

## Briefing Paper

# Using Catchment Ecosystem Valuation in Water Decisions

Although the projected costs and benefits arising from a particular management or investment option are important determinants of decision-making in the water sector, financial and economic analyses traditionally take little account of ecosystem values. This is despite the fact that wetlands, forests, grasslands and other natural habitats have a high economic value because they store, treat and regulate water for downstream users, as well as guarding against natural and human-induced hazards such as erosion, pollution, landslides, floods and droughts.

Ecosystem values are still largely left out of water equations. They do not factor in decisions about how to allocate water, how much to charge for water services, where to channel investment funds, or what design of infrastructure to choose. For the most part, the economic and financial calculations that underpin water decisions remain fundamentally incomplete – and are therefore often misleading in their conclusions and recommendations.

Ecosystem under-valuation is of particular concern to water utilities such as SA Water. With a mandate which incorporates both commercial and public service goals, SA Water is charged with delivering water services in a way that is commercially successful, competitive and cost-effective. At the same time the

corporation must balance these business interests with social and environmental responsibility. The benefits and cost-savings that ecosystems generate for water service delivery (and, conversely, the water costs that are incurred when ecosystems are degraded) are of utmost importance to SA Water's financial, social and environmental bottom-line.

The problem is not that natural ecosystems have no economic value, but rather that these values are poorly understood, rarely articulated, and difficult to quantify. More accurate water planning, which factors in the business opportunities associated with ecosystem services and the business risks associated with ecosystem degradation, requires that ecosystem values are measured and counted alongside the other costs and benefits that traditionally form the focus of financial and economic analysis.

Having recognised the importance of ecosystem valuation to their core goals, SA Water commissioned a study that would help to further define and operationalise these concepts. The aim is to find ways of integrating the value of catchments as assets into SA Water's internal planning and evaluation processes, and as external justification for future pricing regulators. This briefing paper summarises the findings of the project.

More accurate water planning requires that ecosystem values are measured and counted alongside other costs and benefits



## Defining the value of ecosystems for water

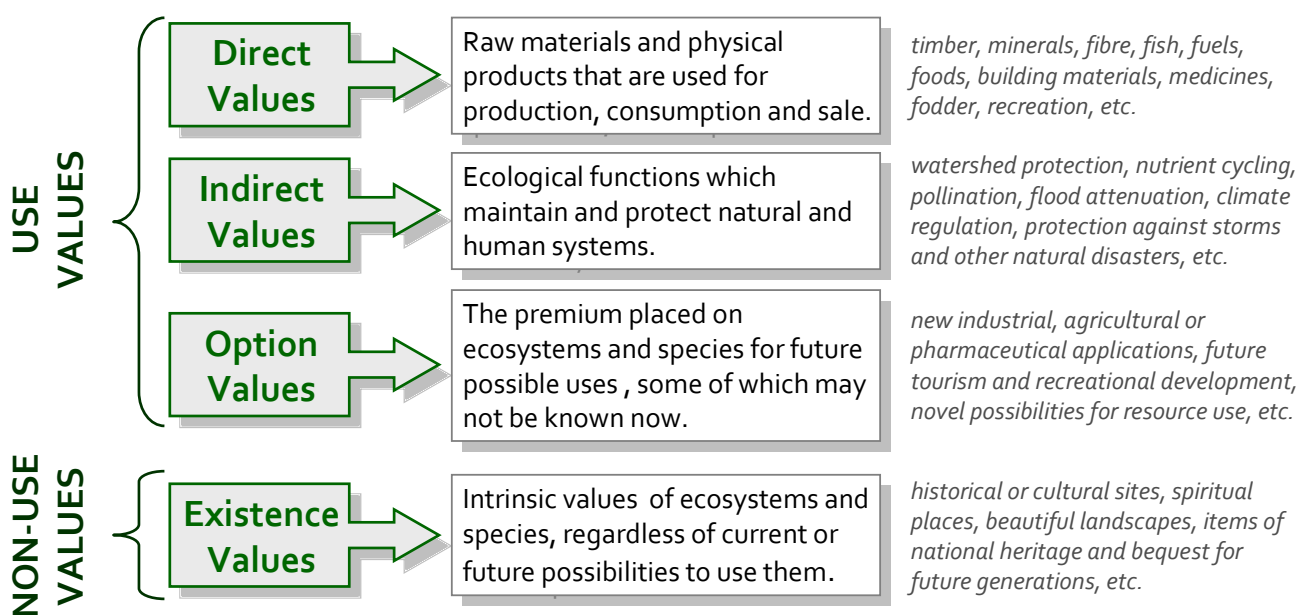
One of the reasons that ecosystem values have tended to be excluded from financial and economic calculations is that, until recently, concepts of environmental costs and benefits have been based on a very narrow definition. The primary emphasis has been on the commercial use of natural resources, and the physical products that ecosystems yield – commodities such as timber, fish, fuel, minerals or pasture.

Other ecosystem services – such as water treatment, flood control or water quality regulation – have simply not formed a part of these analytical frameworks. This is even though, in many cases, the economic value of ecosystem services far outweigh those from direct, extractive resource uses.

Over the last two decades the application of a more inclusive “total economic value” framework has however provided a set of conceptual and methodological tools to enable ecosystem values to be more easily and accurately assessed in relation to water services. The concept of total economic value has now become one of the most widely used frameworks for identifying and categorising environmental benefits. Instead of focusing only on direct commercial values, it also encompasses subsistence and non-market values, ecological functions and non-use benefits.

Looking at the total economic value of a ecosystem essentially involves considering its full range of characteristics as an integrated system – its resource stocks or assets, flows of environmental services, and the attributes of the ecosystem as a whole. Broadly defined, the total economic value of ecosystems includes:

- **Direct values:** raw materials and physical products which are used directly, such as those providing energy, shelter, foods, agricultural production, water supply, transport and recreational facilities.
- **Indirect values:** ecological functions which maintain and protect natural and human systems, such as maintenance of water quality and flow, flood control and storm protection, nutrient retention and climate regulation.
- **Option values:** the premium placed on maintaining a pool of species and genetic resources for future possible uses, some of which may not be known now, such as leisure, commercial, industrial, agricultural and pharmaceutical applications and water-based developments.
- **Existence values:** the intrinsic value of ecosystems and their component parts, regardless of their current or future use possibilities, such as cultural, aesthetic, heritage and bequest significance.



The total economic value of ecosystems

## Linking ecosystem service values to human wellbeing

Ecosystem services have value to human beings because they generate benefits for them. As the total economic value framework shows, these benefits may be purely commercial, they may relate to people's basic needs and requirements to survive, or they may involve less tangible quality of life indicators.

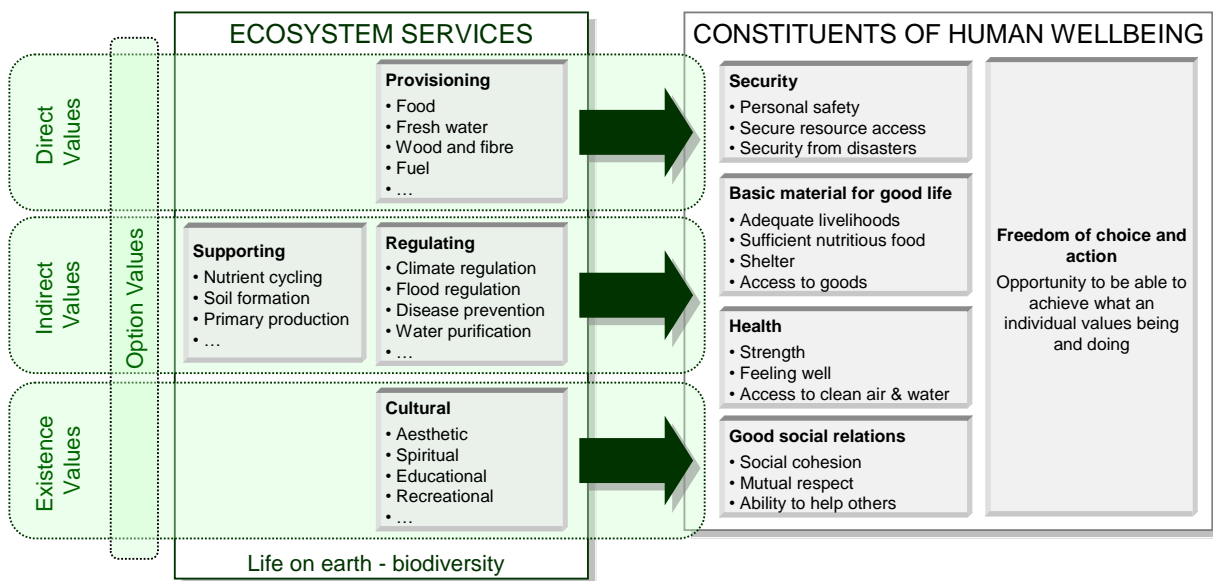
All these components of human wellbeing are a key concern to SA Water. The corporation's dual commercial and public service mandate means that SA Water is concerned not just with the role of ecosystems in the delivery of water supply and quality services, but also with generating broader benefits for the South Australian society and economy.

Over the last few years, human wellbeing concerns have come to the forefront of ecosystem valuation. This is due in large part to the findings of the Millennium Ecosystem Assessment, which stimulated a renewed focus on the links between ecosystem services and human wellbeing. The Millennium Ecosystem Assessment, completed in 2005, was a four-year international audit of ecosystems conducted under the auspices of the United Nations. Among other things, it developed a framework which has now become the dominant paradigm for understanding and expressing the relationships between ecosystems and human behaviour. It is also a framework into which economic values can easily be incorporated, in relation to the water services that ecosystems provide.

This framework posits that people are integral parts of ecosystems, and that a dynamic interaction exists between them and other parts of ecosystems. Changing human conditions drive, both directly and indirectly, changes in ecosystems and thereby cause changes in human and economic wellbeing.

Ecosystems generate provisioning services such as food, water, timber and fibre; regulating services that affect climate, floods, disease, wastes, and water quality; supporting services such as soil formation, photosynthesis, and nutrient cycling; and cultural services that provide recreational, aesthetic, and spiritual benefits. In turn, each type of ecosystem service corresponds to a different component of total economic value as described in the previous section.

Having categorised the services and values that a given ecosystem supports, the framework provides a systematic way of examining how changes in its management or status impact on the various components of human wellbeing. Human wellbeing is assumed to have multiple constituents, including security, the basic material for a good life, health, good social relations and freedom of choice and action. Overlaying valuation onto this framework, it becomes possible to see how changes in ecosystem services and human wellbeing are manifested as costs and benefits for different stakeholder groups.



Ecosystem services, economic values and human wellbeing

## Measuring the value of ecosystem water services

Having understood the linkages between ecosystems, the services and economic values they provide, and human wellbeing, a next step is to find ways of factoring these costs and benefits into water calculations. Ecosystem valuation provides a means of doing this.

The basic aim of valuation is to determine people’s preferences: how much they are willing to pay for ecosystem goods and services, and how much better or worse off they would consider themselves to be as a result of changes in their supply. By expressing these preferences, valuation aims to make ecosystem services directly comparable with other sectors of the economy when investments are appraised, activities are planned, policies are formulated, or land and resource use decisions are made.

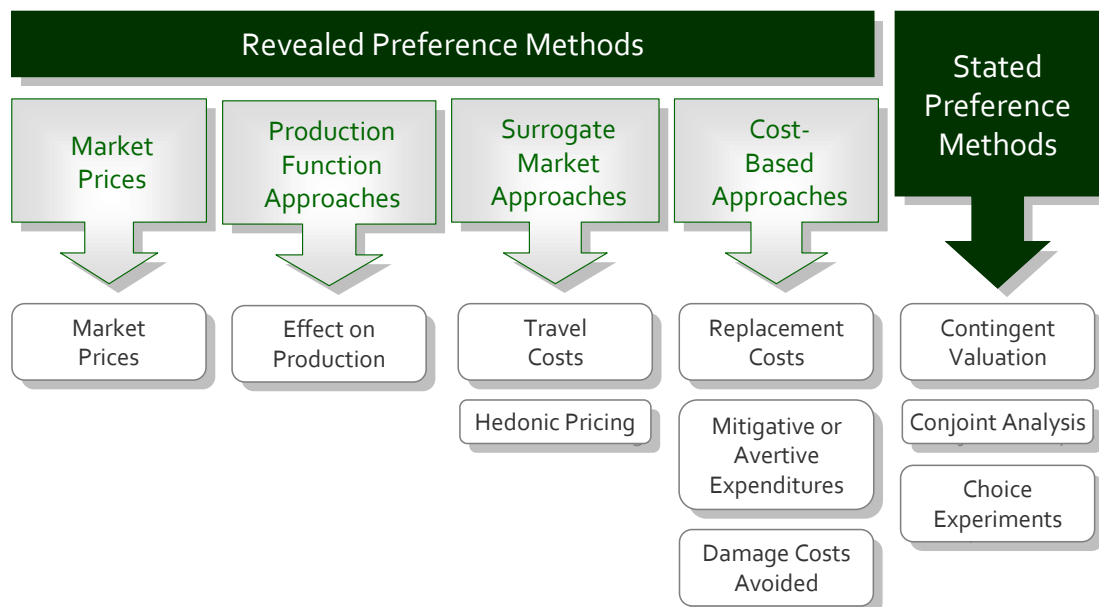
A better understanding of the economic value of ecosystems does not necessarily favour investments in their conservation and sustainable use. It does however permit them to be considered as economically productive systems within the realm of water sector decision-making.

The question of how to place a monetary value on ecosystem services has posed something of a challenge to economists. The easiest and most

straightforward way to value goods and services, and the method used conventionally, is to look at their market price: what they cost to buy or are worth to sell.

However, as ecosystem water services very often have no price (or are subject to prices which are highly distorted as regards their real value), market prices only have very limited application. Whereas it is relatively easy, for example, to estimate the returns from agriculture or to assess the water quality benefits delivered by a treatment plant just by looking at the market prices involved, it is virtually impossible to carry out a comparable calculation for wetland wastewater treatment services or for the waterflow services delivered by natural grasslands.

For this reason, a suite of methods have been developed with which to value ecosystem services which cannot be assessed accurately via the use of market prices. Today a wide range of methods which move beyond the use of direct market prices are available, and used, for valuing ecosystem benefits. As illustrated below, these include approaches which ask people to state their preferences directly, as well as those which use indirect methods to impute people’s preferences as revealed through their purchase of related goods and services.



Commonly-used methods for ecosystem valuation



Effect on production	Relates changes in the output of a marketed good or service to a measurable change in ecosystem goods	<b>Pollination services.</b> Effect on production techniques were used to value the vulnerability of agriculture to pollinator insect decline. The study measured the economic impact of pollinators on agricultural output via the use of dependence ratios quantifying the impact of a lack of insect pollinators on crop production value. The study found that the total economic value of insect pollination worldwide amounted to €153 billion, which represented 9.4% of the value of world agricultural production used for human food in 2005 <i>Gallai, N., Salles, J-M, Settele, J. and B.E. Vaissière, 2007. Economic valuation of the vulnerability of world agriculture confronted to pollinator decline. Institut National de la Recherche Agronomique, Paris.</i>
Travel costs	The amount of time and money people spend visiting an ecosystem for recreation or leisure purposes	<b>Recreation services.</b> The Conservation Reserve Programme (CRP) aims to mitigate the environmental effects of agriculture in the USA. A study was carried out to assess the impacts of improved environmental quality on freshwater recreation, using travel cost methods. More than 1,500 visitor surveys assessed travel costs to wetlands, lakes and rivers where water was an important reason for the trip. The study found that the contribution of CRP efforts to these values was just over \$35 million, or about \$2.57 per hectare. <i>Feather, P., Hellerstein, D. and H. LeRoy. 1999. Economic Valuation of Environmental Benefits and the Targeting of Conservation Programs: The Case of the CRP. Resource Economics Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 778, Washington DC.</i>
Hedonic pricing	The difference in property prices or wage rates that can be ascribed to the different ecosystem qualities or values	<b>Amenity services.</b> Hedonic pricing techniques were used to value the landscape and amenity services of wetlands in Portland, Oregon. More than 15,000 observations of residential home sales were made, investigating the property price as well as structural, neighbourhood and environmental characteristics. Results showed that wetland proximity and size exerted a significant influence on property values. <i>Mahan, B.L. 1997. Valuing Urban Wetlands: A Property Pricing Approach. US Army Corps of Engineers Institute for Water Resources, Evaluation of Environmental IWR Report 97-R-1, Washington DC.</i>
Replacement costs	The cost of replacing an ecosystem good or service with artificial or man-made products, infrastructure or technologies, in terms of expenditures saved	<b>Water treatment services.</b> Replacement costs were used to value the wastewater treatment services provided by Nakivubo Swamp in Uganda. The wetland runs from the central industrial district of Kampala, through dense residential areas, before discharging into Lake Victoria. It treats and processes around a half of the city's wastewater. The replacement cost of these services in terms of the artificial technologies required to reach a similar level of water quality would be around \$2 million a year for the municipal council. <i>Emerton, L., Iyango, L., Luwum, P., and A. Malinga. 1999. The Economic Value of Nakivubo Urban Wetland, Uganda. IUCN – The World Conservation Union, Eastern Africa Regional Office, Nairobi.</i>
Mitigative/avertive expenditures	The expenditures be required to mitigate or avert the negative effects of the loss of ecosystem services, in terms of expenditures saved	<b>Water quality services.</b> Poor drinking water quality is a major problem in Gotland, Sweden. Mitigative expenditure techniques were used to value the services that natural wetlands provide in reducing nitrate levels in water. These looked at the costs of various measures for nitrogen abatement, including reducing farmers' applications of fertilisers and manure and increasing the capacity of sewage treatment plants. The study found that the value of investing in wetland restoration and management is more than twice as high as the costs of these mitigative actions. <i>Gren, I. 1995. The value of investing in wetlands for nitrogen abatement. European Review of Agricultural Economics 22: 157-172.</i>
Damage costs avoided	The costs incurred to property, infrastructure and production when ecosystem services which protect economically valuable assets are lost, in terms of expenditures saved	<b>Flood attenuation services.</b> The economic impacts of alien plant Invasions in South Africa were valued by looking at damage costs caused through increased fire risk, soil erosion and loss of flood protection. These included the costs associated a wildfire on the Cape Peninsula in March 1999 that created water-repellent conditions in an invaded area which formerly had no overland flow. Flooding following heavy rains resulted in cleanup costs of more \$ 150,000 and flood damage to dwellings of a similar amount. In another example, two wildfires burnt 8,000 ha on the Cape Peninsula in January 2000, where insurance claims amounted to \$5.7 million. <i>Van Wilgen, B. W., Richardson, D. M., Le Maitre, D. C., Marais, C. and D. Magadlela. 2001. The economic consequences of alien plant invasions: examples of impacts and approaches to sustainable management in South Africa. Environment, Development and Sustainability 3: 145–168.</i>
Contingent valuation	Infer ecosystem values by asking people directly what is their willingness to pay for them or their willingness to accept compensation for their loss	<b>Water quality services.</b> Contingent valuation techniques were used to assess Bangkok residents' willingness to pay to clean up the Chao Phraya River, which is one of the most polluted in Thailand. The aim was to assess the potential to recover the costs of new wastewater treatment facilities. Focus groups and questionnaires elicited bids for additional water payments or taxes, and found that almost 80% of city dwellers are both willing and able to pay for improvements in water quality. <i>Tapvong, C. and J. Kruavan. 1999. Water Quality Improvements: A Contingent Valuation Study of The Chao Phraya River. Environment and Economics Program for Southeast Asia, International Development Research Centre (IDRC), Ottawa.</i>
Conjoint analysis	Elicits information on preferences between scenarios involving ecosystem services between which the respondent would have to make a choice, at different prices or costs saved	<b>Tourism services.</b> A conjoint analysis was used to ascertain the tourism value of rivers in the Crocodile Catchment in South Africa. A combination of a representative range of relevant river attributes (the number of crocodiles and hippos, number of waterbird species, diversity of the riverscape, and density of riparian trees) were presented, and four levels were defined for each depending on catchment management practices. Two questions provided values for the 'ideal' and 'worst' scenarios relative to the status quo. The study found that about 30% of tourism business in the National Park (currently worth about \$17 million in terms of on-site expenditure, \$33 million in terms of economic impact, and \$125 million in terms of consumers' surplus) would be lost if rivers were totally degraded. <i>Turpie, J.K. and A. Joubert. 2001. Estimating potential impacts of a change in river quality on the tourism value of Kruger National Park: An application of travel cost, contingent and conjoint valuation methods. Water SA 27(3): 387-398.</i>
Choice experiments	Presents a series of alternative resource or ecosystem use options, each defined by various attributes including price, and asks respondents to evaluate these "sets", which each contain different bundles of ecosystem services	<b>Conservation and recreation services.</b> A choice experiment study, administered via a postal survey, was used to measure conservation and recreational values for Forestry Commission woodlands in South East England. Three dimensions of forest management were investigated: nature conservation (wildlife preservation and ecological functions), provision for public access (recreational activities) and experience of nature (appreciation of woodlands for the opportunity of having direct contact with nature). A fourth dimension was also added: distance of the woodland relative to the respondent's place of residence. The findings of the study revealed strongly-expressed preferences towards higher levels of woodland conservation and lower levels of provision for public access in the form of recreational facilities. <i>Manukyan, A. 2005. Choice Experiments and the Social Value of Forests: Forestry Commission Woodlands in South-East England, UK. University of Brighton/Forest Research, Brighton.</i>

Examples of the application of ecosystem valuation techniques in the water sector

## A framework for valuing catchment ecosystems in water decision-making

Drawing together these conceptual and methodological advances, the project developed a framework for valuing ecosystems in the context of water decision-making. The aim was to provide a simple, straightforward set of steps which will yield values that can easily be integrated with the costs and benefits that are more conventionally included in financial and economic analysis.

The focus was on generating information about catchment ecosystem values which could be used to inform SA Water’s management planning, investment appraisals and policy formulation. A particular concern was to be able to calculate the value of investments in catchment management as part of a “multiple barrier approach” to delivering water quality, water supplies and other benefits to SA Water and its customers.

The framework involves four basic steps, to be applied in a given catchment in relation to desired water goals:

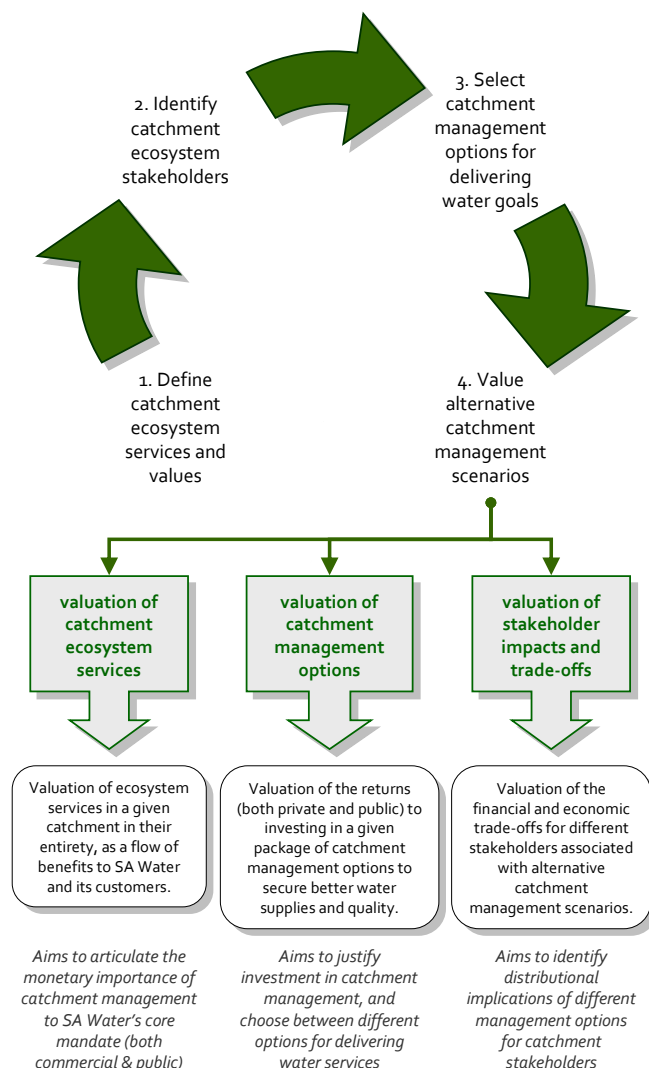
**Defining catchment ecosystem services and values:** using the categorisation of ecosystem services and values provided by the Millennium Ecosystem Assessment and Total Economic Value frameworks, this provides a baseline of the current ecological and economic status quo from which changes can be measured.

**Identifying catchment ecosystem stakeholders:** assessing the different sectors and groups who depend on catchment ecosystem services and whose actions impact on their status, this identifies who will be affected by (and will themselves affect) catchment investments and management options.

**Selecting catchment management options for delivering water goals:** this lays out the different technological, infrastructure and catchment management options that are being considered to reach a particular water goal, and which will either impact on the provision of ecosystem services, depend on them, or make efforts to enhance them.

**Valuing alternative catchment management scenarios:** using the various ecosystem valuation techniques outlined in the previous section, this measures the economic impacts of changes in ecosystem services under the selected management alternatives. The intention is to calculate the returns to catchment investment for SA Water overall, in relation to the delivery of water services, and in terms of the broader social and economic benefits and costs that will be generated for society.

The next section of this briefing paper looks at how this framework was applied to the Blue Lake Catchment Ecosystem in Mount Gambier. The aim was to identify, analyse and value catchment ecosystem goods and services in relation to investment and management options for improving water quality.



Steps in valuing catchment ecosystems in water decisions

## Ecosystem valuation in the Blue Lake Catchment, Mount Gambier

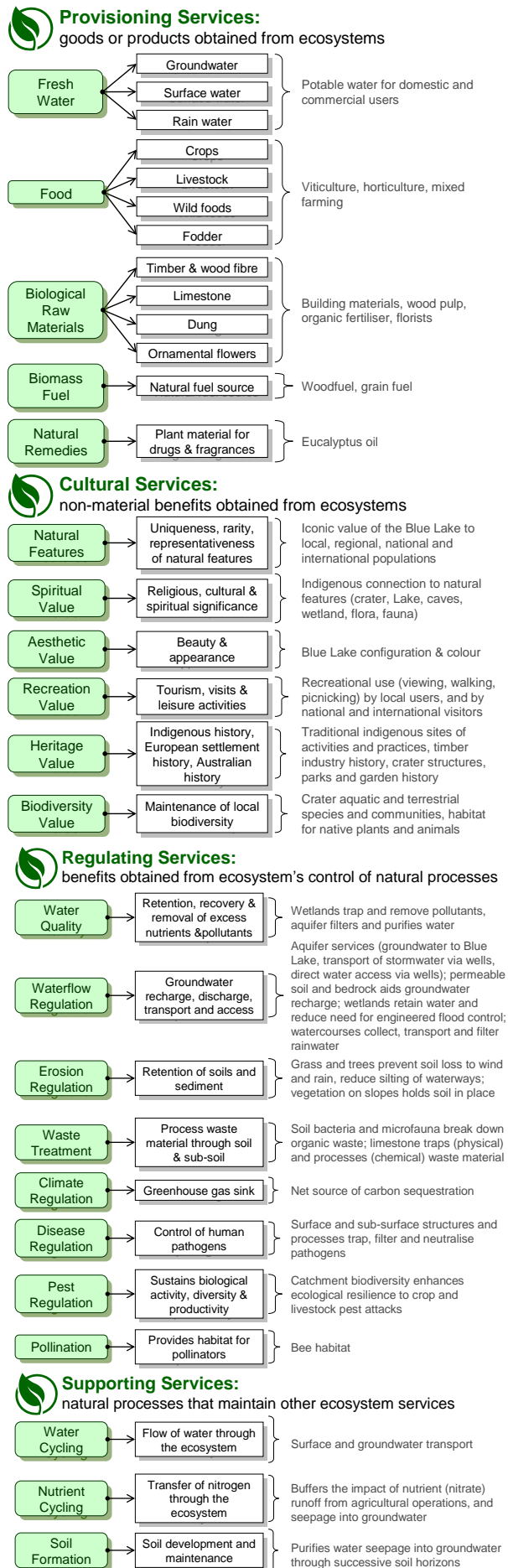
The Blue Lake is an iconic natural feature in the south-east of South Australia. It sits on the northern edge of the City of Mount Gambier, the largest regional city in the State with a population of approximately 23,000. The Blue Lake provides most of the domestic, commercial and industrial water for the City, and attracts on average over 400,000 international and domestic visitors spending over A\$100 million.

Both the quality and the availability of water in the Lake is of critical importance for the city's people, as well as for other users. The threats to water supply are linked primarily to changing rainfall patterns, coupled with rapidly increasing demand. Mount Gambier has experienced below average rainfall for at least a decade. Levels of water the Blue Lake have declined by approximately two metres over this time.

The main threats to water quality are nitrates (largely caused by farming and septic tanks), metals and hydrocarbons (largely associated with industries). Other threats to water quality and health, such as E-coli, cryptosporidium and giardia are monitored, as also are sporadic algal blooms and endocrine disruptors. The water from the Blue Lake is treated by SA Water prior to distribution.

The study aimed to show how investments in better and more sustainable ecosystem management would yield concrete economic pay-offs in terms of meeting water supply and quality goals. To do this, it valued the ecosystem services which contribute to these goals, in the light of modelling catchment management initiatives would which maximise these ecosystem values. The steps outlined above were followed.

**Step 1: Define Catchment Ecosystem Services and Values:** The following table indicates the ecosystem services of the Blue Lake catchment, categorised according to the MEA framework.



As outlined in Briefing 1, the study argued that SA Water’s catchment management strategy is required to consider this suite of catchment ecosystem services, to meet the demands of both its private and public mandate.

**Step 2: Identify catchment ecosystem stakeholders:** The linkages between the ecosystem services carried out by the Capture Zone and the users or beneficiaries of those services was explored. The following table summarises some of the key user categories:

Ecosystem Service Beneficiaries	
Beneficiaries	Examples
Licensed irrigators	Irrigated cropping.
Industrial businesses.	Timber milling, Production facilities.
Primary producers with bores (no water licenses).	Livestock grazing.
Primary producers without bores (no water licenses).	Timber plantations. Non-irrigated cropping.
Domestic users.	Residential homes, recreation.
Commercial users.	Restaurants, hotels, motels.
Local government (District & City).	Parks and gardens, public facilities.
Non-catchment residents	State, national and international Tourism. Carbon sequestration. Biodiversity conservation.
Indigenous groups	Indigenous sites and activities of cultural significance.
Other cultural users	Aesthetic uses. Heritage uses.

**Step 3: Select Catchment Management Initiatives For Delivering Water Goals:**

After consideration of a number of options, the catchment management system chosen for modelling was **improved management of stormwater**. This would employ new stormwater

well management techniques (including traps, capping and wetlands) together with development of wetlands to capture and process stormwater and to recharge the unconfined aquifer. Water benefits would include better prevention of contaminants entering the aquifer; reduction in water treatment costs; increase in natural wetlands, adding to biodiversity and conservation; and tourism and education benefits of increased wetlands.

Under this system, four catchment management initiatives to improve water availability and quality were designed and modelled:

**Drainage Well Management:**

*‘High Risk’ Drainage Well Management:*

Implement 25 filtration retrofits to settling chambers of bores (22 council bores, three private bores). The retrofit involves the addition of a filtration step (polypropylene or gravel media) in the triple chamber settling pits.

*‘Medium Risk’ Drainage Well Management:*

Instigate three monthly cleaning regime of 200 drainage bores and drainage pit sites. Introduce shroud fitted to the outlet pipe to prevent floatable materials entering the drainage bore.

*Cap unused wells:*

Cap 50 unused drainage wells to reduce water treatment, maintenance, and contaminant risk costs.

**Water-Sensitive Urban Design (WSUD) and Mini-Wetland Stormwater Management:**

Direct stormwater capture to two kinds of wetlands: a large natural wetland and a commercial wetland.

The study models a 100 Ha wetland with walking trails and a basic interpretive centre to encourage tourism. Such a wetland would produce a range of benefits: water available for Managed Aquifer Recharge (MAR) to replenish the water balance; water purification benefits through natural cleansing processes within the wetland; direct tourism benefits from wetland visits; multiplier effects for regional tourism benefits; biodiversity



maintenance; bio-sequestration of carbon; and iconic value. Water waste streams have available economic value if developed in combination with commercial wetland crops to increase the value of the wastewater resource, offset the use of fresh reticulated water or fresh bore water, and become an input to crop production. This study models the production of a reed crop.

#### Rainwater Harvesting:

The rainwater harvesting initiative focuses on rainwater capture at the property level.

The residential property initiative modelled is based on the provision of an incentive for households to install certified rainwater collection systems that are connected to a home's hot water, toilets and garden use. The direct economic benefit of this approach is the value of water directly captured and used. This initiative also values the benefit to the community from restoring underground water flows as the demand on the Blue Lake water balance is reduced.

Under the commercial property initiative part of the valuation is also the benefit reflected in increased commercial rentals attached to the savings by commercial tenants in water bills.

#### **Step 4: Value alternative catchment management initiatives.**

Benefits and costs associated with the values and users for each initiative were identified, and net benefit flows estimated across the 20-year horizon. The UK Treasury recommendation of a 3.5% discount rate was adopted, as representing best international practice. Net Present Values were then calculated for each of the initiatives.

The first initiative, *Drainage Well Management*, yields an estimated NPV of \$4.8 million. Of this over \$1 million of the benefit value derives from avoided water treatment costs. However, the most significant benefit, more than \$4.5 million, is derived from the benefit of avoiding a contaminant outbreak. Costs relating to this option are both capital and operating costs. The cleaning and

maintenance costs are substantial, as the risks to population health of inadequate operations are real and, as noted, of high impact.

The second initiative, *WSUD and Mini-Wetland Stormwater Management*, yields an estimated NPV of approximately \$850,000. Benefits are comprised largely of the value of captured stormwater and of avoided treatment costs. The modelling also includes an estimate of the impact of providing more water to habitats of significance outside the Capture Zone. These are related to ecosystem integrity and resilience. The modelling also considers biodiversity maintenance for established wetlands. The economic value is relatively small, under these assumptions, but it has been included as an example of this kind of value and valuation. Costs under this option relate to relatively minor amounts for incremental development, capital investment, and operations.

The third initiative, *Wetlands and Aquifer Recharge*, includes two sub-options, a large natural wetland and a commercial wetland. The NPV of the first initiative is approximately \$14.8 million. Major benefit values for this initiative derive from the value of captured water and avoided treatment costs, and in this option includes a significant value related to recreation benefits. A simple Travel Cost method has been used to approximate this value, drawing on known tourism data, and a making conservative assumption about numbers of tourists likely to visit such a wetland.

The set of minor, but important, benefits of a large natural wetlands includes: carbon sequestration, valued using physical quantities established in environmental research studies, and an assumed carbon price, based on current discussions about the proposed Federal Carbon Pollution Reduction Scheme; an estimate of biodiversity value based on Victorian Bush Tender values; existence value, using a benefit transfer approach from another rural Australian study, and aggregated to the population of the South East region. Costs of this option relate mainly to the acquisition and

development costs, and by the building and operating of a small interpretive centre.

The second initiative under this option is the construction of a commercial wetland. Here the NPV is a negative: -\$3.7 million. Clearly the relatively small benefits of avoided water treatment costs, supplemented by the commercial value of the reed crop (at current levels of technology and current pricing), are outweighed by the substantial capital investment and operational costs. Carbon sequestration benefits are registered, but play no material part in the valuation.

The fourth initiative, *Stormwater Harvesting (Residential and Commercial)*, yields the largest of the indicative NPV's, at \$22.8 million, with approximately half of the total economic value being contributed by each initiative. Water value avoided treatment cost benefits from both are substantial. There are important social benefits of both initiatives, in the contribution made to maintaining the water level of the Blue Lake.

**Sensitivity Analysis:** Three variables were examined: discount rate, annual rainfall and carbon price.

At discount rates of 7% and 10% the NPV values of all four options are reduced under these scenarios. Under the 10% scenario all options maintained a positive NPV. The total NPV of all options is maintained at 40% of the base case value.

Annual rainfall levels 40% lower and higher than the annual average reduce and increase total NPV respectively by approximately 25%.

Carbon price volatility has little impact on the carbon price in either direction. Emerging international developments in carbon trading could change this result.

## **Conclusions & management recommendations of the study**

1. An integrated catchment approach to improving water quality and availability outcomes, based on maximising ecosystem values, in the Blue Lake Capture Zone can yield positive corporate and social outcomes.
2. Specifically, a Stormwater Management approach, implemented through a number of key initiatives, shows promise of improving water quality and availability in the Blue Lake Capture Zone.
3. The modelled outcomes of the Stormwater Management approach in the Blue Lake Capture Zone incorporate a range of social, economic and environmental benefits, many of which are linked. The Ecosystem Services framework appears to offer a coherent, well-credentialed analytic method for capturing these elements and their linkages.
4. The economic valuation framework, which seeks to derive Total Economic Value for the proposed initiatives in the Blue Lake Capture Zone across these benefit categories, and across the costs associated with them, appears to offer a flexible and comprehensive methodology for:
  - Quantifying and monetarising the benefits and costs associated with the proposed initiatives;
  - Investigating the viability of individual options;
  - Comparing the economic, social and environmental benefits of different management options.



This paper was produced as part of the “Catchments as Assets” Project.

Carried out as a collaborative exercise between UniSA and SA Water, the project aimed to generate information which would assist in integrating the value of catchments as assets into SA Water’s internal planning and evaluation processes, and as external justification for future pricing regulators. It ran between June 2008 and July 2009.

**For further information, contact:**

Dr Geoff Wells  
Division of Business  
University of South Australia  
North Terrace, Adelaide SA 5000  
[geoffrey.wells@unisa.edu.au](mailto:geoffrey.wells@unisa.edu.au)  
<http://www.unisa.edu.au/IGSB/>

Nicole Lewis  
SA Water House  
250 Tarndanyangga (Victoria Square)  
GPO Box 1751, Adelaide SA 5001  
[nicole.lewis@sawater.com.au](mailto:nicole.lewis@sawater.com.au)  
<http://www.sawater.com.au>