Funding coastal protection in a changing climate:

Lessons from three projects in Australia

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ACCARNSI DISCUSSION PAPER

MAY 2017

NCCARF
National
Climate Change Adaptation
Research Facility
National Adaptation Network
SETTLEMENTS AND INFRASTRUCTURE

This paper was motivated by the Australian Federal Government climate change adaptation initiatives. The authors are members of the Australian Climate Change Adaptation Research Network for Settlements and Infrastructure (ACCARNSI), one of four networks within the National Climate Change Adaptation Research Facility (NCCARF).

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SETTLEMENTS AND INFRASTRUCTURE

1. Introduction

Australia's settlement pattern shows a strong preference for coastal areas with the highest population densities in coastal cities along the east, south-east and south-western coasts. More than 85% of the Australian population lived within 50km of the coast in 2001 (ABS 2004) and population density continues to increase along the coast and in major cities (ABS 2016). There are a range of reasons for this settlement pattern. Coastal areas are valued for recreation providing access to beaches, parks, islands and oceans making them attractive places for residential development. Coasts are also valued for transport, enabling trade and access to natural resources. All these community and commercial demands attract the development of infrastructure such as water, roads, ports and electricity.

While coastal areas provide many positive benefits, which attract development, they equally pose a range of hazards through exposure to storms, erosion and coastal inundation. Climate change projections compound these risks and when estimates of sea level rise and increased weather events are applied to existing rates of coastal inundation and erosion, the result is a significant increase in the likelihood and extent of damage to property and infrastructure.

There is no comprehensive up-to-date information on the value of assets at risk from climate change along Australia's coast, even though climate change is expected to be a significant threat to coastal areas. For instance, by 2050, global losses due to coastal flooding are expected to exceed US$1 trillion and by 2100 these losses will amount to between 0.3–9.3% of global GDP per year which could mean global economic collapse (Hallegatte et al. 2013). In 2011, the Australian Government conducted a national climate change risk assessment to determine the combined value of commercial, light industrial, transport and residential assets at risk from a sea level rise of 1.1 metres (high end scenario for 2100). This report found that the replacement cost of existing infrastructure will be in excess of $226 billion (Commonwealth of Australia 2011). However, this estimate does not take social costs or the increase in extreme weather events into account, nor any projections of the increase in the value of assets that will be at risk in the future. Another report by Deloitte Access Economics (2016) projected the total economic costs of natural disasters to reach $34 billion per annum by 2050 in Australia from around $10 billion per year in 2015. But this figure does not take the exacerbating effects of climate change into account; the projected increase is due to an increase in the value of coastal infrastructure.

In discussing coastal protection as a strategy to adapt coastal property and infrastructure to projected climate change impacts, it is important to recognise that alternative strategies exist and should be considered. Alternative strategies involve moving buildings and infrastructure away from areas subject to erosion and inundation hazards and are referred to as *retreat*, *planned retreat* or *managed realignment*. Funding and financing these strategies have a range of differing considerations to coastal protection and have been excluded from consideration within this report.

This report opens with a discussion of coastal protection and funding of coastal protection in Australia and is followed by a detailed discussion of three case studies. The case studies are presented in a similar manner: first, the rationale behind the project is explained, then the basic project parameters are presented and finally, the different approaches to funding each project is described. The final section compares the funding features of the case studies and the outcomes achieved and discusses implications for coastal protection funding in the future.

2. Coastal Protection

Coastal protection and engineering works are a prominent feature of developed portions of the Australian coastline. Until the late 1960s, the development of ports and harbors was the dominant driver for coastal engineering works, however, by the 1970s managing erosion had become a significant issue for many regions, including Adelaide, South East Queensland and parts of the NSW coast (Gourley 1996). The need for coastal protection is expected to increase as the impacts of climate change become more prominent along the coast, aggravating existing rates of erosion and inundation.

Alongside planning controls, land acquisition, and planned retreat, coastal protection works are one of the responses available to coastal communities seeking to reduce the exposure of development to erosion and inundation hazards. Coastal protection works include a range of hard and soft measures from seawalls, groynes and offshore breakwaters through to beach re-nourishment and dune vegetation. The cost of implementing coastal protection measures varies and not all measures will be suitable in a given area.

For instance, the cost of building seawalls ranges from $2300/lineal meter through to $17,000/lineal meter. The variation in costs is driven by the many factors that impact on seawall designs, for example, the depth of the seawall toe or footing which is a design characteristic that reduces potential for scour and possible failure of the wall during large wave events and overall size.

In Australia, state governments are responsible for regulating coastal protection works and the majority of states have some form of coastal legislation which prescribes an approvals process for undertaking coastal protection works. Local governments, as a function of the states, often have a role as project proponents of coastal protection works, if hazards impact on public infrastructure, or in coordinating works that impact on private property, undertaken by private entities.

3. Funding coastal protection

The value of assets exposed to climate change hazards demands an ongoing need for coastal protection; however, the challenges of funding coastal protection have not been addressed, nor have they received significant attention by governments or researchers. Funding coastal protection works in Australia has traditionally been achieved through the allocation of public funds by local and state governments alone or in partnership. Repairs or reconstruction due to damaged infrastructure after extreme weather events can also be funded through the federal government's National Disaster Relief and Recovery Arrangements. Coastal protection from climate change, which is essentially a form of climate change adaptation, is increasingly falling within the remit of local governments, creating new costs through the implementation of new measures (seawalls and beach nourishment) and increasing the costs of existing responsibilities (upgrading roads, drainage and water supply) (Banhalmi-Zakar et al 2016). Discussions between different levels of government on possible means to cover the costs of coastal protection works generally pointed to the need for local governments to access either state or federal government funding through grant schemes.

Consideration of funding coastal protection must also recognise a number of significant non-government actors involved, in addition to government entities. These non-government actors include; the owners of foreshore properties exposed to coastal hazards as well as local residents, tourists and businesses as the users and beneficiaries of coastal assets such as beaches, estuaries and surf zones. These non-government actors can have a significant role in many coastal protection projects. There are examples of private property owners pooling resources to self-fund the construction of coastal protection works such as seawalls to protect their properties from erosion. For example, private property owners at the Belongil Spit in Byron Bay (NSW) have taken legal action against governments to establish their rights to undertake coastal protection works.

When protection works provide a benefit to private landowners, the process for reaching agreement to fund such projects is the source of significant tension between state and local governments and between foreshore property owners who directly benefit from the project and other local resident or rate payers. For local government the relatively large cost of coastal protection projects can introduce political risk of accusation of bias towards foreshore property owners (by other residents), and places strain on available capital. State governments are equally reluctant to provide funding fearing that this may establish a precedent that could become unfeasible across large stretches of coastline. This tension between parties delays and adds planning costs, compounding the already contested nature of many coastal protection projects.

In many coastal protection plans, local governments exclude funding issues for coastal protection expenditure on the grounds that coastal protection is a public good and therefore should be funded via consolidated revenue. So, while the exclusion of explicitly dealing with funding for coastal protection plans may be justifiable, there is increasing recognition that identifying funding to meet the expenditure requirements of coastal protection plans is beyond the capacity of the current finance structures of local governments (Banhalmi-Zakar et al 2016).

4. Coastal Protection Funding Case Studies

Three projects have been selected as case studies to demonstrate a range of options used to fund coastal protection. These options include a mix of public and private funding, purely public funding, and project finance through a 'traditional' public-private partnership model. Two of the three cases are located in Queensland, while the Tweed Sand Bypass in Tweed Shire is situated across the border between New South Wales and Queensland (Figure 1). All three projects have been completed and information regarding details of the funding arrangement were accessible via council and project websites. Both timing of the projects and transparency with respect to the funding arrangements used were key constraints to case selection.

Figure 1 Case study locations

Rationale and details of the three projects are provided in the next three sections. The main features of the case studies are provided in Table 1.

Table 1 Overview of case studies

Name	**Tweed Sand Bypass**	**Gold Coast Seawall (also known as the 'A-Line')**	**Toogoom Seawall**
Location	Tweed Shire, across the NSW/Queensland border at Tweed Heads	Gold Coast, in South East Queensland	Town of Toogoom in the Northern part of the Fraser Coast Local Government Area
Description	Sand bypassing involving a permanent dredge, pumping station pipe system and sand outfalls	Rock rubble seawall, covered by sand	Rock rubble seawall
Jurisdiction	Special agreement between NSW and Queensland	Gold Coast City Council (Qld)	Fraser Coast Regional Council
Date of construction/ implementation	2000-2001	1970s to present	2016
Scale	Multiple States	Approx. 36km along the coast region	0.370 km adjacent to 15 properties
Ownership	Capital transfers to government partners at the conclusion of the contract		Local government

4.1 Tweed River Entrance Sand Bypass Project

Figure 2 Location Overview - Tweed River Entrance and elements of the Tweed River Entrance Sand Bypass Project

The Tweed River Entrance Sand Bypass Project is a large system, comprised of a jetty and pumping station (on Letitia Spit just south of the Tweed River in Northern NSW) and a series of pipes, which transfer sand to an outlet at Snapper Rocks located at the Southern end of the Gold Coast in Queensland. The project commenced operations in 2001 and follows a decades of negotiations between the Queensland and NSW state Governments to re-establish the flow of sand from NSW into Queensland following the 1964 extension of the Tweed River training walls by the NSW Government. The extension of the Tweed training walls in 1964 trapped the longshore transport of sand into Queensland which reduced the width of beaches and made coastal infrastructure and property vulnerable to erosion as well as having negative impacts on tourism when beaches were damaged by erosion.

Both the NSW and Queensland State Governments have enacted specific legislation to facilitate the Tweed Sand Bypass Project that sets out the following objectives (16):

- Objective 1 - To establish and maintain a navigable depth of water of at least 3.5 metres below Indian Spring Low Water (ISLW) in the approach to and within the entrance channel to the Tweed River over a width equal to that between the rubble mound breakwaters;
- Objective 2 - To achieve a continuing supply of sand to the Southern Gold Coast beaches at a rate consistent with the natural littoral drift rates updrift and downdrift, together with the supply of such additional sand to the beaches as is required to restore the recreational amenity of the beaches and to maintain it.

Funding the Project

The project was designed and built by McConnell Dowell (Australia) with finance provided by the ANZ. The ongoing operation and maintenance of the project is through the Tweed River Entrance Sand Bypassing Company, a subsidiary of McConnell Dowell, set up under a 24 year contract with the states of NSW and Queensland to 2025 (NSW Land and Water Conservation 2001). At the conclusion of the 2011/12 financial year, payments of $AU106.4million, which included establishment and operations and maintenance costs, had been made by the government parties.

Table 1 Estimated cost and allocations through the different stages of the project

Stage	Task	Estimated Cost (1990 AUD millions)	NSW	Queensland	
				State	GCCC
1	Initial Sand Supply	$10	75%	12.5%	12.5%
2	Establishment	$13.5	75%	12.5%	12.5%
3	Operating	$1.9	50%	25%	25%
4	Platform/Trestle replacement @25 yrs	$8.45	50%	25%	25%

"*As the project was innovative, and the technology uncertain, it was thought that it would be desirable for the sand bypassing system to be run by the private sector to limit the need for day to day involvement of the two Governments. The involvement of the private sector was a difficult task for the size of the project because of the large variability in the coastal processes, and hence the risks associated with the undertaking. It was decided that the risk could best be shared by involving a private sector partner in a long- term agreement in which payment would be related to the performance of the system*." (Dyson, Victory and Connor, 2001)

The performance of the project is measured by the volume of sand pumped from NSW into Queensland.

Table 3 Annual Costs and Volumes Bypassed by State

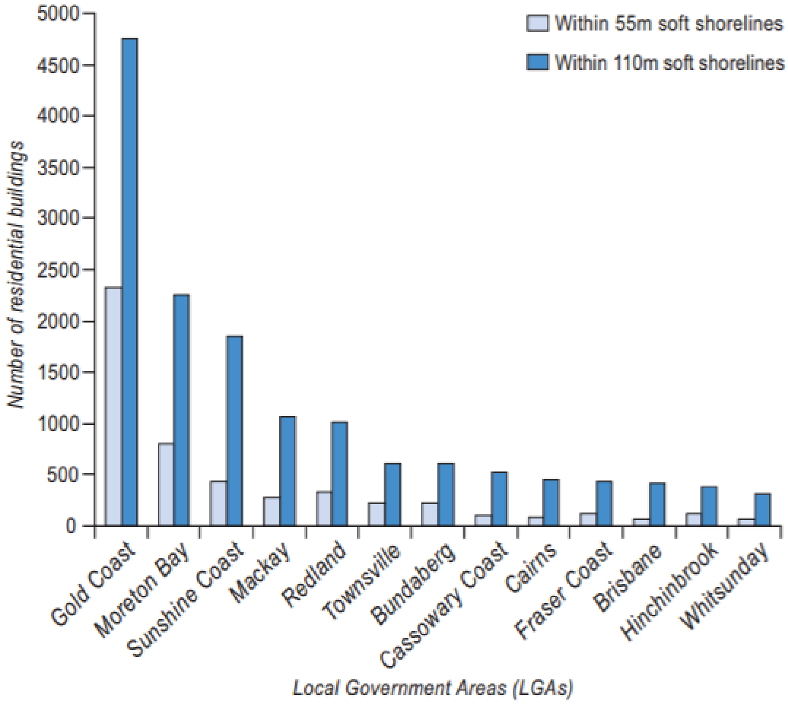
Year	99/00	00/01	42401	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
Volumes (m3)		575869	721364	787026	496367	724931	552284	562247
NSW	$2.9 M	$3.5 M	$5.5 M	$6.4 M	$5.3 M	$5.3 M	$5.5 M	$5.3 M
Queensland	$1.8 M	$2.6 M	$3.8 M	$4.9 M	$3.9 M	$3.9 M	$4.1 M	$3.9 M
Total	$4.7 M	$6.1 M	$9.3 M	$11.3 M	$9.2 M	$9.2 M	$9.6 M	$9.2 M
Year	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
Volumes (m3)	585809	409232	395609	518169	436092	319883	465501	552682
NSW	$4.6 M	$5.6 M	$4.1 M	$4.1 M	$4.1 M	$4.2 M	$1.9 M	$2.5 M
Queensland	$3.2 M	$4.2 M	$2.7 M	$2.6 M	$2.6 M	$2.7 M	$1.8 M	$2.2 M
Total	$7.8 M	$9.8 M	$6.8 M	$6.7 M	$6.7 M	$6.9 M	$3.7 M	$4.7 M

The Tweed Sand Bypass project was an unprecedented form of funding coastal protection in Australia over 15 years ago that remains innovative in its approach today. It carries the hallmark of typical project financing, a financing mechanism that is typically used to fund large and complex projects such that the costs and benefits are restricted to the project, as well as the creation of a special purpose vehicle (the project company) to operate the project. The innovative aspect of the project lies in linking project performance to volume of sand pumped and the unique collaboration and contractual agreements behind the initiative.

4.2 City of Gold Coast A-Line Seawall

The Gold Coast is an internationally recognised beach tourism destination in South East Queensland that receives more than 4.5 million visitors each year. The demand for accommodation within close proximity to the Gold Coast beaches has contributed to a relatively high proportion of development close to an erodible shoreline. In 2009 the Commonwealth of Australia conducted an assessment of climate change risks to Australia's coast and found that the Gold Coast was the most exposed Local Government Area because it had the largest number of buildings within 100m of the erodible shoreline. While extensive coastal development has been beneficial to the region by providing opportunities for tourist visitors to live by the beach, it has come at the cost of a long history of responding to erosion events.

Figure 3 Queensland Local Government Areas with the most residential buildings located close to the soft shoreline



Source: Commonwealth of Australia (2009)

Today the City of Gold Coast Seawall, also referred to as the A-Line wall, with reference to the walls' planning alignment, is the result of a long history of attempts to stabilise the Gold Coast shoreline by public and private actors. During the first half of 1967, a series of storms caused significant beach erosion and property damage along the coast. As a result of these events, a range of private and government responses to erosion culminated in a series of *ad hoc* responses that included dumping old car bodies on the shoreline (Figure 4).

Figure 4 1967 Use of old car bodies for coastal protection Gold Coast style   Source: GCCM (2013)

Figure 5 Gold Coast Seawalls and erosion in 1967 after Tropical Cyclone Dina   Source: Delft (1970)

One such event was Tropical Cyclone Dina. The picture above (Figure 5) shows the difference in erosion between areas with and without seawall, and where a seawall has failed between two seawalls. The increased erosion shown in the figure between two seawalls highlights the consequences of uncoordinated construction of coastal protection.

Clearly, such individual attempts at coastal protection were unsustainable over the long-term and a coordinated approach was necessary. The Gold Coast City Council responded by adopting a policy to construct a seawall along what was then the erosion scarp adjacent to public land (the A-line). By 1970 the seawall had a standard design that was endorsed by the Queensland State Government (Figure 6). Two years later all new foreshore strata developments required a seawall constructed to the standard endorsed by the state as a condition of approval.

The objective of the Gold Coast City Council A-line seawall policy is "*to ensure that development occurring in the City's ocean beach areas is managed to ensure the protection of the property and the preservation of the beach environment*." (GCCC, 2011)

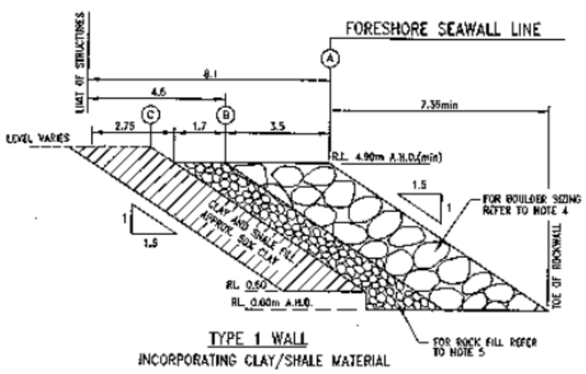


Figure 6 Cross Section Gold Coast A-Line Seawall   Source: GCCC (2003)

The Gold Coast City Council has financed the construction of the seawall adjacent to public land mostly from general revenue through council rates for example, and grant assistance from the State Government. The GCCC has not taken responsibility for the construction and financing of the seawall where it would be adjacent to private property, leaving it to individual property owners to complete such work to approved design standards to protect their property. However, In recognition of the negative impact failing to complete sections of the seawall may have on others, GCCC has established the Gold Coast City Council Constraint Code: Ocean Front Land, which requires evidence of completion of the seawall to standard prior to issuing approvals for building works.

A 2013 review of the Gold Coast Seawall by Griffith Centre for Coastal Management found that the cost of construction of 1 meter of seawall to the current standard at the time was $2300 (GCCM 2013). The review identified the total length of Gold Coast urban shoreline adjacent to either public or private land and then examined design certificates issued for seawalls to determine how much of the constructed seawall was certified to the current A-line design. The results are displayed in Table 5 below showing the total length of the Gold Coast's urban shoreline, the land tenure of shoreline and seawall under public and private, the length of seawall, the length of the seawall that has been certified and the investment required (based on 2013 figures) to protect the urban shoreline with a seawall to a certified standard.

Table 5 Gold Coast Seawall investment requirements

Tenure	**Length** (km)			**Investment required** ($,000,000)
	Urban shoreline	Seawall	Certified	
Public	22.6	11.1	1.9	47.5
Private	8.9	6.6	4.5	10.2
Total	31.5*	17.7**	6.4	57.7

*Estimated **Actual

Source: Adapted from GCCM (2013)

Since 2013, Gold Coast City Council has been undertaking an ongoing program to complete the seawall adjacent to public land with the completion of $5.4 million worth of works to replace and complete the seawall at Kurrawa, Broadbeach and Narrowneck, and Main Beach in 2016.

4.3 Toogoom Seawall

Toogoom is a small coastal community approximately 20 kilometres North West of the town of Hervey Bay in Queensland, within the Fraser Coast Regional Council (FCRC) (Figure 7). Toogoom is recognised for its safe swimming and recreational fishing opportunities and low-key development and ongoing erosion thought to be due to an imbalance in sediment entering into Hervey Bay.

Figure 7 Overview of Toogoom and the location of the seawall

Figure 8 Alignment of Toogoom Seawall showing affected properties

Source: FCRC (2013b)

The Toogoom Seawall Project provides erosion protection for 15 properties through the construction of a rock boulder revetment wall along 370m of shoreline. The seawall was completed in May 2014 but has a long history in terms of planning dating back to 2002. The 12 year planning period involved issues with approvals, changing regulation, establishment of a Marine Park and concerns of local property owners (Lawson et. al. 2007). In October 2013, the FCRC called for tenders for the construction of a seawall with a contractor appointed in late 2013 and the works being completed by May 2014.

In July 2013, FCRC adopted a new policy on coastal protection that allows the FCRC to design and construct coastal protection works if a settlement is threatened by erosion and requires multiple property owners to act together. The policy seeks to address the issues of uncoordinated coastal protection and also includes a mechanism for FCRC to be reimbursed for the costs of construction from property owners through charging a special rates levy.

"The policy applies to those properties identified under the Shoreline Erosion Management Plan within immediate threat and if the majority of residents in an affected area want action then Council will facilitate talks with the relevant state departments, help develop plans and oversee construction of the revetment wall."

This policy was enacted in the case of the Toogoom Seawall Project. As a result, the FCDC amended its 2013/14 budget and sought additional borrowing to accommodate the expenditure. In applying this policy, the FCRC determined that as the benefits of the project accrue to a definable group of private property owners, the benefitting parties (property owners) would be ultimately responsible for funding the project. The council will undertake the project and essentially lend property owners the cost of the seawall initially (FCRC 2013a). The allocation of costs to property owners of the 15 protected properties is assessed through a special rates levy payable over 10 years and calculated as follows:

construction costs + interest X property total seawall length
frontage

Source: (FCRC 2013b)

The overall Project cost was $1.1 million, which amounts to a cost of $3000/m and, if distributed evenly across each of the properties, comes to approximately $73,000 per property (FCRC 2013a). The median property value for Toogoom for 2017 is listed by RPdata as $310,000 with foreshore property sales over the past 12 months listed between $500,000 and $650,000 (on realestate.com.au). In this context, the coastal protection expenditure is significant and assuming 4% interest rates (interest rates have not been publicly disclosed), monthly repayments on the approx. $73,000 per property would be more than $700.

Discussion

The aim of this paper was to identify and discuss the ways in which coastal protection is funded in Australia. Three case studies that employ different funding schemes were presented, demonstrating that funding approaches beyond purely intergovernmental transfers such as grants or internal revenue are already used in Australia to deliver coastal protection projects. These approaches range from the involvement of private sector financiers, to utilising special rates levies and regulatory measures by councils to allocate funding responsibilities to private property owners.

The three cases described here all share some important characteristics, such as they all involved the construction of new projects (although completion of the Gold Coast Seawall has taken decades and continues today) and were all engineered structures. They were also all undertaken in Queensland or, in the case of the Tweed River Entrance Sand Bypass Project, had to be completed in accordance with Queensland legislation. This means that differences in State regulations did not drive differences in how funding for the projects were structured. Points of marked difference between these projects include scale and cost and these are known to play a key role in the finance options available (Banhalmi-Zakar et al 2016). For instance, project financing is only viable for large projects where the costs and benefits of the project are tied exclusively to the project's performance. The largest of all three case studies the TRESBP project was delivered as a Public Private Partnership and jointly funded by local and state governments with finance provided by a bank (ANZ). Project performance was intimately tied to the volume of sand pumped and special legislation was introduced that specified contractual obligations between various government bodies. This example demonstrates that given sufficient scale, the use of novel approaches can reduce financial risk and enable private financing in the delivery of coastal protection projects.

The Gold Coast Seawall shows an approach where a large-scale coastal protection project can be implemented over a long time period by clarifying the roles and responsibilities of public and private land tenure holders. The Gold Coast Seawall model is an example of an initiative by a local government to address the problem of uncoordinated coastal protection by establishing a design standard and alignment and allocating responsibilities (thereby setting the 'rules of the game'). While this approach still demands input from private property owners, it reduces their costs of procurement and risks of the negative consequences of *ad hoc* actions by adjacent property owners.

The Toogoom Seawall case study shares a number of characteristics with the Gold Coast Seawall however, in this instance the council's leadership extended to procurement, expedited implementation and cost recovery. Costs were allocated to specific property owners who were deemed to benefit from the outcomes of the project. Local governments have been known to take similar approaches in funding essential urban infrastructure in Europe. Given majority approval of residents (sometimes 70-80% required), cost recovery falls on all property owners that are expected to benefit from the project (Banhalmi-Zakar 2016).

Coastal protection is already an important issue for coastal communities and is expected to become increasingly so in light of the expected impacts of climate change on Australia's coastline. The fiscal impacts of natural disasters and sea level rise are predicted to reach new heights over the next few decades and cause unprecedented stress on local, state and federal government budgets. The need to find new ways to fund coastal protection measures is apparent and the three case studies demonstrate that different approaches are available. The following recommendations will assist stakeholders in developing new funding schemes and finance structures to meet the needs of coastal communities:

Recommendations

- Initiate development of coastal protection performance metrics
- Encourage appropriate use of financing
- Reduce cultural and institutional restrictions to early engagement between supply and demand for financing (seek dialogue, partnership and collaboration with private sector)
- Build financial literacy within planning, asset management, engineering and natural resource management functions
- Acknowledge an ongoing role for public funding

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