Sydney Harbour
Coastal Zone Management Plan
Scoping Study

Sydney Coastal Councils Group

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Executive Summary

This scoping study summarises the key coastal management issues and provides guidance on potential management actions to be addressed in an integrated coastal zone management plan (CZMP) for Sydney Harbour.

The issues and recommendations for actions were identified through a number of sources, including stakeholder engagement processes, a data and literature review conducted for the study area, and exemplary scientific studies such as Hedge *et al*. (2013).

The issues, in order of importance, are:

- The protection of, and maintenance or improvement of, habitats in estuarine and terrestrial riparian areas. Historically, habitat loss or degradation has occurred as a result of coastal development, resources extraction, shipping and boating and pollution by invasive species (Hedge *et al*., 2013). Management of these areas to survive or influence future impacts from projected climate change is also a concern.
- The maintenance and/or improvement of water and sediment quality. The primary concerns around water and sediment quality are faecal contamination, particularly after rainfall events, stormwater contaminant input from estuary catchments, as well as the interconnected and aged nature of the water infrastructure present in and adjacent to the Harbour. Further investigation into nutrient and contamination pathways is recommended (Hedge *et al*., 2013).
- The provision of safe and equitable public access to the Harbour and foreshore that is supported by appropriate infrastructure is a consistent concern for user groups.
- Risks associated with coastal inundation. A CZMP provides an opportunity for this issue to be managed consistently throughout the geographical plan area, and also establish clear guidance on the management of sea level rise benchmarks for surrounding areas. However there are a number of major implementation concerns to be addressed, including integration with other programs, and the funding and feasibility of determining inundation extents for the plan area.
- The stability of shorelines within Sydney Harbour is a concern, with approximately 50% of the shoreline is composed of built habitats such as seawalls. In addition, the presence of cliffs indicates an eroding coastline. The establishment of flexible management approaches within the CZMP to deal with a variety of erosion scenarios is required.
- The ongoing and sensitive preservation/conservation of cultural and heritage sites is expected to continue to be a high profile management issue for the community. The inclusion of heritage sites in a CZMP will need to consider integration with existing management plans, statutory requirements and other programs.
- Sydney Harbour has high value to a range of user groups, clubs, associations and individuals. The aspirations and values of these users are diverse. Reconciling the disparate objectives of these users is a challenge of preparing a CZMP for Sydney Harbour. Maintenance of views of the Harbour is seen by stakeholders as strongly contributing to the amenity of the area. It is recommended that user group and stakeholder consultation must form a key part of the future preparation of a CZMP.

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1. Introduction

1.1 Background and Purpose of the Scoping Study Project

1.1.1 Project Background

The pressures upon coastal zones are ever increasing. Governance arrangements are complex and involve numerous agencies and stakeholders. Management remains fragmented and, often, *ad hoc*. The Sydney Coastal Councils Group (SCCG), in partnership with the City of Sydney and Greater Sydney Local Land Services (GSLLS) (formerly Hawkesbury-Nepean Catchment Management Authority) is seeking to address this, and undertake a scoping study for the preparation of an Integrated Coastal Zone Management Plan (CZMP) for Sydney Harbour with a view to protect, enhance, maintain and restore this valuable asset.

The NSW Government provides guidance on the form, content and certification process for a CZMP under the *Coastal Protection Act 1979* in "Guidelines for Preparing Coastal Zone Management Plans" (OEH, 2013). These guidelines set out the Coastal Management Principles to be considered in the preparation of the integrated CZMP for Sydney Harbour.

A Project Advisory Committee (the Committee) was formed in late 2013 to guide the project, review and value-add project outputs, build relationships and networks, and share data, expertise and experience. Invitations for membership of the Committee were sent to all relevant NSW government agencies, SCCG Member Councils and other councils within the Harbour falling within the geographical scope of the project. The invitation was also broadcast more generally via the SCCG's website, newsletter and LinkedIn page.

The Committee (which represents 31 stakeholder organisations) has a broad suite of skills and expertise such as coastal processes, geomorphology, law and policy, education and training, public relations, project management and finance.

"protect, enhance, maintain and restore this valuable asset"

1.1.2 Purpose of the Scoping Study Project

Following the formation of the Committee, GHD was engaged to prepare the Scoping Study (this report) for the integrated CZMP for Sydney Harbour. The Scoping Study investigates the process, desire and necessary elements to be considered in the development of an integrated CZMP. This report has been prepared by GHD. The SCCG manages the project with financial assistance from the New South Wales Government through the Office of Environment and Heritage and the other project partners, City of Sydney Council and GSLLS. This document does not necessarily represent the opinions of the NSW Government or the Office of Environment and Heritage.

The SCCG has well established relationships with many key stakeholders and undertook preliminary consultation prior to commissioning this Scoping Study. Stakeholders flagged by SCCG as being critical to the success of this project include councils, other government agencies, researchers, practitioners, policymakers and not-for-profit organisations. The community (general public) was also identified as a critical stakeholder in the development of a CZMP, however, community participation will form part of the CZMP preparation and is outside of the scope of this Study.

The Scoping Study Report is supported by the outputs from the Stakeholder Survey, Stakeholder Workshop and Literature and Data Review. Accordingly, the key tasks of the Scoping Study Project are summarised as follows:

- to undertake a literature and data review relating to the management and use of Sydney Harbour, and matters to be addressed by a CZMP for the Harbour;
- using the information assembled in the literature and data review, to scope and prioritise Sydney Harbour's values, risks, usage and management issues by engaging in stakeholder consultation; and
- Scope and provide guidance on potential management actions.

1.2 Study Area

The study area (as illustrated in Figure 1-1) was specified in the project brief as the portion of Sydney Harbour incorporating the area downstream of Clarke's Point, Birchgrove to Sydney Heads, including:

- Port Jackson;
- Middle Harbour;
- Parramatta River;
- Hunters Hill;
- Yulrubin Park, Birchgrove; and
- All local government areas abutting Sydney Harbour (to the extent that they are within the Study Area) – Ku-ring-gai, Lane Cove, Leichhardt, Manly, Mosman, North Sydney, Sydney, Warringah, Willoughby and Woollahra.

There are two existing plans upstream of this point (i.e. of the confluence of the Parramatta and Lane Cove Rivers):

1. Lane Cove River Coastal Zone Management Plan (WBM BMT, 2012). This includes part of the frontage for Willoughby and Lane Cove Councils.
2. Parramatta River Estuary Coastal Zone Management Plan (Cardno Lawson & Treloar, 2012). This includes part of the frontage for Leichhardt Council.

Given that CZMPs (and therefore capture of the key coastal management issues) are already in place for the Lane Cove and Parramatta Rivers, this report captures the coastal management issues for the Harbour outside of these areas (i.e. downstream of Clarke's Point, Birchgrove). Existing coastal zone management plans cover part of this study area for five separate sections of shoreline within the Manly Council local government area. Coastal zone management plan technical studies have commenced for Mosman and Woollahra Council areas.

1.3 Integrated Coastal Zone Management

1.3.1 Definition of ICZM

Integrated coastal zone management (ICZM) is a holistic dynamic, multidisciplinary and iterative process to promote sustainable management of coastal zones, covering the full cycle of information gathering, planning, decision making, management, and monitoring of implementation. ICZM uses informed participation and cooperation between all relevant stakeholders in order to assess the goals for a given coastal zone and subsequently implement management actions towards meeting these goals.

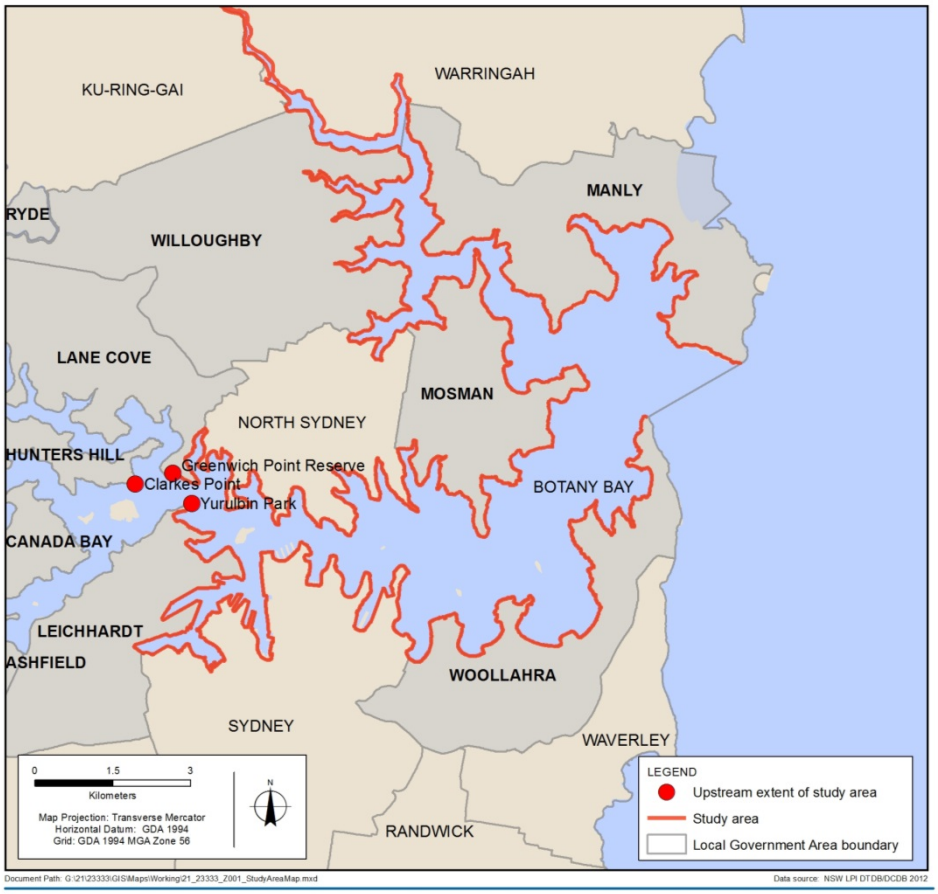

Figure 1-1 Study area extent illustrating coastal zone to the confluence of the Parramatta River and Lane Cove River[1]

Whilst it is a continuous and evolving process, it seeks over the long-term to balance the benefits from economic development and human uses with the need for protecting, preserving and restoring a coastal zone, while managing the risk to human life and property, and providing the benefits of public access and encouraging enjoyment of the coastal zone, all within the limits set by natural dynamics and carrying capacity. The standard principles of ICZM instil a "systems thinking" approach and formed the basis of the Sydney Harbour Scoping Study project based on the Project Brief (European Commission, 2013; Pegaso Project, 2014: Engineers Australia, 2012) as follows:

1. take a broad perspective (geographic and thematic);
2. take a long term perspective;
3. provide for adaptive management (responding to new information and conditions);
4. provide for local specificity;
5. work with natural processes;
6. use participatory planning;
7. support and involve all relevant administrative bodies; and
8. use a combination of instruments

[1] Local Government area names in bold have CZMP's for at least part of their shoreline in place or underway.

The ‘integrated’ nature of ICZM refers to the merging of objectives as well as the integration of the many instruments needed to meet these objectives i.e. all relevant policies, government sectors, and levels of administration. In addition, it refers to the management of the land and marine interface in a study area both spatially and temporally. As such, an optimal balance between environmental protection and the development of economic and social sectors is paramount. As part of the approach of ICZM, many aspects within a coastal zone are expected to be considered and accounted for, including the spatial, functional, legal, policy, knowledge and participation dimensions. Accordingly, the four main goals of ICZM are to:

1. maintain the functional integrity of a coastal system;
2. reduce resource-use conflicts;
3. maintain the health of the environment; and
4. facilitate the progress of multi-sectoral development.

These principles and goals, combined with the NSW Guidelines for Preparing Coastal Zone Management Plans, provide the basis of how an integrated CZMP for Sydney Harbour should be prepared and implemented. In turn, the purpose of this integrated CZMP is also to:

1. provide for coordination and liaison between the overarching integrated CZMP and the more local CZMPs prepared by local Council; and
2. develop a common understanding and consensus of objectives and priorities to inform any revisions of the integrated CZMP including integration of policy and management actions.

In practice this approach provides a framework for organisations to work together to achieve joint objectives.

Sources: IMCORE, RPSOnline, SPINF

1.3.2 Why ICZM – The Importance of ICZM to Sydney Harbour

The dynamic natural processes that occur within Sydney Harbour produce diverse and productive ecosystems. On another note, the existing uses of Sydney Harbour are numerous, while the management of the Harbour is multi-layered, with a large number of agencies and government departments playing a role in its governance (within the present study area this currently comprises 9 Federal government agencies, 17 State government agencies spread across 13 departments, 9 local governments and 2 Corporations). As no single agency has sole responsibility for the Harbour, management has historically often been piecemeal.

Due to the complex nature of issues and governance in Sydney Harbour, it has been recognised that an overarching approach such as ICZM may be a suitable way forward to achieve sustainable future management of Sydney Harbour.

1.4 Outcomes of the Stakeholder Engagement Process and the Literature and Data Review

During the first phase of the project a stakeholder engagement survey was undertaken (based on the outputs of the SCCG Sydney Harbour Survey (2013).

The purpose of the stakeholder engagement survey was to source accurate and appropriate information to inform the project, and gain stakeholder opinions about the priorities that should be captured in an integrated CZMP for Sydney Harbour. These initial information sources are provided in Appendix A.

In parallel with the survey, an intensive desktop review of existing literature and other relevant data was undertaken. In turn a stakeholder engagement workshop was held with the Advisory Committee. The full Literature and Data Review report is available in Appendix B and the Stakeholder Engagement Workshop Report is available in Appendix C.

Overall there is a wealth of relevant information regarding key issues and concerns for the future management of Sydney Harbour. The results of the survey, literature and data review and the workshop have allowed for a comprehensive identification of the management issues, within the key themes for Sydney Harbour coastal zone management. These are presented with the related risks and values in Section 2 of this Report.

2. Themes for an Integrated CZMP for Sydney Harbour

On the basis of the information assembled throughout this study and summarised in Appendix A (i.e. survey, literature review, workshops), the management issues of key importance for Sydney Harbour have been grouped into the following themes in priority order:

- Protection and Maintenance/Improvement of Estuarine and Riparian Terrestrial Habitats
- Maintenance/Improvement of Water/Sediment Quality
- Foreshore Access
- Coastal Inundation
- Shoreline Stability
- Cultural and Heritage Protection
- Recreational Use and Amenity

Each theme is presented in terms of an overview, followed by details on each management issue as follows:

- Context of that issue in relation to the theme
- Gaps in studies/data identified through the literature and data review, or by stakeholders
- Values of the Harbour that would be addressed if the issue was resolved
- Risks associated with that issue if it is not addressed
- Temporal and spatial variability of the issue
- Who the primary stakeholders are for that issue
- The outcome if the issue is addressed
- Recommendations for actions and associated stakeholders

As the literature reviewed tended to focus on technical or administrative issues in isolation, the prioritisation of themes was based on stakeholder views and the importance attached to those views, particularly in relation to issues identified consistently over numerous stakeholder engagement activities. The first 4 themes were consistently identified as areas of key concern by stakeholders in all previous engagement activities, but were assigned differing levels of importance.

This view on the first two issues is mirrored by a 2014 survey of the community, which identified that “the three greatest environmental threats to the Marine Estate as perceived by the NSW community are: littering/dumping of rubbish/marine debris (47%), oil and chemical spills (34%) and water pollution from sediment or run-off (29%).” (Sweeney Research, 2014). In addition, the focus on maintenance and improvement applies to the broader catchment, not just the actual Harbour waters and its foreshore.

The key values associated with Sydney Harbour were identified through the literature review and stakeholder engagement activities; these values are listed below and are referred to by the various management issues. Given the range of competing interests and lack of a comprehensive values study specifically applying to Sydney Harbour, no prioritisation of these values has been made.

- Safe and healthy access to the Harbour

- Maintenance or enhancement of Harbour views
- High quality of outdoor experience
- Maintenance and improvement of high water quality
- Appreciation of low key/natural public areas
- Preservation of natural areas and threatened species
- Sustainable use and management of the Harbour
- Preservation and appreciation of cultural heritage

The expected risks associated with not undertaking action include, but are not limited to those specified for each management issue. These risks have been identified based on the readily available information to date, stakeholder engagement activities, and our experience and judgement. Additional risks may be identified through detailed, issue-specific risk assessments.

2.1 Theme 1 – Protection and Maintenance/Improvement of Estuarine and Riparian Terrestrial Habitats

Habitats within Sydney Harbour include seagrass communities, saltmarsh communities, mangrove habitats, rocky reefs, macroalgal communities, open water/semi-pelagic environments and large expanses of soft-sediment benthic environments (Sydney Institute of Marine Science [SIMS], 2013). These habitats support a range of marine flora and fauna species including plankton, infaunal and epifaunal invertebrates (e.g. polychaetes, molluscs, crustaceans, echinoderms), birds (marine and shorebirds), marine reptiles, marine mammals, fish, sharks, and marine plants.

There are two protected marine areas of relevance to the study area:

- Sydney Harbour National Park (DEH, 2014e)
- North Harbour Aquatic Reserve (DPI, 2014b)

In addition, the entire shoreline of Sydney Harbour and its tributaries is an Intertidal Protected Area (DPI, 2012), with the exception of the shoreline between Manly Point and the southern end of Forty Baskets Beach. This protection prohibits the harvesting of seashore animals between the mean high water mark and 10 m seaward of the mean low water mark.

Interrogation of the Environmental Protection and Biodiversity Conservation (EPBC) Protected Matters Search tool and the BioNet Wildlife Atlas indicate a number a threatened species and/or populations have the potential to occur within the marine, intertidal and riparian habitats of Sydney Harbour. These species may inhabit Sydney Harbour on temporary or permanent bases for the purposes of foraging, dispersal, migration, sheltering/ resting and breeding, and include:

- Three Threatened Ecological Communities;
- One Endangered population;
- Four marine mammals;
- Five marine reptiles;
- Three fishes;
- Six sharks; and
- 27 birds.

Over 586 species of fish are found in Sydney Harbour (Hedge *et al*., 2013).

Habitats considered particularly important for threatened populations include the Manly area within the North Harbour Aquatic Reserve as this area supports the only breeding colony of little penguin (*Eudyptula minor*) in NSW and is listed as critical habitat for the species (DECC, 2007b). The Harbour houses endangered populations of the seagrass *Posidonia australis*, which are restricted to Middle Cove, Watson's Bay and the North Harbour area (DPI, 2012b); it no longer occurs in Rose Bay (C. Ganassin, personal communication, June 2015). In addition to providing habitat for threatened species, Sydney Harbour also supports species listed as Migratory and Marine under the Commonwealth EPBC Act. These species include marine mammals, marine turtles, sharks, marine birds and shorebirds.

Hedge *et al.* (2013) conducted a comprehensive review of scientific research specific to Sydney Harbour. This exemplary study was released during this project, and provides a current summary of the science behind the two primary issues identified by stakeholders as being of management concern. It also contains a number of suggestions for further research, some of which are considered to be of strong relevance to the management issues recommended for inclusion in a Harbour-wide CZMP.

Management Issue 1.1 – Loss of foreshore habitat

Statement

Shoreline modification and loss of natural riparian habitat have the potential to adversely impact habitats and protected species.

Context

The shoreline of Sydney Harbour has been extensively modified since European settlement with over 50% replaced by seawalls, boat ramps, and other man-made structures. In addition to this, the position and shape of the shoreline has been altered through reclamation works and localised infilling. Pitblado (1978) estimated at that time that these works affected approximately 77 km of the original 322 km shoreline, or 24%. Since this time further modifications are expected to have occurred.

Studies such as Chapman and Bulleri (2003) indicate that natural shorelines support greater biodiversity than artificial shorelines. There has been progress in identifying ways in which biodiversity on artificial structures can be increased (e.g. DECC, n.d.), however further work in this area would be beneficial.

Hedge *et al.* (2013) identified numerous studies that examined habitat modification on hard substrata, but very few on soft sediments.

Gaps

1. There does not appear to have been a comprehensive recent survey of biodiversity within Sydney Harbour and its catchment.
2. Hedge *et al.* (2013) identified a lack of Sydney Harbour specific studies on how habitat modification affects soft sediment infauna.
3. Further Sydney Harbour specific studies were suggested by Hedge *et al.* (2013) on the ecological patterns and processes occurring on natural shores rather than artificial shores (but particularly on rocky intertidal assemblages).
4. There do not appear to be any whole-of-Harbour plans or strategies for the management of important ecosystems such as seagrass beds, saltmarsh and mangroves. This was also identified by Hedge *et al.* (2013).
5. Further exploration of how changes to the design of structures such as seawalls can be applied within Sydney Harbour to improve the biodiversity of these environments in intertidal and subtidal areas (Hedge *et al.*, 2013).

Values addressed

1. Preservation of natural areas and threatened species
2. Appreciation of low key/natural public areas
3. Maintenance and improvement of high water quality

Risks

1. Reduction/loss of intertidal and shallow subtidal flora and fauna
2. Reduction in water quality

When

At all times

Where

Harbour wide

Who is involved

Adjacent land owners, Local government, Office of Environment and Heritage (OEH), Fisheries NSW, Marine Estate Management Authority (MEMA), Roads and Maritime Services (RMS), Academia, Australian Museum

Outcome if issue is addressed	Reduction in further loss of ecological values within the Harbour.	
Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Undertake a comprehensive survey of the biodiversity of Sydney Harbour and its catchment.	Academia, Local government, OEH, MEMA, Fisheries NSW, Australian Museum
	Sydney Harbour specific studies on how habitat modification affects soft sediment infauna (Hedge *et al.*, 2013) (6.3.1).	Academia, Fisheries NSW, Australian Museum
	Development of a whole-of-Harbour management strategy for seagrass beds, saltmarsh and mangroves (6.8). This was also identified by Hedge *et al.* (2013).	Local government, OEH, MEMA, Fisheries NSW, RMS, Australian Museum
	Further investigation into the diversity of bottom sediments in the study area including sandy beaches to the east of the Harbour Bridge, to increase the limited pool of knowledge regarding this habitat type in the study area (*Hedge et al.*, 2013) (6.3.2).	Academia, Fisheries NSW, Australian Museum
	Further Sydney Harbour specific studies on the ecological patterns and processes occurring on rocky intertidal assemblages (*Hedge et al.*, 2013) (6.3.2).	Academia, Fisheries NSW, Australian Museum
	Further exploration of how changes to the design of structures such as seawalls can be applied within Sydney Harbour to improve the biodiversity of these environments in intertidal and subtidal areas (Hedge *et al.*, 2013) (6.3).	Academia, Fisheries NSW, RMS, OEH, Australian Museum

Management Issue 1.2 – Recreational Fishing

Statement	Resource extraction has the potential to adversely impact habitats and protected species.
Context	Commercial fishing within the Harbour has been banned since 2006, due to elevated levels of dioxins in fish and crustaceans (DPI, 2006a). The highest contamination concentrations are generally restricted to the bedded embayments and decrease markedly seaward in the Harbour (Roberts *et al*., 2008; Davis and Birch, 2010, 2011). Recreational fishing within Sydney Harbour remains a popular pastime. Ghosn *et al.* (2010) identified that compared to other estuaries in New South Wales, recreational anglers in Sydney Harbour retained a greater proportion of undersized fish in their catch. In addition, considerable quantities of fish, crabs and cephalopods caught from areas where fish consumption is not recommended were being retained by anglers.
Gaps	1. Further research is required into the effects of recreational fishing on the ecological values present in the study area. The last major assessment was undertaken in 2008 (reported in Hedge *et al*., 2013). 2. The impacts of organic pollutants on food networks within the Harbour are not well understood (Hedge *et al*., 2013). This has implications for the consumption of fish caught recreationally.
Values addressed	1. Safe and healthy access to the Harbour 2. Preservation of natural areas and threatened species 3. Sustainable use and management of the Harbour
Risks	1. Reduction/loss of species diversity. 2. Sustainability of fishery threatened. 3. Continued incidences of poisoning due to the consumption of contaminated fish.
When	At all times
Where	Harbour wide, but especially upstream of the Sydney Harbour Bridge.
Who is involved	Fisheries NSW, MEMA, Roads and Maritime Services (RMS), Academia, Local government, Australian Museum
Outcome if issue is addressed	Reduction in further loss of species diversity within the Harbour.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Investigation into local fishing patterns to understand the local risk of consumption of contaminated fish and crustaceans within the Harbour, and inform future management plans (Hedge *et al*., 2013) (6.4).	Fisheries NSW, Academia, MEMA, RMS

	Investigation into improved methods of communicating risks around the consumption of contaminated fish. (5.3)	Fisheries NSW, NSW Health

Management Issue 1.3 – Shipping and Boating

Statement	Shipping and boating have the potential to adversely impact habitats and protected species.
Context	Vessel movements can deter the use of key habitats by fauna known to inhabit those areas. Anchoring, mooring, boat wake, prop wash, littering and pollution can also result in physical damage to estuarine flora and fauna (Widmer and Underwood, 2004). In addition, the provision of shore-based infrastructure to support vessel usage can result in the loss of adjoining habitat (refer Management Issue 1.1).
Gaps	1. An understanding of longer term trends in commercial and recreational vessel movements and their impacts on estuarine habitats.
Values addressed	1. Preservation of natural areas and threatened species 2. Maintenance and improvement of high water quality
Risks	1. Reduction/loss of species diversity due to vessel movements. 2. Sustainability of fishery threatened.
When	At all times.
Where	Harbour wide.
Who is involved	RMS, Fisheries NSW, MEMA, Sydney Ports Corporation (SPC), Local government, Sydney Ferries, recreational boating and fishing groups, Australian Museum.
Outcome if issue is addressed	Reduction in further loss of species diversity within the Harbour.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Investigation into long term trends in commercial and recreational vessel movements and their impacts on estuarine habitats (6.7)	RMS, Fisheries NSW, Sydney Ports Corporation (SPC)

Management Issue 1.4 – Invasive Species

Statement	Pollution by invasive species has the potential to have further adverse impacts on habitats and protected species.
Context	Non-Indigenous Species (NIS) and novel species have been identified as an issue impacting on the overall ecosystem within the study area. Hedge *et al.* (2013) reported that NIS causes biodiversity loss through the displacement of native species. NIS are often introduced through the discharge of ballast water or hull fouling of recreational and commercial vessels. Several NIS that are likely to occur in Sydney Harbour are known to have negative impacts on habitats, e.g. *Caulerpa taxifolia* (Creese *et al.*, 2004). Piola *et al.* (2008) indicated that contamination in the waters also assists the spread of NIS. Whilst there is a general understanding of the manner in which NIS enters Sydney Harbour from overseas ports, there is not a clear understanding of how NIS spread in a regional context (Hedge *et al*., 2013).
Gaps	1. The local conditions that encourage establishment of NIS are not well understood (Hedge *et al*., 2013).
Values addressed	1. Preservation of natural areas and threatened species 2. Sustainable use and management of the Harbour
Risks	1. Reduction/loss of species diversity due to native species displacement. 2. Sustainability of fishery threatened.
When	At all times.
Where	Harbour wide.
Who is involved	RMS, Fisheries NSW, MEMA, Sydney Ports Corporation (SPC), Department of Agriculture (Biosecurity), Academia, Australian Museum.
Outcome if issue is addressed	Reduction in further loss of species diversity within the Harbour.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Use of genetic investigation techniques to provide evidence of NIS status and origin to assist in determining management measures to control NIS within the study area (Hedge *et al*., 2013) (6.7).	Academia, Australian Museum
	Identification of opportunities for improved controls on ballast water discharge and limiting hull fouling.	RMS, Fisheries NSW, MEMA, Sydney Ports Corporation (SPC), Department of Agriculture (Biosecurity), Australian Museum

Management Issue 1.5 – Climate Change (Habitats)

Statement	There is uncertainty around the impacts of a changing climate on estuarine and riparian habitats.
Context	The coastal waters of south-eastern Australia have been identified as warming faster than the global average (Ridgway and Hill, 2012), and by 2070 ocean temperatures off Sydney Harbour are expected to increase by 3 ºC (Hedge *et al*., 2013). Whilst an oceanic sea level rise of 1.7 mm a year is not predicted to impact mangrove habitats in the Harbour; saltmarsh habitats are expected to be squeezed as shoreward migration is constrained by existing development. Potential increases in the frequency and severity of storm events may increase pressure on existing coastal infrastructure and encourage further armouring of the shoreline. In this context habitats that form a natural barrier to wave action such as mangroves and seagrasses may be lost or become more important for infrastructure protection (Hedge *et al*., 2013). In addition, changes to the East Australian Current (EAC) may change the behaviour of tidal flows in and out of Sydney Harbour, potentially introducing tropical species into the Harbour which will seek to compete with native and established introduced species.
Gaps	1. Hedge *et al*. (2013) identified that the current state of knowledge around projected climate change impacts within Sydney Harbour relies on studies conducted in similar estuaries or on similar groups of species found within the Harbour. There is a large gap in understanding how climate change stressors will impact on ecosystems in and adjacent to the Harbour.
Values addressed	1. Preservation of natural areas and threatened species 2. Sustainable use and management of the Harbour
Risks	1. Reduction/loss of species diversity due to climate change. 2. Sustainability of fishery threatened.
When	Next 10 to 20 years
Where	Harbour wide.
Who is involved	Local government, OEH, Fisheries NSW, MEMA, Academia, Australian Museum
Outcome if issue is addressed	Reduction in further loss of species diversity within the Harbour.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Improved modelling tools to investigate the impacts of climate change within the study area (Hedge *et al*., 2013) (6.3).	Academia
	Improved coordination of planning and management between stakeholders (4.4).	Local government, OEH, Fisheries NSW, MEMA

2.2 Theme 2 – Maintenance/Improvement of Water/Sediment Quality

Sydney estuaries have been subject to substantial anthropogenic inputs from widespread urbanisation and development (Alquezar *et al*., 2006a; Hatje *et al*., 2001). Urban and industrialised run off has been particularly prevalent from sources such as power stations, lead and zinc smelters, sewerage works, refineries, manufacturing and agricultural practices (Alquezar *et al*., 2006b; Birch, 1996; DPI 2014a; Irvine and Birch, 1998; McCready *et al*., 2000), as well as stormwater pollution associated with general urban development (LLS, 2014c).

Most contamination in the study area results from a combination of current inputs such as stormwater with these historical inputs (Birch and McCready, 2009). The highest contamination concentrations are generally restricted to the upper reaches of bedded embayments and decrease notably seaward in the Harbour (Roberts *et al*., 2008; Davis and Birch, 2010, 2011).

Water and sediment have the potential to act as a sink for contaminants entering estuarine environments, leading to prolonged contamination (Alquezar *et al*., 2006a) and subsequent biological and ecological impacts. These include elevated concentrations of contaminants within the tissues of marine organisms (Kirby, Maher and Harasti, 2001; Kirby, Maher and Krikowa, 2001), alterations of the biology and physiology of marine organisms (Alquezar *et al*., 2006a,b) and ultimately issues relating to human health from the consumption of contaminated animal tissues or ingestion of affected waters (DPI, 2014d).

In response to ongoing health concerns, long term monitoring programs were established to monitor bacterial levels and water quality parameters within Sydney Harbour. Results from these programs indicate there has been a gradual improvement in water quality over time (DEH, 1990; OEH, 2013b); however it is noted that rainfall events are often the trigger for beaches becoming susceptible to faecal contamination (DEH, 2011). Continuation of these monitoring programs is important for the identification and responsive management of areas of poor water quality, infrastructure performance and emerging water quality issues.

GSLLS has developed the Sydney Harbour Catchment Water Quality Improvement Plan (SHCWQIP) to identify threats to water quality in the Harbour and its tributaries, and to set the targets for pollutant load reductions (in terms of total nitrogen, total phosphorus, suspended sediment and pathogens) required to protect the condition and values of the Sydney Harbour and its tributaries (Freeman, 2015).

As for Theme 1, Hedge *et al.* (2013) presented the current scientific understanding of water and sediment quality in the Harbour, and a number of suggestions for further research relevant to the management issues recommended for inclusion in a Harbour-wide CZMP.

Hedge *et al*. (2013) summarised that water quality in the Harbour is influenced by the following characteristics:

- Harbour salinity is generally in the order of 35 psu. At the Harbour mouth this can be reduced to about 30 psu in the top water layers (4 m) after very heavy rain.
- Tides in the Harbour are semi diurnal and reverse every six hours. Towards the Harbour entrance, tidal velocities can be as high as 0.25 m/s (unpublished data by Roughan *et al.*, 2012, in Hedge *et al*., 2013).
- "Ten kilometres offshore at the 100 m isobath, oceanic temperatures range between 12 ºC and 25 ºC in February. Temperatures are … more mixed in winter ranging between 16 ºC and 20 ºC in June" (Hedge *et al*., 2013). Unpublished temperature data indicates that temperatures within the Harbour average 19.7 ºC, and temperatures of up to 28 ºC have been recorded (Hickey, 2014),

- Freshwater inflows deliver over 90% of Total Suspended Solids and metals during high river flow. Conversely base flow conditions deliver high levels of nutrients to the study area.

Management Issue 2.1 – Stormwater Contamination

Statement

Stormwater contamination has adverse impacts on water and sediment quality in Sydney Harbour.

Context

Hedge et al. (2013) described rainfall over the Sydney Harbour catchment as "… characterised by dry conditions, punctuated by infrequent, high-precipitation events (rainfall > 50 mm per day)." The small size and density of urbanisation (86%) results in rapid run-off during high precipitation events (Beck and Birch, 2012a,b).

High levels of copper, lead and zinc were identified by Davis and Birch (2010) as being present in stormwater from urban roads. In addition, the levels of metals in catchment soils are similar to those detected in the Harbour, indicating that soil erosion or stormwater filtration through the soils may be an important source of metals (Davis and Birch, 2010).

High turbidity and nutrient loading into the Sydney Harbour catchment has the ability to adversely affect water quality in the study area (Birch and McCready, 2009). The delivery of Total Suspended Solids into the Harbour directly affects the quantity and quality of light penetration through the water column, thereby influencing photosynthesis (Hedge *et al*., 2013) whilst the enrichment of estuaries via nutrient input stimulates plant growth (eutrophication) and disrupts the balance between the production and metabolism of organic matter, sometimes leading to decreased ecological function (Cloern, 2001).

Many Harbourside historical reclamations incorporated contaminated and dredged sediments, or garbage. Rainwater filters through this material and the resulting leachate is dispersed into the Harbour through tidal movements.

GSLLS has completed a series of catchment pollutant export models (CPEMS), which simulate pollutant delivery to the Harbour for a variety of climatic conditions. These CPEMS have been integrated with a 3-dimensional hydrodynamic model of the entire Harbour and up into the freshwater reaches of its tributaries. The resulting Water Quality models simulate the delivery and transport of pollutants. Use of these models to inform management actions is still in its early stages.

Gaps

1. Hedge *et al.* (2013) reiterated that the impacts of emerging contaminants on natural systems are a globally recognised knowledge gap of concern (Barnes *et al*., 2008, Philips *et al*., 2010 (both cited but not referenced) in Hedge *et al*., 2013) and apply to the study area due to the nature of contaminant pathways present in the Harbour.
2. To date there has been no published assessments of nanoparticles, micro-plastics or other emerging contaminants within Sydney Harbour (Hedge *et al*., 2013).
3. The spatial distribution of non-point source pollutant inputs to the study area from urban run-off and stormwater drains were identified, mapped and modelled during the development of the SHCWQIP. However, the input of leachate from contaminated lands and other groundwater borne contaminants identified by Hedge *et al.* (2013) remains a knowledge gap.

4. Whilst there is now an understanding of the relative contribution of the various catchments (Freeman, 2015), a concise list all of the actions currently underway to intercept or manage contaminants before they reach the Harbour is yet to be compiled.
5. The causal effects of the ecological response (phytoplankton dynamics) to nutrient enrichment in Sydney Harbour were modelled to develop the SHCWQIP. However, further refinement of this model is required to incorporate any influence that sediment bound contaminants have on nutrient exchange at the sediment/water interface. This refinement is currently being addressed by GSLLS in cooperation with OEH and SIMS.

Values addressed	1. Safe and healthy access to the Harbour 2. High quality of outdoor experience 3. Maintenance and improvement of high water quality 4. Preservation of natural areas and threatened species
Risks	1. Reduction/loss of species diversity due to toxicity. 2. Sustainability of fishery threatened. 3. Potential threat to public health 4. Reduction in water-based recreational opportunities
When	After rainfall events, especially heavy rainfall.
Where	Harbour-wide, but especially in upstream waterways with poor tidal flushing.
Who is involved	GSLLS, OEH, Local government, Academia
Outcome if issue is addressed	Improved water and sediment quality Reduction in further loss of species diversity within the Harbour. Restoration of the fishery (particularly east of the Harbour Bridge). Improved accessibility for primary contact recreation after rainfall events.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	A high resolution biogeochemical modelling system has been developed for Sydney Harbour to inform the SHCWQIP. However, this modelling system requires refinements to improve its capacity and reliability with regard to nutrient dynamics and contamination pathways. This refinement is currently being addressed by GSLLS, in partnership with OEH and SIMS as a component of the Sydney Harbour Estuary Processes Study (SHEPS) currently underway (5.6).	Academia, GSLLS, OEH

Use of the CPEMS and linked water quality models to identify impacts of planned remedial actions or propose potential solutions for interception or management of contaminants before they reach the Harbour (5.6)	GSLLS, OEH, Local government
Investigations to determine sources of point source pollution affecting the water and sediment quality of the study area, and what role these have on determining the spatial distribution of contamination (5.2). GSLLS is currently modelling the distribution and potential re-suspension of sediment bound contaminants, including the influence of vessel traffic on these processes within the Harbour. This work will be incorporated into the SHEPS, which is due for completion in June 2016.	Academia, GSLLS, OEH, Local government
Further analysis of water and sediments across the study area to determine the importance of emerging contaminants and their pathways into the Harbour (5.4)	Academia, GSLLS
Further investigations into the linkages between water quality and planktonic organisms, which is particularly important for areas of the Harbour which are slower to flush such as the inner parts of Port Jackson (5.3). GSLLS is working in partnership with OEH and SIMS to investigate relationships between water/sediment quality and various estuarine biota (including benthic invertebrate communities, zooplankton, and various microorganisms) within the Harbour as a component of the SHEPS.	Academia, GSLLS, OEH,

Management Issue 2.2 – Faecal Contamination

Statement	Faecal contamination has adverse impacts on water quality in Sydney Harbour (DEH, 2014e).
Context	Modelling of overflows and discharges to the study area by Birch *et al.* (2010) suggest that historically, sewage has contributed just over 50% of the Total Nitrogen and Total Phosphorus Loads to Sydney Harbour. This issue is linked to the limited capacity, interconnected and aged nature of the water infrastructure present in and adjacent to the Harbour, which results in overflows, particularly during/immediately after rainfall events. SHCWQIP (2015) identifies that the vast majority of pathogens (93% Enterococci and 80% faecal coliforms) are contributed from sewer overflows. Conversely, TN, TP and TSS are clearly dominated by diffuse sources, which account for 90% of nutrient and 98% of sediment loads.
Gaps	1. There are no studies on the causal effects of nutrient enrichment on the ecology of Sydney Harbour, although GSLLS has completed a series of catchment pollutant export models (CPEMS), which simulate pollutant delivery to the Harbour for a variety of climatic conditions. These CPEMS included sewer overflows, and could be used in the development of these studies. 2. There are no studies that examine the relationship between swimming and similar recreational exposure (primary contact) to poor microbiological water quality and adverse health outcomes in the Australian setting.
Values addressed	1. Safe and healthy access to the Harbour 2. High quality of outdoor experience 3. Maintenance and improvement of high water quality 4. Preservation of natural areas and threatened species
Risks	1. Reduction/loss of species diversity due to toxicity. 2. Sustainability of fishery threatened. 3. Potential threat to public health 4. Reduction in water-based recreational opportunities
When	At all times, but especially after rainfall events.
Where	Harbour-wide, but especially in upstream arms of waterways with poor tidal flushing.
Who is involved	GSLLS, Sydney Water, Local Government, NSW Health, OEH
Outcome if issue is addressed	Improved water and sediment quality Reduction in further loss of species diversity within the Harbour. Restoration of the fishery (particularly east of the Harbour Bridge). Improved accessibility for primary contact recreation after rainfall events.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***

A high resolution biogeochemical modelling system has been developed for Sydney Harbour to inform the SHCWQIP. However, this modelling system requires refinements to improve its capacity and reliability with regard to nutrient dynamics and contamination pathways. This refinement is currently being addressed by GSLLS, in partnership with OEH and SIMS as a component of the Sydney Harbour Estuary Processes Study (SHEPS) currently underway (5.6)	Academia, GSLLS, OEH, Sydney Water
Further investigations into the linkages between water quality and planktonic organisms, which is particularly important for areas of the Harbour which are slower to flush such as the inner parts of Port Jackson (Hedge *et al*., 2013) (5.3). GSLLS is working in partnership with OEH and SIMS to investigate relationships between water/sediment quality and various estuarine biota (including benthic invertebrate communities, zooplankton, and various microorganisms) within the Harbour as a component of the SHEPS.	Academia, GSLLS, OEH,
An epidemiological study that demonstrates the relationship between faecal pollution and adverse health outcomes in the Australian setting (5.4).	NSW Health, OEH, Sydney Water

Management Issue 2.3 – Contaminated Land

Statement	The restoration/remediation of sites degraded by historical contamination has had mixed success.
Context	The contamination status of the study area has been well characterised, with literature highlighting the extensive metal contamination present in the sediment coupled with the presence of non-metallic contaminants such as organohaline pesticides and polycyclic aromatic hydrocarbons (e.g. Birch and McCready, 2009). Over 50% of the sediment in the study area exceeds the Interim Sediment Guideline concentrations for Lead and 100% of the sediment exceeds trigger values that prompt further investigation of activities that may disturb the sediment (Hedge *et al*., 2013; Birch and Taylor, 2002a), although contamination levels tended to increase with distance upstream of Sydney Heads.
Gaps	1. Hedge *et al*., 2013 identified that much of the literature collated on stressors/threats to the study area concentrate on these stressors in isolation rather than a cumulative impact assessment or consideration of stressor interaction. Recent evidence suggests that the effects of nutrients and metals may be synergistic; leading to the prediction that nutrient enrichment in the study area may actually be masking stronger effects of metal contamination. 2. A detailed understanding of "the feasibility of restoration of degraded systems within contaminated environments" (Hedge *et al*., 2013).
Values addressed	1. Maintenance and improvement of high water quality 2. Preservation of natural areas and threatened species
Risks	1. Continued loss of species diversity due to toxicity. 2. Sustainability of fishery threatened. 3. Potential threat to public health
When	Next 5 – 10 years
Where	Harbour wide
Who is involved	Academia, Land managers, Local government, OEH, Environment Protection Authority
Outcome if issue is addressed	Improved water and sediment quality Reduction in further loss of species diversity within the Harbour. Given that habitat continues to be lost within the Harbour, improving restoration outcomes will also assist habitat retention. Restoration of the fishery (particularly east of the Harbour Bridge).

Issue to be addressed in CZMP	*Action (and Literature review chapter reference)*	*Stakeholder*
	Assemble existing or undertake new studies to assess cumulative impacts from or interactions between contaminants (Hedge *et al*., 2013) (5.6)	Academia
	Undertake studies to assess the relative success and therefore feasibility, of previous remediation actions on reducing contamination/removing contaminants and restoring ecosystems (5.6)	Academia, OEH, EPA

Management Issue 2.4 – Climate Change (Rainfall and Water Circulation)

Statement

Projected changes to rainfall and the East Australian Current (EAC) due to climate change may have implications for water flows on the continental shelf and tidal exchange in Sydney Harbour.

Context

There is uncertainty over how the projected changes to rainfall patterns, temperature and sea levels under climate change scenarios changes will affect current water and sediment quality characteristics within the study area.

Alterations to rainfall patterns may alter rates of contaminant delivery to the Harbour. For example, an increase in the frequency of intense rainfall events may increase soil erosion and therefore the delivery of contaminants and suspended solids to the Harbour.

Changes to the EAC may change the behaviour of tidal flows in and out of Sydney Harbour, resulting in changes to tidal exchange (flushing) and therefore water quality.

Hedge *et al*. (2013) examined this issue in detail and made several recommendations for further research.

Gaps

1. Hedge *et al*. (2013) did not identify any circulation modelling studies of the study area which investigate the interactions between the EAC offshore, coastal waters and circulation within the Sydney Harbour estuary itself.
2. An understanding of the synergistic impacts of global climate change and the documented contamination status of the sediments within the study area (Hedge *et al*., 2013).
3. Hedge *et al*. (2013) identified knowledge gaps in the direct or indirect effects of the delivery of nutrients and contaminants to open water or benthic biota within Sydney Harbour. Typically strong linkages have been made between water quality and planktonic organisms but this has not been well studied in Sydney Harbour. Climate change may exacerbate the processes involved in run-off, contamination and nutrient delivery to the study area.

Values addressed

1. Improved water and sediment quality
2. Reduction in further loss of species diversity within the Harbour.
3. Restoration of Sydney Harbour as a fishery (particularly east of the Harbour Bridge).
4. Sustainable use and management of the Harbour

Risks

1. Reduction/loss of species diversity due to toxicity.
2. Potential threat to public health
3. Reduction in water-based recreational opportunities

When

Next 5 to 10 years

Where

Harbour-wide

Who is involved

Academia, OEH

Outcome if issue is addressed	Improved understanding of likely changes in water and sediment quality as a result of climate change impacts.	
Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Development of a circulation modelling study of the study area to investigate the interactions between the EAC offshore, coastal waters and circulation within Sydney Harbour (Hedge *et al*., 2013) (5.6).	OEH, Academia
	Further research into the expected impacts of increased rainfall runoff within the catchment on water and sediment quality (5.6).	OEH, Academia

2.3 Theme 3 – Foreshore Access

Sydney Harbour covers an area of 5,255 hectares and contains 317 km of foreshore (RMS, 2014b). Access to the foreshore and Harbour forms an inexorable part of a number of other coastal management issues. User groups place a very high value on the maintenance or improvement of access for passive and active recreation, commercial opportunities, transport, tourism and amenity.

Users seek access to Harbour:

- Beaches;
- Foreshore and aquatic reserves;
- Waterways; and
- Moorings.

Access to these areas is gained through foreshore and other reserves, private properties, club facilities, and from outside the Harbour (i.e. the Parramatta River or through Sydney Heads). Some foreshore reserves and private club facilities are unable to cope with demand during peak periods (Manly Council, 2004a).

The *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005* (SREP) contains specific provisions to encourage retention or improvement of public access through the development approval system. In particular, clause 22 seeks that:

"(a) development should maintain and improve public access to and along the foreshore, without adversely impacting on watercourses, wetlands, riparian lands or remnant vegetation,

(b) development should maintain and improve public access to and from the waterways for recreational purposes (such as swimming, fishing and boating), without adversely impacting on watercourses, wetlands, riparian lands or remnant vegetation,

(c) if foreshore land made available for public access is not in public ownership, development should provide appropriate tenure and management mechanisms to safeguard public access to, and public use of, that land,

(d) the undesirability of boardwalks as a means of access across or along land below the mean high water mark if adequate alternative public access can otherwise be provided, …"

Applications for foreshore development must be referred to the Foreshore and Waterways Planning Advisory Committee for consideration against the provisions of the SREP. The SREP Development Control Plan provides additional guidance on the desired outcomes for the Harbour.

Council Local Environmental Plans also contain provisions which guide access to all public areas throughout each local government area.

From 2003 to 2013, the Sharing Sydney Harbour Access Program provided applicant matched capital works funding in excess of $12 million to public land managers and user groups to support safe and healthy access to the Harbour and its tributaries.

Management Issue 3.1 – Disabled Access

Statement	Access to the Harbour is constrained for people with a disability.
Context	The topography and intensity of development adjoining the Harbour constrains the practicality of access in some locations. Steep slopes can restrict access to ambulant persons only. Whilst North Sydney Council has developed a foreshore access strategy to balance access for all (NSC, 2007), there is very little other published information available on how improvements to disabled access to Sydney Harbour is being addressed. Upgrading of access facilities should seek to achieve disability compliance where practically and economically feasible.
Gaps	1. Whilst the number and distribution of land-based foreshore access points, the type of access provided (e.g. pedestrian/boating/commercial etc.) and the relative contribution of each to the provision of access may be known within individual local government areas, desktop research did not identify centralised information for foreshore access to disabled users. 2. There is no Harbour-wide audit of foreshore access.
Values addressed	1. Safe and healthy access to the Harbour 2. High quality of outdoor experience
Risks	1. Access to the Harbour will be inequitable for those with a physical disability 2. Demand for disabled access will be higher at other locations, thereby increasing competition and potential conflict 3. Existing infrastructure may be underutilised 4. Disabled users may incur an injury
When	At all times
Where	Harbour-wide
Who is involved	Local government, disability advocacy groups
Outcome if issue is addressed	Equitable and safe access to public land adjoining the Harbour.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Undertake a Harbour-wide audit of foreshore access to identify areas of greatest need for the disabled. (7.4)	Local government, CZMP Steering Committee
	Prioritisation of proposed infrastructure through a cost-benefit analysis (7.4)	Local government, CZMP Steering Committee, Department of Planning and Environment

Management Issue 3.2 – Competition for Access

Statement	There is significant competition for foreshore access between residents and visitors.
Context	Public consultation on community plans consistently identified that ongoing access to the foreshore and Harbour are highly valued by the community (e.g. Manly Council, 2011; Woollahra, 2009). Approximately 134 km of the Sydney Harbour foreshore and tributaries is fronted by public lands which provide public access (DOP, 2003). Most Councils offer parking permits to residents to manage parking concerns, however with many user groups forecasting increases in participation (Carnival Australia, 2011; Tourism Australia, 2014; Boating Industry Association, 2012; ORS, 2013), there is potential for demand to increase, leading to increasing competition between user groups, and in particular, between residents and visitors.
Gaps	Nil.
Values addressed	1. Safe and healthy access to the Harbour 2. High quality of outdoor experience 3. Appreciation of low key/natural public areas
Risks	1. Loss of low-key and natural public areas if public land managers seek to cater for intensive/high demand usage. 2. Loss of community cohesion as competition increases.
When	At all times
Where	Harbour-wide
Who is involved	Local government, Harbour users
Outcome if issue is addressed	Equitable access to public land adjoining the Harbour. Retention of low-key and natural public areas.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Share/develop strategies to facilitate equitable access (7.4)	Local government, CZMP Steering Committee
	Review of Sharing Sydney Harbour Access Plan (2.5)	Department of Planning and Environment

Management Issue 3.3 – Connectivity of Access

Statement	There is a need for the provision of safe and environmentally appropriate connectivity between foreshore access points.
Context	Connectivity between foreshore access points in Sydney Harbour has been extensively addressed through the "Walking Coastal Sydney" project (SCCG, 2007). However, there are locations where connectivity between public access points is limited, or only provided via the street network, e.g. NSC, 2007; SCCG, 2007. Where public land is available, any provision of access to achieve or restore connectivity needs to be implemented in a manner sensitive to the needs of the local environment and adjoining land owners.
Gaps	1. There is no compiled Harbour-wide audit of proposed future public access linkages.
Values addressed	1. Safe and healthy access to the Harbour 2. High quality of outdoor experience 3. Appreciation of low key/natural public areas 4. Preservation of natural areas and threatened species
Risks	1. Existing access points are not utilised to their full potential 2. Ongoing safety concerns from utilising the existing street network for access, particularly conflicts between pedestrians and vehicles 3. Loss of or damage to habitat through uncontrolled access.
When	Next 5 to 10 years
Where	Harbour-wide
Who is involved	Local government, adjoining landowners, environmental lobby groups.
Outcome if issue is addressed	Improved connectivity between foreshore access points. Reduction in car/pedestrian conflicts. Potential for additional opportunities for natural area appreciation.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Undertake an audit of foreshore access to identify areas with potential for future connectivity linkages (7.4).	Local government, CZMP Steering Committee

Management Issue 3.4 – Supporting Infrastructure

Statement	The provision of appropriate supporting infrastructure at foreshore access points is inconsistent throughout Sydney Harbour.
Context	Foreshore access to Sydney Harbour occurs on a number of scales. Access ranges from simple sets of stairs between private properties, to large public reserves containing toilet and bathing facilities, dedicated car parking and playgrounds. Historically, supplementary infrastructure was most likely provided as part of individual park upgrades or as a result of community pressure. An assessment of the need for this type of infrastructure is unlikely to have been conducted in consultation with adjacent local government areas. Australian Standards such as AS 2156 “Walking tracks, Part 1: Classification and Signage” provide guidance on signage to provide consistency of information. However, these standards are unlikely to have been utilised consistently for Harbour access. Whilst not all access points require the same extent of supporting infrastructure, there may be some locations around the Harbour that would benefit from the provision of infrastructure that encourages usage such as signage, parking, lighting, toilets etc. A consistent approach is required for the provision of this infrastructure, in order to optimise safe, appropriate and equitable access.
Gaps	1. There does not appear to be a documented hierarchy or approach to determining the extent of supplementary infrastructure at a particular location that should be provided to support public access to the Harbour. 2. An agreed standard for Harbour access signage.
Values addressed	1. Safe and healthy access to the Harbour 2. High quality of outdoor experience 3. Maintenance and improvement of high water quality 4. Appreciation of low key/natural public areas 5. Preservation of natural areas and threatened species 6. Sustainable use and management of the Harbour
Risks	1. Existing access points are not utilised to their full potential 2. Public nuisance complaints from residents (e.g. littering, light spill) 3. Safety around using poorly lit facilities such as access paths or toilets
When	At all times
Where	Harbour-wide
Who is involved	Local government, adjoining landowners, wider community
Outcome if issue is addressed	Equitable and safe access to public land adjoining the Harbour. Optimised usage of public access points.

Issue to be addressed in CZMP	*Action (and Literature review chapter reference)*	*Stakeholder*
	Consideration of the development of a common standard/design for infrastructure in foreshore areas (7.4).	Local government, CZMP Steering Committee
	Development of a hierarchy of design elements to be provided for various scales of beach access (7.4).	Local government, CZMP Steering Committee
	Undertake a Harbour-wide audit of foreshore access to identify the supplementary infrastructure needed to support or encourage public access (7.4).	Local government, CZMP Steering Committee

Management Issue 3.5 – Private Structure Impacts on Access

Statement

Private structures and coastal protection works such as seawalls (particularly seaward of private property) restrict public access along the foreshore.

Context

Historically, public access along the foreshore seaward of property boundaries has been possible at some locations in the Harbour; sometimes this access was limited to times of low tides. However, the construction of private structures such as jetties and swimming pools within the inter-tidal area, and private or leasehold developments such as slipways, yacht clubs and marinas has limited accessibility. Issues also arise in relation to the timeliness of maintenance activities to minimise safety risks to the public.

Seawalls too, have in places progressively contributed to beach lowering, resulting in the loss of an inter-tidal area accessible by pedestrians. Seawalls protecting public land such as parks and reserves still provide an opportunity to gain access to the Harbour, whereas private structures can completely sever along-shore access. This issue has clear linkages with Management Issue 3.3 (Connectivity of Access).

These structures are largely built for private benefit, but have a wider impact on the recreational opportunities available to the community. These opportunities may include the appreciation of areas known to be frequented by local indigenous groups prior to European settlement, as well as items of maritime heritage significance.

Gaps

1. There is not a clear understanding of the extents where public access was formerly available but now has been severed or compromised.

Values addressed

1. Safe and healthy access to the Harbour
2. High quality of outdoor experience
3. Appreciation of low key/natural public areas
4. Preservation of natural areas and threatened species
5. Sustainable use and management of the Harbour
6. Preservation and appreciation of cultural heritage

Risks

1. Potential injury by pedestrians seeking foreshore access in the vicinity of a privately owned structure
2. Legal issues associated with public access across a leasehold area.
3. Loss of access to cultural heritage places.

When

At all times, but particularly during low tide.

Where

Harbour-wide

Who is involved

Local government, RMS, adjacent landowners

Outcome if issue is addressed

Restored/increased opportunities for public access along the foreshore.

Issue to be addressed in CZMP	*Action (and Literature review chapter reference)*	*Stakeholder*
	Undertake a review of foreshore areas to identify where previous access has been severed, and opportunities (e.g. easements) and constraints for restoring this access (7.4).	Local government, CZMP Steering Committee, RMS
	Review of Sharing Sydney Harbour Access Plan (2.5).	Department of Planning and Environment

Management Issue 3.6 – Private Use of Public Land

Statement	Unauthorised private use of public land restricts public access along the foreshore.
Context	Encroachment on the foreshore by Harbour-front property owners has occurred throughout. Sometimes the encroachment is unintentional or of a temporary nature, with garden extensions, boats or similar stored outside of the private property boundary on public land. In other instances substantial structures such as boat houses, swimming pools and seawalls have been constructed partially or entirely on public land. The presence of these items can impede access along the foreshore, and are often perceived negatively by the wider community, particularly as waterfront properties command premium land values. Most Councils have encroachment policies in place, but enforce them to differing degrees. Unauthorised water craft storage also occurs in local parklands, whereby small craft are stored on the grass for often daily usage. This too is unpopular with local community groups, who raise safety, aesthetics and equity concerns. Tree damage has also been recorded due to dinghies being chained or dragged e.g. Manly Council (2004). The Boat Storage Policy for Sydney Harbour (DIPNR, 2004) includes this issue alongside moorings and marinas, but provides little detailed guidance. Some local governments, such as Woollahra, have acted to address this issue by preparing their own policy (WMC, 2007) and charging storage fees. However, this issue is dealt with inconsistently throughout the Harbour.
Gaps	1. An audit of all Council regulations governing this issue within Sydney Harbour.
Values addressed	1. Safe and healthy access to the Harbour 2. Maintenance or enhancement of Harbour views 3. High quality of outdoor experience 4. Appreciation of low key/natural public areas 5. Preservation of natural areas and threatened species 6. Preservation and appreciation of cultural heritage
Risks	1. Potential for injury due to tripping hazards 2. Potential for damage to private assets stored on public land 3. Loss of cultural identity/atmosphere
When	At all times
Where	On sandy beaches and adjacent parkland throughout the Harbour
Who is involved	Local government, RMS, Crown Lands, adjacent landowners, boat users
Outcome if issue is addressed	Equitable and safe access to public land adjoining the Harbour.

Issue to be addressed in CZMP	*Action (and Literature review chapter reference)*	*Stakeholder*
	Develop a consistent policy for managing boat storage in public areas (7.2.8).	Local government, CZMP Steering Committee, RMS, Crown Lands
	Enforce encroachment policies (7.4).	Local government

2.4 Theme 4 – Coastal Inundation

Inundation of coastal areas can result from a number of different influences, and includes irregular but temporary extreme events such as storm tide or tsunami, or permanent progressive inundation, such as projected sea level rise.

The management of coastal risks and hazards within NSW is primarily covered by the *Coastal Protection Act 1979*, as well as supporting legislation and guideline documents. Guidelines for the assessment of coastal risks are described in *Guidelines for Preparing Coastal Zone Management Plans* (OEH, 2013a).

In accordance with the majority of coastal risk assessments undertaken within NSW, recent risk assessments for Sydney Harbour foreshores have been completed during the early stages of CZMP preparation. This work has been completed through the NSW State Government's Coastal Zone Management Program.

The majority of these previous risk assessments focused on the assessment of hazards as a result of coastal inundation of the Sydney Harbour foreshore, including high resolution hydrodynamic modelling by the CSIRO in 2012 of inundation under current climate, extreme event and sea level rise projections commissioned by the SCCG on behalf of its member councils (McInnes *et al.*, 2012).

In addition, flooding studies completed by councils such as Leichhardt, Manly and Mosman considered tidal and wave inundation from Sydney Harbour due to the intrinsic link between the Harbour and the floodplains of the local government areas. These flooding studies have been completed under the NSW State Government's Floodplain Management Program.

Key foreshore assets which may be exposed to inundation hazards include those listed below, and eight islands within the Harbour:

- Sydney Opera House
- Kirribilli House
- Barangaroo
- Harbour Bridge Infrastructure
- Sydney Harbour National Park
- Garden Island Naval Base
- Fort Denison
- Circular Quay and Darling Harbour Transport Hubs
- Numerous Marinas and Yacht Clubs
- Royal Botanical Gardens
- White Bay Port Infrastructure
- Gore Cove Refinery

Management Issue 4.1 – Coastal Risk Prioritisation

Statement	There are differing coastal risk management priorities between councils in relation to inundation.
Context	In some cases, the assessment of coastal risks may not be considered a high priority by some councils surrounding Sydney Harbour. This may be due to the relatively small percentage of land affected by coastal hazards or low level of perceived risk. For example, a flooding study for Leichardt Council (Cardno, Lawson Treloar, 2010) considered tidal and wave inundation from Sydney Harbour, whereas a catchment based flood study for the City of Sydney (Webb, McKeown and Associates, 2007) considered storm surge but not waves or rising sea levels. In contrast, councils such as Mosman have a proportionally long length of coastline, iconic beaches, high ecological habitat values and important transport infrastructure in close proximity to potential coastal hazards. A coastal hazard study for this area is currently under preparation. The priority assigned to completion of a risk assessment will vary between LGA's. Consequently, securing buy-in from all councils will require significant consultation as well as careful scoping and implementation of the CZMP.
Gaps	1. Agreement on the specific outcomes to be delivered by the CZMP.
Values addressed	1. Safe and healthy access to the Harbour 2. Sustainable use and management of the Harbour
Risks	1. Inconsistent consideration of inundation hazards 2. Development of inconsistent planning and management responses
When	Prior to CZMP development
Where	Harbour-wide
Who is involved	Local government, OEH, Department of Planning and Environment, Sydney Harbour Foreshore Authority
Outcome if issue is addressed	Consistent priorities for managing coastal risk.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Discussion with project partners to confirm the specific outcomes of the CZMP (4.4).	CZMP Steering Committee

Management Issue 4.2 – Inundation Management Approaches

Statement	There are differing approaches to inundation planning and management between councils.
Context	Some councils may prefer to manage foreshore issues on a case by case basis, in response to environmental, safety, social, political and economic issues at a local level. In some locations, the preferred management approach for sea level rise may be for development to retreat, whereas in another location the approach may be to accommodate. The completion of a single integrated project may be perceived as constraining the management approaches available to councils.
Gaps	1. In order to consider the minimum criteria for assessing the extent of coastal hazards as specified by the NSW Government, an extensive dataset would be required for the study area. 2. Whilst much of this information is held by local and state government, comprehensive data sets do not generally exist. Significant resources would be required to source and compile this information such that a detailed assessment of coastal risks could be undertaken.
Values addressed	1. Safe and healthy access to the Harbour 2. Sustainable use and management of the Harbour
Risks	1. Inconsistent consideration of inundation hazards 2. Development of inconsistent planning and management responses
When	Prior to CZMP development
Where	Harbour-wide
Who is involved	Local government, OEH, CZMP Steering Committee, Department of Planning and Environment,
Outcome if issue is addressed	Agreed and flexible approach to inundation planning and management

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Reassessment of the available datasets, in light of the project requirements (4.6).	CZMP Steering Committee
	Develop a consistent dataset for use in hazard and risk assessment, if existing data is unsuitable (4.5)	Local government, CZMP Steering Committee
	Determination of an agreed approach for the development and management of areas vulnerable to inundation (4.6)	Local government, CZMP Steering Committee, Department of Planning and Environment

Management Issue 4.3 – Lack of Study Outcomes

Statement	Detailed outcomes and specific actions in relation to inundation are lacking in some previous CZMP studies.
Context	Previous CZMP studies, such as those completed for the Parramatta (Cardno Lawson Treloar, 2012) and Lane Cove Rivers (WBM BMT, 2012a) were completed to facilitate broader planning and assessment outcomes. Due to limitations of the available data and assumptions made in the assessment process, these studies did not allow application of the results on a small-scale basis (e.g. assessment of individual lots). The agreed outcomes for the CZMP will inform the level of investigations necessary to deliver these.
Gaps	1. Identification of, and agreement on, the detailed outcomes for the CZMP.
Values addressed	1. Safe and healthy access to the Harbour 2. Sustainable use and management of the Harbour
Risks	1. Studies completed do not allow results to be applied on the desired scale 2. Stakeholder disengagement as project not delivering intended vision 3. Fragmented approach to inundation planning and management will continue.
When	Prior to CZMP development
Where	Harbour-wide
Who is involved	Local government; OEH; Department of Planning and Environment, Division of Local Government; CZMP Steering Committee
Outcome if issue is addressed	Agreed CZMP outcomes for inundation management.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Discussion with project partners to confirm the specific outcomes of the CZMP. In particular, it will be necessary to define the manner in which the CZMP is to be utilised (such as property level assessment, or higher level). Following this, consistent assumptions and agreed planning horizons can be determined (4.6).	CZMP Steering Committee

Management Issue 4.4 – Integration with Other Programs

Statement	There is a need for a clear and consistent approach for the CZMP to integrate with other programs that manage inundation.
Context	The results of a coastal risk assessment would need to be considered against similar flooding risk assessments completed through the Floodplain Management Program. The relative importance of the links between these risk assessments varies between councils. For example, flooding studies undertaken by councils such as Leichhardt (Cardno, Lawson Treloar, 2010), Manly (Cardno, in prep.) and Mosman (MHL, in prep.) considered tidal and wave inundation from Sydney Harbour due to the intrinsic link between the Harbour and the floodplains of these local government areas. Integration will also be required with other planning programs such as GSLLS' Sydney Harbour Catchment Water Quality Improvement Plan (SMCMA, 2010), and other smaller risk related projects.
Gaps	1. Status update and assembly of all current and future proposed inundation mapping projects.
Values addressed	1. Safe and healthy access to the Harbour 2. Maintenance and improvement of high water quality 3. Sustainable use and management of the Harbour
Risks	1. New assessments conflict with existing adopted assessments 2. Confusion/debate over which planning document has precedence 3. Changes to funding and resourcing arrangements for other programs as a result of conflicting assessments
When	Prior to CZMP development
Where	Harbour-wide
Who is involved	Local government; GSLLS; Department of Planning and Environment, Division of Local Government; CZMP Steering Committee
Outcome if issue is addressed	Consistent understanding of how CZMP interacts with other programs to manage inundation.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Consideration of how coastal inundation mapping would integrate/interact with other programs such as flood mapping (4.3).	CZMP Steering Committee

Management Issue 4.5 – Data Accessibility

Statement	Data to support a Harbour-wide understanding of inundation risk is not widely accessible.
Context	The land immediately adjacent to the foreshores of Sydney Harbour includes a wide variety of landowners, including private residential and commercial as well as local, state and federal government bodies. Securing access to existing datasets and these foreshore areas for data collection purposes will require extensive liaison with a large number of land owners and lessees. For example, as detailed in section 4.7 of the Literature and Data review, data is held by the Manly Hydraulic Laboratory, Sydney Ports, SCCG, CSIRO etc. Compilation of the required dataset will require merging of a large number of different datasets from a variety of sources.
Gaps	1. In order to consider the minimum criteria for assessing the extent of coastal hazards as specified by the NSW Government, an extensive dataset would be required for the study area. 2. Whilst much of this information is held by local and state government, comprehensive data sets do not generally exist. Significant resources would be required to source and compile this information such that a detailed assessment of coastal risks could be undertaken. Very little information on these datasets was identified by stakeholders as part of this literature review.
Values addressed	1. Safe and healthy access to the Harbour 2. Sustainable use and management of the Harbour
Risks	1. Duplication of existing data set preparation if access is not provided. 2. Large expenditure at the beginning of the project. 3. Data assembled must be suitable for use in line with scale of agreed CZMP outcomes/project requirements.
When	Prior to CZMP development
Where	Harbour-wide
Who is involved	Local government; OEH; Department of Planning and Environment, Division of Local Government; CZMP Steering Committee
Outcome if issue is addressed	A comprehensive dataset for use in management of inundation risk.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Reassessment of the available datasets, in light of the project requirements (4.4).	CZMP Steering Committee, Coastal Engineers

Management Issue 4.6 – Investigation Costs

Statement	The cost of investigating coastal risks and devising management approaches is expected to be significant.
Context	The completion of a single integrated CZMP project for Sydney Harbour would offer cost savings through economy of scale and greater efficiency. However a project of this scale would require a large implementation cost to cover the investigation of coastal risks such as inundation at the required level of detail and development of appropriate management measures over a long length of complex foreshore. The approach to funding such a study would require careful consideration; issues will include how costs are to be shared amongst local government and State government, particularly, for those organisations who have recently undertaken hazard or risk assessments for this purpose.
Gaps	1. The cost of funding such as study is not known, and will be dependent on a review of the suitability of available datasets for use. 2. A model for determining how costs would be shared between project partners/key stakeholders
Values addressed	1. Safe and healthy access to the Harbour 2. Sustainable use and management of the Harbour
Risks	1. Disagreement between project partners on funding model. 2. Investigation costs are prohibitive for some project partners
When	Prior to CZMP development
Where	Harbour-wide
Who is involved	Local government; OEH; Department of Planning and Environment, Division of Local Government; CZMP Steering Committee
Outcome if issue is addressed	Agreed funding model for preparing the CZMP

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Estimate the costs required to infill gaps and compile a comprehensive dataset (4.4).	CZMP Steering Committee
	Assess funding availability and the feasibility of the overall project (4.4).	OEH
	Determination of an agreed approach for the funding of the project (4.6).	Local government, CZMP Steering Committee, Department of Planning and Environment, OEH

Management Issue 4.7 – Coastal Reforms

Statement	There is uncertainty amongst local government stakeholders regarding coastal reforms
Context	The NSW Government is currently conducting a two-stage coastal reform process in order to address community concerns about coastal management arrangements in NSW (OEH, 2015). Stage I of the NSW Government's coastal management reforms is complete. Stage II of the reforms covers the following three key areas: • establishing a simpler and more integrated legal and policy framework for coastal management • providing improved guidance and technical advice to councils, while enabling and supporting local decision making • identifying potential funding options, particularly to implement coastal asset management strategies. Liaison with state government representatives would be required throughout the study to ensure that the work undertaken is in accordance with the Stage II reforms.
Gaps	Nil.
Values addressed	1. Sustainable use and management of the Harbour
Risks	1. Continued uncertainty will erode confidence in Government to support Integrated Coastal Zone Management
When	At present
Where	Harbour-wide
Who is involved	Local government, Department of Planning and Environment, OEH
Outcome if issue is addressed	Improved statutory, technical, and financial support for coastal management in NSW

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Continued liaison with OEH regarding the coastal reform process currently being undertaken by the NSW Government. This would ensure that the future assessment of coastal risks meets or exceeds the requirements of the NSW State Government (4.6).	CZMP Steering Committee

Management Issue 4.8 – Sea Level Rise Benchmark

Statement	There is no consistent approach to the consideration of sea level rise in planning for inundation.
Context	The NSW Government no longer recommends state-wide sea level rise benchmarks for use by local councils (DOP, 2010; DECCW, 2010; OEH, 2013). This approach aims to allow councils to consider local conditions when assessing future hazards. Accordingly agreement on consistent sea level rise planning benchmarks could be advanced through a Sydney Harbour CZMP. In addition, there is uncertainty over the most suitable approaches for the management of stormwater and associated flooding under elevated sea levels, particularly for low lying areas.
Gaps	1. An agreed sea level rise planning benchmark for use in a Sydney Harbour CZMP.
Values addressed	1. Safe and healthy access to the Harbour 2. Maintenance and improvement of high water quality 3. Sustainable use and management of the Harbour
Risks	1. Inconsistent planning for sea level rise in adjoining local government areas 2. Inadequate planning for future stormwater infrastructure
When	Prior to CZMP development
Where	Harbour-wide
Who is involved	Local government; OEH; Academia; Department of Planning and Environment, Division of Local Government; CZMP Steering Committee
Outcome if issue is addressed	A consistent approach to the consideration of sea level rise in planning for inundation.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Agreement on sea level rise planning benchmarks by all councils covered by a Sydney Harbour CZMP (2.3.2).	CZMP Steering Committee, Department of Planning and Environment, OEH
	Determination of an agreed approach for the management of stormwater under sea level rise scenarios (Stakeholder Workshop).	CZMP Steering Committee, Department of Planning and Environment, OEH, Local government

2.5 Theme 5 – Shoreline Stability

Sydney Harbour contains a variety of shoreline types, ranging from sandy beaches, rocky ledges, cliffs and man-made coastal protection structures such as seawalls. In the upper reaches of some embayments, there are also vegetated banks and mud flats with mangroves. The 317 km of shoreline (RMS, 2014b) provides habitat for intertidal species (DECC, 2009).

The stability of sandy shorelines can be impacted by events such as wave action from storm events and scour from flooding, a deficit in the sediment supply to the area and progressive sea level rise. There are 52 beaches east of the Sydney Harbour Bridge (Short, 2007), over 25 of which are frequently used for swimming (OEH, 2013a). Many of these beaches are backed by seawalls of varying age, condition and design standard.

Other areas vulnerable to erosion are the numerous cliffs around the Harbour. Cliff erosion presents a different problem compared to sandy shorelines as cliff collapse can occur under conditions such as heavy rainfall (Australian Geomechanics Society, 2007), often exacerbated by intensive development on these slopes. Failure can be rapid but the timing is often impossible to predict (Manly Council, 2003).

Management Issue 5.1 – Consistency of Erosion Assumptions

Statement

Assumptions to guide planning for erosion management are not consistent throughout the Harbour.

Context

Interrogation of Smartline (Australian Government, 2013) indicates that approximately 10 km of sandy beaches are contained within the study area, some of which are backed by seawalls. Some of these seawalls are likely to have heritage significance or protect items of historical interest.

Stability or erosion assessments have been undertaken for various beaches. Published assessments include those undertaken as part of CZMP development (e.g. Manly Council (2009a,b)), although it is expected that many more unpublished local assessments of beach erosion of varying ages are held by local government stakeholders within the study area. Some beaches may never have been the subject of an erosion assessment. The assumptions and parameters used in the assessments to date are unlikely to be consistent throughout the study area. Assumptions used in the assessments are usually driven by the outcomes desired by the client.

Consideration of the stability of cliffs and other steep slopes adjacent to the foreshore is also important for many Harbour stakeholders, particularly in light of the intensity of development on many of these slopes, views and recreational opportunities afforded by these vantage points.

Only Manly Council's Coastal Management Plans include consideration of geodiversity and cliff/slope stability (e.g. Manly Council, 2012a).

Gaps

1. The length of the various shoreline types (rocky shorelines, beaches, artificial structures etc.) within the study area has not been well documented, even though information is available.
2. The Smartline shoreline data (www.ozcoasts.gov.au) provides information on shorelines throughout Australia, including within Sydney Harbour. However, it does not permit ready extraction of this data for local government areas in upstream sections of estuaries (such as Leichhardt, North Sydney and Willoughby), or separation of the data for those local government areas with ocean frontages (Manly and Woollahra). One of the complexities with this information relates to how it will ultimately be used. For example, a section of coastline may contain a seawall at the rear of a sandy beach. The shoreline may be classified as either type depending on how the shoreline is being defined.
3. Data sources identify that that some of the Sydney Harbour shoreline type information was provided to the Smartline project by NSW Maritime (Australian Government, 2013). The currency, coverage and availability of the NSW Maritime data is unclear at this time, but it may be more efficient to use the NSW Maritime data for any shoreline analysis.
4. Reassessment of available datasets, in light of the project requirements will be required before existing assessments can be used

Values addressed

1. Safe and healthy access to the Harbour
2. High quality of outdoor experience
3. Appreciation of low key/natural public areas

	4. Preservation of natural areas and threatened species 5. Sustainable use and management of the Harbour 6. Preservation and appreciation of cultural heritage
Risks	1. Management responses may be inconsistent for similar beaches
When	Prior to CZMP preparation (specific outcomes agreement) During CZMP development (future coastal protection works)
Where	Harbour-wide
Who is involved	Local Government, OEH, Academia, Coastal Engineering professionals
Outcome if issue is addressed	Consistent approach to the assessment of erosion for use in planning.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Agreement on the specific outcomes of the CZMP and how it is to be utilised are vital for informing the development of consistent assumptions for the assessment of erosion due to storm events, sediment deficits, sea level rise and catchment flooding, and combinations of these (4.6).	Local Government, OEH, Academia, Coastal Engineering professionals
	Identification of areas that may be subject to future coastal protection works (including cliff stabilisation) (4.5).	Local Government, OEH, Coastal Engineering professionals

Management Issue 5.2 – Beach Nourishment Sources

Statement

Sustainable future beach nourishment sources are not well documented or shared between coastal managers.

Context

The erosion of beach areas can result in the loss of a recreational area heavily used by the community. In tourist or high demand areas, it may not be considered to be timely or practical to wait for the natural return of beach sediments.

Understanding why the erosion occurred is an important part of any intervention works. In areas where erosion is long term or is expected to be exacerbated due to sea level rise (Jones, 2008), concerns have been raised in relation to the overall loss of beach areas (Manly Council, 2011).

In these situations, beach nourishment is seen as a means of retaining a recreational beach (e.g. Manly Council, 2004). The source and affordability of suitable beach sediments for use in these situations should be identified (Manly Council, 2011). Ideally, it would be preferable to have completed these investigations and have the requisite approvals in place prior to emergency demand for sediments.

An assessment of sources for use in nourishing NSW ocean beaches in light of climate change impacts did not consider the needs of beaches within Sydney Harbour (AECOM, 2010). Harbour beaches are likely to require much smaller nourishment volumes and a lower nourishment frequency compared to ocean beaches due to the calmer wave environment, which will then affect economies of scale in acquiring the nourishment material.

Gaps

1. Identification of and equitable access to sustainable future beach nourishment sources.

Values addressed

1. Safe and healthy access to the Harbour
2. High quality of outdoor experience
3. Sustainable use and management of the Harbour

Risks

1. Sediment supply from nourishment sources is insufficient to meet future demand.
2. Following a severe storm event, competition from other coastal managers for nourishment material may be strong unless agreements are already in place.
3. The cost of procuring suitable beach sediments in small quantities is prohibitive, particularly from offshore sources.
4. Economics may dictate that beach nourishment may need to be supported by hard engineering structures such as groynes or seawalls.

When

Next 5 years, particularly for application after erosion events.

Next 10 -20 years for identifying sources suitable for mitigating sea level rise impacts.

Where

High-patronage, sandy, recreational beaches throughout the study area.

Who is involved	Local government, OEH	
Outcome if issue is addressed	Equitable and sustainable access to nourishment resources.	
Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Identification of areas that may be subject to beach nourishment (4.2).	Local government, OEH
	Identification of sustainable nourishment sources (4.2) for use within the Harbour	OEH
	Development of an approach for equitable access to nourishment sources (4.2)	OEH, CZMP Steering Committee

Management Issue 5.3 – Cliff Erosion

Statement	The management of cliff erosion is inconsistent throughout the study area.
Context	Consideration of the stability of cliffs and other steep slopes adjacent to the foreshore is important for many Harbour stakeholders, particularly in light of the intensity of development on many of these slopes, views and recreational opportunities afforded by these vantage points. The presence of cliffs indicates an eroding shoreline – this has the potential to pose threats to private property, and public access and safety, at the top of the cliff as well as at the bottom (Australian Geomechanics Society, 2007). There is also the potential for connectivity of walking paths to be affected. Many of the Harbour's indigenous cultural heritage sites are located on or adjacent to cliff areas (Macdonald, 1985) and some are vulnerable to loss from cliff collapse. Only Manly Council's Coastal Management Plans include consideration of geodiversity and cliff/slope stability (Manly Council, 2012a).
Gaps	1. Identification of locations where cliff stability is a concern requiring active management.
Values addressed	1. Safe and healthy access to the Harbour 2. Maintenance or enhancement of Harbour views 3. High quality of outdoor experience 4. Appreciation of low key/natural public areas 5. Preservation of natural areas and threatened species 6. Preservation and appreciation of cultural heritage
Risks	1. Fatality or injury due to cliff collapse 2. Loss of or damage to cultural heritage sites 3. Loss of or damage to adjacent infrastructure
When	Next 5 years
Where	Harbour-wide
Who is involved	Local government, NSW Parks and Wildlife Service, Sydney Harbour Federation Trust, Traditional owners
Outcome if issue is addressed	Consistent management of cliff erosion.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Identification of areas that may be subject to cliff stabilisation works in the future (3.4).	Land managers
	Development of an agreed approach to management of cliff erosion (3.4).	Land managers

Management Issue 5.4 – Coastal Protection Structures

Statement	There is no consistent approach to the ownership and maintenance of coastal protection structures such as seawalls.
Context	Approximately 50% of Sydney Harbour's shoreline is composed of built habitats such as seawalls (Chapman and Bulleri, 2003). Other structures include groynes, stormwater outlets and jetties. Whilst Gordon (1989) examined seawalls for Sydney's Ocean Beaches, no detailed assessment was located that identified the condition and status of these and other coastal protection structures within the Harbour. In some locations, there is uncertainty over the ownership (and therefore maintenance responsibility) of coastal protection structures such as seawalls. In addition, there has been significant debate in recent years over the right of property owners to protect their land from erosion (EDO, 2011).
Gaps	1. Clear understanding of existing ownership of coastal protection structures.
Values addressed	1. Safe and healthy access to the Harbour 2. High quality of outdoor experience 3. Preservation of natural areas and threatened species 4. Sustainable use and management of the Harbour 5. Preservation and appreciation of cultural heritage
Risks	1. Fatality or injury due to structure collapse 2. Loss of or damage to historical infrastructure 3. Loss of or damage to adjacent infrastructure/property
When	Next 5 years
Where	Harbour-wide
Who is involved	Local government, adjoining landowners, RMS
Outcome if issue is addressed	Clear allocation of responsibility for maintenance of coastal protection structures.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Sydney Coastal Councils Group (2013) provided recommendations in relation to the ownership and management of coastal protection structures. Addressing these recommendations as part of CZMP development is supported: • Confirm ownership. • Establish maintenance strategies. • Remove inappropriate structures. • Address legal matters (Workshop).	Local government, CZMP Steering Committee

Management Issue 5.5 – Ageing and Failing Seawalls

Statement	Ageing and failing seawalls are being dealt with inconsistently.
Context	There is currently no agreement between stakeholders on a consistent approach to the management of ageing or failing seawalls, particularly in light of sea level rise projections. This issue is linked to uncertainty over the ownership and maintenance responsibility for these structures (see Management Issue 5.4)).
Gaps	1. The way that various land managers respond to beach erosion, cliff collapse and seawall failure do not appear to have been documented. Collation of this information will form a necessary starting point for discussion amongst these stakeholders.
Values addressed	1. Safe and healthy access to the Harbour 2. High quality of outdoor experience 3. Preservation of natural areas and threatened species 4. Sustainable use and management of the Harbour 5. Preservation and appreciation of cultural heritage
Risks	1. Fatality or injury due to structure collapse 2. Loss of or damage to historical infrastructure 3. Loss of or damage to adjacent infrastructure/property
When	Next 5 years
Where	Harbour-wide
Who is involved	Local government, adjoining landowners, Roads and Maritime Services
Outcome if issue is addressed	Clear and consistent approach to deal with inadequate structures.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Collate summary of coastal management methods employed when responding to seawall failure (Workshop)	CZMP Steering Committee
	Development of an approach to identify and manage inadequate structures (Workshop).	Local government, Roads and Maritime Services, Maritime Engineers, CZMP Steering Committee

Management Issue 5.6 – Flexible Erosion Management

Statement	A Sydney Harbour CZMP needs to allow for flexibility in the application of erosion management responses.
Context	The impact of an erosion event may require different management responses in different locations, depending on the local site conditions, usage of the area and presence of erosion buffers. Stakeholders have expressed concern that enforcing a consistent set of erosion management responses will constrain flexibility or restrict innovative approaches to coastal management.
Gaps	1. The way that various land managers respond to beach erosion, cliff collapse and seawall failure do not appear to have been documented. Collation of this information will form a necessary starting point for discussion amongst these stakeholders.
Values addressed	1. Safe and healthy access to the Harbour 2. High quality of outdoor experience 3. Sustainable use and management of the Harbour
Risks	1. Management responses are too inflexible to give the most appropriate outcomes for specific sites 2. Management responses may be cost prohibitive 3. Stakeholder disengagement from CZMP process
When	Next 5 years
Where	Harbour-wide
Who is involved	Local government, OEH, Roads and Maritime Services
Outcome if issue is addressed	Consistent but flexible erosion management responses.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Development of a flexible erosion management approach, providing a hierarchy of responses to deal with: • Event responses, e.g. natural beach recovery vs beach scraping vs nourishment. • Safety concerns, including as a result of cliff instability and seawall failure. • Specific areas under current or future erosion threats without coastal protection structures, or that contain ageing, failing or potentially inadequate seawalls, using studies such as Sydney Coastal Councils Group (2013) as guidance (Workshop).	Local government, OEH, Coastal Engineers, Maritime Engineers, Geomechanical Engineers, CZMP Steering Committee

2.6 Theme 6 – Cultural and Heritage Protection

The indigenous history of the Sydney Harbour area has been considered extensively by previous studies, with AMBS (2005) and Attenbrow (1991) providing accounts of the Aboriginal Clans of the Port Jackson area and its catchment. Indigenous communities have retained a strong connection to Sydney Harbour. Indigenous cultural heritage sites are still located on or close to the Harbour shoreline (particularly items such as middens), and a CZMP will need to sensitively consider any potential impacts on these.

The non-indigenous heritage of Sydney Harbour has been extensively covered (e.g. Stephenson and Kennedy, 1966), and the role of the Harbour in European colonisation well documented. Individual sites for inclusion in a CZMP need to be identified.

Twenty items of national significance are identified on the Australian Heritage Database either in, or in very close proximity to Sydney Harbour.

The database of Maritime Heritage Sites (DEH, 2014b) contains 171 sites within Sydney Harbour, 154 of which are shipwrecks.

Management Issue 6.1 – Cultural Heritage Consistency

Statement	There is no consistent consideration, documentation or coverage of sites of cultural and heritage significance in Sydney Harbour.
Context	Management of sites of cultural or heritage significance in Sydney Harbour is currently undertaken by a wide variety of management agencies using a variety of planning tools, e.g. Watts, 2003; SHFT, 2011; NSW Parks and Wildlife Service, 2014. Many sites of indigenous heritage significance are culturally sensitive and as part of their preservation strategy, their existence or location is not widely promoted. A CZMP provides an opportunity for consistent consideration of these plans in a Harbour-wide context, and to ensure that high-level planning on adjacent lands is consistent with the desired outcomes of existing cultural heritage sites.
Gaps	1. Much of the existing heritage information is not available electronically, or was unavailable for review within the literature review. Targeted collection of this information for specific sites may be required, depending on how heritage aspects are to be treated in a CZMP.
Values addressed	1. Preservation and appreciation of cultural heritage
Risks	1. Management actions incompatible with or insensitive to cultural heritage management. 2. Damage to or loss of heritage site.
When	At all times
Where	Harbour-wide
Who is involved	Traditional Owners, Sydney Harbour Federation Trust, National Parks and Wildlife Service, OEH, Local government
Outcome if issue is addressed	Complementary and sympathetic management of culturally significant coastal areas.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	A decision will be required on whether to include or exclude culturally sensitive sites from a CZMP, and if they are to be included, the most appropriate way of doing this (7.3.1).	CZMP Steering Committee
	Should a CZMP be tasked to identify key heritage sites for conservation purposes, a separate research project to identify individual sites for inclusion would be required (7.6).	CZMP Steering Committee

The inclusion of heritage sites in a CZMP will need to consider integration with existing management plans, statutory requirements and other programs (7.3, 2.4.6).	CZMP Steering Committee

2.7 Theme 7 – Recreational Use and Amenity

Sydney Harbour has high value to a range of user groups, clubs, associations and individuals. The aspirations and values of these users are diverse. Reconciling the disparate objectives of these users is a challenge of preparing a CZMP for Sydney Harbour.

Over 50 agencies, organisations and user groups with an interest in Sydney Harbour have been identified to date as part of this project.

Sydney Harbour was the most visited NSW Marine Estate in 2013/14 (Sweeney Research, 2014), with 59% of survey respondents visiting the Greater Sydney area.

One of the key values of the Harbour identified by users focussed on access for recreation (Sweeney Research, 2014; Manly Council, 2011). This included the maintenance of views and the amenity provided by being able to recreate in the Harbour.

Activities centred on Sydney Harbour including boating, fishing and Harbour-side recreation such as walking and picnicking form an important part of the NSW and Australian economy (Destination NSW, 2014). There are competing demands for boat storage, Harbourside recreation and tourism spaces.

Management Issue 7.1 – User conflicts

Statement	The intensity and sustainability of use in particular locations within the Harbour has the potential to give rise to conflict over management priorities, particularly between commercial and recreational Harbour users.
Context	The array of user groups and their diverse aspirations for Sydney Harbour illustrates the pressure on the coastal zone. All user groups report likely growth in demand including the cruise and tourist industry, boating and fishing (Carnival Australia, 2011; Tourism Australia, 2014; Boating Industry Association, 2012; ORS, 2013). The use of the Harbour as a part of the transportation system for Sydney as urban consolidation continues is also critical. Harbour foreshores are being increasingly opened as former industrial uses decline. While pedestrian, cycle and boat access may have a different footprint to port related uses the intensity of use in particular locations has the potential to give rise to conflict over management priorities. Community planning documents consistently identify passive and active recreation opportunities associated with the Harbour as being highly valued by the community (e.g. WMC, 2013; North Sydney, 2013, Manly Council, 2004).
Gaps	1. There is limited direct information about the aspirations of user groups specifically in relation to Sydney Harbour. Specific research and broad consultation with stakeholders would be required to report meaningfully on views about the future of Sydney Harbour.
Values addressed	1. Safe and healthy access to the Harbour 2. Maintenance or enhancement of Harbour views 3. High quality of outdoor experience 4. Maintenance and improvement of high water quality 5. Appreciation of low key/natural public areas 6. Preservation of natural areas and threatened species 7. Sustainable use and management of the Harbour 8. Preservation and appreciation of cultural heritage
Risks	1. Conflict between stakeholders if unsustainable management practices are implemented. 2. Loss of amenity for wider community if community needs are not addressed. 3. Damage to economy if commercial operators are not able to remain viable.
When	At all times
Where	Harbour-wide
Who is involved	All stakeholders
Outcome if issue is addressed	Agreement on equitable or acceptable shared usage of Sydney Harbour.

Issue to be addressed in CZMP	*Action (and Literature review chapter reference)*	*Stakeholder*
	User group and stakeholder consultation must inform the future preparation of a CZMP (7.7).	CZMP Steering Committee
	A transparent process for determining and prioritising the goals and actions set in a CZMP will need to be established and agreed with stakeholders (7.7).	CZMP Steering Committee
	Any consultation needs to include strategies to confirm the current understanding of values held in relation to Sydney Harbour and to address sustainably competing objectives and conflicting values (7.7).	CZMP Steering Committee

Management Issue 7.2 – Former Defence Sites

Statement	Management of former defence sites by the Sydney Harbour Federation Trust (SHFT) may not be consistent with other publicly accessible land if they are not included within a Sydney Harbour CZMP.
Context	Former defence sites, managed by the SHFT, provide a combination of recreation, commercial development and tourism on Sydney Harbour. These sites have management plans and processes in place to consider long term uses. Site specific management plans have been prepared for all sites except for Snapper Island (SHFT, 2013).
Gaps	1. Nil.
Values addressed	1. High quality of outdoor experience 2. Preservation and appreciation of cultural heritage
Risks	1. Inconsistent treatment of former defence lands compared to other publicly accessible land.
When	At all times
Where	HMAS Platypus Cockatoo Island Woolwich Dock and Parklands Snapper Island Chowder Bay Georges Heights Middle Head North Head Macquarie Lightstation
Who is involved	SHFT
Outcome if issue is addressed	Consistent treatment of former defence lands compared to other publicly accessible lands

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	A decision will be required on whether to include or exclude these sites from a CZMP (2.4.6).	SHFT

Management Issue 7.3 – Maintenance of Views

Statement	Maintenance of views of the Harbour is seen by stakeholders as strongly contributing to the amenity of the area.
Context	Consultation by local government on community plans consistently identifies that the maintenance of Harbour views from parks and properties is a major local issue/value (e.g. Woollahra Council, 2009; North Sydney, 2013). Building controls are regulated by local government. Harbour views are also affected by the aesthetics of the foreshore – not only parks and the style and location of their facilities, but also the design and appearance of adjacent private or government development.
Gaps	1. Nil.
Values addressed	1. Maintenance or enhancement of Harbour views
Risks	1. Harbour views will be limited to those either on the foreshore or to selected private properties.
When	All the time, but especially during daylight hours.
Where	Harbour-wide
Who is involved	Community; Local Government; Department of Planning and Environment, Division of Local Government; Development Industry.
Outcome if issue is addressed	Maintenance of views of the Harbour to current extents.

Issue to be addressed in CZMP	***Action (and Literature review chapter reference)***	***Stakeholder***
	Ensure management actions maintain or enhance Harbour views for the wider community (7.4).	CZMP Steering Committee

3. Next steps

The Scoping Study Project has identified key themes for the management of the Sydney Harbour study area. These themes and associated management issues will provide a framework for developing a suitable governance structure and a framework to prepare and implement an integrated CZMP for Sydney Harbour (estuary) study area.

The development of an agreed governance structure and framework will be necessary to minimise the barriers to enabling the successful implementation of an integrated CZMP for the Harbour. Two key suggestions provided during the Scoping Study Project that should be considered are:

1. Identification and confirmation of an appropriate "champion" for the integrated CZMP for Sydney Harbour. The "champion" should be the decision-maker for the process and have the ability to influence. The task of identifying and confirming a "champion" for the project could be undertaken by the existing Advisory Committee.
2. Consideration of a spatial planning management tool and implementation approach where spatial planning of harbour areas are an extension of land-use planning. The aim of combining land-use planning with harbour spatial planning would be to reduce conflicts at the water-land interface. Successful spatial planning draws together a comprehensive understanding of the various sectoral interests and values with the analysis of constraints and opportunities through a spatial (e.g. a GIS) platform.

Overall, it was recognised by stakeholders that developing and implementing an integrated CZMP for the Harbour would be a challenge, due to barriers such as a lack of funding, complex governance arrangements, land capacity limitations, public versus private interest and ownership of assets, balancing the needs of a wide and diverse range of stakeholders and gaining community support. Notwithstanding this though, there is an appetite and support from stakeholders for developing an integrated CZMP for Sydney Harbour, with many stakeholder participants commenting that it is overdue and necessary for the successful future management of Sydney Harbour.

Recommendations in the report include suggestions on decisions critical to progress of the CZMP that should be made in the early phases of the project. These comprise:

Management Issue	***Recommended Action***
3.4 – Supporting Infrastructure	Consideration of the development of a common standard/design for infrastructure in foreshore areas.
4.1 – Coastal Risk Prioritisation 4.3 – Lack of Study Outcomes 5.1 – Consistency of Erosion Assumptions	Discussion with project partners to confirm the specific outcomes of the CZMP. In particular, it will be necessary to define the manner in which the CZMP is to be utilised (such as property level assessment, or higher level). Following this, consistent assumptions and agreed planning horizons can be determined, particularly for the assessment of erosion due to storm events, sediment deficits, sea level rise and catchment flooding, and combinations of these.
4.6 – Investigation Costs	Determination of an agreed approach for the funding of the project.
4.8 – Sea Level Rise Benchmark	Agreement on sea level rise planning benchmarks by all councils covered by a Sydney Harbour CZMP
6.1 – Cultural Heritage	A decision on whether to include or exclude culturally sensitive

Management Issue	*Recommended Action*
Consistency	sites from a CZMP, and if they are to be included, the most appropriate way of doing this
7.1 – User conflicts	A transparent process for determining and prioritising the goals and actions set in a CZMP will need to be established and agreed with stakeholders

Discussion on these and the other management issues identified in the Scoping Study Project should be conducted through workshops and ongoing targeted consultation. This will then inform the successful preparation and implementation of an Integrated CZMP for Sydney Harbour.

4. References

Engineers Australia (2012) *Climate Change Adaptation Guidelines in Coastal Management and Planning*; Engineers Australia National Committee on Coastal and Ocean Engineering.

European Commission (2013) *Integrated Coastal Management*. http://ec.europa.eu/environment/iczm/

Pegaso Project (2014) *Pegaso Project*. http://pegasoproject.eu/

All other references are contained in the literature and data review document as references or further reading.

Appendices

Appendix A – Information sources for Scoping Study

The key tasks in the Project were to undertake a literature and data review, use the information assembled in the review to scope Sydney Harbour's usage and management issues, engage with the key stakeholders and in turn provide an understanding of existing processes/conditions within the Harbour study area and suggest ways forward to proceed with an integrated CZMP for Sydney Harbour.

Background - Initial Pre-Scoping Study Workshop 2013

A workshop was conducted by SCCG staff at the Advisory Committee's inaugural meeting in 2013 as a first step in engaging members and drawing upon their individual and collective intellectual capital. Members were organised into small groups at the beginning of the meeting, and groups were asked to identify management issues by brainstorming under the categories of economic, environmental, social and governance. The outcomes of the workshop are provided in Appendix C and were used to inform the preparation of the stakeholder components of the Scoping Study (i.e. workshop and surveys).

Stakeholder Engagement Approach

The importance of integrating stakeholder engagement for this project was well recognised. There is a complex interaction of regulatory responsibility, data collection, and competing priorities for the Harbour and the natural environment. Clarity around the values, objectives, goals, priorities and respective responsibilities of key stakeholders has been a useful component of the whole Scoping Study project.

To follow best practice in community and stakeholder engagement, our approach has been guided by the Core Values and Code of Ethics of the International Association for Public Participation (IAP2). A key first step in formulating an engagement strategy is to utilise the IAP2 Public Participation Spectrum as a means of deciding the appropriate level of engagement, the engagement 'promise' and the most effective engagement tools for the project.

The appropriate level of public participation required for this project was considered to be at the 'involve' level for key stakeholders and at the 'consult' level for other interested stakeholders. By engaging stakeholders at the 'involve' level, the SCCG and the GHD project team worked with stakeholders to ensure that the key issues of concern are incorporated in the scoping study. This formed the basis of the workshop and surveys for the project.

In addition to the IAP2 guidelines, it was recognised that key messages for the project were important. As such, the project has been supported by clear and consistent messages as agreed with SCCG, which have been used in communications with key stakeholders.

This stakeholder engagement approach and the key messages formed the basis of the survey and workshop.

Survey

Background

The purpose of the survey was to source accurate and appropriate information to inform the project, and gain stakeholder opinions about the priorities that should be captured in an integrated CZMP for Sydney Harbour.

The survey was sent by the SCCG directly to the Sydney Harbour CZMP Advisory Committee, the SCCG Technical Committee, and various Sydney Harbour stakeholders not represented on those committees.

The first part of the survey comprised a series of yes/no questions seeking data or literature specific to Sydney Harbour on:

- condition and management
- governance
- characteristics and health of the Harbour and its catchment
- ecology, biodiversity and habitats
- cultural heritage
- hydrology and water quality issues
- risks and hazards
- social or community issues
- other data/literature relating to coastal zone management (not specific to Sydney Harbour)

All questions were followed by an opportunity to provide the material identified, or details on how it could be obtained.

The second part of the survey asked participants to identify and prioritise the 10 most important management issues for their area, and why they were important. As a prompt, a list of 35 different issues, developed from the Initial Pre-Scoping Study Workshop and other CZMP's, was provided. These issues ranged from plan development issues (e.g. governance and funding) through to technical issues (e.g. erosion, heritage conservation). An opportunity was also provided to include other issues not on the list.

Survey outcomes

A total of 40 respondents from 26 different organisations participated in the survey. Of the 40 respondents, 29 (73%) completed the survey in its entirety. The breakdown of organisations that participated in the survey was:

- Local Government: 44%
- State Government: 24%
- academic: 12%
- non-government environmental: 12%
- special interest: 8%

Only a limited number of respondents provided data or literature for use in the literature review. Most of the information provided was already publicly available on websites. Internal documents and data were not provided, although some respondents indicated a belief that some data may exist, but its location was unknown to them personally. Most survey respondents did not circulate the survey to their colleagues.

Key issues and concerns identified in the survey comprised:

- natural flora and fauna protection / enhancement / restoration;
- water contamination / water quality;
- stormwater pollution;
- managing risks to public safety and built assets;
- pressures on coastal ecosystems;

- access to the coastline;
- development in areas vulnerable to coastal hazards;
- protection of coastal landscape / coastal erosion;
- loss of intertidal habitat;
- coastal zone management implementation, monitoring and review;
- Aboriginal Heritage conservation;
- funding to implement a coastal zone management plan; and
- climate change.

A similar process to identify management issues was completed in 1997 as a result of a Coastal Community Workshop to develop the Regional Coastal Management Strategy for Sydney (SCCG, 1998). As part of the assessment of survey results a comparison to the 1997 assessment of issues for Sydney Harbour was undertaken. Analysis of the key issues identified the following trends:

Common issues between 1997 and 2014
Water quality (e.g. management of, impact on biodiversity, stormwater and sediment impacts, and health and safety of recreational users);
Nature conservation (e.g. concerns for future sustainability of natural systems, loss of habitat, increasing pressure on coastal ecosystems)
Public access (e.g. how to manage increased access and demand along the foreshore, identification of actions that maintain public access and access for recreational use)
Governance (e.g. roles and responsibilities, ownership – public/private and jurisdictional boundaries)
Climate change (e.g. sea level rise and uncertainty over impacts)
Aboriginal heritage conservation (i.e. the need to preserve sites of significance, the importance of heritage in the Harbour's history and the fact that sites are highly vulnerable to loss and damage)

Issues in 2014 survey not raised in previous consultation
Funding (e.g. requirements to implement an integrated CZMP, how to minimise threats to public safety and funding needs essential for maintenance of foreshore infrastructure);
Managing development risks (e.g. balance between development and public use, nature of development could influence future attitudes towards these areas and public safety concerns over ageing sea walls).

Literature and Data Review

Background

A desktop review of existing literature and other relevant data was undertaken. Literature and data sought for consideration in the review included internal reports, surveys, briefing notes,

memoranda, studies, manuscripts, metadata etc. directly or indirectly relevant to the management of Sydney Harbour.

The information was assembled through an initial reference list provided by the SCCG; an internet search of typical keywords expected to be associated with the management of Sydney Harbour to locate publicly available documents; a targeted online survey sent to key stakeholders and subsequent follow up, seeking details of reference material held or known to them, and an indication of the priority management issues for that organisation to be captured by the plan; assessment of the reference lists contained in material collected in the above activities; and a workshop with key stakeholders held in April 2014.

As the scope and budget of the study only permitted collation and review of key literature and data, the internet search was restricted to identifying readily accessible information in the public domain. Further details of the approach undertaken to prepare the Literature and Data Review are outlined in Appendix B.

In addition to the Literature and Data Review providing a stocktake, as such, of the work undertaken on Sydney Harbour (where readily available), the Literature and Data Review provides a resource of background reference material for future use in the preparation of a Sydney Harbour CZMP.

Literature and Data Review Outcomes

The existing management of Sydney Harbour is multi-layered, with numerous agencies and government departments playing a role in its governance. A key observation from the literature and data review process was that amongst these agencies and other stakeholders, there appears to be debate over whether the legislative definition of “coastal zone” applies to Sydney Harbour.

Other key observations from the literature and data review included:

- CZMP’s already cover part of the study area (for 5 separate sections of shoreline within the Manly Council local government area). CZMP technical studies have commenced in Mosman and Woollahra Councils. No coastal specific management planning was identified within the study area for Lane Cove, North Sydney, Leichhardt or the City of Sydney, however this may reflect the local and historically heavily modified and developed nature of the shoreline in these LGAs. Largely riparian shorelines in Willoughby, Ku-ring-gai and Warringah Councils were covered by natural area management plans.
- Coastal risks and hazards have been inconsistently dealt with throughout the study area, in particular with respect to projected sea level rise and extreme storm events. Whilst inundation information is available, very little other data was made available, although it is likely that it exists. Consistency of assumptions and the modelling approach between the datasets is expected to be a major issue moving forward.
- Water quality issues continue to be of importance, even though Harbour water quality has improved over the years. Observations made during the Literature and Data Review found that faecal contamination and stormwater inputs are the major factors affecting water and sediment quality within the Harbour. Whilst regular monitoring programs have identified gradual improvements, particularly in water quality, the recording of high levels of contaminants immediately after rainfall events indicates that breaching is still occurring.
- The historical loss of habitat, and direct and indirect impacts from Harbour users continue to affect the ecological values of the Harbour, including three threatened ecological communities, one endangered population, four marine mammals, five marine reptiles, three fish species, six sharks and 27 birds.

- Key values attributed to the Harbour by users include visual and physical access to the Harbour for active and passive recreation in a safe and healthy way.. These users represent a broad section of the community.
- Further data collection activities are recommended, in particular detailed discussions with multiple parts of stakeholder organisations in order to identify all relevant and available documentation and data, which were not previously made available by stakeholder organisations through the survey.

The full Literature and Data Review including the issues, gaps and recommendations is provided in Appendix B.

Stakeholder Workshop

Background

One of the key activities undertaken to prepare the Scoping Study was a four hour stakeholder workshop held at Town Hall House on Wednesday 16 April 2014. Representatives from a wide range of key Sydney Harbour stakeholders were invited to participate in the workshop. From those invited, 35 people attended, representing 30 different organisations with state government agencies (40% of invitees) being most significantly represented, followed by local government councils and groups (30% of invitees), and educational institutions (10% of invitees).

The objectives of the workshop were to:

- Engage stakeholders to harness individual, agency and collective knowledge regarding Sydney Harbour and coastal zone management.
- Provide a forum where participants feel comfortable to communicate freely, and to share and develop knowledge and resources.
- Inform participants regarding the project, in particular, the scoping study purpose and how it relates to the overall CZMP preparation process.
- Present the results of the data and literature review to date and discuss key gaps.
- Provide participants with an opportunity to develop a shared understanding of each other's interests and concerns relating to the current and future management of Sydney Harbour.
- Review, update if applicable, and reach agreement on a priority list of 'whole of Harbour' management issues for inclusion in a future CZMP.
- Endeavour to secure consensus on required actions and responsibilities for preparing a CZMP.
- Outline the next steps for the scoping study.
- Gather information so that the 'Influence' and 'Resources' sections of the project Communications Strategy can be updated for use in the Scoping Study.

Workshop Outcomes

Key findings derived from the workshop were:

- There is an appetite for developing and implementing an integrated CZMP for Sydney Harbour, with many participants commenting that it is overdue and necessary for the successful management of Sydney Harbour in the future.

- Participants acknowledge that developing and implementing a plan will be a challenge, due to barriers such as a lack of funding, complex governance arrangements, land capacity limitations, public versus private interest and ownership of assets, and balancing the needs of a wide and diverse range of stakeholders.
- An integrated approach to the management of Sydney Harbour under the Sydney Harbour Manager (1999-2001) was considered to add value to existing management approaches at that time. By involving all stakeholders with an interest in the Harbour through various forums and networks, stakeholders were able to internally negotiate and compromise positions on key issues, resulting in one united voice speaking to state and local government.
- Participants identified a wide range of management issues that will need to be addressed in the development of any plan. Issues for a CZMP to address were:
  - Balancing demand for access to recreational opportunities
  - Adverse impacts on water quality from stormwater and other runoff
  - Impacts of invasive species on flora and fauna (aquatic and terrestrial)
  - Management of stormwater in the context of climate change
- Key issues centred around the development of the plan included governance, funding to implement any actions, determining public and private ownership of assets and their management, resolving conflict between stakeholders with opposing interests in Sydney Harbour and gaining public support for any plan that is implemented.
- Involving the community in the development of an integrated CZMP will be important for gaining public support, which may in turn generate sufficient political will, support and funding to implement the CZMP.

Detailed findings from the workshop including participant feelings about the development of an integrated CZMP, views about Sydney Harbour, identifying top management issues and past management approaches are further outlined in Appendix C.

Appendix B – Literature and Data Review

Appendix C – Stakeholder Workshop Outcomes Report