CONSULTATION DRAFT

NSW Coastal Management Manual

Part C: Coastal Management Toolkit

Using Cost–Benefit Analysis to assess coastal management options:

Guidance for councils

Published by:
Office of Environment and Heritage on behalf of the State of NSW
59 Goulburn Street, Sydney NSW 2000
PO Box A290, Sydney South NSW 1232
Phone: +61 2 9995 5000 (switchboard)
Phone: 131 555 (environment information and publications requests)
Phone: 1300 361 967 (national parks, general environmental enquiries, and publications requests)
Fax: +61 2 9995 5999
TTY users: phone 133 677, then ask for 131 555
Speak and listen users: phone 1300 555 727, then ask for 131 555
Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

Report pollution and environmental incidents
Environment Line: 131 555 (NSW only) or info@environment.nsw.gov.au
See also www.environment.nsw.gov.au

ISBN 978-1-76039-184-3
OEH 2015/0805
November 2015

Contents

Appendices

List of figures

List of tables

Glossary

Benefit cost ratios (BCR) – assess benefits and costs in terms of their relativity to one another. A BCR<1 indicates that the costs outweigh the benefits. A BCR>1, indicates that the benefits of a project outweigh the costs and it is therefore viable.

Discount rates – are rates used to discount a future stream of welfare/ wellbeing changes, whether they are costs or benefits.

Distributional analysis – consists of identifying and attributing costs and benefits to those parties impacted by options. In the case of coastal erosion options the parties impacted by coastal erosion can include:

- individual property owners – those impacted immediately by coastal erosion risk
- the local community – the community in the immediate vicinity of the impacted coastal area (e.g. beach)
- business – businesses that are impacted by the coastal erosion and/or activities taken to deal with erosion in the local government area
- visitors – tourists and visitors to the local government area, including to the immediate vicinity of the impacted coastal area
- the council responsible for the local government area of interest.

Double counting – the situation whereby benefit and cost categories overlap and are included twice in the cost–benefit analysis.

Economic impact assessment – an assessment of economic activity in the community is different from a cost–benefit analysis, in its consideration of economic impact. A CBA assesses welfare changes, including changes in producer and consumer surplus. Economic impact assessments generally consider economic changes, such as employment impacts and second-round effects.

Expected value – the value of a cost or benefit multiplied by the probability of it occurring.

Externalities – costs and benefits not directly captured in market transactions.

Full life cycle costs – where capital, operational and maintenance costs, deconstruction and rehabilitation costs are captured in terms of project construction.

Market based techniques – some non-market goods and services may not have obvious market prices for the basic reason that they have never been traded, or fully traded in markets.

Monte Carlo modelling – a technique used to understand the impact of risk and uncertainty in projects and forecasts. It can be used to estimate the likelihood or probability of future coastline change.

Net present value (NPV) analysis – consists of discounting the costs and benefits of the base case, which is business as usual, and the various options being considered.

Probabilistic risk profile (PRP) – a risk profile generated using Monte Carlo modelling to estimate probabilities around variables associated with coastal erosion. Such variables include severe weather events, the rate of recession, and the rate of net sand loss. They provide information on the future probability that coastal erosion will reach various points landward of today's waterline.

Revealed preference methods – use observation of purchasing decisions and other behaviour to estimate surrogate market prices for non-market goods and services.

Risk – *risk* – refers to situations with known probabilities. That is, the number and size of each possible outcome is known and the chance of each outcome occurring can be objectively determined. For example, in the case of throwing unbiased dice, the number of possible outcomes and their probabilities are known prior to the event.

Stated preference techniques – approaches based on asking people what they are willing to spend to obtain a particular outcome.

Uncertainty – refers to situations with unknown probabilities. That is, the number and size of each outcome may or may not be known, but the chance of any single outcome occurring cannot be objectively determined. For example, the demand for new services is dependent on many factors and the relative influence of these factors may vary over time in an unpredictable manner.

Welfare economics – the basic concepts underpinning CBA are drawn from a branch of economics known as 'welfare economics'. Welfare economics is concerned with the effect of making particular choices about how scarce resources such as time, labour, money, can be allocated to increase the economic wellbeing of individuals and groups. These parties in aggregate can be defined as 'the community'.

Welfare changes in the community consist of changes in 'producer surplus' and 'consumer surplus'. Producer surplus and consumer surplus are derived from the extra economic welfare ('utility') that producers or consumers gain from consuming or purchasing goods.

1 Introduction

Many local councils find it difficult to implement timely and effective coastal management options for a number of reasons, including a lack of community consensus on the most suitable strategy to implement, and a lack of reliable information on the economic costs and benefits of proposed options.

Economic assessment approaches can help decision-makers better understand the socio-economic implications of adopting particular management options, and help them to make choices about which options will provide net benefits to the community.

Cost–benefit analysis (CBA) is an economic assessment approach which can play a valuable role assisting coastal councils to make decisions about appropriate coastal management options. A CBA approach can accompany other decision-making criteria which councils may wish to use (e.g. technical feasibility, community acceptability, environmental impact), to ensure that an optimal management response is selected.

To help councils develop effective coastal management options, the NSW coastal management manual includes guidance for councils wishing to carry out detailed cost–benefit analyses of options. It is hoped that this guidance will help councils to identify robust, and appropriate, management options that will meet the needs of their communities. It is intended to assist council staff with relevant economic expertise, or economic consultants engaged by council to develop valid CBAs of coastal management options. Additional resources that may assist in the preparation of CBAs are listed in Appendix 1.

2 What is cost–benefit analysis?

Cost–benefit analysis (CBA) is a form of economic appraisal that can be used to estimate changes to the economic wellbeing of local and wider communities. A CBA is used to estimate and compare the costs and benefits of implementing a proposed project or management activity with the costs and benefits of a ‘base case’, which represents a continuation of current conditions under which the proposed project/ policy is not implemented.

In the case of CBAs for proposed coastal management activities, the base case would represent a continuation of council’s prevailing approach to coastal management (i.e. a ‘business as usual’ situation). The costs and benefits of alternative management options are then compared with the costs and benefits of the base case to identify any incremental differences between the base case and the alternative approaches.

It is fundamental to note that a base case is not the same as a ‘do nothing’ approach, as councils are already carrying out various management activities to address coastal erosion. A ‘do nothing’ approach would involve councils ceasing all coastal management activities, and so does not represent a continuation of the status quo, and does not represent an appropriate base case.

A CBA considers direct costs and benefits for different groups and also any positive or negative effects on ‘third parties’ (called positive and negative ‘externalities’), such as the changes in the value of beach recreation and amenity. It should be noted that although individual groups in the community may benefit from a particular management action, others may be disadvantaged. However, if the sum of the benefits of a particular option exceed the sum of the costs incurred, the option would appear to provide an overall benefit.

A CBA also considers the timing of each of the costs and benefits associated with particular options, and converts future costs and benefits into today’s prices so that all impacts can be meaningfully compared regardless of timing. In this way, a CBA can enable a comparison of options that deliver different streams of benefits and costs over time.

A CBA should consider all viable legal and engineering options for achieving the objectives of the issue being considered (e.g. 'how to protect coastal properties from erosion impacts over the next 50 years'), and use the best available information to inform the economic analysis. The robustness of the CBA is likely to depend on the quality and accessibility of information available, for example, material already included in an existing Coastal Management Plan.

Councils planning to produce a CBA should be aware of the following fundamental issues that CBAs need to address.

Scope – A CBA should include all direct and indirect impacts. Direct impacts include any revenues of the management option being considered less the opportunity cost of resources (such as capital and labour) used for the option. Indirect impacts are impacts on third parties (externalities) whether positive or negative. They include all the environmental and social costs and benefits. Therefore, CBAs are concerned with those parties experiencing costs and benefits directly, or via externalities. CBAs do not consider 'second-round' flow-on impacts on parties who are **subsequently** affected by the 'first-round' costs and benefits being imposed directly or via externalities.

The basic concepts underpinning CBA come from a branch of economics known as 'welfare economics' which is concerned with the effect of making particular choices about how scarce resources such as time, labour and money can be allocated to increase the economic wellbeing of individuals and groups. These parties in aggregate can be defined as 'the community'. CBA is not concerned with the interactions that occur in the local, state or national economy between the different sectors of the economy (firms, households, government and financial institutions).

Although major investment in capital works, such as coastal defence structures, is likely to (indirectly) stimulate economic activity in other (linked) sectors of the local economy, these indirect flow-on effects are not considered in a CBA. Councils interested in such impacts will need to look to other economic assessment approaches such as regional economic input–output analysis as a complementary input to the decision-making process. (See also Chapter 2.4 of the NSW Government Guidelines for Economic Appraisal.[1])

Timeframe – The CBA evaluation period should be long enough to capture all costs and benefits attributable to the option under consideration. The timeframe should reflect the expected economic life of the principal asset (e.g. offshore defence works). This timeframe is generally deemed to be the expected design life of the principal asset. It is recommended that long-term projects use a 30-year timeframe post construction, consistent with the NSW Government Guidelines for Economic Appraisal, and where applicable, a residual value for impacts beyond that time period. However, where predictable and relevant, a longer timeframe can be adopted, as has been done for CBAs of sea walls with a design life of 50 years.

Risk and uncertainty – A CBA should take account of risk and uncertainty. Where possible, coastal risks should be modelled using Monte Carlo methods to provide a probabilistic assessment of their potential impact. Other approaches can be utilised to derive probabilistic estimates where shown to be valid. Uncertainties should be addressed through sensitivity testing of key variables and assumptions (see Appendix 2: Monte Carlo modelling of uncertain coastal processes).

Unquantified factors – Where certain impacts generate costs and benefits which cannot be quantified or monetised with any confidence, the CBA should also include qualitative information to accompany the estimates of such unquantifiable costs and benefits, to help

[1] available from NSW Treasury at www.treasury.nsw.gov.au/Publications_by_Policy_Area.

inform the decision-making process (see Appendix 3: Non-market valuation and benefit transfer).

Discount rate – Discounting is used in CBAs to convert the stream of future costs and benefits occurring over the life of the project into today's prices. The NSW Treasury recommends that the sum of the costs and the sum of the benefits occurring throughout the life of the project should be discounted at a seven per cent rate, with sensitivity testing using a four per cent and 10 per cent rate.

Perspective – The perspective adopted in a CBA should be determined by the purpose of the analysis. Where CBA is being used as a decision-support tool for councils developing coastal management options, the focus of the CBA will be the local government area (LGA), and the overall frame of reference will be the LGA community as a whole. Even though councils do not operate as independent entities and council decisions can have impacts beyond LGA boundaries, the CBA will be concerned only with the question of whether the LGA community will be better off as a result of a particular management option being adopted.

In the event that a broader state focus was sought, the CBA should adopt a statewide perspective.

Excluding second-round/ flow-on effects – A CBA is primarily intended to identify changes in economic welfare, and not the second-round impacts of proposed coastal management options on parties not directly affected, or affected via externalities.

In the case of coastal management options, such second-round effects would include employment and indirect expenditure not directly related to the presence of a beach. Multipliers should not be used in a CBA to estimate impacts on the local economy, as they are based on different economic concepts and interrelationships from those used in a CBA.

However, second-round impacts on businesses in the local community can be described qualitatively in the CBA document as part of the overall CBA process, although they are not an integral part of the material a CBA needs to address. It should be noted that the potential effect of different management options on local businesses may be temporary, as some businesses would be able to adjust to changing market opportunities by modifying the types of goods and services they provide.

3 What does a CBA look like?

As noted above, CBA is a decision-support tool that councils can use to assess whether a particular management option will provide net benefits to the local community compared to other alternative developments or options which will achieve the same objectives.

Projects which will operate over relatively long timeframes, including engineering works with long design lives, are likely to affect a wide range of different parties, and generate potentially large costs and benefits directly and on third parties. A detailed assessment of the costs and benefits of such large scale or long-lasting projects can provide a valuable contribution to council decision-making.

Given the time, level of detail and technical knowledge required to produce a good quality CBA, it would not be a good use of council resources to carry out detailed CBAs for projects that are only expected to have minor costs and/or benefits for a very limited number of parties. The scope and level of detail included in a CBA should be proportionate to the nature and scale of the coastal issue(s) being addressed. The coastal management manual provides guidance relating to identifying and quantifying coastal risks and hazards. The information made available through the manual will also determine the appropriate level of detail that should be addressed in the CBA.

A completed CBA should provide the following information, in the form of a set of documents:

(i) a written report describing:

- the coastal management issues that need to be addressed in a prospective coastal management plan, and what such a plan should achieve
- a socio-economic profile of the LGA community
- a profile of the environmental values of the subject area (including amenity and recreational values)
- a base case representing a continuation of current management approaches
- alternative options for achieving the desired objective
- the key features of the base case and each alternative, and their costs and benefits
- the results of the economic analysis of the base case and alternatives, clearly describing the assumptions used, and showing their estimated net present values (NPVs) and benefit cost ratios (BCRs), and
- conclusions about the preferred option, as demonstrated by the analysis

(ii) a section of the report providing a distributional analysis of the allocation of the costs and benefits of the preferred option

(iii) spreadsheets showing the above quantified costs and benefits for the base case and alternative options

(iv) appendices describing those costs and benefits which cannot be quantified, and other material outside the main CBA, which could be taken into account in some form to help inform council's decision-making processes about the choice of suitable management options.

The next sections of this guidelines describe each step of the CBA, and discuss particular issues that analysts need to take into account to help produce robust results.

4 Step 1: Defining the problem and the need for action

The first step in carrying out a CBA requires the analyst to consider why there is a need for council to undertake some intervention, and what such intervention should achieve; for example, that the coastal areas in the LGA have been defined as an erosion hotspot vulnerable to physical damage and loss of private and public assets, and intervention is needed to prevent damage to such assets into the foreseeable future.

Due to the dynamic nature of the NSW coastline, erosion risks cannot be determined with high levels of certainty. However, councils can improve their understanding of risks and the need for intervention through using probabilistic techniques such as Monte Carlo modelling.

Probability risk profiles (PRPs) for erosion occurrence can be generated using a Monte Carlo simulation approach, in which the probability of sand distribution and shoreline change can be modelled to estimate future coastal change. PRPs represent the likelihood, or probability, that a beach will move landward past a given point, or line, by a specific time in the future.

The Monte Carlo approach samples all of the feasible possibilities and produces a comprehensive assessment of the likelihood of future coastline change, and accounts for uncertainty in coastal processes and responses. Further information on treating the uncertainty associated with coastal processes is provided in Part B of the coastal management manual.

Monte Carlo modelling is suitable for use in CBAs because estimates of future economic impacts are based on the assessed probability of impact from coastal erosion. That is, it is possible to estimate the expected value of property and asset loss due to coastal risks.

In addition to collecting information about the risks of erosion for the areas in question, it is suggested that councils collect background material on the socio-economic and environmental characteristics of the areas that are likely to be affected, by producing a socio-economic profile and an environmental profile.

Additional information on Monte Carlo modelling is provided in Appendix 2.

4.1 Socio-economic profile

As noted above, the perspective of the CBA is that of the LGA; however, coastal erosion hotspots occur at smaller scales, e.g. the beach under threat of erosion, and the greatest impacts will be on the local community. This means that adopting an LGA perspective can run the risk that relevant impacts on the local community may not be identified. Therefore, it is suggested that a socio-economic profile of the local community be undertaken to enable such impacts to be better understood by analysts.

No two coastal communities are identical in terms of their community demographics, the nature and age of their workforce, income levels, the nature of businesses in the community, and the extent of tourism. Understanding the socio-economic characteristics of a community can provide valuable insights into how different coastal management options, if implemented, may affect the community.

For example, once a preferred option has been identified through a CBA, analysts can use the information from a socio-economic profile to qualitatively identify and describe potential second-round impacts on the local community, such as impacts on businesses, employment, and income. The assessment can even extend to social cohesiveness impacts (such as the possibility of residents leaving the local community). Finally, the socioeconomic assessment could identify potential equity considerations, which may in turn affect funding decisions.

A socio-economic profile outlining the different characteristics of the local community and its interactions with the broader LGA and region, will help improve the quality and decision-support value of a CBA and can enhance economic outcomes for the community while respecting equity concerns. A template of a possible socio-economic profile is provided in Appendix 4; however, additional information can be collected that may be relevant to the specific circumstances of individual communities.

4.2 Environmental profile

NSW coastal areas and their hinterlands contain a wide range of environmental attributes with different values for the local and wider NSW community.

These values primarily consist of ‘use’ values such as recreational experiences from visiting beaches or surfing, ‘indirect use’ values where environmental attributes provide inputs into other activities such as the role of mangrove areas as nurseries for commercial fish species, and ‘non-use’ values, such as the value to individuals from knowing that a coastal vista may be protected for future generations to appreciate.

Different coastal management options will have different impacts on these values, and lead to different costs and benefits for different groups. For example, a management option that changes the physical profile of a beach may affect the recreational value of the beach for beach users (a direct use value); offshore coastal defence works may alter near-shore saltmarsh or seagrass habitats for commercial species (an indirect use value); and unmanaged coastal erosion may affect heritage associations held by older, long-term residents (non-use values).

CBAs of different coastal management options need to acknowledge potential impacts on these environmental values, and the relative costs and benefits of management options, for different groups. It should be noted that many of these environmental values, such as amenity or heritage value, cannot easily be expressed in terms of market prices and thus need to be estimated through non-market valuation approaches, as discussed in Appendix 3.

An environmental profile which outlines the different environmental values of the area being studied (including amenity and recreation values), will help improve the quality and decision-support value of a CBA, and can improve the definition of the CBA base case (see below). Changes to these values will also need to be considered when comparing the costs and benefits of different management options relative to the base case.

Before proceeding to Step 2, councils should assemble as appropriate the above information about potential risks, the local socio-economic and environmental characteristics of the areas likely to be affected, and the specific outcomes management options should achieve. Under Step 2 analysts should develop detailed descriptions of a range of alternative options that could achieve the desired common outcomes.

5 Step 2: Developing a detailed base case

As noted above, analysts will need to develop a detailed base case, which represents a continuation of present council management activity. The base case will provide the reference case against which alternative options should be considered.

5.1 Defining the base case

The base case in this instance is the ‘business as usual’ option; as noted above, this is not the same as a ‘do-nothing’ approach. The reason for the base case to be defined as the business as usual option is that councils may already be undertaking coastal management activities, for example through sand nourishment, dune management and stabilisation, and/or protective works.

A change in management of coastal erosion associated with a particular alternative management strategy needs to be identified as the change from the status quo (i.e. the business as usual case). This approach is used to identify the marginal change associated with different management practices compared to current management practice in order to estimate the net present value (NPV) and benefit cost ratio (BCR) of the various management options being considered.

5.2 Assessing business as usual management activities

In order to develop the base case for the CBA, it will be necessary to catalogue the current activities council is carrying out to manage coastal erosion risk.

These activities may include opportunistic beach nourishment, dune maintenance and stabilisation, and the protective works. However, the base case should not include costs incurred by councils for routine clean-up activities not directly associated with the above erosion management activities, where these activities are part of council’s normal operational/ beach maintenance activities, and would continue irrespective of which specific erosion management strategy was adopted.

5.3 Costing the base case

All costs and benefits associated with the base case should be identified and monetised (where possible) over time. The approach involves estimating a stream of costs and benefits associated with current council activities into the future, relative to the present. This process will let councils know whether, and to what extent, continuing with their current management activities will improve the coastal erosion issues they face over time.

6 Step 3: Identify management options to be considered relative to the business as usual base case

6.1 Defining discrete management options

Options which are judged to be feasible and suitable for consideration in the CBA need to be internally consistent, and not dependent or consequential on other options (i.e. they need to be discrete options). To avoid confusion between the costs and benefits expected to occur under a particular option, and the potentially different costs and benefits that may occur under variants of that option, variants should be treated as individual options in their own right.

More detailed information on the identification of coastal management options is provided in the coastal management manual, including the nature of possible management options that might be considered.

7 Step 4: Identify costs and benefits of coastal management options

The costs and benefits of the management options being considered in the CBA can be defined in the following categories:

- direct costs
- direct benefits
- positive externalities
- negative externalities.

Costs and benefits include costs and benefits resulting from changes to market and non-market values (see Appendix 3). Where possible, these should be assigned a monetary value, but it may also be necessary to provide a qualitative description of the nature of the change.

The key assumptions made in carrying out CBA, and the data/ information required to estimate the relevant costs and benefits, should also be clearly described.

Allocative effects influence the overall level of economic welfare in society. Since total resources are limited, the decision to use resources to undertake a particular initiative will mean that those resources cannot be used for other purposes. This represents an allocative cost in terms of production and consumption opportunities foregone. This concept is known as the ‘opportunity cost’.

In contrast to allocative effects, distributional effects such as taxes, levies, subsidies, etc. represent transfers in economic welfare between different groups in society; such transfers do not alter the total level of economic welfare in society. In other words, while some groups may be worse off following implementation of a particular strategy, other groups will be better off by an equivalent amount, and overall levels of economic welfare in society will be the same.

When undertaking a CBA, only allocative (‘real’) effects should be included when analysing the overall net impact of each option. However, distributional (sometimes called ‘transfer’) effects that have no net impact on the CBA reference community are still highly relevant for decision-makers, because they provide an understanding of how management options affect different groups in the community. Distributional effects should be considered separately as a complementary input to the decision-making process (see Section 11).

7.1 Direct costs

7.1.1 Damage to or loss of built assets

Household property and council-owned assets

The damage to, or loss of built assets (such as household property or council-owned assets) may be included in the CBA. Inclusion of such costs is dependent on whether asset owners are located within the LGA. For example, some property owners may reside outside the LGA, and so costs and benefits accruing to these owners are outside the scope of the analysis. The value of assets should reflect the likelihood of the asset being damaged or lost due to coastal erosion over the timeframe of the analysis.

Further information relating to costing property damage/loss is provided in Appendix 5.

State-owned or operated assets

The state may own or operate built assets that may be at risk in coastal areas in NSW. For the purposes of the CBA, the state is treated as an asset owner. The loss of state assets may be incorporated as a cost in the CBA, subject to advice from affected agencies about any alternative plans for service delivery.

7.1.2 Loss of income

Loss of income might be included if residents are assumed to leave the LGA. The extent of income loss incurred by members of the community who may have to vacate properties and leave the LGA will be dependent on the management option being considered. The analyst would need to justify the basis for their assumptions about loss of income.

7.1.3 Full life cycle costs

Full life cycle costs need to be included in the CBA for options that involve expenditure on built infrastructure (e.g. revetments) or for formal retreat options, where properties are assumed to be vacated in a given timeframe. These costs will include capital expenditure, operational and maintenance expenditure, demolition costs and site rehabilitation costs (see Figure 1).

Figure 1: Life cycle costs

The maintenance costs of revetments can be substantial, and need to be accounted for in terms of the timing of these costs over the economic life of the proposed infrastructure.

7.1.4 Loss of environmental values

A loss of environmental values (including amenity and recreation values) may occur under different management options, and will impose costs on certain members of the local and wider community relative to the base case. Where primary information on lost values is not available, it may be possible to adopt and apply appropriate information on changes in value from peer-reviewed economic literature (see Appendix 3).

In the case of the potential loss of environmental values relating to beach activities, for example surfing and swimming (see Section 4.2), potential loss of beach areas under some options will need to be considered in terms of the availability of alternative substitute locations where the recreational activity could occur.

If there are alternative beach locations within a reasonable travelling distance or travel time, these should be considered in the analysis (see Appendix 6). In cases where visitors and residents can relocate to another beach location, for the purposes of the CBA it is assumed that only minimal costs will be imposed on potential beach users unless there is convincing evidence to the contrary. In the majority of cases, activities that occur on one beach can be relocated to another location, and environmental values will not be affected.

7.1.5 Business impact

The impact of different coastal management options on local businesses presents some difficulties for analysts. If particular businesses are directly affected by certain management options, the direct economic welfare impacts of these options need to be considered in the CBA. It may also be necessary to consider whether effects are temporary, or represent a permanent loss. In addition, factors unrelated to the proposed options may also temporarily affect business activity, such as a reduction in tourist expenditure due to visitors' perceptions of the likelihood of shark attacks, or potential contamination of local seafood. Analysts need to be aware of the potential influence of such unrelated factors.

If businesses are indirectly affected (second-round, flow-on effects; see Section 2: *What is cost–benefit analysis?*), these impacts are not considered in the CBA.

Changes in beach width arising from management options may impact accessibility, and thereby affect beach visitation rates. As such, consideration of the impacts of coastal erosion on visitation and associated expenditure may be used to estimate business impacts (although only marginal changes in producer surplus, not total expenditure, should be included; see Appendix 6).

The substitution of visitation to a particular beach to another beach will also have an impact on businesses. If a business shifts location due to a specific management option, costs would be incurred in relocation, but if the new business site is located in the same LGA there is no net change to the welfare/wellbeing of the community. In this situation, impacts should be considered as part of a distributional analysis, as described in Step 8.

Indirect flow-on effects from changing business expenditure (as might be determined using input–output multipliers) should not be included in the CBA, as these are second-round effects (see under 'Scope' in Section 2: *What is cost–benefit analysis?*).

7.2 Negative externalities

A CBA requires that all relevant costs and benefits for affected parties are identified, whether they are readily quantifiable or not. Economic impacts on market and non-market values (see Appendix 3) should be included in a CBA. Changes in non-market values are not readily identifiable because non-market values generally do not have a clear transaction, or market, price. As well as their direct impacts on different parties, coastal management options may have (unintended) third-party impacts (externalities) on other groups, including the wider community. These externalities may be negative (costs) or positive (benefits).

Negative externalities may include impacts on environmental values (e.g. increased pollution, reductions in native vegetation); social values (e.g. impact on heritage values, reduced social cohesion); and economic values (e.g. travel time increases; increases in death/injuries that lead to lower workforce output).

Negative externalities that impact recreational values are of particular interest in the context of coastal management. These negative externalities may include disamenity associated with engineered structures (especially in the absence of nourishment), increased turbidity, and reduced surfing and fishing conditions. Additional information about valuing recreation impacts is provided in Appendix 6.

It may not be possible to readily identify or estimate the value, and changes in the value of many negative externalities. In such cases analysts should at least aim to describe potential externalities in the CBA document so that they can be considered in council's overall decision-making process. Additional information on valuing externalities is provided in Appendix 3.

7.3 Direct benefits

7.3.1 Avoided costs

In economic analysis, a party is judged to obtain a benefit when it does not have to bear a cost it would otherwise have to incur. Owners of coastal properties that would otherwise be damaged or lost due to coastal erosion, would benefit from management options that reduce or eliminate the risk of erosion. That is, the benefit they receive is the avoidance of the cost they would otherwise incur.

7.3.2 Gains in environmental value

Particular management options may deliver benefits to members of the local and wider community through activities (such as sand nourishment or dune stabilisation) which increase amenity, recreation and other environmental values relative to the base case. As with the losses of environmental values mentioned above (i.e. costs), where primary information on environmental values is not available, it may be possible to adopt and apply appropriate information on changes in value from peer-reviewed economic studies using benefit transfer (see Appendix 3).

CBA analysts are interested in the difference between the environmental values applying under the base case and those applying under different management options, i.e. different options lead to a decrease in values (a cost) or an improvement (a benefit) when compared to the base case.

7.4 Positive externalities

As noted above, as well as their direct impacts on different parties, coastal management options may have (unintended) third-party impacts (externalities) on other groups, including the wider community. These externalities may be positive (benefits) or negative (costs).

Positive externalities may include impacts on environmental values (e.g. increases in populations of threatened species or areas of high conservation value); social values (e.g. formal conservation status for coastal heritage assets, improved public health); and economic values (e.g. cleaner beaches encouraging increased off-season visitation).

Where analysts are not able to estimate the economic impact of positive externalities, they should aim to describe these potential externalities in the CBA document. Additional information on valuing externalities is provided in Appendix 3.

8 Step 5: Estimating net present values and benefit cost ratios

Net present value (NPV) is the sum of the discounted project benefits less the sum of the discounted project costs. The benefit cost ratio (BCR) is the ratio of the present value of benefits to the present value of costs.

In algebraic terms NPV and BCR can be expressed as follows:

$$NPV = \sum_{n=0}^{N} \frac{B_n - C_n}{(1+r)^n}$$

$$BCR = \sum_{n=0}^{N} \frac{B_n}{(1+r)^n} \Big/ \sum_{n=0}^{N} \frac{C_n}{(1+r)^n}$$

Where:

B_n = benefits in year n expressed in constant dollars

C_n = costs in year n expressed in constant dollars

r = real discount rate

N = number of years that costs and/or benefits are produced.

A project is potentially worthwhile if the BCR is greater than one, i.e. the present value of benefits exceeds the present value of costs. If projects are mutually exclusive, this rule would indicate that the project with the highest BCR should be chosen.

8.1 Illustrative example of discount rate and timing effects on costs and benefits

Discounting is used in CBAs to convert the stream of future costs and benefits occurring over the life of the project into today's prices. The NSW Treasury recommends that the sum of the costs and the sum of the benefits occurring throughout the life of the project be discounted at a seven per cent rate, with sensitivity testing using a four per cent and 10 per cent rate.

The higher the discount rate, the lower is the present day dollar value of future costs and benefits. If the future stream of costs and benefits are discounted at a higher rate, it means that a dollar is worth less in the future than it is today, in today's prices.

Table 1 shows the impact of different discount rates for a management option costing $1.5 million and generating benefits of $2 million (costs and benefits both occurring in the second year of the management option).

Table 1: Example of the impact of different discount rates on the present value of future costs and benefits

Discount rate	Costs	Benefits	Net present value
4%	$1,442,308	$1,923,077	$480,769
7%	$1,401,869	$1,869,159	$467,290
10%	$1,363,636	$1,818,182	$454,546

Note: All costs are incurred in year 2. All benefits are obtained in year 2. This example is illustrative in nature only and is not intended to represent the timing of costs and benefits of real-world coastal management options.

Table 2 shows the impact of timing on discounting costs of $1.5 million and benefits of $2 million when they occur at different times in the future.

Table 2: Discounted (present day) value of costs and benefits incurred at different times in the future

Discount rate	Year costs incurred	Year benefits received	Net present value
	Year 2	**Year 2**	
4%	$1,442,308	$1,923,077	$480,769
7%	$1,401,869	$1,869,159	$467,290
10%	$1,363,636	$1,818,182	$454,546
	Year 20	**Year 20**	
4%	$740,442	$987,256	$246,814
7%	$443,796	$591,728	$147,932
10%	$269,788	$359,718	$89,930
	Year 50	**Year 50**	
4%	$228,292	$304,390	$76,098
7%	$58,300	$77,734	$19,434
10%	$15,461	$20,615	$5,154

Note: This is an indicative example only.

9 Step 6: Interpretation of net present value and benefit cost ratio results

A BCR is a ratio of costs to benefits and provides information on the ‘value for money’ proposition of a management option. NPV provides information on the net total amount of benefit obtained.

Once NPVs and BCRs have been estimated in Step 5 above, analysts will need to consider the implications of the results produced.

The simple decision rule is that implementing an option will be in the interests of the community if it has a positive NPV and a BCR greater than one. That is, there is a net benefit to the community.

However, management options will be ranked differently depending on whether the NPV or BCR result is used. Understanding the difference between these two decision criteria allows the analyst to provide a more nuanced assessment. Councils should use both criteria when selecting a preferred management option.

10 Step 7: Sensitivity testing

Analysis of coastal hazards and erosion is inherently subject to very high levels of uncertainty due to the unpredictable nature of the underlying physical processes and the economic and social responses to these processes. This issue is compounded by the difficulty in obtaining relevant data to allow analysis of these relationships.

The NSW Government Guidelines for Economic Appraisal strongly recommend that analysts carry out sensitivity testing to assess whether the results of the CBA are sensitive to changes in key assumptions and variables. Sensitivity testing can help the analyst to better understand how robust the analysis is in the face of uncertainty about key variables that are difficult to accurately quantify (e.g. the impacts of management options on tourism, the availability and cost of sand to undertake nourishment, and environmental values). This is particularly relevant to non-market values that have been derived through alternative methodologies and proxies.

The results of sensitivity testing provide information on the robustness of the analysis, and can identify when more detailed analysis or data collection is required. For example, if small changes in estimates of tourism benefits result in management options changing rankings or falling below acceptable NPV and BCR thresholds, the reliability of the analysis is questionable and more analysis of tourism-related impacts is required.

It is recommended that the analyst spend a considerable amount of time and effort in sensitivity testing. The results of, and conclusions drawn from sensitivity testing should be reported in some detail and their implications discussed so that councils fully understand the strengths and weaknesses of the analysis. In particular, the analyst should be able to assess whether a major decision about adopting a management option can be justified on the basis of the results of the sensitivity testing.

As noted previously, the NSW Treasury guidelines recommend using a discount rate of seven per cent to discount the future stream of the costs and benefits of each option being considered in the CBA. The guidelines also recommend that analysts re-run the discounting process using discount rates of four per cent and 10 per cent to assess whether the NPVs and BCRs (and relative rankings of the different options) are sensitive to changes in the discount rate. If there is evidence of such sensitivity, there will be a greater risk that a particular management option will not be able to reliably deliver the required benefits to the community.

11 Step 8: Distributional analysis

The analyst will identify relevant costs and benefits associated with different management options as part of carrying out a CBA. In doing so, the analyst is able to identify the distribution of costs and benefits among the different parties affected.

A distributional analysis should be carried out to explore the implications of management options on impacted parties, as identified earlier. The broad groupings will be identified in the CBA; however, the distributional analysis should focus on the implications of the management options for those groups identified. The distributional analysis should include transfer-type payments (i.e. those that do not necessarily result in net welfare changes) in order to provide a clear understanding of their implications for individuals and council budgets.

Broad categories of parties identified in any coastal CBA will include at least: the local community, visitors (tourists), business, and government. Each of these broad categories of parties can be further teased apart (see Table 3) as determined necessary by council to fully support its decision-making. The level of information available will ultimately determine the extent to which parties can be identified and relevant costs/benefits allocated to them.

Table 3: Identification of parties relevant to decision-making

Broad category	Refined categories	Further possible refinements, where relevant
Local community	• At-risk property owners • Not at-risk property owners • Beach users vs non-users	At-risk property owners: • Owner-occupier • Holiday home owner (within/ without LGA) • Investor (within/ without LGA)
Visitors	• Visitors from elsewhere within LGA • Out-of-LGA visitors	Out-of-LGA visitors: • NSW • Interstate • International
Business	• Beach related • Non-beach related	Beach related: • Tourist dependent • Local community dependent
Government	• Local government • State government	State government: • Infrastructure agencies (roads, buildings) • Environmental asset agencies (vegetation, beaches) • Natural resource agencies (owners of sand, other natural resources)

The following example illustrates the process of distributional analysis. In the case of a management option involving building a seawall with beach nourishment, the physical impacts of adopting this management option may include:

- erosion will be halted, although seawall end-effects will be generated
- the beach in front of the seawall will be maintained over time, and
- dunes and dune vegetation will be lost when the seawall is built.

The indirect and direct social and economic impacts of adopting this management option may include:

- Risk for (previously) at-risk properties is eliminated or mitigated:
  - property owners (residential, commercial or government) benefit from their assets being secured against erosion in the long run, and
  - consequential benefits may result, e.g. the avoidance of erosion-related repairs to assets and/ or removal costs.
- Value is retained as the beach is maintained through sand nourishment:
  - social activities dependent on the beach will be maintained commensurately, and
  - visual amenity will be maintained (often realised through property values).
- Economic activity (solely or partly) dependent on the beach (e.g. beachfront motels, guesthouses) will continue over time as the beach is maintained through nourishment.
- Costs will be incurred in building a seawall and maintaining it in the long term. Costs will also be incurred for the corresponding beach nourishment, subject to volumes required and available sand sources. Sensitivity testing regarding the cost of beach nourishment may be required.
- Councils may be affected (positively or negatively) in the following ways:

  - rates revenue is maintained without redistribution in the LGA due to protection of properties
  - council may avoid repair and replacement costs of at-risk council assets (e.g. local roads, sewers), and
  - there may be financial impacts on council funds from construction of a seawall. The analyst should take the identified social and economic impacts of the management option, and by attributing them to different parties, identify the potential 'winners' and 'losers' associated with a particular management option. More detailed analysis can identify the scale of benefits or costs incurred by the different affected parties. The number of parties that can be identified in a distributional analysis will be dependent on the information available to the analyst. For example, it is not possible to ascertain the impact on property investors if there is no information on at-risk investment properties (e.g. the number of affected parties, whether the properties are owned by local investors or investors from outside the LGA).

The results of a distributional analysis can be used to identify possible equity issues and inform funding decisions.

12 Step 9: Checking to avoid common errors in a CBA

There are some common errors that councils need to be aware of when carrying out CBAs. There is a strong possibility that such errors will fundamentally affect the results of the CBA and produce questionable results.

12.1 Not considering unanticipated impacts and ignoring non-market impacts

Many potential costs and benefits are unanticipated when management options are being considered in a CBA. In particular changes to non-market values are generally harder to anticipate and quantify and may be overlooked by analysts. Nevertheless, analysts should attempt to identify and estimate all affected parties and relevant costs and benefits as early in the process as reasonably possible. It may be necessary to amend the CBA as new information comes to hand during the course of the analysis, or following public consultation.

12.2 Double counting

Impacts can be accidentally double counted. This is usually because they are inherently reflected in the pricing of other benefits.

Another example of double counting frequently occurs in relation to property values. The market price of properties in the study area reflects a number of attributes that each property possesses, including visual amenity, proximity to the coast and the recreational opportunities from using the beach of which the residents of the property can readily take advantage, i.e. the value of recreational experiences to residents is already reflected in the price they are willing to pay to buy or rent the property in question. Thus it would be double counting for analysts to separately and additionally estimate the change in recreational values residents would experience under different coastal erosion management options, as the change in the value of the recreational experience would be reflected in the change in the market price or rental cost of the property in question[2].

12.3 Miscounting

Miscounting can be seen in relation to the identification of certain types of costs or benefits. For example, a loss of rates may be considered a cost; however, in some circumstances, this cost would be 'balanced out' or offset by the fact that property owners reduce their expenditure on rates payments.

Appendix 7 provides more information on the treatment of rates in a CBA.

Another form of miscounting is to assume that a business as usual cost that is <u>avoided</u> in an alternative management option is a benefit. For example, the cost of removing an illegally built seawall cannot be counted as both a cost in a business as usual option <u>and</u> a benefit in a retreat option.

12.4 Misusing multipliers and including flow-on effects

It is important for councils, and contractors engaged by councils, to appreciate that CBA approaches are concerned with changes in the welfare of individual parties, such as local residents, business owners, tourists from outside the area and owners of state assets.

CBA is concerned with the question of whether such parties are made better off, or worse off by particular options, projects, etc. Where there is an overall net benefit or overall net cost identified through a CBA, analysts conclude that the option in question will be (or will not be) in the interests of the community as a whole.

CBA is not concerned with economic changes that may affect the structure and performance of a local economy as a whole, such as overall levels of employment, changes in household income, or direct and flow-on effects on the economic relationships between the sectors that make up the local economy.

Such flow-on effects are considered in economic transaction analyses such as regional economic input–output analysis, which allows for the estimation of economic multipliers which show flow-on effects. Councils interested in better understanding the effects of economic developments on the local LGA economy as a whole will need to use different economic assessment techniques from those involved in CBA. (See also Chapter 2.4 of the NSW Government Guidelines for Economic Appraisal.)

12.5 Timing

The time that particular costs and benefits occur under different management options should be properly specified. For example, the impacts of a planned retreat option do not necessarily occur in Year One; this option may be planned to take place over a 20 to 50-year timeframe. This option will requires specifying the costs of vacating and demolishing properties and relocating services over a number of years.

[2] Landry and Hindsley (2011) suggest that hedonic price studies can generally detect an influence of beach quality on house prices up to a distance of ~300 metres from the beach (*Land Economics* vol. 87(1)). However, this 300 metre limit is likely to be an artefact of the technique itself (related to the minimum effect size that is likely to be detectable through hedonic analysis), rather than an indication that environmental values are not capitalised in housing values throughout coastal regions more broadly.

12.6 Wrongly including, or mis-specifying financial impacts

As mentioned in the introduction to these guidelines, it is fundamental to recognise that a CBA is not the same as a financial analysis; a financial analysis will consider a different range of issues from a CBA, and treat certain issues in a different way. Before attributing costs and benefits, analysts need to be aware of certain financial matters that are not considered in a CBA, or need to be adapted before they can be used properly.

Financial concepts that should not be included, or should be adjusted, in a CBA include the following:

(i) Interest payments – interest payments should not be included in a CBA as this would lead to double counting. Discounting in a CBA implicitly reflects interest payments during the assessment timeframe as it reflects the opportunity cost of the option.
(ii) Residual value (RV) is the value of an option/project at the end of the assessment timeframe (or its economic life). In a CBA the RV of an asset at the end of its economic life is generally zero; however, where there is some continuing impact (a benefit or a cost), there may be a positive RV, or a liability. The RV should be the lower of (a) the replacement cost, or (b) the present value of the future stream of net benefits at the arbitrary earlier end of the project.
(iii) Depreciation is an accounting item that represents the decline in the value of an asset. Depreciation is excluded from a CBA because the cost of capital expenditure is allowed for by the discounting process.
(iv) Transfer payments should generally be excluded from a CBA as there is no net impact on society, because benefits are being transferred from one party to another. These impacts should, however, be reflected in any distributional impact assessment.
(v) Taxation can distort real resource costs from society's perspective (for example, tariffs on imported goods lead to higher than necessary prices for these goods). However, there are also certain taxes that attempt to internalise externalities and therefore may lead to prices more accurately reflecting real resource costs. Where appropriate, market prices should be adjusted to avoid allocating resources to projects where taxes are being applied, as the existence of a tax will distort the ‘real’ economic costs of the resources involved.
(vi) Sunk costs are costs that have been committed and cannot be recovered. These costs should not be included in a CBA because they have already been incurred and so should not affect new investment or policy decisions.

13 Conclusion

It is hoped that the above guidelines will help coastal councils and their consultants produce robust CBAs of alternative management options which show the relative costs and benefits of the options in question. This information can help councils to make informed choices about which management option (or options) will provide the greatest net benefits to their community.

As mentioned earlier in these guidelines, CBA is a decision-support tool which incorporates social, economic and environmental impacts. It is not a means of providing a definitive statement of which management option council should adopt. The decision on which option council should implement is likely to depend on a number of other considerations which are not addressed in a CBA. However, a well-constructed CBA can provide an important contribution to the stock of information council can use in its decision-making processes.

Appendix 1: Selected guidelines for planning and implementing CBAs

The material provided in these guidelines is consistent with the NSW Treasury and State Government guidelines for the preparation of economic appraisals and cost–benefit analyses, which establish the key principles public sector bodies should follow when conducting CBAs of infrastructure projects and proposed policy or management initiatives (see NSW Government Guidelines for Economic Appraisal, NSW Treasury 2007).

Other relevant NSW Government documents include:

- NSW Treasury (2007), '*Economic Appraisal Principles and Procedures Simplified*'
- NSW Treasury (2008), '*Guidelines for Capital Business Cases*', and
- NSW Department of Urban Affairs and Planning (2002), '*Guideline for economic effects and evaluation in EIA*'.

The Commonwealth Government also produces useful guidelines for carrying out CBAs, such as:

- Department of Finance (2006), *Introduction to Cost–Benefit Analysis and Alternative Evaluation Methodologies*
- Department of Finance (2006), *Handbook of Cost–Benefit Analysis*
- Office of Best Practice Regulation (2007), *Appendix B: Best Practice Regulation Handbook*, and
- Council of Australian Governments (2007), *Appendix C: Best Practice Regulation*
- Office of Best Practice Regulation (2014), *Cost–Benefit Analysis* webpage, www.dpmc.gov.au/office-best-practice-regulation/cost-benefit-analysis.

Other useful references include:

- UK Department of the Treasury (2002), *Appraisal and Evaluation in Central Government (The* Green Book), www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf
- National Competition Council website, www.ncc.gov.au.

Appendix 2: Monte Carlo modelling of uncertain coastal processes

Expected value of costs and benefits

Coastal hazards and processes have stochastic characteristics which need to be accounted for when estimating the costs (and benefits) of coastal management options. Cost–benefit analysis (CBA) incorporates risk (a situation with known probabilities) through the estimation of expected values for costs and benefits. That is, the probability of an event is multiplied by its dollar value to estimate its expected value.

The benefit of a management option involving a revetment is the risk mitigation or protection afforded to property and infrastructure that might otherwise be lost (i.e. the benefit is equal to the avoided cost). If the property will definitely be lost in the absence of risk mitigation (i.e. where there is a 100% chance of property loss), the avoided cost of property and infrastructure loss is equal to the value of the property/infrastructure.

However, coastal processes are inherently unpredictable, and the analyst needs to estimate the risk-adjusted cost by estimating the probability of loss, and from this, calculate the expected value of property and infrastructure loss.

For example, an analyst may determine that $20 million worth of property and infrastructure faces a 50 per cent chance of loss in 20 years' time. The expected value of property and infrastructure at risk at Year 20 is $10 million. Therefore, assuming a 20-year timeframe for the analysis, the protective benefit of a seawall is equivalent to $2.3 million in today's dollars.

Estimating risk probabilities

Reviews of coastal hazard assessment studies in NSW show that it is uncommon for existing coastal erosion hazard lines to be expressed probabilistically. Rather, 50-year and 100-year hazard lines usually represent 'best-estimate' predictions, which might be interpreted as a conservative average prediction. Best-estimate hazard lines are not suitable for application in CBA because the likelihood that the line will be exceeded within the planning period is lost in the expert judgement used to derive the prediction.

Some hazard line approaches do consider and communicate uncertainty in predictions of future coastline change through the use of uncertainty envelopes (e.g. lower, average and upper predictions) and qualitative likelihoods (e.g. almost certain, unlikely and rare predictions). However, such approaches do not quantify the probability of coastline change at a future point in time, and so are not appropriate for use in a CBA.

It is up to the analyst to decide which approach they wish to use to estimate the probability of coastline change; however, Monte Carlo simulation provides one means of considering the uncertainty in each factor contributing to coastline change, and provides a calculated prediction of coastline change in terms of the probability of exceedance, i.e. the coastline position that has a 50 per cent (or 10 per cent, etc.) probability of being exceeded in the year 2050 (or 2100, etc.). Rather than selecting single values for each contributing factor, inputs are randomly sampled from predefined probability distributions through an iterative procedure that generates a probability distribution of the output (i.e. coastline change)[3].

[3] Further information on Monte Carlo simulations and other means of estimating probabilities is available in the coastal management manual.

Appendix 3: Non-market valuation and benefit transfer

As noted above, the costs and benefits associated with different management options include both direct impacts, and positive and negative impacts on third parties (externalities).

Many of the goods and services which deliver costs and benefits can be readily expressed in market prices such as dollars per tonne, changes in house prices, etc. Other goods and services do not have such immediately obvious market prices (e.g. the value of a trip to the beach or the value of attractive coastal vistas). Lack of observable market prices for these 'non-market' goods and services creates a potential area of difficulty for analysts carrying out CBAs, who may need to find ways to identify surrogate or proxy market prices for these non-market goods and services so they can be compared with goods and services with market prices on a common basis.

A large number of studies of varying quality provide estimates of the value of many types of non-market goods and services; however, such studies may not precisely relate the particular location or the type of goods or services in question. Analysts have limited options for identifying non-market values in CBAs where reliable information is not available. These options include carrying out specific data collection and analysis exercises, adapting results from similar studies, or describing non-market values in qualitative terms in the CBA. A pragmatic approach for obtaining estimates of non-market values is to use a benefit transfer approach as described in point (iv) below.

Approaches for estimating non-market values in CBAs are considered below.

The main approaches for estimating non-market values are:

(i) 'market-based' approaches
(ii) revealed preference approaches
(iii) stated preference approaches, and
(iv) benefit transfer.

CBA of coastal management options often involves trade-offs between market goods (like property and infrastructure) and non-market goods (like beach amenity), so the way in which values for non-market goods are incorporated into CBA can influence the relative performance of different management options.

Analyses that exclude or use over-conservative estimates of non-market goods and services will bias decision-making towards the protection of property and infrastructure and other market-based goods and services. Analyses that over-estimate the value of non-market goods and services will bias decision-marking towards the protection of non-market values, and where expected non-market benefits are not realised, may lead to sub-optimal outcomes.

Given the importance of including realistic non-market values, and the potential difficulties associated with estimating them, it is necessary to consider on a case by case basis, whether the inclusion of such values in the analysis is likely to fundamentally alter the ranking of different management options. Ideally the influence of non-market values on the ranking of management options should be determined through a sensitivity analysis that incorporates non-market value parameters across a reasonable range.

Results of such a sensitivity analysis should be used to determine whether more accurate estimates of non-market goods might need to be collected through more intensive primary data collection methods (i.e. methods (i) to (iii) below).

(i) Market-based approaches

Some non-market goods and services may not have obvious market prices for the simple reason that they have never been traded, or fully traded, in markets. Temporary or partial market trades can indicate prices at which suppliers are willing to provide the goods and services and consumers are willing to pay to obtain them. Such temporary or partial markets can provide information to analysts about the value of the commodity to the different parties, and act as an (albeit partial) indication of the economic value of the non-market good or service.

Non-market values can also be estimated by considering the contribution of the non-market good or service to the production of a commodity that does have a market price. For example, apiarists will pay private native forest owners to manage forests used by local bee populations to produce honey, which apiarists then sell. The value of the forests (to apiarists) can be seen as the costs that apiarists are willing to pay to receive the services provided by the forests.

Another market-based method for estimating prices for non-market goods and services is to consider their contribution to the production of goods and services which do have market prices, via an avoided cost approach. This approach would involve estimating what it would cost a producer to obtain the benefit which the non-market good provides to their production activity using different (market-priced) goods and services.

For example, if a water supply authority was not able to obtain already high quality fresh water from a protected catchment, what cost would they incur in obtaining high quality water supplies through other means, for example by water filtration technology?. The savings from using high quality water from a protected catchment instead of from an alternative source represents a proxy value for the catchment management activity.

Similarly, in some locations, mangrove areas can provide coastal erosion protection at a lower cost than structural measures. The difference in cost between these approaches can represent a proxy market value for the coastal erosion functions of the mangrove areas. The above market-based approaches are shown in Table A3.1.

Where market-based approaches are not appropriate, analysts may use two types of approaches: observing the amounts people are willing to spend to obtain a particular non-market good or service (a 'revealed preference' approach), or asking people what they are willing to spend to obtain a particular outcome (a 'stated preference' approach). These approaches are discussed below).

Table A3.1: Market-based valuation techniques

Valuation technique	Purpose
Market price	
Estimation of market price	Identify actual value of environmental goods/services and estimate private costs/benefits
Estimation of contribution to production	Identify actual value of environmental goods/services as inputs, and estimate value of private costs/benefits
Estimation of avoided costs of replacement/damage avoidance	Estimate costs of alternative sources of services normally provided by natural environments or costs/benefits of protecting environmental goods/service

(ii) Revealed preference methods

Revealed preference approaches use observation of purchasing decisions and other behaviour to estimate surrogate market prices for non-market goods and services. The following approaches are commonly used:

- The travel-cost method – uses recreation expenditure (and travel time) as a proxy for the value people place on visiting a specific site, such as a national park.
- The hedonic pricing method – attempts to isolate the influence of non-market attributes such as proximity to a park or an ocean view, on the price of goods (such as houses).

Revealed preference methods can produce valid non-market value estimates if properly designed and implemented; however, as these methods are based on actual observed behaviour and expenditure, by definition they can only be used to estimate expenditure that has been, or is being, incurred to obtain the benefits of a non-market good or service (e.g. actual costs incurred by visitors in travelling to a national park to obtain recreational experiences) (see Table A3.2).

Revealed preference methods cannot be used to estimate the value of non-market goods and services which do not involve personal use (such as an individual's willingness to pay to ensure that threatened species are protected 'in their own right' for perpetuity). Such goods and services possess 'non-use' values.

In these situations an individual may express an intention to pay and to allocate part of their income to obtain the associated benefits, but no actual expenditure has been incurred, and no expenditure preferences have been exhibited in practice which can be used as surrogate market prices. Stated preference approaches are applicable for estimating such non-use values.

Table A3.2: Revealed preference techniques

Valuation technique	Purpose
Revealed preference	
Travel-cost method	Estimates value of benefits resulting from recreational experiences in natural environments (e.g. beaches, parks)
Hedonic pricing	Reveals preferences of individuals for particular environmental attributes, based on their behaviour

(iii) Stated preference methods

As noted above, stated preference approaches are based on asking people what they are willing to spend to obtain a particular outcome. Popular stated preference approaches are contingent valuation and choice modelling, which are based on surveys seeking to elicit the respondents' willingness to pay to obtain certain hypothetical outcomes from a range of different policy options with different attributes.

There are many different elements that practitioners need to take into account in designing and implementing stated preference surveys to produce defensible results, including:

- The proposals being considered in the survey have to be understood and believable to respondents; many researchers use a visual representation of the proposals under consideration and any associated outcomes (like beach width and water quality) to assist in this.
- The funding vehicle (the way survey respondents are expected to pay for the proposal in question) must be clearly identified and must be plausible (e.g. through a special levy).
- Respondents must be carefully selected to be an unbiased sample of the population of interest. Large sample sizes (around 500 for contingent valuation and over 1000 for choice modelling are usually required). It is necessary to collect data from respondents on variables that may affect their responses, such as age, gender, education, occupation, income, attitudes to environment, distance from site, country/city place of residence, and other possible influences. These variables allow survey respondents to be scaled to the relevant population.

It is crucial that surveys provide clear and specific information about the environmental outcomes that people are being asked to value. Outcomes should be expressed in terms of endpoints that people directly value and should align with the expected outcomes of the options being considered. People will often answer survey questions even if they do not understand or approve of the questions and so there is an important role for follow-up questions that can be used to filter out unreliable responses.

The familiarity of respondents with the environmental issue in question can influence how well they respond to even well-designed preference surveys. For example, people who are visiting a national park and are surveyed on-site about their willingness to pay to visit the park, are likely to provide well-informed answers, based on their knowledge and feelings about the park, and possibly also their knowledge about substitute sites they might prefer if the cost of visiting changed.

In contrast, when people are asked about locations that are relatively unfamiliar to them (and which they may never visit) they rely more on the information presented to them and may have to construct their preferences during the survey.

Two conclusions follow from this. Firstly, survey design, including the information provided to respondents and techniques for eliminating unreliable answers, is of particular importance when valuing less familiar (or more complex) outcomes. Secondly, value estimates may be less accurate for unfamiliar outcomes, even with careful attention to survey design.

Such problems are more likely to occur in the case of non-use values, and so stated preference methods may be less effective in estimating this type of value (in common with market-based and revealed preference methods). However, there are expert consultant groups (often specialised academic groups) who can do this work on behalf of councils. Stated preference techniques are shown in Table A3.3.

Table A3.3: Stated preference techniques

Valuation technique	Purpose
Stated preference	
Contingent valuation	Determine individual's hypothetical valuation of environmental goods/services
Choice modelling	Determine individual's hypothetical valuation of specific environmental attributes

(iv) Benefit transfer

When good quality primary data is not available (as unfortunately is likely to be the case for estimating non-market values and associated costs and benefits for coastal management options), benefit transfer may be worth considering.

Benefit transfer operates by transferring values in some way from existing valuation studies to a target study. The values can be transferred as a single value, or the results of several studies can be combined to generate a pooled estimate. Transferring value estimates from one site to another is not likely to have the same precision as using the other forms of non-market valuation mentioned above.

It is crucial to note that simply transferring unadjusted estimates from one location to another is not advisable, as the similarity between the two areas, and the willingness of consumers to pay for the non-market goods and services in question, can vary in a number of ways. For example:

- the physical characteristics of the two locations
- the socio-economic characteristics of their relevant populations

- the institutional/administrative setting
- the likely change in the value of the non-market good between the two different situations
- the structure of the local economy
- the market conditions applying to the different locations (e.g. supply and demand for the non-market good and variation in availability of substitutes).

It is more reliable to adjust the estimated non-market values for the original location to better suit the new location by using expert judgement, re-analysing existing study samples to identify sub-samples of data suitable for transfer, or looking at any meta-analyses of previous estimates to give high level indicative estimates for the new location.

A shortage of suitable primary studies in Australia suggests that even though benefit transfer can only reliably be used in a limited range of circumstances, it is likely to be the most pragmatic approach for most situations. Some examples of estimates used to approximate non-market values for coastal erosion CBAs which could be used as the basis for benefit transfer will be provided in a table below as new coastal CBAs are carried out. (However as already noted, transfer of such studies will need to take into account the caveats mentioned above).

Table A3.4: Nonmarket values to use in benefit transfer in the coastal erosion CBAs

Study	Method	Estimates
Raybould & Lazarow, Economic and social values of beach recreation on the Gold Coast	Travel–cost method	GC residents spent travel costs between $64 per adult and $270 per adult accessing the beach in 2007; GC day visitors spent travel costs of $15 to $45.
Pitt, M 1993, The Contingent Value of Maintaining Natural Vegetation on Beach Dunes, Paper presented at the 37th Annual Conference of the Australian Agricultural Economics Society, Sydney, Australia, February 1993.	Contingent valuation	Expressed in $2011 (ABS 2012): $83.23 per household.
URS Travel cost study – Assessing the value of the Victorian Coastline, August 2007	Travel-cost method	Min. $43, average $48, max. $54 per visitor per day, expressed in $2007.
Quantifying the Value of Sydney's Beaches, Coastal recreation (beaches), Sydney Coastal Councils Group	Hedonic pricing , travel–cost method, contingent valuation	HP: an environmental premium associated with beachfront properties of around 40%, relative to an otherwise identical property immediately landward of the first row; TC: Travel costs associated with daytrip recreation are around $6 per person per day, with additional onsite expenditure of around $5; CV: Approximately half of all respondents would give in principle support to the development of a beach management fund to prevent erosion impacts (at the beach where they were surveyed), with a further 20% of respondents willing to consider donating if the fund was dedicated to their 'home' beach.
Is Choice Modelling Really Necessary? Public versus Expert Values for Marine Reserves in Western Australia, 2009	Choice modelling	Annual WTP value for the public range from AUD$26 to AUD$108 per household per year ($2009) as estimates of benefits provided by marine parks.
Beach and Surf Tourism and Recreation in Australia: Vulnerability and Adaptation (BASTRA) Raybould, Anning 2013	Travel–cost method	This study estimated the consumer surplus for resident beach visits in the Clarence Valley Shire of NSW. Fuel only model $6.10; fuel only plus time @ 40% of hourly rate $9.30, expressed in $2013. Consumer surplus per adult per visit resident beach visits. This assessment takes the lower estimate by not including the opportunity cost of travel time, employing the lower consumer surplus (CS) for estimate of $6.10 in calculations.

Appendix 4: Template of socio-economic characteristics

A socio-economic profile should be prepared in the early stages of a CBA to help scope the likely costs and benefits to the local community. In preparing a socio-economic profile, the analyst may choose to use Table A4.1 below as a template. Additional information should be collected on a case-by-case basis, and should address the particular aspects of the community being reviewed.

Table A4.1: Socio-economic indicators (by LGA, local region, state)

Demographic factors	• Population • Age • Family composition • Migration • Retiree population • Place of work • Place of residence
Education	• School retention • Qualifications • Skills
Relative (dis)advantage	• SEIFA index • Cost of living

Residential infrastructure	• Number and value of housing
	    ○ Current and proposed
	• Housing ownership
	    ○ Rentals
	    ○ Absentee investors
	    ○ Local residents
	• Other

Labour force	• Full and part-time employment • Unemployment • Under-employment • Participation rate • Occupation
Income	• Wages • Business profitability
Industry structure	• Employment • Gross value • Location quotients • Number of businesses that depend on beach activities

Appendix 5: Valuing assets under the business as usual case and alternative management options

The valuation of assets should reflect sound economic principles. The basic principles described in Table A5.1 should be considered as a default when valuing various asset types. Alternative approaches can be utilised where considered more appropriate.

Table A5.1: Valuation approach by asset type

Asset	Approach
Private property	Values of properties should reflect current market value where available. Additional details relating to valuation of different types of private property are provided in Table A5.2
Built infrastructure: • roads • utilities (electricity, water and sewerage) • buildings	Replacement cost values should be utilised. Note that replacement costs may only provide a minimum value. For example, a road lost due to erosion may require rebuilding in a different location involving higher costs than estimated using the replacement cost approach.
Non-built assets: • parks • beaches • other environmental assets	See Appendix 3: Non-market valuation and benefit transfer.
Biodiversity	Where applicable: The Office of Environment and Heritage is developing a biodiversity credits calculator to estimate the loss of biodiversity due to development. When completed this tool will offer an alternative approach to estimating the value of lost biodiversity.

Valuing private property

The value of private property impacts arising from erosion is dependent on a number of factors, including:

- whether the property in question is unimproved (undeveloped land) or improved (has dwellings or other structures)
- whether the property is an owner-occupied residential property, a rental property[4], or other commercial property
- whether or not dwellings or other structures on the land are relocatable.

Suggested treatment of private property impacts that accounts for each of these factors is provided in Table A5.2.

[4] Information on owner-occupied vs. rental properties is available at a fine spatial scale (Statistical Area 1) from ABS census data.

Table A5.2: Accounting for loss of different types of private property

Property type	Suggested treatment
Unimproved land	Valuer General's land value for the relevant or similar parcel. Only the proportion eroded or inundated should be considered a loss.
Improved residential, owner-occupied	Market price for the relevant or similar parcel. Where property-specific market data is not available, an alternative approach is to use the latest NSW Valuer General's land values and apply an uplift factor to account for the additional value of a house on the land. The uplift factor can be estimated by decomposing most recent sales data (from surrounding areas) into land and house components. The entire value should be considered to be lost if erosion or inundation affects the dwelling. Impacts on land where the dwelling is unaffected should be valued as for unimproved land. Personal and social impacts are also likely to be relevant.
Improved residential, rental	No economic loss. Any loss of rent at affected properties is likely to be offset by lower vacancy rates and/or higher rental prices at other properties in the LGA.
Improved commercial	Loss of commercial value in proportion to expected loss of beach access or visitation (see Appendix 3) and/or business relocation costs that include possible rental increase in association with reduced property supply.
Relocatable dwelling	Relocation costs plus the loss of land value moving from a waterfront property to a lot of similar size with average value for the relevant LGA.

For unimproved or residential properties (except relocatable dwellings) it may be relevant to include potential changes in house and land values in response to risk; however, the analyst faces significant challenges estimating the extent to which risk has been capitalised into property values. In some cases (like Old Bar), it is evident from declining house prices that risk has been capitalised; although the extent to which it has been capitalised is unknown. In other cases (like Collaroy–Narrabeen and Belongil beaches) it appears that risk has not yet been capitalised into house prices. In the face of these challenges, without strong evidence of risk-capitalisation, it is recommended that the analyst utilise current market prices with no risk-adjustment.

Appendix 6: Valuing recreation impacts

For local residents whose properties are likely to be directly impacted by coastal erosion, recreational beach values are considered to be capitalised in property values. This is because hedonic pricing techniques can generally detect an impact of beach proximity on house prices for houses located within 300 metres of the coast (Landry & Hindsley 2011)[5].

For local residents whose properties are unlikely to be impacted by coastal erosion, and who live more than 300 metres from the beach, we consider that recreational beach values are still likely to be capitalised in house prices to some degree; the 300 metre limit identified in hedonic pricing studies is likely to be an artefact arising from the statistical limitations of hedonic analysis techniques, rather than a definitive cut-off point beyond which beach values do not impact house prices.

Moreover, even if recreation values are not capitalised in house prices for residents who live more than 300 metres from the beach, we consider that most will respond to coastal erosion at a specific site they previously used for recreation by substituting an alternative site within the LGA. Any associated increase in travel cost is likely to be relatively small, and represents a transfer to other members of the community.

Given the above, explicit accounting for recreational value of residents is likely to represent double counting (see Section 12.2). For this reason, the discussion below relates only to valuation of <u>tourist</u> recreation impacts.

Note that in accounting for the recreation values obtained by tourists, only the portion of tourist expenditure that is producer surplus should be included, as this is the appropriate measure of value to the relevant LGA. In the absence of more specific data (e.g. itemised expenditure data) expenditure can be converted to producer surplus using a conversion factor of 0.3 (i.e. only 30 per cent of total expenditure is considered producer surplus; the remainder is the cost of producing goods and services).

The impact of erosion or inundation on beach access

Where coastal erosion or inundation restrict access to a specific beach site, it is necessary to consider how recreational users are likely to respond; are they likely to cancel their outing completely or will they move to an alternative beach site? A study undertaken in the NSW Clarence Valley[6] reports that when confronted with a major erosion event:

- six per cent of tourists are unconcerned and remain at the eroded site
- 17 per cent of tourists cancel their beach activity
- 78 per cent of tourists are willing to go elsewhere.

Research suggests that tourists in different areas are willing to travel different distances to avoid erosion[7]. This should be considered when determining the portion of tourism that would be lost from an LGA if erosion were to limit recreational opportunities at specific sites.

Suggested treatment of recreation impacts that accounts for these different behavioural responses is provided in Table A6.1.

---

[5] Landry, CE & Hindsley, P 2011, 'Valuing beach quality with hedonic property models', *Land Economics* 87(1), 92–108.

[6] Raybould, M, Anning, D, Ware, D & Lazarow, N 2013, *Beach and surf tourism and recreation in Australia: Vulnerability and adaptation*, FRDC 2010/536, Fisheries Research and Development Corporation.

[7] ibid.

Table A6.1: Accounting for recreational losses based on likely tourist responses

Behavioural response	Suggested treatment
Remain at the impacted site	No economic impact
Cancel beach activity	Loss of expenditure
Go elsewhere	Increased travel cost to alternative beach site (assumed negligible if neighbouring beaches appear to offer equivalent experiences)

The beach substitution rate of 78 per cent provided in the above-mentioned Clarence Valley study is considered suitable for benefit transfer for CBAs relating to other NSW locations, and should be used to estimate recreation impacts unless there is a good reason to vary it. Such reasons might include:

- a more relevant local study
- intensive use of the affected beach by specific user groups (like surfers or divers) that consider it to be unique or unparalleled by other beaches within the LGA (either in general or under certain weather or surf break conditions)
- commercial services that are provided at the site that may not be transferred to another site (e.g. commercial kayaking or learn-to-surf schools where appropriate conditions are not available at other sites; shops, cafes, restaurants are not as conveniently located)
- crowding and/or parking have been identified as major issues that are likely to limit use of alternative beaches within the LGA.

The impact of erosion or inundation on other beach attributes

In addition to beach proximity and accessibility, a range of other considerations can influence tourists' selections of beach sites. These include factors like amenity, water quality, safety and seclusion (or avoidance of crowding). Given that coastal erosion and associated mitigation measures can impact beach width and other amenity values, turbidity and associated water clarity, and local surf break conditions, particular effort should be made to estimate visitation impacts that might arise as a result of changes to one or more of these attributes.

As there is no explicit market for amenity and the other factors listed above, estimating their value for the purposes of CBA will require use of stated preference techniques (see Appendix 3). Ideally this should target the preferences of those tourists who currently visit the relevant LGA, so that any change in their likely visitation rates can be estimated as a real marginal change in expenditure.

Appendix 7: Treatment of council rates and state land taxes

Analysts may wish to include the financial effects of council rates and state land taxes in the cost–benefit analysis (CBA); however, the validity of doing this will depend on the assumptions underpinning the analysis.

(i) Council rates

Certain management options may result in the apparent loss of rates revenue by councils, for example when a property is vacated under the base case option. In these situations the council might well assume that the loss of rates constitutes a cost; however, as the CBA is based on costs and benefits relating to the LGA community, whether this assumption is correct or not will depend on a number of factors, as outlined below.

In essence, two scenarios can be considered:

1. The home owner is forced to vacate their property (due to coastal erosion) and leaves the LGA, or
2. the home owner is forced to vacate their property, but continues to live in the LGA through:
   (a) purchasing a new property, or
   (b) purchasing a second-hand property, or
   (c) renting accommodation.

Under Scenario 1, council would experience an absolute reduction in rates revenue; however, this reduction would be offset by reduced service provision costs (e.g. council services, infrastructure maintenance), because the stock of rateable properties has now declined. This is shown in Table A7.1.

Table A7.1: Rates-related impacts of Scenario 1; home owners leave the LGA

Scenario 1	Council	At-risk property owner[1]
	Reduced rates revenue	Reduced rates payment (not considered as part of the CBA)
	Reduced costs of council services provision	
Net effect	No change/marginal change in council financial position	

Key:

1. The property owner leaves the LGA and so is outside the scope of the CBA

Under Scenario 2, further assumptions will need to be made to address those circumstances where the former property owner purchases a new property, purchases a second-hand property, or rents accommodation in the LGA. The anticipated effect of these additional assumptions is shown in Table A7.2.

Table A7.2: Rates-related impacts of Scenario 2; home owner vacates original property but stays in the LGA

Scenario 2	Council	At-risk property owner
• New property purchase	No change in rates revenue	No change in rates payable
	No change in costs of council services provision	
Net effect	No/marginal change in council rates revenue. Property owner's rate payments remain unchanged (or marginal change)	
• Second-hand property purchase	Reduced rates revenue	No change in rates payable
	Reduced costs of council services provision	
Net effect	No/marginal change in council rates revenue. Property owner's rate payments remain unchanged (or marginal change)	
• Rent accommodation	Reduced rates revenue	Reduced rates payment[1]
	Reduced costs of council services provision	
Net effect	No (or marginal) change in council financial position. Former at-risk property owners may or may not be marginally better off (with respect to rates payments)	
Total net effect	There is likely to be no (or marginally positive) net impact[2]	

Key:

1. Reduced rates payment is offset to the extent that rental payments cover rates payments for investor-owner. This is dependent on rental return and extent of negative gearing by investor-owner.
2. The total effect is dependent on assumptions concerning the proportion of at-risk home owners that purchase new versus second-hand properties and the proportion choosing to rent accommodation.

For completeness, the above analysis should also be carried out to consider the potential impacts that would occur if at-risk properties are owned by investor-owners or absentee owners.

Finally, the above analyses need to take into account the net marginal impact compared to the base case option. The marginal impact is subject to assumptions around how the base case will unfold, and whether residents will leave the LGA or not.

Quantifying the net rates-related impact is likely to be data intensive. Therefore, given the marginal anticipated effect, it is considered acceptable for the analyst to take a qualitative approach and to describe rates-related impacts. Underlying assumptions should be clearly spelled out by the analyst.

(ii) Land taxes

Land taxes are paid to a party (i.e. the state government) outside the scope of the CBA. Therefore, benefits or costs to the state government are not included in the CBA. To the extent that land taxes are not paid due to land being lost to erosion, a benefit is obtained by land owners. Only benefits to land owners living within the LGA are to be included in the analysis. Absentee owners (investor or otherwise) are considered to be outside the scope of the analysis, and any benefits accruing to them are not included in the CBA.