Valuation of ecosystem goods and services in Victoria, Australia

INFORMATION PAPER FOR EXPERT MEETING ON ECOSYSTEM ACCOUNTS

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1 Introduction

1. The purpose of this paper is to address concepts and questions raised in Issue 10: principles of monetary valuation in the System of Environmental-Economic Accounts (SEEA) Experimental Ecosystem Accounts: A Proposed Outline, Road Map and list of issues[6]. Quoting from this:

> *"There is a general consensus on the principle that monetary valuations in SEEA should be consistent with the SNA. However, there are a number of technical challenges to achieve this and also compile meaningful information for ecosystem accounts in monetary terms. In particular, there is a need to continue to take stock of existing practices and build a collective understanding on what is feasible or efficient and which approaches are appropriate for what purposes.*
>
> *The scope of ecosystem accounts, in principle, may include valuations of services already included implicitly in the SNA and valuations of services not included in because they are flows outside of the SNA production boundary."*

2. Two tasks are identified in the roadmap document:

1) Review current proposals for valuation from the perspectives of policy relevant uses, technical soundness, feasibility for regular and comprehensive accounting, and coherence with the general accounting framework
2) Compile list of the key technical challenges for monetary valuation in the ecosystem accounts

3. This paper addresses both of these issues. It does this by briefly reviewing some of the key principles and concepts associated with the valuation of ecosystem stocks and flows, and then, links those to both the SEEA and market-based environmental programmes employed in Victoria (Australia) to procure environmental outcomes on private land. The aim of these programmes is to preserve or change the mix of ecosystem goods and services delivered from private land in order "*…to maintain or improve the capacity of ecosystems for delivering services to present and future generations…*"(quote from paragraph 10 of roadmap).

4. The programmes in Victoria require detailed information on the environmental assets and the suite of market and non-market goods and services delivered by these assets. The programmes target investment in protecting existing environmental assets or altering the management of environmental assets to enhance the flow of ecosystem goods and services. This approach explicitly recognises that human input to the management and use of environmental assets directly contributes to the production of ecosystem goods and services. Given this approach, it is important from the outset to understand the relationship between environment assets and the flows of goods and services that they produce, and to work with accepted definitions and classifications of assets, ecosystems and ecosystem good and services.

[6] http://unstats.un.org/unsd/envaccounting/londongroup/meeting17/LG17_9a.pdf

5. The SEEA Central Framework defines:

- *"Environmental assets are the naturally occurring living and non-living components of the Earth, together comprising the bio-physical environment, that may provide benefits to humanity. 7*

- *Ecosystems are areas containing a dynamic complex of biotic communities (for example, plants, animals and micro-organisms) and their non-living environment interacting as a functional unit to provide environmental structures, processes and functions.*[8]

- *Ecosystem services are the benefits supplied by the functions of ecosystems and received by humanity."*[9]

6. The SEEA Central Framework has a classification of assets, including environmental assets, which appears to cover all of the assets that need to be included in SEEA. The Central Framework does not provide a classification of ecosystems, although it notes the potential to build on the land cover classification for the purposes of constructing ecosystem accounts (paragraphs 5.241 and 5.312). This would appear a logical starting point and also helps to bridge the SEEA Central Framework and the SEEA Experimental Ecosystem Accounts. The classification of ecosystem services the Common International Classification for Ecosystem Services (CICES)[10], is a link to the Central Product Classification, which provides a very good starting point. Importantly, the CICES approach recognises land as an asset, the quality of the land and the potential of that land to provide ecosystem services.

2 Valuation of environmental assets and ecosystem goods and services

7. The valuation of assets can be a complex task. The following concepts related to valuation of assets have been taken from the draft SEEA (October 2011, paragraphs 2.103-2.107) which are drawn from the System of National Accounts (SNA):

- An asset is a store of value representing a benefit or series of benefits accruing to the economic owner
- An economic owner is the institutional unit entitled to claim the benefits associated with the use of an asset.
- Economic benefits reflect a gain or positive utility arising from economic activity (production, consumption, accumulation)
- Economic assets are classified as either produced assets, non-produced assets or financial assets.
    - Produced assets are assets that have come into existence as outputs of processes that fall into the production boundary of SNA (buildings, machines and stores of wheat for future use). Produced assets also include cultivated biological resources (assets) – sheep for wool, breeding stock and orchards for the production of fruit.

[7] October 2011 Draft SEEA Central Framework, paragraph 2.17, p. 30

[8] October 2011 Draft SEEA Central Framework, paragraph 2.21, p. 31

[9] October 2011 Draft SEEA Central Framework, paragraph 2.22, p. 31

[10] Haines-Young, Roy and Marion Potschin (2010) Proposal for a Common International Classification of Ecosystem Goods and Services (CICES) for Integrated Environmental and Economic Accounting, Prepared for EEA for the UN Committee of Experts on Environmental-Economic Accounting, 23- 25 June 2010, New York. (http://unstats.un.org/unsd/envaccounting/ceea/meetings/UNCEEA-5-7- Bk1.pdf)

- Non-produced assets are assets that have come into existence in ways other than through processes of production. They include natural resources, contracts, leases, licences and purchased goodwill.

8. Following the SNA, the preferred approach to the valuation of environmental assets in the Draft SEEA Central Framework (October 2011, paragraph 2.107) is market value. In some cases there are few or no markets for environmental assets. Alternative approaches for estimating market value are available and the use of net present value (NPV) is recommended in the Draft SEEA Central Framework (October 2011, chapter 5).

9. The NPV approach is based on estimating the economic returns to owners from the goods and services that flow from the environmental assets. Some of the flows, including water, energy, timber and food, come from environmental assets and are flows of ecosystems goods and services. These flows of goods and services have market values which make the underlying environmental asset amenable to NPV valuation. However, other ecosystem goods and services, and especially those of regulation, maintenance and cultural services usually do not have explicit market values, even though they might be highly valued by society. A range of approaches have been developed to estimate values including: hedonic pricing; replacement cost; change in productivity etc.

10. In addition to these approaches, significant progress is being made in the design and creation of institutions that mimic the way markets reveal prices[11]. The common feature of these techniques (sometimes referred to as market-based instruments) is that they aim to overcome complexities that inhibit transactions (leading to price revelation) in domains of the economy where markets have not evolved.

11. Tradable permits for pollution is a simple example of where a market can be created by capping emissions, creating rights to pollute and allowing these rights to be traded. This intervention allows those buyers who value pollution permits highly to secure rights to pollute (within the cap) and allows those firms able to provide low-cost abatement to sell pollution permits. This process of self-selection of high-value consumers and low-value producers mimics the way markets discover prices.

12. For other environmental goods and services, the complexities that inhibit transactions are more severe requiring purpose-built interventions to facilitate transactions. Smart markets[12] for example, can be created to overcome complexities such as: the asset package problem[13], policy complexity[14], time complexity[15], strategic complexity etc[16]. A field trial of a smart market for native vegetation offsets (The Native Vegetation Exchange) is currently under way in Victoria. In this case the environmental asset is the land containing specific types of native vegetation that need to be packaged and traded to offset the clearing of native vegetation for development. If successful, this intervention will discover prices based on the private information of market participants and will expand the boundary of the market economy.

13. In regular markets prices are determined by information from the marginal transaction. For example, if there are fewer buyers than sellers, price is determined by the last

[11] Roth 2002

[12] An example of a smart market is where computers are employed to calculate the optimal combination of units of an asset given the valuations of buyers for different combinations of assets e.g a combinatorial auction.

[13] The package problem refers to assets where the value of one item is interrelated to the ownership of a second item. This occurs with mobile phone spectrum.

[14] Policy complexity refers to situations where the rules required to regulate transactions become so complex that it becomes costly to understand and abide by these rules.

[15] Time complexity refers to the problem that not all market participants arrive at the market place at one time.

[16] Plott et al 2008

buyer's bid price. Similarly where there are fewer sellers than buyers, clearing prices are determined by the last genuine sellers offer. For many categories of environmental goods and services that have public good characteristics, it has not been possible to design institutions capable of revealing buyers' bid prices. It has, however, been possible to design and create new institutions capable of revealing information about the *offer prices* (willingness to sell price) of producers able to supply ecosystem services. Landholders, for example, can reorganise their production systems to produce environmental goods and services and are able to make offers to supply these goods and services in a competitive environment. The BushTender[17], a single environmental outcome program, and EcoTender[18], a multiple outcome environmental program, employ reverse price auctions to allocate conservation contracts to landholders.

14. This institutional setting has been designed to reveal the cost of each landholder's proposed additions to the stock of environmental assets and the provision of ecosystem services. To facilitate the efficient allocation of funds, a significant investment in landscape information and biophysical modelling (EnSym, https://ensym.dse.vic.gov.au/) was required to inform the decisions about the appropriate price that should be paid for the expected environmental services produced[19].

3 Conservation auctions in Victoria, Australia

15. Since 2003 the Victorian government and associated institutions have used conservation auctions to procure environmental goods and services on private land across Victoria. In simple terms the government is a buyer of ecosystem goods and services and private landowners are the sellers.

16. Over this time, the auctions have increased in sophistication, starting as single-outcome auctions (BushTender) that focused only on terrestrial benefits, to multiple environmental outcome auctions (EcoTender) that aimed to deliver multiple benefits, including terrestrial, wetland, rivers and catchment condition[20]. Additionally, the number of land management options for which payments can be made increased over time. The first tenders focused only on the outcomes derived from the management of remnant native vegetation, whereas latter tenders purchased management activities and environmental outcomes resulting from revegetation. The management of remnant native vegetation increased the supply of ecosystem services from existing environmental assets whereas revegetation aims to increase the overall stock of environment assets – land with native cover. Over time this stock will deliver an increasing amounts desired ecosystem services.

17. The conservation auctions were run as sealed bid tenders. The sites are assessed by government officials and scored based on the environmental benefit produced by undertaking particular management actions on a site. For example, excluding cattle grazing from remnant native vegetation by fencing and undertaking weed control. The capacity of the remnant native vegetation to produce more ecosystem services, such as improved habitat for wildlife (including rare and endangered species), water filtration, and accumulation of biomass, is increased as a result of managing the site better. This increase is scored and is known as the 'Environmental Benefit Index' or EBI. The EBI is used alongside landholder bids to determine the value for money of each site (i.e. dollar per EBI), thus enabling the government (i.e. the investor) to distinguish between high and low value bids[21].

[17] Stoneham et al 2003

[18] Stoneham 2007, Eigenraam et al, 2007

[19] Eigenraam et al 2007

[20] Eigenraam et al 2007

[21] Connor et al 2008, Eigenraam et al 2011

3.1 EnSym

18. To support the administrative process used in later auctions (i.e. EcoTender) the Victorian Department of Sustainability and Environment (DSE) developed an Environmental Systems Modelling Platform or EnSym. EnSym is a computer program that has been designed by DSE to model the impact on the environment derived from our actions in the landscape. EnSym utilises spatial information such as climate data, elevation, vegetation type, soil type and land use to model outputs including surface water, ground water dynamics and native habitat changes. The scientific models employed in EnSym are widely sourced from leading credited scientists in their field.

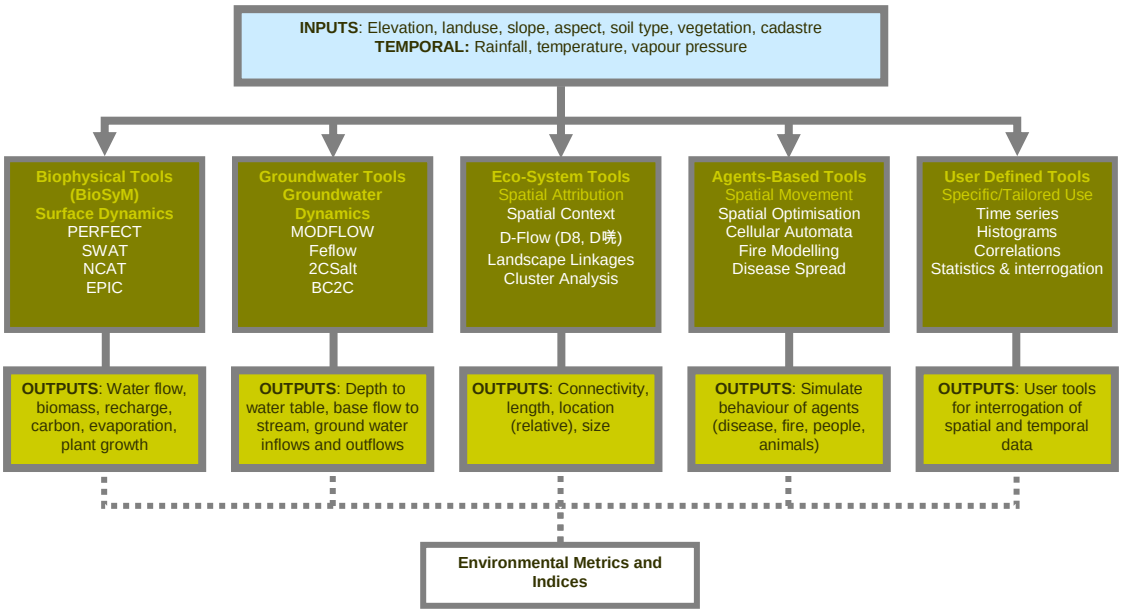
19. A large part of the science driving ecoMarkets is based on mapping Victoria into 20-metre grids. This level of landscape detail is a first for Victoria and possibly the world. The new landscape modelling techniques make it possible to identify the contribution that each 20-metre grid can make to improving environmental outcomes.

20. At its most basic level, this grid system characterises how each 20-metre area fits into the overall ecosystem. This detailed knowledge of the unique aspects of any particular location in the landscape allows prediction of the catchment scale impacts of any land management action or group of actions. For example, revegetating along a stream with indigenous plants will: create improved habitat for native flora and fauna; filter water runoff which reduces sedimentation and prevents harmful nutrients from entering the stream; and, finally sequesters carbon. However, this revegetation will also use water that will not be available for aquatic flora and fauna or consumptive purposes downstream. Developing the science to understand these interactions is critical if we are to make real improvements to the environment and avoid potentially unwanted outcomes.

21. For the first time DSE Victoria can accurately identify and assess environmental quality and judge the relative dollar value of potential improvements to the land. This means they can more easily report on the condition of their ecosystems and quantify in dollar terms the contribution the environment makes to the Victorian economy.

22. EnSym has embedded in it a series of toolboxes (Figure 1 below) and metrics that calculate the current condition of a site and also predict the change in environmental outcomes expected as a result of undertaking management actions. It also stores information in an easily accessible data structure.

Figure 1. Overview of EnSym Toolboxes



23. EnSym employs each of the tools to estimate the improvement in the supply of ecosystem services resulting from changes in management. EnSym simulates and forecasts changes in ecosystem services – water quality, habitat services, landscape connectivity, recharge to groundwater aquifers, etc – which are aggregated in the 'Environmental Benefit Index'.

24. Between 2007 and 2011 EnSym has been used to collect and process data, create conservation management plans for over 5,500 sites on 900 farms in 19 conservation tenders that together distributed over $10 million of public funding.

3.2 Applying EcoTender transactions to the SEEA framework

25. The following discussion centres on the largest EcoTender programme undertaken to date, which was run in West Gippsland, Victoria (see Figure 2 below). In the West Gippsland EcoTender, 262 bids were submitted by landholders, that represented over 1,530 hectares and an existing 271,304,904 EBI. From this the Victorian government awarded AUD$2.5 million of conservation contracts covering 1,262 ha and the purchase of an estimated 306,010,395 EBI.

Figure 2. West Gippsland EcoTender

3.2.1 Market prices for ecosystems services

26. Figure 3 below shows the abridged supply curve for EBI for the West Gippsland EcoTender. In EcoTender there are two forms contract used to reveal price:

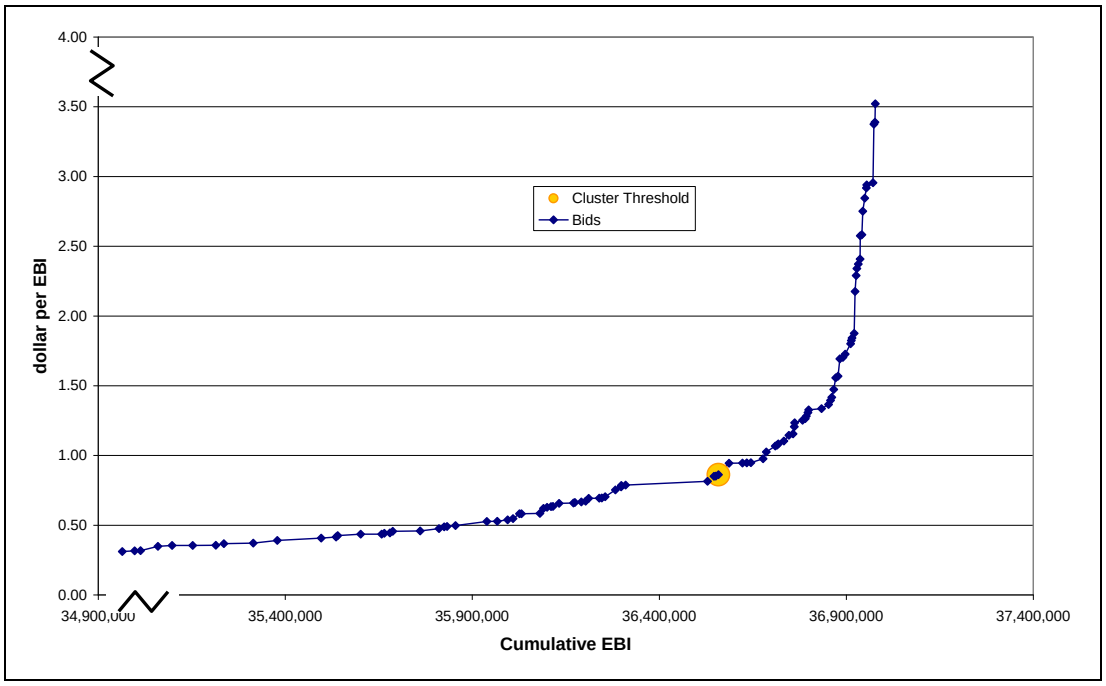
a) Short-term conservation contract – this type of contract pays a landholder to manage a site for conservation purposes for five years. The site cannot be used for any other commercial purpose. Generally the site has been used for intermittent grazing or wood harvesting which is no longer allowed whilst the site is manage for conservation purposes. The EBI resulting from EnSym is a measure of the improvement or additional ecosystem services that will result from the change in management. This contract reveals the price that the landholder will accept for managing the land and associated vegetation for the provision of ecosystem services (supply price). This price is what the government must pay for an increase in ecosystem services.

b) Permanent contract – the same type of restrictions apply for a permanent contract as for the short term contract. However, the landholder also agrees to change the property rights associated with the site by entering into a permanent *on-title* change to the site. Ownership of the land remains with the landholder and the obligation to manage the site for conservation purposes exists in perpetuity. That is, when the land is sold to another owner, the obligation is passed to the new owner. The EBI resulting from EnSym is a measure of the change in EBI plus a multiplication factor for the permanence of the sites existence (i.e. the benefits are not for 5 years, but for perpetuity). All else being equal a landholder entering into a permanent contract will generate a greater EBI value for their site. This contract reveals both the price of providing EBI (additional ecosystem services) and can also be used to assess the value of the land and other environmental assets covered by the contract.

27. The data on the price paid for the environmental benefits may be representative, or at least correlated with, the value of the ecosystems goods and services that are delivered from environmental assets. These values could also be combined with additional information on the cost of management to generate asset values.

28. The auction reveals the supply side (landowners) of the environmental market however the willingness to pay – demand side (in this case the government) – is not known fully. This is because the budget allocated by government is largely arbitrary and set in this instance for the purposes of demonstrating the conservation tender approach. That said, the auction aimed to provide an incentive to landholders to truthfully reveal their true costs for changing or modifying the use of their land for increased provision of a desired suite of ecosystem goods and services. The government preferences for ecosystem services are built into the EBI. Generally these preferences reflect an ecological view of rare and threatened flora and fauna, landscape connectivity and landscape function (species, water, nutrient and sediment movement).

Figure 3. Supply curve for West Gippsland EcoTender



29. In the absence of a true demand curve an algorithm has been developed based on information theory that identifies the point that splits all bids into two discrete groups – low cost and high cost providers[22]. The price that separates the groups is referred to as the threshold price, see Figure 3. All bids to the left of the threshold price are deemed successful and all bids to the right are deemed high cost and rejected. This method is more efficient than the traditional budget method for identifying a cut-off price in auctions where the budget in many instances is close to exceeding the value of all submitted bids, as can often be the case in small scale conservation auctions[23].

30.

[22] Eigenraam et al 2011

[23] Eigenraam et al 2011

Table 1 provides a summary of the bids and the mean prices paid for both short and long term contracts. Of the total bids 43% were successful consisting of 41% of short term contracts and 71% of the long term contracts. The higher percentage of long term contracts may reflect the preference built into the EBI which gives a higher score to long term (contracts) bids. This is done to reflect the 'risk' element of investing in ecosystem services on any given site. A long term contract represents a binding change to the property rights of the land thus reducing the risk of that land being used for purposes other than ecosystem production in the future.

31. The price per hectare for the long term contracts is higher than short term contracts. This may reflect the difference between renting a site for the production of ecosystem services as opposed to transferring the assets rights on a permanent basis to the production of ecosystem services. It could also reflect that the current land owner believes that the restriction on land use will devalue the property when it is sold in the future. At this point it is difficult to infer asset values for land that produces ecosystem services because the bid selection process is based entirely on the EBI.

Table 1. Summary EcoTender prices for EBI and hectares

	Number of bids **All *(Successful)***	**Mean AUD$/Ha** ***Successful bids***
All contracts	263 *(115)*	1,915
Short-term contracts	243 *(100)*	1,670
Permanent contracts	21 *(15)*	2,950

32. The cutoff price determined by the threshold algorithm is 0.497 (Figure 3 – see yellow dot). This can be thought of as the marginal price in traditional economic theory. However, in this case the government is a monopsy – price discriminating between buyers. The government pays the actual price landholders bid rather than the marginal price. The mean price paid by the government per EBI for 0.07.

33. The EBI per hectare is analogous to tonnes of wheat per hectare. All other factors being equal, the asset value of land that produces wheat is generally based on the discounted future value of wheat that can be produced on the land and the costs associated with producing the wheat, including the degrading the condition of the land, and transporting wheat to market. In Victoria the EBI takes into account the same type of information. The condition of a site is assessed to determine its capacity to produce ecosystem services and its location is assessed to determine it capacity to provide those services to the surrounding landscape (landscape context based on species etc). Finally the management actions a bidder is willing to commit to for future years influences the condition of the site and its subsequent ability to provide ecosystem services.

Table 2. Condition Scores Environmental Assets for West Gippsland

EBI – Condition Elements	**Terrestrial Assets**	**River Assets**	**Wetland Assets**
Opening Condition	61,769.50	22,919.72	2,381.61
Additions to condition			
Acquisitions	7,130.09	3,837.56	241.06
Reclassification			
Reduction in condition			
Natural losses	-141.44	- 51.68	-0.02
Reclassification			
Closing condition	68,758.16	26,705.60	2,622.64

34. Table 2 provides a disaggregation of the condition component of the EBI for West Gippsland. The opening condition represents the current condition as it was assessed during the tender process for terrestrial, river and wetland assets. The additions to condition via acquisitions[24] were modelled using EnSym and are the result of management actions that will be undertaken by *successful* landholders and paid for through either long or short term contracts. The total allocation of funding to landholders (AUD$2.5m) is the cost to the Victorian government to improve the condition of the assets. It is not possible to assign the funding to value individual environmental assets because some sites have more than one asset

[24] A question arises with respect to terminology. Are the additions to condition acquisitions are a change in classification?

on them. When landholders bid, they bid on the whole site which aligns with the aim of the programs aim to manage the landscape as an integrated unit of environmental assets.

35. The reduction in condition due to natural losses is the result of natural degradation of the sites which were not successful. Many of the sites are isolated, exist on private land and are not actively managed for the production of ecosystem services. EnSym also estimates the losses to a site if it is not managed.

36. The closing condition is net of acquisitions and natural losses. The change in ecosystem services from the improvement in overall condition is reflected in the physical accounts tables below. The data provided through the West Gippsland EcoTender should allow us to estimate values for the four types of ecosystem accounts, namely;

- Physical accounts for the supply and use of ecosystem goods and services
- Monetary accounts for the supply and use of ecosystem goods and services
- Physical accounts of the environmental assets that supply the ecosystem goods and services
- Monetary accounts of the environmental assets that supply the ecosystem goods and services

Table 3. Physical Account for Environmental Benefits Index

EBI - Physical Account	**Agriculture**	**Forestry**	**Aquaculture**	**Use of built up and related areas**	**Land used for maintenance and restoration of environmental functions**	**Other uses of land**	**Land not in use**	**Total**
Annual EBI Flow to 30 June 2010	271,304,904							271,304,904
Increase in EBI flow due to:								
Acquisitions					35,855,034			35,855,034
Reclassification					270,155,361			270,155,361
Reduction in EBI flow due to:								
Natural losses	(84,838)							(84,838)
Reclassification	(270,155,361)							(270,155,361)
Annual EBI Flow to 30 June 2015	1,064,706				306,010,395			307,075,101
Change in annual flow								***35,770,196***

37. Within the SEEA framework, the environmental asset that is most related to EcoTender transactions is 'Land'. Specifically, each EcoTender contract results in an increase in the area (and value) of 'Land used for the maintenance and restoration of environmental functions', and a reduction in area land used for 'Agriculture'.

38. Within the SEEA framework, supply of ecosystem goods and services (defined by unit EBI) can be represented in the physical accounts in Table 3 above. During the tender process, the current supply of unit EBI for sites is determined through site assessments and spatial simulation. Sites that are managed under contract are expected to increase in EBI over time,

whereas those not managed are expected to depreciate due to factors such as weed and pest inundation, grazing and soil degradation (*natural losses)*.

39. Table 3 shows the changes in flow of EBI (ecosystem services) from the land associated with the tender program. It does not account for all the other land in the region of West Gippsland. At this stage there is insufficient data to forecast or estimate both the condition and services being provided on the remaining land. However, for illustrative purposes the data are quite powerful. It shows that as a result of the tender and the transaction between the government and landholders there has been a reclassification of land from 'Agriculture' to 'Land used for the maintenance and restoration of environmental functions' and a subsequent net increase in the flow of EBI from the region for the areas assessed.

40. A question of terminology arises with respect to acquisition and reclassification. Currently within Table 3 the change in flow of EBI has been allocated to both reclassifications (270,155,361) and acquisition (35,855,034). The acquisition reflecting the additional EBI from the change in management of the sites. This approach provides a clearer picture of the outcomes from the economic-transaction from an accounting point of view. However, the total increase could be recorded against reclassification (306,010,395) to Land use for maintenance.

41. From an accounting perspective (and possibly an ecological one too) there has been a reclassification of the land providing EBI (ecosystem services) from agriculture (-270,155,361 EBI) and an addition to the overall flow of EBI from land due to improved management (+35,855,034 EBI). As noted above there was a fall in the condition of some environmental assets which is also reflected as a fall in the flow of EBI (ecosystem services) due to natural losses. However, the net position is an increase in the flow equivalent 35,770,196 units of EBI per annum.

42. Table 4 shows the change in land use in hectares for the physical asset for land. In this instance there are data available to calculate the opening balance of land across each of the classifications. For this region there is a total of 1.7 million hectares dominated by land for agriculture and land for maintenance of environmental services. This particular region contains a lot of public land and state and national parks.

43. As a result of the tender there 1,263 hectares of land has been reclassified from 'Land used for the maintenance and restoration of environmental functions' to land used for 'Agriculture'.

44. From the accounts presented here the following summary observations can be made:

- the total reclassification of land was 1,263 ha
- the total reclassification of the flow of ecosystem services is (306,010,395 EBI) associated with that land
- the total cost was AUD$2,419,518
- there was an improvement in condition for terrestrial, river and wetland assets

Table 4. Physical Account for land assets

Land - Physical (ha)	Agriculture	Forestry	Aquaculture	Use of built up and related areas	Land used for maintenance and restoration of environmental functions	Other uses of land	Land not in use	Total
Opening stock	739,687	120,430	-	82,359	758,572	3,400	9,371	1,713,819
Additions to stock								
Acquisitions								
Reclassification					1263			
Reduction in stock								
Natural losses								
Reclassification	-1263							
Closing balance	738,424	120,430	-	82,359	759,835	3,400	9,371	1,713,819

45. The supply side of the tender market provides the building blocks to start populating monetary environmental accounts. This information may be used to determine the asset values. The price paid is a gross price and difficult to use for asset valuation. There is a need to obtain more information about landholder costs to produce the ecosystem service a so calculate a net price that could provide an estimate of the asset value based on an NPV approach. In the future there are possible links with land accounts and the spatially allocation or imputation of cost information.

4 Discussion and Conclusion

46. The Victorian government has made a significant investment in conservation auctions and the administrative tools needed to support them. The auctions have revealed a supply side price for private landowners for a selection of ecosystem goods and services but true demand side price (willingness to pay by government) has not yet been determined. Despite this possible limitation, the information revealed in the process is potentially very useful for government decision-making, and the conservation auction processes are continuing. Further structuring of the information from the conservation auctions into an accounting framework should further enhance the usefulness of these data.

47. Some key questions or issues to emerge from the work in Victoria:

a. How can the supply side market values revealed in the conservation auction process be used in an accounting framework?

b. How would the transactions already undertaken be recorded in the SNA or the SEEA Central Framework?

c. How can an ecosystem accounting framework, building on the SNA and SEEA, be used by governments (and other investors) in policy development and decisions about allocation of financial resources?

d. What would be the structure of a set of ecosystem accounts to inform government decision-making?

e. What data would be needed to underpin the accounts and what data collection, processing and output systems would be needed to make the annual production of accounts a reality?

48. To answer these and other questions the Victorian government is working with the Australian Bureau of Statistics on pilot set of land and ecosystem accounts for Victoria. The pilot project is expected to be complete by mid-2012.

49. This pilot will address the need of natural resource managers and governments to justify their decisions relating to investments in environmental protection and management, not only in terms of the benefits to the environment, but also in terms of financial accountability. It will also investigate how accounts could be used by Governments in balancing the allocation of resources between different areas of public interest: environment, health, education, defence, transport, etc.

50. A key issue at present is that environmental management agencies are not geared to provide the information necessary to judge the effectiveness or otherwise of spending on environmental protection. As such much of the current investment is poorly informed by data and there is little opportunity to review, and if necessary modify, individual investment decisions or the strategies used to guide them. The conservation auctions have, as an unintended benefit, begun to address this underlying data issue. The development of land and ecosystem accounts will continue to address this gap and in particular should allow information from a variety of other sources to be integrated more easily.

51. The use of accounting to link the condition of environmental assets to the ecosystem goods and services and to the investments made in environment protection and management can reveal the unit costs of improving the condition of environmental assets and the flow of ecosystem goods and services. Over time, this should enable governments and other investors to identify where, when and how financial resources can be most usefully deployed. In particular, it should enable managers to distinguish when there are, or are likely to be, diminishing returns on investments.

52. A key potential of environmental accounting is that it can be used to show the timing of investments and the timing of the benefits that are expected from this investment. This is particularly important for governments as investments made now may not deliver benefits for many years. As such the structure of accounts needs to show the future benefits of spending made now. This may have parallels with cash and accrual accounting in business accounting.

53. So far the experience of developing and running the conservation auctions and developing pilot land and ecosystem accounts has identified several practical issues. These include:

- The importance of spatially referenced environmental information systems for assessing environmental assets (stock) and biophysical modelling to estimate flows of ecosystem goods and services.
- The need to work collaboratively across government agencies at the national, state and region levels and with a range of disciplines (economic, environmental science, accounting, data management, etc).
- The need to develop a common terminology for discussing environmental accounting.

54. Natural resource managers and governments must justify their decisions relating to investments in environmental protection and management, not only in terms of the benefits to the environment, but also in terms of financial accountability. Increasingly they are being asked to be more accountable for public expenditure and to demonstrate the environmental outcomes resulting from investments. Often it is difficult to measure or estimate the environmental outcomes that result from the financial investment made to increase the quality of the environment and the benefits that flow from this.

55. Notwithstanding the theoretical and measurement difficulties, ecosystem accounting, and in particular the extension of the SEEA Central Framework in ecosystem accounting, appears to offer a coherent way to assess the volume, value and timing of benefits obtained from government spending. Exactly how to apply the data from EnSym and EcoTender to the SEEA is not yet clear, but the Victorian government, Australian Bureau Of Statistics and others are willing and able to contribute to the resolution of issues concerning valuation.

5 Questions for discussion

56. These two questions have been extracted from the discussion in section 4.

a. How can the market values revealed in the conservation auction process be used in an accounting framework? , How can the demand side for ecosystem goods and services be measured? Is there an alternative to governments to setting the level of demand on behalf of the general population?

b. How can the market values revealed in the conservation auction process be used in an accounting framework?

c. How can an accounting framework be used by governments (and other investors) in policy development and decisions about allocation of financial resources?

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