsibility: Council planners will be responsible for developing a DCP (based upon the Draft DECC DCP) to ensure details for appropriate WSUD and stormwater controls are provided with each development application.

3c) Appropriate on-site sewage systems to be adopted, suitable for soils, topography etc

Residential developments on Scotland Island and the western foreshore rely on on-site effluent disposal. These systems are typically problematic and may contribute pollutants to the waterway even when working efficiently and sited correctly.

Every existing on-site effluent disposal system should be audited on a recurrent basis to determine if it is functioning adequately and is appropriate to the site constraints (eg based on soil types and depths, site slope and system capacity), to ensure that excessive pollutants are not being directed to the environment. Recommendations should be stipulated as to maintenance and/or replacement by the residents.

For new developments, development controls should be reviewed to ensure the use effective effluent disposal systems based on site characteristics. Waterless and “hightech” composting toilets should be considered for all new installations or to replace failing systems.

For sensitive land areas, such as land in close proximity to the waterway, Council should consider instigating Development Controls which stipulate that the reticulated potable water supply will not be connected to new developments unless connection to the reticulated sewerage network or an alternative means of “off-site” disposal is arranged. SEPP (Major Projects) 2005 states that certain subdivisions of land not connected to sewerage works would require approval under Part 3A of the EPA Act.

Scotland Island has been earmarked for connection to the reticulated sewerage network, as part of Stage 2 of Sydney Water’s Priority Sewerage Program (PSP). If it is found that the majority of systems along the Western Foreshores also require replacement, discussions with Sydney Water should be held to also have these areas in the PSP to be connected in conjunction with the Scotland Island connection.

Potential for greywater reuse treatment and disposal systems should be considered in conjunction with the *NSW Guidelines for Greywater Reuse in Sewered, Single Household Residential Premises* (DEUS, 2007), for example to ensure the land does not become saturated.

Responsibility: Council would be required to conduct audits of all of the on-site and septic systems around Pittwater, although assistance could be sought from Sydney Water. Audit results should be provided to Sydney Water to assess the priority and timeframe for connecting areas to the reticulated sewerage network.

3d) *Developments not to incorporate pollution and/or sediment discharges to the waterways*

Council outlines development controls in the LEP and DCPs to restrict types of development within different sections of the Local Government Area (LGA). This option involves reviewing existing development controls (some of which were prepared many years ago), and amending these controls as necessary, to ensure that Pittwater estuary is protected from potential future pollution and sediment discharges.

Responsibility: Council planning officers. This management strategy is similar to strategies in the Lower Hawkesbury Estuary Management Plan (particularly Strategy 1g). Benefits may exist in the sharing of information regarding procedures for updating development controls and coordinating likely LEP and DCP controls implemented.

3e) *Developments not to degrade scenic amenity of the Pittwater estuary and surrounds*

As per 3d, but with a focus on protecting and retaining the scenic amenity of the Pittwater estuary and its surrounds. The scenic amenity of the foreshore includes not only vistas and views at locations around the waterway, but natural environments such as bushland and riparian vegetation which conveys a sense of natural beauty at various locations throughout the estuary. New, infill and re-developments should be required to meet standards of design which are in keeping with surrounding natural or urban aesthetics, but also which maintain or enhance natural aesthetics within the estuary.

Responsibility: Changes to development controls should be made, as necessary, by Council.

3f) *Public amenity and existing foreshore values to be retained / improved for foreshore developments*

As per 3d, but with a focus on retaining or indeed improving, public amenity and foreshore values around the Pittwater estuary and its surrounds. This should include improvements (rehabilitation and maintenance) to foreshore habitats as part of the development controls for new, infill or re-developments along the foreshore. Particular emphasis should be placed on commercial development along the Pittwater foreshore (eg marinas) to ensure that public access to the foreshore is maximised, and habitat values maintained or improved. Seawalls should be constructed (or maintenance works completed) according to the Best Practice Guidelines developed by DECC.

Changes to development controls should be made, as necessary, by Council. For those marina development that are “designated development” under Part 3A of the EPA Act, consultation with DP will be required to implement this strategy.

Responsibility: Council planning officers will be responsible for ensuring controls are specified in conditions of consent for new developments. Consultation with DP will be required to ensure this strategy is implemented where the marina development falls under Part 3A of the EPA Act (ie, is Designated Development). This management strategy is similar to strategies in the Lower Hawkesbury Estuary Management Plan (particularly Strategy 1g). Benefits may exist in the sharing of information regarding procedures for updating development controls and coordinating likely LEP and DCP controls implemented.

3g) *Make stricter sediment & erosion controls for developments*

This option involves reviewing current requirements for Sediment and Erosion Control Plans and conditions of consent for new urban developments. If the requirements do not reflect current best practice standards, the requirements shall be amended to ensure that all possible action is taken to reduce sediment loads to the estuary.

Responsibility: Council planning staff should undertake update of control requirements to best practise standards.

3h) *Require all marina developments (> 9 berths) to have pump-out services*

This option involves modifying the existing statutory and/or non-statutory regulations, or developing new regulations, to require all new marinas or redevelopment/modifications to existing marinas with more than 9 berths to install sewage pump-out facilities. A clause stating this intent could be included in the new Pittwater LEP, inserted under Part 5 Miscellaneous Provisions (refer the Standard LEP template).

SEPP (Major Projects) 2005 indicates that development consent for marinas that are classed as “Designated Development” falls under Part 3A of the EPA Act. And all marina developments need to comply with the WM Act. In this case, it may be applicable for Council to request DP to modify or develop specific statutory regulations for Pittwater, such that pump-out facilities are mandatory for marina developments in the Pittwater Estuary. Similar controls have recently been implemented for Sydney Harbour, which require new marinas or redevelopment of existing marinas larger than 9

berths to include pump-out facilities. Further, the Lower Hawkesbury EMP also includes a strategy to improve pump-out provisions from marinas (ie, strategy 1i).

Responsibility: Council, Department of Planning and NSW Maritime would be mainly responsible, with assistance from other state agencies as required.

4 Activity Controls / Modifications (for existing development).

4a) *Limit proximity of boating activities to environmentally significant areas and other sensitive areas (eg weed infested areas), incl. no anchoring*

To protect areas of significant environmental value (such as Careel Bay wetlands, migratory bird habitats and extensive seagrass beds), more general waterway activities should also be controlled in the general proximity of such areas. Controls may include lower speed limits and 'no anchoring' zones, to discourage inappropriate activity and frequent visitation by vessels. Careel Bay and the areas in front of Barrenjoey (Station) Beach are two such areas that should be considered for 'no anchoring'.

'No anchoring' zones should also be established in areas that contain *Caulerpa taxifolia* infestation to prevent spread of the weed.

Boat wake has also been identified as a cause of foreshore erosion in some locations, and speed restrictions may be appropriate to mitigate damage to sensitive foreshore habitats in some locations.

Responsibility: NSW Maritime, with assistance from DPI Fisheries and Council, should administer the relocation of relevant moorings, changes to boating speeds, and establishing no anchoring zones. A similar strategy has been put forward in the Lower Hawkesbury EMP (Strategy 7g). There may be benefits in coordinating with facilitators of the LHEMP to assist NSW Maritime and DPI Fisheries in undertaking this strategy. The HNCAP outlines targets which support this strategy, particularly target RH3-1 Important Wetlands. Further, if appropriate, there may be reason to support for Lower Hawkesbury EMP (Strategy 7i) which aims for an additional Maritime officer, to assist with waterway compliance and regulatory activities outlined for Pittwater.

4b) *Replace existing moorings with seagrass friendly moorings in areas close to existing seagrass beds, and where seagrass could potentially recolonise.*

Moorings have a significant impact on seagrass beds, causing "scalping" circles where slackened mooring chains during the low tide have dragged and damaged seagrass beds. The removal of seagrass can allow for further erosion and degradation of remaining seagrass.

A report by DPI Fisheries (Bowman, 2008) outlines for each bay/embayment/area in Pittwater the number of moorings, the type and condition of seagrass, and significant mooring impacts. The findings of this report should be utilised in determining priority areas for removal.

The Bringing Back the Fish program funded by the National Heritage Trust has enabled the replacement of 32 moorings with seagrass friendly moorings within Pittwater. Ongoing monitoring of the replaced moorings will be conducted over the next 3 years to determine the environmental

recovery around the moorings, the acceptability to the mooring users, and the capacity of the moorings to withstand various weather conditions. Further information about the project can be obtained from the HNCMA.

Removal of moorings is unlikely to be achievable in the short term, as alternative locations for the moorings are not available. In the interim, all moorings located within or in proximity to seagrass beds, which cannot be readily relocated should be replaced with seagrass friendly moorings.

Responsibility: HNCMA, NSW Maritime, with assistance from DPI Fisheries and Council, should administer the replacement of existing moorings with seagrass friendly moorings.

4c) If necessary, reduce boating speed limits in areas of high waterway use / traffic (eg western side of Scotland Island)

A number of areas have been identified as experiencing high boat traffic by NSW Maritime. The Bayview region between the Royal Motor Yacht Club and the Royal Prince Alfred Yacht Club is described as a choke point for boat traffic, and the number one location for boat congestion. The route between Scotland Island and Church point is described as the second most congested and dangerous, particularly as this traffic crosses the channel and other main routes in Pittwater (Pers. comm., Steve Nugent, NSW Maritime, April 2009). The area west of Scotland Island between Church Point and the western foreshores communities is described as a 'commuter highway'.

Other public wharves and jetties which allow for commuter access are also highly trafficked areas of Pittwater. In general, the entire estuary is said to experience considerable boat traffic.

Given the high vessel traffic utilising this section of the estuary, and in the interests of public safety (particularly when travelling at night), NSW Maritime Authority should review current speed restrictions in all areas that are known commuter routes.

Responsibility: NSW Maritime. As noted previously, strategies related to NSW Maritime activities and resourcing are outlined in the Lower Hawkesbury EMP (eg Strategies 7e, 7i) and possibilities for coordinating efforts for both waterway areas should be considered.

4d) If necessary, relocate existing moorings away from areas of high environment significance and/or high vessel traffic

Removal or relocation of a small number of moorings within the areas heavily trafficked by boats should be investigated, for example, moorings in front of public wharfs or adjacent to popular traffic routes. Consideration should first be given to surrendering the mooring, possibly with compensation to the lessee. Where removal is not possible, relocation of the mooring must consider the impact to the aquatic environment. The moorings should not be relocated to any area which contains seagrass or other significant aquatic habitat, or *Caulerpa taxifolia*, and best practise mooring types utilised.

Responsibility: NSW Maritime is responsible for reviewing the existing mooring locations with respect to traffic and negotiating removal. Where relocation is required, NSW Maritime should consult with DPI Fisheries to determine locations of minimum risk to the environment.

4e) *Remove significant impediments to fish passage*

Aquatic fauna habitat can be improved by removing barriers to fish passage along creeks. The flood gate on Cahill Creek, upstream of Pittwater Road and adjacent to Bayview Golf Club has been identified as the number one priority site for floodgate removal in the Hawkesbury Nepean Catchment (DPI, 2007). Discussions between the structure owner, DPI Fisheries, Council and HNCMA to manage the structure to allow for improved aquatic habitat should be undertaken.

Other barriers to fish passage may include road crossings and weirs. DPI Fisheries has recently completed an assessment of road crossings in the Hawkesbury-Nepean Catchment. The project investigated approximately 480 road crossings across 23 local government areas, including Pittwater. While 99 sites were identified as potential fish passage obstructions, none of these obstructions were found to occur in Pittwater. (DPI, 2006a)

The DPI conducted a review of weir structures, concentrating on weirs they deemed to be a priority. None such weirs existed in Pittwater. However, DPI strongly recommended that all redundant structures be removed from water ways. The removal of such structures provides great benefit to the waterway by enabling unrestricted fish passage and the reinstatement of natural sediment fluxes within the waterway system. Where it is not possible for the removal of a structure, remediation of such structures should be undertaken in accordance with best practice, such as the NSW State Weirs Policy. (DPI, 2006b)

In 2009, DII (Fisheries) installed an auto-tidal gate within the existing structure on a trial basis. The auto-gate allows some tidal flushing of the upstream channels in the golf course, and passage of fish between the upstream and downstream reaches of the gate. However, Action FM3 from the Draft Mona Vale / Bayview Floodplain Risk Management Study and Plan (Cardno, 2008) recommends the complete removal of the flood gate, which would further benefit fish passage and natural environmental flows.

Responsibility: The option would be co-ordinated by DPI Fisheries and Council with substantial input from DECC and HNCMA.

4f) *Encourage all existing large marinas (> 30 berths) to install pump-out services*

This option involves requiring existing larger marina developments (> 30 berths) to install sewage pump-out facilities. A voluntary charter could be established with marina operators in the first instance. More assertive measures could be considered in the future depending on the uptake of the voluntary charter. These measures could be linked with on-going licences or conditions of future development.

One such assertive measure may be to add a clause to the new Pittwater LEP that applies to existing marinas, so that any future development/modifications of existing marinas requires this to be considered. The clause stating this intent could be inserted under Part 5 Miscellaneous Provisions (refer the Standard LEP template).

Responsibility: Council, DECC, and NSW Maritime would be mainly responsible, with assistance from other state agencies, as required.

- 4g) *If necessary, reduce the total number of moorings within Pittwater to a more appropriate capacity / mooring limit, through opportunistic relinquishment and offsets through new marina developments.*

A mooring cap has been applied within Pittwater, however, the appropriateness of this cap should be reconsidered in light of environmental constraints, existing facilities, waterway activities, and physical space available. If necessary, the cap should be reduced, and moorings removed on an opportunistic basis. The cap could also be extended to berthed vessels, such that there is a regulated limit on the total number of vessels 'stored' in the waterway. In this way, where new wet berths are created, a corresponding number of swing moorings should be relinquished and cancelled (with priority in areas of environmental conflict), to ensure there is no net increase in the number of vessels 'stored' in the waterway.

Responsibility: NSW Maritime would be mainly responsible, with assistance from Council and other state agencies, as required.

5 Construct New or improved services / assets.

- 5a) *Install new and/or upgrade and repair existing waterway access locations / points, and foreshore access and facilities*

This option involves reviewing the existing level and type of waterway infrastructure, such as public wharves and jetties, boat ramps, tie-up pontoons, fuelling and pump-out facilities etc, to determine its ability to protect the surrounding environment in addition to serving the demands of waterway users. The review should also include foreshore facilities for public access and recreation.

The review should determine:

- where the facilities are inappropriate to the surrounding environment and should be removed or relocated;
- where facilities require upgrade to better protect surrounding habitats, as well as meet the needs of waterway and foreshore users; and
- where new facilities are suitable for installation.

Public accessways should be confined to areas of low conservation significance wherever possible. Where there is a strong demand for public access to foreshore areas of high conservation significance, such access should be formalised and closely controlled to minimise environmental damage. Foreshore restoration or rehabilitation works should be undertaken as part of access improvement works.

A program of works should be developed aimed at addressing identified shortfalls and rationalising under-utilised infrastructure and facilities, which can then be implemented on a prioritised basis when funding becomes available. Works could include for example provision of defined visitor car parks (to avoid over-parking and congestion in residential streets), seats, lighting, picnic tables, barbecue facilities, landscaping and walking tracks (either formal or informal, and enabling disabled access). A

focus should also be given to removing private encroachments that obstruct access or inhibit enjoyment of public foreshore open space.

This strategy aligns with strategies 1e and 1h of the Lower Hawkesbury EMP which relates to the rationalisation and improvement of waterway and foreshore infrastructure in keeping with the needs of environment and community.

Responsibility: Council, with input from DECC, HNCMA, DPI Fisheries, and NSW Maritime. Works associated with the outcomes, such as the rationalisation of access facilities, in some instances may relate to HNCAP target RH1-4 Best Practise for Public River Access Recreation Areas, while works involving rehabilitation of foreshore habitat are in keeping with River Health targets RH1-2 and RH1-3 for riparian vegetation regeneration and rehabilitation. As such, HNCMA assistance with capital works may be applicable.

6 Environmental Rehabilitation.

6a) *Repairs / rehabilitation of significant heritage sites (Aboriginal or early European)*

It is likely that many sites of historical significance have become degraded with time. Some of these sites are still used on a regular basis (eg wharves and seawalls) and in some cases, may represent a public risk. This option involves carrying out repairs to these structures to ensure their integrity, or restoring currently degraded structures / sites as show-pieces of former usage and estuary based activities. For sites of natural heritage (primarily Aboriginal sites), rehabilitation would involve erosion stabilisation, revegetation and protective measures, to conserve sites as best as possible.

Responsibility: Council would primarily be responsible for repairs and restoration of historical items / structures, with DECC and Department of Lands also partially responsible for structures below the high water mark (ie on Crown Land). Natural heritage sites would be the responsibility of DECC, Lands and Council. Assistance may be sought from the HNCMA in enhancing and rehabilitating sites of significance (target MT C1-4). Further, coordination with similar strategies in the Lower Hawkesbury EMP (strategy 2t and 2u) may be considered.

6b) *Redress erosion along Pittwater foreshores and along catchment streams / tributaries*

There were twenty six areas of foreshore erosion identified in the Pittwater EPS, however, a recent inspection conducted by DECC (Daniel Wiecek, December 2008) of all public land accessible by foot along the foreshore of Pittwater Estuary found the majority of foreshore stretches to be without erosion issues, except for two sites. These two sites are:

- Two locations within McCarrs Creek Reserve, one fronting Cicada Glen Creek and one fronting McCarrs Creek; and
- Rowland Reserve at Bayview Park.

The other six high priority erosion sites listed in the EPS were assessed by DECC as no longer presenting an erosion impact, and were noted to have either stabilised or to have been natural fluctuations. The sites found to have stabilised were: at the end of Beach Road, Palm Beach; at the reserve at the end of Nabila Road, Palm Beach; between the playing fields at Careel Bay; at the

northern end of Paradise Beach, Clareville; at the northern, eastern, and southern shorelines of Crystal Bay, Newport; and at the foreshore adjacent to Yachtsmans Paradise, Newport. The three erosion sites within the National Park (Great Mackerel Beach, Currawong Beach and The Basin), may also require re-assessment by NPWS, to determine the state of erosion issues at these sites at present.

The design of remediation options should aim for the protection of foreshore and aquatic habitats. Preference shall be given to soft-engineering solutions, such as shoreline re-grading, stabilising vegetation and modifying the erosion mechanism, to avoid the construction of additional rock walls around the foreshore. The investigation of bank erosion mechanisms needs also to consider the impacts of sea level rise and climate variability (eg, storm surge) in the design of remediation actions.

An investigation of the foreshore erosion at Rowland Reserve has recently been completed (WorleyParsons, 2008), and the recommended strategy for remediation of erosion at this site was to construct “a combination of a benched revetment with mangroves over about 30% of the total foreshore length, a benched revetment with saltmarsh over 20% of the length, a beach cut into the foreshore over 25% of the length, and a conventional rock revetment over 30% of the length” (Worley Parsons, 2008). This strategy was also endorsed by DECC and the local community, as part of the project.

Under new SEPP (Infrastructure) 2007 provisions, Councils works teams would be able to undertake the required environmental management activities (as provided by DECC) at McCarrs and Cicada Glen Creek without the need for development consent. Major works, however, should be formally designed and undertaken by specialist contractors.

Responsibility: This option would be implemented by Council (in co-operation with private property owners as necessary). Assistance may also be sought from DECC. This strategy is likely to be supported by the HNCMA, as it relates to river health targets RH1-2 Riparian vegetation regeneration, and RH1-3 Riparian vegetation rehabilitation. Further, a similar creek rehabilitation strategy has been outlined in the Lower Hawkesbury EMP (Strategy 14c). There may be avenues for coordinating funding applications and effort with the LHEMP and HNCAP strategies.

6c) *Re-vegetation along estuary foreshores and along riparian zones within catchment (on both public and private lands) to connect habitats, provide shade and enhance ecological communities (esp. EECs)*

Assessment by Williams and Thiebaud (2006) indicated there to have been a 31% loss of mangroves and at least a 15% loss of saltmarsh in Pittwater between 1977 and 2000. Broad-scale mapping of riparian vegetation condition conducted by HNCMA indicated Pittwater to have 25- 50% tree cover (HNCMA, 2007), which largely describes the good riparian vegetation protected within Ku-ring-gai NP.

This option involves planting indigenous species along the foreshores of the estuary to improve the habitat potential (for fish and invertebrates, as well as birds), and consequently the scenic amenity of the waterway. Revegetation should also extend along catchment riparian zones, tributary creeks and across landscapes wherever possible, to connect important habitats and vegetation stands.

Voluntary revegetation on privately owned lands would be encouraged through education, assistance and incentives, such as through HNCMA programs or similar.

In addition to the immediate estuary foreshores, remediation should extend to the tributary creeks and streams within the catchment. Many of the natural tributaries draining to Pittwater have been replaced with formalised 'hydraulically efficient' channels, culverts and pipes. This has tended to increase velocities along and into waterways, as evident by erosion at the downstream end of drains and channels. Formalised drains also provide little habitat value and can super-heat the water, particularly during summer, which also negatively impacts the aquatic ecology downstream. It is proposed to "deformalise" some of these waterways by replacing existing concrete lined drains with more natural meandering vegetated channels. Where the ability to do works is limited by space and land ownership issues or potential flood impacts, channels should at the least be revegetated for shade and to prevent water heating. Priority locations for creek rehabilitation or enhancement would include:

- Careel Creek (particularly upstream from Barrenjoey Road)
- Mona Vale Main Drain (open drain through light industrial area at Mona Vale)
- Cahill Creek (upstream of Bayview Golf Course)
- Bayview Golf Course channels and watercourses (restoration of environmental flows and habitat enhancement).
- Bayview Golf Course floodgates (investigation of the operation and impacts of Pittwater Road floodgates on flooding, water quality and fish movement).

Under new SEPP (Infrastructure) 2007 provisions, Councils works teams would be able to undertake these environmental management activities without the need for development consent. Best practise guidelines for foreshore and creek bank stabilisation works are provided to assist Council's works crews with minor works. Major works, however, should be formally designed and undertaken by specialist contractors.

Further, Action FM12 from the Draft Mona Vale / Bayview Floodplain Risk Management Study and Plan (Cardno, 2008) relates to improving the ecological condition of channels, reducing weed growth and implementing debris as control structures, as a floodplain management action. Action FM12 is consistent with this strategy, and combining the implementation of the strategies could provide cost efficiencies for Council.

Responsibility: This option would be coordinated by Council's bushcare co-ordinator and implemented as required by Council's works teams. The HNCMA have identified the improvement of river health via stable and health riparian areas as an investment priority (p 29, HNCMA, 2007) and have set targets RH1-2 and RH1-3 which aim for riparian vegetation regeneration and rehabilitation. Assistance from HNCMA to complete this strategy for Pittwater may additionally assist with meeting the HNCAP targets. This option is also similar in intent to strategies 2p to 2s outlined in the Lower Hawkesbury EMP.

6d) *Weed and exotic species removal, including *Caulerpa taxifolia**

The option involves considerable on-ground works to systematically remove weeds and exotic species from the estuary's waterways (particularly *Caulerpa taxifolia*) and along the foreshores and connected riparian zones (eg along tributary streams).

On private land, removal of weeds would occur through the education of landowners, targeted incentive programs for weed removal, and, if required, the enforcement of Noxious Weed Act provisions.

It has been reported that *Caulerpa taxifolia* is now appearing all over Pittwater estuary (pers. comm., Steve Nugent, NSW Maritime, April 2009).

DPI Fisheries, with support from the HNCMA and Council, should continue to manage *C. taxifolia* outbreaks (using salt treatment or other new methods) and implement the NSW Caulerpa Control Plan. Community education should also target ways to reduce the spread of *C. taxifolia*.

Responsibility: Weed removal from foreshores and bushland areas could be organised through the local Landcare co-ordinator and Council's Natural Resources staff. Support from the HNCMA should also be sought, as HNCMA has identified pest plant management and control as one of its investment priorities (HNCMA, 2007), and in its Biodiversity Targets B4-1 Weed Control and B4-2 Maintenance of Weed Control. Pest and weed management activities are strategies 13a and 13b of the Lower Hawkesbury EMP, and the benefits of combining programs and/or funding applications through the HNCMA and other state agencies should be investigated.

7 Pollution Reduction Measures.

7a) *Targeted measures for reducing marina operations waste*

This option involves holding discussions with individual marina operators to identify ways to minimise the input of pollutants to the waterway. Similar to the voluntary pump-out charter (refer Strategy 4f), a voluntary marina waste charter could be established with marina operators in the first instance. More assertive measures could be considered in the future depending on the uptake of the voluntary charter. These measures could be linked with on-going licences or conditions of future development. Four marinas hold discharge licences with DECC (formerly EPA).

The aim of the charter would be for all marinas to be operating with best practise methods for minimising runoff from boat maintenance activities (such as anti-fouling using slipways etc). A similar strategy has been outlined in the Lower Hawkesbury EMP (refer strategies 12l and 12m).

Responsibility: Council would carry out negotiations, with the assistance of DECC, DPI Fisheries and NSW Maritime as required.

7b) *Targeted catchment management measures, following catchment-wide urban pollution and sediment runoff audit (esp. areas discharging to poorly flushed embayments)*

This option involves assessing activities and land uses that constitute potential sources of pollutants within the Pittwater catchment. Water quality monitoring, detailed mapping and site inspections could

be undertaken (particularly of suspected pollutant contributors, eg landfill sites, golf courses, playing fields, industrial sites, and even individual developments). Pollutant identification would be carried out on a sub-catchment basis, with areas draining to the poorly flushed parts of the estuary being assessed as a priority (eg Mona Vale Main Drain, Careel Creek, Cicada Glen Creek and Winji Jimmi Bay).

Once identified, potential sources of pollution should be addressed through mitigative measures, to reduce pollutant and sediment discharges to the estuary (especially in the poorly flushed southern sections of Pittwater). As a starting point, a number of the actions recommended in the Pittwater Stormwater Management Plan (PSMP) (PBP, 1999) target the issue of catchment erosion and turbidity generation in Pittwater estuary, particularly due to unvegetated and exposed ground surfaces and unsealed roads (especially on Scotland Island). Further, a Scotland Island Erosion and Sediment Control Plan (Witheridge 2004) has been developed. The recommended actions typically involve sealing of roads, revegetation, and runoff diversions, to reduce sediment loads to the estuary, and thereby reduce turbidity and other environmental impacts arising from sediments. Given the age of the document, the Stormwater Management Plan should be reviewed and updated before extensive implementation.

This strategy, which aims to reduce pollutant inputs to the Pittwater estuary, and thus Lower Hawkesbury estuary, is in keeping with strategies and intent of the Lower Hawkesbury EMP (eg, Strategies 12i, n, o, r and others associated with Risk 12 of the LHEMP). It may be useful for Pittwater Council to consult with Hornsby Shire Council (HSC), to ascertain which actions have been utilised and found successful under similar strategies from the Lower Hawkesbury EMP.

Responsibility: Council would be responsible for identifying pollutant sources, and for some pollutant mitigation, with assistance and advice from DECC, particularly in cases where landowners of identified sites will be responsible for mitigation. Council would also be responsible for reviewing and updating the Stormwater Management Plan, and indeed for implementing the Plan, within the context of the overall Pittwater Water Management Plans.

7c) Minimise overflows from the reticulated sewerage system (through Sydney Water consultation)

There are 23 identified designed sewerage overflow locations around the Pittwater estuary. A survey of all known overflow locations undertaken by Council staff in 1993 listed a total of 60 overflow locations within the Pittwater LGA, 38 of which discharged to Pittwater. Sydney Water has estimated that sewage from overflows contributed about 18% of the average annual bacterial load to stormwater within the Pittwater catchment (Sydney Water, 1998), and a relatively minor contribution to total nutrient load. High bacterial loads to the estuary, particularly during rainfall events, are currently compromising the safety of the public who bathe within Pittwater (even at designated bathing locations, eg Bayview baths).

Sydney Water is currently undertaking its SewerFix Wet Weather Abatement Program, which involves improvements to pipes, storage facilities and design overflow, in areas across Sydney including Pittwater. The work is required as part of licensing agreements with DECC. In addition, upgrades to the Warriewood STP are underway and Warriewood has also been targeted for assessment and repair of sewerage components under the SewerFix program.

This option would involve Sydney Water prioritising sewer improvements (under the SewerFix program) within the Pittwater catchment, to substantially reduce overflows into the local stormwater system and Pittwater estuary.

Responsibility: Dialogue with Sydney Water should be initiated by Council, and supported by other government agencies, such as DECC (EPA) and Department of Health, as required. Similar discussions with Sydney Water have been cited in strategies of the Lower Hawkesbury EMP (eg 12q, y, z), and there may be advantages in coordinating such discussions with all parties.

8 Community Education. Specifically, consider different combinations of a range of topics, using different approaches, and targeting different audiences.

Topics	Approaches	Audiences
<ul style="list-style-type: none"> - No discharge status of Pittwater - Discouragement of use of high-pollution older-style 2 stroke outboard motors - Catchment management, including use of fertilisers, pesticides etc - Appropriate foreshore use (including education of foreshore landowners) - Aboriginal values - General environmental values of estuary 	<ul style="list-style-type: none"> - Signage - School kits - Public displays - Brochures - Demonstrations - Face to face discussions 	<ul style="list-style-type: none"> - Waterway users - Waterway commercial operators/businesses - Foreshore users - Foreshore landholders - Foreshore commercial operators/businesses - Catchment users - All catchment residents - All catchment commercial operators/ businesses

Pittwater estuary is a designated 'no discharge' zone, which means effluent from boats is not allowed to be discharged within any part of the estuary. Discharges can only be made at designated pump-out facilities (or offshore in the ocean). In spite of this, it is expected that effluent is being discharged directly to the estuary from time to time, particularly by older boats that do not have holding tanks. Further, while holding tanks are required by law for commercial vessels, such legalities do not apply to recreational vessels.

Older style two-stroke engines are known to exhaust up to 30% of the fuel/oil mix directly to the waterway. New style direct injection two stroke motors, and four stroke motors, have much lower emissions than old style two-stroke motors.

A widespread education program is required to ensure appropriate use of fertilisers and pesticides, and minimise runoff to surface water and groundwater systems, for both large scale operators (eg golf courses and Council playing fields) and smaller private landowners. A map of existing areas and education programs already underway in the Pittwater LGA is illustrated in Figure F-1 below.

Education of foreshore and estuary users is also required to ensure activities are undertaken appropriately, giving due consideration to the environment and other users. In particular, education should cover:

- The ecology of foreshore habitats, the inter-tidal zone, seagrass beds and the estuary generally;
- Consideration of wading or roosting migratory birds (and the potential disturbance by humans, dogs and noisy activities);
- Collection of litter and dog faeces, with provision of bins;
- Areas suitable (and unsuitable) for swimming;
- Responsible bait collection and compliance with Fisheries Bag Limits.

The Pittwater estuary, within the Gu-ring-gah homelands, holds intrinsic heritage and cultural resource values for the Indigenous people who occupied the lands. Awareness by the general community about the former land occupation by these people should be increased. For example, Council signs could display words reflecting connection to the local Aboriginal landowners (eg Pittwater... "part of the Gu-ring-gah homelands").

The wider community of Pittwater (including all who live with the catchment) should be targeted for general education regarding the significance of the Pittwater estuary, its diverse environments and values, and the potential impacts of day to day human activities. Such education could focus on sensitive areas of the estuary such as Careel Bay, and also on particular issues, such as reducing nutrients in runoff and the spread of environmental weeds.

Delivery of community education is expected to take a multi-faceted approach. Interpretive signage, brochures, public displays, and schools programs would be effective for targeted and general education. Community education courses run through the Coastal Environment Centre could also target potential actions and best practises that can be undertaken by individuals. Guidelines and educational material should also be accessible on Council's webpage.

This management option has similar intent to strategies 6g and 6h of the Lower Hawkesbury EMP. There may be cost and other benefits in coordinating such activities for both plans simultaneously.

Responsibility: Implementation would require a co-ordinated and co-operative effort between many different agencies. It is recommended that Council be responsible for co-ordination of community education. Assistance would be required through DECC (EPA), NSW Maritime, HNCMA, DPI Fisheries, DECC, and organisations such as the boating industry, as well as individual operators (eg marinas). There may be significant cost savings and other benefits in coordinating education activities relating to reducing pollutants from boating and waterway uses with those outlined in Lower Hawkesbury EMP strategies.

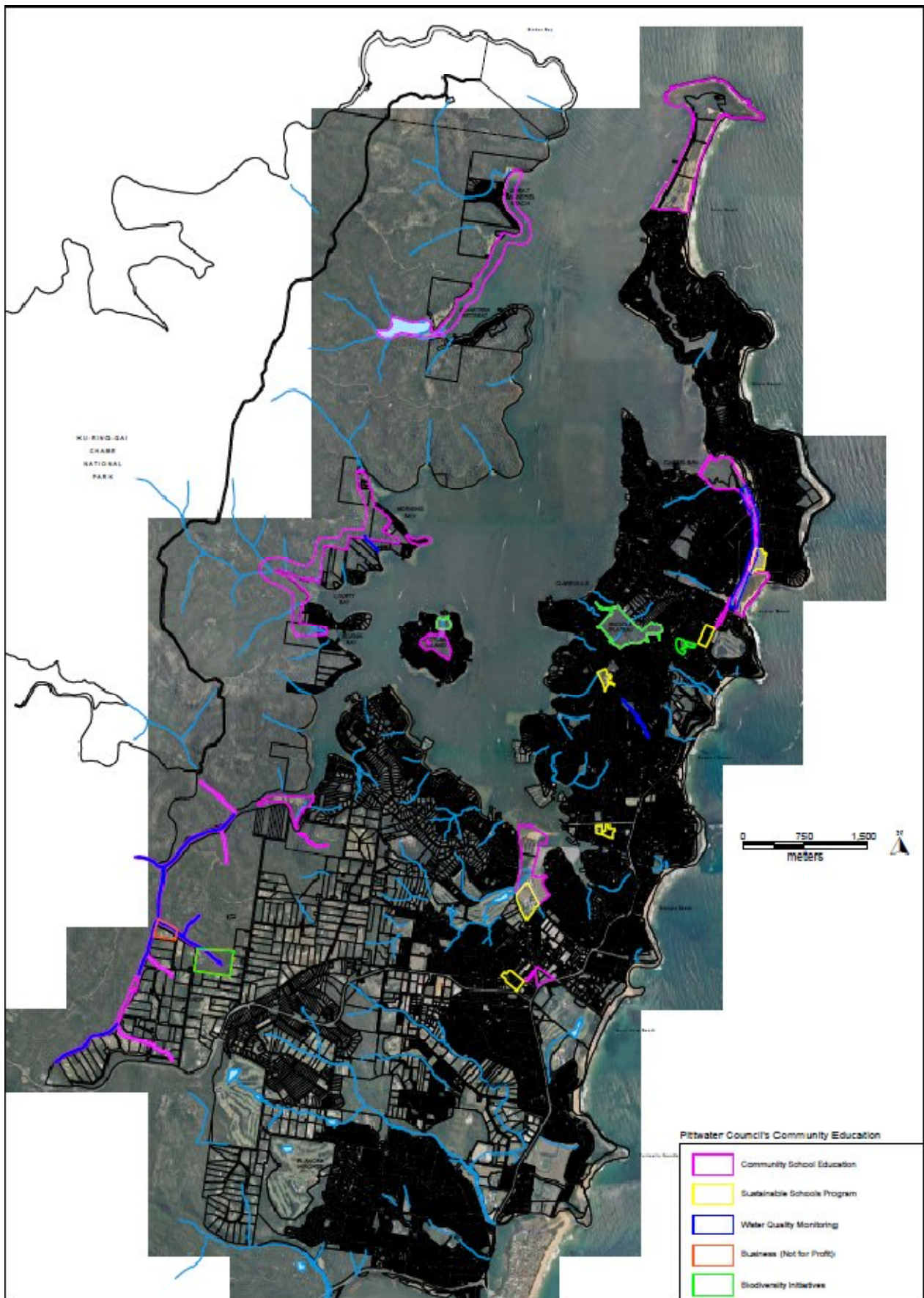


Figure F-1 Existing Community Education Programs and Locations within the Pittwater LGA

9 Increase Compliance with Existing Regulations (through additional resources /officers) covering:

- 9a) Permanent occupancies on boats
- 9b) Boating regulations re: speeds, dangerous behaviour, caleurpa controls / washdown
- 9c) Sediment and erosion controls, as well as other development controls / conditions
- 9d) On-site sewage systems operation
- 9e) Water pollution from boats and waterway businesses (eg marinas)

Pittwater contains a high density of moored and berthed vessels within poorly flushed embayments (eg McCarrs Creek, Winji Jimmi Bay, Crystal Bay). Where people reside on vessels in these areas for long periods of time, they have the potential to degrade water quality unless they use shore-based toilet and laundering services, or they discharge to holding tanks which they regularly pump out to the reticulated sewerage system. NSW Maritime regulations prohibit the permanent occupation of boats.

There is a minority of boat owners that disobey boating restrictions and behave inappropriately. This behaviour represents a threat to other waterway users, and indeed to the foreshore and waterway habitats of the estuary.

Pittwater is designated a 'no discharge' zone, however, it is expected that effluent is still discharged, particularly from older boats without holding tanks, and from recreational vessels that do not legally require the use of holding tanks.

Building sites and other developments within the catchment are usually required to meet designated standards for controlling site runoff. Rigorous auditing of construction sites to ensure compliance of Sediment and Erosion Control Plans and other related conditions of consent for developments is necessary.

Every existing on-site effluent disposal system should be audited on a recurrent basis to determine if it is functioning adequately and is appropriate to the site constraints (eg based on soil types and depths, site slope and system capacity), to ensure that excessive pollutants are not being directed to the environment. Recommendations regarding maintenance and/or replacement of the systems should be based on the outcomes of the audits.

Overall, a higher level of compliance auditing is required for the various existing controls and regulations that aim to protect the estuary from degradation. Greater resources are therefore required to undertake the auditing process.

A strategy for increasing the compliance with existing Maritime regulations by appointing an additional NSW Maritime officer (or "Riverkeeper") has been outlined in the Lower Hawkesbury EMP (Strategy 7i). Such a strategy has the potential to assist with this and other strategies in the Pittwater EMP (ie 19, 25, 26 & 27) which relate to maritime compliance activities. In order to achieve the relevant strategies in both plans, there may be benefits to Pittwater by coordinating with facilitators of the LHEMP in this regard.

Responsibility: Enforcement of existing regulations is the primary responsibility of NSW Maritime and Council, with assistance by other organisations, including Water Police, DECC (EPA), and DPI-Fisheries.



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