HOW DO YOU PRICE THE PRICELESS? COASTAL ZONE MANAGEMENT AND ECONOMICS APPRAISAL IN THE UK AND NSW.

H Braddock[1], N I Pontee[2], P Dean-Jones[1]
[1]Umwelt Environmental Consultants, Teralba, NSW.
[2]Halcrow, Swindon, UK.

Introduction

The desire for people to be near or directly on the coast is higher than ever, and with increased want, comes increased pressure, and increased risk. Managing coastal environments and coastal risks requires a multi-faceted approach that considers natural processes and how these processes affect assets. This should consider both man-made and natural assets, historically, now and in future. In recent times, integrated coastal zone management (ICZM) practices have been promoted. These endeavour to include ecological, amenity, social and cultural values when developing management plans. Economic appraisal is also a key integrating tool, but is not used consistently in ICZM in Australia. However, the tool and capacity for integrated analysis and option evaluation of these diverse values are slowly spreading across management networks.

The coastal zone management frameworks in the UK (particularly England and Wales) and NSW have the same general goals, to sustainably manage coastal resources and assets and to reduce risk to people and property. In the UK, coastal management is delivered through a three-tiered framework which produces high level Shoreline Management Plans (SMPs), more localised coast and estuary Strategy Plans, and site specific schemes (Pontee and Parsons, 2010). In NSW, it is more of a two-tiered approach where Coastal Zone Management Plans (CZMPs) are prepared by local Councils, but not for coastal regions. Investment in scheme level projects occurs, but is rare outside the Sydney Metropolitan Area, especially for the open coast.

A key difference in the UK and NSW frameworks is the way in which economic appraisal is used to support, justify and prioritise coastal investment. Although generic or qualitative economic assessments are widely used in high level coastal zone planning, there is little advice or guidance for Councils about appropriate strategies or techniques for economic analysis of coastal zone issues. This would aid in more thoroughly addressing the long term financial implications of undertaking or not undertaking works, and the most appropriate actions and timings to incur the most benefit.

This paper will give a general overview of the coastal management frameworks in the UK and NSW. It will look at economic assessment as a means of supporting actions and justifying investment decisions and some basic methods from the UK for enumerating benefits.

Coastal management in the UK and NSW

Coastal process and coastal zone management issues in the UK and Australia have been known and observed for centuries. Most coastal communities have a storm within living memory that serves as a reminder that they are living in a dynamic environment, and that occasionally that environment changes. In the UK, it was the storm surge of 1953 that decimated much of the east coast of England and generated a program of

coastal defence improvements. In NSW, severe storms occurred in 1974 and 1978 and served to highlights the need for the appropriate management of coastal issues.

Coastal management in NSW is delivered through two key pieces of State Government legislation - the *NSW Coastal Protection Act 1979 (CPA 1979),* and the *NSW Coastal Policy 1997*. The current coastal management framework is in a significant period of reform and is a work in progress. It has evolved over the last ~30 years. Although coastline and estuary management plans have been prepared by councils for a number of years, it has only been in recent times that the production of a Coastal Zone Management Plan (in its current form) has become a compulsory requirement (DECCW, 2010) under the *CPA 1979*. Some guidance notes are available to aid coastal engineers, scientist and planners to prepare the CZMPs. However, these guidance notes are more focused on what should be considered within a CZMP, rather than how and to what level of detail. This is consistent with NSW regulatory and planning trends to provide guidance on the quality of planning outcomes, but not on acceptable solutions. Therefore, each local government area produces a Coastal Zone or Estuary Management Plan (or both) which assesses physical processes, identifies at risk areas, determines a suite of actions and estimates determines priority of these actions independently.

Implementation of a CZMP is through Local Government with support from the State Government and the local community. The CZMP actions are generally carried out over a ten year period. Although these plans are linked to a wider hierarchical planning framework e.g. a regional strategy or catchment action plan, it is more of a "bottom-up" process that is sometimes not directly or clearly aligned with local or state strategic natural resource management (NRM) or land-use frameworks.

In England and Wales, the coastal management framework is also relatively new, and although it has developed over the last 200 years, the more formal framework processes were established in the last ~15 years (Pontee *et al*., 2008a, b; Pontee and Parsons, 2010, 2012; Burgess *et al.,* 2012). The Department for Environment, Food and Rural Affairs (Defra) has the overall responsibility for the environment. With delegated powers from Defra, the Environment Agency (EA) has the ultimate responsibility for managing flood and coastal erosion risk. The EA also administers 24,000 miles of defences, on behalf of the Crown (EA, 2009b). Coastal management is delivered through a multi-tiered framework which is very much a "top-down" process. The framework produces:

- Shoreline Management Plans (SMPs)
  These are broad investigations covering large spatial areas of coast and estuary, from tens to hundreds of kilometres. They provide high-level assessments of the present coastal and estuary erosion and inundation risks due to coastal processes, and likely future implications due to climate change for a hundred years.

- Strategy Plans
  These are localised coast and estuary studies that cover smaller spatial areas of coast and estuary, and are more detailed. They assess local scale processes and risk and the technical, social, environmental and economic implications for a suite of potential options. These plans are produced for a 100 year time period.

- Schemes
  These are the detailed design phase of the framework, which depending on the scheme would include detailed design of sea walls or a managed realignment area, detailed assessment of the processes in the area and future implications with the scheme in place, detailed costings and implementation information.

Although the general aims and goals of the frameworks and coastal management processes between the UK and NSW are similar, there are many differences. Much of the difference can be attributed to the historical differences in the nature of the environments. The UK has a high population density and much of the coast has been modified in some way, including walls, revetments and reclamations, thus, the management framework and framework guidelines (of which there are many) have been developed to suit. In contrast, Australia has a lower population density and the coast is largely natural beach, dunes and cliffs. Thus, historically, there has been much less of a need to develop detailed processes and guidelines.

Another key difference is the emphasis and consequent investment that England's Central Government and Wales' Welsh Assembly Government have been prepared to make to facilitate detailed analysis of coastal processes, and the investigation and implementation of management options (see for example Pontee and Parsons 2010; Pontee *et al,* 2011). This is also linked to perceived significant risk.

In 2009, the UK Central Government set aside £2.1 billion for the three years to 2011 to combat flooding and coastal erosion, more than £500 million a year (EA, 2009a). This arose from the recognition of the present day risks, and that risks are escalating with the effects of climate change. It is recognised that strategic approaches are needed on the coast in order to ensure that local schemes do not adversely affect downdrift areas and that schemes needed in the short term are sustainable over the long term (Burgess *et al.,* 2012). Importantly, strategic management at the coast is supported by a centralised prioritised approach to funding. There have been several approaches to this over the years (Pontee and Parsons, 2012) but an overarching aim has to be to make best use of government funds by funding those schemes that represent best value for tax payers. The same recognitions exist here NSW; however, the investment in strategic frameworks has, until now, been much lower.

Economic Assessment to Support Coastal Management Decisions

Economic assessments, and in particular cost-benefit assessments, are common practice to support and justify investment decisions in many industries. Where the difference lies is that in the UK, without economic justification, i.e. full appraisal of the costs, damages and benefits, Central Government funding for schemes is virtually impossible to secure. Therefore, the enumeration of the economic implications of any potential option, or not implementing an option, is essential. Options involving some works are typically compared to the costs of 'doing nothing' as a baseline.

In NSW, some consideration of the financial implications of management options is a requirement in the coastal management planning context. However, guidelines or suggested evaluation methods are not readily available. The focus is more on determining the funding arrangements, and ensuring partner organisations agree to the terms of any potential funding agreements. Additionally, there is often little budget to allow any economic assessment at CZMP level. At scheme level, shore protection methods come at a significant cost which is usually beyond the financial capacity of some councils. If external funding is required, more thorough economic appraisal is required (NSW Govt., 1997; cited in Anning *et al.* 2009).

An understanding of the economic implications of the management decisions we make is fundamental, especially in the long-term, so why no emphasis on these types of assessments at CZMP level? It may be because the State Government has moved to shift responsibility (and therefore liability) to Councils and individual property owners (Gordon *et al*, 2011). This is emphasised in the NSW State Plan. Also, the State Government does not directly fund the implementation of management options; rather, 50:50 grants are available through various programs. Thus, partially removing the necessity to carry out any thorough economics at CZMP level.

In NSW, economic assessment of coastal zone issues is a developing field. Many values are difficult to quantify, therefore economics studies are often research projects, rather than routine processes. Economic studies undertaken recently in NSW and QLD have focussed the social and recreational value of the coast. Raybould *et al* (2011) used a travel cost model to enumerate the recreational benefits for the Gold Coast, which were between $365 million and $1.7 billion (depending on whether fuel costs alone were used in calculating the value, or time incorporated as well). The economic implications of climate change on Sydney's beaches were investigated by Anning *et al* (2009) and Anning (2012). Other high level assessments of the economic value of NSW's natural resources have been undertaken for the Department of Planning's Comprehensive Coastal Assessment (DoP, 2006). These pioneering studies have not yet been translated into guidelines or standard methods for assessing economics benefits for a wide range of values to support small scale (i.e. CZMP) projects.

The basics of economic appraisal

One fundamental reason to carry out an economic appraisal is to demonstrate that any options being considered are economically viable and represent good value for money. Economic appraisals also enable the selection of the most economically sustainable options over an appraisal period, and provide transparency, some accountability and quality assurance.

The underlying principle of economic appraisal is cost-benefit analysis. A baseline case is developed, with options assessed against it. It determines how much economic benefit an investment (or cost) would attract. The terms 'costs' refers to the presumed cost to implement an option. This is usually an upfront capital cost, and an ongoing maintenance cost for the project (or structure) life.

Generally, the economic benefits of an option can be seen as the reduction in spend occurring over the appraisal period, as a result of putting an option in place. This can be through:

- an increase in revenue generated over the appraisal period, as a result of putting an option in place;
- an increase in the cultural, environmental, social and recreational values (sometimes not easily enumerated);
- the reduction in the total potential damages occurring over the appraisal period, as a result of putting an option in place.

For management options to be considered economically viable the benefits should be more than the costs, or at least break even. Ideally the costs would pay for themselves through time in the reduction of damages.

Economic assessment guidance in the UK

Within the three-tiered UK framework, the evaluation of the economic viability of any management options is done in the Strategy phase. Thorough guidelines are available to ensure that assessments are undertaken correctly and consistently. The EA produced the Flood and Coastal Erosion Risk Management appraisal guidance (FCERM-AG) in March 2010 (EA, 2010). FCERM-AG supersedes the Flood and Coastal Defence Project Appraisal Guidance (FCDPAG) (Defra, 1999), reflecting the change of focus from flood defences and coast protection to the management of risk. A suite of supplementary notes are also available to operating authorities to aid and support FCERM-AG:

- Revisions to Economic Appraisal, Procedures Arising from the new HM Treasury "Green Book", March 2003 (Defra, 2003);

- Revisions to Economic Appraisal on: Reflecting Socio-economic Equity in Appraisal, Appraisal of Human Related Intangible Impacts of Flooding, July 2004 (Defra, 2004);
- Climate Change Impacts, October 2006 (Defra, 2006);
- Assessing and Valuing the Risk to Life from Flooding for Use in Appraisal of Risk Management Measures, May 2008 (Defra, 2008a); and
- Valuation of Agricultural Land and Output for Appraisal Purposes, May 2008 (Defra, 2008b).

Case Study - An example of a recently competed UK Strategy

This Strategy study was completed for a 20km stretch of coast and the adjacent estuary. The low lying coastal hinterland is predominantly rural, with the exception of a township, comprises an extensive shingle barrier with areas at risk from coastal inundation and erosion. The man-made coastal defences protecting this stretch of coast include seawalls, rock armouring and timber groynes, supplemented with shingle recycling to the existing shingle beach in places. The rest of the coast is natural shingle beach.

The estuarine system is located inland of the shingle barrier. The estuary hinterland is also predominantly rural, with several areas of low-lying land which rise to high ground. The estuary is lined with saltmarshes, some which have been drained for use as agricultural land. The estuary defences consist mainly of earth embankments, with some localised areas of rock armouring protecting areas that are more vulnerable to scour. The key risks are due to saline inundation.

Background Technical Assessment to inform the Economics
There are four types of management options that are investigated as part of a Strategy to manage the risks sustainably (Pontee & Parson, 2009):

1) No active intervention (NAI). This is a 'do nothing' scenario where the coast or estuary frontage is left to evolve naturally with no additional investment in protection.

2) Hold the line (HTL). This relates to maintaining coastal and estuarine defences in their current location.

3) Advance the line (ATL). This would include building new defences seaward of the original line of defence.

4) Managed realignment (MR). This policy refers to the repositioning of the line of defence, allowing the shoreline to move backwards or forwards from its present position, with management to control or limit movement. This policy was formerly known as 'managed retreat' however the naming was revised to account for various permutations of the policy that reposition the line of defence rather than retreating it.

A high level assessment was undertaken to assess the general viability of each of the types of options, from which it was determined that no ATL options would be viable in any of the study locations. A suite of potential treatment options were then developed under each of the management option headings. Example options included (i) reconstructing current estuary and coastal defences (HTL) and (ii) allowing primary estuary defences to fail and constructing secondary defences to protect properties (MR).

Inundation and erosion risk analysis of the various options and scenarios was undertaken to assess the likelihood of inundation or failure of the existing estuary or coastal defences, as well as the inundation and erosion risks to the natural beach and hinterland during storm events. Inundation and erosion modelling was undertaken to convert this information into predicted flood extents and depths, which was then presented graphically as inundation and erosion risk maps. The numerical and empirical modelling predicted the inundation extents and depths (coastal and estuarine) for a range of joint probability water level and wave conditions with Annual Recurrence Intervals (ARIs) of 1 in 1, 5, 10, 20, 50, 75, 100, 200, 300 and 1000 years. Coastal erosion extents were determined for the same ARI events. This information was used to inform the economic appraisal of which assets would be affected, the likelihood of the asset being affected, the depth of inundation and the year in which the asset was considered to be written-off due to inundation or erosion.

Economics Appraisal

The cost-benefit assessment was based on a baseline NAI scenario. This gave the full potential damage value to the coast and estuary system at a moment in time if no further maintenance of defences or emergency action were undertaken. In this case, four years (three time periods) were considered, Year 0, 20, 50 and 100, for the ten ARI events previously noted.

Many months of data acquisition and interrogation was required to provide a robust foundation for the economic assessment. **Table 1** presents the data that was gathered to inform the damages calculations, and highlights the number of damages/benefits streams that were considered and enumerated. It is noted that floodplain risk assessments in NSW go close to this process; however there is little application on the open coast.

Table 1 - Sources of damages

Damages Sources	Sub-category and risk	Data acquired
Property	Residential (erosion & inundation)	A national property data set exists with the most recent sale property value of all homes. This was considered too uncertain for the assessment, therefore a real estate valuer was sent to every residential and commercial property in the study area to provide up to date estimates.
	Commercial (erosion & inundation)	
Services	Electricity (minor erosion & mostly inundation)	Plans from the local network provider showed the location of all major power stations, substations and switchgear. An assumed cost for the following was also provided: - refurbishment cost for minor damage to infrastructure following a minor event -replacement costs following catastrophic damage
	Gas (inundation)	Plans from the local network provider showed the all gas infrastructure. - refurbishment cost for minor damage to infrastructure following a minor event -replacement costs following catastrophic damage
	Phone/Internet	This infrastructure in the area was considered to be highly transferrable, i.e. low risk, in consultation with the service provider. Thus no enumeration necessary.
	Sewerage (inundation)	Plans from the local provider showed the location of all major sewerage treatment plants and pumping stations. - refurbishment cost for minor damage to infrastructure following a minor event -replacement costs following catastrophic damage

Damages Sources	Sub-category and risk	Data acquired
	Potable Water (erosion & inundation)	Plans from the local provider showed the location of all major pipelines and infrastructure. - refurbishment cost for minor damage to infrastructure following a minor event - replacement costs following catastrophic damage
	Traffic (erosion & inundation)	Traffic data attained from Highways Agency and Council traffic monitoring points.
	Rail (inundation)	The locations of key rail lines were mapped using GIS and potential risk assessed.
Agricultural Land	Various land classes (erosion & inundation)	Agricultural land maps from specialists, as well as values for land classes per hectare.
Abstraction Points for irrigation	(inundation)	Abstraction point data from local agricultural specialist and registered operative abstraction point data from the EA.
Ecosystem Services & habitats	(erosion & inundation)	Areas of various habitats and significance of each, plus costs of compensatory habitat re-establishment.
Tourism & recreation	General tourism	Tourism data from local tourism office and EA data.
	Caravan parks (erosion & inundation)	Static and non-static numbers were attainted from individual parks.
Moorings & boating infrastructure	(inundation)	Data from local marinas & yacht clubs.
Sites of cultural/ social significance	Music concert hall (inundation)	Specific revenue and generated from visitors specifically visiting this site.
	Martello Tower (erosion)	Although culturally considered priceless, the cost of relocating the tower was estimated by local heritage specialists.
Indirect sources	Risk to life	Property information and risk level based on proximity to defences or erosion scarps and projected flood depth.
	Flood and erosion warning	Information from Emergency Services, the EA and local Council.
	Emergency services	
	Temporary accommodation	Assumptions made as to how long property owners may have to evacuate and require temporary accommodation.

It is common practice for economics assessments to enumerate property damages associated with hazards. Therefore, the following sections will discuss values which are infrequently evaluated in economics assessments, and may provide some insight for coastal management in NSW. These are services, agricultural land, habitats, and sites of historical or cultural significance. Tourism and recreation has been studied and enumerated quite thoroughly through other Australian examples, therefore will not be considered here. Other damage sources such as abstraction points are less relevant to NSW estuaries, although they are linked to agricultural land damages.

Services

Services includes the power, gas water infrastructure etc we use every day. If one of these is impacted or potentially lost during a storm event, then it has consequences for the service provider and the users. The cost of replacement or refurbishment to apparatus located in the study area was obtained from the various providers. Damages

can be calculated depending on extents and depths of inundation or a write-off/relocation cost for services lost to erosion. This can be translated to an average annual damage (ADD) value. AADs are damages that can be expected to occur, on average, in a typical year. Over a typical year there could be inundation or erosion events with an ARI ranging between 1 in 1 year (i.e. 100% annual probability of occurrence (APO) in a year) and an infinitesimally small percentage (a theoretical value). The AADs are the sum of products of the APO percentages of these events and their corresponding damages.

Table 2 shows ways in which various service damages were enumerated for the Strategy study and the associated general cost build-ups of the management options.

Table 2 - Methods for enumerating services damages

Damages Sources	Sub-category	Damages calculated	Costs
Services	Electricity	Cost for refurbishment per piece of apparatus affected per flooding/erosion event per timeframe. From this the AAD can be calculated to a capped value (write-off cost).	**NAI** - none **Do minimum** (routine and emergency maintenance) - cost for breach repair in coast/estuary defences, shingle recycling after an event **HTL** - cost to med/reconstruct defences to appropriate standard of protection **MR** - cost to bund/ring bank key assets + costs for compensatory habitat where necessary
	Gas	Few gas lines were affected, inundation of ground where lines were present would incur a refurbishment cost depending on extent depth of flooding. Events where gas lines affected calculated, and translated into AAD to a capped value (write-off cost) per timeframe. No erosion risk to infrastructure.	
	Sewerage	Damage value assigned per apparatus per event per timeframe for refurbishment (if flooded to depth >250mm). Damages were costs to refurbishment and for trucking of effluent during refurbishment for 2 weeks. Additional damage values included for sewerage works over other apparatus. AAD calculated and capped at write-off value.	
	Potable Water	Damages assigned for relocation of pipe due to erosion losses. Previous rerouting estimate used to determine per m run cost. No AAD, just one-off replacement value.	
	Traffic	Road repair costs plus indirect cost of traffic diversion (increased travel cost and time due to detoured traffic). Only roads passing through flooded areas that connect major settlements were considered.	
	Rail	Costs to move rail line far too high. Any option would include protection of line if/where necessary.	

Agricultural Land
The agricultural land assessment was mostly related to estuarine flooding, with minimal risk from erosion. The low-lying estuary hinterland was predominantly used as agricultural land and classed Grade 3 (good to moderate quality agricultural land) or Grade 4 (poor quality agricultural land). Data collated by a local land agent was used for the economics as it was more detailed than the nationwide land class mapping available. Land was classed as either arable farmland or grazing marsh.

The AADs for agricultural land were calculated based on the broad-scale estimates of the economic damage of a single annual inundation event, and varied according to land class values based on the most up to date Agricultural Price Index available from Defra. Arable crop inundation damage values were based on a loss of gross margin, less savings in uncommitted costs. Grassland damage values were based on the value of replacement feed.

It was assumed that land inundated every year (i.e. during 1 in 1 year ARI events) would be written off, as yearly saline inundation would sterilize the land, whereas land would recover between the less frequent events. The write-off value (i.e. capping of the AADs or areas sterilized) was calculated by multiplying the land area inundated, by the per hectare value from the agricultural price index.

Habitats
In the UK the majority of coastal habitats are protected under European regulations which have been transposed into UK law. This means that coastal management plans need to assess the impacts on habitats and the requirement for mitigatory or compensatory actions, such as habitat creation. For the Strategy Study, existing habitat areas were based on GIS habitat layers provided from Natural England (an environmental government agency). The assessment considered loss of current habitats (reedbed, grazing marsh, wet woodland, semi-ancient woodland and saline lagoons), as well as the conversion of certain habitats to another over time. So although in some cases there would be a temporary loss of benefit, in the long term a different benefit would apply e.g. fresh water marsh lost, but replaced with saltmarsh in time. Future habitat areas under a NAI scenario were assessed by ecologists with the assessment of potential future habitats determined based on the frequency of inundation. The benefits were calculated as the £/hectare/year value for each type of habitat that would be present in future. The value of a hectare of each habitat type is available in regularly updated appraisal guidelines. A lag time was also factored into the present value (PV) calculations to account for the time new habitat would take establish and be functional.

In addition to calculating the predicted benefits for habitats, it was necessary to provide compensatory habitat for any losses to protected habitat. Within the study area the European designated sites (non-tidal habitats) included grazing marsh, reedbed, and freshwater and saline lagoons. Replacement/recreation costs for each type of habitat were applied. The unit cost rate for provision included the cost to purchase land and recreate the habitat (from previous schemes). Benefits were also attributed to the replacement habitat, which would be created as a result of the management option.

Habitats and Ecosystem Services
With the potential loss of habitats under various options, is can be necessary to consider the various indirect (or rather less direct) benefits that habitats provide:

- opportunities for open access outdoor recreation;
- supporting and enhancing biodiversity;
- contributing to the visual quality of the landscape;
- carbon sequestration.

Carbon budgets have come to the forefront of Australian policy recently, so it may be appropriate to look at how the loss of carbon sequestration is considered as part of the economic habitat assessment. Each hectare of habitat type has an estimated carbon sequestration rate available in the appraisal guidelines. The loss or gain of any habitat areas based on an option implemented is then assessed i.e. a net loss or gain in area. This can be translated into pounds per tonne of carbon per year (£/t CO2e/yr) based on the most recent traded carbon values (DECC, 2012) and applied as a damage or a benefit.

Sites of historical or cultural significance

The enumeration of this value is relevant in the NSW setting as the coast holds many sites (e.g. middens) that are very significant to the indigenous community. Although, the example used in this project was the loss of a Martello Tower (a 200 year old historic fort) due to erosion of the shingle ridge, the concept of considering culturally significant features is the same.

The Martello Tower is the biggest and northern most tower of its kind which gives it heightened significance. It is priceless in terms of historical value, as all Martello Towers are considered to be, therefore how can a number be placed on it? In this particular case, damages were assigned as a one-off cost for relocation of the tower, at the time when the erosion risk was considered significant enough to move it. Although it would be much favoured to protect the structure *in situ* as its location is partly was gives the tower its significance, the only way to effectively enumerate potential damages was the cost of moving it. So although some of the inherent value would be lost, the actual structure would still remain.

Discussion

Although choices have been made about management of the coastal landscape for centuries, formal risk based coastal zone management systems in the UK and NSW are relatively recent. Governments and communities are recognising that risks must be managed to enable populations to continue to live and play along the coast. It is also recognised that any management must be affordable and sustainable.

To date, a key difference between the UK and NSW is the amount of money that has been invested to investigate, assess and manage these risks, as well as the funds available for the implementation of options. It is obvious to state that with additional investment, more can be done and less funding means less detail in CZMPs. But it is important to consider how much additional value the additional investment in studies could bring. Does more money equal better risk management? Generally, yes. Strategic management frameworks also help ensure the development of more sustainable approaches. More investment means better quality data to facilitate detailed background studies. It also allows for better understanding of processes, hazards and risks at the appropriate scales, whilst lowering levels of uncertainty. By extending economic analysis to consider the long term financial risks associated with coastal values, decision makers get a more comprehensive understanding of the scale of risk and the trade-offs that may be required.

The NSW framework has some advantages over the UK in that it offers a more streamlined approach. Although it may seem that bureaucracy in NSW is somewhat difficult to navigate, the fact is that if a management option to protect a public asset makes it into a CZMP, once Council has enough money to undertake it, it will (in theory) be done. The relatively low cost of analysis is consistent with the capacity of small regional and local councils with limited resources to manage risks in these areas.

In contrast, the UK, approach has been very labour intensive. The background studies are interrogated to the n^{th} degree by a panel to ensure every investment cent is justified. Finite central budgets have meant that in the past there have been examples of the financial benefits of schemes needing to outweigh the costs by upwards of 8:1 before funding was secured. This led to many schemes that were economic but not affordable and therefore were not taken forward. In recognition of this problem, the UK government adopted a new Partnership Funding system from April 2012 which ensures that many schemes will still receive full Government funding, whilst others will qualify for a contribution to the costs (Pontee and Parsons, 2012).

In the UK, if persons property is currently protected by an EA managed defence, but it can no longer be demonstrated that it is financially viable to continue to protect that property, then it is possible a NAI policy may be adopted. NSW properties owners already carry their own liability and the responsibility to protect their homes from coastal hazards. More detailed local scale process analysis and economic appraisal would also aid coastal property owners to understand risk more holistically, which may in turn encourage them to join forces with neighbour and Councils to come up with more sustainable and consistent local protection schemes.

Some of the economic valuing methodology examples noted could be applied in the CZMP context. This may provide Councils and the community with a more thorough understanding of the financial implications of management of the coastal zone. Having more certainty around if/when risks will be realised and the financial implications will aid in focussing efforts and prioritising investment to better facilitate long term financial sustainability. It will also aid in planning investment in the long term, rather than one or two budget cycles.

Conclusions

Although economic assessments are widely used in high level coastal planning, there is little money, advice or guidance at ground level in NSW. Improved guidance would aid in more thoroughly addressing the long term financial implications of undertaking or not undertaking works, and the most appropriate actions and timings to incur the most benefit. Such guidance needs to be standardized but offer enough flexibility to cope with the wide range of coastal settings that exists around the Australian coast.

An important finding from this paper is that aspects of economics appraisal process in the UK could be applied in NSW quickly and easily. This would allow the evaluation of some important coastal values that are not widely considered at present. This could potentially have a number of benefits:

- Encourage Councils to look more closely at investment, and the most appropriate timing for investment.
- Aid coastal managers to make stronger cases for additional support from the State Government for cases where significant loss of value can be demonstrated.
- Aid in encouraging coastal property owners to join forces (potentially with Council) to help develop and fund scheme level projects where multiple properties are affected by coastal processes.
- Contribute to ensuring long term strategies are considered and planned for on a wider scale.

References

Anning, D., Dominey-Howes, D., Withycombe,G. (2009). What Price Climate Change? – Valuing Sydney Beaches to Inform Coastal Management Decisions: A research outline. Management of Environmental Quality: An International Journal. (Special Issue: Human-ecosystem interdependence in coastal cities). Volume 20, Issue 4, pp. 408-421.

Anning, D. (2012). Estimation of the economic importance of beaches in Sydney, Australia, and implications for management. Submitted in fulfilment of the requirements of the award of the degree Doctorate of Philosophy. School of Biological, Earth and Environmental Sciences University of New South Wales.

Burgess K., Pontee, N., Hosking, A. (2012). Deriving the benefits of strategic shoreline management. Proceedings of the Eighth International Conference on Coastal and Port Engineering in Developing Countries (PIANC-COPEDEC VIII), Session TS43: Coastal Zone Management and the Environment – III, Chennai, India.

DECCW (2010). Guidelines for preparing Coastal Zone Management Plans. http://www.environment.nsw.gov.au/resources/coasts/101019GdlnsCZMPs.pdf

Defra (1999). Flood and Coastal Defence Project Appraisal Guidance Note 3 Economic Appraisal (FCDPAG3).

Defra (2003). Flood and Coastal Defence Project Appraisal Guidance Economic Appraisal FCDPAG3 – Supplementary Note to Operating Authorities March 2003. Revisions to Economic Appraisal Procedures Arising from the New HN Treasury "Green Book".

Defra (2004). FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities July 2004

Defra (2006). FCDPAG3 Economic Appraisal: Supplementary Note to Operating Authorities – Climate Change Impacts.

Defra (2008a). FCDPAG3 Economic Appraisal: Supplementary Note to Operating Authorities - Assessing and valuing the Risk to Life for use in appraisal or risk management measures. May 2008.

Defra (2008b). FCDPAG3 Economic Appraisal: Supplementary Note to Operating Authorities – Valuation of Agricultural Land and Output for Appraisal Purposes. May 2008.

Economics for the Environment Consultancy Ltd. (EFTEC) (2010). Flood and Coastal Erosion Risk Management: Economic Evaluation of Environmental Effects. Produced for the Environment Agency.

Environment Agency (2009a). Investing for the future - Flood and coastal risk management in England - A long-term investment strategy. Published by the Environment Agency, Rio House, Bristol UK.

Environment Agency (2009b). Long-term investment strategy annexe 1 - Flood risk management: the last ten years. Published by the Environment Agency, Rio House, Bristol UK.

Environment Agency (2010). Flood and Coastal Erosion Risk Management appraisal guidance (FCERM-AG). Published by the Environment Agency, Rio House, Bristol UK.

Gordon, A.D., Lord, D.B., Neilson, A.F. (2001). NSW Coastal Protection Act – a disaster waiting to happen. NSW Coastal Conference 2011, Tweed Heads NSW, November 2011.

NSW Dept. of Planning (2006). Project Summary Sheet CCA 22a: Economic Values of Natural Resources and Natural Environments on the NSW Coast. Comprehensive Coastal Assessment.

NSW Department of Planning (1997). NSW Coastal Policy. http://www.planning.nsw.gov.au/PlansforAction/Coastalprotection/NSWCoastalPolicy/tabid/173/language/en-AU/Default.aspx

NSW Government (1979). *Coastal Protection Act 1979* No 13. http://www.legislation.nsw.gov.au/maintop/view/inforce/act+13+1979+cd+0+N.

NSW GOVERNMENT (1997). Guidelines for Economic Appraisal. Office of Financial Management, NSW Treasury Department.

NSW Government (2006). NSW State Plan - A New Direction for NSW. http://web.archive.org/web/20070207162458/http://www.nsw.gov.au/StatePlan/pdf/State_Plan_complete.pdf

Pontee, N.I. and Parsons, A. (2012). Adaptation as part of sustainable shoreline management in England and Wales. Proceedings of the Institution of Civil Engineers, Maritime Engineering Journal, 165, MA3, pp 113-130.

Pontee, N.I., Parsons, A., Ashby Crane, R., (2011). Possible Implications Of Localisation and Austerity Measures Flood And Coastal Risk Management. Coastal Management 2011. Innovative Coastal Zone Management: Sustainable Engineering for a Dynamic Coast. 15-16 November 2011 in Belfast.

Pontee N. I. and Parsons, A. (2010). A review of coastal risk management in the UK. Proceedings of the Institution of Civil Engineers, Maritime Engineering Journal. Volume 163, Issue MA1, pp 31-42.

Pontee N., Hosking, A., Hamer, B., Burgess, K., (2008a). Mississippi to Medway: climate destabilisation and strategic risk management. Presented at ICCE 2008: 31st International Conference on Coastal Engineering, Hamburg, Germany.

Pontee N. I., Burgess K., Hosking A., Parsons, A. (2008b). Achieving sustainable shoreline management. COPEDEC VII, 2008: 7th International Conference on Coastal and Port Engineering in Developing Countries, 24-28 February 2008, Dubai, UAE.

Raybould, M., Lazarow, N., Anning, D., Ware, D., & Blackwell, B. (2011). A Travel Cost Model of Local Resident's Beach Recreation Values on the Gold Coast. NSW Coastal Conference 2011, Tweed Heads NSW, November 2011.