Valuation and treatment of water resource stocks

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1. Introduction

1. The Australian Bureau of Statistics (ABS) is investigating methods for estimating the value of water resources for possible inclusion within the balance sheet of the Australian System of National Accounts, in the Water Account, Australia and in a new annual environmental accounting publication. The System of Environmental and Economic Accounting – Central Framework (SEEA Central Framework) and the 2008 edition of the System of National Accounts (2008 SNA) are the relevant international statistical standards to guide the conceptual and accounting basis for this work. However, while both frameworks include water resources within their respective asset boundaries, neither the 2008 SNA nor the SEEA Central Framework provide conclusive guidance on the valuation of water resource stocks.

2. This note interprets the 2008 SNA and maps the SNA assets to the physical assets of SEEA Central Framework for the purpose of guiding estimation of the value of water resource stocks. The 2008 SNA discussion of valuation of water resource stocks reflects the historical progression of SNA balance sheet estimation and the priority placed on generating estimates of the value of land—wherein some of the value of water resources is embedded.

3. The absence of unambiguous guidance on the treatment and measurement of water resources partially explains why, some twenty years after these resources first appeared as an asset item in the SNA, no national statistical agency, to our knowledge, reports values for water resources within the balance sheet of their national accounts, nor as part of environmental or water accounts.

4. Previous ABS research presented to the London Group (Comisari *et al*. 2011) indicates that in valuing water resources net present value approaches in practice tend not to work because of problems associated with estimating the value of capital used to capture and distribute water within typically heavily regulated markets for water. As such, tradable water rights probably represent the best opportunity to generate estimates of the value of water resource stocks in Australia. Further research will be important for clarifying the concepts, methods and outputs related to the valuation of water resource stocks.

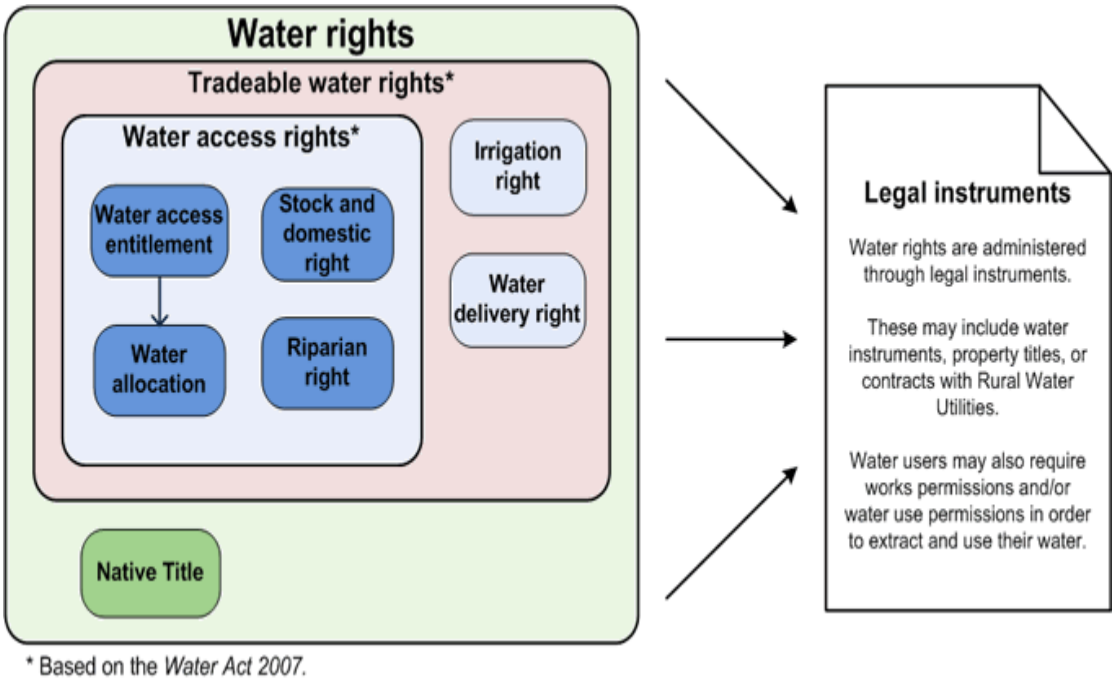
5. A side issue raised by the examination of water rights for valuation is how to record the significant volumes of water held by the Australian government for allocation for the benefit of the environment in physical and monetary supply and use tables. This issue is briefly discussed as a note at the end of the paper in the context of adding the environmental as a sector in accounting tables as suggested by Heins and Edens (2013).

2. Water rights and the Australian National Water Market

6. Where tradable water rights are in widespread use, the successful valuation of water resources will likely involve the use of information pertaining to these rights. An understanding of these instruments is therefore an important backdrop to the discussion of the valuation and recording of water resources within the SNA and the SEEA Central Framework. In Australia, water access and use is governed by statutory water rights administered by individual state and territory governments. The various water rights operating within the Australia

National Water Market are summarised in Diagram 1 and described further in the paragraphs immediately following.

Diagram 1: Water rights in Australia



* Based on the *Water Act 2007*.

7. The Australian National Water Initiative (NWI) defines a *water access entitlement* as "a perpetual or ongoing entitlement to exclusive access to a share of water from a specified consumptive pool as defined in the relevant water plan". These water access entitlements are attached to land parcels which adjoin waterways or sit above aquifers and have been gifted to the holders—though volume based charges apply to any water extracted under these entitlements. Water access entitlements are tradable, though not all are permitted to be traded separately from the land to which they relate.

8. A *water allocation* derives directly from the water access entitlement. Each season, the relevant jurisdictional government assesses water availability within a catchment and announces how much (the 'allocation') of the water access entitlements can be used given prevailing water availability. These water allocations are usually determined/reflected as a percentage of the total share to which each water access entitlement holder is entitled. An example serves to illustrate the relationship between water access entitlements and allocations.

9. A farmer may hold an ongoing water access entitlement of 10 Giga litres (GL) p.a. However, this does not mean the farmer necessarily has the right to extract 10 GL p.a. Rather, the jurisdictional government may announce that, due to prevailing conditions in the catchment, only 80 per cent of the entitlement may be extracted in the current season. Thus, for the current year the water allocation in this example is 8 GL (i.e. 10 GL access entitlement times the 80 per cent 'allocation').

10. Australian water allocations are tradable separately from land, that is, these allocations can be sold separately from the land to which the allocation was initially attached. Further, the allocation may be sold to an entity that operates

outside of the water catchment from which it is bought. The entity may, in fact, own no land at all.

11. Irrigators that receive water through a network of irrigation infrastructure operators (IIO) will typically hold a *water delivery right* against the IIO that allows this receipt of water and such rights may be tradable within delivery systems. The IIO is an entity that operates water service infrastructure to deliver water where the primary use is for irrigation. In many cases, irrigators in Australia do not hold a statutory water access entitlement. Instead, the IIO holds the statutory water access entitlement (often called a bulk entitlement) collectively on behalf of these member irrigators. Such member irrigators hold a contractual irrigation right that entitles them to receive water from their IIO. These irrigation rights may be transformed into tradable water access entitlements.

12. *Stock and domestic water rights* and *Riparian water rights* provide limited water rights to their holders—typically, drinking water, domestic use, fishing etc. Neither is tradable separately from the land to which they attach. Holders of *Native Title* with respect to water are able to undertake a limited range of non-commercial uses of water. Such rights are tied not only to specific location(s) but also to specific person(s) and cannot be traded.

3. Conceptual frameworks

13. For official statisticians, balance sheet estimates of water resource stocks are primarily guided by two complementary international statistical standards: the 2008 SNA; and the SEEA Central Framework. Though these standards are consistent, the scope of the SEEA Central Framework describes measures expressed in both monetary and physical terms, while measures recorded in the 2008 SNA are exclusively monetary.

14. The SEEA Central Framework asset boundary includes 'water resources' under the broader heading of 'natural resources' (paragraph 5.18). The water resources are classified as: surface water, groundwater and soil water (Table 5.2.1).

15. The SEEA Central Framework considers asset accounting for physical stocks of water resources in some detail though no conclusive guidance is provided on the monetary valuation of these resources. Recognising the need to pursue the development of methods further this matter is assigned to the SEEA Central Framework research agenda where it is suggested that the general principles of valuation of environmental assets tend to be inappropriate to water resources (paragraphs A2.26 and A2.27).

16. The SEEA Central Framework provides a physical asset account for water resources (Table 5.11.2) but there is no corresponding presentation for water resources in monetary terms. The System of Environmental-Economic Accounting for Water ('SEEA-Water') discusses valuation of 'water resources' but, like the SEEA Central Framework, does not deal specifically with the valuation of water resource stocks.

17. The text on composite assets within the SEEA Central Framework discussion of monetary asset accounts for land (paragraphs 5.300 to 5.310) does not

specifically address the case of combined land-water assets though this is an important aspect of measuring the value of water resources.

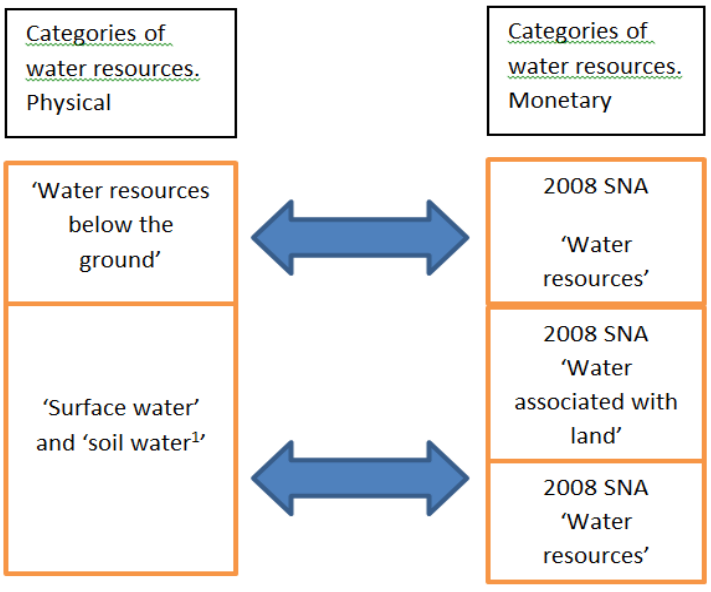
4. Land and water resources in the 2008 SNA and the SEEA Central Framework

18. This section seeks to clarify the links between the 2008 SNA and SEEA Central Framework definitions and recording of land and water resources. While the 2008 SNA does not generally deal with physical measures of assets, it broadly describes three separate physical components within water resource stocks: water resources below the ground (groundwater); water associated with land (which includes soil water); and surface water resources. These physical elements of water resources are then married to various asset items within the 2008 SNA—the correspondence is described in the paragraphs below and is more generally depicted in Diagram 2. The 2008 SNA definition of the asset 'land' is the starting point in understanding the definition and treatment of these three elements.

19. 'Water resources below the ground' are explicitly described by the 2008 SNA as being excluded from the value of 'land' (paragraph 10.175). SNA indicates that such resources should form part of 'water resources' in circumstances where they are:

> "used for extraction to the extent that their scarcity leads to the enforcement of ownership or use rights, market valuation and some measure of economic control." (Paragraph 10.184.)

Diagram 2: Relating physical categories of water to SNA asset items



[1]Soil water is assigned to the SNA category 'water associated with land'

20. The remaining components relate to surface water and soil water. 'Water associated with land' is a part of the SNA asset 'land' and relates to:

> "any inland waters (reservoirs, lakes, rivers, etc.) over which ownership rights can be exercised and that can, therefore, be the subject of transactions between institutional units". (2008 SNA, paragraph 10.175.)

21. While not specifically mentioned soil water is also part of land in the context of the 2008 SNA. Soil water can only be accessed via land, for example by the growing of rain-fed crops. Soil water cannot be transacted separately from land, except perhaps if the soil and water contained in the soil is extracted and sold which is likely a rare case.

22. The final water resource component in the 2008 SNA is that part of surface water included in 'water resources'. The 2008 SNA distinguishes these from 'water associated with land' in paragraph 10.175, where it states that:

> "water bodies from which water is regularly extracted, against payment, for use in production (including for irrigation) are included not in water associated with land but in water resources."

23. As such, the 2008 SNA is assigning all groundwater to 'water resources'; water integrated with land ownership to 'water associated with land'; and surface water subject to purchase, extraction and use in production as part of 'water resources' (along with groundwater).

24. In addition to the categories of water resources described in Diagram 2, there is an SNA (monetary) item called 'permit to use a natural resource' which includes such things as tradable water rights. These permits are not a type of natural resource but may provide a basis for the development of values for water resources. They are discussed below but note that the full value of these rights does *not* appear in the SNA balance sheet—rather; only the value of these rights extending beyond that of the underlying asset is recorded.

25. The 2008 SNA pointedly excludes 'water resources below the ground' from the value of land while including surface water (reservoirs, lakes, rivers, etc.). However, a parcel of farmland located above a significant and accessible aquifer usually has a higher market value than a similar farm with no access to groundwater (assuming water scarcity). It would be surprising if reported land values found within any typical set of national accounts in fact excluded the value of 'water resources below the ground'. Nevertheless, assigning the full value of 'water resources below the ground' to 'water resources' is helpful in better supporting stand-alone estimates of water resources.

26. As stated above, the Australian water rights known as 'water access entitlements' are historically linked to parcels of land and were created by gift from the government. Also historically, the water to which these rights relate is subject to ownership rights directly linked to the land, and the 'permanent' sale of these water rights (i.e. where the right is passed in perpetuity to another owner) would occur upon the sale of the relevant land parcel. In this case the value of the water would be difficult to separate from the value of the land and hence recorded with the value of the land.

27. With the relatively recent separation of some types of water rights from the land, certain types of water rights are now sold independent of the land. Table 1

presents a correlation of the 2008 SNA and SEEA Central framework definitions of land and water resources against the main types of Australia's water rights.

Table 1. 2008 SNA and SEEA Central Framework and main water rights in Australia.

Water Rights in Australia	2008 SNA	SEEA Central Framework
Water entitlements and allocations	Water resources (Surface water Groundwater)	Water resources Surface water Groundwater
Stock and domestic Water rights	Land	Water resource Soil water
Native title water rights	Land	Water resource Surface water Groundwater Soil water

28. The different definitions used for the physical and monetary scope of water resources in the 2008 SNA and SEEA Central Framework is confusing. To guide water valuation according to the 2008 SNA we suggest commencing with a definition of the asset 'water resources', rather than with the balance sheet item 'land'. The former is the asset for which new values are most wanted. The exclusion of soil water and some types of surface water from the definition water resources in the 2008 SNA should be clearly noted along with the fact that they are (notionally) included in the value of land.

29. For the purpose of consistency between the physical and monetary definitions of water resource it is suggested that the coverage of water resources valued in water accounts be the same as in the 2008 SNA. Thus, if estimates are developed within the water accounts for soil water and for the surface water rights sold with land, then these values will need to be deducted from the land assets in the 2008 SNA. This is not ideal but is a practical way forward and concordance tables could be developed to show where the differences occur.

30. By adopting the above approach we can avoid consequential items of confusion arising from the approach taken by the 2008 SNA. For example, paragraph 10.184 of the 2008 SNA states that where it is not possible to separate the value of surface water from the associated land, the whole should be allocated to the category representing the greater part of the total value. Confusingly, the balance sheet discussion at paragraph 13.51 states that 'water' (along with non-cultivated biological resources and other natural resources) is recorded in the balance sheet *only to the extent that this value is not included in the value of the associated land asset* [our emphasis]. This is clearly recommending that the only element of water value to be separately identified in the balance sheet is that part over and above what is embedded in the value of the associated land. That is, even where it is possible to separately identify the full value of surface water from the associated land, SNA advises it is inappropriate to record this amount against 'water resources' in the balance sheet. This treatment, of course, is necessary under the approach taken by the 2008 SNA in order to avoid double-counting of water in the balance sheet but it is confusing, and analytically unhelpful to those with a specific interest in water resources and water

accounting. The suggestion above avoids this confusion and allows for a more meaningful reporting of the value of water resources in water accounts and potentially the balance sheet.

5. Water rights in the 2008 SNA and SEEA Central Framework

31. The 2008 SNA balance sheet treatment of water rights considers recording of these rights only when they create a significant value beyond that of the underlying natural resource. In the context of balance sheet reporting this is appropriate, since it ensures that the majority of value is assigned to the underlying natural resource (i.e. water) and avoids double counting of tradable water right(s) against the underlying water resource. But further guidance on the use of tradable rights in valuing the underlying natural resource is needed. The SEEA Central Framework provides no conclusive guidance, while the 2008 SNA provides a solitary observance on the valuation of water resources, non-cultivated biological resources and other natural resources. It suggests that as:

> "observed prices are not likely to be available, they are usually valued by the present value of the future returns expected from them." (Paragraph 13.51.)

32. This paragraph repeats, verbatim, the advice of the 1993 SNA (paragraph 13.61). Over the past twenty years, however, the use of water rights to manage this scarce resource has grown dramatically and might reasonably be expected to grow further. In the experience of the ABS, the valuation of water resources on the basis of expected future returns is unlikely to yield analytically useful results[2]. In fact, our early research suggests that it is far more likely that tradable water rights will support viable values for water resources.

33. Water rights are economic instruments established to manage the competing potential uses of a scarce natural resource. It is appropriate that the treatment of water rights and the use of these rights in valuing water resources be located in the SEEA Central Framework.

6. Conclusion

34. The 2008 SNA recommends inclusion of water resources values within the national balance sheet. The 1993 SNA introduced (and the 2008 SNA maintains) the category of 'water resources' as a specific asset category; nevertheless some of the value of water is embedded and therefore 'hidden' within the value of land. In order to measure water resources as a stand-alone item, it is necessary to understand the location of various elements of water resources among various 2008 SNA and SEEA Central Framework assets and for a concordance to be developed.

35. The SNA provides guidance on the demarcation between 'water associated with land' and 'water resources' but this guidance does not align well with the SEEA Central Framework asset classification. The text in the 2008 SNA points to the increasingly important body of instruments used to control ownership and trading in water resources where these resources are scarce but the practice of

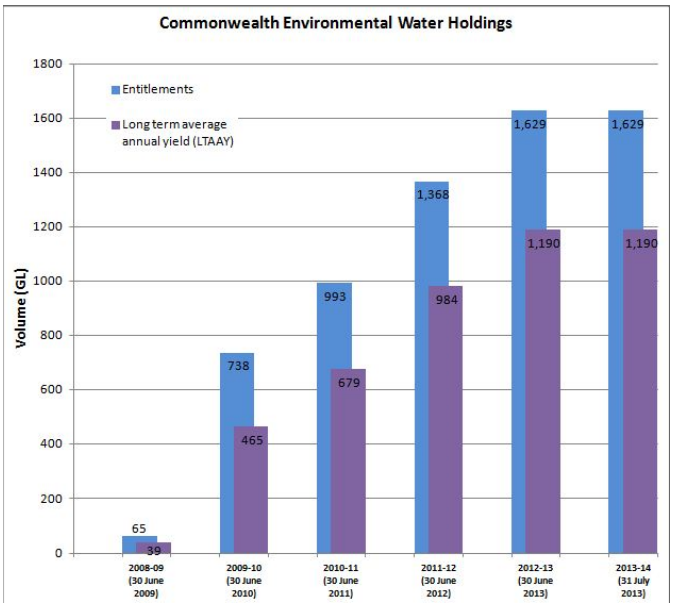
[2] Comisari, P. *et al.* 2011.

valuing water resources is poorly developed in both national and environmental accounting.

7. Note of the treatment of water rights held by the Australian government for environmental purposes.

36. In the course of investigations into the valuation of water a question arose concerning the treatment of the water rights held by government and the associated flows for the purpose of environmental benefit within the Murray-Darling Basin (the Basin). The volume of these rights has grown over 5 a short period (Fig. 1) and the amount held in July 2013 was 1,629 GL and represents approximately 10% of water consumption in Australia[3].

Figure 1 Commonwealth Environmental Water Holdings 2009 to 2013.



37. This water is called the "Commonwealth's environmental water holdings[4]" and is held by the Commonwealth Environmental Water Office. This water is made available for the purposes of protecting or restoring the environmental assets of the Murray-Darling Basin. There are around 18,000 identified environmental assets in the Basin.

38. The objectives of the laws governing water management in the Basin are specified in the Water Act 2007. One objective is particularly:

> 3d (ii) to protect, restore and provide for the ecological values and ecosystem services of the Murray-Darling Basin

39. As such, the purpose of these holdings by the government is clearly for environment benefit.

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[3] Water consumption is a form of net water use. In brief consumption equals the total use of abstracted water less the water used for hydro-electric power generation and water cooling that is returned to the environment with no change in water quality (i.e. no pollution is added). See the ABS *Water Account, Australia* for more information).

[4] See http://www.environment.gov.au/ewater/about/holdings.html

40. The water held by government was obtained through a variety of means including the purchase of water rights (e.g. from irrigators) and through infrastructure investments that reduce the amount of losses from the water supply infrastructure. As such the water rights were either formerly held by industries, mostly agriculture and the water supply, and the physical flows of water associated with the rights were used in economic production and accounted for in the physical and monetary supply and use tables.

41. With the change in ownership of the water rights, the use of the flows that are associated with these rights would also be expected to change. Assuming that all of the water associated with the rights is used by the government (i.e. not sold in a particular year to another user in another industry), and following the current structure of the supply and use tables of the ABS Water Account, Australia[5], the water could be recorded as a use by government (public administration). While this recording would be accurate it does not provide a clear indication of the use of the water.

42. An alternative recording would be to adopt the presentation suggested by Heins and Edens (2013) and show the use of water by the environment. This would enable users of the account to see the portion of the economically allocated water that is used for the benefit of the environment.

8. Questions for discussion

1. Question to the London group are:

    a. Do you agree with the interpretation of the 2008 SNA guidance on valuation of water resources?

    b. Do you consider that tradable water rights provide potential as a means to generate estimates of the value of water resources?

    c. Do you consider that any update to the SEEA Central Framework should reflect the emerging understanding and use of tradable water rights to value water resources?

    d. Are there any comments on the possible treatment of water held by government for environmental benefit?

[5] The ABS physical and monetary supply use tables present use by industry and align broadly with the SEEA Central Framework, although the presentation is different.

9. References

Australian Bureau of Statistics. 2010. *Environmental Issues: Water Use and Conservation, March 2010, ABS* cat. no. 4602.0.55.003. ABS, Canberra.

Australian Bureau of Statistics. 2012. *Water Account, Australia, ABS* cat. no. 4610.0. ABS, Canberra.

Australian Government. *National Water Market.* *http://www.nationalwatermarket.gov.au/about/rights.html*

Comisari, P., Feng, L. and Freeman, B. 2011. *Valuation of Water Resources and Water Infrastructure Assets*. Paper presented to the 17th meeting of the London Group on Environmental-Economic Accounting. Stockholm, Sweden. 12-15 September 2011.

Edens, B. and Hein, L. 2013. Towards a consistent approach for ecosystem accounting. *Ecological Economics* 90: 41-52.

European Commission, Food and Agriculture Organization, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, World Bank. 2012, *System of Environmental-Economic Accounting Central Framework.* *http://unstats.un.org/unsd/envaccounting/White_cover.pdf*

European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, World Bank. 2008, *System of National Accounts 2008.* *http://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf*

National Water Commission. 2012. *Impacts of water trading in the southern Murray-Darling Basin between 2006-07 and 2010-11.* National Water Commission, Canberra. *http://archive.nwc.gov.au/__data/assets/pdf_file/0009/21996/NWC_7019_WTR_Full.pdf*

National Water Commission. *National Water Initiative.* *http://nwc.gov.au/nwi*

Obst, C. 2012. *Valuation of water resources used for hydro-power.* Unpublished note dated 12 October 2012. Supplied by the author as editor of the SEEA Central Framework.

United Nations. 2012, *System of Environmental-Economic Accounting for Water.* *http://unstats.un.org/unsd/envaccounting/seeaw/seeawaterwebversion.pdf*

United Nations, International Monetary Fund, Organisation for Economic Co-operation and Development, World Bank and Commission of the European Communities, 1993. *System of National Accounts 1993*, Brussels/Luxembourg, New York, Paris, Washington D.C.