

Methodology to value the natural and environmental resources of the City of Cape Town

FINAL REPORT

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Executive summary

The City of Cape Town is endowed with a relatively high amount of natural assets as found in natural biota, the water environment and the atmosphere. These assets yield a flow of ecosystem goods and services that supports municipal service delivery and enhances the wellbeing of all the City's inhabitants.

The broader economic value of the natural assets and the goods and services these assets generate for the City of Cape Town is poorly understood and therefore largely ignored in decision-making and management processes. The real value of these ecosystem services is not acknowledged in the City's accounting systems and, therefore, not reflected in the City's budgets for improved management and expansion of natural assets. Also, very little recognition is given to the real cost of environmental degradation, including the direct costs, replacement costs and the opportunity costs.

The broad objectives of this project are to develop a coherent natural resource economics model and methodology for the City of Cape Town that can be used to guide the generation of a business case for the environment. The focus of the overall project is to influence budget allocations by developing focused economic arguments for investing, maintaining and expanding the City's natural assets.

The six generic steps proposed in this report to prepare a valuation study on EGS in a city context are:

1. Assess the relative importance of different natural assets for the generation of EGS
2. Estimate the importance of EGS to users/beneficiaries
3. Establish the links between EGS and development objectives
4. Assess the ability of the City to influence the value of EGS through management
5. Assess the ability of ecosystems to yield a sustainable flow of EGS and prioritise according to risks.
6. Apply valuation techniques to selected case studies

A short discussion on each of these steps follows.

First, it is important to distinguish between two related concepts, namely natural assets and ecosystem goods and services (EGS). Natural assets are the stocks of environmental resources owned by the City (the City's natural capital). Ecosystem goods and services (EGS) are the flows of benefits derived from these assets (the interest or services generated by the capital). Following the Millennium Ecosystem

Assessment (2005) four categories of ecosystems goods and services are distinguished:

- **Supporting services** are those services necessary for the production of all other ecosystem services, such as soil formation, photosynthesis, primary production, nutrient cycling and water cycling. These are intermediate services which form the basis for provisioning, regulating and cultural services and, as such, are seldom valued separately.
- **Provisioning services** relate to the products derived from ecosystems, including food, fiber and fuel, genetic resources, medicines and pharmaceuticals.
- **Regulating services** include benefits derived from the regulation of ecosystem processes, such as air quality relation, climate regulation, water regulation, erosion regulation, disease regulation, pest regulation and natural hazard regulation.
- **Cultural services** are the benefits people obtain from ecosystems such as reflection, recreation, inspiration and aesthetic enjoyment. It includes cultural diversity and educational values.

Second, these ecosystem goods and services provide benefits to several different groups of people. To perform an effective economic valuation on the supply of these ecosystems goods and services, a vital step is to quantify the number of and type of beneficiaries. High-level distinctions were first made between 'local users' and 'regional, national and international users'. Among the local users, further distinctions were made among 'residents', 'key commercial groups' and 'key public bodies' and were sub-divided as follows:

Classified under 'residents' are:

- Recreational and sporting groups
- Harvesters, fishers and subsistence producers
- Educational groups
- Cultural and religious groups
- Property owners
- Low-income residents (to indicate particularly high levels of dependency)

Classified under 'key commercial groups' are:

- Tourism and recreation
- Film, advertising and events
- Arts and crafts
- Real estate
- Construction and manufacturing
- Urban agriculture
- Fishing (including shellfish)

Classified under 'key public bodies' are:

- Economic development
- Health and welfare
- Disaster management
- Water quality and provision
- Waste management
- Conservation bodies (e.g. SANParks and CapeNature).

Most significantly, however, is that this classification is based on the user groups identified as being relevant to the City line functions themselves, which signals appreciation for the fact that ecosystems goods and services do have a tangible value to the City's inhabitants. For any given EGS, the number of users and estimates of the value of the EGS to those users are critical considerations. These will determine the anticipated level of importance of EGS in absolute terms and relative to other services which, in turn, should guide the focus of valuation work.

Third, although awareness is growing with regard to the broad links between natural assets and economic development outcomes, there is a need to better understand and spell out these links when considering the value of natural assets. The Integrated Development Plan (IDP) is recognised as the key development plan for the City and for an argument on the value of EGS to be accepted, the links with strategic development objectives as included in the IDP, is a vital.

Fourth, another factor for valuation studies to make an impact is the mandate and level of control the City has over the natural assets. Some assets and flows may i) be almost completely under the control of the City, ii) be shared with other institutions and groups, or iii) fall completely outside of the City's control. The assets and flows completely outside of the City's control will generally be less important when motivating for an increased allocation of financial resources. The City has a well-defined mandate on service delivery, but its' environmental mandate is still unclear. The City is currently reviewing its environmental mandate which will most probably have an influence on where funds will be allocated and what organisations the City will partner with in the fulfillment of their mandate.

Fifth, experience shows that one cannot necessarily rely on natural assets to provide sustained flows of EGS and the economic values associated with them. Certain environments are likely to be more vulnerable to habitat loss and degradation implying that they face greater ecological risks. These are the environments where thresholds are important and exceeding these would have particularly onerous consequences in both ecological and socio-economic terms. The natural assets that

could be on the brink of disaster and those that have a higher impact need to be given priority in assessment and allocation of resources.

Sixth, once the key EGS have been prioritised using the preceding steps in the methodology, further assessment using economic valuation techniques can be done. Such valuation studies should focus not only on the benefits of preserving or maintaining natural assets and flows, but also on the reduced costs (or savings) of mitigation flowing from a more pro-active management of the City’s natural assets and EGS. For example, if a wetland is not properly managed and loses its functions, the costs of alternative technologies to (partially) substitute such functions can be substantial. It must further be noted that the opportunity cost of losing natural assets and flows may appear incrementally small at first, but will generally increase exponentially with increased scarcity. Aside from the restrictions of the available adequate budget, there are two important considerations when selecting a valuation technique. The first relates to the availability of data and the selection of an appropriate framework. The second relates to which is the most appropriate technique considering the data and in a given context. It is often necessary to use a combination of valuation techniques rather than a single technique to value environmental benefits. Some techniques lend themselves more readily for use in combination with other techniques.

A valuation study done for the Zandvlei area as part of a wider City-funded study on the value of open space areas was chosen as the ideal case study to apply this methodology. This case study offers the chance to consider a number of benefit streams from a well-defined natural asset, using a variety of valuation techniques. Ecosystem goods and services and chosen valuation techniques for Zandvlei are as follows:

	Ecosystem services	Valuation techniques
Regulating	Water regulation	Replacement cost, preventative costs, costs of disaster or system failure
	Natural hazard regulation (floods, etc.)	
	Water purification and waste treatment, assimilation	
	Space for biota to live and reproduce (refugia)	
Cultural (information)	Recreation and tourism	Travel cost, property price/hedonics. contingent valuation and choice experiments
	Provision of inspirational beauty	
	Aesthetic values and sense of place	
	Educational issues (e.g. school excursions, scientific research)	
	Use in cultural and artistic practices and ceremonies	
	Use in religious practices and ceremonies	
	Use in productions (film and events), advertising and publications	

Provisioning	Wild flowers for harvesting	Effects on production, cost of alternative sources
	Provision of materials for craft, fashion (e.g. shells)	
	Fish and marine resources	

The results of this Zandvlei case study shows that the vlei is a source of significant benefits for a wide variety of users. Note, from a technical perspective, that the property value, travel cost and contingent valuation techniques had areas of overlap that would need to be accounted for in an overall estimate of value. Although management issues are not summarised here, it should also be noted that the case study found clear links between values and management, water quality and security levels. Specific values are summarised as follows:

Valuation technique	Estimated value (2000)	Annual value (2000)
Property value technique	R84 million	+/- R6 million
Travel cost	R10 million	R700 000
Contingent valuation	R9 million	R640 000
Replacement cost	R24 million–R180 million	R2 million–R15 million

Zandvlei is only one small case study used as a way to demonstrate how the proposed valuation methodology could be applied. A presentation on the methodology and case study set the stage for a prioritisation of EGS in the City in a participatory and facilitated setting with invited City line function managers and senior staff representing all functions related to ecosystem goods and services in the City. This included those involved in the management of environmental resources, parks, tourism, heritage, sports and recreation, wastewater, stormwater, solid waste and spatial planning. A participatory rapid appraisal approach was followed. Four focus groups were randomly identified with 4–6 people in each group. Participants were asked to identify and shortly motivate what, in their view, the most important linkages are between all identified EGS in the City and:

- beneficiaries
- the achievement of development objectives
- the City's environmental mandate and ability to influence and
- ecological and socio-economic risks.

The focus group discussions were limited to 15 minutes per topic after which focus groups reported back to others. The report back was summarised for the benefit of the entire group and used as an input to further off-line analysis and ranking.

The five services that were ranked with highest relative importance for valuation are as follows:

- Natural hazard regulation: Buffering ecosystems (e.g. reefs, kelp can reduce the impact of storms and large waves, managing natural areas for invasive aliens reduces risk of fires)
- Recreation and Tourism: People often choose sites based on the natural or cultivated characteristics of an area
- Water purification and waste treatment, assimilation: Ecosystems can cause impurities but also help filter out and decompose organic wastes
- Space for biota: Regulation of habitat and space
- Aesthetic values and sense of place: Aesthetic values are reflected in support for parks, scenic drives and housing locations

In the next phase of the project these selected ecosystem goods and services are valued to provide a credible argument to invest in and maintain natural assets in the City.

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1 Introduction

The City of Cape Town (CCT) administers a 2 500 km² area that is rich in biodiversity, ecosystems, landscapes and coastal environments. However, as a developing city Cape Town also faces many social and economic development challenges. As a result, priority is placed on increasing and promoting development in an effort to build the economy. This development focus often occurs at the cost of the natural environment.

Environmental concerns are often viewed as an obstacle to growth and development. This implies a preference for human-created basic services as opposed to natural services which are often of higher quality. This polarised thinking on the economy–environment interaction negates that a healthy environment provides a sustained flow of ecosystem goods and services that have important socio-economic benefits as well (Millennium Ecosystem Assessment 2005).

The broader economic value of the natural assets and the goods and services these assets generate for the City of Cape Town is poorly understood and largely ignored as part of decision-making and management processes. Currently these direct and indirect economic services are provided for without any real commensurate investment in the City's environmental resources. The real value of these ecosystem services is not acknowledged in accounting systems and, therefore, not in the City's budgets for improved management and expansion of natural assets. Also, very little recognition is given to the real cost of environmental degradation, including the direct costs, replacement costs and the opportunity costs.

The broad objectives of this project are to develop a coherent natural resource economics model and methodology for the City of Cape Town that can be used to guide the generation of a business case for the environment. The focus of the overall project is to influence budget allocations by developing focused economic arguments for investing, maintaining and expanding the City's natural assets.

As such, the overall study is constructed according to the following phases:

- **Phase one:** International review of valuation techniques and their applicability, pros, cons and data requirements
- **Phase two:** Consultation with City line functions in order to better understand the ecosystem goods and services found in the City, using a participatory approach
- **Phase three:** Development of a methodology to value the natural resource base of the City of Cape Town

- **Phase four:** Pilot valuation to demonstrate and test the valuation methodology
- **Phase Five:** Development of the business case

This report builds on Phases one and two and meets the requirements of Phases three and four which are focused on the development of a methodology to value the natural resource base of the City of Cape Town using a pilot case study as an example.¹

The development of a methodology is important as this allows for a clear and logically repeatable framework for the valuation and the building of a business case. At the heart of the methodology is the need to prioritise assessment in order to optimise on both the return and the risks of using the City's natural resources.

This report is organised as follows: in section 2 the overall approach to methodology development is discussed, including main definitions used and an overview of EGS and beneficiaries in the City. Section 3 reports on key considerations in the development of a methodology to value the natural and environmental resources of the City of Cape Town. In section 4 a six-step valuation methodology is proposed and in section 5 this methodology is applied to a City specific case study. Section 6 reports on how EGS were prioritised for further valuation in support of the business case. Section 7 concludes.

2 Approach to methodology development

2.1 Overall approach

The overall project and process of developing the methodology started with an international review of valuation techniques in Phase one. This review provided clarity on the current best practice in the field and started the process of conceptualising the methodology development. It was followed, in Phase two, by a consultation process with City line functions to generate a list of the ecosystem goods and services, and its users or beneficiaries. These lists were then reconciled with the international literature on ecosystem goods and services in order to refine and add to them. The first two phases thus provided much of the 'raw material' that was needed to develop the methodology which could then be analysed further. Aside from the internal study team processes, two workshops were held with key resource economists in order to develop and test the methodology. These workshops proved

¹ See also the individual reports on international literature review (Natural Value 2008) and the consultative process (Natural Value 2009a).

insightful and allowed for a relatively wide range of views to be brought to bear on the subject. In addition to expert resource economics inputs, the City itself was consulted ensuring that the methodology was adequately scrutinised from the perspective of a group of line function managers and senior staff.

2.2 Definition of terms

In order to develop the methodology, it is important to distinguish between two related concepts, namely natural assets and ecosystem goods and services (EGS). Natural assets are the stocks of environmental resources owned by the City (the City's natural capital). Ecosystem goods and services (EGS) are the flows of benefits derived from these assets (the interest or services generated by the capital). In order to clarify these concepts an analogy of a bank account may be used. The amount of money deposited by the account holder is the asset component, while the interest earned on the account is income and, therefore, a flow value. If the asset value of the money deposited is withdrawn, or in other words, the capital is spent, the interest earnings are lost. So too with natural capital, if the stock of natural assets are destroyed, the flow of ecosystem goods and services are also forfeited.

The consultative process identified a number of assets under the City's control, including the following:

- Blaauwberg Conservation Area (BCA)
- False Bay Ecology Park (FBEP)
- The City's 23 nature reserves
- The City Parks (include playgrounds, cemeteries, crematoriums and landscaped roads)
- Freshwater river systems
- Coastal areas, incl. near shore
- Watercourses and wetlands

Ecosystem goods and services are categorised in Section 2.3. A number of studies that highlight the annual flows of values associated with the ecosystem goods and services of the City are given in the international review report.

2.3 Categorising and listing ecosystem goods and services

The valuation exercise should begin with the consideration of a comprehensive list of EGS in order to ensure that the multi-faceted nature of the environment is captured and no EGS are overlooked. Before continuing with a methodology, it is important to categorise and develop a comprehensive list of EGS. The consultation process with City line functions yielded an exhaustive list of the EGS which were reconciled with

the international literature on EGS to generate an EGS list for the City. At a conceptual level, this list is based on the Millennium Ecosystem Assessment (2005) framework which was chosen because of its international acceptance and logical nature. In addition, this framework can be reconciled with resource economics frameworks such as the Total Economic Value (TEV) framework. The Millennium Ecosystem Assessment (2005) distinguishes among four categories of goods and services:

- **Supporting services** are those services necessary for the production of all other ecosystem services, such as soil formation, photosynthesis, primary production, nutrient cycling and water cycling. These are intermediate services which form the basis for provisioning, regulating and cultural services and, as such, are seldom valued separately.
- **Provisioning services** relate to the products derived from ecosystems, including food, fiber and fuel, genetic resources, medicines and pharmaceuticals.
- **Regulating services** include benefits derived from the regulation of ecosystem processes, such as air quality relation, climate regulation, water regulation, erosion regulation, disease regulation, pest regulation and natural hazard regulation.
- **Cultural services** are the benefits people obtain from ecosystems such as reflection, recreation, inspiration and aesthetic enjoyment. It includes cultural diversity and educational values.

In terms of the Total Economic Value framework, provisioning services largely fall within the direct use category, regulating services are mainly indirect use values, and cultural services comprise both a direct use component for values such as recreation and an existence value component for the remainder. Table 1 presents the EGS list for the City of Cape Town and shows how intermediate supporting services, such as primary production systems and ecological cycles, support or contribute to the generation of regulating, provisioning and cultural services. These three categories of EGS are then used by beneficiaries and, therefore, have value.

Table 1 Categories of ecosystem goods and services

Ecosystem goods and services		
Supporting services Photosynthesis Soil formation Primary production Nutrient cycling Water cycling	Regulating	Water regulation (flows, etc.)
		Natural hazard regulation (floods, etc.)
		Water purification and waste treatment, assimilation
		Erosion regulation
		Pollination
		Disease regulation
		Pest regulation
		Climate regulation – local (air quality)
		Climate regulation – global
		Space for biota to live and reproduce (refugia)
	Provisioning	Fresh water provision
		Fuelwood provision
		Building materials provision (wood, sand, etc.)
		Wild flowers for harvesting
		Provision of plant and animal material for medicines and biochemicals
		Provision of materials for crafts, fashion (e.g. shells)
		Fish and marine resources
		Genetic resources with potential pharmaceutical and other biochemical uses
	Small-scale urban farming	
	Cultural (information)	Recreation and tourism
		Provision of inspirational beauty
		Aesthetic values and sense of place
		Educational uses (e.g. school excursions, scientific research)
		Use in cultural and artistic practices and ceremonies
		Use in religion practices and ceremonies
	Use in productions (film and events), advertising and publications	

2.4 Beneficiaries or users

The economic value of EGS is determined by people’s active and passive use of these goods and services. A number of different user categories are distinguished. In this study the user categories are identified through a synthesis of the beneficiary categories identified in the international review report and information derived from the consultative process. The user groups identified during the consultative process are given in Table 2.

Table 2 User groups identified during the consultative process

Categories	Types (examples)	Notes
<p>Tourist groups: Interviewees explained that Cape Town is a favoured tourist destination partly as a result of its natural environment.</p>	<p>International tourists National tourists Local tourists</p>	<p>Data and levies related to tourism are available at nature reserves, tourism organisations, city parks</p>
<p>Recreation groups: Interviewees noted that the Cape Town environment offers space for a wide variety of recreational activities.</p>	<p>Sailors, surfers, rowers Horse riding Walkers, cyclists, hikers Sports</p>	<p>A number of the organised recreational groups keep data pertaining to their numbers. These include sailing clubs, etc.</p>
<p>Harvest groups: The activity of harvesting natural resources and other resources is a limited activity.</p>	<p>Wild plant harvesting Urban agriculture Gathering fuelwood</p>	
<p>Information and cultural groups: The natural environment provides a space of learning and human development.</p>	<p>School excursions Scientific research History enthusiast Religious experience Book writers</p>	<p>The nature reserves have data related to school excursions, gate fees, etc.</p>
<p>Industry groups: These are business activities which make use of the City's natural environment.</p>	<p>Film and events industry Shipping industry Tourism industry Manufacturing and construction Advertising industry Craft makers</p>	<p>The City of Cape Town's economic information group has industry specific information/data that can be accessed.</p>
<p>Residential groups: Households derive a variety of benefits from the natural environment. This is the protection from floods and natural drainage provided by the environment.</p>	<p>Households (properties)</p>	

In order to choose appropriate user categories, high-level distinctions were first made between 'local users' and 'regional, national and international users'. Among the local users, further distinctions were made among 'residents', 'key commercial groups' and 'key public bodies' and were sub-divided as follows:

Classified under 'residents' are:

- Recreational and sporting groups
- Harvesters, fishers and subsistence producers
- Educational groups
- Cultural and religious groups
- Property owners
- Low-income residents (to indicate particularly high levels of dependency)

Classified under 'key commercial groups' are:

- Tourism and recreation
- Film, advertising and events
- Arts and crafts
- Real estate
- Construction and manufacturing
- Urban agriculture
- Fishing (including shellfish)

Classified under 'key public bodies' are:

- Economic development
- Health and welfare
- Disaster management
- Water
- Waste
- Conservation bodies (e.g. SANParks and CapeNature).

This framework has been utilised by a number of other important international studies. For example, Eftec (2006) differentiates between individual users, commercial entities and public sector groups. Costanza (2008) classifies 17 ecosystem services based on their spatial characteristics. Most significantly, however, is that this classification is based on the user groups identified as aspects being relevant to the City line functions.

3 Key considerations in methodology development

The focus of the overall project is to influence budget allocations by developing focused economic arguments for investing, maintaining and expanding the City's natural assets. It is neither practical nor desirable to value all goods and services generated by natural assets in the City, necessitating a logical and replicable methodology for prioritising natural assets for valuation. Through the study process and consultations, it became apparent that the methodology needs to address the following key consideration or needs for it to be effective:

- **There is a clear need for an initial broad scoping and comprehensive listing of the City's natural assets and flows from these assets.** This means that a comprehensive understanding of the categories, quantity and quality of (a) natural assets and (b) ecosystem goods and services flowing from these assets, is gained before certain EGS flows are prioritised. For example, the value of the natural environment lies not only in tangibles such as green open spaces and nature reserves, but also in intangibles such as improved quality of life, enhanced property values, the value of beautiful streets and the value of certain natural icons. Furthermore, in a developing country context, the importance of the environment in meeting certain needs of people who do not receive high levels of utility services or infrastructure need to be explicitly acknowledged and managed for. Another example is that the accessibility of existing natural assets and the expansion of green space for people with low incomes are likely to be important objectives as these areas, when managed well, provide benefits that can improve wellbeing. The maintenance of these areas also provides direct employment benefitting many more indirectly. Overall, such a comprehensive approach would, to some extent, militate against strategic behaviour to maximise partially focused budgets within City structures and also leave sufficient scope for changing priorities over time. Therefore, as a first consideration, the methodology needs to be as comprehensive as possible in mapping the natural assets and EGS nexus and not be limited by existing structures and functions within the City.
- **It is equally important to be able to focus on key EGS** that are particularly beneficial and thus worthy of prioritisation. Following a consultative process with a group of line function managers and senior staff as well as an international literature review, it is clear that a rich and diverse set of ecosystem goods and services support the socio-economic wellbeing of City inhabitants, as expected. These goods and services benefit a large number and a diverse range of beneficiaries. This information itself can be used to raise awareness and educate people on the wide range of benefits provided by sufficiently large and well-maintained natural assets. A key issue for the purpose of this project was where to focus valuation and financial-economic modelling efforts and to develop an argument based on targeted and relevant data and information (see UNDP/UNEP 2008). For example, given the focus on making a business case for environmental management, it is advised to first focus on tangible, direct benefits of maintaining and expanding natural assets,

as well as the goods and services that may flow from these assets, before attempting to value other intangibles and indirect benefits. An example of such intangibles is the close proximity of a natural and agricultural landscape in Constantia to an urban centre. These intangible values are likely to be reflected in property prices and in the willingness of visitors to travel to the area, but would require extensive valuation work and use techniques that, although correct and credible in the literature, increases the risk of not being accepted in the development of a higher-level business case for the environment. This does not mean that no risks should be accepted but raises the issue to search for those assets where highest returns in terms of focused efforts can be achieved at lowest risks.

- **It is important to differentiate between an economic valuation technique and an economic valuation methodology.** It is a well-known fact that economic valuation techniques cannot be applied indiscreetly to every situation. Every case would have a unique problem statement and the methodology need to be broad enough to fit different types of problems. Some techniques are more suitable for certain goods and services than others. It is, therefore, crucial that City decision-makers receive not only a set of valuation techniques but also a complete methodology on how to approach economic valuation of ecosystem goods and services. A methodology can best be described as “a system of methods”.
- **The link between specific natural assets and the specific flow ecosystem goods and services needs to be defined.** According to the OECD (2005), natural assets consist of biological assets (produced or wild), land and water areas with their ecosystems, subsoil assets and air. This is, however, not the way cities have categorised their functions (both organisationally and financially) and, therefore, natural assets can be – within this context – better categorised in terms of an overlap with existing organisational structures: natural areas and reserves, parks, sports grounds, agricultural and vacant land, watercourses, wetlands and dams, the near-shore environment, and the atmosphere. Sub-soil assets are acknowledged as assets, but the City does not have any direct jurisdiction over these. What is important is that the flow of EGS from each of these assets is specifically defined to better facilitate choices on the relative importance of and focus on such assets when constructing an economic argument for investment in natural assets. It is further important to recognise that the set of natural assets, individually and jointly, may form part of an urban ecology of one or more larger

ecosystems. A particular natural asset may for instance be a corridor for species movement between feeding and breeding habitats.

- **The links between different EGS and beneficiaries need to be clearly defined** in order to understand which EGS are of value to whom. This information can then be used to prioritise and target EGS for further assessment. The number of beneficiaries, as well as estimates on the value for each of the ecosystem goods and services to these beneficiaries, determine what the highest ranked values are likely to be. For this project, the categorisation of users was informed by consulting line managers in the City. Although such categories may be updated over time, the approach provides a robust way of prioritising those specific ecosystem goods and services that are most likely to be of high value to all or certain inhabitants of and visitors to the City. Including aspects of value from a local beneficiary perspective is not always applied. In a high-level case study on the economic value of open spaces in Durban, users were not explicitly categorised as estimated values of EGS were transferred from other international studies and applied on a per hectare basis (Mander 2009). In the context of this project where specific arguments on the value of natural assets to socio-economic wellbeing need to be formulated and used to support budget applications, an approach that ignores the value that local beneficiaries attach to ecosystem goods and services is not appropriate.
- **The importance of EGS to socio-economic development needs to be clear.** Budget allocations are informed by the strategic objectives of the City's Integrated Development Plan (IDP) which, at this stage, has no specific high-level allocation to any specific environmental category. EGS need to be ranked according to their impact on the IDP strategic focus areas. Where key EGS are identified but not acknowledged in the IDP, a separate argument needs to be developed for the inclusion of these EGS in further planning updates.
- In order to **better understand the chances of successful interventions**, the City's ability to influence the value of EGS through management and their environmental mandate should be key considerations when allocating resources. Some natural assets and flows may be almost completely under the control of the City, others may be shared with other institutions and groups, while still others may fall completely outside the control of the City. The assets and flows completely outside the control of the City are not important when motivating for an

increased allocation of financial resources. It must be noted that the City may still be responsible for enforcement of regulations or inputs according to NEMA regulations on natural assets that are not directly within the City's control.

- As ecosystems may or may not be close to thresholds and can be subject to many different types of natural and anthropogenic pressures, **EGS need to be screened on the basis of ecological and socio-economic risks**. Specific attention need to be paid to expected changes over time the impacts this may have on natural assets and therefore on the sustained flow of EGS. If a particular flow of EGS benefits a large proportion of the population and it is at risk of being lost or altered in a fundamental way in future, it would need to receive urgent attention. Risk assessment do need to take place in some form or another whether in a very detailed scientific and/or modelling way or as part of a good governance process. One example is two case studies in Saldana and Richard's Bay respectively, that placed a comparative risk assessment at the heart of its approach (Crafford 2009). Risk descriptions, together with a systems analysis and complemented by a quantitative or qualitative analysis of scientific studies elsewhere (but relevant to these Bays) provided the production functions employed to simulate changes in the level and quality of EGS. The comparative risk assessment (CRA) discussed in these case studies is an example of how to prioritise EGS based on the risk of different types of hazards (e.g. harmful algal blooms, invasive organisms, shock wave effects of blasting, habitat loss due to dredging and land reclamation, oil pollution, and disposal of saline wastewater) on the continued flow of EGS.

4 The six step valuation methodology

Based on the key considerations discussed in the previous sections, a methodology was developed according to the following six steps:

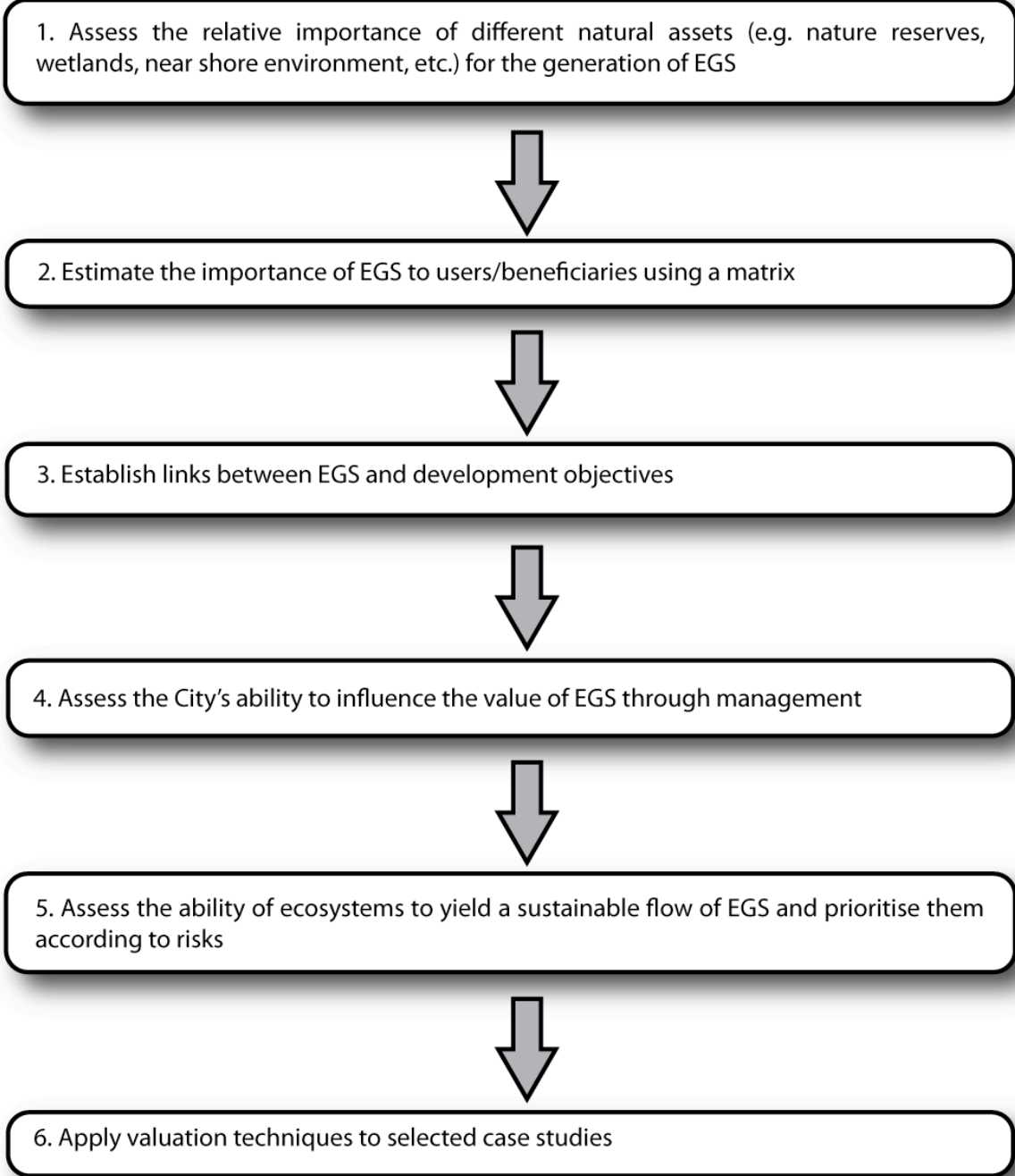


Figure 1 Six step valuation methodology

More detail on each step is provided in the following sections.

4.1 Assess the relative importance of different natural assets for the generation of EGS

The natural assets of the City can be divided into a number of different categories which, in turn, yield different types and levels of EGS. A basic understanding of the relationships between natural assets and EGS flows is needed in order to appreciate which ones are important in the generation of different EGS. This information can then be used to assist in further prioritising EGS for assessment. It can also contribute to making the necessary links between the management of key assets and EGS outcomes. Table 3 outlines the broad categories of natural assets used to categorise the sources of EGS. The three basic categories of biota (fauna and flora) and soils, the water environment and the atmosphere provide the first level of basic categorisation. Biota (fauna and flora) and soils are then divided into natural areas and reserves, municipal parks, sports grounds, agricultural lands and vacant land. Within the water environment category it is useful to distinguish between watercourses, wetlands and dams (aquatic environments), and the near shore coast (marine environments).

Table 3 Natural asset categories of ecosystem goods and services

Relative importance of natural assets as sources of EGS							
Biota (fauna and flora) and soils					Water environment		Atmosphere
Natural areas & reserves	Municipal parks	Sports grounds	Agricultural lands	Vacant land	Water courses, wetlands and dams	Near shore coast	

4.2 Estimate the importance of EGS to users or beneficiaries

The value of ecosystem goods and services is determined by people’s active and passive use thereof. It is, therefore, critical to consider who the users or beneficiaries of EGS are, and the relative importance of these EGS to different users. This is best done using a matrix of users against EGS categories (as presented in Table 4).

Table 4 Matrix of beneficiaries plotted against EGS category

Ecosystem goods and services (EGS) categories			Beneficiaries/ users																
			Primary local beneficiaries/users and relative importance of EGS to them														Re	Na	Int
			Residents					Key commercial enterprises					Key public bodies						
			R&S	H,F&S	Ed	C&R	P	L	T&R	F,A&E	A&C	RE	C&M	UA	F	Ec	H&W	DM	W&W
Supporting services	Regulating	Water																	
		Natural hazard																	
		Water and waste																	
		Erosion																	
		Pollination																	
		Disease																	
		Pest																	
		Air quality																	
		Climate																	
		Refugia																	
	Provisioning	Fresh water																	
		Fuel																	
		Building materials																	
		Wild flowers																	
		Medicine																	
		Ornamental																	
		Fish and marine																	
		Genetic																	
		Urban agric																	
Cultural (information)	Recreation and tourism																		
	Inspirational																		
	Aesthetic																		
	Educational																		
	Heritage																		
	Religious																		
	Media																		

Key: R&S = Recreational and sporting groups; H,F&S = Harvesters, fishers and subsistence producers; Ed = Educational groups; C&R = Cultural and religious groups; P = Property owners; L = low income groups; T&R = Tourism & recreation; F,A&E = Film, advertising and events; A&C = Arts and crafts; RE = Real estate; C&M = Construction and manufacturing; UA = Urban agriculture; F = Fishing (including shellfish); Ec = Economic development; H&W = Health and welfare; DM = Disaster management; W&W = Water and Waste; S&CN = SANParks & CapeNature

For any given EGS, the number of users and estimates of the value of the EGS to those users are critical considerations. These will determine the anticipated level of importance of EGS in absolute terms and relative to other services which, in turn, should guide the focus of valuation work. Such a process of prioritisation can be run relatively easy on a high level involving experts, managers and/or beneficiaries from the system. Section 7 presents the result of a workshop held with a group of line function managers and senior staff in this regard.

It should be kept in mind that different lists of EGS and categorisations of users can be used. In this case both EGS and user groups were identified by consulting City line managers and categorised by the project team. Although such lists and categories may be updated over time, the approach provides a robust way of prioritising those specific ecosystem goods and services that are most likely to be of high value.

4.3 Establish links between EGS and development objectives

Although awareness is growing with regard to the broad links between natural assets and economic development outcomes, there is a need to better understand and spell out these links when considering the value of natural assets. In this regard, the Integrated Development Plan (IDP) is recognised as the key development plan for the City. This plan can be viewed as a strategic guide with regard to development effort and resource allocation. According to the City's latest 5-year IDP, the following eight strategic focus areas have been identified (City of Cape Town 2009):

1. Shared economic growth and development
2. Sustainable urban infrastructure and services
3. Energy efficiency for a sustainable future
4. Public transport systems
5. Integrated human settlements
6. Safety and security
7. Health, social and human capital development
8. Good governance and regulatory reform

These strategic areas are necessarily broad in order to be comprehensive. From the perspective of the contribution of EGS to these focus areas, it is likely that the greatest emphasis will fall on the following: Shared economic growth and development, Sustainable urban infrastructure and services, Integrated human settlements, and Health, social and human capital development.

The City faces several specific ecological challenges which have been acknowledged in the earlier IDP of 2006/7 (see Box 1). Within the Environmental Resource Management Department (ERMD) strategies have been developed or are being developed for the following:

- Energy and climate change
- Biodiversity
- Coastal zone management
- Environmental education, training and awareness
- Air quality management
- Integrated waste management

Box 1 Ecological challenges in the City of Cape Town

Cape Town is located in a highly sensitive and vulnerable ecosystem. The environment is one of the strongest assets driving tourism. Rising levels of pollution threaten the river system and there are high levels of air pollution. The Cape Floral Kingdom has almost 9 000 different plant species and many animal species. Cape Town is situated in the heart of the Cape Floral Kingdom (the smallest and richest of the world's six plant kingdoms), making Cape Town an area of global importance, otherwise known as a global "hotspot" of biodiversity. In fact, Cape Town is known internationally as a global biodiversity hotspot without parallel. More importantly, lots of species occur in Cape Town and nowhere else on earth. Cape Town has the dubious distinction of also being one of the earth's mega-disaster areas – those areas that have already or are on the verge of losing a significant part of their biodiversity. The extinction rates in Cape Town are the highest for any metropole in the world. Not only is Cape Town rich in plant biodiversity, but also in animal biodiversity. Added to this, Cape Town is surrounded by a unique and diverse marine environment, which supports many different marine plants and animals such as abalone, the southern right whale and great white shark. The link to tourism should be emphasised. However, the point that the environment is Cape Town's greatest asset, not just from a tourism perspective, but it is our life support system, also needs to be made. Balancing this with the social constraints is a huge challenge. Conservation of the natural environment is not a luxury but a necessity as the natural environment provides us with basic needs such as food, clean water, storm water and flood attenuation service, and assists with decreasing air pollution and many other services. Everyone has the basic right to a clean, safe and healthy environment. It is vital that the City ensures that it is sustainable.

Source: City of Cape Town (2007)

It is proposed that the EGS (as ranked in Table 1) are assessed according to their impact on the IDP strategic focus areas and associated specific objectives as relevant to the ERMD. Where key EGS are identified that are not acknowledged in the IDP, separate arguments need to be developed for inclusion in further planning updates. The City is currently busy with a more specific City Development Strategy (CDS) and the EGS will need to be assessed according to expected impacts on strategic objectives defined here as well in future.

4.4 Assess the City's ability to influence the value of EGS through management

The previous steps in the methodology do not make a distinction between natural assets and EGS flows on the basis of their ownership status or the level of control that the City has over the EGS. This is, however, an important factor as some assets and flows may i) be almost completely under the control of the City, ii) be shared with other institutions and groups, or iii) fall completely outside of the City's control. The assets and flows completely outside of the City's control will generally be less important when motivating for an increased allocation of financial resources. Ranking or screening EGS according to the ability of the City's ability to maintain or expand natural assets and the flow of ecosystem goods and services is thus an important step before devoting resources to the valuation of EGS or developing a business case.

The process of ranking can relatively easily be executed with inputs from City line function managers and senior staff who understand the nature of boundaries and have experience with regard to levels of control within the given mandates. Legal obligations are also relevant here. In certain instances, the City's management of natural assets can be viewed as a response to its legal obligations. For example, the rehabilitation and management of wetland areas can be motivated by a desire to avoid liability that may stem from flood events. This kind of legally-driven motivation generally adds to motivations built on economic values and other factors. The City has a well-defined mandate on service delivery, but its' environmental mandate is still unclear. The City is currently reviewing its environmental mandate which will most probably have an influence on where funds will be allocated and what organisations the City will partner with in the fulfillment of their mandate.

4.5 Assess the ability of ecosystems to yield a sustainable flow of EGS and prioritise them according to risks

Experience shows that one cannot necessarily rely on natural assets to provide sustained flows of EGS and the economic values associated with them. Moreover, certain environments are likely to be more vulnerable to habitat loss and degradation implying that they face greater ecological risks. These are the environments where thresholds are important and exceeding these would have particularly onerous consequences in both ecological and socio-economic terms. For example, if a river system experiences effective ecological collapse due to pollution, species can be lost and health hazards can emerge, with associated ecological and socio-economic costs. The natural assets that could be on the brink of disaster and those that have a higher impact need to be given priority in assessment.

Ranking or screening EGS according to the level of ecological and socio-economic risks they face is, therefore, an important step before devoting resources to valuation. As with the other steps, the process of assessing which assets may be most vulnerable or scarce can relatively easily be executed with inputs from City line function managers and senior staff who understand the ecological functioning of the natural assets within the City.

4.6 Apply valuation techniques to selected case studies

Once the key EGS have been prioritised using the preceding steps, further assessment using economic valuation techniques can be done. Such valuation studies should focus not only on the benefits of preserving or maintaining natural assets and flows, but also on the reduced costs (or savings) of mitigation flowing from a more pro-active management of the City's natural assets and EGS. For example, if a wetland is not properly managed and loses its functions, the costs of alternative technologies to (partially) substitute such functions can be substantial. It must further be noted that the opportunity cost of losing natural assets and flows may appear incrementally small at first, but will generally increase exponentially with increased scarcity. Although economic valuation techniques have been described and discussed in detail in Phase one of the project, a brief overview is given in the following sections focused on appropriate technique choice and application.

4.6.1 Techniques commonly used for valuation

Valuation techniques can be divided into demand curve approaches and non-demand curve approaches (see Figure 2). Demand curve approaches are welfare measures in the sense that the implications of changes in environmental quality or attributes on society can be assessed. In addition, values are derived rather than prices. Non-demand approaches are easier to estimate than demand curve approaches, and are generally more appropriate when there are not large disparities between price and value.

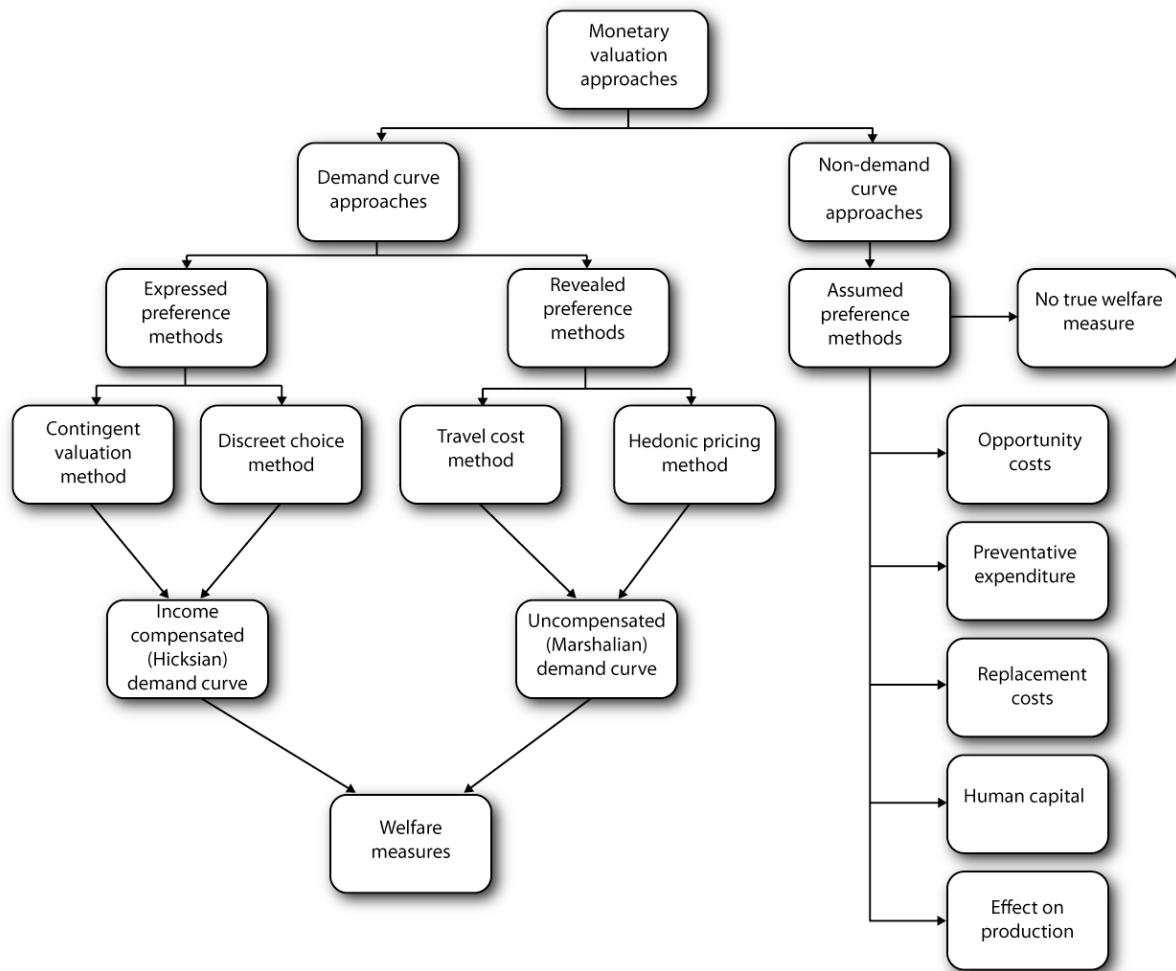


Figure 2 Monetary valuation techniques and economic welfare

4.6.2 Practical considerations when choosing a valuation technique

Aside from the restrictions of the available adequate budget, there are two important considerations when selecting a valuation technique. The first relates to the availability of data and the selection of an appropriate framework. The second relates to which is the most appropriate technique considering the data and in a given context. Regarding the first consideration, a sound approach is to first categorise values based on the nature and availability of prices (Blignaut & Lumby 2004). The following five categories are distinguished: market prices, shadow prices, direct proxies, indirect proxies, or no proxies at all. Figure 3 provides a framework for selecting an appropriate valuation technique based on these categories.

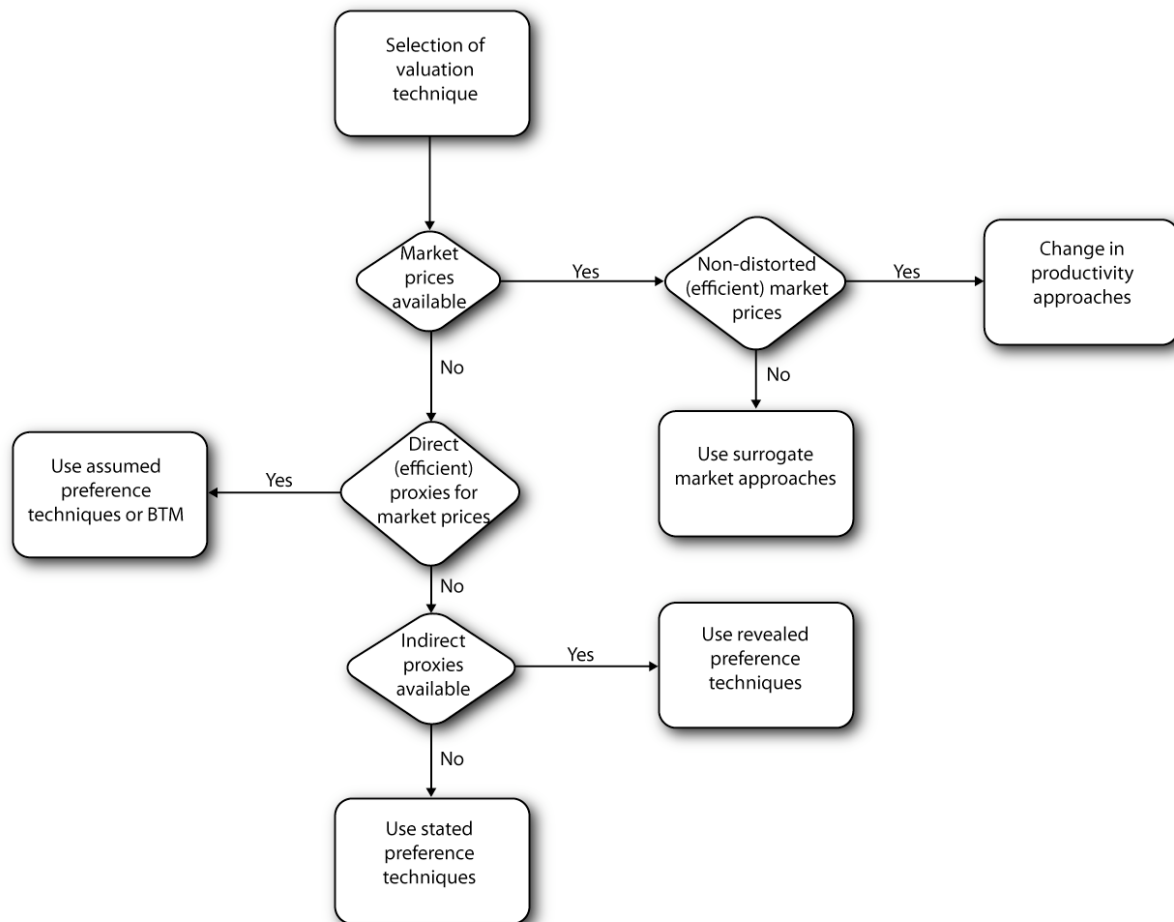


Figure 3 Choosing a valuation technique

Source: Based on Bignaut and Lumby (2004).

The options are as follows:

- If efficient market prices are available, change in productivity techniques are preferable.
- If non-distorted (efficient) market prices are not available, surrogate market approaches (such as the travel cost and hedonic pricing methods) are used.
- When market prices are not available but direct (efficient) proxies are, a variety of assumed preference techniques (such as replacement cost, cost of illness, opportunity cost or dose response methods) or other benefit transfer methods (BMTs) are applicable.
- When indirect proxies are available, revealed preference methods (such as the travel cost and hedonic pricing methods) are appropriate.
- Finally, if no market prices or proxies are available, non-market methods (such as contingent valuation or choice modelling approaches) may be used.

It should be noted that it is often necessary to use a combination of valuation techniques rather than a single technique to value environmental benefits. Some techniques lend themselves more readily for use in combination with other techniques. Once a technique is selected based on the availability of data, and issues of compatibility with other techniques are investigated, a number of failsafe principles need to be applied. Table 5 outlines the common avoidable pitfalls encountered in valuation. For example, a technique may be compatible with other techniques, but if they value the same thing in different ways issues such as double counting may be a factor. Furthermore, while a technique might be easy to apply in practice, the results of certain valuation studies may not be readily transferable to a local context. The given context of a study is important for all valuation studies. In addition to these principles, it might also be appropriate, in certain instances, to control for income differentials between groups. Otherwise it suggests that poorer people value the environment less, which is clearly not an accurate interpretation.

Table 5 Avoiding common pitfalls in valuation

Use net benefits, not gross benefits	Failing to consider the costs involved in using resources (the cost of harvesting products, for example, or the cost of piping water from its source to the user) results in an over-estimate of the value of ecosystem services.
Include opportunity costs	The cost of an action is not limited to the out-of-pocket costs involved in implementing it. It also includes the opportunity costs resulting from the foregone benefits of alternative actions (or inaction). Omitting opportunity costs makes actions seem much more attractive than they really are.
Do not use replacement costs	... unless you can demonstrate (i) that the replacement service is equivalent in quality and magnitude to the ecosystem service being valued, (ii) that the replacement is the least-cost way of replacing the service, and (iii) that people would actually be willing to pay the replacement cost to obtain the service.
Do not use benefits transfer	... unless the context of the original valuation is extremely similar to the context you are interested in. Even then, proceed with caution. However, it is a good idea to compare the results with those obtained elsewhere.

Table 5 Avoiding common pitfalls in valuation (cont.)

Do not use value estimates based on small changes in service availability to assess the consequences of large changes in service availability	Economic value estimates are not independent of the scale of the analysis. Value estimates are almost always made for small ('marginal') changes in service availability and should not be used when contemplating large changes.
Be careful about double counting	Many valuation techniques measure the same thing in different ways. For example, the value of clean water might be measured by the avoided health care costs or by a survey of consumer WTP for clean water. But consumer WTP for clean water is due (at least in part) to their desire not to fall sick, so these two results should not be added together. If they are, the value of clean water will be over-estimated.
Do not include global benefits when the analysis is from a national perspective	More specifically, only consider benefits (or costs) that affect the group from whose perspective the analysis is done. Including benefits which are primarily global in nature in an analysis undertaken from a national perspective is a particularly common form for this mistake, and results in an over-estimate of the benefits to the country.
Adjust for price distortions	... when conducting the analysis from the perspective of society as a whole, but not when conducting the analysis from the perspective of an individual group.
Avoid spurious precision	Most estimates are, by necessity, approximate. Do not simply paste the result in the spreadsheet, with its three decimal points, into the report: round the result appropriately. When there is substantial uncertainty, report the results as ranges.
Submit results to sanity checks	Are the results consistent with other results? Are they reasonable in light of the context? Extraordinary results are not necessarily wrong, but must be checked carefully. Extraordinary results require extraordinary proof.

Source: Pagiola et al. (2004).

5 Case study: Zandvlei

The previous sections outlined the theoretical and conceptual aspects of the methodology. In order to make it more real, we now turn to a hypothetical application of the methodology using an existing valuation study.

A valuation study done for the Zandvlei area as part of a wider City-funded study on the value of open space areas (see Turpie et al. 2001) was chosen as the ideal case study. This case study offers the chance to consider a number of benefit streams from a well-defined natural asset, using a variety of valuation techniques. It also illustrates a number of the key ways in which City management can and does influence values and the welfare outcomes associated with these values.

Zandvlei is situated in the south peninsula and is bordered by Lakeside, Muizenberg and Marina Da Gama. It's a natural open water wetland used for a number of recreational activities such as canoeing, sailing and windsurfing. Some of its shores in Lakeside and Muizenberg are lawned parkland, equipped in places with braai and picnic spots, sports fields and also a boating clubhouse. The portion of Lakeside/Muizenberg North between the vlei and the railway line is similar to the portion of Muizenberg that borders it on the south. Residential housing in both these areas offers easy access to the water and, in some cases, a view over it. Marina Da Gama on the eastern shores also offers these same benefits, but is distinct in having been designed as a marina. Properties bordering on the water have direct private access to it and often feature small jetties.

In the sections that follow, Zandvlei is assessed using the six step methodology outlined in the previous sections and drawing upon Turpie et al. (2001).

5.1 Assess the relative importance of different natural assets for the generation of EGS

In the case of Zandvlei, consideration of the relative importance of the source environment(s) is made simpler as the primary natural assets that provides the bulk of EGS at Zandvlei is the wetland area. However, the site also contains the following areas that provide important EGS:

- The municipal park with lawns, sport facilities and braai areas provide significant amenity

- Non-aquatic natural vegetation areas
- Coastal area where the vlei enters the sea at Muizenberg

To understand values at Zandvlei it is thus important to appreciate the different elements that these areas bring to the whole.

5.2 Estimate the importance of EGS to users/beneficiaries

Using the overall list of EGS one can identify important EGS in the area. Note that this process should include a field trip to areas such as Zandvlei for ground truthing. In the case of Zandvlei, the focus of overall values falls on regulating and cultural services that are provided at a local level (see Table 6). Although provisioning services are also present in the form of harvesting of flowers and fishing they are not as prominent by comparison.

Table 6 Ecosystem goods and services provided by Zandvlei

	Ecosystem services
Regulating	Water regulation
	Natural hazard regulation (floods, etc.)
	Water purification and waste treatment, assimilation
	Space for biota to live and reproduce (refugia)
Cultural (information)	Recreation and tourism
	Provision of inspirational beauty
	Aesthetic values and sense of place
	Educational issues (e.g. school excursions, scientific research)
	Use in cultural and artistic practices and ceremonies
	Use in religious practices and ceremonies
Provisioning	Use in productions (film and events), advertising and publications
	Wild flowers for harvesting
	Provision of materials for craft, fashion (e.g. shells)
	Fish and marine resources

The key focus regarding beneficiaries falls on benefits to the City of Cape Town's residents. Under residents, the following categories are key users of the vlei, in likely order of importance:

- Recreational and sporting groups
- Property owners
- Educational groups
- Cultural and religious groups
- Harvesters, fishers and subsistence producers

Note that, although the vlei is in a middle- to higher-income area, it is well-used by residents from nearby lower-income areas who have limited easy access to similar facilities.

Under key commercial groups, the following groups benefit from EGS at the vlei, in likely order of importance:

- Tourism and recreation with an emphasis on local recreational use (as opposed to tourism from outside of the City of Cape Town).
- The real estate industry benefits from the enhancement of property values.
- The fishing industry is supported by the nursery function performed by the vlei.
- The film, advertising and events industry benefits from the use of the vlei as a venue.

Key public bodies that benefit include the following:

- Health and welfare benefits from the facilitation and encouragement of a healthy outdoor lifestyle.
- Disaster management benefits from the maintenance of water flows in order to minimise floods.
- Water and waste benefits from the water quality control and waste assimilation function provided by the vlei.

From the above it is clear that the vlei creates a relatively large variety of value streams to various users. Focusing on these users provides a departure point for the valuation of the vlei.

5.3 Establish links between EGS and development objectives

Regarding the broad guidance provided by the City IDP, one can argue that the EGS provided at Zandvlei impact most positively on the following IDP focus areas:

- Health, social and human capital development
- Sustainable urban infrastructure and services

Social and human capital development benefits are clearly associated with the various recreational, sporting, educational and cultural uses of the vlei. The vlei can also be viewed as 'ecological infrastructure' providing virtually free services when functioning properly that would be costly to provide in its absence.

More tenuous, but nevertheless valid, links with the following focus areas can also be found:

- Shared economic growth and development
- Integrated human settlements

5.4 Assess the City's ability to influence the value of EGS through management

Zandvlei is already a relatively intensively managed area when compared to other vleis in and around the City of Cape Town. Lawned areas around the park, sporting areas and braai/picnic areas particularly are actively managed and relatively well-maintained. In addition, water flows both into the vlei and out of it into the sea have been manipulated and control is exercised over them. At an overall level, it thus stands to reason that the City has a relatively high ability to influence the state and value of this area. One caveat in this regard is that control over flows into the vlei is probably the area where the City has to deal with the highest levels of unpredictability.

5.5 Assess the ability of ecosystems to yield a sustainable flow of EGS

With continued adequate City management, the park, braai and sporting areas should yield a sustainable flow of EGS. In addition, assistance in management should be forthcoming from boat clubs and residents with an interest in keeping the area maintained.

With regard to risks, water quality probably presents the most difficulty to City management as it is not as easy to control by comparison to other EGS flows in the area. Note that the security risk is currently not particularly high relative to other open space areas in the City. However, it remains a risk that leads to decreased value flows and presents particularly difficult management challenges.

5.6 Applying valuation techniques

5.6.1 Choosing valuation techniques

In order to choose appropriate valuation techniques one can draw up a table that links EGS flows to appropriate valuation techniques. Table 7 presents the results of this exercise for Zandvlei. It shows that there are a number of valuation possibilities and that prioritisation is required. The 2001 study of this area came to the conclusion

that the replacement cost technique was best suited for estimating the value of regulating services provided by the vlei and that the hedonic pricing, travel cost and contingent valuation techniques were best suited for estimating cultural services values. Provisioning services were not measured mainly because their magnitude relative to regulating and cultural services was relatively small. If these were to be estimated, harvesting value could be measured simply by estimating the market value of harvested goods such as reeds and flowers. Benefits to fish production would probably be more complex as it would require the drawing of clear links between the functioning of the vlei and fish production.

Table 7 Matching EGS to valuation techniques at Zandvlei

	Ecosystem services	Valuation techniques
Regulating	Water regulation	Replacement cost, preventative costs, costs of disaster or system failure
	Natural hazard regulation (floods, etc.)	
	Water purification and waste treatment, assimilation	
	Space for biota to live and reproduce (refugia)	
Cultural (information)	Recreation and tourism	Travel cost, property price/hedonics. contingent valuation and choice experiments
	Provision of inspirational beauty	
	Aesthetic values and sense of place	
	Educational issues (e.g. school excursions, scientific research)	
	Use in cultural and artistic practices and ceremonies	
	Use in religious practices and ceremonies	
Provisioning	Use in productions (film and events), advertising and publications	Effects on production, cost of alternative sources
	Wild flowers for harvesting	
	Provision of materials for craft, fashion (e.g. shells)	
	Fish and marine resources	

The following sections provide brief summaries of the valuation application and results taken from Turpie et al. (2001). All amounts are in the year 2000 rands.

5.6.2 Replacement cost technique

Wetlands are widely recognised as particularly important providers of EGS per area and tend to ‘punch above their size’. Several of these services may save cities significant amounts in terms of infrastructural costs which they would have had to incur if the natural systems were not present. In Turpie et al. (2001), three replacement cost estimates were used for determining the equivalent functional value for selected wetlands, namely:

- Estimation of the cost of constructing an artificial wetland
- Estimation of the cost of providing the same level of water quality enhancement using a treatment plant
- Estimation of the cost of providing for the identified flood storage capacity only, i.e. the construction of a detention pond providing flood storage

For Zandvlei the replacement cost of a treatment plant was estimated at R180 million and the replacement cost of a flood storage capacity at R24 million illustrating the magnitude of the 'free' services provided. No estimate of the cost of constructing an artificial wetland was provided.

5.6.3 Hedonic pricing/property value technique

The hedonic case study at Zandvlei differed from the norm in that it used both estate agent interviews and the more conventional statistical technique to generate value estimates. Its focus was on the estimation of the effects of the vlei and associated open space on properties in close proximity. For the statistical analysis, property sales data was sourced from Cape Property Services (including house prices and characteristics), distance to open space was measured using municipal maps and regressions were run using house characteristics and proximity to open space.

The results of the statistical analysis compared well with those of the estate agent interviews. The former technique yielded total property price premiums associated with the vlei of R77 million for all houses, while that latter yielded an estimate of R87 million.

5.6.4 Travel cost technique

The travel cost survey focused on recreational use value by treating travel cost as a surrogate for value. As such, the technique is less prone to bias than stated preference methods because it estimates the value of an amenity on the basis of the actual behaviour of users. The results of the survey indicated that the consumers' surplus ranged from R1 for visitors from further afield to R33 for visitors living adjacent to Zandvlei, averaging R15 per visitor. The estimated total consumers' surplus, and hence total recreational use value using this measure, was estimated at approximately R700 000 per year. Note that survey respondents felt that the source of this value was relatively equally spread between the nature reserve, park areas and open water area.

5.6.5 Contingent valuation techniques

In the contingent valuation exercise, visitors were asked if they would pay a fee to make use of Zandvlei on the condition that they would be able to influence how this money was spent. Most (85%) respondents were willing to pay an entrance fee. Of those who were not willing to pay, some respondents voiced concern that payment might be a municipal proposal (i.e. not so hypothetical). The average willingness-to-pay was R6.40 per entry suggesting an overall willingness-to-pay, or recreational use value, of approximately R640 000 per year in 2000. This estimate was similar to that estimated using the travel cost technique. Note, however, that it focuses on recreational use and not other value streams such as option and existence value.

5.6.6 Discussion

The Zandvlei case study shows that, as suspected, the vlei is a source of significant benefits for a wide variety of users. These values are summarised in Table 8. Note, from a technical perspective, that the property value, travel cost and contingent valuation techniques had areas of overlap that would need to be accounted for in an overall estimate of value. Although management issues are not summarised here, it should also be noted that the case study found clear links between values and management, water quality and security levels.

Table 8 Summary of value estimates for Zandvlei

Valuation technique	Value (2000)	Annual value (2000)
Property value technique	R84 million	+/- R6 million
Travel cost	R10 million	R700 000
Contingent valuation	R9 million	R640 000
Replacement cost	R24 million–R180 million	R2 million–R15 million

6 Prioritising EGS in Cape Town using the methodology

Prioritisation of EGS in the City was done during a participatory and facilitated setting with invited City line function managers and senior staff representing all functions related to ecosystem goods and services in the City. This included those involved in the management of environmental resources, parks, tourism, heritage, sports and recreation, wastewater, stormwater, solid waste and spatial planning; or the following City functions:

- Strategy and Planning
 - Environmental Resource Management Department
 - Biodiversity Management
 - Policy and Strategy
 - Heritage
 - Environmental Management Systems
 - Spatial Planning
- Community Development
 - Sports, Recreation and Amenities
 - City Parks
- Economic and Social Development
 - Tourism
- Utility Services
 - Water services
 - Wastewater
 - Stormwater management
 - Solid Waste services

The conservation function was also represented by CapeNature's business unit manager for the Cape Metro.

The six step methodology was formulated to act as a high-level guide to prioritise future valuation work and business case exercises. With this in mind it was applied in a workshop with the study team and key City line function managers and senior staff.

A participatory rapid appraisal approach was followed. Four focus groups were randomly identified with 4–6 people in each group. Participants were asked to identify and shortly motivate what, in their view, the most important linkages are

between all identified EGS in the City and:

- beneficiaries
- the achievement of development objectives
- the City's environmental mandate and ability to influence and
- ecological and socio-economic risks.

The focus group discussions were limited to 15 minutes per topic after which focus groups reported back to others. The report back was summarised for the benefit of the entire group and used as an input to further off-line analysis and ranking. The collation of all inputs and subsequent discussions resulted in three broad categories of EGS or uses that should be prioritised and considered further:

1. Water quality and regulation of flows
2. Recreational use
3. Conservation of globally important biodiversity

A more formal evaluation was done after the workshop whereby each group's discussion points, as contained in the minutes of the meeting, were used to rank importance within each of the four discussion focus areas in a spreadsheet matrix. If two separate groups mentioned the same linkage, the relevant block scores a two, if three groups mention the same linkage the block scores a three, etc. This analysis did not reveal major differences with the summary presented at the end of the workshop, but revealed some important nuances. Table 9 contains a summary of EGS ranked according to higher, high, medium, and low importance relative to each other. The five services that were ranked with highest relative importance for valuation are the regulation of natural hazards, recreation and tourism, water purification and waste treatment/assimilation, space for biota and aesthetic values and sense of place. Definitions are as follows:

Natural hazard regulation: Buffering ecosystems (e.g. reefs, kelp can reduce the impact of storms and large waves)

Recreation and Tourism: People often choose their sites based on the natural or cultivated characteristics of an area

Water purification and waste treatment, assimilation: Ecosystems can cause impurities but also help filter out and decompose organic wastes

Space for biota: Regulation of habitat and space

Aesthetic values and sense of place: Aesthetic values are reflected in support for parks, scenic drives and housing locations

Table 9 Relative importance of EGS based on perceptions of City line function managers and senior staff

Higher	High	Medium	Lower
Natural hazard regulation	Water purification and waste treatment, assimilation	Climate regulation – local (air quality)	Climate regulation global
Recreation and Tourism	Space for biota	Small scale urban farming	Fresh water provision
	Aesthetic values and sense of place	Water regulation	Building materials provision
		Fish and marine resources	Provision of inspirational beauty
			Educational users
			Cultural and artistic practices
			Religious practices
			Erosion regulation
			Disease regulation
			Harvesting
			Materials for craft and fashion
			Use in productions, advertising and publications

Note: Based on results of workshop with City representatives, 12 March 2009

The regulation of natural hazards and recreation and tourism attracted the highest scores as based on the workshop discussions. Regulation of natural hazards includes the importance of the environment to deal with storm water, flooding and sea storms, and to buffer against or absorb disasters. Such ecosystem services may reduce risks to and costs of development. Ecosystem services can provide an important role in disaster risk management. If this is not managed properly it also poses a major risk to infrastructure and service delivery.

Recreation and tourism services included comments on the importance of nature reserves, parks, natural and open spaces, and sport grounds for recreational activities (e.g. braai, picknick, birding, dog walking, sports, fishing) by City residents, as well as the importance of a sustained flow of EGS to tourism and recreational fishing as economic sectors in the City. Recreational services indirectly benefits health as well. Ecological risks include climatic changes and pollution.

The environment’s purification of water and waste followed closely, as well as space for biota and aesthetic values/sense of place. It was clearly stated by participants that the water purification function is important for downstream users in terms of recreational activities (such as wetlands and beaches) and human health. The continuation of the water purification function is also under severe pressure already due to excessive water pollution and resulting eutrophication.

According to the workshop participants, the environment provides a further key function by providing space for biota. Fynbos areas have become very fragmented especially in low lying areas. Coastal dunes are under pressure. The maintenance of biodiversity can play an important role in enhancing human settlements and, when properly managed, can enhance safe public areas. Fire management, for instance, is directly linked to the management of fuel loads. It was mentioned that educational use of natural biota is an aspect that needs specific attention.

Aesthetic values are gained through nature reserves and green areas, and are expected to create tangible amenity values in human settlements. Urban sprawl and coastal development, however, are major risks.

7 Conclusions

A robust and tested methodology to value the natural assets of the City of Cape Town was developed and presented in this report. This methodology is based on a national and international literature review (Natural Value 2008), inputs from local resource economic experts, two independent external reviews (Natural Value 2009b) and in a participatory process with city line managers and senior staff (Natural Value 2009a). The six generic steps followed to prepare a valuation study on EGS in a city context are:

1. Assess the relative importance of different natural assets for the generation of EGS
2. Estimate the importance of EGS to users/beneficiaries
3. Establish the links between EGS and development objectives
4. Assess the ability of the City to influence the value of EGS through management
5. Assess the ability of ecosystems to yield a sustainable flow of EGS and prioritise according to risks.
6. Apply valuation techniques to selected case studies

The six-step valuation methodology was first tested against a local case study, before applying this to the selection of key ecosystem goods and services for the City of Cape Town. City line managers and senior staff played a prominent role in selecting ecosystem goods and services for valuation. The five services that were ranked with highest relative importance for valuation are the regulation of natural hazards, recreation and tourism, water purification and waste treatment/assimilation, space for biota and aesthetic values and sense of place.

This methodology to value the natural and environmental resources of the City of Cape Town will be used as basis for the further development of a business case to invest in and maintain the City's natural assets.

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