

3 MANAGEMENT AIMS AND OBJECTIVES

In order to guide the development and implementation of the Parramatta River Estuary CZMP, the Committee developed a series of management aims and objectives. In accordance with the *Guidelines for Preparing Coastal Zone Management Plans* (DECCW, 2010b), the aims and objectives were formulated with a focus on estuarine health, and the sustainable use and enjoyment of the estuary by the community. Human uses of the estuary waterway and foreshore are considered primarily with respect to how they impact on estuarine health.

These management aims and objectives constitute the framework of the Plan. Any options or actions considered as part of the Plan are required to work towards the attainment of these aims and objectives. The process of developing the management aims and objectives is, therefore, important in focussing the direction of the Plan.

3.1 Determining Management Aims and Objectives

Two workshops were held with the Committee to develop the management aims and objectives (see Section 1.4). The approach adopted was to develop a single broad aim for each of the ten key management issues identified in Section 2.8. For each of the ten aims, a series of more specific management objectives were then developed.

Prior to the first Committee Workshop, draft aims and objectives were developed by the Cardno study team based on the *Data Compilation and Review Study* (Cardno, 2008) and *Estuary Processes Study* (AECOM, 2010) for discussion with the Committee members. The Committee broke into two groups and engaged in discussion on priorities for management and how the aims and objectives should be phrased. The original intention was that the management objectives would be fairly specific and directly measurable. However, the Committee considered that it would be beneficial to find a balance between outlining more specific outcomes within the objective wording, while at the same keeping them sufficiently flexible to enable the development of a wide range of management options. The outcome of this discussion was a final list of management aims and objectives. After the workshop, the comments on the aims and objectives were compiled and collated by the study team.

At the second Committee Workshop the Committee members confirmed the final management aims and objectives (Table 3.1). The Committee members were also asked to provide input on the objectives prioritisation. This involved each Committee member allocating a “high”, “medium” or “low” priority against each objective. The results were then averaged by the Cardno study team, and are presented in the final column of Table 3.1. The prioritisations reflect the relative importance of the different management objectives in the first period of implementation. For example, water quality was viewed by all Committee members as being a key management issue that requires immediate attention, and as a result, four of the six objectives relating to water quality were consistently rated as having a high priority by the Committee members. The prioritisation of the objectives was also used to rank the management options (see Section 4.1.3).

Table 3.1: Management Aims and Objectives

Key Management Issues	Management Aim	Objective ID	Management Objective(s)	Objective Prioritisation
<i>Land Use Planning and Development</i>				
Increased pressure is being put on the estuary due to large foreshore developments and land use changes as industrial areas are re-developed.	Foreshore development and land use planning incorporates the principles of ecologically sustainable development.	1A	Ensure integration of the Parramatta River Estuary CZMP aims and objectives into other strategic planning and natural resource management activities, instruments and policies (e.g. regional strategies, and council DCPs and LEPs).	High
<i>Water and Sediments</i>				
Water and sediment quality within the estuary is generally poor.	To improve water quality in the estuary such that it is suitable for a range of environmental functions and recreational uses.	2A	Minimise incidences of illegal dumping of waste into the estuary.	Medium
		2B	Reduce the level of contaminated sediment and other pollutant loads entering the estuary from catchment runoff.	High
		2C	Reduce the incidence of sewer overflows affecting the estuary and improve compliance with recreational water quality guidelines for all sites monitored under the Harbourwatch program.	High
		2D	Limit the mobilisation of pollutants from contaminated foreshore areas and bed sediments into the water column through minimising their disturbance.	Medium
		2E	Ensure all new developments do not have a negative impact on estuarine water quality.	High
Much higher sediment loads are entering the estuary than in pre-European times.	To reduce the environmental damage caused by sedimentation.	3A	Reduce sediments entering the estuary, particularly where sedimentation affects vulnerable ecological communities such as seagrass.	High
<i>Estuarine Ecology</i>				
There have been historic and ongoing declines in ecological values due to a range of threatening processes.	To maintain and enhance the ecological values associated with the estuary, both aquatic and terrestrial.	4A	Protect and enhance estuarine habitats (both aquatic and foreshore habitats), with a focus on providing ecological connectivity between core habitats.	High
		4B	Naturalise existing concrete lined and highly modified creeks as opportunities arise.	Medium
		4C	Reduce the occurrence of weeds and pests in aquatic and terrestrial habitats in and around the estuary.	Medium
		4D	Incorporate additional aquatic habitat opportunities into existing areas of limited habitat.	Low

Key Management Issues	Management Aim	Objective ID	Management Objective(s)	Objective Prioritisation
<i>Bank Condition</i>				
Erosion is impacting on bank stability and estuarine and riparian vegetation in a number of locations.	Manage bank erosion to reduce its environmental impacts and improve the social amenity of the estuary.	5A	Actively encourage the replacement of the current RiverCat with another vessel that has a lower environmental impact (i.e. particularly with respect to bank erosion).	Medium
		5B	Rehabilitate high priority sections (AECOM, 2010) of eroding shorelines.	High
Seawalls line a substantial proportion of the Parramatta River estuary and have led to a significant loss of foreshore habitat. Much of this infrastructure is dated and the need for maintenance and repair is likely to further increase with SLR.	The foreshore is managed to protect existing assets while maximising environmental values.	6A	Remove seawalls where feasible and restore a natural intertidal zone.	Medium
		6B	All seawalls, including those that are to be retained and new seawalls that are proposed, should where feasible, incorporate the principals of environmentally friendly design features (after DECC and SMCMA, 2009).	Medium
<i>Human Usage and Recreation</i>				
Accessibility of the foreshore, as well as the availability and suitability of recreational facilities is not consistent across the estuary, particularly in the context of residential development of former industrial sites along the foreshores.	Enhance access to the estuary and its foreshores for a wide range of user groups, while ensuring estuary health is not compromised.	7A	Maintain and improve public access along the estuary foreshores and waterway, without compromising estuarine health.	High
		7B	Ensure that recreational facilities continue to be provided for a range of different user groups at strategic locations.	High
		7C	Achieve recognition of the iconic status of the Parramatta River and capitalise on foreshore and waterway linkages.	High
<i>Monitoring, Evaluation and Reporting</i>				
There is currently no baseline information on estuary health, or any coordinated monitoring programs within the Parramatta River estuary.	Adopt coordinated monitoring programs for the Parramatta River estuary that provide information on estuarine health and also monitor the effectiveness of implementation of the Plan in working to continually improve the management of the estuary.	8A	Implement a coordinated estuary health monitoring program in line with the NSW MER Strategy. This program should incorporate elements that assist in assessing the effectiveness of implementation of the Plan in achieving the stated aims and objectives. The program should also incorporate a reporting function to provide information to the community and key stakeholders.	High
There is a need for improved education of the community and other stakeholders in relation to estuary processes and their linkages to catchment processes. There is also a need to improve communication and reporting on estuary management initiatives.	To increase community awareness about the Parramatta River estuary.	9A	Promote public awareness of cultural heritage in and around the estuary.	Low
		9B	Provide information to the community on the potential impacts of climate change on the Parramatta River.	Low

Key Management Issues	Management Aim	Objective ID	Management Objective(s)	Objective Prioritisation
<i>Coastal Hazards</i>				
The Parramatta River estuary foreshore is subject to coastal hazards such as storm surge that will increase with climate change and have the potential to negatively impact on public and private assets.	Risks from coastal hazards affecting the estuary are appropriately managed.	10A	Plan for and mitigate (or increase the capacity to adapt to) the impacts of climate change and SLR on foreshore-based public infrastructure and ecological communities.	Medium

3.2 Integration with Existing Plans

There are currently in place two pre-existing Plans with which the aims and objectives of the Parramatta River Estuary CZMP are required to be consistent:

- The *Sydney Metropolitan Catchment Action Plan* (SMCMA, 2009); and
- The *Parramatta River Foreshore Plan 2009-2016* (PCC, 2009).

The *Catchment Action Plan* (SMCMA, 2009) is discussed briefly in Appendix A. The CAP includes Catchment Targets that correspond to aims for management which take as their focus ecological conservation, waterway health, strategic land use management, improved community awareness and involvement in natural resource management, and monitoring and evaluation. It is noted that, over the last 12 months, the SMCMA has been reviewing the CAP and it has been exhibited as the *Draft Catchment Action Plan 2012 A Plan for Sydney's Liveability* (SMCMA, 2012b). As the SMCMA and HNCMA have now been amalgamated, the status of the current CAP and draft CAP is not clear.

The *Parramatta River Foreshore Plan* (PCC, 2009) articulates a series of management principles under the categories of habitat, water management, landscape, visual quality and future urban form, access, recreation, and cultural heritage.

A review of the aims and objectives presented in Table 3.1 indicates that they are wholly consistent with those presented in the CAP (SMCMA, 2009), draft CAP (SMCMA, 2012b) and the *Foreshore Plan* (PCC, 2009).

4 MANAGEMENT OPTIONS AND ACTIONS

The aims and objectives established in Section 3 describe what the Committee and community members would like to achieve through implementation of the Parramatta River Estuary CZMP. The management options and actions articulate how the Committee intends to go about this process. For the purposes of this study, the management options describe the general activities to be undertaken under the Plan, whereas the actions detail the specific activities that are to be undertaken to progress that management option.

As previously discussed, early on in the project it was identified that there was a need to focus the Parramatta River Estuary CZMP. This desire to focus the Plan stems from:

- The need to target key management issues affecting the whole estuary where the Committee can do something to improve the current situation;
- The need to target those key management issues that are currently impacting on estuarine health (Section 2.8);
- The need to ensure all the actions and options are reasonable, feasible and achievable;
- Recognition that there are finite resources for implementation of any actions identified in the Plan, and that these should be directed to the highest priority areas; and
- An understanding that the Plan is required to be updated every 5 to 10 years in accordance with the Guidelines (DECCW, 2010b).

For these reasons, the Committee agreed to develop an implementation strategy (Section 5) that targets priority activities within the first phase of implementation. When the Plan is updated in 5 to 10 years' time the actions listed within the implementation strategy may be updated to address any emerging issues or to include additional activities to replace those actions that have been completed in the preceding implementation phase. This is considered appropriate within the context of adaptive management.

Therefore, there was a need to prioritise the management options and actions in order to identify those activities that would provide the greatest net benefit for the first phase of implementation. The process of developing and prioritising management options is discussed in Section 4.1 and management actions are discussed in Section 4.2. Section 5 details the implementation strategy and provides the Action Plans.

4.1 Developing and Prioritising Management Options

4.1.1 Options Development Process

A total of 40 management options were developed, each of which addresses one or more of the management objectives listed in Table 3.1. The process by which the options were developed is outlined below:

- *Preliminary Options List:* Once the management aims and objectives had been identified, Cardno prepared a preliminary list of 49 management options for discussion with the Committee.
- *Committee Workshop 2:* The preliminary options list was then presented to the Committee for discussion on 18 May 2011. The Committee broke into two groups, each of which discussed a

subset of the full list of preliminary options. As a result of these discussions, the options list was revised to a list of 63 options.

- *Post Workshop Feedback:* Committee members were also provided with an opportunity after the workshop to provide comment on the revised list of 63 management options, and any further amendments to the list of options were made as required based on any further feedback received after the workshop. This resulted in further revision of the management options to a list of 50 management options, resulting from:
 - Two or more overlapping options being combined into a single option,
 - Duplicate options being deleted, and
 - The removal from the list of options that are already being implemented by a local or State authority.

At this stage, the list of management options were assessed and prioritised in accordance with the methodology outlined in Section 4.1.2.

- *Committee Workshop 3:* Each of the 50 management options was also discussed with the Committee at the third and final workshop on 9 June 2011. At this time, each individual management option was discussed and the Committee agreed on the final option wording and prioritisation. A number of options were re-worded, and in some instances options were combined such that the list was further reduced. At the conclusion of the workshop, the Committee had reached a consensus on a final list of 40 management options, of which 23 were identified as having a high priority.

General feedback provided by the attendees at the Community Information Session on 21 July 2011 was that the options developed addressed what were perceived to be the main issues in the estuary (Appendix B).

4.1.2 Options Assessment and Prioritisation

The goal of the options assessment and prioritisation process was to identify which options would provide the greatest net benefit for the first 5 to 10 year phase of implementation. Once the priority options were identified, more specific management actions were developed (Section 4.2), and these form the implementation strategy in the Plan (Section 5).

The options assessment process included consideration of how the proposed option would impact on the estuary values and how well it would achieve the management objectives and the priority objectives in particular. The assessment criteria against which the management options were assessed included:

- Public access;
 - Recreational amenity;
 - Cultural heritage;
 - Economics;
-
- Water and sediments;
 - Estuarine ecology; and
 - Climate change.

Each management option was scored to assess how well it performed against each of the assessment criteria in accordance with the methodology described in Table E.1 of Appendix E. These scores were then summed to calculate a preliminary benefit index with possible values between -27 and +27. The preliminary benefit index was adjusted to account for the objective prioritisations shown in Table 3.1, by summing the preliminary benefit index and the objective prioritisation score to give an adjusted benefit index (to enable this a numerical value was assigned to the objective prioritisation, with High scoring 3, Medium scoring 2 and Low scoring 1). The adjusted benefit index was used to rank the options. The results are presented in Section 4.1.3.

This approach effectively provides a triple-bottom line assessment of the options through the inclusion of environmental, social and economic criteria. It also considers how well each option addresses the management objectives, and whether it addresses a high priority objective.

Further assessment was undertaken of the management actions falling under each option, as outlined in Section 4.2.2, with a view to prioritising the works proposed by each management authority.

4.1.3 Options Assessment Outcomes

Table 4.1 presents the final list of 40 management options, and identifies the 23 high priority options. Tables E.3 and E.4 of Appendix E include the full details of the assessment for each management option, including:

- The option ID number;
- A description of what the option entails;
- The primary management objective addressed by the option;
- Any other management objectives also addressed;
- A score corresponding to the objective prioritisation value allocated to the primary management objective (Table 3.1);
- Scores against the seven assessment criteria (see Section 4.1.2);
- Preliminary benefit index, representing the unadjusted sum of the scores;
- Comments on the potential impacts of not implementing the option (i.e. business as usual);
- Comments on the key advantages of implementation;
- An adjusted benefit index; and
- The resultant overall ranking of the management option.

Some brief notes are also provided in Tables E.3 and E.4 of Appendix E for each option in relation to the main advantages/disadvantages of implementation, and the potential consequences of not implementing the option (i.e. 'business as usual approach').

Table 4.1: Ranked Management Options

Option ID	Option Description	Primary Objective Addressed	Corresponding Management Issue(s)	Option Ranking (Blue = HIGH PRIORITY)	Additional Comments (High Priority Options Only)
<i>Land Use Planning and Development</i>					
1	New and revised Plans of Management should be compatible and consistent with the recommendations of the Parramatta River Estuary CZMP.	1A	Increased pressure is being put on the estuary due to large foreshore developments and land use changes as industrial areas are re-developed.	7	Promotes good governance and coordinated and holistic management, which will assist in addressing the currently disjointed management approach across the large catchment area.
2	When undertaking reviews of planning instruments or engaging in strategic land use planning, seek consistency with the Parramatta River Estuary CZMP and, where possible, update the relevant instrument as required.	1A		1	Specific planning controls that promote estuarine health can be incorporated into revised planning instruments. For example, WSUD policies can be updated and/or generated by councils to enforce the application of WSUD principles into planning for all new developments or redevelopments in their LGA.
3	Work with relevant Aboriginal community groups along the Parramatta River to determine management options for identified Aboriginal heritage sites.	1A		24	-
4	Develop provisions under Development Control Plans that provide for the incorporation of best practice WSUD and ecological connectivity along the estuary foreshores for sites subject to redevelopment.	2E	Water and sediment quality within the estuary is generally poor.	2	Provides an avenue to develop biodiversity corridors throughout the estuary, improving connectivity and biodiversity values of the estuary. Similarly for WSUD which will address stormwater management within the catchment. Considering large areas of the foreshore could be subject to redevelopment from industrial to residential land use in the future (similar to Rhodes in the City of Canada Bay), this could improve conditions for a large proportion of the estuary. See Figure 2.3 for current industrial land use locations along the foreshore and historical land use change patterns throughout the estuary.
<i>Water and Sediments</i>					
5	Promote the reporting and enforcement of penalties for illegal dumping on the estuary foreshores and waterway.	2A	Water and sediment quality within the estuary is generally poor.	36	-

Option ID	Option Description	Primary Objective Addressed	Corresponding Management Issue(s)	Option Ranking (Blue = HIGH PRIORITY)	Additional Comments (High Priority Options Only)
6	Ensure the prompt removal of waste materials dumped in the estuary or along its foreshores for disposal at a suitably licensed waste management facility.	2A	Much higher sediment loads are entering the estuary than in pre-European times.	36	-
7	Retrofit appropriate WSUD features in existing urban areas of the catchment targeting locations upstream from where stormwater runoff and associated pollutants are impacting sensitive estuary locations.	3A		7	Provides an opportunity to promote good catchment management and to reduce the magnitude of stormwater impacts on the estuary and its tributaries, targeting high priority sensitive estuary locations in the first instance. Examples of WSUD features are shown in Figure 2.9.
8	Modify, upgrade or repair existing SQIDs, stormwater infrastructure and management practices as required to maintain or improve their effectiveness. This should include development of maintenance schedules for existing infrastructure where they are not currently in place.	2B		7	Has the potential to improve water quality in the estuary and its tributaries and to reduce stormwater impacts on bank condition, or where stormwater is causing erosion (e.g. Figure 2.8). Photos of existing SQIDs within the catchment are shown in Figure 2.7.
9	Work with Sydney Water to prioritise maintenance and upgrade of the sewerage network within the catchment on an ongoing basis to reduce sewage overflows. This activity should include investigations into the incidence of illegal private connections to the sewerage and / or stormwater network.	2C		24	-
10	Reduce sediment inputs through bank stabilisation works in estuary tributaries.	2B		14	Would reduce the risk of erosion occurring from the banks of the estuary and its tributaries, and consequently reduce the level of threat to estuarine water quality and ecology due to sedimentation.

Option ID	Option Description	Primary Objective Addressed	Corresponding Management Issue(s)	Option Ranking (Blue = HIGH PRIORITY)	Additional Comments (High Priority Options Only)
<i>Estuarine Ecology</i>					
11	Develop and implement a strategy for the coordinated management of estuarine and riparian biodiversity across administrative boundaries for the estuary as a whole. The strategy should incorporate biodiversity corridors and SLR consideration, to ensure the ongoing provision of habitat and connectivity between habitat areas.	4A	There have been historic and ongoing declines in ecological values due to a range of threatening processes.	4	Provides opportunity to undertake strategic planning as an investment in both current and future biodiversity. The option also provides an improved capacity for ecological adaptation throughout the estuary by considering areas where landward migration of vegetation/habitat is viable (see Section 2.3).
12	Minimise impacts of moorings and boating on seagrass.	4A		31	-
13	Manage public access at environmentally sensitive foreshore locations. Priority areas may include key habitat and vegetation communities located in areas that are frequented by the public.	4A		14	This would reduce the risk of impacts on foreshore ecology, with added benefits where public access is also compromising bank condition or causing erosion and sedimentation.
14	Reduce the unauthorised clearing of riparian and estuarine vegetation.	4A		24	-
15	Work with private landholders and bush care groups to encourage and assist in the re-vegetation of foreshore areas, and the management and conservation of existing vegetation. As a priority, target landholders with ecologically significant vegetation present on their land.	4A		24	-
16	Undertake improvements to foreshore infrastructure, where possible, to reduce their impacts on aquatic habitats. Consider the need, where feasible, to relocate or decommission infrastructure where it is impacting on environmentally sensitive locations.	4A		4	Provides an opportunity to strategically manage recreational infrastructure throughout the catchment, while at the same time improving the condition of the natural environment. Failing foreshore infrastructure should be targeted as a priority (e.g. Figure 2.30), especially where this infrastructure currently presents a risk to public safety.

Option ID	Option Description	Primary Objective Addressed	Corresponding Management Issue(s)	Option Ranking (Blue = HIGH PRIORITY)	Additional Comments (High Priority Options Only)
17	Undertake works to provide for the ongoing preservation of estuarine and riparian habitats under climate change conditions. This should include the enhancement of existing habitats where there is possibility of retreat, or establishing additional habitat areas as required, to maximise habitat under SLR conditions.	4A		7	These options provide a long term benefit in maintaining and potentially improving the extent of estuarine vegetation. Provides for maintenance of estuarine biodiversity and ecosystem services into the future by considering the potential for landward migration, as discussed in Section 2.3. Examples of habitat restoration works are shown in Figure 2.24.
18	Manage identified public foreshore areas where they are required for the retreat of estuarine vegetation in response to SLR.	4A		7	
19	Undertake creek naturalisation works of existing channelised creeks, focusing as a priority on channels coming to the end of their design life.	4B		14	Provides an opportunity to provide improved ecological value within estuary creeks and to potentially incorporate WSUD features into creek naturalisation works.
20	Undertake ongoing monitoring and management of aquatic and terrestrial weeds (incl. noxious weeds) and introduced species (both flora and fauna).	4C		14	This would reduce the risk to estuarine biodiversity throughout the catchment by reducing the threats associated with introduced species. Also has the potential to increase the extent and condition of existing habitat areas.
21	Improve the environmental value of existing seawalls through the addition of habitat, where feasible.	4D		14	This option has the potential to increase the extent of estuarine habitat by incorporating the principles of the <i>Environmentally Friendly Seawalls Guidelines</i> (DECC and SMCMA, 2009) when retrofitting and/or replacing seawalls (e.g. Figure 2.17).
Bank Condition					
22	Formally negotiate with Harbour City Ferries for a change in vessel (from the RiverCat) that would have less wake impacts.	5A	Erosion is impacting on bank stability and riparian vegetation in a number of locations.	14	This option would assist in reducing the extent/magnitude of bank erosion caused by the RiverCat wake, resulting in improved bank condition. It would also reduce the rate of loss/damage to intertidal vegetation and seawalls caused by the RiverCat wake.
23	Encourage bank and foreshore erosion control techniques that maximise the use of riparian and estuarine vegetation.	5B		14	Provides the potential to improve the condition and increase the extent of estuarine vegetation, improving ecological connectivity throughout the catchment.

Option ID	Option Description	Primary Objective Addressed	Corresponding Management Issue(s)	Option Ranking (Blue = HIGH PRIORITY)	Additional Comments (High Priority Options Only)
24	All management authorities involved in the building, design and approval of new seawalls, or major upgrades of existing seawalls, should promote their compliance with the <i>Environmentally Friendly Seawalls Guidelines</i> (DECC and SMCMA, 2009) within legislative constraints.	6B	Seawalls line a substantial proportion of the Parramatta River estuary and have led to a significant loss of foreshore habitat. Much of this infrastructure is dated and the need for maintenance and repair is likely to further increase with SLR.	14	Potential to increase the extent of estuarine habitat, or at least reduce the rate of loss of intertidal habitat, through incorporation of the principles of <i>Environmentally Friendly Seawalls Guidelines</i> (DECC and SMCMA, 2009) when retrofitting and/or replacing seawalls (e.g. Figure 2.17).
<i>Human Usage and Recreation</i>					
25	Maintain and improve existing public access (i.e. bike and walking paths) for the Parramatta River estuary to provide transport linkages throughout the LGAs, giving consideration to sensitive environmental locations.	7A	Accessibility of the foreshore, as well as the availability and suitability of recreational facilities is not consistent across the estuary, particularly in the context of residential development of former industrial sites along the foreshores.	14	The primary benefit is in providing improved connectivity, public access and recreational amenity throughout the estuary. Value added benefits include reduced vehicle emissions and improved public health within the catchment.
26	Repair or upgrade existing foreshore facilities identified as failing or as being in poor condition in the <i>Estuary Processes Study</i> (AECOM, 2010) as funding opportunities allow.	7B		31	-
27	Continue to conduct surveillance and compliance monitoring with a view of removing or regulating unauthorised foreshore structures / uses.	7B		41	-
28	Strategically provide foreshore infrastructure to support boating in the Parramatta River estuary, with due consideration of any potential impacts on the estuary.	7B		24	-
29	Develop and implement an integrated approach to the provision of recreational amenity for the estuary as a whole.	7B		14	Provides the potential to improve recreational amenity throughout the estuary, while also reducing any negative impacts on the environment.
30	Provide viewing points and interpretive signage at appropriate locations to promote an appreciation of the estuary and enhance the visitor experience.	7B		24	-

Option ID	Option Description	Primary Objective Addressed	Corresponding Management Issue(s)	Option Ranking (Blue = HIGH PRIORITY)	Additional Comments (High Priority Options Only)
31	Work with the key stakeholders to develop and implement a vision for the Parramatta River estuary that delivers world-class facilities for both residents and visitors. The vision should recognise the regional, State and Federal significance of the Parramatta River as an iconic waterway.	7C		31	-
32	Work together to develop and implement a program for industry and the community to raise awareness of issues relating to estuary management and estuarine health. Key elements of the program could include: <ul style="list-style-type: none"> - Good catchment management practices; - The heritage significance of the estuary and its foreshores; - The types of activities that are permitted, or are not permitted, in different parts of the foreshore or waterway; - The use of vegetation for bank and foreshore protection works; - The potential impacts of climate change on the estuary; and - How individuals can reduce their impact on the estuary. 	2B	Water and sediment quality within the estuary is generally poor.	2	Provides opportunity to raise community awareness and promote good catchment management practices to reverse the decline in ecological values of the estuary due to human activities. Also provides the potential to improve overall estuarine health with a whole-of-community effort.
<i>Monitoring, Evaluation and Reporting</i>					
33	Develop and implement a communication strategy for the implementation stage of the Parramatta River Estuary CZMP.	8A	There is currently no baseline information on estuary health, nor are there coordinated monitoring programs within the Parramatta River estuary.	7	Provides the opportunity to promote estuary management, educate the community about estuary issues, and attract people to the estuary.
34	Develop and implement a holistic and rigorous monitoring program that coordinates the efforts of the various stakeholders responsible for management of the Parramatta River estuary and includes monitoring of climate change impacts.	8A		4	Provides the opportunity to establish standardised baseline information and track trends in estuarine health. This may also enable comparison against similar estuaries in NSW. This option promotes holistic and coordinated adaptive management, addressing the currently disjointed management approach.

Option ID	Option Description	Primary Objective Addressed	Corresponding Management Issue(s)	Option Ranking (Blue = HIGH PRIORITY)	Additional Comments (High Priority Options Only)
35	Encourage DPI (Fisheries) to periodically map the distribution of estuarine vegetation (seagrass, saltmarsh and mangroves) for the estuary.	8A		34	-
<i>Coastal Hazards</i>					
36	Within the regular program of upgrades, provide additional capacity in the stormwater network to account for changes in rainfall patterns and elevated estuary water levels under climate change conditions.	10A	The Parramatta River estuary foreshore is subject to coastal hazards such as storm surge that will increase with climate change and have the potential to negatively impact on public and private assets.	36	-
37	Restrict new foreshore developments in areas where tidal inundation hazards under current and future SLR scenarios are quantified.	10A		36	-
38	Manage foreshore infrastructure with likely tidal inundation risk in such a way as to allow adaptation to SLR.	10A		36	-
39	Assess the potential impacts of SLR on the estuary foreshores.	10A		7	Provides information to assist strategic, long term planning of the estuary foreshores and waterway as existing risks due to coastal hazards may increase under climate change conditions.
40	Identify cultural heritage sites that are currently affected by coastal hazards or that may be affected by coastal hazards under climate change conditions, and develop appropriate management responses to address these issues.	9A	There is a need for improved education of the community and other stakeholders in relation to estuary processes and their linkages to catchment processes. There is also a need to improve communication and reporting on estuary management initiatives.	34	-

4.2 Detailed Management Actions

The options assessment process identified which options would provide the greatest net benefit for the first phase of implementation of the Parramatta River Estuary CZMP. The Committee then developed a series of more detailed management actions that addressed the high priority management options, representing the individual activities that are undertaken by the various Committee members to implement that option. These actions form the implementation strategy in the Plan (Section 5).

4.2.1 Actions Development Process

A preliminary list of management actions was developed by the Cardno study team to stimulate discussion at the third Committee workshop held on 9 June 2011. Initially the study team and the Committee discussed the following key points for consideration when developing actions:

- Does the action address one (or more) of the high priority management options?
- Is the proposed action realistic, technically feasible and achievable? Is it likely that there are sufficient resources available for commencement within the first period of implementation (next 5 to 10 years)?
- How does the proposed action fit in with existing plans, strategic documents or other initiatives being undertaken by the Committee members?
- What specific actions proposed within the *Estuary Processes Study* (AECOM, 2010) would be appropriate for inclusion in the Plan?
- Who should be responsible for implementation of the action? Where a single authority is taking primary responsibility, is any support or information required from other Committee members?
- Is the action location specific?
- Is there a need for any ground-truthing or other investigations required to develop the action? Alternatively, does this need to be noted for further consideration at the implementation stage?

The Committee then worked through those preliminary draft management actions proposed by Cardno that were identified for implementation by the Committee as a whole, and suggested any amendments required. A number of new actions for the Committee were also proposed. This was a useful discussion for the purpose of identifying related initiatives being conducted by the various attendees. After the conclusion of the workshop, Cardno circulated the list of actions for implementation by the Committee for further comment by the members and amendment as required.

At the workshop the attendees were also encouraged to develop a list of up to five management actions for their own agency or authority. This was considered to be a reasonable and realistic number of activities for the first period of implementation. It was suggested that the various local councils and other authorities refer in the first instance to the actions proposed within the *Parramatta River Estuary Processes Study* (AECOM, 2010). After the workshop, Cardno supported the Committee members in developing suitable management actions for implementation by their organisation. This involved a number of emails, telephone conversations and, in some cases, a meeting with the organisation.

Most authorities included within their list of management actions some of those suggested in the *Estuary Processes Study* (AECOM, 2010), and where necessary built on these by including additional management

actions that either aligned well with other initiatives being conducted by their organisation or that they otherwise considered a priority. In other cases, a management action was developed to assist in implementation of the Plan or to address a knowledge gap. There were also a number of instances in which the action was developed to ensure the aims and objectives of the Plan are communicated through their organisation, or are progressed via initiatives undertaken by other organisations.

Technical feasibility was considered in a qualitative fashion at the actions development stage. Based on the information provided, it was considered that none of the management actions developed were technically infeasible, noting that in some instances more detailed, quantitative investigations would be required to confirm that this is the case.

The community was provided with opportunity to comment on the draft management actions proposed for their local area at the information session held on 21 July 2011. The feedback received indicated that they were supportive of the proposed actions and felt that they addressed the key management issues they had observed in their local areas.

4.2.2 Action Descriptions and Prioritisation

Actions Description

A total of 67 management actions were developed, including 21 actions for implementation by the Committee as a whole. Appendix F contains the full list of unranked management actions grouped under their relevant options. The following information is provided for each management action in Appendix F (Tables F.1 and F.2) and Section 5:

- A unique identification number;
- A description of the action;
- Primary responsibility for implementation and supporting organisations (where relevant);
- Location for implementation (where relevant);
- Management category (see below);
- Notes on implementation and decommissioning (as required);
- A brief summary of the key anticipated environmental and social impacts (both positive and negative) of the actions;
- Scores against the three action assessment criteria (see Table E.2 in Appendix E);
- Relevant management options score;
- Benefit index, representing the unadjusted sum of the scores and the management option score;
- Indicative cost of implementation (capital and ongoing costs);
- Net present value for each action;
- Cost:benefit ratio for each action; and
- The resultant overall ranking of the management action (from 1 to 67).

In addition to these 67 prioritised actions a further 16 management actions were identified as generic actions of significant benefit or high priority that may be implemented by any council or authority in the event the necessary resources become available. These generic actions have been provided as a stand-alone list as they cannot be costed or prioritised along with the other actions in the strategy.

Management Categories

As indicated above, each action was also assigned a management category corresponding roughly to the general organisational structure found within local councils and those other organisations responsible for implementation. They include:

- *Planning* – These actions provide for development of a planning instrument, regulation, policy or guideline, plan of management, or similar;
- *Investigations* – Actions falling under this category relate to further studies, surveys or investigations. This includes actions that may then lead on to specific works or other activities;
- *Works* – These actions involve maintenance or actual on the grounds works (e.g. construction of a footpath or WSUD feature). This includes actions that may be phrased as investigations, but that are likely to be implemented or for which sufficient detail was available to cost construction;
- *Monitoring* – Actions falling within this category provide for some type of monitoring activity; and
- *Communications/Education* – Relevant actions relate to information dissemination or awareness raising on estuary management issues, activities or the results of monitoring. This category may also include actions that relate to liaison with other authorities to progress specific programs or activities.

Indicative Cost of Implementation

Preliminary indicative costs of implementation were also developed for each management action, including a capital cost and annually recurrent costs (e.g. for maintenance or ongoing implementation). A Net Present Value is then calculated based on these costings, representing a cost of implementation over the first period of implementation. The Net Present Value has assumed a 10 year period of implementation and has adopted a discount rate of 7%.

The costings were calculated based on experience on similar projects and/or information provided by the Committee members. Where possible, brief notes have been provided as to the factors considered in developing the costings (Section 5.1). It is noted that these costings are indicative only and further detailed costings should be prepared prior to implementation of an action. Further information may become available over time that would change the costings significantly.

Actions Prioritisation

The options assessment and prioritisation process (Section 4.1) considered how well each management option addressed the management objectives (Section 3) based on consideration of the potential environmental and socio-economic impacts of the option. This allowed the Committee to objectively prioritise the management options, and identify areas on which to focus management initiatives in the first period of implementation that would provide the greatest net benefit to estuarine condition/health.

However, the management actions provide a higher level of detail, and it was considered that it would be useful to further consider the specific constraints and opportunities associated with each action in order to assist the

implementation process. Furthermore, it was recommended that the management actions be prioritised to assist the Committee members in allocating resources for implementation.

The actions prioritisation was based on a cost:benefit index calculated based on a function of the cost of implementation (represented by the Net Present Value) and the benefit index. The benefit index is based on the sum of scores provided in relation to:

- The likely compatibility of the management action with the statutory and non-statutory framework;
- The potential for the land tenure status of the subject site (where known) to necessitate landowner consent or require additional consultation;
- The likely community acceptance, which has been assessed by the study team based on the feedback provided by the community during the course of the project; and
- The ranking of the corresponding management option under which the action falls (see Tables F1 and F2 in Appendix F for full details).

The scores applied to each of these criteria and data sources used to inform the scoring are identified in Table E.2 in Appendix E.

The cost:benefit index was then used to prioritise the management actions for each responsible group/authority; the higher the cost:benefit index, the higher the priority. The outcomes of this process are presented as an implementation strategy in Section 5.