

# Our Harbour Our Asset

An overview of economic activities and values associated with Australia's most iconic harbour, and its use by the city that surrounds it



Sydney Institute of Marine Science Technical Report



© Sydney Institute of Marine Science, 2015

This publication is copyright. You may download, display, print and reproduce this material provided that the wording is reproduced exactly, the source is acknowledged, and the copyright, update address and disclaimer notice are retained.

**Disclaimer**

The views presented in this report do not necessarily reflect the views of The Sydney Institute of Marine Science. This report is a review of other literature written by third parties. Neither the Sydney Institute of Marine Science nor the affiliated institutions take responsibility for the accuracy, currency, reliability, and correctness of any information included in this report provided in third party sources.

More information on how some of the values were estimated is available in a volume of Appendices, available from SIMS on request.

**Recommended Citation**

Hoisington, C., 2015, *Our Harbour Our Asset: An overview of economic activities and values associated with Australia's most iconic harbour, and its use by the city that surrounds it*, Sydney Institute of Marine Science, Sydney, Australia.

National Library of Australia Cataloging-in-Publication entry  
ISBN: 978-0-646-94782-2  
Publisher: The Sydney Institute of Marine Science, Sydney, New South Wales, Australia

Available on the internet from [www.sims.org.au](http://www.sims.org.au)

For further information please contact:  
SIMS, Building 19, Chowder Bay Road,  
Mosman NSW 2088 Australia  
T: +61 2 9435 4600 F: +61 2 9969 8664  
[www.sims.org.au](http://www.sims.org.au)  
ABN 84117222063

Author: Caroline Hoisington  
Editors: Dr Joanne Banks and Karen Raubenheimer  
Designer: Marian Kyte

Cover photo: New Year's Eve fireworks over Sydney Harbour.  
Photo Taras Vyshnya / Shutterstock.

Opposite: View from the South Head Heritage Trail in Sydney Harbour National Park.

Photos by Marian Kyte, unless otherwise stated.

Photos included in this report do not in any way imply endorsement by the photographer of this work or the authors and contributors.

## Acknowledgements

I am very grateful for advice, reviews and information from colleagues and officials in several agencies that made this work possible and improved it in many ways. The process of creating this report has taken more than three years and involved considerable updating. At times, it seemed that developments around the Harbour were taking place faster than the paper research, writing and production, but that is surely an indication of both how central the Harbour is to the city and how much activity is tied to it.

I'm grateful that SIMS commissioned this research, despite the fact that it soon became apparent to me why – to the best of my knowledge – no one else has been foolhardy enough to attempt what began as an estimation of the total economic value of Sydney Harbour. It is now more realistically entitled an overview of economic activities and values associated with the Harbour for technical reasons and limitations explained in the text.

I owe many thanks to those who have made this work possible, including a number of readers and editors at SIMS and elsewhere including, in rough chronological order, Charlie and Geoff Shuetrim, Peter Steinberg, anonymous colleagues and finally

Jo Banks, who has taken on the considerable task of pulling it all together with the very able design assistance and many photographs by Marian Kyte. Together they have made it far more readable and appealing and finalised the work.

Finally, gaps and mistakes are all mine. They will, I hope, be seen as a call for others to update, correct and supply better data. I believe that an overview of economic values – that is, not just financially quantified value, but all those values and activities that we care about and want to keep or even improve upon, from financial transactions to the free use of public parks – that are dependent upon or closely linked to Sydney Harbour is a useful endeavour. It emphasises to us the importance of the Harbour in our lives and in the character of our city and shows it is worthy of our care.

**Caroline Hoisington**

Author, Sydney, October 2015

Caroline Hoisington is a Resource Economist and Visiting Fellow at the Sydney Institute of Marine Science



# Contents

Executive Summary	6	1.7 Environmental values: ecosystem services, biodiversity and quality	30
Introduction	8	Ecosystem services	
An economic assessment of values associated with Sydney Harbour		Biodiversity values – estuaries	
1 Values in, on and around Sydney Harbour	11	Indicators of valuing environmental quality	
1.1 Harbour Functions: ports, maritime activities, transport, the Royal Australian Navy	12	1.8 Cultural heritage and the arts, scientific research and teaching	35
Sydney's ports and trade		Cultural heritage and the arts	
Maritime revenues from Sydney Harbour operations		Science, research and educational values	
The Royal Australian Navy		Spiritual, religious and altruistic values	
Harbour transport ferries and water taxis		2 Summary	38
1.2 Cruising revenues and tourism more generally	16	3 A conceptual approach to future risks and opportunities	43
Revenues from the cruising industry		3.1 Sources of Harbour values	43
Tourism more generally		3.2 Sources, changing values and possible risks	43
1.3 Harbour foreshore: landscape, icons, attractions and special events	18	Geography	
Landscape values		Water quality	
Sydney's icons: the Harbour and structures on its shores		Healthy marine ecosystems	
Major events on and around Sydney Harbour		3.3 Studies into values of estuaries with major cities	46
1.4 Higher land values and real estate prices closer to Sydney Harbour	23	San Francisco Bay natural resources services valuation	
Residential housing		4 Technical Notes	47
Commercial property		4.1 Estimation methodology	47
1.5 Harbour-related private businesses	25	Total economic valuation	
1.6 Outdoor leisure and sporting activities	26	4.2 Some technical issues which arise in making an economic assessment of Sydney Harbour	49
Boating		5 Conclusion and relevance for future study	51
Swimming		6 Endnotes	52
Use of Harbour parks and walks on the foreshores			
Recreational fishing			
Snorkelling and scuba diving			

# Executive Summary

Sydney Harbour and our coastal beaches are arguably the city of Sydney's greatest environmental assets. Much of Sydney's appeal comes from its waterside lifestyle and natural attractions that are, fundamentally, environmental assets. As is true for environmental assets generally, we do not pay for the Harbour directly. We may pay to live close to it, to sail, fish or scuba in and on its waters, or to enjoy a festival on its foreshore, but we are essentially paying for these activities and amenities, not for the Harbour itself. This complicates any effort to estimate its value, but it is worthwhile nonetheless to assemble as much information as possible about the economic activities and values that are dependent upon the Harbour as an overview and a basis for guiding future research. The goal of this report is to start this process.

The concept of assessing the economic value of Sydney Harbour is fascinating, but the complexity of the task is challenging. This may explain why we are unaware of any previous economic valuation of Sydney Harbour. Sydney Harbour and the city of Sydney are so intimately linked as to be inseparable, and the number and assortment of activities relating to the use of the Harbour further complicate the task.

From first principles alone, the economic contribution of Sydney Harbour is likely to be enormous. The city of Sydney has evolved with the Harbour, which has, in turn, shaped the character of the city. The fact that Sydney is so linked to its Harbour contributes significantly to the quality of life in Sydney and its appeal. It is relatively unusual, globally, to have such a large and vibrant city so closely linked to a beautiful estuary with extensive natural parks and wild areas, good water quality and a high diversity of marine life.

The same definition of Sydney Harbour was used in this economic study as for a companion scientific study, *The Sydney Harbour Research Program State of the Harbour Report 2014*. The boundaries include the entire estuary, reaching from the Parramatta Weir to a line joining North and South Heads at their closest point. The time frame of the study, from now to the next 20 years, is also the same.

This report focuses on a wide range of economic values of Sydney Harbour, from the market-based to environmental service valuations to important values that are not easily quantifiable or subject to market valuation. The approach taken goes well beyond a strictly monetary one, recognising value in relation to any aspects of the Harbour that society would want to retain or enhance, and for which it would consider incurring a sacrifice (for example, investment to protect ecosystems or foreshore amenity).



above: Sydney skyline from Cockle Bay. Source: Photo Gareth Edwards. [https://commons.wikimedia.org/wiki/File:Sydney\\_skyline\\_from\\_Cockle\\_Bay\\_2012-08-06.jpg](https://commons.wikimedia.org/wiki/File:Sydney_skyline_from_Cockle_Bay_2012-08-06.jpg)

below right: Sculpture by the Sea, Bondi to Tamarama coastal walk, attracts thousands of visitors each year. 'Coastal Totem' by Linda Matthews, 2014. Photo courtesy the artist.

Eight groupings have been used to value the Harbour, encompassing 22 individual sources. These are:

1. Harbour functions: ports, maritime activities, transport, the Royal Australian Navy
2. Cruising industry and tourism
3. Harbour foreshore landscape values
4. Incremental values of land and real estate
5. Private businesses
6. Outdoor leisure and sporting activities
7. Environmental quality
8. Cultural heritage, arts, science, option, existence and bequest values

The values covered in this report represent economic values for which Sydney Harbour plays a central role or makes an essential contribution. In other words, without the Harbour, these values would be either non-existent or very much reduced. Because there are a number of impediments to estimating how much of the total value of these economic activities can be attributed to the Harbour, they are referred to as 'indicators of value' rather than a total valuation.

These indicators of value come from a wide variety of sources, which are cited in the text and endnotes. Conceptually, the values range widely (annual financial revenues and incremental housing values for instance) categories overlap in part with others (e.g. the economic benefits of tourism and of cruise ships), and there are a variety of other challenges in estimating the value of the Harbour.

Summary tables are provided in Section Two: Table 7 – *Economic activities and indicators of value and revenues associated with Sydney Harbour*, and Table 8 – *Values associated with Sydney Harbour (annual and present value over 20 years)*. In these tables the indicators of value are estimated in monetary terms where possible. Others are shown only in terms of numbers of users or participants. Those that cannot be quantified in either way at this point are only described qualitatively.

Of the 22 sub-values, monetary calculations were possible for 12. Values for which calculations could not be found present opportunities for further research. A summary is provided here with details listed in Table 8.

Activities & Functions	Estimated Value Provided	No Valuation (Research Opportunity)
<b>Harbour Functions</b>	Harbour port, revenues	Royal Australian Navy
	Maritime revenues for services	
	Sydney ferries	
<b>Cruise ships &amp; tourism</b>	Cruise ships expenditures	Other Sydney Harbour tourism
<b>Foreshore landscape values</b>	Sydney Opera House	Other icons and attractions
	Taronga Zoo	
	Major events on & around SH	
<b>Value of land &amp; real estate</b>	Domestic real estate	Commercial real estate
<b>Private Businesses</b>		Harbour dependent
		Adjacent to harbour
<b>Outdoor leisure &amp; sporting activities</b>	Recreational Fishing	Boating
		Swimming
		Parks & walks
		Snorkelling, scuba diving
<b>Environmental Quality</b>	Ecosystem services	Biodiversity
	Valuing cleaner water	
<b>Culture, heritage, arts &amp; science; option, existence &amp; bequest</b>	Sydney Harbour Federation Trust	Other historical & cultural sites
	Science research & teaching	
		Option, existence & bequest

The methodology used in this report is an adaptation of the total economic valuation (TEV) approach often used in valuing environmental assets. The goal is to determine a monetary worth for a range of values of various sorts in a way that makes a total possible. However, there are many complexities in trying to estimate economic values for Sydney Harbour; data is seldom available in the necessary format and it is very difficult to separate the city and the harbour as individual sources of value. Different reporting agencies also report in different formats and reporting of revenues may overlap, raising the risk of double counting. Some important values are currently not quantified or quantifiable in dollar terms and some are apparently not quantified at all as of yet, such as the numbers of users of harbor-side parks and pools. The technical issues which arise in making an economic assessment of Sydney Harbour are outlined in as much detail as is possible for a report of this nature.

This effort at estimating total values is a starting point to understanding the changes that occur 'at the margins.' Policy makers, and indeed the public, want to know what can be gained, or what can be lost. In the case of Sydney Harbour, the question is often phrased as: What is at risk?

Even though individual estimates of values at this stage are limited, the process of assembling them may help to create a better understanding of the value of Sydney Harbour, and how we may be able to derive greater sustainable value into the future.

Decisions on the multiple competing uses of Sydney Harbour are being made every day, both implicitly and explicitly. Thinking through how we perceive the value of the different dimensions of Sydney Harbour should help inform these decisions. The hope is that this report is a solid step along the way towards a more informed decision-making process.

I and my colleagues at SIMS hope that this initial effort will be updated and expanded over time with input from readers of this report and the experts and agencies involved.



# Introduction

## An economic assessment of values associated with Sydney Harbour

'Sydney Harbour features abundant natural areas that contain a multitude of nature-based pursuits, Aboriginal cultural heritage experiences, convict and colonial history representations, iconic and internationally significant World Heritage and National Heritage attractions, hidden coastal delights, and one-of-a-kind activities that are easily accessible from the city centre. The landscape reflects Australia's icons and is inextricably linked to landscapes across the country.'

Sydney Harbour is an Australian icon, the heart of the city and its symbol. The Harbour is the first attraction – along with the iconic Opera House on its foreshore – that people in Australia and overseas name as quintessentially Sydney. The Harbour is a matter of civic pride because of its beauty and its historical and cultural associations. It is also so distinctive as to have become an image for

Australia internationally. On the website Trip Advisor – globally one of the most widely used and successful travel sites, where attractions, activities, accommodations etc. are rated by users – Sydney Harbour is rated the number 1 out of 295 attractions listed for Sydney.<sup>2</sup> The international 'Clean up the World Day' started as 'Clean up Sydney Harbour Day' suggesting that the image of the Harbour has helped to spread environmental awareness globally. It is clear that international interest in the Harbour is wide. Google Earth is currently in the process of filming the underwater landscape of Sydney Harbour to include in its world maps.

Sydney and its population have evolved around its harbour and beaches and, in turn, these have substantially shaped Sydney and the structure of its society and economy. In particular, patterns of development, the nature of Sydney's built infrastructure, the city's lifestyles and lifestyle preferences, transport patterns, services and, in a deep sense, Sydney's social fabric have all been shaped by its harbour and beaches and their associated foreshore areas. Degradation of these environmental assets would result in significant damage to the city, undermining the values that have been built over more than two centuries of urban and social evolution.



The Harbour is part of the city's image as a centre for outdoor activities and water sports, including internationally watched events such as the Sydney Hobart Yacht Race. The New Year's Eve fireworks, broadcast world-wide, and many more special events take place on the Harbour foreshores. It is an important part of many businesses, both directly and indirectly, and residents who can afford to do so often choose to live near the Harbour or with a view of it.

Sydney Harbour is surprisingly biologically diverse. It supports a large range of habitats that includes not only the beaches and open water that we see most, but also intertidal reefs, seagrass beds, salt marshes, mangroves, rocky/hard shorelines (natural and artificial) and soft sediments. These all provide ecosystem services. However, these habitats face multiple threats to varying extents, ranging from urban pollution to physical disturbances, habitat loss, over-harvesting, invasive species and the effects of climate change.<sup>3,4</sup>

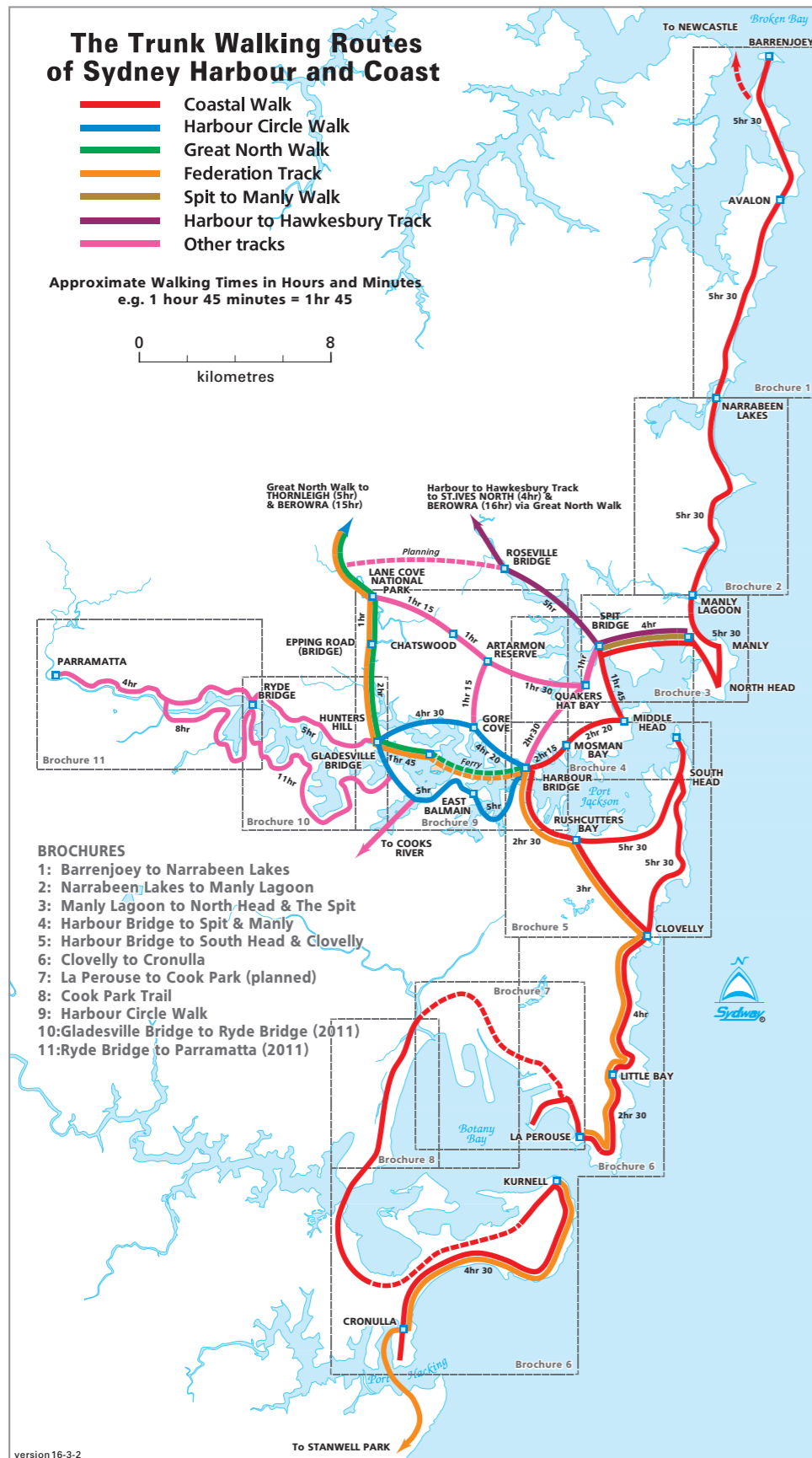
This report reviews a wide range of economic values, from market-based to environmental values such as ecosystem service valuations and amenity value.<sup>5</sup> It is designed to be a preliminary assessment, and hopefully can be continued, refined and expanded under such programs as the Sydney Institute of Marine Science's (SIMS) Sydney Harbour Research Program (SHRP). Sydney Harbour is a valuable asset for the many people who appreciate it and use it for different purposes. Our goal here is to complement biophysical research into the Harbour with economic assessments, both to help protect the Harbour from the threats it faces and to identify opportunities to improve it.

above: Robertson Park, Watson's Bay is a significant attraction for locals and tourists offering seafood by the beach, Harbour ferries and scenic views.

right: Kayaking at Clifton Gardens, Chowder Bay. Photo courtesy SIMS.

left: Chowder Bay from Sydney Harbour National Park, showing multiple uses including the SIMS facilities, historic buildings, wharves, swimming beach, private boating and views towards the headlands.





above: Map of the trunk walking routes of Sydney Coast and Harbour. Source: Walking Coastal Sydney. [http://walkingcoastalsydney.com.au/brochure\\_outlets.html](http://walkingcoastalsydney.com.au/brochure_outlets.html). [http://walkingcoastalsydney.com.au/downloads/trunkSydCoastHbr\\_21.03.07.pdf](http://walkingcoastalsydney.com.au/downloads/trunkSydCoastHbr_21.03.07.pdf). © 2007 Sydney Coastal Councils Group

right: Greenwich Point Ferry Wharf.

above right: Harbourside beach and ferry wharf, Manly. Photo Caroline Hoisington.

## 1. Values in, on and around Sydney Harbour

The approach to valuing Sydney Harbour in this paper derives from eight groupings of aspects and uses of the Harbour that encompass 22 sources of values:

1. Harbour functions: ports, maritime activities, transport, the Royal Australian Navy
2. Cruising industry and tourism more generally
3. Harbour foreshore landscape, built icons, attractions and special events
4. Incremental land values due to proximity to the Harbour
5. Harbour-related businesses dependent on the Harbour or benefiting from proximity
6. Outdoor leisure and sporting activities including boating, swimming, parks and walks, recreational fishing, snorkelling and scuba diving
7. Ecosystem service values, biodiversity and indicators of people valuing environmental quality
8. Cultural heritage, the arts, scientific research and teaching, option, existence and bequest values

The starting point is the use as a functioning harbour for trade, transport, defence and its draw for tourism. Use of the harbour foreshores for infrastructure icons



and as a site for public and private events leads to its landscape values and in turn to the incremental value of real estate near the harbour and its value for private businesses of all sorts, operating both near and on the water. Next are the many values of the harbour as an outdoor place for sporting and recreational activities from boating, fishing, swimming and scuba diving to the extensive use of walking trails and parks on its edges. Environmental values include ecosystem service values and the value that residents and visitors place on environmental quality, particularly clean water. Finally the values of cultural heritage and the arts, scientific research and teaching are discussed, along with option values (knowing one could use something), existence (valuing that it exists) and bequest values (for the next generation(s) often one's own descendents) all hard to quantify, but of significant value.



# 1.1 Harbour Functions: ports, maritime activities, transport, the Royal Australian Navy

## Sydney's ports and trade

'Our ports handle more than \$61 billion worth of trade each year, contribute about \$2.5 billion to the NSW economy, and generate employment for more than 17,000 people throughout the logistics chain.'<sup>1</sup>

Sydney Ports manages the navigation, security and operational safety needs of commercial shipping on Sydney Harbour and Port Botany, as well as the ports of Yamba in the state's north and Eden in the far south. The Corporation also works to protect the environments of these ports. The services it provides include: Harbour Master; Pilot; survey; navigation; vessel traffic management; safety; security and environment; emergency response and clean up; and the management of dangerous goods regulations.

Sydney Ports also operates Sydney's two international cruise terminals (the Overseas Passenger Terminal (OPT) at Circular Quay and White Bay Cruise Terminal, west of the Harbour Bridge at Balmain) and hosts dry bulk facilities at Glebe Island. Sydney Ports plans, designs and develops port and cruise related infrastructure.



above: Port Authority of New South Wales ensures safe movement of ships, cargo and passenger vessels through Sydney Harbour.

below: View towards Sydney's eastern suburbs, featuring the Manly Ferry and various boating activities on the Harbour.

With much of the trade shipping having moved to Botany Bay, cruising facilities are being further developed in Sydney Harbour. The White Bay Cruise Terminal was opened in April 2013 giving Sydney two dedicated cruise facilities. Using both White Bay berths and the OPT at Circular Quay Sydney Harbour can host three substantial cruise ships simultaneously. Planning is also continuing on the upgrade of the OPT, necessary for one day turnaround of the larger 4000 passenger cruise ships. Cruising is growing rapidly with 240 cruise ship visits to Sydney Harbour in 2012-13, up from 199 in 2011-12, 153 in 2010-11 and 119 in 2009-10. This is a compound annual growth rate over the three years of more than 26% per year.<sup>2</sup> (Revenues from the cruising industry are treated in the section on cruising revenues and tourism generally).



Port Botany received 1601 'chargeable vessel visits' in 2011-12 compared with 540 in Sydney Harbour and 38 in the smaller ports of Yamba and Eden.<sup>3</sup> A similar pattern held for 2012-13 with respective figures of 1617, 552, and 76 visits.<sup>4</sup> This suggests that most of the trade contribution to the NSW economy comes from Port Botany operations, estimated at about 75% based on numbers of chargeable vessel visits. If the number of cruise ship visits (240) to Sydney Harbour is deducted from the totals in order to look at traded goods only, Port Botany would account for about 80% of the trade figure and Sydney for 16%.

Direct estimates of the value of this trade are difficult to obtain. However, if this proportion of vessel visits is reflected in a similar pattern for financial returns from trade and employment, Sydney Harbour would have been the source of about 16% of the totals listed in the 2011-12 Annual Report, quoted above, or \$10 billion for the value of goods traded, \$430 million for harbour operations added to the NSW economy and employment equal to 3000 full time jobs. The value of the harbour operations is included in the listing of revenues in Table 8, but the value of goods traded is excluded.

## Maritime revenues from Sydney Harbour operations

NSW Roads and Maritime Services (RMS) provides services and raises revenues from boat registrations, operating licenses, mooring fees, and other boating, surveys and registration services. It uses these revenues for safety education, accident investigation, control, planning, management and administration, enforcement, navigation and maintenance, mooring management, event management, and various small grants to councils for boat ramps and other infrastructure. It maintains and upgrades wharves for Sydney's ferries. It also receives significant revenues from rents and leases of wetland areas on the Harbour foreshores (for jetties and the like) as well as for shipping operations including wharfage, channel fees and channel deepening.

Information on revenues for maritime operations was taken from the NSW Maritime Annual Report for 2011.<sup>5</sup> Most of the information in the annual reports is given for NSW in total. With the assistance from the NSW RMS, the maritime operational revenues for Sydney Harbour only were separated out from those of all of NSW. The total revenue for operations in Sydney Harbour in 2011 came to over \$33.5 million as shown in Table 1. (This total is also shown, when updated to 2013 equivalent, to be compatible with other estimates in this report.)

Table 1: Maritime revenue – estimates for NSW and Sydney Harbour 2011

Revenue items	Amounts (000s)
Boat registrations	\$2375
Boat licenses	\$2299
Mooring fees	\$1954
Various boating fees	\$220
Survey fees, registration, exams, etc.	\$1296
Channel fees Sydney Port Corporation	\$895
Property rents and leases	\$24,544
Maritime revenue associated with Sydney Harbour in 2011	\$33,583
<i>Adjust, 2011-2013 dollars</i>	1.0362
Maritime revenue associated with Sydney Harbour in 2011, adjusted to 2013 dollars equivalent	\$34,799

Sources: personal communication and annual report<sup>6</sup>

Due to reorganisation, revenues and expenditures are listed with roads as part of the NSW Roads and Maritime Annual Report starting in 2012-13. Some figures are available for Maritime only, but most of these are for all of NSW, so it is difficult to tell what proportion is due to Sydney Harbour activities specifically, except when projects are listed with specific locations. For example, in 2012-13, expenditures included \$15.4 million for the commuter wharf upgrade program in Sydney Harbour, part of a multi-year program that will total \$89.5 million.<sup>7</sup>

## The Royal Australian Navy

From first settlement through various wars, defences have been constructed around the Harbour. The Royal Australian Navy (RAN) currently maintains the Fleet Base East (FBE)<sup>8</sup> in the Harbour. Military uses of the Harbour have taken on historical and cultural values as the 100-year anniversary celebrations in October 2013 – with an International Fleet review of military and tall ships and celebrations – clearly showed.<sup>9</sup>

FBE (HMAS *Kuttabul*) in Sydney Harbour is now one of the two major navy defence establishments in Australia, with Fleet Base West (HMAS *Stirling*) in Western Australia being the other. Today *Kuttabul* serves as the administrative centre for FBE, a precinct that extends beyond the borders of *Kuttabul* and includes the Garden Island dockyard and adjacent wharf facilities at nearby Woolloomooloo.<sup>10</sup> In addition, training and medical facilities exist on Middle Head in the Harbour.

The Royal Australian Navy is an example of the difficulties of estimating individual values for Sydney Harbour. The costs of setting up and maintaining a naval base and the ships are extensive, but national

defence is one of the values that we collectively are willing to pay for. Fleet Base East and the navy training facilities are arguably of great value to Australia's military and defence system. However, no monetary valuation of the Sydney Harbour military operations or its infrastructure could be determined, nor how these might differ from another site for the base.

## Harbour transport ferries and water taxis

The NSW Ferries Annual Report of 2011-12<sup>11</sup> quoted in Table 1 includes information on routes, fleet and various performance indicators. This includes:

- Total revenue ca. \$163 million, costs ca. \$153 million, and operating surplus ca. \$9.8 million
- Estimated cost per passenger journey in 2011-12 was \$8.50
- Over 14.7 million passenger journeys were recorded in 2011-12
- Approximately 31% of all passenger journeys were made by people commuting to work or education, while 47% were for sightseeing/leisure and 21% were for private business, such as shopping, meeting friends or attending appointments
- Manly has the busiest route with 5.8 million passengers
- Inner Harbour routes accounted for 7.2 million passengers
- Parramatta River services carried almost 1.8 million passengers
- A total of 656 full-time equivalent staff was employed as of 30 June 2012

If updated to 2013 dollars, the total revenue is estimated at \$173 million. There are also benefits in terms of travel costs avoided by people not using their cars (if estimated at the average of per km government rates for the calculated 1.5 million km travelled by ferry, this amounts to over \$1 million/year). In addition, the (unquantified) benefits of not having to spend as much to expand road facilities, and the appeal to tourists and residents of the enjoyment and convenience of taking ferries are important but were not estimated here.

*'In July, Harbour City Ferries (HCF) – a partnership between Transfield Services and Veolia Transport Australia – took over the operation of Sydney Ferries. This was done under a service contract with TfNSW designed to benefit customers with the best of private sector experience and management practices. Control of key assets and strategic decisions will remain with the NSW Government. The contract requires the operator to meet a number of performance benchmarks in key areas including safety, reliability and customer service. The contract also delivers significant improvements in value for money for taxpayers.'*<sup>12</sup>

This new arrangement, begun in July 2012, was reported in the NSW Department of Transportation Annual Report<sup>13</sup> where progress was summarized as shown here in Table 2: Comparison of ferry performance indicators. Figures for the ferry services were listed, showing continued growth in numbers of passengers and trips but did not include financial results.

Table 2: Comparison of ferry performance indicators

Performance Indicator	2011-12	2012-13	Change 2011-12 to 2012-13
Passenger boardings	14,768,332	14,943,173	1.2%
Scheduled ferry trips	173,329	174,029	0.4%
Passenger boardings / ferry trip	85.2	85.9	0.8%

Source: Transport for NSW Annual Report 2012-13

In the report most of the extensive financial reporting is for the transport operations as a whole, including rail, buses, RMS and more. Only a few financial figures for ferries are mentioned, mostly under 'service group statements' where total figures for expenses and revenues are less than 1% of the total expense and revenues and the net result for the year is negative. This reflects NSW Transport's new role of overseeing the franchise-holder HCF, rather than operating them.

### Fast Ferries

The websites for Manly Fast Ferries<sup>14</sup> and Sydney Fast Ferries<sup>15</sup> both provide information about their operations, but not financial information as both are private companies. Both offer faster transport ferries between Manly and Circular Quay and also special cruises for events including New Year's Eve, Australia Day and the start of the Sydney Hobart Yacht Race. Manly Fast Ferries also offers other combinations including Manly, North Sydney, Darling Harbour and an eco-tour with hop on hop off fares between Manly, Q-Station, Watsons Bay,

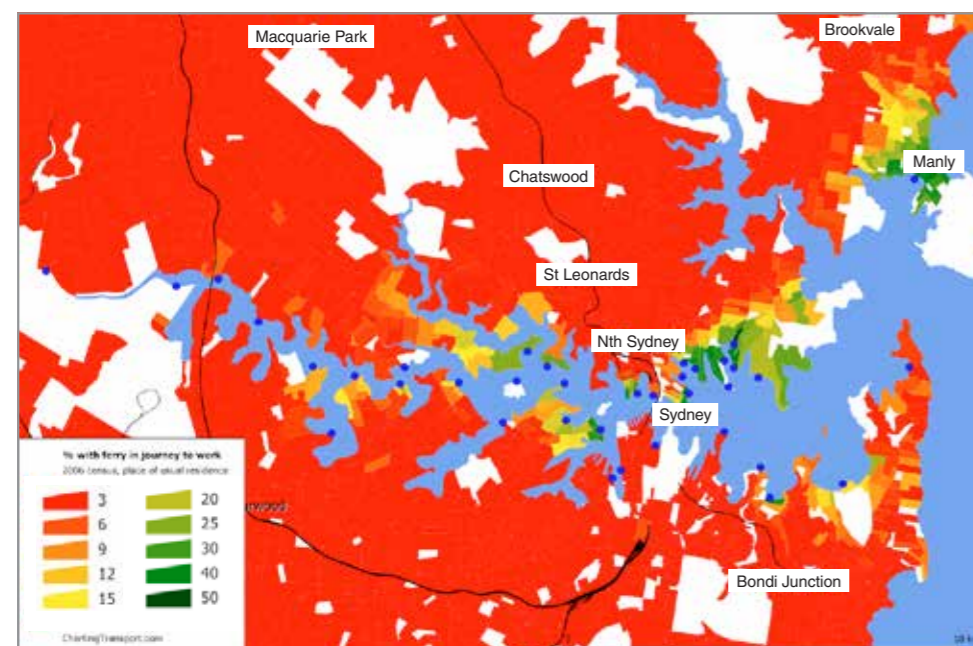


Watsons Bay Ferry Wharf services Sydney Ferries, peak hour commuters, tourists and private cruises.

Taronga Zoo, North Sydney/Luna Park, Circular Quay and Darling Harbour. Sydney Fast Ferries offers adventure cruises and private charters.

### Harbour water taxis

There are approximately 15 water taxi companies operating on Sydney Harbour, all private companies. Their fares are considerably higher than the ferries but financial information was not found and seems not to be publicly available.



left: Map showing the percentage of people who use ferries to commute to work. Source: chartingtransport.com/category/sydney

right: Circular Quay is on the northern edge of Sydney's CBD between the Bennelong Point and The Rocks. It is a tourist hub and transport interchange for ferry, bus and rail services, and cruise ships at the Overseas Passenger Terminal.





## 1.2 Cruising revenues and tourism more generally

### Revenues from the cruising industry

Current estimates for the value of the cruise ship industry vary. A report for the company Cruise Down Under<sup>1</sup> stated that the total contribution to the Australian economy by the cruising industry in 2012-13 was over \$2.06 billion per year, of which \$1.23 billion was in direct expenditure. In that report, the figures for Sydney Harbour show a direct expenditure in Sydney in 2012-13 of \$1.0247 billion.

Other estimates from the Carnival Australia submission to the Barangaroo Review<sup>2</sup> said cruising contributed \$221 million to the NSW economy in 2007-08 but had grown by over 20% per year since then and projected a figure of over \$660 million by 2011, which would be closer to the Cruise Down Under estimates if updated. The same report says that an Access Economics report in 2011 based on 2007-08 data found that cruising contributed \$1.2 billion to the Australian economy, but based on current growth patterns, there is every reason to believe that cruising now contributes at least \$3 billion to the national economy. The Industry Snapshot chart for 2011 shows the value of cruising for Australia at \$3 billion/year and for NSW at \$660 million.<sup>3</sup>

These figures for the value of the cruise sector vary in part due to differences in what is being estimated. The largest estimates are for all of Australia and include information based on surveys undertaken as to how much cruise passengers spend before or after their trips. Clearly there is considerable overlap with tourism estimates for at least that part of the estimate. However, Tourism Australia states that its estimates do not include prepaid tours. It is not possible to break these figures down, but because the totals for tourism generally were not added into the totals in Tables 7 and 8, the total estimates for Sydney Harbour cruise ships are presented here. Table 3 represents the most recent and complete figures from the Cruise Down Under report, which show that Sydney Harbour cruises are responsible for a contribution of about \$1.025 billion expenditure to the Australian economy.

Table 3: Sydney Harbour cruise figures in brief, 2012-13

Description	Quantification (days)
Visit days	240
Passenger days at port	970,560
Crew days at port	185,420
Expenditures	\$ Australian
- Passengers	358,720,000
- Crew	42,340,000
- Operator	494,420,000
- Corporate	129,190,000
Total	1,024,700,000

Source: AEC Group Ltd. 2013<sup>4</sup>

### Tourism more generally

'Sydney benefits from its unique physical environment; a beautiful harbour, beaches and reserves and iconic buildings and infrastructure such as the Sydney Opera House and Sydney Harbour Bridge. It is largely this physical environment offering that has historically drawn tourists to Sydney.'<sup>5</sup>

Tourism values can be measured in terms of annual revenues, data for which are available through Destination NSW and archived from Tourism NSW. Tourism represents a very large economic value to Sydney in terms of revenues brought into the city from both international and national visitors. It is also an important source of employment. The total revenue that tourism brought to Sydney was \$13.5 billion in 2012, of which \$5.69 billion was from those who stated that their prime motivation was holiday/pleasure, although those who come for other reasons (visiting friends and relatives, business or other including education) also use the Harbour and



above: Sydney Harbour is Australia's premier cruise ship destination. Source: NSW Government. Port Authority of New South Wales. [http://www.sydneyports.com.au/port\\_operations/cruising](http://www.sydneyports.com.au/port_operations/cruising).

right: Aerial view of North Head showing the extensive bushland in Sydney Harbour National Park and walking trails. Courtesy Sydney Harbour Federation Trust and SIMS.

its many facilities. It is not possible to separate out how much of visitors' time and money was spent directly on activities in, on and around the Harbour, but there are many indications of how important it is as a tourist drawcard.

The tourist website Sydney 100<sup>6</sup> lists the 'Top 100 things to do in Sydney', and the top 10 all involve the Harbour, from activities on it to seeing sites adjacent to it (e.g. catching the Manly Ferry, Harbour Cruises, the Royal Botanic Gardens). Trip Advisor<sup>7</sup> lists Sydney Harbour as the #1 of 293 'attractions in Sydney,' while 16 more of its top attractions are integrally linked to Sydney Harbour. The Darling Harbour redevelopment is focusing heavily on tourism and income generation:

'The International Convention Centre Sydney, which includes the convention and exhibition centres plus the entertainment theatre, will generate \$200 million annual economic benefit for NSW.'<sup>8</sup>

Employment is projected at 3700 jobs during construction, and 4000 jobs in tourism, hospitality, entertainment, facilities management and venue operations, once in operation.

There is no doubt that Sydney Harbour is an important part of Sydney's attraction to tourists. It functions as a site for sporting, artistic and commercial activities. It offers a beautiful setting

for city life generally. It is also a spectacular site to witness on arrival, whether viewed by air from a descending airplane or by water when travelling between North and South Heads. But this does not tell us how much of the income from tourists can be ascribed to the Harbour. One possibility is to borrow an estimate from the assessment of the Sydney Opera House where a performance was considered to be worth an additional 38% compared to what it would be at another location. If for example we (arbitrarily) assume that half of that was for the building and half for the setting on the Harbour, we could estimate that 17% of Sydney's tourism revenues are due to Sydney Harbour. This assumption yields an estimate of about \$2.5 billion per year to ascribe to the draw of the Harbour.

However, no dollar figure for tourism has been included in the summary value estimates. Any such number is hard to rigorously derive and there is a large risk of double counting since figures for the cruising industry and revenues from other cited activities in, on and around the Harbour would include some tourist numbers and revenues. Tourism revenues are therefore presented as a separate category for reference in summary Table 7, but not as attributable to the Harbour in Table 8. This omission of non-cruising tourism revenues does presumably contribute to a significant underestimate of the value of the Harbour, and could be an important direction for future research.



## 1.3 Harbour foreshore: landscape, icons, attractions and special events

### Landscape values

In February 2013, Sydney Harbour was declared an official National Landscape, a title that it shares with fifteen other iconic places in Australia.<sup>1</sup> These are promoted as part of a campaign subtitled 'the best destinations to experience Australia's outstanding nature and culture.'<sup>2</sup> It is impressive that Australia's largest city, with a population of over 4.5 million people, can be considered a prime destination to experience nature. Sydney Harbour is the only site of the 16 declared National Landscapes centred within a major city. That is part of the appeal and importance of the Harbour and its foreshores.

The National Landscape website describes Sydney Harbour as 'one of the most environmentally diverse landscapes in the world.'<sup>3</sup> While the campaign is aimed at promoting tourism, and some of the above list may be partially responsible for the revenues from tourism, many of these activities are likely enjoyed by locals more regularly and frequently than by tourists. Because nearly all of the suggestions and attractions listed above are free, they are largely non-market values for residents.

Residents and tourists alike may make use of Sydney Harbour parks and the extensive Harbour foreshore trails for exercise, the views, the experience of nature, perhaps identifying plants or seeing native wildlife, or as an opportunity to do something healthy and fun with family or friends. Barbecue facilities and children's playgrounds are heavily used and much valued, but these values are hard to define as for most, there is no charge.



above: The Sydney Opera House, one of the world's most famous performing arts centres, has become an icon of Sydney and Australia.

below: Gadyan Track on Berry Island Reserve, North Sydney. Scenic and well maintained bush walks line many areas of the Harbour foreshore.

Several ways to estimate the value of natural resources economically – where costs or benefits cannot be easily monetised – have been developed.<sup>4</sup> A common way to value outdoor experiences and national parks where visiting is free, or for a nominal parking fee, is to look at various aspects of 'contingent valuation' such as surveys where people are asked their willingness to pay for things. Another is to look at the costs people incur, including travel time and expenses, to reach specific places, as a basis for calculating economic surplus for all visitors. These could underestimate costs of those living closest around Sydney Harbour, but in any case, no estimates for such values for Sydney Harbour were found.

### Sydney's icons: the Harbour and structures on its shores

Urban pride is hard to quantify, yet it is clear that it exists, and for many people the Harbour and surrounding icons are part of their pride in their city. These icons are known around the world, including the Opera House and the Harbour Bridge particularly, but others such as the Royal Botanical Gardens as well. To the extent that they are draws for tourists, their value is captured in the tourism statistics, but they are also valued by Sydney's residents and many other Australians.

The value of these icons in this sense is largely unknown. To the extent that each is unique and very much part of Sydney's character and its identity as a city, their value is far greater than an assessed value of the buildings or the land and improvements or the paid usage. Recent examples of valuation of icons do exist, one in which monetary values were estimated for the Sydney Opera House and one for the Sydney Harbour Bridge where a number of amenity values were listed but not estimated in monetary terms.



The Sydney Harbour Bridge connects the CBD with the North Shore and is popular for walks, bridge climbs, tourists as well as being an integral part of Sydney's New Year's Eve celebrations.

### Sydney Opera House

Figures from the Opera House Annual Report for 2012-13<sup>5</sup> include the production of 1895 live performances, seen by 1.37 million people, 8.7 million visits per year and 310,000 guided tours. It creates 12,165 direct and indirect jobs in Australia. The report states also that 95% of all Australians see the Opera House as a national icon and a source of national pride. It notes that in 2007, the Opera House was inscribed on the World Heritage list by UNESCO as a 'masterpiece of human creative genius.'

An unusual and very interesting paper entitled 'How do you evaluate an icon? The Sydney Opera House: economic, cultural and digital value'<sup>6</sup> makes an estimate of the total economic value of the Sydney Opera House based on ticket sales, contribution to businesses in the precinct, and employment. Estimates of social values were also included, such as 'iconic and experiential value' to residents and visitors, as well as the 'potential digital value,' which relates to the future worth of the Opera House as a promotional tool.

The report presents an annual value contribution of \$254 million to the Australian economy, of which \$141 million is from direct value in ticket sales and bars, shops and restaurants on site, plus \$113 million indirectly through supply chains etc. The analysis becomes particularly interesting when it estimates the additional cultural and iconic values.

A number of surveys were conducted to estimate the Opera House's appeal as an Australian brand and tourist attraction. It also considered the future value of its digital videos and on-line performances

contributing to building identity, adding value as a national symbol and attracting future audiences. The value of attending a performance at the Opera House relative to an alternate venue was calculated as a total increase in value equal to 38% of ticket sales. The 'intangible cultural and national identity value perceived by all Australians' was given as an iconic value worth \$2.1 billion over the next 40 years. This, plus the additional values including transaction values for food, beverage and retail; consumer surplus and choice; and potential digital value contributing to Australia's tourism draw were presented as having a total present value of \$4.6 billion over 40 years.

In summary, the report is unusual and perhaps unique in estimating both market and non-market values for a Sydney icon. These estimates are calculated and explained well, and such social values are real and worth estimating. However, this report is the only place that this research has been able to find such an extensively developed valuation, and including the large values such as 'potential digital value. This would inflate the valuation of the Opera House excessively in comparison to other important foreshore icons where no such estimates could be found. The figure of \$254 million annual value added has therefore been used in the summary figures.

### Sydney Harbour Bridge

As part of the Australian Heritage Database, Places for Decision, the document entitled 'Sydney Harbour Bridge'<sup>7</sup> gives a good summary of characteristics that are challenging to quantify but clearly of high value.

The famous Bridge Climb and the Pylon Lookout both sell tickets and create revenue, but unlike the Opera House, the Bridge does not have performances and ticket sales. In 2013, the Bridge Climb celebrated its 3 millionth climber to scale the top of the Bridge.<sup>8</sup>

The Bridge does, of course, generate revenues and costs to the government in tolls and upkeep costs. The Daily Mirror ran a front-page story on October 14, 1988, with the headline 'AT LAST, WE OWN IT,' revealing that Premier Nick Greiner had announced the 'grand old coathanger' was finally debt-free after 56 years.<sup>9</sup> Despite this and some controversy, the tolls were kept. According to an article in 2012,

'Another \$90 million will be collected by the state government on the Sydney Harbour Bridge, the state's only government-owned toll road. Roads and Maritime Services said it reinvests all toll revenue back into road infrastructure. 'The Sydney Harbour Bridge and Sydney Harbour Tunnel revenue is not separately invested but aggregated with other revenue in RMS' operating bank account and working capital,' an RMS spokeswoman said.'<sup>10</sup>

These revenues are related to infrastructure and roads and not to the value of the Bridge as an icon, an estimate for which could not be found.

### The Royal Botanic Gardens and the Domain

'The 30 hectares of Botanic Garden are surrounded by 34 hectares of urban parkland known as the Domain. Both the Garden and Domain are endowed with significant natural and cultural heritage values, and play a central

role in Sydney's festivals and cultural events, as well as the recreational and sporting pursuits of city workers and residents.'<sup>11</sup>

The Royal Botanic Garden, Sydney had 3,990,834 visitors in 2012-13. Its annual report shows significant revenues and expenses, but the Sydney Botanical Gardens are only part of the entire trust's operations, which were not reported separately in that report, nor found elsewhere.

### Attractions

Sydney Harbour has numerous foreshore attractions, including Taronga Zoo, Luna Park, and many features of Darling Harbour including the Aquarium, Maritime Museum, Convention Centre, Entertainment Centre, IMAX movie theatre, gardens, restaurants and more. The Harbour has historical sites, art districts and a great many commercial businesses. Because most of these are treated in other sections of this paper, they are not further elaborated upon here. Their value is likely to be very large, but collecting them all and disaggregating them from other categories was considered to be beyond the scope of this report.

### Major events on and around Sydney Harbour

'Sydney already has a unique range of tourist products aimed at different types of tourists including cruises on Sydney Harbour, the opportunity to experience indigenous flora and fauna and the Bridge Climb. Sydney also hosts world-class cultural events and festivals, including the internationally renowned Sydney New Year's Eve fireworks; the largest Chinese

New Year celebration outside China; the Sydney Festival; Sydney Writers' Festival; Sydney Film Festival; Sydney Mardi Gras; Sydney Fringe Festival; the Biennale of Sydney and Art and About, major musical premieres and similar events.'<sup>12</sup>

In a document released by the NSW Government, titled 'A Plan to Make NSW number 1,'<sup>13</sup> one of the stated goals for future planning is:

'Increase the number of major international sports, artistic, creative and cultural events in NSW from 2010 to 2016 by 10%. Tourism and events are a \$28 billion a year business and support more than 162,500 jobs across the State. International events are important to our economy and make our State a more vibrant place to live.'<sup>14</sup>

Actions listed in this study to increase the number of major international events in NSW include:

- Complete the development of a world class arts and cultural precinct at Walsh Bay
- Construct a world-class conference and exhibition facility at Darling Harbour to enable NSW to compete for international business events
- Make NSW an event destination – Destination NSW will market NSW and promote the state through an annual program of events.

Major events are clearly seen by the tourism industry as a part of the draw for tourists, but most are also supported by residents of Sydney. According to Destination NSW,<sup>15 16</sup> total major events in NSW bring in more than \$600 million/year to the state from outside NSW. Based on listings of individual events



online for the year, listed in the Appendices in Volume Two of this report (available for download on SIMS website), it is estimated here that about 80% of these were in Sydney, and a number are very closely linked to the Harbour including New Year's Eve in Sydney, Sydney Festival, Vivid Sydney, Sydney International Art Series, Biennale of Sydney and the start of the Sydney to Hobart yacht race.

The New Year's Eve fireworks in 2011-12 were reported to have attracted 1.5 million people to the Harbour foreshore and contributed \$156 million to local businesses.<sup>17</sup> Numbers for 2013-14 were similar, with 1.65 million people on the foreshores and the figure of \$156 million cited again.<sup>18</sup>

According to a Destination NSW media release<sup>19</sup>:

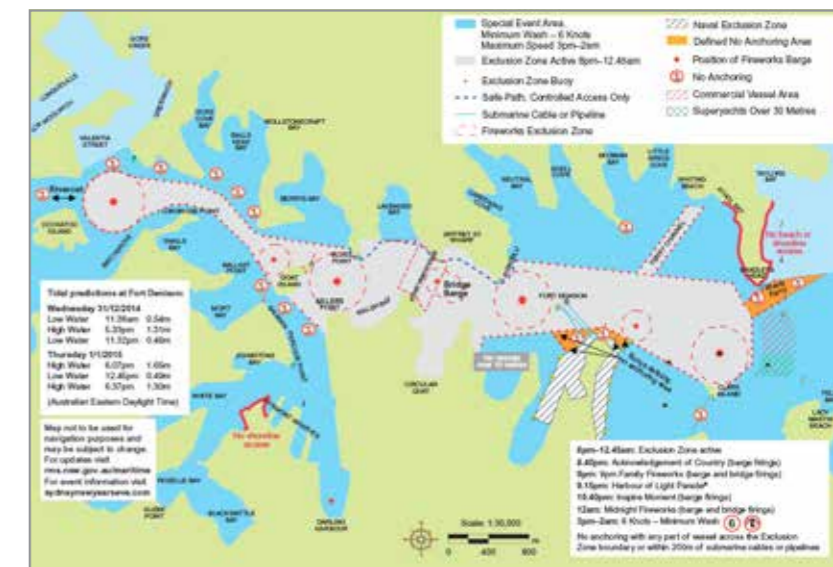
'Last year the Sydney Festival attracted more than 500,000 people with more than 120,000 tickets sold to paid events, including more than 33,000 people who attended events in Western Sydney. In 2012, it injected almost \$57 million into our economy.'



above: The Royal Botanic Gardens is a large historical garden and popular attraction located adjacent to the heart of the city and Harbour foreshore. Source: Sydney Opera house celebrating Jessica Watson, 2010. Photo Pavel. [https://commons.wikimedia.org/wiki/File:Sydney\\_Opera\\_house\\_3.jpg](https://commons.wikimedia.org/wiki/File:Sydney_Opera_house_3.jpg)



left: Giraffes at Taronga Zoo overlook the Sydney skyline on the foreshore Harbour. Source: Photo Jan Derk. [https://en.wikipedia.org/wiki/Taronga\\_Zoo#/media/File:Sydney\\_taronga\\_zoo.jpg](https://en.wikipedia.org/wiki/Taronga_Zoo#/media/File:Sydney_taronga_zoo.jpg)



above: Luna Park lights up the Harbour shoreline at Milson's Point, North Sydney. Source: Photo Adam J.W.C. [https://commons.wikimedia.org/wiki/File:03.01.2009-luna\\_entrance2.jpg](https://commons.wikimedia.org/wiki/File:03.01.2009-luna_entrance2.jpg)

right: Map showing numerous locations of fireworks in Sydney Harbour and boating restrictions for New Year's Eve celebration 2014-15. Source: [www.sydneynewyears eve.com/plan-ahead/boating](http://www.sydneynewyears eve.com/plan-ahead/boating), accessed 15 July 2015.

left: Giraffes at Taronga Zoo overlook the Sydney skyline on the foreshore Harbour. Source: Photo Jan Derk. [https://en.wikipedia.org/wiki/Taronga\\_Zoo#/media/File:Sydney\\_taronga\\_zoo.jpg](https://en.wikipedia.org/wiki/Taronga_Zoo#/media/File:Sydney_taronga_zoo.jpg)

While Destination NSW has made projections of contribution to the NSW economy from the Sydney Festival in the past, none were found for the 2014 event.

The Sydney Festival 2014 Annual Review<sup>20</sup> posted a summary that includes:

- \$18 million turnover
- 144 events held, at 32 venues, of which 63 were free
- 124,000+ tickets sold
- 456,000+ people attended the 63 free events
- 1036 artists from 19 countries
- 1.1 million+ visits to the Sydney Festival website

The first Handa Opera – La Traviata – was held in 2012 on a stage specially-built over the Harbour water. According to NSW Tourism, 40,000 people attended and the event brought in \$30 million in box office and other related revenues.<sup>21</sup>

NSW Deputy Premier and Minister for Tourism and Major Events, Andrew Stoner, said in 2014:

*'Since 2012 the mass appeal of Handa Opera on Sydney Harbour has attracted more than 11,300 overseas and interstate visitors, delivering \$20 million to the NSW economy.'*<sup>22</sup>

This example highlights the difficulties in assembling and estimating economic values for the Harbour. For example, the 2012 report cited gross proceeds for



above: Lights on the sails of the Sydney Opera House, part of the light show of Vivid Sydney 2011. Source: Photo Nigel Howe. [http://commons.wikimedia.org/wiki/File:Vivid\\_Sydney\\_2011.jpg#mediaviewer/File:Vivid\\_Sydney\\_2011.jpg](http://commons.wikimedia.org/wiki/File:Vivid_Sydney_2011.jpg#mediaviewer/File:Vivid_Sydney_2011.jpg)

'box office and other revenues' and the 2013 estimate would have had a similar broad scope, while the 2014 report cited a different measure: contribution to the NSW economy from direct visitor impact, thereby counting only revenues from overseas and interstate visitors. This is an example of how different agencies and even successive governments can report economic results in very different ways.

The VIVID festival has become an extraordinary success in terms of attendance numbers, draw for tourists and financial results. Visitor numbers have now nearly trebled in just three years – from 500,000 in 2012 to 800,000 in 2013 and now approaching 1.4 million. Most astonishingly, 19,500 international tourists booked VIVID travel packages for the single purpose of this experience and nearly half of those visitors (9,700) were from China. The economic benefit of Vivid 2014 has yet to be analysed, but the value of the 2013 event was estimated at more than \$20 million.<sup>23</sup>



left: Fireworks during Handa Opera's performance of Carmen on Sydney Harbour, 2013. Source: Opera Australia. Photo James Morgan. [https://opera.org.au/aboutus/media\\_centre/images/hosh/fireworks](https://opera.org.au/aboutus/media_centre/images/hosh/fireworks)

## 1.4 Higher land values and real estate prices closer to Sydney Harbour

There is a strong correlation between proximity to the Harbour and increases in land values and real estate prices. In this analysis an attempt was made to identify how much this value ('hedonic value' in economic terms meaning relative to personal pleasure, in this case views or proximity to the water and associated amenity values) increases property prices compared to similar properties that are not near the Harbour.

### Residential Housing

State Government real estate reports give price information (Rent and Sales Reports, quarterly) measured in rings in a bulls-eye type formation around central Sydney – the CBD – which is similar to but not identical to proximity to the Harbour. In these reports median house prices are about 30% higher in the middle ring and 50% higher in the inner ring compared to the all-Sydney median price.<sup>1</sup>

In order to obtain a sense of the incremental value in house prices nearer to the Harbour, the next step in this analysis was to review the 82 suburbs immediately adjacent to the Harbour and calculate the values based on actual median selling prices and total numbers of houses and units in each area.

This total was then compared to an index of the incremental value of real estate in these suburbs over the highest value ring in the Rent and Sales Report rings, which is the Inner Ring of Sydney real estate. The incremental value of the real estate in the areas closer to the Harbour compared to that of the Inner Ring was estimated to be approximately \$40 billion.

This is considered to be an underestimate because some values were not available (not enough sales to be statistically reliable in some areas, which were therefore entered as zero values). Values for real estate with views of the Harbour are also more highly valued than the suburb averages, and homes actually on the water increase dramatically in value, sometimes by a factor of ten, although some of that increase would be attributable to houses in these locations tending to be larger than the average. This initial estimate did not differentiate for housing amenities. A further, more detailed development of this estimate of incremental values for domestic real estate in proximity to the Harbour would be of considerable interest.

### Commercial Property

The value of commercial real estate will also be influenced by proximity to the Harbour, though in more complex ways. For some commercial real estate there may be little value in being near to the Harbour, but for others it is considerable.

As a qualitative example, the massive development at Barangaroo can be considered. The value of



right: Aerial view of Sydney Harbour showing extensive property both commercial and residential. Courtesy Charlie Shuetrim.



left: Located on the western side of Sydney's CBD, Barangaroo will include commercial and residential development, retail, dining, hotel, foreshore walks and reserves. Source: Photo Joshua Favaloro. [https://commons.wikimedia.org/wiki/File:Barangaroo\\_South.JPG](https://commons.wikimedia.org/wiki/File:Barangaroo_South.JPG)

below right: Manly Wharf has businesses including cafes, watercraft rental and shops alongside the harbourside beaches. Photo Caroline Hoisington.

the Barangaroo development project is very much dependent upon its location. If the same size land area could be found inland, it would be of far less value. This is partly because this site is centrally located near to the CBD, but a great deal of its appeal is that it is also situated on the Harbour, which adds prestige, importance, visibility and aesthetic appeal to its easy accessibility by water and from the centre of the city. The Barangaroo website makes this explicit:

'Barangaroo will turn the western city foreshore into the only place in the CBD where people can connect with and touch the harbour waters. Rock pools and native sandstone will form the rejuvenated foreshore; two new harbour coves will reclaim 2.7 hectares of harbour lost to previous development. Helping make what is already a great city to live in and even better place to work, relax and play.'<sup>2</sup>

It would be interesting to compare land values of the Barangaroo development with a similar size inland area of a comparable distance to the centre of Sydney. This would be analogous to the comparison of residential real estate described above. Since Barangaroo clearly benefits from proximity to both the City and the Harbour, such a comparison would help with the difficulty of separating city and harbour values. However, there is no such area available for comparison, so this is not feasible. Given the complexities, no formal analysis of the incremental value for commercial real estate adjacent to the

right: Map of Sydney Harbour sites showing local areas surrounding the Harbour, water quality sampling sites, parks and builtup areas. Source: <http://www.environment.nsw.gov.au/beach/MapSydHarb.htm>. © State of New South Wales and Office of Environment and Heritage.

Harbour and attributable to the Harbour was attempted as it is beyond the scope of this paper.

Another example of the extraordinary, but not estimated, incremental value of land on Sydney Harbour is the newly announced Bays Urban Renewal Program.<sup>3</sup> It is intended to extend over approximately 80 hectares of public land around Balmain, Rozelle, Annandale, Lilyfield and Pyrmont – an area four times the size of Barangaroo. It is to be converted to housing, retail, tourism, commercial, recreation and maritime use over a 30-year development period. The area is described as 'the prime stretch of harbour' and the development as an opportunity 'with the potential to create the next big destination after the iconic Sydney Opera House.'



## 1.5 Harbour-related private businesses

There are many private, commercial businesses that benefit from proximity to the Harbour, but mostly financial data on such private businesses is commercial in confidence and not accessible.

A short summary of the types of businesses that rely fundamentally on the Harbour and/or benefit from proximity to the Harbour is listed in Table 4.

There are many websites for commercial companies offering Harbour-related experiences. For example:

- Sydney Harbour Escapes website<sup>1</sup> lists charter boats by their size including 28 small boats, 22 medium sized and the largest 16 that can take between 70 and 800 guests. This site claims to only offer boats offered from companies screened for quality and reliability, so presumably there are more. Daily, hourly and longer charter rates are posted, but not overall market figures.
- Whale watching Sydney<sup>2</sup> offers cruises leaving from Sydney Harbour from May to December.
- Sydney Seaplanes' website<sup>3</sup> entitled 'The treat of a lifetime' is an example of a company that focuses on tourists and locals alike.

Table 4: Types of private businesses relying directly on the Harbour

Type of business	Types of revenue
Marinas and commercial dock	Boat mooring rental fees; sales of fuel, maintenance contracts
Boating	Boat sales, repairs, parts etc.
Fishing	Sales of bait and tackle; fishing gear
Harbour sport	Sales and rentals of kayaks, canoes, stand-up paddle (SUP) boards, scuba gear, snorkel gear etc.
Sailing, scuba diving and kayak schools and trips	Fees for lessons and outings
Harbour organised activities, cruises and trips	Sailing, history and dinner cruises, SIMS ecology cruises; whale and dolphin watching trips; fast thrill boats
Waterside taxis and limousines	Fares for ad hoc trips; organised event transport and viewing
Harbour side dining	Revenue compared to that of non-harbourside restaurants
Seaplane flights and the bridge climb	Harbour viewing for both; seaplanes also do commuter runs and visitor trips up the coast of the northern beaches



# 1.6 Outdoor leisure and sporting activities

## Boating

This outstanding environment is an extremely popular venue: the Boating Industry Association (BIA) estimated ten years ago that more than one million people use Sydney Harbour for water-based recreation activities each year.<sup>1</sup>

Overall growth in Sydney Harbour is projected to be relatively modest for larger vessels requiring storage space, with an annual growth rate around 1% and a growth to 2026 of around 19%. While this growth is comparatively subdued, Sydney Harbour has, nevertheless, the highest demand for on-water storage of any region in the state and relatively few avenues for expansion.<sup>2</sup>

In 2010, NSW Maritime produced a report on boat ownership and the need for more storage facilities<sup>3</sup> in NSW, which also broke down some of the data down into regions. It showed 19,128 recreational and commercial boats operating in Sydney Harbour

out of a total of 228,643 in all NSW. With 18,011 recreational boats, Sydney Harbour accounted for only 8% of the recreational boats in NSW but the 1084 commercial boats in Sydney accounted for 20% of the commercial boats. Sydney Harbour was listed as having 6228 moorings.

Sydney has the lowest number of boats per person of the NSW regions (at 19/1000 people). The density of boats on the Harbour water is, however, the highest for boating areas in NSW in the report, at 51.4 per km<sup>2</sup>. The Harbour also has proportionally more ownership of larger boats than other regions. This category is growing, but boat ownership growth in Sydney overall was the lowest among NSW regions.

Reports from 2004 and 2007 listed over 40 private marinas<sup>4</sup>, over 4700 private moorings and about 570 private berthing pens or jetties and 14 rowing clubs with boat shed access.<sup>5</sup> There are also many smaller boats parked on streets and homes and lack of mooring spots is projected to be a constraint. There are about 90 sailing clubs in NSW according to the website of Clubs of Australia,<sup>6</sup> about 30 of which are on Sydney Harbour. Wikipedia lists more than 10 rowing clubs in Sydney, excluding school clubs. A web search for boating clubs generally on the Harbour reveals more than 40 by name, including dragon boat racing clubs.



Camp Cove in Sydney Harbour National Park, near South Head, is popular for swimming, snorkelling, kayaking and picnics, and offers spectacular views of the Harbour and city.

These clubs generally charge membership fees. Many have restaurants and bars, and some have retail sales or offer other services. No study of their economic value was found.

Most of the values associated with harbour beaches, walking trails and parks, both National Parks and the numerous neighbourhood parks around the Harbour, are difficult to translate into market values at this stage. Such estimates would require interviews and 'willingness to pay' studies, as well as indications of the number of people undertaking these activities and for how many days per year. Availability of alternative places for similar activities would also influence totals. Meta-analysis of data on values for such activities could be used to obtain median values multiplied by reasonable estimates of usage. At the time of writing, it was not possible to find any such surveys and valuation studies for Sydney Harbour.

## Swimming

A locally published book<sup>7</sup> and a web search for swimming beaches in Sydney Harbour, compiling listings from numerous sites, revealed over 50 named beaches within the Harbour. There may be some duplication here due to the use of different local names and this is still not a complete list. Nonetheless, Sydney Harbour offers a very large number of beaches for swimming, but the number of swimmers or swimmer-days was not found. A more comprehensive survey of harbour users would be very useful.

The book *Sydney's Best Harbour and Coastal Walks*<sup>11</sup> lists 36 walks in seven different regions, all adjacent to the water. These trails add up to over 220 km in seven different regions, along the Harbour and the Sydney coast. Of those, 122 km are on the Harbour. Some well-used walks, particularly the Spit Bridge to Manly walk, appear to have walkers every day of the year, barring exceptionally bad weather.

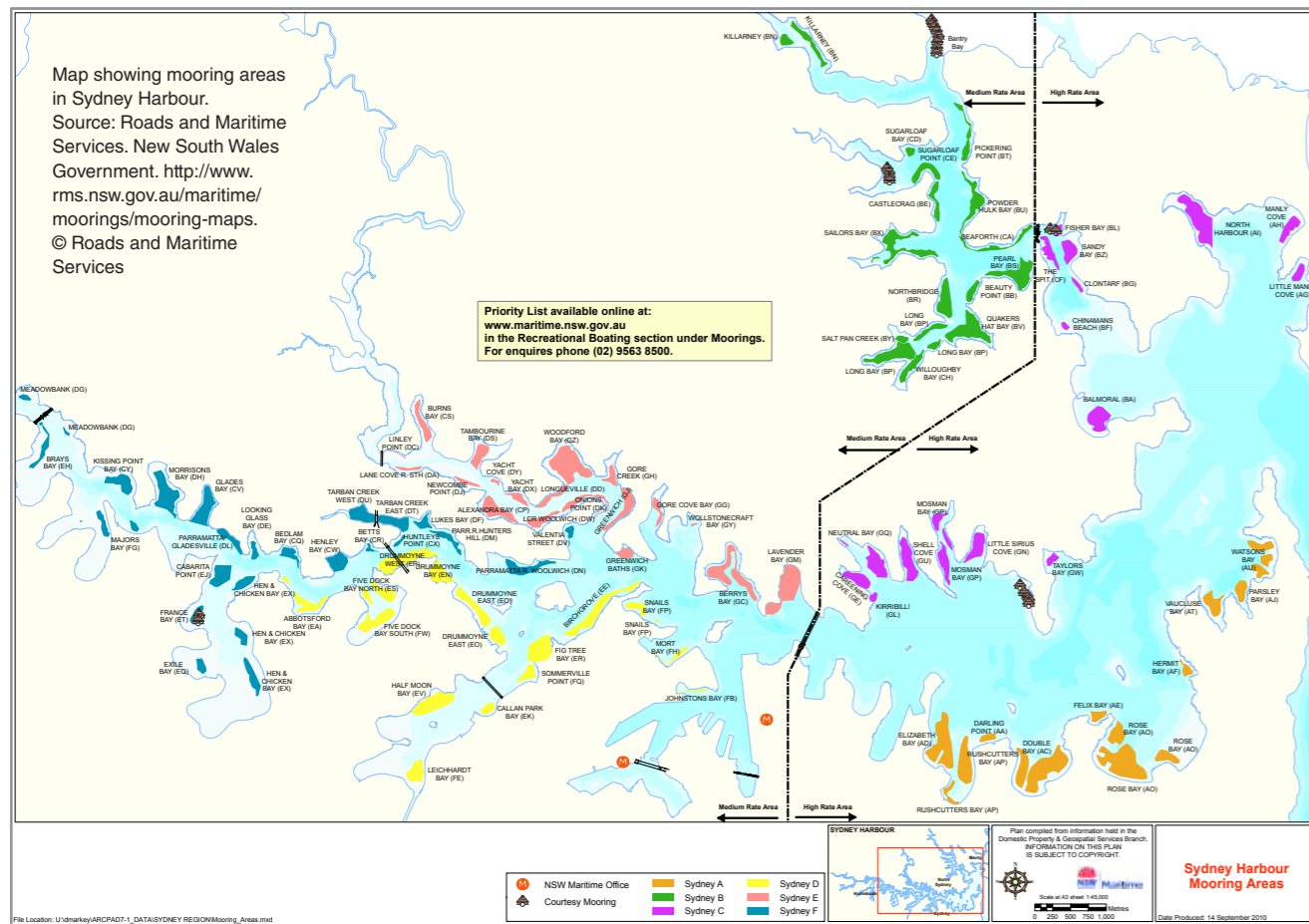
## Use of Harbour parks and walks on the foreshores

Both the Sydney Harbour National Park Draft Plan of Management<sup>8</sup> and the subsequent Plan of Management<sup>9</sup> suggest a link between Sydney Harbour National Park and revenues for Sydney. However, neither report quantified these revenues.

Visitor surveys done by NPWS and cited in the Plan of Management show very active use of National Parks. For example, the Nielsen Park and Hermitage Foreshore area (Precinct 1) showed very high levels of repeat visitation, with a significant proportion being local visitors and with 71% travelling less than half an hour to reach the precinct. Levels of visitor satisfaction were high in this precinct with 73% of visitors surveyed reporting to be 'very satisfied' with their visit.<sup>10</sup>



Popular walking tracks around Middle Head and historic barracks in Sydney Harbour National Park.



## Recreational fishing

A survey conducted of recreational fishers in the summer of 2008<sup>12</sup> covered the entire Harbour including the Parramatta and Lane Cove Rivers, and was analysed in terms of Eastern and Western Zones (East and West of the Sydney Harbour Bridge). The survey data supported a number of conclusions relevant to an economic appraisal:

- About 300,000 hours of daytime fishing effort were expended in the Sydney Harbour estuary over the 3-month survey period
- 96% of fishers were residents of the suburbs of Sydney, and 62% of Harbour fishing is shore-based and 38% boat-based
- 33 different species of fish were caught and kept; the ten species most commonly caught accounted for about 90% of the catch
- The total harvest was about 225,000 individuals, estimated at 74 tonnes of finfish, crabs and cephalopods. About 48.7 tonnes were caught and kept from the Eastern Zone and 25.3 tonnes from the Western Zone, suggesting that the health warnings against consuming fish caught upstream of the Bridge (the Western Zone) are not fully adhered to.
- Another 293,000 individuals were caught and discarded (and not weighed). Most of these were discarded because they were undersized. Nevertheless, strikingly high percentages of the catch of the top 5 species caught and retained were smaller than legal limits. The highest percentage by taxa was snapper at 97% undersized and in total 47% of the top 5 taxa were undersized.

Using a ratio of summer to total-year catches from earlier work,<sup>13</sup> the total year's catch in Sydney Harbour would be estimated at ca. 160 tons. An average estimated landing price of \$10/kg (a price which allows for the fact that fish sold at retail have been cleaned and some filleted, and that a large proportion of the catch was smaller than legal size limits) produces a rough estimated value of about \$1.6 million/year for the catch in 2009 dollar terms or over \$1.7 million in 2012 dollar values. While commercial fishermen receive wholesale prices for their catch, estimates based on retail prices are more appropriate for the value of recreational catch that is kept, since the fish are presumably eaten and are a substitute for buying at retail prices.

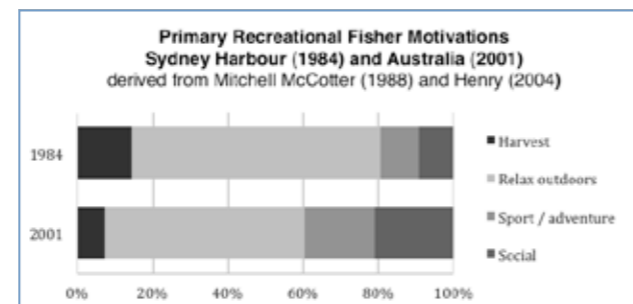
While fishers spend different amounts to fish and some may be subsistence fishers, it is clear that for most the amount that recreational fishers spend to catch 1 kg fish on average is much higher than the



Sydney Harbour attracts recreational fishing from the shoreline, wharves and boats.

retail price of fish and also higher than the expenses incurred by commercial fishers.<sup>14</sup> Enjoyment of the activity itself is a major motivation, and it is clear that most recreational fishers are motivated by more than the harvest as the results of two surveys shown in Figure 1 make clear.

Figure 1: Recreational Fisher Motivations



Source: J Turnbull, in press, 2014

### Expenditure by recreational fishers

'The economic value of sport fishing to a region is roughly equivalent to the willingness to pay on the part of fishermen for the experience of landing fish.'<sup>15</sup>

Because of the many values of the recreational fishing experience, using only the estimated price for the catch would underestimate the value of recreational fishing in Sydney Harbour. The total value of recreational fishing to the recreational fishers is considered to be more accurately captured in the amounts spent by the recreational fishers each year.



Scuba diving and snorkelling in the calm waters of Camp Cove, near South Head.

ABARE states that 5 million Australians report to have engaged in recreational fishing at least once a year and the total amounts spent in pursuit of recreational fishing activities are substantial. These figures come from an extensive survey of recreational fishing in Australia, published in 2003 based on surveys conducted in 2000-2001 by Henry and Lyle.<sup>16</sup> The NSW Dept. of Primary Industries estimates that one million people engage in recreational fishing in NSW waters each year.<sup>17</sup>

Henry and Lyle report that fishers fishing in NSW (residing in NSW and elsewhere) spent a total of \$554,204,435, in 2000, on 6,878,599 fisher days. This equates to \$81/day in 2000 terms, about 20% of which was spent on travel and accommodation, and about half on boats and trailers. In 2012 terms this is almost exactly \$100/day as an average daily expenditure for fishers fishing in NSW. Other reports<sup>18</sup> suggest that Sydney resident day fishers spent around \$100/day in 2003 figures – 2013 dollar equivalent would be about \$130/day – on tackle, boat fuel and hire, clothes and travel. Where in NSW they were fishing was not specified.

Given the results of the 2008 survey of recreational fishers by Ghosn et al,<sup>19</sup> 96% of the fishers in Sydney Harbour were from Sydney suburbs. Not many fishers from elsewhere come to Sydney Harbour to fish, making it very much a local activity. Therefore, expenditures on travel and accommodation charges would be relatively low for the locals fishing in Sydney Harbour compared to their expenses for traveling elsewhere. Furthermore, 62% of the fishing is from shore, which is a relatively high proportion compared to other estuaries in NSW. Fuel and boat charges therefore would not be as high as in some areas.

A lower average expenditure, in the neighbourhood of \$75/day, seems more likely for those fishing in Sydney Harbour.

A 2013 report from the Australian National Centre for Ocean Research and Security (ANCORS) on the expenditure of recreational fishers in NSW<sup>20</sup> divided NSW into four regions with the Sydney Region being one. It estimated that half of the fishers residing in the Sydney Region were fishing in Sydney Harbour and half elsewhere (Botany Bay, other popular estuaries and the ocean). Therefore in the Sydney Region about 160,000 recreational fishers would be fishing in Sydney Harbour. If on average they fished 8 days per year (average from the report) and spent \$75/day, the total would be extrapolated to approximately \$71 million/year. Future survey work on Sydney Harbour recreational fishers would likely improve upon these estimates.

## Snorkelling and scuba diving

Snorkelling, like swimming, is typically a very low-cost activity, involving little in the way of equipment and often low travel costs within the Sydney Harbour area. It is enjoyed by both children and adults. Several websites recommend snorkelling sites in the Harbour.<sup>21 22</sup>

Scuba diving is equipment-intensive, much more expensive and not suitable for small children. It draws people from near and far. Sydney Harbour is not as widely known as a destination for divers, but local divers insist that diving in Sydney Harbour is of high quality because of the extraordinary biodiversity in the Harbour: 'Some sites have incredible macro life, especially Camp Cove, Parsley Bay and Clifton Gardens in Sydney Harbour' and Sydney has 'some of the best diving you will ever find.'<sup>23</sup>

There are at least 14 widely recognised dive sites in the Harbour.<sup>24</sup> Sydney has about a dozen dive shops, but their revenue and the amount of diving in Sydney Harbour were not available.

A poll taken for the Dive Industry Association of Australia<sup>25</sup> regarding marine parks included in background data the result that of the 1007 respondents, scattered throughout NSW and weighted by age, gender and region to reflect the latest ABS population estimates, 6% said they scuba dive and 25% said they snorkel. Since there is most likely overlap between the two groups, the implication would be that 25% of the residents of NSW either scuba dive or snorkel or both. This estimate appears to be too high, but additional data on participation in snorkelling and scuba diving were not found.

# 1.7 Environmental values: ecosystem services, biodiversity and quality

## Ecosystem services

In a landmark study in 1997, a group of scientists led by Robert Costanza,<sup>1</sup> attempted to value the world's ecosystem goods and services, placing a value on seventeen ecosystems worldwide using a meta-analysis of extensive published data. In 2014, results of an extensive survey update were published.<sup>2</sup> The estimated value of the world's ecosystems in the 1997 paper was US\$33 trillion per year (in US\$ 1995 terms). That estimate was updated to US\$45.9 trillion/year (in US\$ 2007 terms) for the 2014 paper. Overall the estimates of value of the earth's ecosystems increased from the 1997 (updated) total value of US\$125 trillion/year. There was a large increase in the 2014 paper, which was due mostly to more surveys and data and more comprehensive value estimates. The total estimated value would have been about US\$145 trillion/year, but about US\$ 20 T/year was estimated lost due to ecosystem degradation and loss.

The 1997 study estimated the value of 17 ecosystem services for 16 biomes. The 2014 study was based largely on a 2012 study by de Groot et al. (2012)<sup>3</sup> which estimated the value of ecosystem services in monetary units provided by 10 main biomes: open oceans, coral reefs, coastal systems, coastal wetlands, inland wetlands, lakes, tropical forests, temperate forests, woodlands, and grasslands.

The coastal ecosystems in the 1997 included estuaries, seagrasses and algae beds separately. In the later studies they were amalgamated into coastal systems. However, a table showing the totals for both years for estuaries shows virtually no change from the 1997 values (except for updating to US \$2007 values).

Since that study, much work has developed the concept of ecosystem services as a means to value contributions to human welfare made by specific ecosystems or biomes, including marine ecosystems. When biomes and ecosystem services are combined in lists or tables of types of services provided by different ecosystems, the combinations of specific types of services/benefits provided by specific biomes can run into the hundreds.

Costanza's figures for the value of estuaries generally were US\$19,004 ha/year in the 1997 study (in US\$1995 dollars) and US\$28,916/ha (in US\$2007 dollars) in the 2012 and 2014 studies. Costanza *et al* state in the 2014 paper that the 'estuaries did not show a significant increase in value per ha but these were among the best studied in 1997.'<sup>4</sup> Updating these estimates to A\$2012 used in the current paper would give about \$28,000 per ha or \$2.8 million/km<sup>2</sup>.

A study in Canada<sup>5</sup> assembled data from 70 separate studies to estimate the value of non-market benefits of aquatic ecosystems in British Columbia's Lower Mainland. The Canadian study showed a wide range of ecosystem service values, which are presented Table 5. The wide range of valuations is because the figures pertain to many different near-shore ecosystems including beach, estuary, forest, lakes/rivers marine, riparian buffer, salt marsh, wetland, and eelgrass beds. The authors stated that '*results suggested that aquatic ecosystems provide the local residents with significant benefits and more research is needed to identify impediments to the continued supply of these benefits.*'

The figures are presented here as in the original study, in 2010 Canadian dollars per hectare (which are very nearly the same as 2012 Australian dollars per hectare).



Underwater structures, piers and pillars become habitats for crabs and other marine creatures. Photo John Turnbull.

Table 5: Estimates of Canadian near shore ecosystem services

Ecosystem Service	Low value per hectare	High value per hectare
Aesthetic and Recreational	\$18,854	\$282,747
Disturbance Regulation	\$2,941	\$296,886
Habitat Refugium and Nursery	\$5,083	\$62,633
Nutrient Cycling	\$17,249	\$47,833
Waste Treatment	\$1,351	\$115,089
Water Supply	\$3,932	\$44,887
Food Provisioning	\$1.58	\$1.58
Gas and Climate Regulation (Air Pollution Regulation)	\$539	\$539
Gas and Climate Regulation (Carbon Sequestration)	\$122	\$869
Gas and Climate Regulation (Carbon Storage)	\$3,480	\$4,520
Total	N/A	N/A

Source: Canadian Study<sup>5</sup>

Many other studies have been done in recent years on economic evaluations of ecosystem services. Examples include: applying ecosystem services as a common language for ecosystem-based management;<sup>6</sup> identifying some of the controversies in defining the contributions to human well-being from functioning ecosystems;<sup>7</sup> valuing ecosystem services in terms of ecological risks and returns;<sup>8</sup> arguing for a more comprehensive multi-criteria assessment dialogue and process;<sup>9</sup> and capturing ecosystem services, stakeholders' preferences and trade-offs in coastal aquaculture decisions using a Bayesian belief network application.<sup>10</sup>

Some ecosystem survey studies have been conducted in Australia, but none to date on Sydney Harbour that could be found. Useful environmental functions provided by Sydney Harbour include filtering water, cooling the city and moderating its temperature swings, providing nurseries for important seafood species for recreational fishers in the harbour and (for both recreational and commercial fishers in the ocean) and carbon sequestration.

A valuation of estuarine systems in Australia more generally has been undertaken by Blackwell.<sup>11</sup> A great deal of work has gone into comparing studies, valuation methods and compiling initial results, but it is not yet known how closely these results reflect ecosystem service values for Sydney Harbour. The figures are presented here, updated to 2012 dollar values (Table 6).

Table 6: Assessment valuing Australian estuaries

	Willingness to Pay	Consumer Surplus	Market Value	Sum
Ecoservice	------(in 2012 \$/km2) -----			
Protection	156,308			156,308
Water quality	658,940			658,940
Recreational boating		39,146		39,146
Fishable water	2,149,577			2,149,577
Swimmable water	1,700,086			1,700,086
Fish conservation	208,056			208,056
Food, fisheries			4,126	4,126
Recreational fishing			24,691	24,691
Port services			4,174	4,174
Total for study estuaries, value per km <sup>2</sup>	4,872,967	39,146	32,990	4,945,103
Updated to 2012 dollars	4,989,452	40,082	33,779	5,063,313

Source: Blackwell Study<sup>11</sup>

Using figures shown above in Table 6 for Sydney Harbour as the entire estuary of 55 km<sup>2</sup> (with the area estimated for swimming reduced to 3 km<sup>2</sup> and for nursery services to 15km<sup>2</sup>) the total value of ecosystem services for Sydney Harbour exceeds \$175 million/year. For comparison, estimates using the most recent Costanza figures<sup>12</sup> cited above for the whole estuary results in a value of similar magnitude of about \$150 million/year.

Information on the extent of the different habitats in Sydney Harbour (sea grass beds, kelp beds, rocky shores, soft mud bottom, open water column, etc.) and their condition is not complete. More information is needed in order to estimate the value of the Harbour in terms of environmental services.

Poloczanska et al<sup>13</sup> provide the first comprehensive synthesis of climate change impacts for Australian ecosystems. The biological description of impacts is comprehensive, and the authors state that the biological changes are significant and likely to have economic consequences. Overall figures for the value of several Australian marine systems from CSIRO are cited, but no per ha values are given. The total value for tidal marsh and mangrove systems is quoted as being from Blackwell (2005) the same source as used in Table 6 above.



## Biodiversity values – estuaries

‘There is still an issue of how to value the irreplaceable and fundamental supporting and regulatory functions of marine biodiversity and its intrinsic value when set against competing economic interests in marine spatial planning. This issue will continue to underpin the case that is made for designating marine protected areas on scientific criteria alone regardless of monetary values.’<sup>14</sup>

Sydney’s Harbour and coastline are home to an extraordinary diversity of marine life – from large vertebrates such as dolphins and penguins to microscopic plankton. More than twice the number of fish species has been recorded from Sydney Harbour (550) than from the entire coast of the United Kingdom (200).<sup>15</sup> Biodiversity generally is very high, including 3000 species of crustaceans, molluscs, polychaetes, echinoderms and fishes in total, as a study by the Australian Museum confirmed.<sup>16</sup> However, no attempts to estimate the economic value of the biodiversity of Sydney Harbour were found.

Valuing biodiversity has been done for other coastal areas. For example, a valuation of biodiversity, using both monetary and non-monetary measures, was done in the United Kingdom in Lyme Bay,<sup>17</sup> an area where fishing, diving and wildlife watching are important. Four groups of users were interviewed: dive businesses, dive clubs, sea anglers and charter boat operators. Turnover/expenditures were calculated for the overall usage of the area by the marine leisure and recreation industries, which came to a total of at least £17 million/year (in 2008) or A\$32 million (Australian 2013 dollars). This is a value equivalent to about A\$11,500 per km<sup>2</sup> for the entire bay. The report further points out that this value comes primarily from biodiversity hot spots in the bay. The authors also used interview results to produce maps of the areas in the bay that were visited by the different users and by frequency of use, providing a map of the biodiversity hot spots



above: Weedy seadragons are a particular highlight for scuba divers. Photo Rob Harcourt.

below left: Kelp found in Sydney Harbour provides important refuge for many marine species. Photo Sean Connell.

below right: Interaction with blue gropers is common in Sydney Harbour. Photo Andrew Boomer.

considered to be a planning priority. These usage numbers and maps were called non-monetary estimates of value.

Although other non-monetary values were mentioned, no valuation was attempted and most of the focus was on the monetary estimations. The authors stated that their study failed to cover some human values (‘the refreshment and stimulation of the human body and mind through the perusal and engagement with living marine organisms in their natural environment’ was mentioned) as well as the ecosystem values of keeping other marine biological systems functioning.

## Indicators of valuing environmental quality

### Willingness of Sydney and NSW residents to pay for cleaner harbour water

‘In 1989, 250,000 people attended a concert on Bondi Beach protesting ocean outfall of sewerage, prompting a government pledge of \$7 million to clean up Sydney Harbour.’<sup>18</sup>



above: Nudibranchs are the focus of citizen science projects within the Harbour and surrounds. Photo Emma Birdsey.

below right: Stormwater run off at Chowder Bay. Photo SIMS.

An extensive study titled ‘Economic and Financial Evaluations for the Sewerage Overflow Licensing Project’ (ACIL, 1996)<sup>19</sup> was completed as part of Sydney Water’s investigations into reducing sewerage overflows into Sydney Harbour and elsewhere in the Greater Sydney region. Part of the work included estimating the population’s willingness to pay (WTP) in dollars per year for different levels of water quality, defined in terms of different lengths of intervals between overflow incidents in ten different regions, three around Sydney Harbour and seven elsewhere in the greater urban area.

The data was collected through extensive surveys and presented as detailed reports. Final figures included the average household’s willingness to pay for three different options in the three Sydney Harbour areas, based on level of improvement in dollars per year. Responses from Sydney and other NSW areas were then aggregated for totals to obtain a NSW community valuation for cleaner water in Sydney Harbour in millions of dollars per year for each option.

The total figures for willingness to pay for cleaner water, in Sydney Harbour areas only, ranged from over \$30 million per year for the lowest level of cleaning to \$50 million/year for the cleanest option in 1996 dollars, or ca. \$50 million to \$75 million annually in current dollars. Moreover, it is essential to note that this is not a total (annual) value for clean water in the Harbour but the marginal value for increasing the quality from the condition in 1996 to hypothetical improved states. That is, the figures represent an improvement from somewhat polluted to less polluted, not from low quality to pristine. It is thus an under-estimate of the total value of having clean water in the Harbour. The study projected the annual values over 20 years (discounted at 7%) to calculate a present value of the WTP for cleaner water in the Harbour. In today’s dollars, the cleanest option was worth \$796 million.

Sydney Water has invested hundreds of millions of dollars in improving water quality in the Harbour since this study was conducted in 1996, so at least a good part of this improvement has been achieved, and it is not necessarily the case that further improvements would be valued as highly. Nonetheless, it does represent a substantial valuing of clean water in the Harbour by nearby residents and those in NSW generally.

### Sydney Water Corporation expenditures on cleaning Harbour water

The survey described above<sup>20</sup> is an example of contingent valuation or a ‘stated preference’ model of values. Revealed preference models are based on actual purchases by consumers. It can be argued that the funds spent by Sydney Water Corporation on sewage infrastructure for improved water quality in the Harbour represent a kind of revealed preference in the sense that the population overall was willing to pay for these improvements. It is not a usual argument for a number of reasons (e.g. it was not direct payment by people for cleaner water but part of the normal water bills; not everyone agrees with expenditures for a public good, etc.) but it is nevertheless something that Sydneysiders generally appear to be very pleased about, judging by media reports. In this sense these expenditures are another indication of the value of cleaner water in the Harbour, in addition to the willingness to pay survey cited above.

From 1998-2001, Sydney Water spent ca. \$466 million for the North Side Storage Tunnel (NST), which stores wastewater and stormwater, transferring it to North Head wastewater treatment plant to protect the Harbour.<sup>21</sup> A 2003 auditor’s report described the Harbour water as ‘cleaner than it has been in a generation,’<sup>22</sup> illustrating how quickly the NST began to show good results. A more recent account states that ‘since commissioning over 40 billion litres of diluted sewage has been prevented



from entering Sydney Harbour.<sup>23</sup> In addition, between 2007 and 2012, Sydney Water spent \$250-\$300 million on the section of the Sewer Fix Program<sup>24</sup> that affected Sydney Harbour.

Sydney Water continues to upgrade the sewage system in many ways, from upgrading pumping stations to repairing leaks. In addition, in the early 1990s, more funds were spent on the Clean Waters Program to protect the beaches and the Harbour, as well as other areas. In these programs, it is not easy to separate how much of what was spent in total benefitted primarily the Harbour and how much affected other areas, including the Hawkesbury-Nepean and ocean beaches.<sup>25</sup> It is therefore difficult to say how much was spent on improving water quality in Sydney Harbour in total. A reasonable estimate would be that it was at least \$700 million, based on the figures above. The willingness to pay figures, which are of a similar magnitude, are used in the summary tables (Tables 7 and 8).

### Whales and the Harbour

In recent years, there have been numerous pictures in Sydney's papers and on television of whales spotted in the Harbour, sometimes with young.<sup>26</sup> While hard to quantify, this sort of general excitement is an indication of a form of civic pride that Sydney Harbour is now clean enough to entice such giant, charismatic wildlife.

The health of the Harbour supports business as well. Sydney's whale-watching businesses, which take clients from the Harbour out into the ocean, are now thriving. 'This has turned whale watching into a big business for Sydney, now said to be the best city to view whales because they come close to the Harbour, even entering it at times.'<sup>27</sup>

### Environmental volunteers' labour on Bushcare

'Sydneyiders have demonstrated for decades they greatly prize their natural environment. They value the health of the bushland fringing their neighbourhoods and the water quality of their rivers, estuaries and coastal regions. Thousands of volunteers have invested 'sweat equity' working as Bushcare volunteers to weed and regenerate localities.'<sup>28</sup>

The Sydney Metropolitan Catchment Management Authority (SMCMA) (now part of Greater Sydney Local Land Services) reported that environmental volunteering in the Sydney Metropolitan region in 2009 totalled 180,196 hours with an equivalent value of \$5.4 million (in 2009 dollars). Environmental Volunteering in the Greater Sydney region added another 52,456 hours valued at \$1.4 million.<sup>29</sup> These



above: Whale in Sydney Harbour. Photo Emma Birdsey.

figures include regular and one-off volunteers in organized programs for which hours are counted. Unfortunately, the fraction of this work in affecting Sydney Harbour's foreshores and areas that affect the Harbour is not known.

The Sydney Metropolitan Catchment Authority 2010-2011 annual report<sup>30</sup> (now part of Greater Sydney Local Land Services) states that more than 17,000 Bushcare volunteers participated in on-ground environmental work across Sydney in 2009.

Another indicator of how Sydney residents value a clean environment is the Clean Up movement. Clean Up The World Day, now an international organisation, was first started in Sydney Harbour:

'In 1989, Ian Kiernan initiated the first 'Clean up Sydney Harbour' recruiting an unexpected and almost overwhelming 40,000 volunteers. From that the event grew to Clean Up Australia Day, starting in 1990 with 300,000 volunteers, and in 1993 it became a global event with 30 million people in 80 countries participating.'<sup>31</sup>

The Australian Review of Operations for 2012-13 cites its income as \$1.4 million from corporate sponsorship, donations, in-kind contributions and revenue from activities.<sup>32</sup> Clean Up Australia Day efforts include foreshores and also scuba divers cleaning underwater in Sydney Harbour and elsewhere. Again, the totals for Sydney Harbour are not known. A conservative estimate of \$5 million/year in volunteered labour time was used.

## 1.8 Cultural heritage and the arts, scientific research and teaching

### Cultural heritage and the arts

The Sydney Harbour Draft Plan of Management<sup>1</sup> states that Sydney Harbour contains an extensive collection of historic sites, representing thirty two of the thirty four NSW State Heritage themes.

Sydney Harbour Federation Trust (SHFT) is transforming several areas around the Harbour to enhance historical, cultural and even artistic values. SHFT is an agency set up by the Australian Government to rehabilitate for public use former Defence and other Commonwealth lands around Sydney Harbour. The Trust works on sites that have significant heritage and environmental values.<sup>2</sup>

The SHFT website<sup>3</sup> includes a map of the main areas where it works (Snapper Island, Cockatoo Island, Woolwich Dock and Parklands, Platypus Neutral Bay, Chowder Bay, Georges Heights, Middle Head, Marine Biological Station, North Head Sanctuary Manly and Macquarie Light station). Cockatoo Island has been designated a UNESCO world heritage site.<sup>4</sup>

Figures from the SHFT Annual Report for 2012-13 include:

- 374,303 people visited Cockatoo Island, 203,229 for the Biennale of Sydney, 2012, and many for the Red Bull X-Fighters World Grand Tour Final.
- Volunteers contributed over 22,000 hours to the Harbour Trust in 2012-13
- 197 venue hire events (compared with 151 in the previous year)
- 47 houses managed
- The revenue from accommodation sites (cottages, camping, heritage houses and harbour view apartments) was \$22,370,241.
- Rental income was \$10,508,000 according to the financial statement
- Land and buildings were valued at \$248,365,000
- Heritage and collections were valued at \$32,005,000.



above: Cockatoo Island is a UNESCO world-heritage-listed island in the middle of Sydney Harbour. It is a popular cultural and events venue. Source: Photo jeremyg3030. [https://commons.wikimedia.org/wiki/File:Cockatoo\\_Island\\_%2815721627741%29.jpg](https://commons.wikimedia.org/wiki/File:Cockatoo_Island_%2815721627741%29.jpg)

below: Cockatoo Island offers 'Glamping', a unique experience of camping under the stars in the middle of Sydney Harbour.

One of the SHFT locations, Cockatoo Island, was described as an 'extraordinary heritage setting on the harbour' that has been a prison, an industrial school and a shipyard. It is now a major venue with a program of activities including temporary events, festivals, art shows and concerts as well as camping, swimming, overnight stays and temporary moorings.

Many of the events listed above under attractions and especially the events taking place on harbour foreshores are artistic events, and they could be listed here as well, from the Handa Opera to the Sydney Biennale and movies projected across the water. Some of them are valued in the previous section on the basis of entrance ticket revenues or associated economic activities.

The Harbour itself is also a subject of much visual art, and some of these pieces have become part of Australia's cultural heritage, viewable at the NSW Art Gallery and elsewhere. SHFT rents studio space to artists which are open to the public for at least three sites. These images and art displays about the Harbour are difficult to value in financial terms.



## Science, research and educational values

The Sydney Harbour Park Draft Plan of Management lists examples of different types of values in the park which have not been reviewed elsewhere. These include its scientific and research value and its education and interpretive values.

A number of universities and institutions undertake research in Sydney Harbour and on its foreshores. The Royal Botanic Gardens, Sydney, conduct a large amount of research and teaching particularly into Australian plants but also internationally. There are also numerous school programs active in and around the Harbour.

The values of research and educational programs have not been quantified nor financial values estimated for this report. The values of research, for instance, would be substantial, some of them related to reducing future risks, and it is hoped they will be quantified in future work.

The types of benefits that can be expected from research into Sydney Harbour are listed here. The potential value of such research is described, but no attempt was made to quantify it.

### Biodiversity monitoring and habitat protection

Sydney Harbour is known by both scientists and scuba divers as a biological hotspot, having high biodiversity and very high endemism with 80% of Australia's species being endemic. One comprehensive inventory of the biodiversity of the Harbour was undertaken through examination of records maintained by the Australian Museum.<sup>5</sup>

From a valuation perspective, it is of use to know what is changing in the Harbour and what effect those changes will have on the vast network of biological systems, which changes may trigger



above: Cuttlefish are commonly observed in the Harbour and have been the focus of much research by SIMS. Photo Andrew Boomer.

below: The annual Fantasea Harbour Hike follows the Harbour foreshore from Kirribilli to Chowder Bay, promoting education about the Harbour while raising funds for further research by SIMS. Photo SIMS.

changes elsewhere, and how they can affect us. Recent research into the strengthening of the Eastern Australian Current (EAC) for example, shows that temperatures in the Sydney area may rise by more than 2°C.<sup>6</sup> With pollution and other stresses, we may lose a number of species before we know they exist.

Research has shown that some habitats in the Harbour are affected by humans, but we do not know what effects species loss and habitat alterations will have on us. It is possible that some undescribed species may have beneficial medical or chemical properties. In any case, it is certain that healthy habitats and functioning species make up interwoven networks of biodiversity that together make the Harbour a diverse and living contributor to the quality of human life in Sydney and providing ecosystem services that we value.

### Ecosystem restoration or extension

If ecosystems that have been damaged or are under threat were improved or protected, economic benefits from ecosystem services would likely accrue. Very little research to estimate such potential benefits has been attempted to date. One possibility that has been investigated scientifically, if not economically, is the mapping of seagrass beds in Sydney Harbour. There have been significant losses of seagrass beds in the Harbour, and seagrasses are particularly valuable in terms of their ecosystem functions as fish nurseries, in filtering water, in stabilising sediments and coastlines and for carbon sequestration.



There are now only an estimated 52 ha (or less, given recent losses in Rose Bay)<sup>7</sup> of seagrasses in the entire Harbour. However, research has investigated areas of potentially suitable seagrass habitat in the Harbour, based on light levels, water movement and other criteria necessary for seagrasses to grow, resulting in an estimate of 342 ha as suitable seagrass habitat. Using the Australian estimate of the value of seagrass ecosystem services of \$41,641/ha<sup>8</sup> the current annual value for seagrasses in the Harbour is \$2.2 million/year. However, if all 342 ha of suitable habitat supported healthy seagrass beds, this would increase to \$14.3 million/year, a potential increase in value of \$12.1 million/year in terms of ecosystem services.

There would clearly be considerable value in both constraining the current trend of diminishing seagrass beds, as well as establishing new seagrasses (and other important ecosystems) in suitable areas of the Harbour should this be shown to be feasible technically.

### Appropriate choice of location and type of investments in maintaining Harbour quality, restoration programs and activities to mitigate pollution

Should the importance and economic advantages be accepted of maintaining, if not improving, the high quality of Sydney Harbour, then knowing where

and how to make investments in such efforts is of considerable value in terms of return on investment. There is, for instance, research being done to determine how much of the contamination of harbour sediments is as a result of old manufacturing sites – as generally believed – and how much is originated from current stormwater.

There are clear advantages to improving general monitoring of the Harbour and collecting data on the health of different ecosystems. Should the information be made public, it would be easier for authorities to focus on informing the public of where and when risks exist, and in some cases, developing the means to remove them.

### Monitoring of climate change

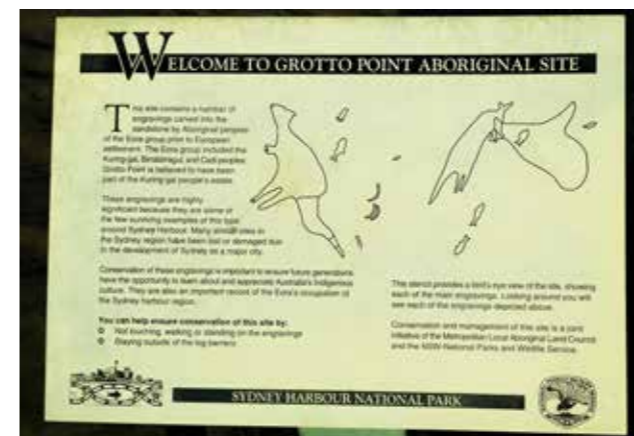
SIMS is currently engaged in monitoring climate change, including studying the EAC and its changes and the effects these changes are having.

There is much still for us to learn about how these changes will affect our Harbour and what the consequences for us as inhabitants of the Harbour City may be.

## Spiritual, religious and altruistic values

These types of values are difficult to specify and even more challenging to value. Australian culture recognises that the first inhabitants and traditional owners of the land, the Aboriginal tribal people, attached very significant spiritual and religious importance to the landscape and felt a strong obligation to care for country that continues today. Modern society is increasingly recognising these values explicitly, with such recognition becoming more mainstream than before.

Under altruistic values, we would include elements that people are willing to pay for or sacrifice but from which they personally do not gain. These can include money spent on causes for reasons of principles or legacy values, such as leaving choices for future generations. Many people care about these things, and for some they are deeply held values. Whether they will ever be quantified and the extent to which they will be important in planning is not yet known.



left: Rock engravings by Aboriginal peoples of the Eora group prior to European settlement, Grotto Point, Sydney Harbour National Park. Photos Caroline Hoisington.

## 2. Summary

The results of this assemblage of the values of Sydney Harbour are shown in expanded form in Table 7 and then summarised in Table 8. Table 7 gives the most complete information about the various activities, detailing quantified and non-quantified information. Table 8 provides a first overview of some of the financial values related to activities and values of the Harbour. Estimates of many important values were not found and these are indicated as NE for not estimated in Table 8.

The component values are described in the text that follows each table and in further detail, including supporting references, in the main text of the report, together with a number of caveats associated with the complexity of the valuations. These explanations provide the background for the appropriate interpretation and use of these tables.

Table 7 shows qualitative descriptions, annual revenues or values and other qualitative annual estimates such as number of users (where data for such estimates could be found). These are necessarily preliminary, given the nature of this type of assessment. The individual indicators reflect different avenues of reviewing the complex, multidimensional values supported by Sydney Harbour. These are referred to as *indicators of value* and *revenues associated with Sydney Harbour* because we do not pay for the Harbour directly.

We use the Harbour in many ways, some of which generate revenues. The Harbour itself is a backdrop, although, when essential to a valuable use, it maybe paid for indirectly (e.g. we might pay to rent a boat for a day on the Harbour, but we pay for the boat, not Sydney Harbour itself).

This list of values includes some very large numbers of varying types, including sums of money, numbers of users and visitors. For some very important values, such as civic pride or use of neighbourhood parks and walking trails on the foreshores, either there is no straightforward method to estimate any quantities (financial or otherwise) or data is simply lacking at present on these parameters.

Table 8 presents parameters for both annual and total values. In most cases, the total values shown in the last column were based on the financial estimates shown in Table 7 converted into an estimate of value over 20 years through standard present value calculations.

In Table 8 a number of categories of values described in the text and listed in Table 7 have no estimate of financial values due to a lack of data and/or lack of adequate means to attribute financial value to them. These are shown as 'not estimated' in Table 8 to emphasise their importance in the value of Sydney Harbour even in the absence of definitive quantifiable estimates. This also highlights important areas of future work.

Considerable caution is needed when working with results at such a summary level as this (Table 8), and the figures in Table 8 should be taken as only indicative. These totals represent a list of different kinds of values for which we have estimates, and aggregating different indicators of value in this way is too challenging for a number of reasons.

If the values in Table 8 were summed, there would be grounds to consider the estimates made as both overestimates and underestimates. Some of the figures shown are given as total revenues, not net revenues or value added. These are important indicators of the scale of the activity but not a good estimate of economic value. In addition, there was no way of accurately ascribing a particular portion of the values shown as attributable to the Harbour itself. The danger of listing these figures is that the list can be interpreted as values that are totally ascribable to the Harbour, which is clearly not the case. On the other hand, so many important economic values are not estimated due to lack of data or lack of technical means resulting in a total would be by definition an underestimate. This certainly supports the view that this value is large and multidimensional, with the total value of the harbour much more complex than simply the list of financial values in Table 8.

The goal of this report is to understand the many ways the Harbour contributes to economic life and values, and to provide a basis for eventually calculating how those values may change as the

Harbour changes, for better or for worse. Ultimately it is most useful to look at marginal changes that may take place in the coming years. These can be used to guide investment decisions and management generally. It is not as useful to imagine impossible scenarios involving 'no harbour' vs. 'perfect harbour.' It is, however, very useful to attempt an overview estimate of the total of Harbour values as a reference and baseline for projects intended to improve or change the Harbour and its functioning.

Much of the value of the Harbour lies in the way that the city has evolved to take advantage of the special features of this harbour. The character of the city, so interlinked with its dramatic harbour, enhances everything from businesses seeking to locate head offices in Sydney to its young people wanting to remain in the area to live and raise their own families. The nature of its buildings, parks and other features, even the preferences of its population, have been shaped by the Harbour in ways that add to the vulnerability of the city to any damage to the nature of its Harbour. The evolution of Sydney around its Harbour is also clearly continuing with the importance of the Harbour to the city seemingly growing. For instance, more businesses and websites now refer to Sydney as the Harbour City. Advertising Sydney to tourists emphasises the Harbour and activities on and around it. Google Earth filming underwater in the Harbour for one of its first 3-D ocean views is a matter of some local pride and interest.<sup>1</sup>



The South Head Heritage Trail in Sydney Harbour National Park, offers scenic views of the Harbour. Starting from Camp Cove, Watsons Bay, visitors walk past beaches and lookouts to the historic red-and-white striped Hornby Lighthouse.



Spectacular views of North Head and the Tasman Sea, along the South Head walk from 'The Gap' to the Macquarie Lighthouse at Watsons Bay.

Table 7: Economic activities and indicators of value and revenues associated with Sydney Harbour

	Economic activity/ Value	Qualitative Assessment	Quantitative Assessment (monetary values)	Quantitative Assessment (other numbers)
Harbour functions	Ports	Trade through Sydney Harbour is extensive and some port operations are expanding, particularly cruise ship numbers and berths	\$10 billion/year trade \$430 million/year contrib. to NSW economy	Employment: 3000 FTE
	Maritime	Upkeep on harbour infrastructure for ferries and private boats; boat licensing, boating safety and related functions	\$35 million revenue estimated for fees, services and rents	Construction and upkeep of wharves, channel markers, moorings, safety classes, licensing boats, publications
	Navy bases	Defence and training facilities	No estimates	No estimates
	Transport	Public ferries; private ferries and water taxis offer convenient and much-prized alternatives to driving, buses and trains for commuters, residents and tourists	\$174 m/year public ferry revenues; private ferries and taxis unknown \$1m/year estimated equivalent in \$/km for reduced auto driving (minimum)	14.9 m passenger journeys/year. ~15 water taxi companies 2 fast ferry companies
Tourism	Tourism	Sydney Harbour draws tourists, contributing to an unknown amount to total visitor numbers and revenues	Sydney: \$13.5 billion/year Sydney Harbour: not estimated except for the cruise ship component	10.5 million visitors/year
	Cruise ships	Cruise ships are the fastest growing category of tourism, bringing revenue, employment and business to Sydney	Sydney Harbour: \$1.025 billion/year expenditure	259 cruise ships 2013-14 >1 m passengers projected for 2015. Increase in volume exceeded 20% per year over the past 5 years
Foreshore landscape	Landscape values	Sydney Harbour is one of 16 listed National Landscapes	Not estimated	Not estimated
	Icons and attractions	Many of Sydney's most well-known and valuable features border on the Harbour and benefit from its proximity – the Opera House, Harbour Bridge, Darling Harbour, Royal Botanical Gardens, Taronga Zoo, Sydney, Luna Park and more	Opera House: estimated as \$254 million/year in value added. Taronga Zoo, Sydney: \$83 million income, over half from admissions <sup>2</sup>	Opera House: 95% of Australians consider it a national icon, it receives 8.7 m visits/year and 1.37 m attend performances, creates 12,165 direct and indirect jobs. Royal Botanical Gardens: 4 million visitors Taronga Zoo, Sydney: over 1.5 million visitors
	Major events	New Year's Eve fireworks, Sydney Hobart Yacht Race, theatre, Handa opera and movies over water, Sydney Festival, Vivid etc.	\$3-400 million/year total estimated. \$156 m/year NYE fireworks alone	1.6 million people on foreshore NYE fireworks 500K visitors Sydney Festival
Real estate	Incremental land and real estate values	Private property values increase with proximity to the Harbour, particularly those on the water, but also those near and with views. An analogous analysis of any uplift in commercial property values was not possible.	\$40 billion price premium estimated near Harbour for private residences, commercial premium not estimated	82 State suburbs border to some degree on the Harbour (data on prices for 110,000 houses sold)
Business	Private businesses	Some retail and services businesses depend on the Harbour. Restaurants and attractions adjacent to it gain visitors; some benefit from proximity to city and water, some from natural surroundings and water	Private businesses, therefore commercial-in-confidence – no studies found into revenues of businesses relying upon or adjacent to the Harbour	66 boat charter companies ~12 dive shops 800 boat, sales, service, hire Restaurants and attractions on waterside or with view unknown

	Economic activity/ Value	Qualitative Assessment	Quantitative Assessment (monetary values)	Quantitative Assessment (other numbers)
Outdoor leisure and sporting activities	Boating	Recreational boating is very important in Sydney Harbour – 8% of all recreational boats and 20% of all commercial boats in NSW are on Sydney Harbour The proportion of larger private boats is high	Studies or summaries of revenues of facilities, expenses on boats and facilities, revenues of boating clubs, values of boats etc. not found	> 1 million people Harbour water-based recreation activities/year – 18,011 recreational boats, 1084 commercial boats, ~40 boating clubs, >40 private marinas, 570 private jetties, 4700 private moorings
	Swimming	Sydney Harbour beaches are widely used by residents, visitors and boaters for swimming, picnics and family outings	Not estimated	50+ named beaches in Sydney Harbour; swimmers or swim days unknown to authorities
	Parks and walks	Sydney has preserved large wild areas around Harbour and on foreshores. National parks and large reserves are well used. Walks around Sydney Harbour are scenic, well-maintained and popular. Neighbourhood parks are heavily used by families for outings, picnics, dog walks, sports and relaxing	Not estimated	122 km harbour-side trails >1 million visitors/year to Sydney Harbour National Park No estimated neighbourhood parks usage or numbers of trail walkers found
	Recreational fishing	High density of recreational boat fishers per km <sup>2</sup> Shore-based fishing also widespread Some charter fishing in Harbour and Harbour used as a departure point for ocean fishing	Average spend per fisher estimated at \$75-100/day (shore and boat-based) \$60 million/year estimated spent on gear, supplies and daily expenses by fishers in Harbour	96% of fishers in Sydney Harbour are residents of Sydney 62% of fishing is shore-based
	Snorkelling and scuba	Snorkelling and diving in Harbour are both considered to be high quality experiences	Not estimated	~12 dive shops in Sydney 14 named dive sites in Harbour Many NSW residents snorkel or dive
Environmental quality	Ecosystem services	Healthy harbour marine ecosystems filter water, stabilise sediments and foreshores, provide habitat and fish nurseries, sequester carbon; cool and moderate city temperatures	\$150-\$175 million/year derived from studies in Australia and equivalent research elsewhere	Quantitative info on extent or health of most ecosystems is incomplete, but seagrass areas are decreasing
	Biodiversity	Sydney Harbour has very high biodiversity	No estimates for Sydney Harbour	Over 550 species of fish – more than European or New Zealand waters – and over 3000 species of crustaceans, molluscs, polychaetes, echinoderms and fishes
	Valuing environment quality	Willingness to pay study for Sydney Water, expenditure for cleaner water and public demonstrations in the past for cleaner water Excitement over whales in Harbour Volunteers for Bushcare and Clean Up days	\$50-70 million/year value for cleaner water (from willingness to pay study); actual expenses estimated at ~\$700 million affecting Sydney Harbour water \$5 m volunteer labour on Bushcare around Harbour	Building of the north side tunnel reduces sewage rainwater overflows in Harbour by ca. 6 billion litres/year
Culture, arts, sciences, intrinsic values	Arts and Cultural Heritage	Many historical sites – Aboriginal and from early European settlement – up to modern uses of islands and foreshores Cockatoo Island Biennale Arts and Cultural Ribbon around Sydney Harbour & CBD Walsh Bay theatres and development plans	Opera house: direct and indirect about \$254-\$888 million/year in study that included social, iconic and on-line publicity values for tourism; Federation Trust: \$33 m/year in rental revenues	Cockatoo Island Biennale: 203,000+ visitors Opera House: 95% of Australians consider it a national icon, it receives 8.7 m visits/year and 1.37 m attend performances, creates 12,165 direct and indirect jobs
	Science, research and teaching	Research by SIMS and universities into biology, ecology, hydrology, water quality	Protection of values of Harbour – no \$ estimate of total	Helping to protect social and other non-\$ values of Harbour School research outings
	Option, existence, bequest values	These have to do with valuing options for future uses, altruism (use by others) and intrinsic values	Not estimated	Not estimated

Table 8: Values associated with Sydney Harbour, annual and present value over 20 years

	Estimates	
	Annual values	PV* 20 years
Activities and functions	in millions of \$	
<b>Harbour functions</b>		
Harbour Port, revenues	\$430	\$4,555
Maritime revenues for services	\$35	\$369
Sydney ferries revenues	\$175	\$1,854
Royal Australian Navy	NE	NE
<b>Cruise ships &amp; tourism</b>		
Cruise ships expenditures	\$1,025	\$10,856
Other Sydney Harbour tourism	NE	NE
<b>Foreshore landscape values</b>		
Icons and attractions		
Sydney Opera House	\$254	\$2,691
Taronga Zoo (ticket revenue)	\$42	\$440
others	NE	NE
Major events on & around SH	\$400	\$4,238
<b>Incremental value of land &amp; real estate</b>		
Domestic real estate	\$3,775	\$40,000
Commercial real estate	NE	NE
<b>Private businesses</b>		
Harbour dependent	NE	NE
Adjacent to harbour	NE	NE
<b>Outdoor leisure &amp; sporting activities</b>		
Boating	NE	NE
Swimming	NE	NE
Parks and walks	NE	NE
Recreational fishing	\$71	\$757
Snorkelling & scuba	NE	NE
<b>Environmental quality</b>		
Ecosystem services	\$160	\$1,695
Biodiversity	NE	NE
Valuing cleaner water	\$75	\$796
<b>Culture, heritage, arts and science</b>		
Arts & cultural heritage		
Sydney Harbour Federation Trust	\$33	\$350
Other historical & cultural sites**	NE	NE
Science research & teaching	NE	NE
Option, existence & bequest values	NE	NE
notes:		
* PV = present value calculation, over 20 years, discount factor used = 7%		
** Sydney Opera House & others that could be considered here were included under Foreshore Attractions		

### 3. A conceptual approach to future risks and opportunities

#### 3.1 Sources of Harbour values

One emergent result of this paper is the concept that the economic values reviewed in this paper derive from three characteristics of the Harbour: its geography, the fact that its water is generally clean throughout much of the Harbour, and that it is a living harbour with vital marine ecosystems. The three are very much intertwined. This concept may be useful for considering future risks and opportunities, because it may help to create a framework categorising which kinds of values are at risk and from what sorts of threats. To elaborate on this idea:

- Geography:** Sydney Harbour is a natural port, used for trade, cruising, defence activities and transport. Proximity to the Harbour also increases land values and real estate prices. The landscape of the Harbour is a setting for activities that benefit from its beauties and natural qualities, from cultural heritage and the arts to Sydney's most famous structures, particularly the Opera House and the Harbour Bridge. Its natural beauty is a source of civic pride.
- Water Quality:** Clean water makes some activities possible or safer (e.g., swimming) or more pleasant (e.g., recreational boating, performances on the foreshores and family time in neighbourhood parks). Tourism falls into this category to the extent that the clean water and healthy outdoor image form an important part of Sydney's attraction to tourists. Clean water is also important for many harbour-related businesses, from sales and rentals of boats and kayaks, harbour cruises and tours to harbour-side dining.
- Healthy marine ecosystems:** Sydney Harbour has a diverse array of natural systems formed around the complex geography of the estuary. These systems provide ecosystem services that contribute many economic values. It is clear that the healthy ecosystems are essential for recreational fishing, scuba diving and snorkelling. Less obviously, these ecosystems are also filtering water, stabilising sediments and shorelines, providing fish nurseries, sequestering carbon and more. The fact that Sydney Harbour is a healthy living harbour is essential to environmental quality generally, even if we do not see it.

### 3.2 Sources, changing values and possible risks

This paper has examined a large range of Sydney Harbour values. Ultimately three general Harbour characteristics – geography, water quality and healthy marine ecosystems – are sources of all the values listed above. This concept leads to an appreciation of Sydney Harbour as more than just a scenic backdrop, and may be a useful framework for managing risks and opportunities in the coming years.

#### Geography

The shape of Sydney Harbour, geologically a drowned river valley or 'ria'<sup>1</sup> makes it a great natural harbour, valuable as a port for cruise ships and shipping, city transportation and recreational boating. From the earliest days its shores were inhabited by Aborigines and then later by Europeans. It was seen as an excellent harbour for a settlement,<sup>2</sup> for security and commerce. It also has hydrological advantages of good drainage and natural protection from flooding on its shores. It is a great sailing/boating venue. Its cliffs and slopes make dramatic views and its natural beauty generally acts as a pleasing backdrop for many cultural events. The result is most land values adjacent to or near the Harbour are higher than those further inland. The landscape and history values of the Harbour instill civic pride, are highly valued and have inspired art over the years.

We may think of the Harbour geography as fixed, but we have modified the size and shape of the Harbour and its waterside areas by draining and filling, hardening banks and reclaiming land to construct port facilities, industrial areas, parklands and residential sites. These changes have improved Harbour foreshores for our human use, but we have also removed wetlands, including salt marshes and mangrove areas, which reduces habitat for many organisms.

Part of Sydney Harbour's beauty comes from the many parks and wild areas on the foreshores, and these are generally highly appreciated and well-managed. Some have been made public park spaces, rather than commercial areas, in part due to extensive efforts and lobbying by residents. The Sydney Harbour Federation Trust (SHFT) is transforming former military areas around the Harbour into foreshore and island public spaces

including parks, walking tracks, artists' districts, research areas and small-scale commercial areas. Part of SHFT's mandate is to protect historical, cultural and environmental values and to foster opportunities for marine research.

This is likely to preclude the transformation of these areas into (for example) dense housing developments or commercial parks in the foreseeable future, so their present values for public use, research and as an integral part of the Harbour foreshore are not predicted to change. Some areas closest to the central city will likely see greater building densities and possible shoreline changes, for example the Barangaroo and Bays developments. The effects of climate change and predicted rising sea levels are as yet unknown though any sea level rise would alter the geography of the Harbour. It is however interesting that insurance companies seem to be doing considerable planning in regard to climate change and potential damages, as presumably they may be faced with claims.<sup>a 3</sup>

## Water Quality

Good water quality makes water sports such as swimming, wind-surfing and stand-up paddle-boarding possible and boating, from kayaking to sailing and motoring, more enjoyable. Water quality also affects the enjoyment of everything that takes place on the foreshores: walks, family games and picnics, concerts, large performances and events, waterside dining and residences, and more. The fact that the Harbour is clean and inviting is clearly also a source of civic pride and adds to the healthy, fresh, sporty image of Sydney (and probably Australia more generally), an image that contributes to its draw for tourists.

Historically, we have both dirtied the Harbour's water and cleaned it. In the past, we dirtied it through industrial dumping and using it as a sewer. In recent years we've cleaned it through waste water treatment and diversion, dredging and/or covering polluted sediments, curtailing industrial discharges and restricting the handling of toxic chemicals used to protect boats and piers. Water quality in the Harbour has improved significantly with infrastructure for the reduction of sewage overflow, compared to the late 1980s situation when public outcry led to investments to improve water quality.

Stormwater runoff still reduces safe swimming days for Harbour beaches and some coastal beaches also, because it carries road residues, lawn and garden chemicals and washed-in litter. Legacy industrial residues (dioxins, organic chemicals and some metals) in sediments remain threats in some areas and were responsible for legislation banning commercial fishing in the Harbour in 2006. Overall, for a Harbour in the centre of a city with over 4.5 million inhabitants, Sydney Harbour is in relatively good shape and improving, and justifiably, this is a source of national pride for many.

Water quality values are, however, more changeable than geographic ones. Most councils within the Sydney Harbour catchment have adopted Stormwater Management Plans that outline near term and longer term strategies for stormwater management, but stormwater runoff may increase in both volume and pollutant load with additional urban growth. Some cities along rivers in other parts of the world<sup>4</sup> limit the use of yard fertilisers to slow-release types in order to reduce nutrient enrichment<sup>5</sup> or restrict the use of persistent pesticides within specified distances to water bodies; others construct biological filtration systems with reeds and other plants at the ends of stormwater drains. These approaches may also be useful for Sydney.

Historical legacy pollution from old industrial sites present in a number of places in the Harbour can be difficult to clean. Sediments can be resuspended with water movement and travel on currents and tides. Dioxins, present since the manufacture of Agent Orange at Homebush, are considered dangerous at such low concentrations that it is hard to remove enough to reduce them to a safe level.<sup>6</sup> Future work to cover contaminated sediments or, in some cases, to block off water areas may reduce the risks associated with some pollution. Although most of the commercial shipping has been moved south to Botany Bay, shipping spills have occurred in the past and are not completely out of the question. Other activities that take place on or near the water, including shipping, boating, coastal development and many tourist activities, have the potential to negatively affect water quality.

## Healthy Marine Ecosystems

The Harbour has an exceptionally wide variety of habitats and eco-systems. These ecosystems support marine food webs and fish nurseries, act as nutrient sinks and recyclers, filter and clean water, and protect and stabilise shorelines. These ecosystem services are mostly, but not entirely, invisible to most of us. One ecosystem product that we are aware of is fish. Without the food webs of a healthy living harbour and clean water, fishing would be limited or non-existent. Sydney Harbour has some remaining pollution problems that caused the cessation of commercial fishing in 2006, but recreational fishing is thriving and – from some areas of the Harbour and within limitations – the fish are safe to eat. Snorkelling and scuba diving are of interest to locals and tourists alike partly because of the Harbour's beauty and relatively clear water and also because of Sydney Harbour's endemism and biodiversity. There is, for example, a greater diversity of fish than the entire Mediterranean or the coasts of New Zealand or Great Britain.<sup>7</sup>

The diversity of Sydney Harbour is partially understood, but many gaps in our knowledge remain. It hosts a diverse population of flora and fauna, however, there have been changes and losses. Populations of some taxa, such as seagrasses<sup>8</sup> and oyster beds that were contributing as fish nurseries and helping to clean water, stabilize acidity<sup>9</sup> and fix sediments have been reduced and others are diminished or threatened. Seagrasses are still a particularly valuable ecosystem, functioning as fish nurseries, sediment stabilisers and providing very high carbon sequestration levels as shown in studies worldwide,<sup>10</sup> but several areas have seen partial or total losses of seagrasses (e.g. Rose Bay, for example, has seen dramatic shifts in seagrass distributions in the past 20 years). The sizes of fish species caught in the Harbour are often smaller than legal limits for several species, and some species

have become economically extinct.<sup>11</sup> Oysters, which are key ecosystem engineers in estuaries along the east coast of Australia, are now economically extinct in the Harbour. Ecosystem services have been reduced or lost because of the loss of the oyster beds (e.g. oysters are particularly good water filterers and cleaners and recent research demonstrates their value in stabilizing pH levels<sup>12</sup>).

Environmental values are mostly not noticeable to us until they are lost. We are aware of the importance of a clean, living harbour to fishing, snorkelling and scuba diving in the Harbour. Most of us, however, have little knowledge or experience with seagrass cover, kelp beds, temperate mangroves, rocky shores, the intertidal areas and their inhabitants or what they do for us. Yet these systems, among several others, are integral to keeping the Harbour clean, healthy and productive for residents, visitors and future generations to enjoy. It may be possible to re-establish or extend some ecosystems, such as seagrasses. Some nursery and refuge areas for fish may need to be protected from extractive uses to allow fish densities and size to rebound to previous higher levels. A major benefit of such actions could be to avoid (or limit risk of) species loss and even to reduce the impacts of climate change by making stronger and more resilient ecosystems.

These three general characteristics of the Harbour affect one another. For instance, the shape of the Harbour and the heads allows the tides and waves to flush the eastern part of the Harbour, cleaning the water. The Harbour water helps to cool and stabilise temperatures in the city. The underwater geography offers habitat for flora and fauna and allows ecosystems to function normally. In turn, these flora and fauna filter the water and stabilise the bottom. Many of our economic activities and the reason we value the Harbour are dependent upon all three characteristics.



Good water quality and conservation of marine habitat contribute to the high levels of biodiversity within Sydney Harbour. Photo John Turnbull.

a Mills, Evan (see citation source in endnotes) cites a number of insurance company actions and assessment regarding climate change. For example, 'A 2007 PricewaterhouseCoopers survey of 100 insurance industry representatives from 21 countries indicates climate change is the number-four issue (out of 33); natural disasters ranks number two. The majority of the other issues are arguably compounded by climate change. The following year, Ernst and Young surveyed more than 70 insurance industry analysts around the world to determine the top-10 risks facing the industry. Climate change was rated number one and most of the remaining 10 topics (e.g. catastrophe events and regulatory intervention) are also compounded by climate change. The investigators note that 'it was surprising that this risk, which is typically viewed as a long-term issue, would be identified as the greatest strategic threat for the insurance industry'.'

## 3.3 Studies into values of estuaries with major cities

Searching for overall estimates of environmental values for estuaries in major cities generally turns up studies of either ecosystem service values only, or concerns about protection from rising sea levels and other potential climate-related threats. There seem to be very few studies where economic activities that take place on or around water bodies adjacent to major cities are valued as environmental benefits or where environmental, social and market values were considered together for a city and water-body combination. The following is the only such study found while researching for this report. A summary of the approach used is given below because such studies are rare, and it provides a useful comparison to the current study of Sydney Harbour.

### San Francisco Bay natural resources services valuation

This study<sup>1</sup> evaluated the various environmental functions of the Bay in relation to a large number of economic activities, including some that could be quantified and some that could not.

The methodology used was to identify possible environmental values in literature sources, resulting in a list of environmental values that was evaluated by experts and then proposed to local stakeholders. A final list was assembled and the available information was summarised. The environmental values included direct uses, indirect uses, non-use and intrinsic values.

All of the values discussed in the San Francisco report were called environmental values. Most of the report was dedicated to direct use values such as commercial and sport fishing, transport, recreation and ecotourism, mineral extraction, wastewater assimilation, residential and industrial water supply and more. The indirect use values were what are now commonly called ecosystem service values. The non-use and intrinsic values were defined in general terms described as option, bequest and stewardship motives, but no attempt to quantify them or relate them specifically to San Francisco Bay was made.

Quantitative assessments were given for most of the values, some in monetary terms and some only in physical numbers. Marinas and boat slips, birds and grey whales migrating, tons of wastewater discharged and drinking water desalinated and

megawatts of power generated were quantified in physical numbers without financial estimates. No quantification was given for subsistence fishing, scientific research, education or non-use and intrinsic values. The values that were quantified in monetary terms were not totalled.

In sum, there are similarities and differences to the methodology used in the study of San Francisco Bay and that used here. In both, lists of values were assembled, and estimates of values listed where these could be found from sources that reported in non-uniform ways. Both reports listed financial values where available, physical quantification where possible, and some values were best effort where neither types of quantification were found. Both studies faced important limitations on estimating values of some major estuary functions and in estimating non-financial but important values.

The authors of the San Francisco study included total values for direct use values and some indirect usage values, but they did not make an overall total. The authors state that their report 'serves as an environmental primer, which can be referenced when considering the linkage between the environment and economy in the San Francisco Bay Area.'<sup>2</sup>



Biodiversity within the harbour attracts local and international scuba divers, providing a source of income to private businesses. Photo Rob Harcourt.

## 4 Technical Notes

### 4.1 Estimation methodology

#### Total Economic Valuation

The methodology used in this paper is an adaptation of the total economic valuation (TEV) approach often used in valuing environmental assets. It is similar to the approach used by the team conducting the San Francisco Bay study discussed above. The goal is to assemble a range of values of various sorts in a way that makes a total possible. This study is a first step towards achieving that goal.

The definitions of what is considered in a TEV vary slightly but the basic concept is the same. This definition is synthesized from several sources.<sup>1 2 3</sup> The TEV is comprised of Use Values and Non-use Values. Use Values include Direct Use Values (market and non-market), Indirect Use Values (functional benefits enjoyed indirectly, often ecosystem service values are included in this) and Option Values (for future direct or indirect use). Non-use Values include Existence Value (from knowing that something exists possibly related to personal values even if one does not intend to enjoy it, e.g. whales or wilderness), Altruistic Values (knowing that someone else will be able to use or enjoy something) and Bequest Values (derived from the idea that future generations, likely one's descendants, will be able to use or enjoy something).

In this report, the emphasis is on making estimates of direct and indirect use values. These can include both consumptive uses (e.g. fish that are eaten) and non-consumptive uses (e.g. enjoying a walk or a cultural event). Non-consumptive uses are harder to value and some valuations have been found but considerable amounts have not. Indirect use values are treated under ecosystem service values. Non-use values are mentioned but no quantifying information was found.

Various methods have been developed to estimate the value of environmental resources and a great deal has been written about the topic.<sup>4</sup> The following methods are used based on standard methodology for estimating values and the types of revenues and asset values estimated with each are listed. Many sources are possible. The list here is based on the summary provided on the site EcosystemValuation.Org:<sup>5</sup>

#### Market Price Method

Market prices can be used for goods and services that are bought and sold in a market. The concept used for net economic benefit for valuation of resources is to identify consumer and producer surpluses to find an estimate of total value.<sup>6</sup> Producer surpluses are often considered to be effectively estimated by Value Added. (e.g.: 'Assumes Gross Operating Surplus is equivalent to Value Added, and that is equivalent to Producer Surplus.'<sup>7</sup>)

Value added is considered to be a best estimate of an industry's value in terms of its contribution to gross domestic product because this does not include the value of intermediate products used, which are manufactured by other industries.<sup>8</sup> Some of the figures gathered and presented in this report, are expressed in value added, but more are in terms of turnover or total (gross) revenue.

Some of the following are described in terms of expenditures by consumers (cruise ships, recreational fishers) which represent revenues for various businesses. (These also imply but do not calculate consumer surpluses.)

Because the data obtained is market-based but not in a consistent format, the information here has been described as 'indicators of value of economic activities for which the Harbour is essential or integral.' The following are examples of where market-based assessments were used in this report:

- Harbour port revenues
- Maritime revenues for services
- Sydney Ferries revenues
- Cruise ships expenditures
- Opera House value added (direct and indirect)
- Taronga Zoo ticket revenue
- Economic value of major events on and around the Harbour
- Recreational fishing expenditures
- Sydney Harbour Federation Trust revenues.



## Hedonic Pricing Method<sup>9 10</sup>

This is a kind of Revealed Preference estimate, based on actual expenditures, but only indirectly measurable. The method estimates economic values for ecosystem or environmental services that directly affect market prices of some other good are measured. This method is most commonly applied to variations in housing prices that reflect the value of local environmental attributes, in this case incremental value of proximity to the Harbour over proximity to central Sydney. Note that this is a first estimate based on available data. A more complete estimate would go into greater detail to construct models with more variables.

- Incremental residential property values by proximity to the Harbour in suburbs that touch on the Harbour

## Contingent Valuation Method<sup>11 12</sup>

This is a Stated Preference method (as opposed to Revealed) used to estimate economic values for virtually any ecosystem or environmental service. The most widely used method for estimating non-use, or 'passive use' values is to ask people to directly state their willingness to pay for specific environmental services, based on a hypothetical scenario.

- Survey of stated willingness to pay for cleaner Harbour water contracted by Sydney Water Corporation for sewer overflow reduction project
- Sydney Water Corporation's actual expenditures on reducing the pollutants flowing into Sydney Harbour in the Sewer Fix program and some of the Clean Waters program represent a kind of social revealed willingness to pay for cleaner Harbour water. Note that this value (about \$700 million) is not far from the present value calculation for the willingness to pay survey (\$796 million).



above: Views towards the city from Bradleys Head Amphitheatre, a popular place for fishing, picnics and bushwalking within Sydney Harbour National Park.

below: SIMS scientists educate hikers about the importance of protecting and preserving the Harbour during the annual Fantasea Harbour Hike. Photo SIMS.

## Substitute Cost Method<sup>13</sup>

Estimates of economic values are based on costs of providing substitute services. Note that these generally only represent partial values and tend therefore to be underestimates. The numbers cited here are described in the text but were generally not considered the best estimates and so not used or else were added to other estimates. Recreational fishers' expenditures are much higher than the retail value of the fish and the enjoyment of the experience is more than the value of the catch, so the value of the catch was not used; the other two estimates produced very small values that were added to the category totals.

- Recreational fishers catch as substitute for buying fish at retail
- Volunteer labour offered freely on Bushcare, equivalent paid value
- Distance travelled by passengers in ferries used as a substitute for trips by private car by valuing at rates accepted by tax authorities. (This excludes out other values of reducing car travel.)

## Benefit Transfer Method<sup>14 15</sup>

Economic values are estimated by transferring existing benefit estimates from studies already completed for another location or issue. These are often used because of the cost of doing surveys in many locations. They are considered acceptable if adjusted to fit local situations.

- Eco-system services values are estimated based on work done elsewhere in Australia and international meta analyses of data surveys analysing numerous studies and sites.

## 4.2 Some technical issues which arise in making an economic assessment of Sydney Harbour

'You are asking an incredibly important question that is impossible to answer.'

*(An economist colleague's reaction to this report)*

This report covers a large array of economic activities associated with the Harbour. Some can be called benefits, some are actually costs of maintaining something we value and use and here these costs have been taken to indicate a social willingness to pay. They are all values in a sense, but vary in content and available data such that combining them into one analysis is complex. There are many technical difficulties in researching what are fundamentally economic benefits derived from a natural environment which is not directly priced. For example they include:

1. The city of Sydney and Sydney Harbour are so intertwined that it is very difficult to separate the two. In this qualitative and quantitative assessment, activities that take place on and around the Harbour are described where it is clear that the Harbour is an important part of the benefits and economic values.
2. Economists make some distinctions that are blurred in this attempt to look at the diverse economic values of Sydney Harbour. There are revenues that come from outside the local area from tourists travelling from afar or from fees for visiting ships using Harbour moorings. Other values reported here are transfer payments: costs for some and revenues for others within the economy, such as local residents paying for moorings to authorities who service them, or residents paying for cleaner water in the Harbour by authorities improving the sewage handling facilities. Where the indicators of economic value are costs, they are considered to be evidence of an unquantified but real consumer surplus. (We wouldn't pay if we didn't value the results more than the costs.) In these examples, the payments for maritime services and the investments in cleaner water are considered evidence of the value of boating facilities and clean harbour water to residents and additionally an (unquantified) boost to the tourism industry.



The Sydney Harbour Bridge Walk is an annual favourite, as shown by the high levels of participation at the 75th Anniversary Walk. Source: Photo Saberwyn. [https://commons.wikimedia.org/wiki/File:BridgeWalk\\_inside\\_arch.jpg](https://commons.wikimedia.org/wiki/File:BridgeWalk_inside_arch.jpg)

3. Data given by different agencies and studies is reported here, but it is clear that some of them overlap, so some were not included in order to avoid double-counting. That is part of the reason the total value of tourism to Sydney is not included in the totalled column in Table 2.
4. Where revenues are given, they are presented differently by different agencies, often as gross revenues where costs are not considered. Some are reported in terms of value added. Some, but not all, include both direct and indirect benefits. One included a good estimate of social values and even an estimate of 'potential digital value' although in the interests of consistency these were not included in the totals here.<sup>1</sup> Net revenues, value added or producer/consumer surplus are better indications of economic value of an activity than one in which costs are not netted out. Without a great deal of additional, more targeted research, it is not possible to remedy the fact that data is presented differently across different agencies and sources. Magnitudes of gross revenues are still an indication of the importance to various users of the Harbour as are other quantitative indicators such as numbers of people involved. Both are presented here in Table 1. Given the differences in methodology used in reporting it is important not to compare valuations or rank them in importance on the basis of magnitude in this first study.
5. While this paper focuses on Sydney Harbour and not on the ocean and beaches along the coast, there are clearly important connections between the Harbour and the ocean. The ocean tides and currents help to flush out the Harbour waters. Whales come into the Harbour and cause excitement among locals and tourists alike. Some of the value of this harbour-ocean relationship is captured in the estimates, but much is not.



View from North Head of the Sydney to Hobart Yacht Race. The annual event draws local and international crowds and is widely publicised around the world. Source: Photo Kspilling. [https://commons.wikimedia.org/wiki/File:Wild\\_oats\\_xi\\_city\\_index\\_leopard\\_skandia\\_going\\_through\\_heads.jpg](https://commons.wikimedia.org/wiki/File:Wild_oats_xi_city_index_leopard_skandia_going_through_heads.jpg)

For instance, while the Harbour functions as a nursery for fish that subsequently move out into the ocean thereby making an economic contribution to commercial and recreational fishing outside the Harbour, the magnitude of this biological function is not known, and so economic valuation is not yet possible.

6. Underlying many attempts to value ecosystem services and environmental assets (which provide ecosystem services) is the fact that their value and their price are not the same. For instance, many non-use values are considerable but they are not priced, which means that they effectively have a price of zero. This does not reflect their value. Even where prices exist, some people may be willing to pay more than this price (for example, for clean water). In both cases, there is a gap between value and price which is a 'consumer surplus,'<sup>2</sup> but an unmeasured one, implying an underestimate in the value of these resources.
7. Many important values are likely to be poorly estimated at present. For example, economic research into the psychology of people's valuing of things has shown a remarkable difference between a willingness to pay for assets that we don't yet have and a willingness to accept payment to give up assets that we already have, with the latter achieving much higher value estimates. The implication here is that Sydneysiders may be willing to pay a lot not to lose the special character of the city, which they may have grown up with or come to value once living here, or on which some businesses would rely. These could include not losing existing values such as clean Harbour water, or wild areas or recreational fishing in the Harbour.
8. Many important values simply cannot be monetised. There are many amenity values that are very difficult to quantify, having to do with enjoying the arts, cultural values, historical sites,

wildlife encounters or giving one a sense of civic pride or a special appreciation for nature and wildlife. Many tourists and residents place a high value on taking a harbourside walk but we cannot estimate that value. There may be indications in ticket sales or travel costs or willingness to pay for some, and sometimes trade-off analyses may be used, but in general, they indicate parts of the total values at best, and many of these values have not been estimated quantitatively. These values can be as important or more important to people and are therefore economic by definition even when they cannot be given an estimate of monetary value. Where found, other quantifiers such as numbers of participants have been reported here.

9. There are important distinctions between marginal values and total values. Ultimately what is of interest for policy-making is not total value but changes 'at the margins', meaning specifically what can be gained or lost. The attempts in this paper to estimate total values should be a basis for further estimation of possible changes – risks, rewards and their valuation.
10. Finally, there are so many economic activities taking place on and around the Harbour that there is an excess of possible information. Part of the challenge is to find the information that is most useful without reviewing every possible source, an exercise that could take years. The approach here has been to search out research papers and to update information, often from material posted by government agencies or other organisations on the web, as they seem generally to be the most current sources of data.
11. All of the above have contributed to difficulties in organising and making consistent estimations. The author hopes that further work by expert researchers in the academic community and in Government agencies will help resolve some of these issues.

## 5. Conclusion and relevance for future study

The approach used in this paper – like the one cited for San Francisco Bay – is broader than most economic analyses. It attempts to create a picture of the economic value of Sydney Harbour by pulling together many sources of information about disparate users conducting activities that rely on the Harbour to an important degree and instances where the Harbour adds value to property, events and activities that take place in, on or around it. These are all considered indicators of economic value, and they range from monetary revenues to environmental and social values.

There are many complexities in trying to estimate economic values for Sydney Harbour, from the fact that data is seldom available in the necessary format to separating the city and the harbour as sources of value conceptually. Different reporting agencies also report in different formats and reporting of revenues may in fact overlap, raising the risk of double counting. Some important values are currently not quantified or quantifiable in dollar terms and some are apparently not quantified at all as of yet, e.g., the numbers of users of harbour side parks and pools.

Two general concepts used in organising an approach to valuation have been developed over the course of writing this first study, and these may be useful for other studies. The first concept is that of classifying sources of value associated with a harbour, for which three have been included: geography, water quality and healthy marine ecosystems, described in the previous section on 'Sources of Harbour values and how they may change.'

This concept of sources of value is useful for considering harbour management and risks. Different activities – or failing to act – may affect different aspects. They are interlinked, but threats to one are not necessarily threats to all three. It also has the advantage of explicitly linking living ecosystems and harbour values.

The second concept is that of the groupings of categories of kinds of values. While the specific indicators of value may change with different harbour situations, the eight groupings of categories are general and may prove useful in other cities' analyses. They are:

1. Harbour functions
2. Tourism generally and cruising
3. Foreshore uses and landscape

4. Incremental real estate values
5. Harbour-related businesses
6. Outdoor leisure and sporting activities
7. Environmental quality, socially valued and ecosystem service values
8. Cultural, historical, scientific and intrinsic values

These two concepts are offered as a basis for discussion of how to approach and classify indicators of economic values of harbours associated with major cities.

Finally, although some of the indicators have been quantified financially, in terms of revenue streams in some cases, or incremental values at least partially attributed to the Harbour in others, it is important to recognise that large financial numbers are not always the best indicators of economic values to people. Some are hard to value financially but are quantified in other ways, including numbers of participants or users or physical measures such as numbers of ships or areas of ecosystems. Some are not quantifiable at all at this stage either because data is lacking or because an appropriate method has not been found. The indicators can be organised into a matrix with (1) qualitative (2) financially quantified and (3) other types of quantified measures, as done in this paper in the first summary table (Table 7). The second summary table (Table 8) summarizes only quantifiable results in both annual and present value terms and it shows a large number of NE or not estimated values, which hopefully will be the subject of future research.

Ultimately what is of interest for policy-making is not total value but changes 'at the margins': meaning specifically – what can be gained? Or, what can be lost? In the case of Sydney Harbour, the question is often phrased as – what is at risk? The attempts in this paper towards estimating total values are presented as a start to be a basis for further estimation of possible changes: risks, rewards and their valuation. This estimation of total value is a starting point for the marginal analyses as it provides an indicator of the role and importance of the Sydney Harbour to many people and groups with varying interests.

Even though individual estimates of values at this stage are limited, the process of assembling them may help to create a better understanding of the value of Sydney Harbour, and how we may be able to derive greater sustainable value into the future. Decisions on the multiple competing uses of Sydney Harbour are being made every day, both implicitly and explicitly. Thinking through what can be said about the value of the different dimensions of Sydney Harbour should help inform these decisions. The hope is that this report is a solid step towards a more informed decision making process.

## 6. Endnotes

### Introduction

- 1 'Sydney Harbour National Landscape' (2014 ) <http://www.australia.com/nationallandscapes/sydney-harbour.aspx>, accessed 10 January 2014.
- 2 Trip Advisor website, Sydney Australia, [http://www.tripadvisor.com.au/Attractions-g255060-Activities-Sydney\\_New\\_South\\_Wales.html](http://www.tripadvisor.com.au/Attractions-g255060-Activities-Sydney_New_South_Wales.html), accessed 15 May 2014.
- 3 Johnston E.L., Mayer-Pinto M., Hutchings P., et al. (in press) Sydney Harbour: What we do and don't know about a mega-diverse estuary. Marine and Freshwater Research.
- 4 Mayer-Pinto M., Johnston E.L., Hutchings P., et al. (in press) Sydney Harbour: A review of anthropogenic impacts on the biodiversity and ecosystem function of one of the world's largest natural harbours. Marine and Freshwater Research.
- 5 Amenity values can be defined as natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.

### 1.1 Harbour Functions: ports, maritime activities, transport, the Royal Australian Navy

- 1 Sydney Ports Corporation Annual Report 2011/12.
- 2 Ibid.
- 3 Ibid.
- 4 Ibid.
- 5 NSW Maritime Annual Report, 2011 – Final.
- 6 NSW Roads and Maritime Services Annual Report, 2011-2012.
- 7 Ibid.
- 8 Fleet Base East <http://www.navy.gov.au/establishments/fleet-base-east>, accessed 15 June 2013.
- 9 Australian Navy, International Fleet Review, <http://www.navy.gov.au/ifr>, accessed 15 June 2013.
- 10 Fleet Base East <http://www.navy.gov.au/establishments/fleet-base-east>, accessed 15 June 2013.
- 11 Ibid.
- 12 Transport for NSW, Annual Report 2012-13 .
- 13 Ibid.
- 14 Manly Fast Ferry website (2013) <https://www.manlyfastferry.com.au/>, accessed 27 February 2014.
- 15 Sydney Fast Ferries <http://www.sydneyfastferries.com.au/>, accessed 27 February 2014.

### 1.2 Cruising revenues and tourism more generally

- 1 AEC Group Ltd. On behalf of Cruise Down Under, with the support of Tourism Australia (2013) Economic Impact Assessment of the Cruise Shipping Industry in Australia (2012-13 | Executive Summary | September 2013).
- 2 Carnival Australia's submission to the Barangaroo review (2013) Submitted 20 June, 2011 [http://www.nsw.gov.au/sites/default/files/CARNIVAL\\_AUSTRALIA\\_BarangarooReviewSubmission\\_110620.pdf](http://www.nsw.gov.au/sites/default/files/CARNIVAL_AUSTRALIA_BarangarooReviewSubmission_110620.pdf)
- 3 Ibid. p.3.
- 4 AEC Group Ltd. 2013 AEC Group Ltd. On behalf of Cruise Down Under, with the support of Tourism Australia (2013) Economic Impact Assessment of the Cruise Shipping Industry in Australia (2012-13 | Executive Summary | September 2013).

- 5 City of Sydney, (2013) Draft Tourism Action Plan, July 2013 [http://www.cityofsydney.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0008/156527/Draft-Tourism-Action-Plan.pdf](http://www.cityofsydney.nsw.gov.au/__data/assets/pdf_file/0008/156527/Draft-Tourism-Action-Plan.pdf)
- 6 Sydney 100 (n.d.) Top things to do in Sydney. [www.sydney100.com](http://www.sydney100.com)
- 7 Trip Advisor.Things to do in Sydney/Attractions. [http://www.tripadvisor.com.au/Attractions-g255060-Activities-Sydney\\_New\\_South\\_Wales.html](http://www.tripadvisor.com.au/Attractions-g255060-Activities-Sydney_New_South_Wales.html), accessed 18 June 2014.
- 8 Darling Harbour Live (2013) Revitalising one of Sydney's favourite places – Darling Harbour. <http://www.darlingharbourlive.com.au/>, accessed 18 February 2014.

### 1.3 Harbour foreshore: landscape, icons, attractions and special events

- 1 Australia's National Landscapes, Sydney Harbour. <http://www.australia.com/nationallandscapes/Sydney-harbour.aspx>, accessed 21 May 2014.
- 2 Tourism Australia (2014) quotation from Sydney National Landscape site. <http://www.australia.com/nationallandscapes.aspx>, accessed 10 May 2014.
- 3 National Landscape, Sydney Harbour website (2014) <http://www.australia.com/nationallandscapes/sydney-harbour.aspx>, accessed 3 March 2014.
- 4 See for example the good discussion of various techniques presented in the report by NOAA, the US National Oceanic and Atmospheric Administration, 'Socioeconomic Assessment Natural Resources Value' <http://www.nerrs.noaa.gov/doc/siteprofile/acebasin/html/socioecn/rvnatres.htm>, accessed 3 September 2014.
- 5 Celebrating 40 years in 2013 (2013) Sydney Opera House, 2012/13 Annual Report.
- 6 Simes, R., et al (2013) How do you value an icon? The Sydney Opera House: economic, cultural and digital value. Deloitte.
- 7 Department of the Environment (2007) Sydney Harbour Bridge. The assessor's summary of significance of the Sydney Harbour Bridge. [www.environment.gov.au/system/files/.../sydney-harbour-bridge.doc](http://www.environment.gov.au/system/files/.../sydney-harbour-bridge.doc) Australian Heritage Database, places for Decision, Class: Historic. Accessed 21 February 2012. Note this link no longer works. But a Google search for 'The Assessor's Summary of Significance of the Sydney Harbour Bridge' links directly to the full nomination document .doc file, listing the Bridge as under assessment in 2005 and nominated in 2007.
- 8 eTravel Business News (2013) BridgeClimb Sydney Celebrates Three Millionth Climber. <http://australia.etbnews.com/139743/bridgeclimb-sydney-celebrates-three-millionth-climber/>
- 9 Haynes, R., (2009) Don't we own the Bridge yet? The Daily Telegraph, January 15, 2009.
- 10 news.com.au (2012) A slow crawl down the super goldmine. February 21, 2012 <http://www.news.com.au/national/a-slow-crawl-down-the-super-goldmine/story-e6frfkp9-1226276388801>, accessed 10 January 2013.
- 11 NSW OEH (2013) Royal Botanic Gardens and Domain Trust Annual Report 2012-13. [www.rbg Syd.nsw.gov.au](http://www.rbg Syd.nsw.gov.au), accessed 25 February 2013.
- 12 City of Sydney, (2013) Draft Tourism Action Plan , July 2013 [http://www.cityofsydney.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0008/156527/Draft-Tourism-Action-Plan.pdf](http://www.cityofsydney.nsw.gov.au/__data/assets/pdf_file/0008/156527/Draft-Tourism-Action-Plan.pdf), accessed 20 February 2014.
- 13 <http://www.2021.nsw.gov.au/>, accessed July 2013.
- 14 NSW Government (2013) NSW 2021, A plan to make NSW number One. <http://www.2021.nsw.gov.au/>, accessed 13 November 2013.

- 15 Events (n.d.) Destination NSW <http://www.destinationnsw.com.au/events>, accessed 3 April 2014.
- 16 Hon. George Souris M.P. (2012) Media Release: Major Events Boost State's Economy 3 January, 2012.
- 17 Sydney Media (2012) A rock 'n' roll rainbow welcome to 2012. [www.sydneymedia.com.au/html/4857-arock-n-roll-rainbow-welcome-to2012.asp](http://www.sydneymedia.com.au/html/4857-arock-n-roll-rainbow-welcome-to2012.asp), accessed 30 March 2012.
- 18 City of Sydney (2014) All-seeing eye's first glimpse of 2014. Posted 1 January 2014 [www.sydneynewyearseve.com/seeing-eyes-first-glimpse-2014/](http://www.sydneynewyearseve.com/seeing-eyes-first-glimpse-2014/)
- 19 New South Wales Government (2014) Major economic and cultural boost as Sydney Festival 2014 gets underway <http://www.nsw.gov.au/news/major-economic-and-cultural-boost-sydney-festival-2014-gets-underway>, accessed 20 February 2014.
- 20 Sydney Festival (2014) Sydney Festival 2014, This is our city uplifted, inspired, excited in review [http://issuu.com/sydneyfestival/docs/sydney\\_festival\\_2014\\_annual\\_review?e=3083398/7223146](http://issuu.com/sydneyfestival/docs/sydney_festival_2014_annual_review?e=3083398/7223146), accessed 2 September 2014.
- 21 Destination NSW (2012) La Traviata on Sydney Harbour a major world event.
- 22 Stoner, A. (July 31, 2014) Handa Opera on Sydney Harbour Returns with Aida, Rebuilding the NSW Economy, Minister for Tourism, Deputy Premier <https://www.nsw.liberal.org.au/news/state-news/handa-opera-sydney-harbour-returns-aida>, accessed 3 September 2014.
- 23 Thomsen, S. (2014) MAKE IT VIVID MONTH: Why Sydney's Amazing Light Festival Needs To Last Twice As Long. Business Insider Australia, 16 June 2014. <http://www.businessinsider.com.au/make-it-vivid-month-why-sydneys-amazing-light-festival-needs-to-last-twice-as-long-2014-6>, accessed 18 June 2014.

### 1.4 Higher land values and real estate prices closer to Sydney Harbour

- 1 NSW Rent and Sales Reports 2012 and 2013, figures calculated from several quarterly reports, found at <http://www.housing.nsw.gov.au/About+us/Reports+Plans+and+Papers/Rent+and+Sales+Reports/>
- 2 Barangaroo website (2013) <http://www.barangaroo.com/discover-barangaroo.aspx>, accessed 1 February 2013.
- 3 Hasham, N. (2014) NSW to develop harbourfront land in biggest urban renewal project since Sydney Olympics, *Sydney Morning Herald*, July 17, 2014 <http://www.smh.com.au/nsw/nsw-to-develop-harbourfront-land-in-biggest-urban-renewal-project-since-sydney-olympics-20140717-ztwke.html>, accessed 4 October 2014.

### 1.5 Harbour-related private businesses

- 1 Hasham, Nicole (2014) NSW to develop harbourfront land in biggest urban renewal project since Sydney Olympics, *Sydney Morning Herald*, July 17, 2014 <http://www.smh.com.au/nsw/nsw-to-develop-harbourfront-land-in-biggest-urban-renewal-project-since-sydney-olympics-20140717-ztwke.html>, accessed 4 October 2014. Sydney Harbour Escapes website <http://www.sydneyharbourescapes.com.au/boat-fleets/view-all-charter-boat-fleets>, accessed July 2013.
- 2 Whale Watching Sydney (2013)<http://www.whalewatchingsydney.com.au/>
- 3 Sydney Seaplanes (2014)<http://www.seaplanes.com.au/>

### 1.6 Outdoor leisure and sporting activities

- 1 Quoted in accessUTS, A Study of Public Use of Boat Ramps on Sydney Harbour: Final Report for Waterways Authority of NSW [NSW Maritime], August 2004, p.7.
- 2 NSW Maritime (2010) Boat Ownership and Storage: Growth Forecasts to 2026.
- 3 Ibid.
- 4 Widmer, W.M. and Underwood, A.J. (2004) Factors affecting traffic and anchoring patterns of recreational boats in Sydney Harbour, Australia. Landscape and Urban Planning 66(3):173-83.
- 5 Williams, 2009 quoted in Ghosn, D.L., Steffe, A.S., Murphy, J.J. (2010) An assessment of the effort and catch of shore-based and boat-based recreational fishers in the Sydney Harbour estuary over the 2007/08 summer period. Industry and Investment, NSW, Fisheries Final Report Series No.122, June 2010.
- 6 Clubs of Australia website (n.d.) Sailing clubs of NSW <http://www.clubsofaustralia.com.au/Yacht/Clubs-in-New-South-Wales.html>, accessed 2 March 2014.
- 7 Link, G. (2012) *Linky's Beach Days: One man's guide to 104 Sydney beaches*.
- 8 NSW Environment, Climate Change and Water NPS, (2010) The Sydney Harbour National Park Draft Plan of Management. <http://www.nationalparks.nsw.gov.au/sydney-harbour-national-park>, accessed June 2012.
- 9 NSW Office of Environment and Heritage, National Parks and Wildlife Service (2012).
- 10 NSW Environment, Climate Change and Water, National Parks and Wildlife Service (2010) Sydney Harbour National Park, Draft Plan of Management, 2010.
- 11 O'Brien, K. (2007) *The Sydney Morning Herald*, Sydney's Best Harbour and Coastal Walks.
- 12 Ghosn, D.L., Steffe, A.S., Murphy, J.J. (2010) An assessment of the effort and catch of shore-based and boat-based recreational fishers in the Sydney Harbour estuary over the 2007/08 summer period. Industry and Investment, NSW, Fisheries Final Report Series No. 122, June 2010.
- 13 Mitchell McCotter and Associates (1988) Sydney and Middle Harbours: Regional Environmental Study. Background Report. Volumes 1-3.
- 14 Alkire, C. (2008) The Value of Recreational Fishing in California: Direct Financial Impacts. Submitted to California Trout. San Francisco, California.
- 15 Battelle Memorial Institute (2008) Conceptual Benefits of Protection< San Francisco Bay Subtidal Habitat Goals Project: Final Report, Appendix 1-2. submitted to NOAA National Oceanic and Atmospheric Administration, San Francisco, CA, July 2008.
- 16 Henry, G. and Lyle, J. (2003) The National Recreational and Indigenous Fishing Survey. FRDC Project No. 99/158, Australian Government Department of Agriculture, Fisheries and Forestry, p.131 [www.affa.gov.au/recfishsurvey](http://www.affa.gov.au/recfishsurvey)
- 17 DPI (2008) Primefact 825, Commercial Fishing In New South Wales August 2008, <http://www.dpi.nsw.gov.au>, accessed October 2011.
- 18 Dominion Consulting Pty Ltd (2003) Identifying the recreational fishing expenditure of Sydney's recreational fishers and its economic and social importance in regional communities of NSW. A Report to the Recreational Trust Fund, NSW Fisheries, November 2003.
- 19 Ghosn, D.L., Steffe, A.S., Murphy, J.J. (2010) An assessment of the effort and catch of shore-based and boat-based recreational fishers in the Sydney Harbour estuary over the 2007/08 summer period. Industry and Investment, NSW, Fisheries Final Report Series No. 122, June 2010.

20 McIlgorm, A. and J. Pepperell (2013). Developing a cost effective state wide expenditure survey method to measure the economic contribution of the recreational fishing sector in NSW in 2012. A report to the NSW Recreational Fishing Trust, NSW Department of Primary Industries, November 2013. Produced by the Australian National Centre for Ocean Resources and Security (ANCORS) University of Wollongong.

21 Time Out website (2013) Sydney's Top 5 Snorkelling Spots. <http://www.au.timeout.com/sydney/sports/features/6735/sydneys-top-5-snorkelling-spots>, accessed 3 April 2013.

22 Weekend Notes website(2014) Sydney's Best Beaches for Snorkelling. <http://www.weekendnotes.com/sydneys-best-beaches-for-snorkelling/>, accessed 3 April 2013.

23 Sydney Diving – Simply the Best. Michael McFadyen's Scuba Diving Web Site (2014) [http://www.michaelmcfadyenscuba.info/viewpage.php?page\\_id=248](http://www.michaelmcfadyenscuba.info/viewpage.php?page_id=248), accessed 3 April 2013

24 Sydney Reef Dive Sites. Michael McFadyen's Scuba Diving Web Site (2014) [http://www.michaelmcfadyenscuba.info/viewpage.php?page\\_id=1](http://www.michaelmcfadyenscuba.info/viewpage.php?page_id=1), accessed 3 April 2013.

25 Galaxy Research (2014) Community Attitude Survey. Prepared for Dive Industry Association of Australia, January 2014, J. Turnbull personal communication on background data.

### 1.7 Environmental values: ecosystem services, biodiversity and quality

1 Costanza, R., D'arge, R., De Groot, R., Stephen Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P., and Marjan Van Den Belt, M. (1997) The value of the world's ecosystem services and natural capital. *Nature*, 387, 253–260 15/5/1997.

2 Costanza R., de Groot R., Sutton P., van der Ploeg S., Anderson S.J., Kubiszewski I., Farber S., Turner R.K. (2014) Changes in the global value of ecosystem services. *Global Environmental Change* 26 (2014) 152–158.

3 de Groot, R., Brander, L., van der Ploeg, S., Costanza, R., Bernard, F., Braat, L., Christie, M., Crossman, N., Ghermandi, A., Hein, L., Hussain, S., Kumar, P., McVittie, A., Portela, R., Rodriguez, L.C., ten Brink, P., van Beukering, P. (2012) Global estimates of the value of ecosystems and their services in monetary units. *Ecosystem Services* 1, 50–61.

4 Costanza R., et al (2014) Op Cit p.155.

5 Molnar, M., M. Kocian and D. Batker (2012) Valuing the Aquatic Benefits of British Columbia's Lower Mainland: Nearshore Natural Capital Valuation, David Suzuki Foundation and Earth Economics.

6 Graneck E.F., Polasky S., Kappel C.V., Reed D.J., Stoms D.M., Koch E.W., Kennedy C.J., Cramer L.A., Hacker S.D., Barbier E.B., Aswani S., Ruckelshaus M., Perillo G.M., Silliman B.R., Muthiga N., Bael D., Wolanski E. (2010) Ecosystem services as a common language for coastal ecosystem-based management. *Conservation Biology* 2010 February; 24(1):207-16.

7 Costanza R., Kubiszewski I., Ervin D., Bluffstone R., Boyd J., Brown D., Chang H., Dujon V., Graneck E., Polasky S., Shandas V., Yeakley A. (2010) Valuing ecological systems and services. *F1000 Biology Reports* 2011(3):14.

8 Abson D.J., Termansen M. (2011) Valuing ecosystem services in terms of ecological risks and returns. *Conservation Biology* 25(2):250-8.

9 Turner R.K., Morse-Jones S., Fisher B. (2010) Ecosystem valuation: a sequential decision support system and quality assessment issues. *Annals of the New York Academy of Sciences* 1185:79-101.

10 Schmitt L.H. and Brugere C., (2013) Capturing ecosystem services, stakeholders' preferences and trade-offs in coastal aquaculture decisions: a Bayesian belief network application, *PLoS One*. 2013 October 14; 8(10).

11 Blackwell, B. (2005) The Economic Value of Some of Australia's Natural Coastal Assets: Their Ecoservice Values, presentation to 2005 Australian and New Zealand Society for Ecological Economics conference, [www.anzsee.org/anzsee2005papers/Blackwell\\_A\\_web.ppt](http://www.anzsee.org/anzsee2005papers/Blackwell_A_web.ppt)

12 Costanza R., de Groot R., Sutton P., van der Ploeg S., Anderson S.J., Kubiszewski I., Farber S., Turner R.K. (2014) Changes in the global value of ecosystem services. *Global Environmental Change* 26, 152–158.

13 Poloczanska E.S., Babcock R.C., Butler A., Hobday A.J., Hoegh-Guldberg O., Kunz T.J., Matear R., Milton D.A., Okey T.A., Richardson A.J. 2007. Climate change and Australian marine life. *Oceanography and Marine Biology: an Annual Review* 45: 407-478. First comprehensive synthesis of climate change impacts for Australian ecosystems.

14 Rees, S.E., Rodwell, L.D., Attrill, M.J., Austen, M.C. Mangi, S.C., (2010) The value of marine biodiversity to the leisure and recreation industry and its application to marine spatial planning. *Marine Policy* 34:868-87.

15 Sydney Institute of Marine Science, <http://harbourprogram.sims.org.au/about-sydney-harbour>

16 Hutchings, P.A., Ah Yong, S.T., Ashcroft, M.B., McGrouther, M.A. and Reid, A.L. 2013. Sydney Harbour: its diverse biodiversity. *Australian Zoologist*. 36. 255-320.

17 Rees, S.E., Rodwell, L.D., Attrill, M.J., Austen, M.C. Mangi, S.C., (2010) The value of marine biodiversity to the leisure and recreation industry and its application to marine spatial planning. *Marine Policy* 34:868-87.

18 Sydney Metropolitan Catchment Authority (2011) SMCMA Annual Report, 2010-2011.

19 ACIL (1996) Economic and Financial Evaluations for the Sewerage Overflow Licensing Project.

20 Ibid.

21 Sydney Water's website (n.d.) <http://www.sydneywater.com.au/SW/water-the-environment/how-we-manage-sydney-s-water/wastewater-network/northside-storage-tunnel/index.htm>, accessed 16 June 2013.

22 New South Wales Audit Office (2003) Performance audit: Sydney Water Corporation: Northside Storage Tunnel project. ed.^eds.), p.^pp. [http://www.audit.nsw.gov.au/ArticleDocuments/135/113\\_Sydney\\_Water\\_Corporation.pdf.aspx?Embed=Y](http://www.audit.nsw.gov.au/ArticleDocuments/135/113_Sydney_Water_Corporation.pdf.aspx?Embed=Y).

23 Sydney Water (n.d.) Port Jackson Water Quality and Sydney Water.

24 Hall, S. (posted 02/01/2010) The SewerFix Wet Weather Alliancing story. <http://www.alliancecontractingiq.com/articles/the-sewerfix-wet-weather-alliancing-story/>, accessed 25 May 2013 and personal communication with consultants involved in the programs listed.

25 (Sydney Water staff, personal communication, 2012).

26 Robinson, G. (2010) Whale and calf take time out in Sydney harbour, *Sydney Morning Herald*, October 7, 2010.

27 Power, Julie, 'A giant leap ... and a tourism bonanza', *Sydney Morning Herald*, June 1-2 2013.

28 Sydney Metropolitan Catchment Authority, Environmental Volunteering in the Sydney Region, 2009.

29 The Sydney Metropolitan Catchment Management Authority, CMA Sydney Metropolitan website now archived: [www.sydney.cma.gov.au](http://www.sydney.cma.gov.au)

30 Sydney Metropolitan Catchment Authority Annual Report, 2010-2011.

31 Clean Up Australia (2013) Review of Operations. [www.cleanup.org.au/About/annual-report.html](http://www.cleanup.org.au/About/annual-report.html), accessed 3 March 2013.

32 Ibid.

### 1.8 Cultural heritage and the arts, scientific research and teaching

1 NSW Environment, Climate Change and Water NPS, (2010) Sydney harbour National Park Draft Plan of Management, now superceded by NSW Office of Environment and Heritage, Sydney Harbour National Park Plan of Management (2012) with a differently worded but similar statement.

2 Sydney Harbour Federation Trust (2013) Annual Report, 2012-13. [http://www.harbourtrust.gov.au/sites/www.harbourtrust.gov.au/files/pages/c474218d-05fa-4d53-a160-adfdd3e76afa/files/shft2012-13annualreport\\_0.pdf](http://www.harbourtrust.gov.au/sites/www.harbourtrust.gov.au/files/pages/c474218d-05fa-4d53-a160-adfdd3e76afa/files/shft2012-13annualreport_0.pdf)

3 Ibid.

4 Street, Andrew P. (2014) Time to tell Cockatoo Island's stories. *Sydney Morning Herald* October 4-5 2014.

5 Hutchings, P.A., Ah Yong, S.T., Ashcroft, M.B., McGrouther, M.A. and Reid, A.L. 2013. Sydney Harbour: its diverse biodiversity. *Australian Zoologist*. 36. 255-320. – See more at: <http://australianmuseum.net.au/publication/Sydney-Harbour-its-diverse-biodiversity#sthash.osjCXjwK.dpuf>

6 Ridgway, K. R. (2007). Long-term trend and decadal variability of the southward penetration of the East Australian Current. *Geophysical Research Letters*, 34(13) L13613, doi:10.1029/2007GL030393.

7 West, G. and R.J. Williams (2008) A preliminary assessment of the historical, current and future cover of seagrass in the estuary of the Parramatta River. NSW Department of Primary Industries – Fisheries Final Report Series No. 98, February 2008.

8 Blackwell, B., 'The economic value of Australia's natural coastal assets: some preliminary findings', presentation to 2005 Australian and New Zealand Society for Ecological Economics conference, [www.anzsee.org/anzsee2005papers/Blackwell\\_A\\_web.ppt](http://www.anzsee.org/anzsee2005papers/Blackwell_A_web.ppt), accessed 15 July 2011.

### 2. Summary

1 Gilmore, H. (2014) Underwater Google 'Street View' to reveal what lies beneath Sydney Harbour. *Sydney Morning Herald*, March 6, 2014.

2 Taronga Zoo (2014) Annual review 2013–2014, *Inspiring Connections Securing a shared future for wildlife and people*. <https://taronga.org.au/sites/default/files/downloads/TCSA%20Year%20in%20%20Review%202014.pdf>, accessed 13 October 2015.

### 3.2 Sources, changing values and possible risks

1 'Roy set out principles by which the estuaries of southeast Australia could be classified into three major types: drowned river valleys, barrier estuaries and intermittently open estuaries. Within the Sydney metropolitan area all of the large estuaries, including the Parramatta River, are drowned river valleys'. Roy, P. S., Williams, R. J., Jones, A. R., Yassini, R., Gibbs, P. J., Coates, B., West, R. J., Scanes, P. R., Hudson, J. P., and Nichol, S., (2001). Structure and function of south-east Australian estuaries. *Estuarine, Coastal and Shelf Science*, 53:351-384.

2 '... the finest harbour in the world, in which a thousand sail of the line may ride in the most perfect security...' – Governor Arthur Phillip, 15 May 1788.

3 Mills, E. (2009) A Global Review of Insurance Industry Responses to Climate Change. The Geneva Papers, 2009, 34, (323–359); © 2009 The International Association for the Study of Insurance Economics 1018-5895/09, [www.palgrave-journals.com/gpp/](http://www.palgrave-journals.com/gpp/)

4 One example is in Lee County in southwest Florida, where fertiliser regulations were put into place in 2008 over concern about 'algae blooms, red tides, fish kills and the destruction of the marine ecosystem' and the Caloosahatchee River water's effects on the estuary and the beaches of Sanibel Island, a major tourism area. Fertilisers containing nitrogen or phosphorous cannot be used during the four month rainy season, and are otherwise limited to mostly time-release forms for nitrogen. No fertilisers are to be used within 3 metres of a water body.

5 Fort Myers Florida Weekly (2009) Lee County fertilizer use regulation takes effect May 13. Florida Weekly May 6, 2009.

6 Netherlands Dredging Consultants (2013) W. Borst, personal communication.

7 Sydney Institute of Marine Science, <http://www.sims.org.au/community/sims-goes-to-sea-with-the-sydney-heritage-fleet/>, accessed 20 February 2014.

8 G. West and R.J. Williams, 'A preliminary assessment of the historical, current and future cover of seagrass in the estuary of the Parramatta River', NSW Department of Primary Industries – Fisheries Final Report Series No. 98 Port Stephens Fisheries Centre, February 2008, p.15.

9 Quenqua, D. (2013) Oyster shells are an antacid to the Oceans. <http://www.nytimes.com/2013/05/21/science/oyster-shells-are-an-antacid-to-the-oceans.html>, accessed 22 May 2013.

10 Fourqurean, J.W., Duarte, C.M., Kennedy, H., Marbà, N., Holmer, M., Mateo, M.A., Apostolaki, E.T., et al. (2012). Seagrass ecosystems as a globally significant carbon stock. *Nature Geoscience*. doi:10.1038/ngeo1477.

11 Turnbull, J., (2014) Is Sydney overfished? Underwater Research Group Bulletin, February 2014.

12 Waldbusser, G.G., Powell, E.N., Mann, R. (2013) Ecosystem effects of shell aggregations and cycling in coastal waters: an example of Chesapeake Bay oyster reefs. *Ecology* 94:895–903 . <http://dx.doi.org/10.1890/12-1179.1>, accessed 22 May 2013.

### 3.3 Studies into values of estuaries with major cities

1 Memorial Institute for National Oceanic and Atmospheric Administration (2008) San Francisco Bay Subtidal Habitat Goals Project: Appendix 1-2, Economic Valuation of San Francisco Bay Natural Resource Services.

2 Ibid.

### 4.1 Estimation methodology

1 Pearce, D.W. (1993) *Economic Values and the Natural World*. MIT Press.

2 Pearce, D., Atkinson, G. and Mourato, C. (2006) Cost-Benefit Analysis and the Environment Recent Developments. OECD Publishing.

3 Gunton, T., Joseph, C. (2010) Economic and Environmental Values in Marine Planning: A Case Study of Canada's West Coast. *Environments Journal* Volume 37 (3) 2010.

4 Many possible sources. See, for instance, the work by Dolf de Groot et al such as: RS De Groot, MA Wilson, RMJ Boumans (2002) A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological economics*, Elsevier <http://www.sciencedirect.com/science/article/pii/S0921800902000897>

5 Ecosystem Valuation, [http://www.ecosystemvaluation.org/dollar\\_based.htm](http://www.ecosystemvaluation.org/dollar_based.htm), accessed 29 January 2012.

6 'The standard method for measuring the use value of resources traded in the marketplace is the estimation of consumer surplus and producer surplus using market

price and quantity data. The total net economic benefit, or economic surplus, is the sum of consumer surplus and producer surplus.' Ecosystem Valuation, [http://www.ecosystemvaluation.org/dollar\\_based.htm](http://www.ecosystemvaluation.org/dollar_based.htm), accessed 29 January 2012.

- 7 Rolfe, J. (n.d.) A total economic value framework for the Great Barrier Reef, presentation CQ University, page presenting Oxford Economics value estimates [https://crawford.anu.edu.au/research\\_units/eeh/workshops/network\\_symposium/pdf/presentations/day\\_one/john\\_rolfe.pdf](https://crawford.anu.edu.au/research_units/eeh/workshops/network_symposium/pdf/presentations/day_one/john_rolfe.pdf), accessed 7 October 2014.
- 8 Simes, R., et al (2013) How do you value an icon? The Sydney Opera House: economic, cultural and digital value. Deloitte Appendix C: Economic contribution studies.
- 9 Pearce, D., Atkinson G., Mourato, C. (2006) Cost-Benefit Analysis and the Environment Recent Developments. OECD Publishing, p.93.
- 10 NOEP, National Ocean Economic Program; Environmental and Recreational (Non-Market) Values – Research Methodologies. Center for the Blue Economy at the Monterey Institute of International Studies <http://www.oceaneconomics.org/nonmarket/methodologies.asp>, accessed 8 October 2014.
- 11 Pearce, D., Atkinson, G., Mourato, C. (2006) Cost-Benefit Analysis and the Environment Recent Developments. OECD Publishing, p.105.
- 12 Bateman IJ and Willis KG, eds. (2001) *Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation Method in the US, EU, and developing Countries*, Oxford University Press.
- 13 JNCC, Joint Nature Conservation Committee (2013), Ecosystem Services Valuation, Cost based approaches. <http://jncc.defra.gov.uk/page-6383>, accessed 8 October 2014.
- 14 See for example, Envalue, A Searchable Environmental Valuation Database, NSW Government, Environment Climate Change and Water <http://www.environment.nsw.gov.au/envalueapp/> for an example of a benefit transfer database, accessed 8 October 2014.
- 15 US Fish and Wildlife Services, Centralized Library of Servicewide Policies, Secondary Methods for Natural Resources Valuation: Benefits Transfer <http://www.fws.gov/policy/NRDA-5.pdf>, accessed 8 October 2014.

#### 4.2 Some technical issues which arise in making an economic assessment of Sydney Harbour

- 1 Simes, R., et al (2013) How do you value an icon? The Sydney Opera House: economic, cultural and digital value. Deloitte.
- 2 Baker and Ruting (2014) Environmental Policy Analysis: A Guide to Non-Market Valuation, Productivity Staff Working paper, Canberra.