1. Design of the Regional Environmental Accounts Trial

NRM Regions Australia, the Wentworth Group of Concerned Scientists and associated scientists and experts in Commonwealth and state agencies undertook this trial to develop a set of regionally based environmental accounts which measure the condition of environmental assets. The purpose of the trial was to test the operational aspects and institutional arrangements necessary for carrying out an ongoing national environmental accounts program, based on the Wentworth Group's *Accounting for Nature* model (2008).

Environmental asset condition accounts measure the attributes of the biophysical environment (assets) over time, allowing examination of trends in change in those attributes. The accounts use a common unit of measure, an index called the *Econd,* to describe the relative condition of an asset against its reference condition.

Australia's 54 natural resource management bodies (NRM regions) formed the institutional setting for the regional environmental accounts trial. Ten regions took part in the *Accounting for Nature* trial between 2011 and 2014 (**Figure 2**). The NRM regions contributed towards the development of accounts through existing operational budgets. In-kind advice and expertise was provided by a number of individuals within research, management and government organisations (see **Supplementary Material 6**). No additional funding was attached to the trial apart from a coordinator position provided to the Wentworth Group of Concerned Scientists by The Ian Potter Foundation.

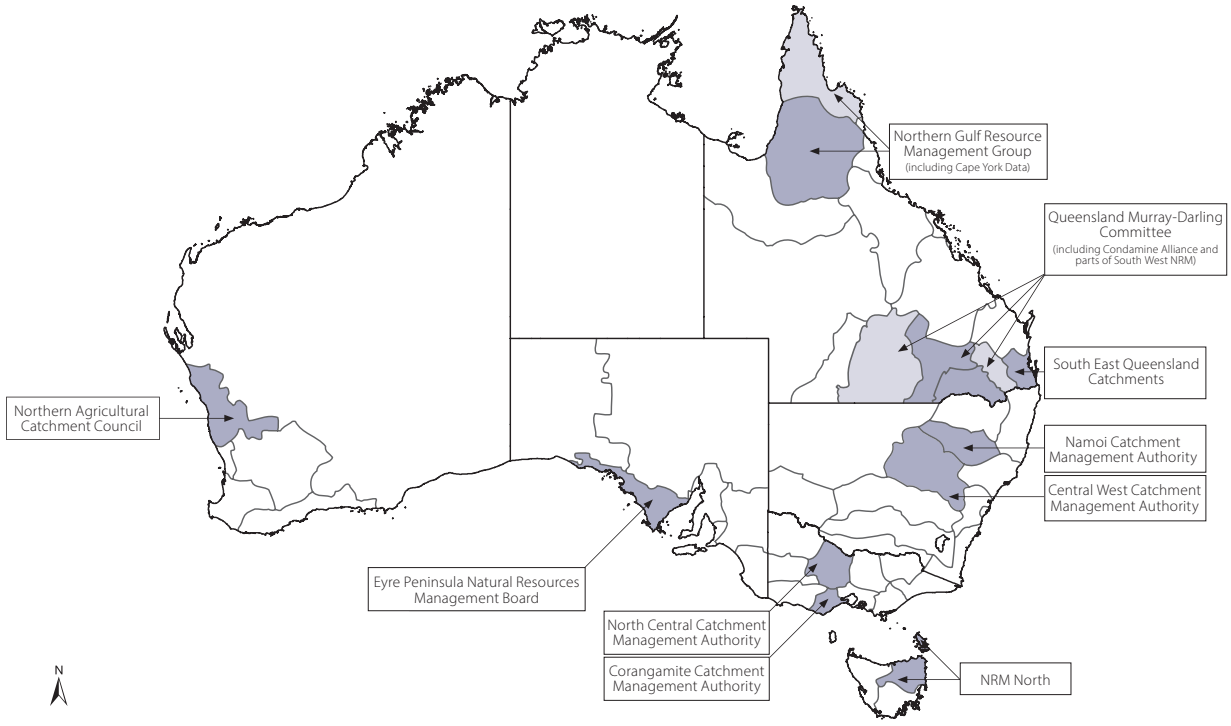

Figure 2: Ten NRM regions tested *Accounting for Nature* as part of the environmental accounts trial, but also covered some assets in adjoining regions (light grey areas).

Results of the trial are presented in two separate, complementary reports. The first is an *Evaluation of the Australian Regional Environmental Accounts Trial* (Sbrocchi *et al.*, 2015). It can be found at www.wentworthgroup.org/programs/environmental-accounts. The *Evaluation Report* examines processes and operational aspects of the regional environmental accounting trial in order to inform the implementation of a national program, based on the *Accounting for Nature* model (2008). It specifically focuses on four matters: processes developed through the trial; application of the *Accounting for Nature* model to regional environmental accounting; testing processes regarding aggregation of measures of environmental condition; and overall assessment of the model for multilevel environmental accounting.

This report, the *Technical Analysis of the Australian Regional Environmental Accounts Trial*, provides a more detailed analysis of the approaches used to compile the accounts and provides recommendations for further development of regional environmental asset condition accounting from a scientific and technical perspective. It draws upon data compiled for the environmental accounts, reflections of individuals, accreditation reports, Scientific Standards and Accreditation

Committee meeting notes, and draft reports and papers. It evaluates the methods and choice of indicators, shows how *Econds* are calculated, and uses these insights to describe the institutional and scientific arrangements required to further develop regional (landscape scale) environmental asset condition accounting practices.

This technical analysis is presented in two parts:

- *Technical Analysis* of each asset, discussing indicator selection and *Econds*, and recommendations for advancing asset condition accounting in Australia.
- *Supplementary Materials*, including descriptions of and links to the *Regional Environmental Asset Condition Accounts* and *Information Statements*; *Accreditation Criteria* used to evaluate the accounts; *Accreditation Reports* which summarise the findings of the accreditation process; *Working Papers* which set out draft accounting standards for specific assets; names of committees and contributors; descriptions of the program logic and evaluation questions; and a *Glossary of Terms*.

Accounts were submitted to the Scientific Standards and Accreditation Committee for native vegetation, native fauna, soils, rivers, wetlands, groundwater, floodplains, estuaries, marine fauna and fish stocks (**Table 1**) to determine whether they were of sufficient quality for regional scale environmental condition accounting. The committee accredited most accounts, with the exception of floodplains, groundwater and fish stocks, as these required further work on condition indicators and reference benchmarks (see Accreditation Reports in **Supplementary Material 4**).

Table 1: Assets submitted by regions for the environmental accounts trial

	LAND			FRESHWATER				COAST	MARINE		
REGION	Native Vegetation	Native Fauna	Soil	Rivers	Wetlands	Groundwater	Floodplains	Estuaries	Marine Fauna	Fish Stocks	Other
Central West Catchment Management Authority (NSW)	✓	✓					✓				
Corangamite Catchment Management Authority (VIC)	✓				✓						
Natural Resources Eyre Peninsula (SA)	✓								✓		
Northern Agricultural Catchments Council (WA)	✓	✓									
Namoi Catchment Management Authority (NSW)	✓					✓					
North Central Catchment Management Authority (VIC)	✓			✓	✓						
Northern Gulf Resource Management Group (QLD)	✓										
NRM North (TAS)				✓				✓			
Queensland Murray-Darling Committee (QLD)	✓	✓	✓	✓	✓						
SEQ Catchments (QLD)	✓	✓		✓	✓			✓	✓	✓	✓

Native Fauna. Birds. Southern Right Whales. Dugongs. Moreton Bay.

A purpose-built set of environmental accounting tables was populated for each of the regional assets. These consist of summary tables, asset tables and data tables showing the underlying data, following the Seven Step approach that was provided to the NRM regions in the *Guidelines for Constructing Regional Scale Environmental Asset Condition Accounts* (p. 3, Sbrocchi 2013). **Figure 3** demonstrates how the Seven Step method can be applied in the compilation of a native vegetation asset account (the seventh step describes the process for submitting an account for accreditation).

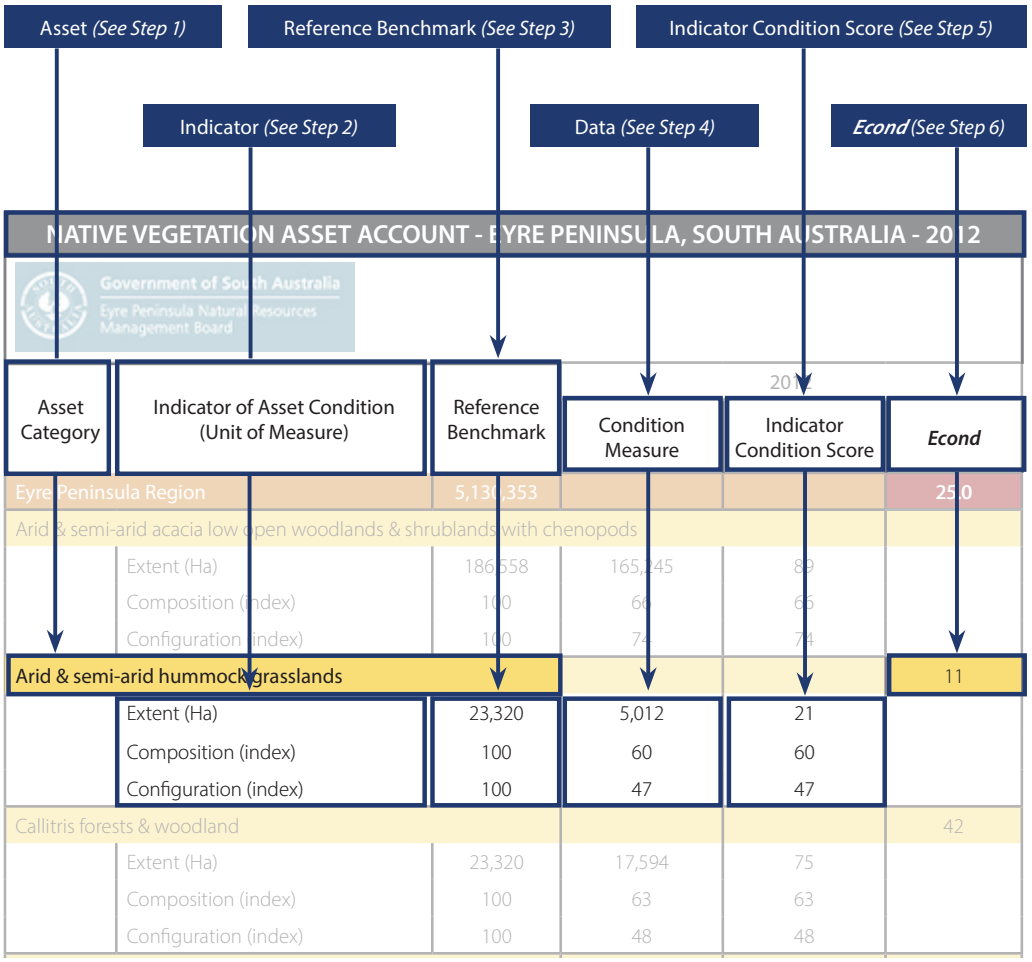

Figure 3: Features of an environmental asset condition account (Sbrocchi 2013).

The South East Queensland region offers examples of the three levels of accounting tables: summary (**Table 2**), asset (**Table 3**) and data (**Table 4**).

The summary table in **Table 2** provides the highest level of data, showing *Econds* and Indicator Condition Scores for the entire region at each time period. In this figure, one or more assets are listed for each asset group (land, freshwater, marine). For each asset, indicator themes are shown (eg for estuaries, they are physical/chemical index, biological health rating and foreshore/riparian habitat extent) with their corresponding Indicator Condition Scores. From these Indicator Condition Scores, regional *Econds* (bold) have been calculated (eg 41 for estuaries in South East Queensland in 2011, circled in red). This process is detailed in the respective asset chapters of this report and the Information Statements available online at: www.nrmregionsaustralia.com.au/our-projects/regional-environmental-accounts.

Table 2: A summary table showing asset scores for the entire South East Queensland region.

REGIONAL ASSET ACCOUNT SEQ CATCHMENTS, QUEENSLAND											
Summary Table											
Class	Asset	**Econd** & ICS	2003	2004	2005	2006	2007	2008	2009	2010	2011
LAND	**Native Vegetation**	**Econd**				**29**					
		Extent				53					
		Composition				53					
		Configuration									
FRESH-WATER	**Rivers**	**Econd**	**74**				**70**	**76**	**78**	**79**	**81**
		Physical/chemical index	82				77	84	85	86	91
		Nutrient cycling index	64				60	75	70	73	61
		Macroinvertebrates index	76				69	74	79	82	88
		Fish index	62				68	65	69	71	76
	Wetlands	**Econd**				**33**					
		Extent				62					
		Composition				59					
COASTAL	**Estuaries**	**Econd**		**57**		**55**	**42**	**44**	**39**	**41**	**41**
		Physical/chemical index	51	57		57	39	40	34	36	37
		Biological Health Rating		58		51	50	53	51	53	49
		Foreshore / riparian habitat extent					48	51	51	51	51
	Moreton Bay	**Econd**		**87**	**83**	**82**	**81**	**81**	**68**	**75**	**75**
		Physical/chemical index		90	85	84	83	82	69	78	77
		Biological Health Rating		73	74	74	74	75	64	64	66
MARINE	**Dugong**	**Econd**			**11**						
		Dugong population			11						

Regional *Econds* are also reported in the more detailed asset table (**Table 3**; eg 41, circled in red). In **Table 3**, the regional *Econds* are further dissected into individual asset classes (eg for estuaries, Albert River estuary, Bremer River estuary etc.). *Econds* and Indicator Condition Scores are reported for each asset class, with their corresponding reference benchmarks and measures. For example, the Albert River estuary *Econd* is 20 in 2011, and the physical/chemical Indicator Condition Score is 12 (circled in yellow).

The data table contains the most detailed level of data, showing specific indicators and the measures used to construct the Indicator Condition Scores for each asset class. **Table 4** provides the data table for the Albert River Estuary in South East Queensland (2010-11), showing the indicators (arranged by indicator theme), reference benchmarks, measures and indicator condition scores for each asset within the region. The asset and data tables are related. For example, the Indicator Condition Score for physical/chemical index of 12 shown in the data table (**Table 4**, circled in yellow), also appears in the asset table (**Table 3**).

Table 3: An asset table showing indicator themes and associated scores for individual estuaries in South East Queensland between 2009 and 2011.

ESTUARIES ASSET ACCOUNT SEQ CATCHMENTS, QUEENSLAND											
Asset Table: Freshwater > Estuaries											
Class	Indicator (unit)	Reference Benchmark	2009			2010			2011		
			Measure	ICS	Econd	Measure	ICS	Econd	Measure	ICS	Econd
Total					39			41			41
Albert River estuary					22			18			20
	Physical/chemical index (%)	100	15.2	15		9.2	9		12.4	12	
	Biological Health Rating (%)	100	29.2	29		29.2	29		29.2	29	
	Foreshore / riparian habitat extent (km)	32.2	15.5	48		15.5	48		15.5	48	
Bremer River estuary					22			21			22
	Physical/chemical index (%)	100	15.2	15		13.0	13		14.2	14	
	Biological Health Rating (%)	100	33.3	33		33.3	33		33.3	33	
	Foreshore / riparian habitat extent (km)	34.8	15.3	44		15.3	44		15.3	44	
Brisbane River estuary					30			31			32
	Physical/chemical index (%)	100	26.2	26		24.8	25		29.4	29	
	Biological Health Rating (%)	100	47.2	47		55.6	56		47.2	47	
	Foreshore / riparian habitat extent (km)	160.6	51.4	32		51.4	32		51.4	32	
Cabbage Tree Creek estuary					22			27			36
	Physical/chemical index (%)	100	10.6	11		17.8	18		28.0	28	
	Biological Health Rating (%)	100	36.1	36		36.1	36		50.0	50	
	Foreshore / riparian habitat extent (km)	12.5	7.4	59		7.4	59		7.4	59	
Caboolture River estuary					26			30			38
	Physical/chemical index (%)	100	9.8	10		17.0	17		30.0	30	
	Biological Health Rating (%)	100	66.7	67		58.3	58		50.0	50	
	Foreshore / riparian habitat extent (km)	42.7	26.9	63		26.9	63		26.9	63	

Table 4: A data table for an individual estuary in South East Queensland (Albert River Estuary 2010-2011).

ESTUARIES ASSET ACCOUNT
SEQ CATCHMENTS, QUEENSLAND

Data Table: Coastal > Estuaries > Albert River Estuary > 2010 - 2011

Indicator	Reference benchmark	Measure	ICS
Physical/chemical index (%)	**100**	**12.4**	**12**
Chlorophyll-a (index)	100	2	2
Dissolved Oxygen (%)	100	46	46
Total Nitrogen (index)	100	14	14
Total Phosphorus (index)	100	0	0
Turbidity (index)	100	0	0
Biological Health Rating (%)	**100.0**	**29.2**	**29**
Mixing Plots (rating)	3	1	33
δ15N (rating)	4	1	25
Foreshore / riparian habitat extent (km)	**32.3**	**15.5**	**48**
Total foreshore / riparian habitat (km)	32.29	15.50	48

A complete set of accounts may have multiple summary asset and data tables, depending on the nature of a region's assets. A full set of accounts can be found online at: www.nrmregionsaustralia.com.au/our-projects/regional-environmental-accounts.

An Information Statement (**Figure 4**) accompanies each regional account. Its purpose is to document the rationale behind selection of assets, choice of indicators, the origins of the data, the analysis and treatment of data, and construction of the *Econds*.

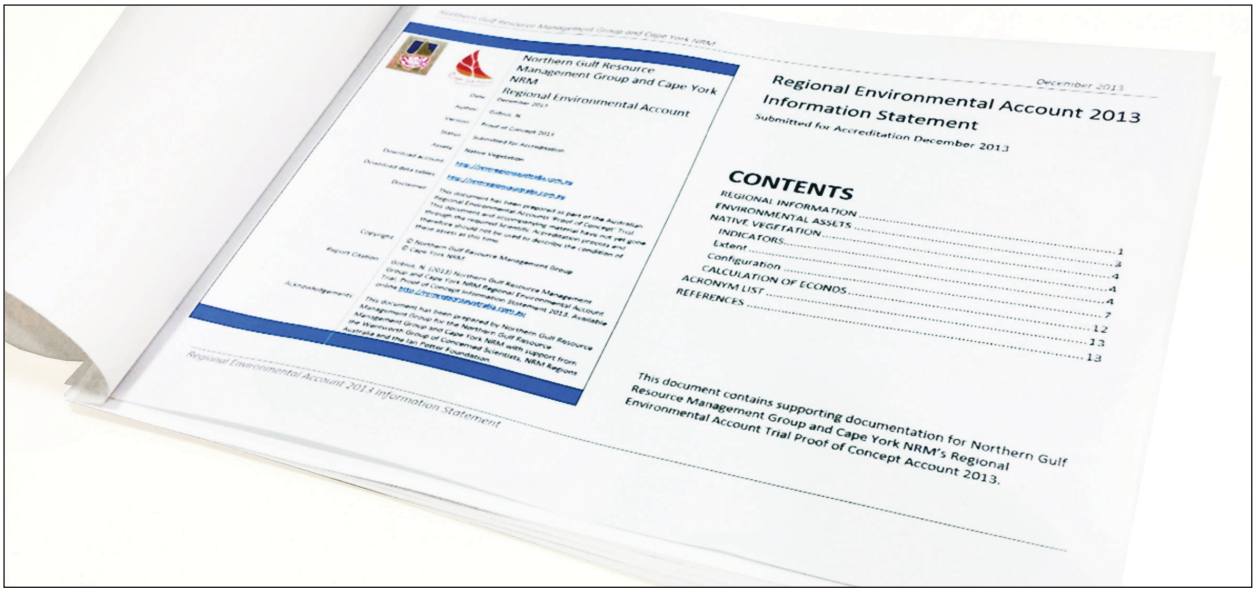

Figure 4: Detailed information statements document the metadata for each account.

Methods used by the regions to construct their accounts are presented for each asset in a series of chapters (**Chapters 2-8**). Each chapter also provides examples of visual presentations of the accounts which assist in interpreting the information from the accounts. These examples are contained within the individual asset chapters of this report.

Accreditation is essential so that policy makers can have confidence that data contained within the account are sufficiently precise, accurate and homogenous to inform decisions (Bureau of Meteorology, 2014; Dalmazzone and La Notte, 2013; IPCC, 2013; United Nations *et al.*, 2012). A pilot accreditation process was undertaken by members of the Scientific Standards and Accreditation Committee, an independent body comprised of scientific experts established to assess regional environmental accounts. The membership of this committee is described in **Supplementary Material 6**. The Committee assessed each account against a set of criteria (**Supplementary Material 3**), based upon the Seven Step method for constructing regional scale environmental asset condition accounts (Sbrocchi, 2013), and documented in a *Draft Accreditation Standards Manual* (Parkes, 2012). Accounts were also assessed against the protocols and indicator

and data quality standards drafted for some assets (native vegetation, native fauna, soil, marine fauna). The structure of each of the following chapters reflects the series of Seven Steps.

To describe confidence in how the accounts achieved each of the accreditation criteria, quality assurance ratings were assigned to each asset account. Quality assurance ratings range between 0 and 5, with a rating of 0 indicating the criteria has not been met for describing the condition of a regional asset (**Table 5**). A minimum rating of 1 was required to be considered as fit for purpose for regional environmental asset condition accounting. These quality assurance ratings are detailed in the accreditation reports (**Supplementary Material 4**), and are also displayed on the visual representations of the accounts.

Table 5: Quality assurance ratings for accrediting regional environmental accounts.

QUALITY ASSURANCE RATING	
5	Comprehensive
4	Substantial
3	Good
2	Reasonable
1	Acceptable
0	Not fit for purpose of regional environmental asset condition accounting

References

Australian Bureau of Statistics. (2013) Measures of Australia's Progress. Australian Bureau of Statistics, Canberra.

Bureau of Meteorology. (2014) Water Accounting Standards Board. Accessed online: August 2014, [http://www.bom.gov.au/water/standards/wasb/].

Dalmazzone S. and La Notte A. (2013) Multi-scale environmental accounting: methodological lessons from the application of NAMEA at sub-national levels. *Journal of Environmental Management* **130**, 405-16.

GHD. (2012) Review of Regional Natural Resource Management Plans. Final Report prepared for the National NRM Working Group.

IPCC. (2013) Procedures for the preparation, review, acceptance, adoption, approval and publication of IPCC reports. In: *Appendix A to the Principles Governing IPCC Work*, Adopted at the Fifteenth Session (San Jose, 15-18 April 1999) and amended the Thirty-Seventh Session (Batumi, 14-18 October 2013).

Parkes C. (2012) Draft Standards and Accreditation Manual. Wentworth Group of Concerned Scientists, Sydney.

Sbrocchi C. (2013) Guidelines for Constructing Regional Environmental (Asset Condition) Accounts: *Quick Guide*. Wentworth Group of Concerned Scientists, Sydney.

Sbrocchi C., Davis R., Grundy M., Harding R., Hillman T., Mount R., Possingham H., Saunders D., Smith T., Thackway R., Thom B., and Cosier P. (2015) *Evaluation of the Australian Regional Environmental Accounts Trial.* Published by the Wentworth Group of Concerned Scientists, Sydney.

United Nations, European Commission, Food and Agriculture Organization, International Monetary Fund, Organisation for Economic Cooperation and Development & World Bank. (2012) *System of Environmental-Economic Accounting Central Framework*. United Nations Statistics Division.

Wentworth Group of Concerned Scientists. (2008) *Accounting for Nature*: A Model for Building the National Environmental Accounts of Australia. Wentworth Group of Concerned Scientists, Sydney.