SINCLAIR KNIGHT MERZ
SKM

Stocktake and Analysis of Australia's Water Accounting Practice

FINAL REPORT

- Final
- 13 October 2006

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Contents

Executive Summary **1**

1 Introduction **12**

1.1 Background **12**

1.2 Project and report overview **13**

2 Information Requirements **14**

2.1 Approach **14**

2.2 Desired outcomes and water accounting reports **17**

2.3 The chart of water accounts **22**

2.3.1 Information elements 22

2.3.2 Accounting entities for water 23

2.3.3 Using the chart of water accounts 26

2.3.4 Aggregating accounts to the state and national level 26

2.3.5 Moving to standard water accounting conventions 28

2.4 Standards **29**

2.5 Accounting for environmental water **29**

2.5.1 Instream environmental rights 29

2.5.2 Extractive environmental rights 30

2.5.3 Reporting on all environmental water 31

3 The Stocktake **32**

3.1 Purpose **32**

3.2 Scope **32**

3.3 Method **33**

3.3.1 Commitment building and stocktake inception 34

3.3.2 Adaptive approach 34

3.3.3 Stocktake forms 35

3.3.4 Stocktake meetings 37

3.3.5 Post stocktake meetings 39

3.4 Definition of water accounting **40**

4 Stocktake Findings **41**

4.1 Measuring physical water parameters **41**

4.1.1 River levels and flows 42

4.1.2 Pipe flows 42

4.1.3 Artificial channel flows 43

4.1.4 Rainfall, evaporation and transpiration 44

4.1.5 Groundwater levels 44

SKM

4.1.6 Broadscale charting of farm dams 45
4.2 Assembling chart of accounts information 45
4.2.1 Reporting units - use of physical water entities 45
4.2.2 Water stock and flow information elements 48
4.2.3 Water use information elements 57
4.2.4 Water entitlements and allocations information elements 59
4.2.5 Environmental rules information elements 61
4.2.6 Terminology 62
4.2.7 Standards 64
4.3 Recording water information 65
4.3.1 Information store types 65
4.3.2 Recording of information elements 67
4.3.3 Use of standards and quality assurance 71
4.3.4 Access and security 72
4.3.5 Application of accounting principles 75
4.4 Reporting water information 77
4.4.1 Existing reports including water accounting information 77
4.4.2 Capacity to prepare proposed water cycle reports 78
4.4.3 Capacity to prepare proposed surface water reports (water balances) 78
4.4.4 Capacity to prepare proposed groundwater reports 82
4.4.5 Capacity to prepare proposed water access entitlement, water allocation and trade reports 82
4.4.6 Capacity to prepare proposed water use reports 87
4.4.7 Capacity to prepare proposed environmental rules reports 88
4.4.8 Aggregation of reporting information 89
4.5 General findings 91
4.5.1 Potential for reporting overload 91
4.5.2 Cooperation of participating organisations 91
4.5.3 Organisational capability 92
4.5.4 Functional management levels 92
4.6 Stocktake conclusion 92
4.7 Summary of stocktake findings 93
4.7.1 Measuring physical water parameters 93
4.7.2 Assembling chart of accounts information 93
4.7.3 Recording water information 95
4.7.4 Reporting water information 97
4.7.5 General findings 98

5 Analysis of water accounting as a discipline 99

5.1 Context 99
5.2 What is water accounting? 101
5.3 Proposed National Water Accounting Process 102

5.4	**Institutional arrangements**	**104**
5.5	**Identification of user requirements**	**110**
5.6	**Conceptual framework**	**112**
5.7	**Procedure for setting of water accounting standards**	**116**
5.8	**Common chart of water accounts**	**118**
5.9	**Accounting systems**	**121**
5.9.2	Starting points for *water information system* standardisation	124
5.10	**Water accounting standards**	**125**
5.11	**Reporting, obligations and compliance**	**126**
5.12	**Assurance**	**128**
5.13	**Capacity building**	**129**
6	**Analysis of water resource accounting**	**130**
6.1	**Description and scope of theme**	**130**
6.2	**Objective**	**130**
6.3	**Current drivers**	**131**
6.4	**Concepts and definitions**	**132**
6.4.1	Water resource accounting	132
6.4.2	Environment vs economy, public and private water	134
6.4.3	Modified water cycle reports	137
6.5	**Reporting**	**139**
6.5.1	Reporting obligations	139
6.5.2	Standard reports	142
6.5.3	Water entities for reporting	148
6.5.4	Report periods	148
6.6	**Measurement**	**149**
6.6.1	Standards and methods	149
6.6.2	Resolving 'balancing items' in reports	150
6.6.3	Information elements in surface water resource accounts	150
6.6.4	Additional information elements in full water cycle accounts	154
6.7	**Recording water resource information**	**157**
6.7.1	Starting points for standardisation	158
6.7.2	Quality labelling	159
6.7.3	Quality assurance	159
7	**Analysis of water market accounting**	**161**
7.1	**Water access entitlements**	**161**
7.1.1	Description and scope of theme	161
7.1.2	Objective	161
7.1.3	Current drivers	162
7.1.4	Concepts and definitions	162

SKM

7.1.5	Water systems	165
7.1.6	Reporting	167
7.1.7	Measuring	172
7.1.8	Recording	173
7.2	**Water Allocations**	**175**
7.2.1	Description and scope of theme	175
7.2.2	Objective	175
7.2.3	Current drivers	175
7.2.4	Concepts and definitions	176
7.2.4.3	Regulated river allocated and unallocated stock and the consumptive	178
7.2.5	Allocation reporting levels	178
7.2.6	Reporting	182
7.2.7	Recording	190
7.2.8	Measurement	193
8	**Analysis of environmental water accounting**	**195**
8.1	**Scope of environmental water accounting**	**195**
8.2	**Objective**	**200**
8.3	**Discussion of environmental water concepts**	**202**
8.3.1	Unregulated streams	202
8.3.2	Regulated streams	202
8.4	**Types of environmental right**	**205**
8.4.1	Instream environmental rights	206
8.4.2	Extractive environmental rights	207
8.5	**Recording and reporting**	**208**
8.5.1	Instream environmental rights	208
8.5.2	Extractive environmental rights	210
8.6	**Environment as a unique holder of rights**	**211**
8.7	**Measurement**	**211**
8.8	**Recording**	**212**
8.9	**Opportunities for improvement**	**212**
8.9.1	Consistency of language	212
8.9.2	Consistency of methods of estimation	213
8.9.3	Consistent presentation	213
8.9.4	Annual plans	213
9	**Analysis of water use accounting**	**215**
9.1	**Description and scope of theme**	**215**
9.2	**Objective**	**215**
9.3	**Current drivers**	**216**
9.4	**Concepts and definitions**	**217**

9.5 Reporting **217**
9.5.1 Reporting obligations 217
9.5.2 Standard reports 217
9.5.3 Water entities 218
9.5.4 Reporting periods 219
9.5.5 Aggregation 219
9.6 Measuring **219**
9.6.1 Information elements 219
9.6.2 Information gaps 220
9.6.3 Standards and methods 220
9.7 Recording **221**
9.7.1 System features 221
9.7.2 Reconciliation 222

10 Recommendations **223**
10.1 Context **223**
10.2 The way forward **224**
10.3 What is water accounting? **225**
10.4 Proposed National Water Accounting Process **225**
10.5 Institutional arrangements **227**
10.6 Capacity building **229**
10.7 Identification of user requirements **230**
10.8 Conceptual framework **232**
10.9 Procedure for setting of water accounting standards **233**
10.10 Common chart of water accounts **234**
10.11 Arrangements for water accounting development **236**
10.12 Priorities for development of water accounting standards **238**
10.13 Water accounting information systems **244**
10.14 Work plan and resourcing estimates **248**

Appendix A Glossary of Terms **252**

Appendix B Information elements **255**
B.1 Water stock **255**
B.2 Atmospheric interchange **256**
B.3 Water flow **256**
B.4 Water use **258**
B.5 Water access entitlement **260**
B.6 Water allocation **261**
B.7 Environmental water rules **262**

SKM

Appendix C Water information systems **264**

Appendix D Examples of published water accounting information – urban water service providers **273**

Appendix E Example chart of water accounts **275**

Appendix F Example water accounting standard for materiality **277**

Appendix G Murray Darling Basin case study **282**

G.1 Background **282**
G.2 Classes of environmental water **282**
G.3 Conversion between instream and extractive rights **284**
G.3.1 Conversion of extractive use to instream use 284
G.3.2 Conversion of instream use to extractive use 285
G.4 River loss or environmental use? **286**

Appendix H Consolidated report templates **287**

H.1 Surface water report template **287**
H.2 Water cycle report template **288**
H.3 Groundwater report template **289**
H.4 Water access entitlement source report template **290**
H.5 Water access entitlement destination report **291**
H.6 Surface water system (regulated river system) report template **292**
H.7 Allocatable stock report template **293**
H.8 General water allocation trade report template **295**

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Executive Summary

Stocktake and Analysis of Australia's Water Accounting Practice

Sinclair Knight Merz was engaged by the Department of Agriculture, Forestry and Fisheries to undertake a stocktake and analysis of Australia's water accounting practice. The aim of the project was to guide the development of standards and guidelines to underpin a national water accounting system, and processes which would support consistent water measurement, monitoring, accounting and reporting at all levels of water management.

The project was overseen by the multi-jurisdictional National Water Initiative Committee (NWI Committee) of the Natural Resource Management Ministerial Council, with advice from an Expert Advisory Panel, established by the NWI Committee. Day to day management was undertaken by the Department of Agriculture, Forestry and Fisheries with the assistance of the National Water Commission.

An information requirements framework was prepared to facilitate and add value to the stocktake, to enable comparison between current practice and what could be in the future. As anticipated, both the structure and detail of the information requirements framework was challenged and as a result reviewed and changed throughout the project.

The Stocktake involved 38 organisations nominated by the jurisdictional representatives of the Expert Advisory Panel to ensure adequate exposure to current practices and systems. Participating organisations included the central water agency in each State and Territory and a range of water service providers. It was made clear that the stocktake was about gaining a snapshot and appreciation of practice and was not about assessing performance or gathering actual data or information elements.

There were 60 stocktake findings, which overall demonstrated that while showing signs of some good practice, water accounting in Australia is at an immature phase and being developed in an ad-hoc fashion.

An analysis of best practice, information gaps and areas for improvement focussed on:

- The development of the intellectual infrastructure necessary to develop water accounting as a discipline; and
- Four themes which cover the anticipated scope of water accounting in Australia – water market, water resource, water for the environment and water use accounting

A disciplinary approach was recognised as the most appropriate way forward and the most likely to achieve a nationally consistent result to maximise the benefits from the considerable efforts and resources being directed to water accounting.

Key drivers for water accounting to be established as a discipline include:

1. With the exception of the Australian Bureau of Statistics (ABS), external users of accounting information cannot command information directly from the provider.
2. Policy makers and water markets will require that information is assembled and reported according to consistent standards.
3. Public confidence in water accounting is required, as the availability of the resource will have social, economic and environmental consequences as policy makers and water markets react to water accounting information.

A significant number of observations and conclusions were documented throughout the analysis phase and substantial bodies of work were developed and drawn together as starting points for further development. Twelve recommendations to progress water accounting were prepared through interaction between the project team and the Expert Advisory Panel.

A working definition of water accounting was developed to explain what water accounting is:

Water accounting is the application of a consistent and structured approach to identifying, measuring, recording and reporting information about water

Recommendation 1: That the working definition of water accounting be adopted.

A proposed national water accounting process was developed as shown in Figure E1. The user requirements, institutional arrangements, procedure for development of standards and guidelines and the conceptual framework provide fundamental intellectual infrastructure to ensure the rigor and logical consistency needed to produce useful water accounting information and to instil the necessary confidence among the users of water accounting reports.

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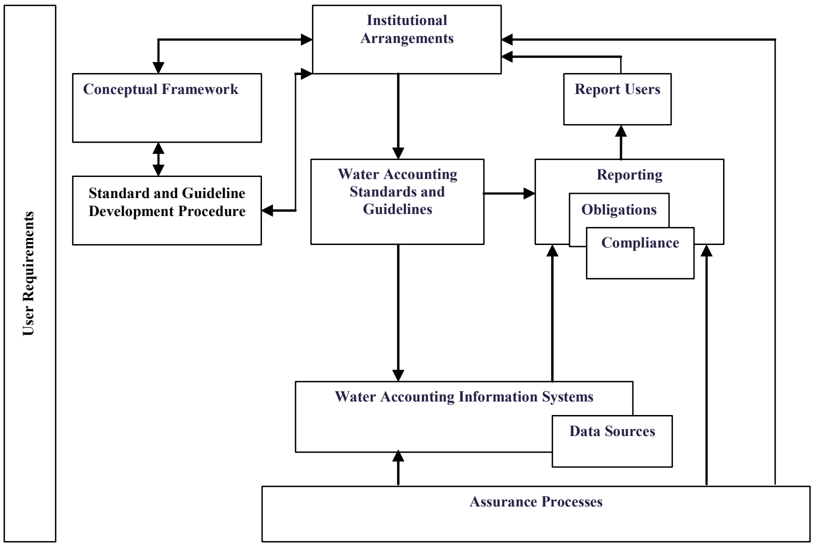


- **Figure E1 Proposed National Water Accounting Process**

Application of the level of discipline inherent in the process will enable progressive building of knowledge, limit the need for revision and iteration and reduce cost in the long run.

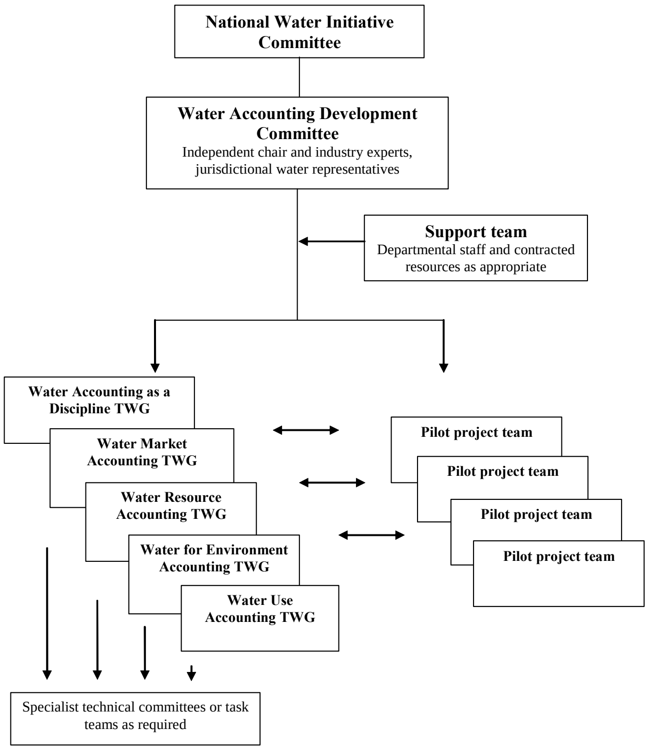
Recommendation 2: That the process for developing and maintaining water accounting as a discipline be adopted as indicated in Figure E1.

A Water Accounting Development Committee comprised of an independent chair, other independent experienced water and accounting experts and jurisdictional water representatives is proposed to ensure appropriate governance and decision making for the first phase development of water accounting. The Development Committee would be the prime body to determine water accounting standards and guidelines and would be linked to the Natural Resource Management Ministerial Council via the NWI Committee for resolution of any matters that may be required in accordance with the provisions of the NWI Agreement.

The Water Accounting Development Committee would have a support team and oversee technical working groups (TWGs) developing the intellectual infrastructure necessary to establish water accounting as a discipline and water accounting and reporting standard and guideline development. It is also proposed that all development work be progressively tested in practice through pilot projects aimed at demonstrating the application of proposed standards and guidelines and informing the essential disciplinary development work through iterative processes.

The interim institutional arrangements, as shown in Figure E2, could be transformed into a more permanent structure, similar to that for the Australian Accounting Standards Board, once the initial development work has progressed sufficiently and the need for a permanent structure was evident through an appropriate assessment. It is unlikely that any specific legal power to mandate water accounting standards will be required in the initial development phase and this aspect would be considered as part of any move to more permanent arrangements.

Recommendation 3: That a Water Accounting Development Committee be established with support from a well resourced dedicated team to oversee the development of water accounting.



- **Figure E2 Proposed interim water accounting institutional arrangements**

Additional capacity will need to be developed within the water industry if we are to deliver national water accounting requirements.

The water accounting development priorities and the proposed Water Accounting Development Committee, its support team and associated technical working groups and subsidiary specialist technical committees or task teams, as well as pilot project teams in jurisdictions and water service provider organisations, will provide significant opportunities to build water accounting capacity. An infusion of qualified accountants and the integration of their skills and perspectives with water industry practitioners and policy formulators is to be encouraged, as is the building of capacity of specialist expertise in such areas as groundwater modelling and associated accounting development.

Recommendation 4: That capacity building, aligned with water accounting development priorities, be addressed as early as practicable.

If water accounting is to emerge as a discipline then water accounting information must serve the needs of external users of water accounting information as well as the management requirements of water businesses.

The development of a detailed user requirements definition is considered essential if we are to support the development of a meaningful national chart of water accounts and to identify water accounting standard development priorities.

Such a task is required to inform the initial stage of water accounting development and could be carried out partially in parallel with and linked to other processes designed to develop an agreed common chart of water accounts for water accounting and agreed reporting formats for key reports.

Recommendation 5: That the detailed requirements of water information users be defined, assessed and reported to inform the scope and development of water accounting.

A conceptual framework is a consistent reminder of the requirements needed to develop rigorous and relevant standards. Any conceptual framework for water accounting must complement the standard setting procedure and facilitate high quality water accounting standards.

The theoretical aspects included in a conceptual framework for water accounting are expected to take some time to develop. Realistically the conceptual framework may not be fully developed for some years, and in the interim it is proposed that work on high priority accounting standards proceed in parallel with the development of the conceptual framework, and that lessons learned during the development of these standards influence the conceptual framework. An outline conceptual framework has been developed as a starting point to assist this iterative process.

Recommendation 6: That a conceptual framework be progressively developed based on the starting point identified in this project and integrated with the development of the initial priority water accounting standards, to facilitate the development of consistent and relevant water accounting standards.

There are advantages in having a structured, transparent procedure for the development of water accounting standards and one based on the process used by Standards Australia is proposed. Whilst the procedure is initiated by a request, initial standard and guideline development may be accelerated by modifying the procedure through active priority setting by the Water Accounting Development Committee and by some concentrated resourcing provision.

Recommendation 7: That a procedure for standard and guideline development be adopted by the Water Accounting Development Committee based on the standards development process applied by Standards Australia.

Accounting information systems cannot function without a chart of accounts. The chart of water accounts for a water accounting information system should define **what** type of information must be gathered and recorded (the information element) and the **level** that the information element is to be aggregated and reported (the water entity) and **who** prepares the water accounting reports (the report preparer).

It is proposed that a national chart of water accounts be developed based on input from all States and Territories. The common chart of water accounts has a direct relationship with the conceptual framework.

Recommendation 8: That a common chart of water accounts be developed based on the starting points identified in this project and including work within jurisdictions.

The development of standards and guidelines is seen as one of the key areas where water accounting practices can be significantly improved in this country. Water accounting standards will address particular subjects and explain and prescribe the treatment of various water accounting issues. Typically, the standards will address the concepts that are listed in the conceptual framework.

There is potential for many standards to be required for water accounting and development of standards is likely to take some years. This time horizon should not inhibit development and it is recommended the focus should initially be on the development of reporting standards as they directly relate to the information user requirements. An initial focus on reporting standards would in turn lead to a focus on the associated information element standards, which in turn links to measuring standards.

The focus should also initially be in agreed target areas where management approaches are settled and development of standards can be both rapid and most beneficial. Proposed standard report templates have been developed as starting points for initial reporting standards development for the water market and water resource accounting themes.

Coordination of work to develop water accounting and reporting standards and guidelines is essential. Technical working groups overseen by the Water Accounting Development Committee are proposed as the main work vehicles as shown in Figure E2 and will have an important coordination role which would be assisted by some common membership.

Testing in practice proposed standards and guidelines through targeted and representative pilot projects, using iterative processes to inform both standards development and the work to develop water accounting as a discipline, is also proposed.

The technical working groups, along with associated technical committees or task teams and the pilot project teams will provide an opportunity to include people with an appropriate mix of skills and perspectives and to build commitment to water accounting development.

Recommendation 9: That nationally coordinated development projects which use a pilot approach in multiple representative areas and which progressively interact with and test other developmental work (user requirements definition, common chart of water accounts, conceptual framework and standards development procedure) be initiated by the Water Accounting Development Committee to progressively develop water accounting and reporting standards or guidelines for:

- water market accounting including water access entitlements, water allocations, use and trading; and
- water resource accounting including surface water, groundwater, water cycle and connected surface and groundwater resource accounting.

Further work is required to progress the key principles and concepts for management and accounting for water for the environment and the extent of the contribution from water for the environment accounting. This includes reconciling approaches to managing and accounting for environmental provision via water planning and indirect rules, which is the most prevalent method throughout Australia, as well as for the wider suite of provisions for the regulated and interconnected and over-allocated systems in the southern Murray Darling basin. It is evident that a particular focus on water for the environment is warranted and a number of proposed starting points have been developed for further consideration.

Recommendation 10: That a technical working group be established to further develop and pilot accounting principles and standards for water for the environment and that the principles and standards resolve the accounting treatment of:

- indirect rules;
- volumetric rights (extractive and in stream); and
- direct rules.

Further work building on and adapting the work of the ABS and practice within industry, is required to progress both management and accounting for water use, for which it is evident that a particular focus is warranted.

Recommendation 11: That a technical working group, building on the ABS Water Statistics User Group, be established by the Water Accounting Development Committee to further develop water use accounting principles and guidelines.

Information sharing is seen as one of the key methods of achieving a higher degree of consistency, transparency and accountability within the water sector. Existing water information systems are not necessarily efficient at producing standard information or reports required by the wider audience.

Most jurisdictions have made significant financial investments in existing water information systems.

Joint ventures or partnerships in water accounting information system development projects that can make rapid advances in national water accounting and reporting are to be encouraged. It is proposed that projects be initiated to develop examples of water accounting information systems that demonstrate to a range of water businesses the potential benefits of applying accounting principles and that have the potential for rapid expansion to relevant parts of the industry. It is envisaged that these will be integrated with pilot projects.

Recommendation 12: That demonstration water accounting information systems projects be supported as soon as the water accounting benefits have been determined.

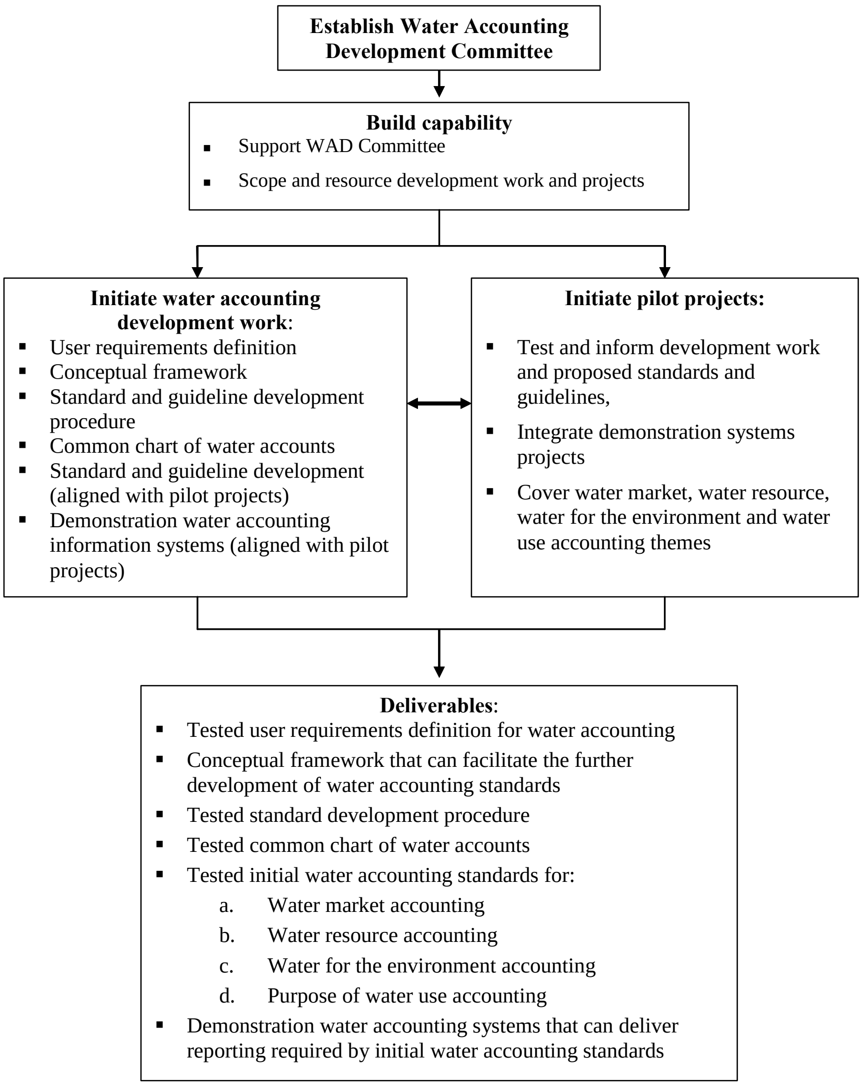
The integration of water accounting development work over the next three years is problematic in that specific project plans have not yet been identified or developed. This is a task to be undertaken by the Water Accounting Development Committee and associated technical working groups.

The following development principles were developed through consultation with the EAP:

- Use appropriate starting points wherever practicable, picking up on relevant work undertaken nationally and within jurisdictions, best practice examples within water businesses and specific developments that have been documented during this project, as a cost effective base on which to build.
- Develop the essential intellectual infrastructure or theoretical base to ensure discipline and rigour in a manner which both learns from and informs practice and practicable developments, through targeted pilot projects which test the application of proposed standards and guidelines and maximises the integration of development work.

- Focus on agreed priorities for development of standards, build on current or proposed good practice reporting and support research and development projects that are effective or offer significant potential in developing national standards for identifying, measuring and recording water information.
- Involve stakeholder representatives and develop business cases as part of each project or priority action initiated to develop water accounting nationally.
- Concentrate on development of a few demonstration water accounting information systems – make real progress on development of information systems with the intent of effective and expandable application of water accounting functionality.

A preliminary work-flow plan, as shown in Figure E3, outlines the general hierarchy of tasks required to initiate development activities.



- **Figure E3 Work-flow plan**

Development of cost estimates for water accounting development work has been based on the establishment of a Water Accounting Development Committee, with some resources, as well as some priority work packages designed to initiate the development of the necessary intellectual infrastructure. This infrastructure includes the development of a user requirements definition, a common chart of water accounts and a conceptual framework, without which further development is likely to stall.

Provision has also been made to undertake some pilot projects to test and complement this work as progress is made. It should be recognised that resources may need to be varied as issues emerge and that some pilot projects may discover water accounting aspects may take significantly more time and resources for progress to be effective.

An indicative cost estimate (shown in Table E1) and a time based chart (shown in Figure E4) have been prepared to provide a preliminary indication of what time and resources might be required to initiate water accounting development in Australia.

These estimates could be further refined by the Water Accounting Development Committee once more specific project briefs have been established.

- **Table E1 Preliminary summary of resources estimates**

Development task	Year 1 ($M)	Year 2 ($M)	Year 3 ($M)	Total ($M)
Institutional arrangements*	0.75	0.75	0.75	2.25
Development of user requirements definition	0.25	0.05	0.05	0.35
Conceptual framework development	0.15	0.15	0.15	0.45
Common chart of water accounts development	0.25	0.25	0.00	0.50
Standards and guidelines development (including pilot projects)**	0.30	0.30	0.30	0.90
Demonstration water accounting information systems projects	0.75	0.75	0.75	2.25
Total	$2.45M	$2.25M	$2.00M	$6.70M

*This includes some provision for centrally coordinated capacity building rather than dedicated capacity building within state and territory jurisdictions

** While pilot projects are part of the development mechanism, the resourcing estimate is notionally based on central facilitation rather than dedicated resourcing at pilot project destinations where additional resources for capacity building will be required if development is to be accelerated.

Water accounting development work plan

PROPOSED PROJECTS	YEAR 1	YEAR 2	YEAR 3
1 Establish Institutional arrangement			Review options
2 Capacity building facilitation		Support as opportunities arise	
3 User requirements definition		Revisit and refine as appropriate	
3 Conceptual framework development		Progressive and ongoing development	
4 Common chart of water accounts		Revisit and refine as appropriate	
5 Standard and guideline development projects		Progressive and ongoing development	
6 Demonstration water accounting information systems projects		Support and integration with other work as required	

- **Figure E4 Proposed time based work plan**

1 Introduction

1.1 Background

SKM was engaged by the Department of Agriculture, Forestry and Fisheries to undertake a stocktake and analysis of Australia's water accounting practices.

The aim of this project was to guide the development of standards and guidelines to underpin a national water accounting system, and processes which would support consistent water measurement, monitoring, accounting and reporting at all levels of water management. The project was undertaken to assist the parties to the National Water Initiative (NWI) to achieve the outcome for water accounting as stated in Clause 80 of the NWI, namely to "ensure that adequate measurement, monitoring and reporting systems are in place in all jurisdictions, to support public and investor confidence in the amount of water being traded, extracted for consumptive use, and recovered and managed for environmental and other public benefit outcomes."

The project was divided into 4 steps, as follows:

- Step 1. develop the **information requirements** of accounting systems at the different levels of water management, against which the initial stocktake of the nation's water accounting systems can be undertaken,
- Step 2. in all States and Territories, undertake a **stocktake** of jurisdictions' and water service providers' current water accounting systems (including current arrangements to account for environmental water), focusing on the agreed information requirements, and having regard to the links between existing registration and accounting systems;
- Step 3. **analyse** the information collected in the stocktake to identify best practice, information gaps and areas for improvement;
- Step 4. make **recommendations** for development of water accounting standards, principles for environmental water accounting and guidelines for reporting and information, including priorities for standards, guidelines and systems development.

The project was overseen by the multi-jurisdictional NWI Committee of the Natural Resource Management Ministerial Council, with advice from an Expert Advisory Panel (EAP), established by the NWI Committee. Day to day management was undertaken by the Department of Agriculture, Forestry and Fisheries with the assistance of the National Water Commission.

1.2 Project and report overview

Project Step 1, the development of information requirements for the stocktake occurred between January and March 2006. Step 2, the undertaking of a stocktake of water accounting systems and practices, were completed between April and June 2006 and presented to the EAP in early July 2006. Step 3, analysis, was undertaken by the project team in July 2006 and presented in the Second Draft Stocktake Report for consideration by and value adding from the EAP in early August 2006. The Final Report was prepared in August and finalised via meeting with the EAP and NWIC in September and October 2006.

A Water Accounting Information Requirements Framework was developed in Step 1 and used in the Step 2 stocktake, in an attempt to help envisage what a national water accounting system might look like. The information requirements framework was prepared to facilitate and add value to the stocktake, to enable comparison between current practice and what could be in the future. As anticipated, both the structure and detail of the information requirements framework was challenged and as a result reviewed and changed throughout the project.

The Final Report recaps the information requirements used in undertaking the stocktake in Chapter 2, and covers the stocktake scope and method developed in consultation with the EAP along with comment on the conduct of the stocktake in Chapter 3.

Chapter 4 sets out the findings from the stocktake and includes some modifications from the First and Second Draft Stocktake Reports as a result of completion of the stocktake in the Northern Territory and a review by the project team of comments received from EAP members.

Inconsistency in terminology occurred as the project progressed, primarily due to proposing an information requirements framework for the purpose of the stocktake and the adaptive approach taken. This has been addressed to a degree in this report through the provision of a glossary of key terms in Appendix A and more consistent use of terminology in the analysis and recommendation chapters.

Chapter 5 presents an analysis of the development of water accounting as a discipline and Chapters 6 to 9 include an analysis of each of four water accounting themes identified in consultation with the EAP – water resource, water market, environmental water and water use accounting.

Chapter 10 presents recommendations arising from the analysis and a work plan outlining priority development to progress water accounting practice in Australia.

2 Information Requirements

2.1 Approach

The approach taken to identifying the information requirements to underpin a national water accounting system was to:

1. consider and synthesise the purpose and outcomes desired from this project and the relevant provisions of the NWI and then to develop the envisaged types of standard water accounting reports which could contribute to those outcomes being achieved,

2. consider the accounting principles and the chart of accounts necessary to support the production of standard water accounting report types and underpin the development of a national water accounting system.

3. develop templates for the standard water accounting report types and examples of the type of reports proposed

4. identify the information elements needed to populate the proposed standard water accounting reports and consider how the information elements are derived or obtained.

A Water Accounting Information Requirements Framework as shown in Figure 1 was developed for use in the stocktake. The framework was agreed by the NWI Committee at its meeting on 22 March 2006 for the purposes of conducting a stocktake of water accounting systems within jurisdictions. Figure 1 shows how Information Elements, which are derived or obtained from Physical Data or from Registers, combine with Physical Water Entities and Institutional Water Entities in a proposed Chart of Water Accounts, which could be used to produce proposed Standard Water Accounting Reports, which in turn contribute to the Desired Outcomes from the project.

It is recognised that the Water Accounting Information Requirement Framework would need to be compatible with broader frameworks for holistic integrated water resource management, which adequately represents the physical water cycle. SKM is confident that the Water Accounting Information Requirement Framework would be compatible with broader frameworks such as SEEA 2003 (System of Integrated Environmental and Economic Accounts, joint publication of the United Nations, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, and the World Bank). The important thing is that all relevant information elements can be captured and are consistent so that arrangement and aggregation of the information elements at appropriate levels is effective.

From a philosophical perspective, it is recognised that while water accounting practices will reflect the prevailing water management regime, it can also influence the management regime through the methodical presentation of information and associated analysis and help bring about beneficial change. For a national water accounting system to be effective the purposes and benefits of its development and use will need to be obvious and relevant to users of the system and an emphasis will be placed on this aspect throughout the project.

The developed Water Accounting Information Requirements Framework will be scrutinised in the analysis Step 3. Each part of the framework, aspects relating to it and how it is envisaged to work are described in the remaining sections of this chapter.

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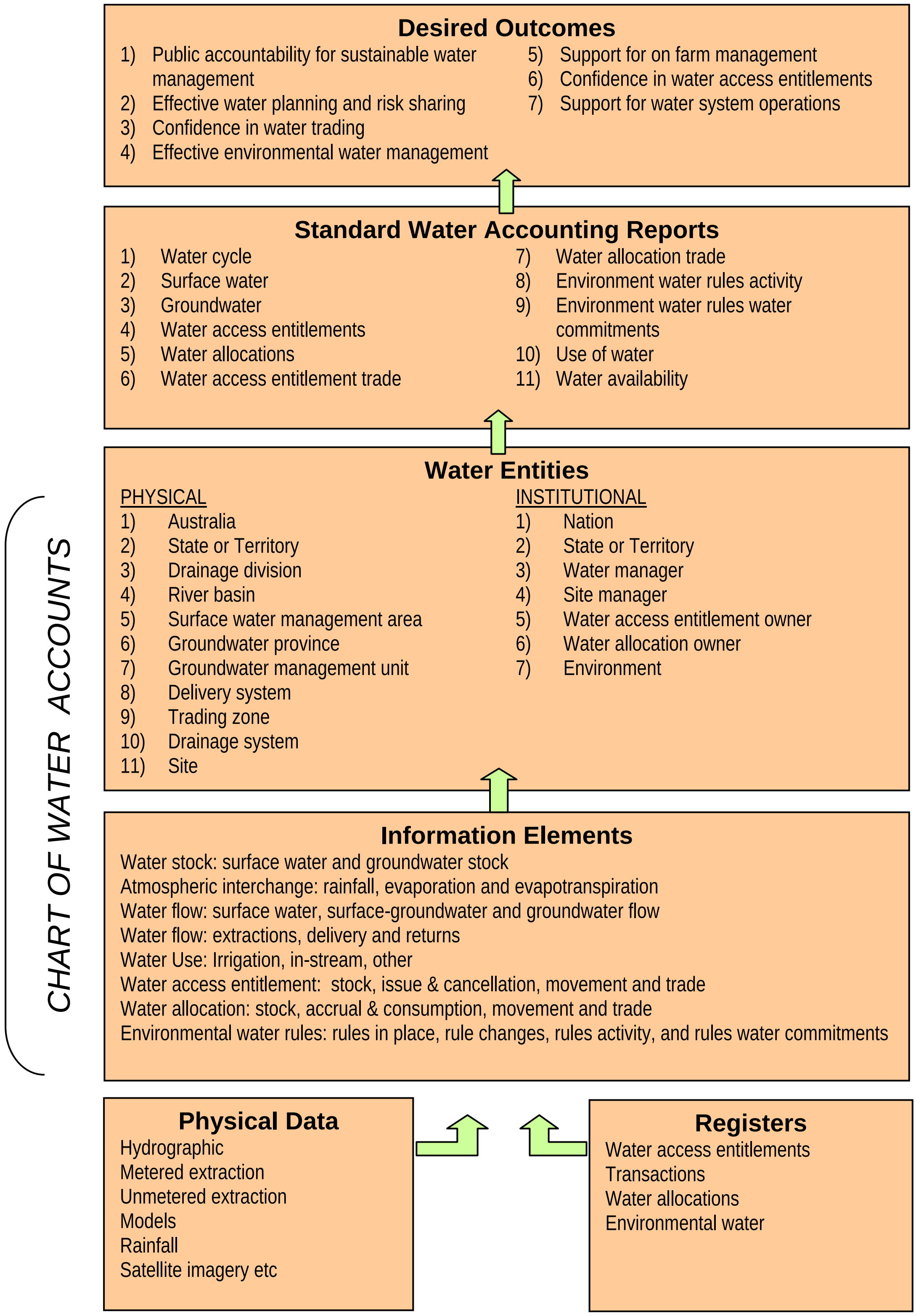


- **Figure 1 Water Accounting Information Requirements Framework**

2.2 Desired outcomes and water accounting reports

A set of desired outcomes, which a national water accounting system would serve, were identified, based on those stated in the NWI agreement and further advice provided by the Expert Advisory Panel. Water accounting systems on their own would not deliver these outcomes, but they could contribute substantially to their achievement. The seven desired outcomes are summarised in the top box in Figure 1.

Standard water accounting report types relevant to these outcomes were identified and are described and explained in Table 1. Detailed templates and descriptions for the eleven proposed standard water accounting reports were developed and were included in the Step 1 Status Report. The reports could be done at various scales, defined by the water accounting entities in the proposed chart of accounts. These entities are discussed in Section 2.3.

In developing these templates financial reporting models were considered and applied, with appropriate modifications, to water accounting. Some templates combine the concept of a financial position statement (balance sheet) and a financial cash flow statement. In some cases assets are replaced with water in storage; revenue is replaced with inflows of water; expenditure is replaced with outflows of water. In other cases revenue and expenditure are replaced with such things as increases and decreases in water allocations or water access entitlements. Water allocations under entitlements and commitments of water under environmental rules can be considered to be unmet liabilities, which are reduced when the water is taken or supplied.

Worked examples of the water cycle, surface water and water availability type of reports were also developed and included in the Step 1 Status Report.

Table 1 Proposed Standard Types of (Water Accounting) Reports

Report type	Description	Physical water entities	Institutional water entities	Comments
Water cycle	Quantifies the elements of the water cycle (rainfall, evapo-transpiration, runoff etc) for a designated water entity for a designated period.	▪ Australia ▪ Drainage division ▪ River basin ▪ Surface water management area ▪ Site	▪ Nation ▪ State or territory ▪ Water manager ▪ Site manager	This report type shows the total picture of the movement and/or position of water from rainfall to the soil, rivers and aquifers, to the economy, to the atmosphere via evapo-transpiration, or to the sea. This report type will primarily be used for planning and monitoring purposes. Theoretically this report can show the effects of land use change and climate change on inflows to rivers and aquifers. It is however not easy to quantify all the elements of this report type and simplifying assumptions may be needed. Errors in measuring or estimating parameters may hamper its value but if progress is to be made toward holistic integrated water resource management and accounting, including surface water and groundwater interaction, then this report type offers value.
Surface water	Quantifies the inflow, outflows, extraction and storage of water for designated water entity over a designated period.	▪ Surface water management area ▪ Delivery system ▪ Drainage system	▪ Water manager	For any surface water system this report type shows the movement and/or position of water in and out. This type of report is already being produced for many river systems, and is relatively straightforward to prepare. It is important for planning, annual and day-to-day operations and could be used to deal with surface water and groundwater interaction.
Groundwater	Quantifies the inflow, outflows, extraction and storage of water for a designated groundwater entity over a designated period.	▪ Groundwater management unit	▪ Water manager	For any aquifer system this report type shows the movement of water in and out. While such reports are available for specific cases, they are not easy to prepare and not generally available. Many of the parameters are estimated or modelled rather than measured. It is essentially used for planning and could be used to help deal with surface water and groundwater interaction.

Report type	Description	Physical water entities	Institutional water entities	Comments
Water access entitlements	Sets out the types and quantity of share units held under water access entitlements, and the increases and decreases in them, for a designated water entity and institutional entity over a designated period.	▪ Surface water management area ▪ Delivery system ▪ Trading zone ▪ Groundwater management unit ▪ Drainage system	▪ State or territory ▪ Water manager ▪ Water access entitlement owner ▪ Environment	Water access entitlements give the holder a right to an ongoing share of a consumptive pool. The size of the share varies from entitlement to entitlement. The total quantity of share units is the essential factor. This report types essentially shows share units held in a water entity and changes in the share units in that water entity over time. Used for planning, public accountability and to support public and investor confidence.
Water allocations	Quantifies the water allocated under water access entitlements and how it is extracted, traded or cancelled from time to time, for a designated physical water entity and institutional water entity over a designated period.	▪ Surface water management area ▪ Delivery system ▪ Trading zone ▪ Groundwater management unit	▪ Nation ▪ State or territory ▪ Water manager ▪ Water allocation owner ▪ Environment	For rights to extract water allocated under entitlements to persons, this report type shows the amount allocated and what happens to it. These types of reports are already commonly produced. A record (a water allocation bank) is normally kept in relation to each person or persons with a right to take water allocated under entitlements. These reports can be rolled up to a range of levels. They are used on a day to day basis by individuals to monitor their available allocation and by institutions to monitor the compliance of persons with their allocations. On a rolled up basis they are used for operational decision making, and for planning.
Water access entitlement trade	For a designated period, quantifies trading activity in water access entitlements for a designated water entity and institutional entity.	▪ Surface water management area ▪ Delivery system ▪ Trading zone ▪ Groundwater management unit	▪ State or territory ▪ Water manager ▪ Water access entitlement owner ▪ Environment	This report type shows the effect of water trading activity on the locations where water is extracted in the longer term. It can be prepared at a variety of levels such as trading zone, water source. On a day to day basis it is needed for operation of trading rules which limit such movements between trading zones. On a long term basis it is used to review whether trading rules are achieving desired results and to analyse trends Iin trading of water access entitlements.

Report type	Description	Physical water entities	Institutional water entities	Comments
Water allocation trade	For a designated period, quantifies movement of water allocations into, out of and within the designated entities, resulting from trade.	▪ Surface water management area ▪ Delivery system ▪ Trading zone ▪ Groundwater management unit	▪ Nation ▪ State or territory ▪ Water manager ▪ Water allocation owner ▪ Environment	This report type shows the effect of water trading activity on the locations where water can be extracted in the short term. It can be prepared at a variety of levels such as trading zone, water source etc On a day to day basis it is needed for operation of trading rules which limit such movements between trading zones. On a long term basis it is used to review whether trading rules are achieving desired results and to analyse trends in trading of water allocation.
Environment water rules	For a designated period, specifies environmental water rules in place and at the start and finish and what rules have been commenced, terminated or modified.	▪ Surface water management area ▪ Groundwater management unit ▪ Site	▪ State or territory ▪ Water manager ▪ Site manager	This report type is a textual rather than numerical report, showing in summary form the environmental water rules that apply
Environment water rules activity	For a designated period, for environmental water rules in place specifies whether they were activated and complied with or not.	▪ Surface water management area ▪ Groundwater management unit ▪ Site	▪ State or territory ▪ Water manager ▪ Site manager	This report type is a textual rather than numerical report, showing in summary form the compliance status of environmental water rules during the specified period
Environment water rules water commitments	Quantifies water committed under environmental water rules and the quantities of water supplied or protected from extraction under those rules, for designated waters over a designated period.	▪ Surface water management area ▪ Delivery system ▪ Groundwater management unit ▪ Site	▪ State or territory ▪ Water manager ▪ Site manager	This report type is similar in concept to the water allocations and use of water report types. Rather than dealing with water allocated under entitlements, it shows water committed under environmental water rules, and rather than recording use of that water, it records the supply or protection of that water, as the case may be. It is used operationally for implementation of the rules, and longer term to demonstrate delivery of environmental water, and for planning purposes. It is only applicable to some environmental water rules.

Report type	Description	Physical water entities	Institutional water entities	Comments
Use of water	Tabulates the volumes of water used by purpose and by source for a specified area over a designated period. (Most of the information for these reports will not be available from the water accounting system)	▪ Australia ▪ Drainage division ▪ River basin ▪ Surface water management area ▪	▪ Nation ▪ State or territory ▪ Business ▪ Household ▪ Environment	These are the type of reports already being prepared by the Australian Bureau of Statistics, who are currently expanding and refining them. They show the uses of water by standard industry groupings, and the sources of water for those uses. These reports demonstrate the economic value being derived from the use of water. They are primarily useful for planning purposes. Linked with other reports such as water access entitlement or water allocation trade report they can show the economic benefits of water reforms over time.
Water availability	Shows the availability of water, which is the water stored less the water committed or allocated, for designated waters over a designated period	▪ Surface water management area (regulated) ▪ Groundwater management unit	▪ Water manager	This report type brings together some elements of the surface water, environmental water rules, and water allocation report types into one report. They are designed to show the way water stored and received into storage is allocated or committed over time, and the extent to which water held is available to be committed. The report type can also apply to groundwater.

2.3 The chart of water accounts

In financial accounting, the chart of accounts provides the basis for the accounting information to be recorded, summed, analysed and reported.

Water accounting should be based on a chart of water accounts that meets the needs of water managers, governments, farmers, environmental interests, other owners of water and people interested in water accounting, including researchers, journalists, water brokers, etc.

A financial chart of accounts consists of natural accounts and accounting entities. A similar structure can usefully be applied to water accounting systems.

2.3.1 Information elements

In financial accounts the natural accounts are the various asset, liability, equity, revenue and expense accounts. The ‘natural accounts’ for water can be grouped into descriptors such as water stocks, atmospheric interchanges, water flows, water use, water access entitlements, water allocations and environmental water rules. The more generic term ‘information elements’ is being used rather than ‘natural water accounts’ because to many the term ‘natural water accounts’ implies information on the natural or untouched state of the water resources, which is not the case for the information elements.

A ***water stock*** is the volume of water in a physical water entity at a particular time, held in such things as storages, channels and aquifers. Stock can be conveniently grouped into surface water stock (storages, channels, snowpack) and groundwater stock (soil water, aquifers).

Atmospheric interchanges are the volumes of water moving between land and the atmosphere. The information elements within this group include rainfall, evapo-transpiration and evaporation.

Water flows represent movements of water into or within a physical water entity, over a specified period. The information elements within this group include surface water flows, groundwater flows, surface-groundwater flows, extractions, deliveries and returns.

These first three categories of information elements relate to the physical water cycle, whereas the next four categories relate more to how water is managed and used.

Water use shows the purposes for which water is used, and the volumes associated with that use. Purposes are categorised in accordance with the ABS groupings of ANZSIC standard classifications.

Water access entitlements are the entitlements issued to persons for a share of the water in a consumptive pool, as per the NWI. The water access entitlements information element group includes share stock, as shown on registry systems at a particular date, and the various changes to water access entitlements such as issue of new entitlements, movements of entitlements in or out of the entity, and trade of entitlements.

Water allocations are volumes of water that are made available for extraction or delivery under water access entitlements. Water allocations can be recorded in water allocation banks, which, like financial bank accounts, are ‘owned’ by persons, can have ‘deposits’ (water allocation announcements), ‘withdrawals’ (physical extraction of water) and ‘transfers’ (assignment of water allocations from one person to another). The water allocations information elements group includes water allocation stock at a particular date, accrual and consumption, movement into or out of the entity and trade.

Environmental water rules are the various rules in water plans which commit water to environmental purposes. They do not include water access entitlements which are committed to environmental purposes, nor the water allocations accruing under those entitlements. The environmental water rules information element group includes schedules of the rules in place, changes to those rules, the activity status of those rules, the water committed under environmental water rules, the use of that water (e.g. by allowing to flow downstream or flow into an environmental asset) over a period of time, and the write-off of committed water which is not used.

The information elements are the individual elements, or lines of reporting, envisaged in the standard water accounting reports outlined in previous sections. They are the key ‘building blocks’ of the envisaged national water accounting system.

The information elements are tabulated in Appendix B. This shows the groups of information elements, the name of each individual information element, (required reporting) frequency, definition of each information element and units.

2.3.2 Accounting entities for water

In a financial chart of accounts, the natural accounts will be joined with entities like cost centres and lines of business.

For example a business might have three regional outlets, five city outlets and a head office. These would all be cost centres. Each of the city and regional cost centres could have multiple lines of business, or profit centres such as hardware, furniture, garden ornaments etc. The cost centres can have multiple lines of business and the managers of these cost centres can be held responsible for each line of business and the overall performance of their cost centre.

Some businesses have multiple entities and use coding to group and sort information within lines of business and related lines of business and cost centres. All city based cost centres may have a code of 1nn while regional cost centres may have a code of 2nn etc. The chart of accounts design controls the recording, summing, analysis and reporting of financial information.

Two types of entities have been identified for association with information elements in a water accounting chart of accounts:

- ***Institutional water entities*** are owners of water access entitlements or water allocations, or organisations that are responsible for the management or oversight of water systems, or categories of water users. These entities are used for various purposes in the proposed chart of accounts in order to allow reports to be generated for water managers in relation to their area of responsibility, or for owners in relation to their water access entitlements or water allocations, or to allow usage to be categorised in a way which allows it to be linked to economic benefits.
- ***Physical water entities*** that group the physical water resources as well as the water access entitlements and allocations that have been issued by Governments.

These water entities are listed and defined in Table 2 and Table 3.

- **Table 2 Institutional Water Entities**

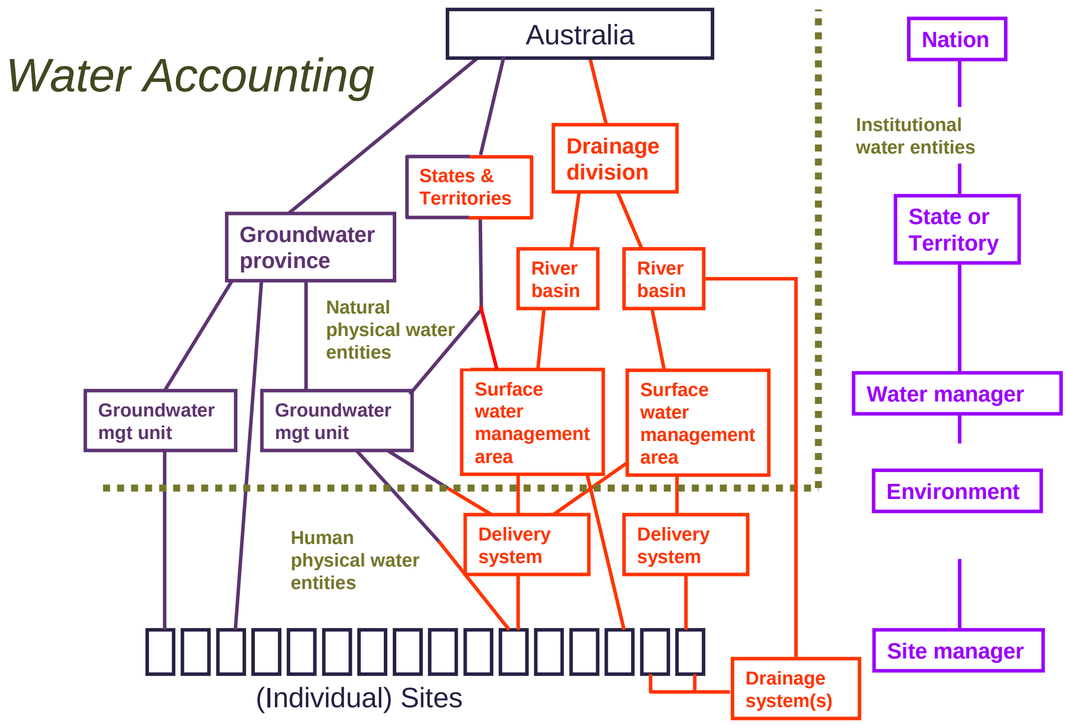
Entity	Description
Nation	The Commonwealth of Australia or a representative agency
State or territory	Any of the States or Territories of Australia or a representative agency
Water manager	A body responsible for management of a physical water entity (eg groundwater management unit, surface water management area, delivery system, urban drainage system). Mostly public authorities (eg Sunwater, NSW State Water, Goulburn-Murray Water, Sydney Water) but also private entities such as Murrumbidgee Irrigation Limited
Site manager	Any person, corporation or public authority responsible for the management of an area of land used for production, amenity or environmental purposes
Water access entitlement owner	Any person, corporation or public authority that owns a water access entitlement
Water allocation owner	Any person, corporation or public authority that owns a water allocation
Environment	A pseudo – owner of water access entitlements or environmental rules. Though the environment doesn't exist as a legal entity, it is useful as a reporting entity as water access entitlements can be committed to the environment, and rules commit water to the environment.

- **Table 3 Physical Water Entities**

Entity	Description
Australia	The continent of Australia including Tasmania.
State or Territory	Any of the States or Territories of Australia
Drainage division	As per Australian Water Resources Assessment 2000
River basin	As per Australian Water Resources Assessment 2000
Surface water management area	An area which is part or whole of a river basin. As per Australian Water Resources Assessment 2000.
Groundwater province	As per Australian Water Resources Assessment 2000.
Groundwater management unit	Any aquifer or set of hydrologically connected aquifers managed as a unit. As per Australian Water Resources Assessment 2000. Also should include 'unincorporated' units.

Delivery system	A set of connected channels, pipes, storages used to deliver water taken from water sources to properties or other delivery systems.
Trading zone	A zone used for management of trading of water access entitlements or water allocations.
Drainage system	A system of works used for the purpose of collecting and draining water from irrigation areas, water from rural areas outside irrigation areas, or storm water from urban areas.
Site	Any land parcel, rural or urban.

Figure 2 is a simplified architecture diagram showing how the physical and institutional water entities relate to each other.



▪ **Figure 2 Water Entity Architecture**

2.3.3 Using the chart of water accounts

With a chart of water accounts established with information elements and water entities as described above, all the desired reports (and many others) can be prepared. For example, surface water reports can be prepared for individual river systems, or for delivery systems, or for river basins. Water cycle reports can be prepared for environmental sites, or river basins. Water allocation reports can be prepared for individuals or water authorities.

Clause 82 (iii) of the NWI calls for water resource accounts that can be reconciled annually and aggregated to produce a national water balance, including:

a) a water balance covering all significant water use, for all managed water resource systems;

b) systems to integrate the accounting of groundwater and surface water use where close interaction between groundwater aquifers and streamflow exist; and

c) consideration of land use change, climate change and other externalities as elements of the water balance.

The proposed standard water accounting reports and chart of water accounts are in theory capable of delivering these requirements.

2.3.4 Aggregating accounts to the state and national level

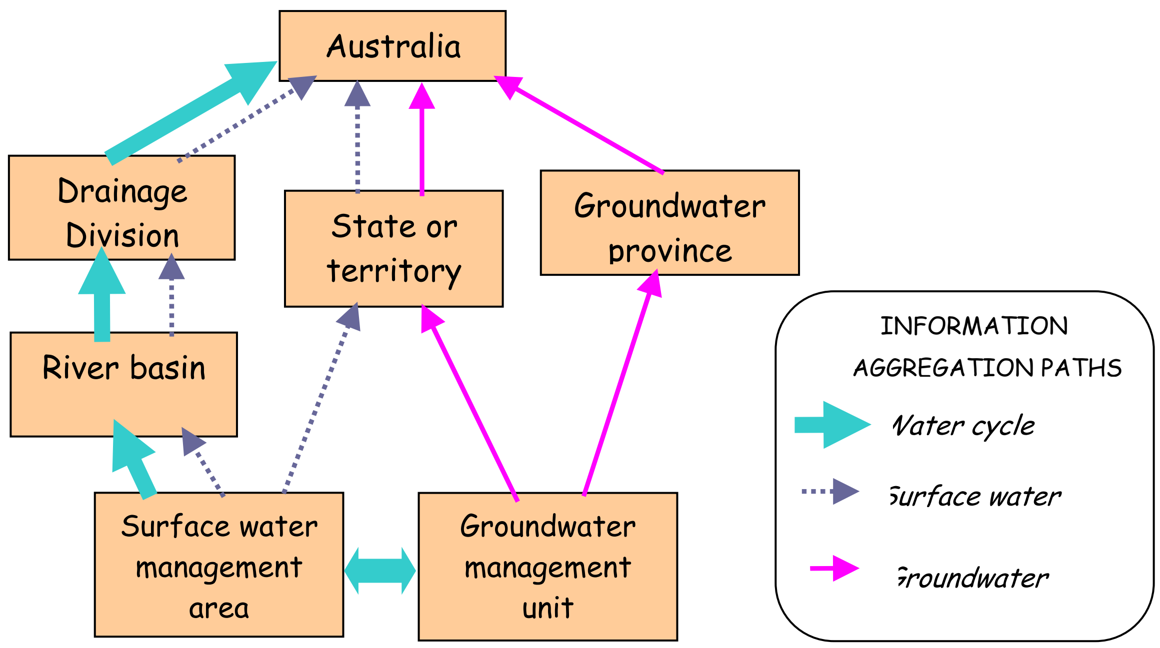
A requirement of the NWI is to develop the capacity to aggregate water accounts to the national level (cl 82(iii)). It is important to scope clearly what can and should be aggregated. The basic elements of the water cycle (rainfall, evapo-transpiration, runoff, storage, extraction etc) are clearly capable of being aggregated. However information elements relating to water access entitlements do not so readily aggregate, as shares in one water system are not the same as shares in another, and to add them to a total number of shares would be misleading.

The requirements of clause 82(iii) can be achieved by aggregating the information set out in the water cycle report. This comprehends water use, groundwater – surface water interaction, land use change and other externalities. Surface water and groundwater reports can also be aggregated but do not and cannot present the full picture, nor can this achieve all the requirements of clause 82(iii).

To achieve this national aggregation, there needs to be a set of accounting entities which cover the whole nation to form the basic building blocks.

In the proposed chart of accounts surface water management areas and groundwater management units have been identified for this purpose. These entities are already defined and have been used in the Australian Water Resources Assessment 2000 (a report of the National Land and Water Resources Audit). They do however need to be comprehensively defined to cover the whole nation. In the Australian Water Resources Assessment 2000 surface water management areas are defined with no gaps (and aggregate to river basins, with respect for state or territory boundaries built in), while groundwater management units are only defined with no gaps by identifying unincorporated areas as “groundwater management units” (in which case aggregation to groundwater province is achieved).

If the accounts are set up so that the reports can be done for these entities, then the information from these reports can be rolled up through different paths to the national level. This is illustrated in Figure 3. The most important aggregation, if it can be achieved, will be the aggregation of water cycle information. Note that this includes both surface and groundwater information. It is recommended that the best entities for water cycle reports are surface water management area (and then river basin). To achieve this it means that groundwater information will need to be accounted within surface water management area (or river basin) boundaries as well as within groundwater management units. In some situations this presents difficulties as groundwater management units cross surface water management area boundaries. However such a protocol is sensible, given the vertical and lateral flow characteristics of groundwater (vertical flows are generally much greater than lateral flows), as well as necessary if holistic and integrated water resource management and accounting is to occur.



▪ **Figure 3 Aggregation of accounts to national level**

2.3.5 Moving to standard water accounting conventions

In addition to having a chart of accounts, and standardised reports, financial accounting includes accounting conventions which would be beneficial for water accounting.

For example, it is proposed that all water accounting transactions should *eventually* follow standard, double entry accounting conventions.

Double-entry financial book-keeping is governed by the accounting equation. At any point in time, the following equation must be true:

> **Assets** (end of period) **=** **liabilities** (end of period) **+** **equity** (start of period) **+** **(revenue** (over period) **−** **expenses** (over period)**)**

Finally, this equation may be rearranged algebraically as follows:

> **Assets** (end of period) **+** **expenses** (over period) **=** **liabilities** (end of period) **+** **equity** (start of period) **+** **revenue** (over period)

This equation must be true, for any time period. If it is, then the accounts are said to be in balance. If the accounts are not in balance, an error has occurred.

Water managers often use the water equivalents of these equations when they compile water balances, of whatever form.

For the accounts to remain in balance, a change in one account must be matched with a change in another account. These changes are known as debits and credits. Note that the usage of these terms in accounting is not identical to their everyday usage. Whether one uses a debit or credit to increase or decrease an account depends on the normal balance of the account. Asset and expense accounts (on the left side of the equation) have a normal balance of debit; liability, equity, and revenue accounts (on the right side of the equation) have a normal balance of credit. Since the accounts must always balance, for each transaction there will be a debit and a matching credit, and the sum of all debits for all accounts must equal the sum of all credits.

Adoption of conventions like these will result in transparent, auditable water accounts, which can readily be reconciled across jurisdictional boundaries.

In the early stages of water accounting it is likely the water businesses will continue to use existing systems to compile water accounting information. As systems are redeveloped or replaced, it is likely that off the shelf software packages incorporating financial accounting practices will be utilised to record water accounting information. The move to commercial accounting packages and double entry, transaction based water accounting is also likely to be influenced by public scrutiny of water accounting reports and the audit of these reports by State Auditors General.

Accounting standards will be considered further in the Analysis in Step 3 of this project.

2.4 Standards

Accounting standards are essential to underpin a national water accounting system. Without them the objectives of having national water accounts will be defeated. Standards are needed to meaningfully aggregate and compare accounting information and reports from different areas and jurisdictions, and to generate public and investor confidence in water availability and water use and the provision of water for the environment.

There are in some cases existing standards in place, for example there are a range of Australian Standards regarding measurement of flow information. However there are many areas where there are no existing standards in place.

The implementation of standards requires there to be in place systems and procedures designed to ensure the standards are implemented consistently and that information generated is reliable and repeatable - ie quality assurance. It is this presence of these procedures, together with standards, which will build confidence in the information.

One of the areas where there has been considerable attention recently is the standards regarding measurement of extraction (diversion) of water. A key finding of a report in January 2005, (*Audit of Murray Darling Basin Cap Data Management Systems* by Marsden, Jacobs and Associates, commissioned by the Murray Darling Basin Commission) was that errors in measurement of extraction from rivers by the largest diverters are outweighing all other errors, that standards are inadequate, and the methods and procedures are inconsistent. Considerable work is now underway to address this and also to prepare national standards for measurement of water extraction.

A recognised project where the adoption of such standards is applicable is The Australian Water Data Infrastructure Project, being managed by the Bureau of Rural Sciences. This project is designed to develop infrastructure to which water data can be transferred. Whilst standards may not necessarily yet exist, it can be expected that protocols and standards will need to be developed to assist interoperable data transfer between jurisdictions. An opportunity exists for the national water accounting developments to influence the development of standards and protocols.

2.5 Accounting for environmental water

It is recognised that the environment holds now, and will continue to hold in the future, two basic forms of rights to water; instream rights and extractive rights.

2.5.1 Instream environmental rights

These are rights to call water from storage into a river, or to prohibit its extraction by others. They include minimum flow rules, requirements to provide periodic freshening flows, entitlements such as the Barmah-Millewa Forest entitlement, and caps on extraction. Because they are often documented in operating rules, they are sometimes referred to as “rules based environmental water.”

In the proposed standard water accounting reports, the “environment water rules activity” report and the “environment water rules water commitment report” deal with instream environmental rights.

The “environment water rules activity” report is simply a collection of all the rules that create the instream environmental rights. It is really a register of those rules, analogous to the various registers of extractive rights to water. It seems necessary to have such a register, and record changes to the rules that change the instream entitlements, in much the same way that a State Water Register records changes in extractive rights. It could exist as a separate part of a State Water Register, and consist of a brief summary of each rule along with a reference to the location of each detailed rule (an operating plan, bulk water entitlement, water sharing plan, stream flow management plan etc.)

The way in which these rules produce actual flow in a particular river system can be shown in a report such as the “environmental water rules water commitment” report. This report will show the volumes of water called out of storage, “used” (and accounted as environmentally beneficial river loss) in riverine wetlands, protected from diversion as “above cap,” and passed to a downstream basin. It is not an audit of compliance with all the rules, but simply an accounting of the flows that resulted from them over the period of the report. The notion of accounting for instream environmental water as flows at the downstream end of a valley is used in water sharing and stream flow management planning.

In principle a non-extractive right cannot be traded with an extractive right. Arrangements to allow extractive users to make use of instream rights must provide for the water to be paid back. The Barmah-Millewa instream entitlement provides for this, and NSW irrigators have in the past “borrowed” water from Snowy Hydro, which holds instream rights to water, not extractive rights.

2.5.2 Extractive environmental rights

These are in principle the same as extractive rights held by a non-environmental water user. They may take the form of a water right, licence or bulk entitlement and in principle are tradable with other similar rights.

Various standard water accounting reports can be used to show only environmental water (or only the water held and used by any other class of owner, such as all the holdings of a particular company or group of companies). The proposed standard water reports for water access entitlements, water allocations, water access entitlement trade, water allocation trade and water availability could be produced for the environment in any appropriate physical water entities.

Other proposed standard water accounting reports such as the water cycle and surface water reports are physical water balances, and will include both environmental water and non-environmental water.

2.5.3 Reporting on all environmental water

To obtain information on both instream and extractive environmental use, it is necessary to look at both the environmental commitment account and at extractive accounts such as water allocation, trade and availability accounts.

A simple example of an environment water rules water commitment report and water availability report for the regulated Goulburn River were included in the **Step 1 Report.**

Environmental water managers are likely to wish to use extractive entitlements in an instream fashion. That introduces accounting complications because in principle such water should not lose its environmental tag as it passes from one river system to another – it should remain “green to the sea.” There are ways to account for this, and such accounting should be consistent across valleys and jurisdictions.

3 The Stocktake

A proposed **scope** and method for a stocktake of Australia's water accounting systems and practices, as **endorsed by the EAP** and as outlined in SKM's Step 1 Status Report, was agreed by the NWI Committee at its meeting on 22 March 2006. The NWI Committee also endorsed a proposal for **commitment building** information sessions in jurisdictions on related NWI projects and were supportive of an **adaptive approach**, which included piloting the stocktake in South Australia and working with EAP jurisdictional representatives to select participating organisations and assist with stocktake implementation.

3.1 Purpose

The purpose of the stocktake was to obtain information from all States and Territories regarding current water accounting systems and practices at levels ranging from each jurisdiction down to water service providers (including current arrangements to account for environmental water).

The stocktake was required to collect information in order to identity best practice, information gaps and areas for improvement, and to make recommendations for development of water accounting standards, principles for environmental water accounting and guidelines for reporting and information, including priorities for standards, guidelines and systems development.

It was intended that the stocktake should examine current water entitlement and rules-based regimes and the current water accounting systems at various levels (initially described as the resource, wholesale and retail). The stocktake intent also included gathering information which may help to refine and make recommendations about the standardisation of information elements and the key information about them to ultimately contribute to the outcomes desired from the project.

The primary difference between this stocktake and other existing information collection exercises was that the information needed to be collected in a detailed and consultative manner, not by survey.

3.2 Scope

The scope of the stocktake was required to be consistent with clause 81 of the NWI, which states that "Recognising that a national framework for comparison of water accounting systems can encourage continuous improvement leading to adoption of best practice, the Parties agree to benchmark jurisdictional water accounting systems on a national scale, including:

- State based water entitlement registering systems;
- Water service provider water accounting systems;
- Water service provider water use/delivery efficiency; and
- Jurisdictional/system water and related data bases."

The stocktake was to provide a focus on the agreed Water Accounting Information Requirement Framework, developed in Step 1 of the project, and have regard to the links between existing registration and accounting systems.

The scope of the stocktake (and hence project) was broadened to conduct commitment building sessions and promote coordination on related NWI projects and to include Western Australia when that jurisdiction joined the NWI.

The number and type of participating organisations was negotiated with EAP jurisdictional representatives and DAFF. Organisational participation provided adequate coverage of different types of organisations, included the lead water resource management department in each jurisdiction and was varied slightly to suit logistical realities while respecting the extent of the contractual commitment

The participating organisations are shown in Section 3.3.4. At the time of report despatch the stocktake meetings in the Northern Territory with the Department of Natural Resources, Environment and the Arts and with the Power and Water Corporation are still to occur. Any significant information arising from these meetings which modifies findings outlined in this report will be included in the appropriate chapter of the final two projects reports Otherwise the stocktake coverage, given the method adopted has been sufficient to gain an appreciation of relevant current practice. Any further stocktake meetings would most likely only provide marginal benefit. Some targeted consultation during the analysis and recommendation steps may be required.

3.3 Method

The key aspects of the stocktake method included;

- commitment building information sessions on related NWI projects and a stocktake inception meeting in each jurisdiction;
- appropriate contact with, notice and information package provision to participating organisations;
- the development and adaptation of stocktake forms to help gather relevant information and complement dialogue with representatives from participating organisations;
- interactive stocktake meetings with an emphasis on the value of dialogue and using a data projector to ensure transparency and understanding; and
- follow up with representatives from participating organisations for capture of any additional information or for validation.

The project method was designed to facilitate refinement of the concepts and macro elements of the Water Accounting Information Requirements Framework while gaining an understanding of micro elements in quite a lot of detail.

3.3.1 Commitment building and stocktake inception

The initial SKM methodology proposed a briefing meeting in each jurisdiction with some stakeholder representatives, probably in conjunction with the stocktake meeting with the lead central agency, to introduce the project and to build commitment.

However, given the emergent need to explain the coordination of this project with other related work under the NWI and in an endeavour to avoid confusion and counter the evident “engagement and information provision fatigue” among water industry organisations, the process was modified to run stand alone information sessions. These meetings were arranged as a joint effort by SKM and representative(s) of the NWI Committee and proved quite effective. The meeting were preceded by a letter from or on behalf of the Chair of the NWI Committee, which were combined with complementary contact, appropriate information provision and arrangements by EAP jurisdictional representatives working with SKM.

Experience from the stocktake pilot conducted in South Australia demonstrated the benefit to the project of commitment building through the NWI information session. This benefit was enhanced by conducting the stocktake inception meeting immediately following the NWI information session. The South Australian experience also provided confidence that the risks from lack of engagement and negative attitudes associated with perceived lack of co-ordination of NWI activities, as identified by the EAP, can be sufficiently mitigated by the adoption of this change to the methodology.

It was clearly evident in the South Australian stocktake meetings that information gathering was far more effective where the organisational representatives either had been personally involved or had been briefed by a colleague who had been personally involved in the NWI information session and/or the stocktake inception meeting.

As a result of the pilot, questions regarding the best timing of meetings and how to get the best fit for each jurisdiction arose. The conduct of the stocktake meeting some time after the inception meeting to allow organisations to digest information, review the forms and arrange for appropriate staff to be available needed to be balanced with the practicalities of logistics and costs.

For Queensland, New South Wales, Victoria and Western Australia the NWI information session and the stocktake inception meeting were conducted during a separate first visit, although in the case of Western Australia the stocktake meetings for Gascoyne Water Co-operative and Ord Irrigation Co-operative were held during the first visit. For the other jurisdictions, the information session and inception meeting were combined in the same visit with stocktake meetings to minimise the cost of travel.

The NWI information sessions and stocktake inception meeting were well received.

3.3.2 Adaptive approach

An adaptive approach was considered essential during the stocktake phase given the discovery and evolution that was likely to occur as the project progressed. Whilst the stocktake method focussed on a series of stocktake meetings with participating organisations, progressive development, testing, piloting and adaptation occurred along with regular interaction between the key project parties.

The strategy for stocktake meetings was refined as further experience was gained:

The first step in the stocktake was to conduct a pilot in South Australia to test both the proposed engagement process and the proposed stocktake meeting structure. This jurisdiction was chosen because of its medium size and a positive disposition to the project.

An NWI information session and stocktake inception meeting was organised with staff from South Australian participating organisations. The stocktake meeings were then conducted over the following two days. Organisations were provided with the following information package prior to the meeting:

- Project Flyer
- Particpant Toolkit
- Step 1 Status Report
- Forms

The process indicated that the forms that were used to conduct the stocktake could be improved in some aspects and these were subsequently modified (See Section 3.3.3). It was also decided that modifications to the information package were required to simplify the engagement process and the partcicpant toolkit was consolidated incorporating parts of the Step 1 Status Report to be made more relevant to stakeholder participants.

Refinements of how to disseminate the stocktake meeting information were also made. Minor adaptations continued to be made throughout the stocktake to fit the particular needs of jurisdictions or participating organisations.

Another major aspect of the scope is the interface between this project and other work being undertaken by the NWI. Specifically, early feedback from the inception meetings indicated the need for improved coordination between NWI projects and the information requests currently being made.

In response to this issue, internal SKM meetings were held to coordinate the two SKM managed projects where possible. As a result the information elements developed for this accounting project were adopted for the Baseline Assessment project in an attempt to standardise terminology for information elements where possible.

3.3.3 Stocktake forms

A set of stocktake forms for the collection and management of water accounting information during the stocktake was developed by SKM. It was anticipated that the use of these forms would ensure the information collected during the stocktake is thorough, and will assist in consistency across all states and different types of organisations. They would also help ensure information obtained during the stocktake is well managed and analysed, can be used to present findings and provide a snapshot of the stocktake.

The forms were designed to group together and aggregate as much information as possible, while also being adaptive and flexible enough to incorporate individual differences, unexpected responses and comments that should be included in the stocktake. Following NWI committee agreement to proceed to Step 2, SKM, with assistance from Australian Bureau of Statistics form designers, developed more user friendly forms. The forms were also modified following the South Australian pilot to provide a more logical sequence of questions.

The stocktake forms were designed to be used by organisations to prepare for the inception and stocktake meetings, and to assist SKM interviewers to clarify and capture information during the stocktake meeting dialogue. Five forms were generally used with purposes as described in Table 4. A full set of completed stocktake forms will be collated on a CD or DVD and provided to DAFF at the completion of stocktake meetings.

The details gathered in each individual stocktake meeting are not intended to be presented, as this is not an audit. The forms proved to be effective in triggering discussions which enhanced knowledge exchange, not all of which was easily recorded on the forms themselves. It was also discovered that several aspects of the forms proved to be less effective or unnecessary. This was to be expected.

Experience from the ABS and others who do large surveys by form is that there is normally a significantly large pilot to test the form. With this stocktake, the whole of the process was less than what would normally be used as a pilot. Thus it was not surprising that the use of the forms was adapted as the stocktake progressed.

Table 4 Stocktake Form Descriptions

.Form	Description / purpose	Comments
One	Organisational overview Designed to collect overview information, to help scope the level of involvement and detail being requested from the organisation and to identify key contacts. SKM used it to tailor the rest of the forms to suit the organisation.	Generally filled out and referred to SKM before the stocktake inception meeting and completed at the inception meeting. Information generally provided by staff with a strategic or organisation-wide perspective.
Two	Physical water entity categories Designed to collect more detailed information on the specific physical water entities that the organisation is involved with.	A separate copy of Form Two was completed for each category of physical water entity. Information generally provided by operational and technical staff. Was introduced at the inception meeting, partially filled out before, but completed at the stocktake meeting.
Three	Information elements Designed to present information elements and data that are required to produce current or envisaged water accounting reports, relating to relevant physical water entity categories. Organisations were asked to indicate whether they are able to derive the information elements and if so, how.	Information generally provided by technical and operational staff This Excel spreadsheet was completed at the stocktake meeting.
Four	Information stores Designed to review the information stores / databases that are used to manage data and information elements that are or could be used in water accounting reports, as well as current water accounting practices.	A separate copy of Form Four was completed for each information store that was identified. Information generally provided by technical and operational staff. Generally completed at the stocktake meeting.
Five	Reporting and future directions Designed to review current water accounting reports and to identify future plans.	Information generally provided by the key contact or staff with a strategic perspective. Generally completed at the stocktake meeting.

3.3.4 Stocktake meetings

A process of strategically distributing stocktake forms enabled each organisation to become familiar with the type of information required to complete the stocktake and added value to the face to face engagement by allowing the organisation to prepare and coordinate information prior to the stocktake meeting.

Stocktake meetings generally took place in the office of the participating organisation with a number of staff involved depending on size and functional complexity. A data projector was used to ensure transparency and an emphasis placed on dialogue to maximise effectiveness.

The Stocktake did not cover all water organisations across the country. It was made clear that the stocktake was about gaining a snapshot and appreciation of practice and was not about assessing performance. Organisations were nominated to participate through consultation with the jurisdictional EAP representatives, with the overall sample selected to ensure adequate exposure to current practices and systems. The involvement of the EAP representatives who were fully aware of the details developed during the initial stages of this project assisted significantly with many of the meetings.

Organisations that participated in stocktake meetings are detailed in Table 5.

- **Table 5 Details of Participating Organisations**

Jurisdiction	Organisation	Key Contact	Resource Manager	Bulk	Retail - Rural	Retail - Urban	Date of Stocktake
Australian Capital Territory (ACT)	Department of Territory and Municipal Services	Peter Liston	Y	N	N	N	15 May
Queensland	Department Natural Resources Mines and Water (DNRMW)	Randall Cox	Y	N	N	N	22 May
	Sunwater	Gary Nayler	N	Y	Y	N	23 May
	South East Queensland Water (SEQ Water)	Reg Bailey	N	Y	N	N	22 May
	Brisbane Water	Greg Tucker	N	N	N	Y	24 May
	Gold Coast Water	Sayed Khan	N	N	N	Y	24 May
	Fitzroy River	Jim Cook	N	N	Y	Y	25 May
	North Burdekin Water Board (NBWB)	Shane McNamara	N	N	Y	N	26 May
New South Wales	Department Natural Resources (NSWDNR)	Paul Pendlebury	Y	N	N	N	31 May
	State Water	Dan Berry	N	Y	Y	N	30 May
	Hunter Water	Emma Hamilton	N	N	N	Y	2 June
	Colleambally Irrigation Cooperative	Kevin Kelly	N	N	Y	N	19 June
	Murrumbidgee Irrigation	John Chant	N	N	Y	N	19 June
	Murray Irrigation Limited (MIL)	David Watts	N	N	Y	N	20 June
Northern Territory	Department of Natural Resources, Environment and the Arts	John Gilmour	Y	Y	N	N	17 July
	Power and Water Corporation	David George	N	Y	Y	N	18 July
South Australia	Department of Land Water and Biodiversity Conservation (DLWBC)	Julie Cann	Y	N	N	N	11 April
	South Australia Water	Stuart Peevor	N	Y	Y	Y	12 April
	Renmark Irrigation Trust	David Morris	N	N	Y	N	N/A

Jurisdiction	Organisation	Key Contact	Resource Manager	Bulk	Retail - Rural	Retail - Urban	Date of Stocktake
	Central Irrigation Trust	Brian Martin	N	N	Y	N	12 April
	Sunlands Irrigation Trust	Craig Ferber	N	N	Y	N	12 April
Tasmania	Dept Primary Industries and Water (DPIW)	Christina Jackson	Y	N	N	N	11 May
	Rivers and Water Supply Commission (TRWSC)	Adrian Paine	N	N	Y	N	11 May
	Hobart Water	Andrew Truscott	N	Y	N	Y	11 May
	Hydro Tasmania	Greg Carson	N	N	N	N	11 May
Victoria	Department Sustainability and Environment (DSE)	Stuart Critchell	Y	N	N	N	8 June
	Melbourne Water	Simone Esler	N	Y	N	N	16 June
	Goulburn-Murray Water (G-MW)	M P Seker	Y	Y	Y	N	9 June
	Southern Rural Water	Terry Flynn	Y	Y	Y	N	15 June
	Goulburn Broken Catchment Management Authority (GBCMA)	Geoff Earl	Y	N	N	N	9 June
Western Australia	Department of Water (DoW)	Rhiannon Addams	Y	N	N	N	13 June
	Water Corporation	Mark Leathersich	N	Y	N	Y	15 June
	Harvey Water	Geoff Calder	N	N	Y	N	13 June
	AQWEST (Bunbury Water)	Geoff Oddy	N	N	N	Y	14 June
	Busselton Water	Keith White	N	N	N	Y	14 June
	Gascoyne Cooperative	Ed Garrett	N	N	Y	N	29 May
	Ord Irrigation Cooperative	Andrew Kelly	N	N	Y	N	29 May
Other	Murray Darling Basin Commission (MDBC)	Maryanne Slattery	Y	Y	N	N	16 May

3.3.5 Post stocktake meetings

After the stocktake meetings, SKM has followed up any issues, questions or further information that has been required, in coordination with the organisation through emails and phone conversations with appropriate personnel.

Validation of information gathered or presented will continue to occur and copies of the project reports are to provided to the participating organisations once they are finalised.

3.4 Definition of water accounting

Both at the meeting of the NWI Committee on 22 March 2006 and early in the stocktake phase of the project the need for a definition emerged. A working definition was framed and included in the Participants' Toolkit.

To assist during the stocktake, the following working definition, which could be refined as the Water Accounting Project proceeded, was developed.

> ***'Water accounting is the identifying, measuring, recording and reporting of relevant water information elements in a consistent and structured manner, to assist users to be informed or to make decisions relating to the status of, or periodic changes to, water stocks, water flows, water use, water access entitlements, water allocations, or environmental water rules**.'*

The latter part of this definition, having been scrutinised by various jurisdictions and project staff, was categorised as being rationale rather than definition. Subsequently an abbreviated version, amended after some feedback from participating organisations, was included in a revised Participant's Toolkit.

The latest working definition, which is likely to further evolve as ideas about water accounting are developed, has been used to structure the findings of the stocktake. It reads as follows:

> ***'Water accounting is the application of a consistent and structured approach to identifying, measuring, recording and reporting relevant information about water.'***

4 Stocktake Findings

Commentary and findings from the stocktake are outlined in this Chapter. Significant findings are numbered and appear in italics at the conclusion of the supporting commentary. It is important to be mindful of the stocktake scope and method and that whilst all central jurisdictional water agencies have participated, only a sample of water service provider organisations were selected to participate. For example, references such as 'all organisations' should be interpreted as meaning 'organisations that participated in the stocktake and whose functions are relevant to the particular subject being addressed'.

4.1 Measuring physical water parameters

The basic building blocks of physical water accounts are measured physical water data of various kinds. This data is used to generate the information elements discussed in section 4.2, either directly or indirectly through using numerical or analytical models of various kinds.

In the stocktake organisations were asked what data they collected, how they collected it, at what frequency the data is collected, how accurately the location of the collection point was known and whether they consciously applied standards and had quality assurance systems in place. The following key physical water data types that were found in the stocktake to be commonly measured amongst participating organisations are discussed in this section:

- River levels and flows
- Pipe flows
- Channel flows
- Rainfall
- Evaporation
- Groundwater levels
- Broadscale charting of farm dams

It was noted that bore logs, pump tests and geophysical data, groundwater quality information, and other parameters are also critical information for determining many aquifer information elements. Physical surveys of storages and rivers are also relevant. However standards and procedures for collecting this information were not investigated in the stocktake.

Finding 1: For all types of physical data the spatial location of measurement points (eg river gauges, bores, meters, etc) was in most cases known to a high level of accuracy – typically within 10m. The reason for this is the ready availability of GPS technology which enables locations to be determined cheaply and accurately.

4.1.1 River levels and flows

River levels are recorded continuously using instruments which are periodically maintained and calibrated. Flows in rivers are derived from the levels based on rating tables which are periodically checked and updated as necessary. In some cases flows below dams are derived from the settings of dam release valves.

The Australian Standards AS 3778 series relating to measurement of flow in open channels covers many aspects of this work. Several organisations indicated that they operate to these standards plus internal standards and have externally accredited quality assurance systems. Other organisations do not have external accreditation but reported that they nevertheless operate in accordance with established industry practices.

Most organisations recorded flow in megalitres per day, but some used cumecs. One organisation, Hydro Tasmania, was observed to use gigalitres.

Many organisations indicated that they label the information collected according to method/quality in accordance with the approach in place in the HYDSTRA information system (or related products Time Studio or HYDSYS which are from the same vendor) which is used to store the information, though it was not determined whether all used the same labels.

Good Practice Example: "Water Monitoring Data Collection Standards"- Queensland Department of Natural Resources, Mines and Water.

DNRMW provided a copy of this document which sets out standards which are required to be applied by staff and contractors of DNRMW and Sunwater to collection of river level and flow information and a range of other water data.

The document sets out methods and required accuracies for measurements and standards for maintaining and calibrating instruments. Generally reference is made to external standards such as the AS 3778 series mentioned above, or published Departmental guidelines.

In cases where standards/guidelines do not exist the document refers to 'industry best practice'. This is a pointer to areas where further development of standards and guidelines is needed.

Finding 2: The measurement of river levels and flows has well established standards and practices which are commonly in use.

4.1.2 Pipe flows

There are a range of methods in use for measurement of flow in pipes. Those identified in the stocktake include mechanical flow meters, ultrasonic or magnetic flow meters, and indirect methods such as calibrated pump hours or pump power consumption.

Ownership and responsibility for installing and maintaining meters was found to vary. Water service providers generally owned, installed and maintained meters on points of extraction from rivers or aquifers, returns and customer delivery points. However, for rural water users who self extract from rivers or aquifers, the ownership and responsibility for the meter is in some areas the responsibility of the water users, and in others the responsibility of the resource manager or a water service provider.

The AS 3565 series of Australian Standards relates to metering of potable water supply. They cover many aspects of meter installation and maintenance. Most urban water service providers indicated that they comply with these standards, and with industry best practice for matters not yet addressed in the standards. For meters on points of extraction from rivers and aquifers and returns of treated effluent to rivers and the sea, the organisations indicated they comply with manufacturer recommendations for instrument installation and maintenance.

However standards for rural water metering are not uniform. Several rural water service providers have in place internal standards for installing and maintaining meters for which they are responsible. NSW State Water has published a standard for installation of meters and other devices for measuring pumped extraction by water users. In general it was found that standards and procedures for rural water metering were patchy.

Frequency of reading meters varied from monthly to once a year. However, taking a different approach, NSW State Water indicated that for regulated river water users it obtains self reported meter readings from water users whenever water is ordered. Periodic readings by State Water staff are used to verify that information, rather than being the first source.

Units of measurement were either kilolitres or megalitres. Urban water service providers and some rural water service providers used kilolitres, but most rural water service providers used megalitres.

All organisations indicated that their information systems differentiated between metered volumes and volumes which were estimated due to meter failure.

Finding 3: No commonly used standards and practices for measurement of piped flow were found to exist except for measurement of piped delivery of potable water in the urban context.

4.1.3 Artificial channel flows

Open channel flows are measured by water service providers in gravity channels for taking and delivering water, and in some cases in storm water channels and drains. Methods of measurement reported were rated structures (flumes etc), formulas based on gate openings, ultrasonic devices and dethridge wheels.

The AS 3778 series includes standards for many of the methods of open channel measurement, and organisations reporting compliance with these standards for river flow measurement also applied any relevant standards for artificial channels.

Many organisations reported concerns with the accuracy of these methods, particularly the method of calculating flows based on gate openings in channels where the gate openings are submerged downstream. A report in January 2005, (*Audit of Murray Darling Basin Cap Data Management Systems* by Marsden, Jacobs and Associates, commissioned by the Murray Darling Basin

Commission) found that errors in measurement of extraction from rivers through gravity channel are substantial; that standards are inadequate, and the methods and procedures are inconsistent. The MDBC has commissioned further work to address this issue.

There were different views expressed on the accuracy and reliability of dethridge wheels. It was found that in many areas these are being phased out in favour of gated measurement and control systems.

Major channel measurement points were either continuously recorded or calculated on a daily basis. Customer delivery measurement points in channel systems were read at varying frequencies. Where total channel control systems are in place information is available on a continuous basis. Where manual reading is required frequency varies from monthly to quarterly.

Finding 4: Measurement of flow in artificial channels has established standards which apply to some methods of measurement but not to many commonly used methods of measurement. Many current methods used, such as Dethridge wheels and formulas for flow at channel control structures, are considered inaccurate or less reliable and are gradually being phased out.

4.1.4 Rainfall, evaporation and transpiration

Measurement of rainfall was reported using either continuously recording instruments (pluviographs or tipping bucket rain gauges) or daily read rain gauges. The continuously recording instruments were often integrated with river flow gauges or integrated weather stations.

Measurement of evaporation was reported using daily-read pan evaporimeters or integrated weather stations. None of the organisations reported any measurement of transpiration.

Organisations generally reported complying with standards and procedures published by the Bureau of Meteorology and instrument suppliers in collecting this information. The common unit of measurement was millimetres.

Finding 5: There are well established standards and procedures, maintained and published by the Bureau of Meteorology, for measurement of rainfall and evaporation. No organisations indicated they directly measured transpiration.

4.1.5 Groundwater levels

Measurement of groundwater head levels in bores is most commonly done with periodic (usually monthly) manual readings (lowering a device down the bore until the water level is reached). A proportion of dedicated monitoring bores have continuous recording devices.

Where measurement is continuous organisations that have standards and procedures for river levels also apply these to groundwater. Queensland's DNRMW has an accuracy standard for these measurement in the document referred to in section 4.1.1. Otherwise standards and procedures were mostly absent.

Finding 6: Organisations with standards and procedures for continuous recording of river levels applied them to continuous recording of groundwater levels. For spot levels (which represent the bulk of groundwater level information collection) standards and procedures were mostly absent.

4.1.6 Broadscale charting of farm dams

In order to estimate the water collected in farm dams at a catchment scale, the approach has been to use satellite imagery, aerial photography and topographic maps to locate the dams and chart their surface area. From this information various techniques have been used to estimate the capacity of the dams and the amount of water that is abstracted from the river system as a result of evaporation or consumptive use of the water in the dams.

This approach has been employed by DSE Victoria, DNR NSW and the MDBC. Early work has been very labour intensive and expensive. Improved techniques for charting the information and deriving the dam capacities and effects are still being developed.

Finding 7: Techniques for identifying farm dams and charting their surface areas at the catchment scale exist and have been extensively used in some areas. However the techniques are expensive to implement and are the subject of ongoing development.

4.2 Assembling chart of accounts information

A set of information elements were identified as being necessary to populate the proposed standard water accounting reports (see Section 2.3). Definitions for these information elements were proposed and are included in Appendix B. These information elements can be assembled at various levels (physical reporting entities) using physical data either directly or as input to models, or using data from other sources such as registers.

The stocktake investigated the capacity of organisations to **assemble** these information elements for various physical entities. They were also asked what **drives** the information collection they currently undertake and what **future plans** exist which may effect this data collection. The viability of the proposed information element definitions was also investigated.

In this section the findings of the stocktake regarding the physical reporting entities and the information elements are set out.

4.2.1 Reporting units - use of physical water entities

The stocktake investigated the physical water entities that organisations currently use for reporting and the viability of using the Surface Water Management Area (SWMA) and Groundwater Management Unit (GMU) entities used in the Australian Water Resources Assessment 2000 (AWRA) for ongoing reporting of water at the resource level.

For surface water, resource management and reporting units generally corresponded to the SWMAs, or groups of SWMAs, or subcatchments of SWMAs. There were some cases (eg Clare Valley Water Allocation Plan in South Australia) where the management units took no notice of AWRA boundaries at all.

The scale of surface water planning units also varied enormously. Tasmania on the one hand has subdivided its SWMAs into 48 catchments for planning and reporting, while on the other hand Queensland has amalgamated SWMAs to form water resource planning (WRP) units many of which are similar in scale to the whole of Tasmania.

For ground water, the resource management units were found to be in part the same as the GMUs, but many have changed significantly since 2000. NSW indicated they have recently gone to considerable effort to complete the division of the whole state into groundwater management units as part of its macro-water planning project, resulting in a whole new set of GMU boundaries

There was a generally stated need for flexibility for some time to come in GMU boundaries, principally because of the rapidly changing and growing understanding of the nature and extent of aquifers.

Boundaries of management units were generally found to be clearly defined down to land parcel scale in statutory orders or plans. Consequently changes to these units could be tracked. However no repositories were identified for boundary definitions and changes to boundary definitions which would enable easy access to this information.

There was no consistent approach to synchronisation of GMU and SMWA boundaries. While the connection between surface and groundwater was generally recognised, there were few cases where it has translated into combined surface-groundwater plans and planning units, this being reflective of the level of knowledge in this regard.

Finding 8: For resource level reporting it was found that:

- *Water information elements and reports could be most easily assembled for high priority management units;*
- *Across the country there is only a partial correspondence of these high priority management units to SWMAs and GMUs used in the AWRA;*
- *outside of these high priority management units the information is generally sparse or of much lower accuracy;*
- *the management units are still changing and evolving, particularly for groundwater; and*
- *few cases were found of fully integrated groundwater and surface water management and reporting units.*

Water service providers generally managed and reported on entities related to the services they provide, these being rural or urban water supply, sewerage, irrigation drainage and stormwater drainage systems. Driven by operational requirements and regulatory reporting demands, water service providers have extensive information relating to delivery and sewerage systems for which they are responsible.

Information on irrigation drainage systems was generally limited to outflows (volumes and quality) which were typically required to be collected under licences. Ongoing collection of water flow information in urban stormwater drainage systems was found to be rare.

Boundaries of all these service related entities were found to be well defined and delineated clearly in statutory instruments.

In relation to 'sites' as a physical water entity, the MDBC reported it was assembling information and developing reports for the icon environmental sites. The GBCMA is also exploring the assembly of relevant water information elements for several wetlands.

Finding 9: Water service providers generally assembled and reported extensive water information in relation to delivery systems and sewerage systems for which they are responsible. However water information for irrigation drainage systems was less common and almost non existent for stormwater drainage systems. Water reporting on environmental sites is at a very early stage of development.

4.2.2 Water stock and flow information elements

The stocktake investigated whether organisations **held** information and had the capacity to **assemble** these information elements for various physical water entities. They were also asked what **drives** the information collection they currently do and what **future plans** exist which may effect this data collection. The viability of the proposed information element definitions was also investigated. The findings in the following table cover these areas.

Information element	Stocktake commentary and findings
Surface water stocks	
Minor catchment storages, Minor on-stream storages, Minor extracted water storages (commonly called farm dams, private off river storages etc)	No organisations indicated that they were able to provide actual volumes in store at particular times, and organisations advised that the cost of gathering this information makes it prohibitive. However there is a considerable body of information on the capacity of these storages. Victoria has done a complete survey of the capacity of these storages by manually extracting data from aerial photography and topographic maps. Other states have done partial surveys using similar approaches. Most states reported knowing the capacities of those storages which are required to be licensed, but this was generally a small proportion of the total. In the near future NSW will be gathering information on the volume in store in extracted water storages (commonly known as off river storages) on regulated rivers in NSW. DNR & State Water are constructing a system whereby irrigators will provide regular information on current volumes in store in extracted water storages as part of the WIX customer information exchange system. The MDBC is funding further work to survey minor storage capacities, and there is considerable scope for further development of techniques using satellite imagery. Stated drivers for information collection were resource planning and licence compliance (for licensed works).
Major on-stream storages, Major extracted water storages	Daily or continuous storage volumes are generally available, the driver being water supply operations and allocation planning.

Information element	Stocktake commentary and findings
River channel storage Artificial channel storage	Organisations generally did not hold this information, nor were there any drivers for them to do so. (Some organisations had done one-off calculations for particular projects). Advice was given that generation of this information element would require additional survey and level information and would require some investment.
Snowpack volume	This information element is irrelevant for most of Australia. No Victorian organisations gather this information. It is known that Snowy Hydro do gather some information on snowpack but they were not available to participate in the stocktake
Finding 10: Volumes in major storages at any time are readily available. Capacities (but not volumes at a particular time) in minor storages (farm dams etc) are available in some areas, and river and channel volumes are generally not available.	
Groundwater stocks	
Soil water volume in storage	No organisations held this information. While it is often assessed and considered important on a farm scale for enterprise planning decisions, the same is not true at a broader level. No methods of gathering this information on a large scale were found. There were no reported drivers to collect this type of information. Current practice for resource management is to call the water that infiltrates down through the soil aquifer rainfall recharge, and to treat the water that drains from the soil into rivers as part of the rainfall runoff.
Aquifers – renewable and non-renewable storage – saline and non-saline	The definitions of these information elements were found to be generally unworkable. The concept of viewing an aquifer like a dam, part of which can be drawn on, and part of which (like the dead storage in a dam) cannot, is inconsistent with aquifer management practice. Many organisations considered the sustainable yield as stock, but using this as 'stock' in a water balance does not work, since it is unaffected by year to year extraction, recharge and outflows. Some organisations indicated that they could estimate total volume in the aquifer and did so for particular projects while Western Australia indicated estimates had been done for a number of aquifers, but otherwise it was not considered to be a useful parameter and often led to misunderstandings about the quantities of water that could be extracted. Assessment of any parameters in saline aquifers was limited to just a few specific cases.
Finding 11: The volumes held in soil and in aquifers were generally not determined	

Information element	Stocktake commentary and findings
Rainfall, evaporation, transpiration	
Rainfall	Many of the organisations surveyed operated a small to large network of rainfall gauges. The main driver for doing so was either flood operations or flood studies, though some rural water service providers operated the gauges for the benefit of their customer's on-farm management. All organisations indicated close cooperation and data sharing with the Bureau of Meteorology. Overall the total network across the country is extensive and comprehensive. Various techniques were used for interpolating rainfall station data to give total rainfall across an area.
Evaporation - catchment storages, minor on-stream storages, minor extracted water storages	No organisations indicated they collect this data
Evaporation - major on-stream & extracted water storages	Several water service providers indicated they calculate evaporation from their storages using actual storage areas and pan evaporation data on the site. Some calculate it using long term average evaporation rates. In both cases this was done for operational purposes. Many organisations did not attempt to derive this information at all.
Evaporation - rivers, artificial channels	No organisations indicated that they have this data or have any reason to assemble it, except for particular on-off projects. NSW DNR indicated that it could be drawn from river models.
Evapo-transpiration - aquifers	This parameter is only relevant to aquifers near the surface. Only Hunter Water Corporation indicated that they could if necessary draw this information from their aquifer models, but had no reason to do so.

Information element	Stocktake commentary and findings
Evapo-transpiration - irrigated areas, forested areas, other areas	No organisations stated that they have any information of this kind except for at a few specific locations eg MDBC are estimating evapo-transpiration in some of the icon environmental assets. In the Water 2010 project the Bureau of Rural Sciences (BRS) have used land use and topographic information together with rainfall and potential evapo-transpiration to generate long term average estimates of actual evaporation and transpiration across the country. Techniques of this kind may be able to derive this information for monthly or annual periods.
Finding 12: Rainfall information is readily available; evaporation is available for some major storages, but otherwise actual evaporation and transpiration volumes were not found to be assembled anywhere. Techniques for calculating evaporation and transpiration on a broad scale have been developed but so far have only been applied to estimate long term average figures	
Surface water flows	
Surface inflow and outflows (into or out of entities)	The definition of surface inflow and outflow proved to be confusing. Inflows were intended to cover such things as upstream inflows to a downstream river (eg tributary inflows to the River Murray). However inflow was sometimes confused with rainfall runoff within the entity. Also it was not clear whether inter-valley physical water transfers and bulk supply of water across an entity boundary were included or not. Further refinement of definitions will be needed. Generally river inflows and outflows are measured by gauging stations for priority management areas, but for other areas they are sometimes gauged and sometimes not. A number of organisations indicated they were developing catchment runoff models for priority ungauged areas which could derive outflows from rainfall, catchment parameters and river gauging stations within or near the catchment. The main historic drivers for direct measurement of flow are operational water sharing, flood operations, and water supply planning. Generally across Australia gauging station numbers declined over the 1980s and 1990s. Several organisations reported that the introduction of new water plans with expanded operational and reporting requirements is driving a renewed expansion of the networks.

Information element	Stocktake commentary and findings
Rainfall runoff (within entities)	Two techniques were reported for estimating this parameter. This first is deriving the information from rainfall and catchment parameters using rainfall runoff models. Some organisations indicated that they had rainfall runoff models in place for particular locations eg catchments of large dams, urban storm-water drainage systems. The second method was to derive the figure by water balance. This is more commonly used where the management unit has measured outflows and extraction. The prime driver for obtaining this information is operational needs, but increasingly reporting requirements such as the Victorian State Water Report are driving assessment of this parameter.
Finding 13: Surface water inflows and outflows and rainfall runoff are available for high priority management areas. Outside of these areas the information is partial, but organisations are investing in increasing coverage.	
Movements of water between aquifers and surface water.	
Aquifer recharge/discharge from rivers, storages, channels, pipes	Two techniques were reported for estimating this parameter. The first is detailed aquifer modelling. The second is by water balance between gauging stations on rivers. Organisations indicated they assessed the quantities involved for specific locations on a project basis rather than ongoing. The only driver found for gathering this information is planning. There were currently no reported drivers for doing other than long term assessments for priority areas. Note that recharge/discharge from pipes and channels is generally not considered material and is ignored except for where it is deliberately induced. Artificial recharge of this kind was considered under the artificial injection information element listed below, though it equally fits under the definition of this information element. It is clear that the element definitions need to be revised to remove this conflict. However leakage is an important parameter for delivery system perspective and needs to be identified as a separate information element.
Finding 14: Information on volumes of water moving between rivers/storages and aquifers was found to be available only as long term estimates for particular locations	

Information element	Stocktake commentary and findings
Aquifer rainfall recharge and injection	
Aquifer recharge from soil water	As noted in the comments about soil water storage, the general practice reported was to ignore soil water and consider the water passing through the soil into aquifers as rainfall recharge. A variety of methods are in use for estimating rainfall recharge, the most accurate being calibrated aquifer models. Organisations indicated that they could estimate long term average recharge for all priority aquifers (NSW have done so for all aquifers as part of their macro planning project), though the confidence in the figures varies depending on the method used and the data available. The driver for estimating rainfall recharge is long term planning. No organisations reported a need for annual estimates.
Injection of water into an aquifer	This information element was added during the stocktake. The definition needs to be expanded to include artificial recharge of near surface aquifers using leaky channels or pondages. Organisations in SA, WA and Qld reported artificial recharge of aquifers by either pumping down a bore or gravity leakage. In SA and WA the driver for accurate measurement is the fact that the volume injected can subsequently be extracted by the organisation, so the volumes are metered. North Burdekin Water Board indicated they calculated the volume of artificial recharge by water balance on the channel system they use to distribute the recharge water.
Finding 15: Long term rainfall recharge estimates for priority aquifers are generally available though their quality varies. Records of annual rainfall recharge volumes were not found. Volumes of water being artificially injected into aquifers were found to be available.	

Information element	Stocktake commentary and findings
Groundwater movements	
Aquifer inflow/ouflow from/to adjoining aquifers (lateral & vertical)	Organisations reported this information only available as one-off assessments for high priority GMUs using models or analytical methods. Often only general behaviour known - not volumes. The driver is resource planning in priority systems.
Finding 16: Lateral/vertical volumes of water moving between aquifers was generally not known, though average volumes were estimated for some priority GMUs.	
Volumes of water extracted from rivers or aquifers	
Extraction for environmental purposes	Where entitlements for environmental water exist, organisations reported that the extraction was metered where the volume was pumped. The MDBC reported that where the water flows overbank or through channels into wetlands and then returns, methods are being developed to estimate the net 'extraction'. The drivers for obtaining this information are compliance with entitlements and reporting requirements
Extraction by delivery service providers	Organisations reported that pumped extractions were all metered, and all gravity extractions were measured using open channel methods. The accuracy of gravity channel extraction measurements was noted as a concern. The main drivers are licence compliance, operations and billing.
Extraction by consumptive users	While metering of extraction from rivers and aquifers is very widespread, there are still major gaps. Extraction from unregulated rivers is mostly un-metered. Metering of extraction from groundwater is likewise patchy. Extraction of water under rights not needing a licence is un-metered everywhere, but this is generally considered to be a comparatively small volume.

Information element	Stocktake commentary and findings
	Metering of water taken from drains was found to be rare. All resource managers reported plans to expand metering coverage. The main driver is water sharing where demand is high and rivers or aquifers are under stress. Additional drivers are moving to usage based tariffs and on farm water efficiency management.
Finding 17: Volumes of water extracted from rivers and aquifers is generally available. However the quality of the information is affected by accuracy problems with measuring large gravity offtakes and the absence of metering of extractions from most unregulated rivers and aquifers.	
Volumes of water delivered to water users	
Delivery by delivery service providers	Nearly all water service providers reported 100% metering. The main driver is billing, as tariffs are generally based on use. There are still a number of smaller councils who do not meter urban water deliveries and who bill on a land value basis, but these are gradually going to metering and usage based tariffs.
Delivery of treated waste water	All organisations delivering treated wastewater to customers reported that it is fully metered.
Finding 18: Volumes of water delivered by water service providers are readily available	
Returns of water to rivers or aquifers or channels (treated or untreated)	
Returns of unconsumed water to rivers or aquifers	Organisations indicated that major returns from irrigation areas (via drainage systems) are directly measured. Smaller returns are estimated. However drainage returns are a mixture of rainfall runoff, tail water and channel escapes There was some confusion over whether returns of irrigation water through infiltration to aquifers was included in this information element or not. A separate information element is needed. The only reported estimates of this parameter are in specific studies.

Information element	Stocktake commentary and findings
Returns of unconsumed water to delivery systems	No organisations reported this occurring
Returns of treated waste water	All organisations returning treated wastewater to rivers indicated that it is fully metered. It was noted that the discharge of waste water to estuaries and oceans needs to be added to the information elements.
Finding 19: Volumes returned to rivers and aquifers are generally available)	

4.2.3 Water use information elements

Information element	Stocktake commentary and findings
Irrigation (by category)	The general method for collection of this information is by survey of irrigators. The ABS surveys a sample of farms every year and a full census every 5 years. Past surveys have not been able to spatially locate the use within SWMAs, but ABS recently obtained additional funding to alter their survey to allow more precise location. Some rural water service providers undertake detailed property assessments on a regular basis, recording the area and crop type. This applies where the sharing of annual allocations is done in accordance with crops and areas rather than fixed customer entitlements. Apart from this water service providers and resource managers have been substantially reducing gathering irrigation usage information over the last 10 years. Queensland DNRMW and Sunwater indicated they have stopped collecting this information altogether. NSW State Water indicate that their new interactive customer information exchange will collect crop types and areas with water orders. This information is used for regulated river models and Cap reporting. Goulburn-Murray Water indicated they are developing methods for gathering information about crops and areas irrigated. The water use categories used by water service providers varied substantially and frequently did not easily map into the categories used by the ABS. Several people expressed concerns about the quality of the information currently gathered by survey. There has also been confusion in the past about whether areas of crops reported are initial or final (NB many irrigators with annual crops will plant large areas, then stop irrigating part of the area if water availability is less than hoped). There was no evidence of any processes to verify even a small sample of the information to ensure farmers are interpreting questions correctly and reporting faithfully.
In stream use (by category)	Organisations reported that volumes of water used for hydro-electric generation and fish farming were available.

Information element	Stocktake commentary and findings
Other (by category)	Urban water service providers reported that they were able to report volumes supplied for residential and industrial purposes but the break-up into categories below this varied. The main drivers for categorisation are different tariff structures and/or different priority for water sharing. ABS survey many industry groups directly to obtain water usage information.

Finding 20: Information on the volumes of water used for various purposes of use was available. The ABS are the major gatherer of this information. While many water service providers gather some information also (and the ABS use their data) some are reducing their collection of this information and some are increasing it.

Finding 21: There is considerable variation in the categories of water use employed by organisations, and the quality of the information gathered is highly uncertain.

4.2.4 Water entitlements and allocations information elements

Information elements	Stocktake commentary and findings
Share units issued, cancelled, current balance Share units moved in/out, acquired or divested	State organisations (except WA) reported that these information elements could be generated from water access entitlement registers in relation to entitlements which conform to the NWI specification for water access entitlements, though system enhancements would be needed. They also reported that many entitlements do not yet conform to this specification (still attached to land, expressed as an authorised area, etc) and that they were at various stages in the process of converting entitlements to NWI specifications and placing them on their registers. Even where entitlements do comply with NWI specification, there remains significant differences between the entitlements in relation to the extent to which shares are bundled with water allocations and water use consents, and the nature of the linkage between the shares and storage rights (often manifested as carryover etc). Rural water service providers where customers have internal water rights (eg Irrigation companies in NSW, Trusts in SA, Boards in Qld, Cooperatives in WA) indicated that they would have difficulty generating these elements as the entitlements do not conform to the NWI specification. In many cases individual entitlements to allocations were variable from year to year depending on things such as crop type and watering system. However all of these water service providers indicated they could potentially provide information similar to the NWI water access entitlement specification. The definitions of trading information elements were not fully accepted and need further work
Water allocation accrual, use, write off, current balance Water allocations moved in or out, acquired or divested	These information elements were available from water allocation management systems for regulated (supplemented) river systems in NSW, Queensland and Victoria. Likewise for water users within constructed delivery systems. Some confusion arose in Queensland and in parts of SA where the term water allocation is used for water access entitlement. A significant difference exists in the nature of water allocations for regulated surface systems. There is considerable variation in the way in which water allocations are tied to storage rights (often expressed in terms of carryover limits, account limits, annual use limits and other parameters). The drivers for maintaining this information are billing, customer compliance and trade. For unregulated systems and groundwater these information elements were mostly not available, largely because use of unregulated river and groundwater water allocations is measured in only a few areas, and trading in

Information elements	Stocktake commentary and findings
	unregulated and groundwater water allocations was found to be virtually non existent. As with water access entitlements, organisations generally had difficulty with the proposed trade information elements.

Finding 22: Most organisations could assemble water entitlement and water allocation information from registers or other databases.

Finding 23: The nature of water access entitlements varied substantially between jurisdictions. Major differences were found in terminology and in the extent to which entitlements were bundled with allocations and with work and use consents.

Finding 24: The nature of water allocations was substantially variable both between and within jurisdictions. There were a range of different types of carryover and capacity sharing in place in regulated (supplemented) river systems. The treatment of water allocations for groundwater and unregulated rivers was highly inconsistent.

Finding 25: The proposed water trade information elements were not fully accepted due to different views of how water trade is defined.

4.2.5 Environmental rules information elements

Information element	Stocktake commentary and findings
Rules current schedule, rules commenced or terminated Rules triggered/complied with	Virtually all organisations indicated that rules were to be found set out in water plans/bulk entitlements/licences/agreements and were not easily able to be pulled together into schedules as envisaged. Water service providers indicated that they were required to report on compliance with these rules in annual reports. NSW DNR indicated it was currently developing a simple register of rules for the purpose of reporting on plan implementation. WA Water Corporation indicated that it has in place an 'Environmental Management System' database of all environmental rules with which it is required to comply, which includes reports on triggering and EPA compliance.
Current balance of committed water, new water committed under rules, release (use) or write off of committed water	Organisations responsible for this information stated that they could provide it from simple tracking systems, typically excel worksheets. MDBC and GMW reported that they were in the process of developing more sophisticated systems for this purpose.
Finding 26: Environmental rules were generally only recorded in plans, licences and other documents, but a few organisations are developing databases of these rules to assist in compliance reporting.	

4.2.6 Terminology

In undertaking the stocktake there were several areas where variations in terminology caused difficulties. In preparing the draft information elements an effort was made to use names and definitions which would be unambiguous, yet where possible be consistent with water industry standard terms (where they exist) and language in common use. However there are many areas where both common use and statutory terms vary across jurisdictional boundaries.

Various documents have attempted to set common terms. The NWI itself includes a glossary of terms and a small number of terms which all the signatories agreed to adopt. The Australian Water Resources Assessment 2000 also includes a glossary of terms, as does the Water Account Australia prepared by the Australian Bureau of Statistics. Most terms in these glossaries are in agreement. But jurisdictions frequently use different terms.

Some examples of differences of interpretation of terms which arose during the stocktake are outlined below:

- The term *water allocation* has different meanings in different jurisdictions despite it being a nationally agreed term.
- Several terms are used instead of the nationally agreed term *water access entitlement*
- *Regulated* rivers in NSW and Victoria are rivers where large headworks catch water and release it down the river to entitlement holders. In Queensland these are referred to as *supplemented* rivers. In South Australia *regulated* rivers are those rivers where licences are required to take water, unregulated rivers are those where licences are not required. Also a source of confusion is the fact that many rivers which are *controlled* by large dams (eg the Snowy River) are not classed as regulated rivers.
- There is no agreed meaning of what constitutes *water trade* yet the term is in common use. It can be interpreted as the movement of a licence to take water from one location to another, or a change in ownership, or a combination of ownership change and change of location. There is dispute over whether a change in ownership without change of location constitutes a trade, and similarly whether change in location without change of ownership constitutes a trade. The word ‘transfer’ is often used interchangeably with trade, yet this can be interpreted in a range of different ways. Lastly the on-sale (and associated delivery) of water (eg delivery of water to a person or organisation through a pipe) is sometimes interpreted as a transfer or trade.
- The term *water use* causes considerable difficulties. *Use* of water is often assumed to mean consumption of water (which can be defined as the removal from the terrestrial

freshwater systems by either evapo-transpiration or loss to saline aquifers or the ocean). Common terminology is that when water is taken from a river or aquifer it is ‘*used*’. For example this is the implied meaning of the term in the Australian Water Resources Assessment 2000.

Yet not all the water applied to crops is 'consumed'. For example a part of the water applied to a crop may drain off then be caught and used again, and another part of the water applied to the crop may infiltrate down into a freshwater aquifer from which it is taken and used again.

There are also many ways water is ‘used’ which are not consumptive, yet provide economic benefits on a par with consumptive uses, for example hydro electricity generation, fish farming.

The assumption that *use* = 'consumption' also often leads to double counting in water balances.

The ABS has attempted to resolve this in its definitions of water consumption and water use, but those definitions are far from accepted.

- The term *environmental water* has no agreed meaning and is interpreted differently by different organisations. Broadly, three different views of the meaning are used in a confused manner.

  The first is that water that is set aside for environmental purposes is environmental water (whether it actually achieves ecological benefits or not). Examples of this are water access entitlements set aside for environmental purposes, and non-entitlement allocations such as the Barmah Millewa in the Murray.

  The second is that any water that achieves ecological benefits is environmental water. For example it is argued by some that any water which flows down a river is ecologically beneficial, even if it is extracted at a point downstream for irrigation.

  The third is that only water consumed (eg by evaporation, transpiration etc) by ecological processes should be accounted as environmental water. For example, in the case of water flowing into a floodplain wetland it is only the water that does not eventually return to the river that is environmental water.

  Sometimes proponents use a combination of these meanings, eg environmental water is water that is set aside for environmental purposes and actually achieves ecological benefits.

  There was no work found anywhere which was attempting to clarify and resolve this issue.

No methods were found for assigning environmental benefit to water applied under particular circumstances or at all.

Finding 27: There were significant differences in terminology and in the understanding of the meaning of several commonly used terms. Important terms which need agreed definitions are water use, water trade, regulated rivers and environmental water. Also the NWI agreed terms water access entitlement and water allocation were frequently not used or used in a way that was inconsistent with the NWI definition. .

4.2.7 Standards

While there are some Australian Standards for collection of physical data, there are none for derivation of the information elements needed for water accounting reports. For example, while there are several methods for interpolating rainfall across an area, none were documented in accepted industry standards. Similarly there are no accepted standard methods for such things as calculating capacity of farm dams in an area or calculating aquifer recharge.

Several of the information elements rely on models. For groundwater models, several organisations reported that they complied with the MDBC Groundwater Flow Modelling Guideline. River models used to assess Cap compliance in the Murray Darling Basin are subject to a technical peer/accreditation. However apart from this there were no industry standards or guidelines found during the stocktake for developing or quality assuring models.

Finding 28: While several organisations prepare reports containing water information elements, there are generally no standards for assembling or deriving those elements. A major area is modelling where some guidelines and professionally accepted practices exist, but no formally accredited (Australian) standards.

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4.3 Recording water information

Recording of water information is a broad term and in this context refers to the primary recording, logging or entry of data, any mechanisms that may be in place for data manipulation and transfer, the storage of data whether it be paper or electronic and the management processes applied to the data including applied standards and quality assurance procedures.

The appreciation of an organisation's ability to produce proposed water accounting reports has been tested through stocktake questions (in stocktake form 4) specifically related to the recording of information in the data stores operated by each organisation.

This section examines the type of information stores being used, the methods used to manage various data and information stores, the level of access control and the degree of storage security. The extent to which accounting principles have been applied to the various data management activities that are undertaken within the participating organisations is also reported in this section.

4.3.1 Information store types

It was observed that the types of information store/s used for water information vary considerably amongst organisations across the nation. Corporate applications range from basic Excel spreadsheets with limited security to proprietary databases developed specifically to suit an organisation's requirements.

Finding 29: The information stores being used for water information ranged from systems with little or no control of access or quality assurance to systems with high levels of security, access control and data integrity.

The full details of the databases operated by the participating organisations are included in Appendix C. In general terms, one or more of the following three types of data stores were found to exist in some form in most organisations.

- Type A - Raw Data Store – Times Series Data Storage

    As discussed in Section 4.1 there are a number of physical water parameters that are commonly measured directly by water organisations. These cover such things as river and storage levels, flows in rivers, channels and pipes, and groundwater levels.

    Most of these measurements are from field instruments on a daily or event basis for operational purposes. Otherwise operational data needs were met by alternative telemetry systems or field staff providing daily information which is recorded in spreadsheets or databases designed for this purpose or at least collect manual through field staff.

In most instances, the repository for such information is a data store only and tends not to be linked to a value adding system (ie it is generally not integrated with any software to manipulate or create information elements for reporting purposes)

Continuous time series information downloaded from instruments was almost universally stored in a systems such as Hydsys, Hydstra and Timestudio. These database systems are specifically designed to store, manage and report continuous water data. They are all now sourced from the same vendor (Kisters Pty Ltd). It is understood that over the next few years they are to be replaced by a single package.

In most cases, a user may extract the information from these systems and manipulate within an additional software tool (ie:excel spreadsheet).

- Type B – Relational databases

  Relational databases (which could also store raw data-used for reporting) were found to exist in the majority of organisations although the complexity varied with the size and responsibility of the organisation. Proprietary databases, custom developed by each organisation for specific purposes, were the main forms observed, though small urban water service providers were found to use one of a few products developed for the industry.

  This type included data relating to registers of entitlements, seasonal allocations transactions, customer consumption (uptake of allocations – metering) and billing/invoicing capabilities. These information stores may also include some operational data input on an ad-hoc or event driven basis.

  These information stores have a moderate level of data manipulation with respect to the recording of some information elements.

- Type C - Environmental rules registers

  Only one system for systematically recording environmental information was discovered during the stocktake. Western Australia's Water Corporation maintains an 'Environmental Management System' to keep track of environmental rules and compliance requirements. This was primarily limited to EPA compliance requirements.

Finding 30: Water service providers are increasingly adopting SCADA or other telemetry systems for rapid access to field information for operational purposes. The long term storage of the data collected using these methods is ad-hoc.

Finding 31: Time series physical water information (typically hydrographic data) is commonly stored and managed in what is effectively an industry standard system: Hydstra (or closely related Hydsys or Time studio)

Finding 32: Database applications used by small organisations were typically in MS Access, while products used by larger organisations were most commonly developed externally in Oracle or to a lesser extent Ingress languages.

Finding 33: Environmental rules are, with one exception, not stored in any kind of database system.

4.3.2 Recording of information elements

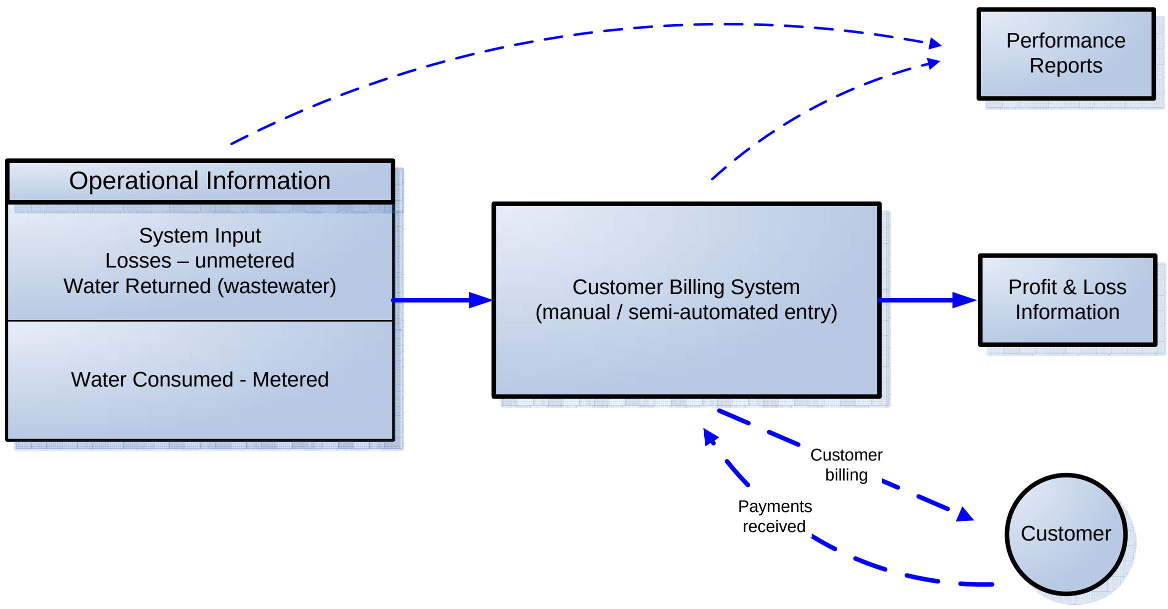
The findings from Section 4.2 of the stocktake demonstrated that recording of information elements may require some data manipulation and subsequent recording of the outcomes of this manipulation.

It was evident from the dialogue initiated through Form 4 that the operation of multiple data stores, which can contain various combinations of directly measured and assembled information elements, is common practice both within organisations and with information sharing between organisations. The potential issues surrounding an organisation's ability to integrate data with this type of arrangement were not fully examined through the stocktake dialogue but are clearly evident through the difficulties that organisations conveyed during the meetings in obtaining and manipulating data for generating some reports.

The recording and subsequent flow of water accounting information ranging from the 'measuring' activities to the 'reporting' activities was found to generally conform with three basic models and is often dependent upon the organisational focus. These models are summarised as follows:

Structure A – Small Retail Organisation

This type of structure, represented in Figure 4, centres around a billing system and the requirement to track/meter deliveries. Some information on performance is maintained but recording and reporting procedures appear to be ad-hoc. Generally the ability of an organisation with this type of structure to produce standard reports requires manual data export and some manual manipulations.



- **Figure 4 Typical Small Retail Organisation Water Data Store**

Finding 34: Smaller water service providers typically run basic systems which are driven primarily by customer billing, with storage of other information on paper, excel or simple Access applications.

Structure B – Larger Bulk Supply Organisation

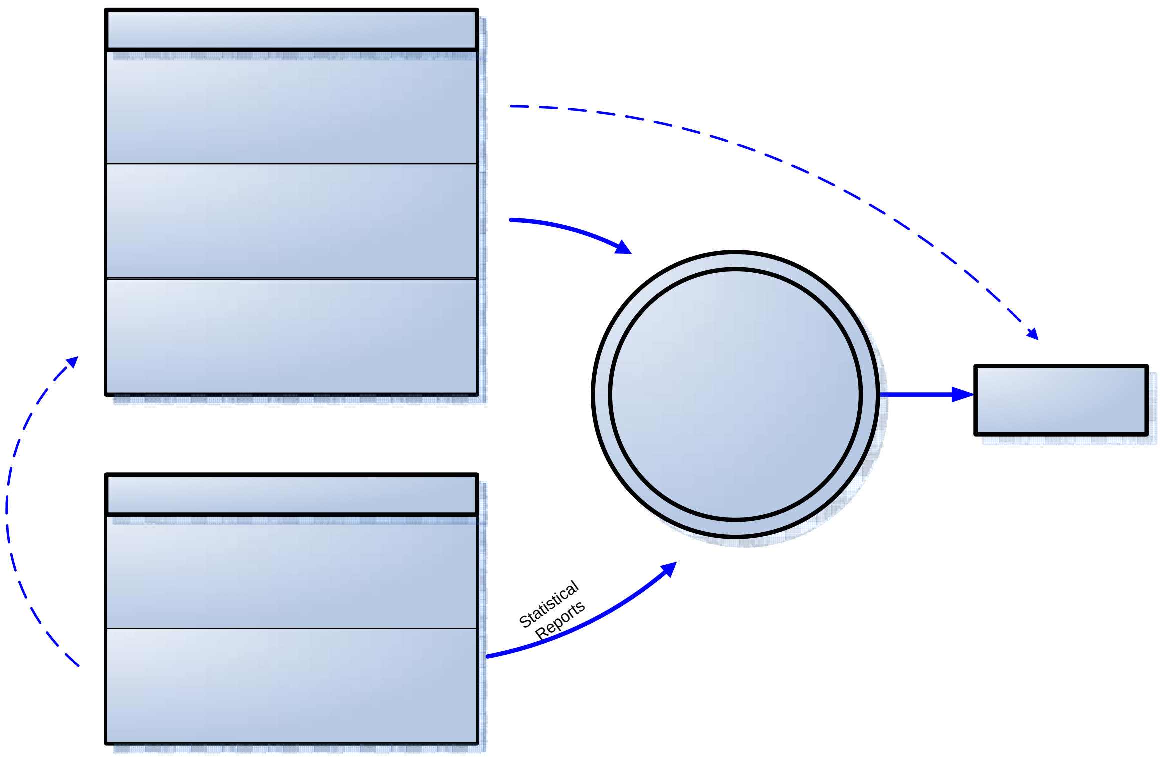
(possibly with some resource management focus/responsibilities)

This type of structure, represented in Figure 5, generally records a broader range of information sources and the organisations that reported this type of structure had a requirement for a higher degree of integration. The features of the observed systems include:

- Separate operational and management systems with some links but not fully integrated.
- Extraction and manipulation of data for reporting is generally undertaken manually and therefore consistency may be a significant issue.
- Evident lack of water accounting (chart of accounts) principles applied to data store. There was very little evidence of data tagging with respect to water accounting although tagging may exist for some other purposes.
- Good practice was observed at Sunwater and NSW State water where allocation to customers, deliveries against allocation and customer billing were integrated reasonably well. The drivers

for the level of system development in these examples are related to billing, allocation planning and statutory requirements.

- Two water service providers – NT Power and Water and Gold Coast Water – had dedicated systems designed to record information for reporting purposes taken (often as totals or averages) from management systems and operational systems and other sources. Everywhere else the information needed for reporting was manually extracted and collated directly from management and operational systems at the time of report preparation.



- **Figure 5 Typical Bulk Water Organisation Water Data Store**

Finding 35: Larger bulk water service providers typically run multiple data stores where the degree of integration is driven by billing, the need to assess reliability of resources for allocation purposes and statutory requirements.

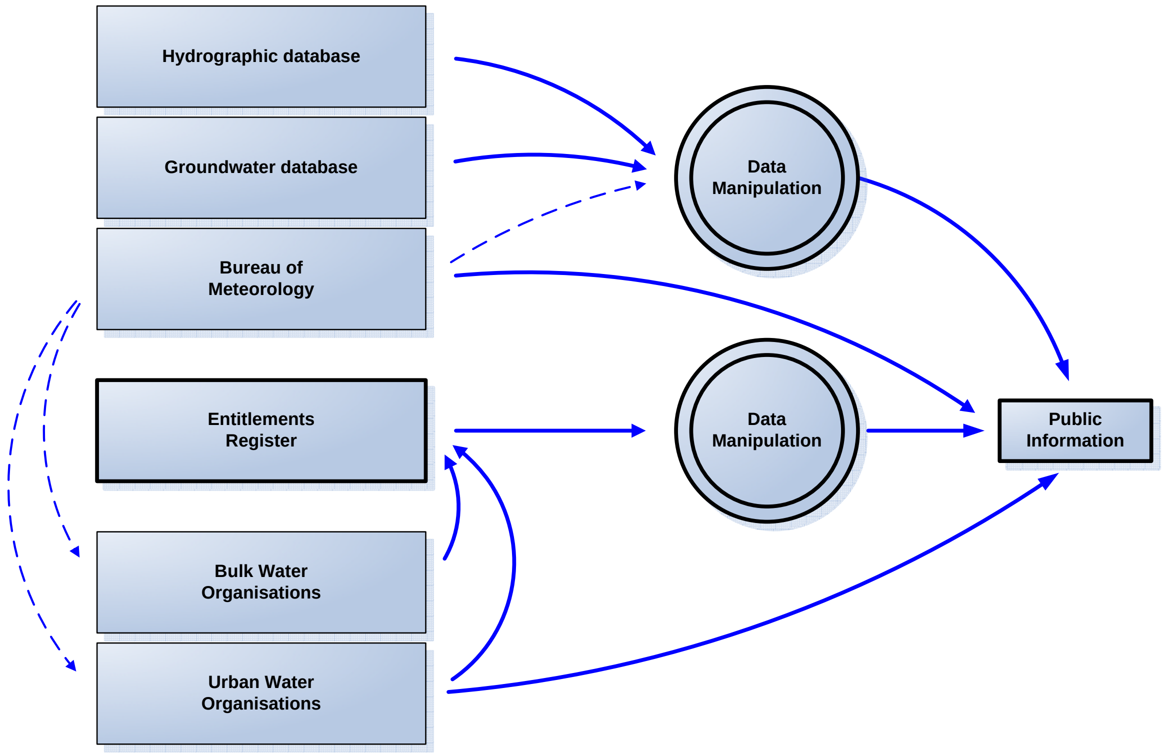
Structure C – Resource Managers

Resource managers were observed to operate many systems with variable degrees of integration as shown in Figure 6. One of the features of this arrangement is that information transfers,

SKM

particularly entitlement and allocation information, are often made from bulk and urban retailers to the resource manager. These are often paper based reports and not electronic data transfers.

It is evident that basic water information on hydrographic sites and groundwater levels is generally recorded and managed by standard stand-alone software. Most of the jurisdictions use either Hydsys, Hydstra or Timestudio for managing surface hydrographic data which are all similar products from the same product family.



■ **Figure 6 Typical Resource Manager Water Data Store**

Observations from stocktake meetings indicated that the newer organisations such as Sunwater have newer systems which manage and integrate data more efficiently than the more mature organisation which were observed to be operating multiple, often poorly integrated, data stores. One of the reasons for this is thought to be the legacy of collation of large quantities of historic information that have been stored in different databases with inconsistent structures. The drivers for improvement of integration were reported as being transparency about allocation decisions and reporting of general statistical information for public information.

An observation of this type of system is the potential for duplication of data, particularly where data is collected by other organisations and is not necessarily stored in a dedicated water accounting store. An example of this could be where reports are transferred but the original data used to generate the reports is not exactly duplicated. It is appropriate to reiterate the status of the Australian Water Data Infrastructure Project (AWDIP) which was discussed in Section 2.4. This project is designed to develop infrastructure to which water data can be transferred. Whilst standards may not necessarily yet exist, it can be expected that protocols and standards will need to be developed to assist interoperable data transfer between jurisdictions.

Finding 36: Information systems run by resource managers or state rural water service providers for storing information on entitlements and allocations were found to be custom built using high end relational databases.

4.3.3 Use of standards and quality assurance

The stocktake meetings indicated that the adoption of formally accredited quality assurance systems or procedures for water information stores has historically been minimal for most organisations across the country.

Many of the participating organisations that use water information either rely on contractors to provide quality assurance or do not have any means of providing assurance. In some instances these contractors are accredited to recognised standards, however some general lack of knowledge observed in the stocktake about the systems that are adopted by contractors may indicate that application of recognised standards is limited. Some of the standards referred to in the stocktake forms include ‘Data management and interchange (eg AS ISO 9735.9-2003)’ and ‘Information security management eg AGIMO)’.

Finding 37: A general lack of awareness of whether any information system standards such as ‘data management and interchange (eg AS ISO 9735.9-2003)’ existed or were applied to an organisation’s data management activities indicates that any standards that have been adopted may not be being followed.

Some of the specific aspects of standards and quality assurance amongst participating organisations are summarised as follows:

- Data Collection (raw data) – Generally manual collection (field measurements (ie meter readings), customer account keeping) or automated by SCADA systems and data loggers (ie streamflow gauges, gate and valve automation etc). Many systems had minor software filtering to detect when unusual measurements are recorded. In the case of contractors such as Thiess, there were quality procedures in place to quality code data.
- Data Estimation – Generally modelling was used to generate information elements where direct measurement is difficult. An example of this is the use of models to estimate sustainable yields from groundwater sources. Other than hard copy reports, there were no clear examples

observed of how the data generated from this type of process was recorded or whether there were any quality controls in place for such information.

- Data storage – As discussed in Section 4.3.1, systems for data storage vary considerably across the country. Many of the local government organisations and water co-operatives have little need to invest in anything other than Excel spreadsheets / Access databases. Multiple examples were observed where these have been developed to include basic data filtering and access restrictions. Although the use of these types of systems would usually indicate that they have been developed by internal staff with less experience of standards than say an external database contractor, there were examples of where organisations had contracted others to develop their systems. A good example of this was the Gascoyne Cooperative system developed for tracking member billing and entitlement movements.

  The larger organisations have generally developed proprietary databases to meet their specific requirements. It was not clear from the stocktake dialogue whether these types of systems, which are generally developed by external contractors, were developed with any accredited standards. In many instances either the appropriate staff were not available to clarify this information or staff were not aware of this issue period. It was observed that whilst some aspects of water accounting were represented in these systems, the integration of systems for dealing with all of the information was lacking. This was reflected in the limited ability of organisations to easily produce standard reports.

- Modification processes – Data entry and/or modification is treated 'loosely' by most organisations. More often than not, changes to data simply overwrite previous information, without formally recording the change as a transaction. In such cases systems often allow recording of comments by the user. A large number of organisations also commented that they are able to audit who altered data, what it was they altered and when it was altered.

Finding 38: There is a general lack of standardisation and consistency in data storage, management and infrastructure, particularly where estimates of some information elements are generated using models.

4.3.4 Access and security

The degree of access and security relevant to information stores have been observed at a number of levels and could be seen to be a complementary aspect of the quality and standards discussed in the previous section.

The stocktake questions relating to security focus on the ability of organisations to control access to their system whether it be authorised or unauthorised access.

Most organisations were found to operate either local access (ie office based) or wide are network access (ie inter-office access) systems. In these instances, applied security measures were reported as primarily being password control for system access. Where there was very little or no external access, organisations did not appear to have any drivers to develop security beyond this extent.

In some cases access was found to be either limited to a small number of staff with defined responsibilities or a delegation system, where different levels of access were assigned to different login accounts, was in place.

Finding 39: Most organisations were found to operate with minimal external access to their data stores although the use of wide area networks was common.

Finding 40: Basic password protection of information systems has been adopted by most organisations.

In the few instances where information stores were able to be accessed externally by the public (eg access to water ordering facilities) the access controls were more stringent. The best practice example was observed at Sunwater where elaborate firewall arrangements have been developed to protect their system whilst allowing web-based querying.

The issue of information storage integrity was also examined. This relates to the degree to which data can be modified either willingly or unwillingly.

The process of backing-up data was evident but not found to be done with a high degree of confidence in many organisations. Many organisations operating on local area networks also reported that although most data modifications are over-writes of existing data, they have the ability to trace who made the changes and when they were made. No clear examples of whether modifications were reconciled against other data sets were supplied. The only examples of where double entry processes were adopted were related to where customer transactions are recorded and a consistent reconciliation process was followed. Duplication of data may have been an issue, particularly where organisations share information. However the stocktake did not collate enough detail to make a complete assessment of this aspect.

Finding 41: A small number of organisations, mostly limited to urban and rural retail, were found to consciously reconcile transaction records on a consistent basis.

Finding 42: The integrity of data systems and the protocols for managing data were highly variable across organisations with very little evidence observed that documentation of relevant processes is in place.

Internet based information, particularly statistical information, was found to be available in most jurisdictions.

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4.3.5 Application of accounting principles

The principles on which organisations were asked to comment relate to whether there are any processes in place for reconciliation of related information, whether processes are in place whereby the change in one set of data is reflected in another, whether an audit trail exists with respect to database access and editing, whether software enforces compliance with principles and whether a chart of accounts exists.

There were a number of participating organisations that believed they had consciously adopted "accounting" standards for use in their information stores (as opposed to various other types of standards). Despite this belief, very few staff involved in the stocktake understood the scope of what the term 'accounting principles' might entail.

The design of most data stores examined during the stocktake was not consistent with the concepts of tagging of water information in a systematic method as would likely be the practice if an accounting framework was being utilised. The apparent lack of a formal chart of accounts would appear to manifest itself in the difficulty many organisations have in coordinating reporting activities. There was also a recognition that some water accounting principles may not be applicable to information stores that store physical (time series) water information.

Finding 43: Although a small number of organisations demonstrated that their data stores display some aspects of accounting principles, there were no examples found of where a system had been consciously designed with a specific chart of water accounts in mind.

Finding 44: The application of some water accounting principles such as double entry accounting was seen to be inappropriate for information stores which record time series data for physical water elements where there is often minimal context (ie no conscious application of either a physical or institutional water entity)

This issue of tagging of information with respect to a chart of accounts did not appear to be a significant issue for the small urban and rural retailers. These organisations deal with very few information elements (mainly with water supply and billing transactions) and can track transactions relatively easily without a complex chart of accounts.

Finding 45: Some urban and rural retail organisations were found to maintain transaction based databases where basic customer water consumption and billing information is the primary focus (ie Type B database).

Once the organisational size and level of responsibility increased, the management of information elements and the flow of information between information stores tended to be a Structure B level.

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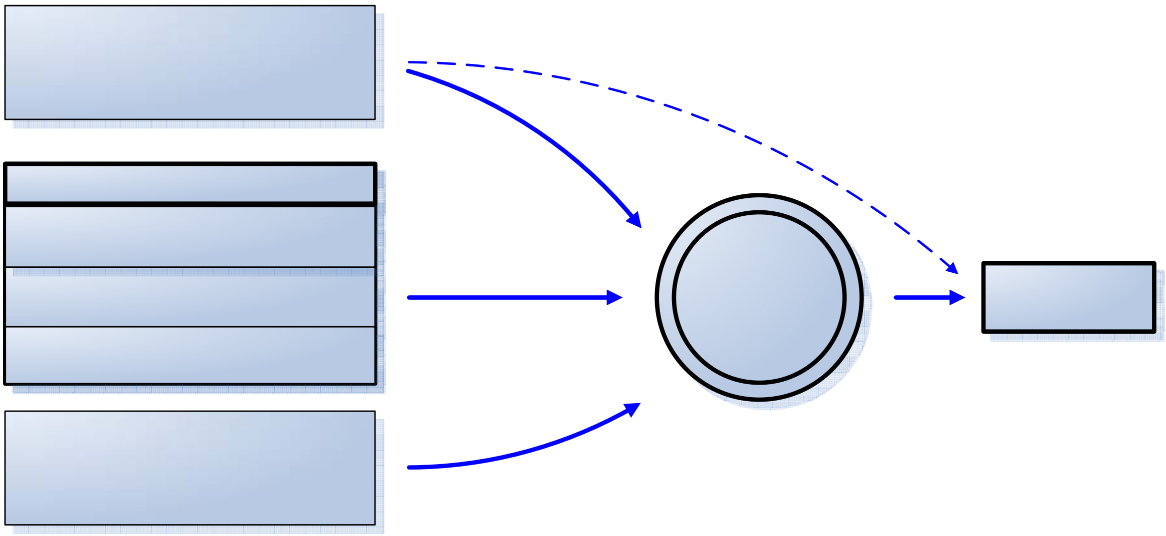
In these cases the general process shown in Figure 7, which did not hold in all cases but was more common than not, was applicable.



- **Figure 7 Typical report assembly process**

The key feature of the arrangements shown in Figure 7 is that the ‘Data Assembly Processes’ are being undertaken by most organisations at this level in an ad-hoc fashion (ie no or little support given to the design of database relationships and consistent recording of data). In the majority of cases, the various data assembly processes are either manual, with data manipulation being undertaken in spreadsheets, or semi-automated with custom designed Access databases. Some organisations expressed concerns that this ad-hoc approach exacerbated the difficulties they were experiencing in meeting the increased demands for reporting. More often than not the process is reliant on experienced personnel to maintain consistency of reporting.

Finding 46: The difficulty experienced by many larger organisations with reporting is linked to the ad-hoc nature of the ‘Data Assembly Processes’. The main cause of this is that databases have not been designed with a formal chart of accounts in mind. This deficiency already causes and is likely in the future to cause, significant compatibility issues for compiling and aggregating data at higher levels.

Environmental F

Although the stocktake did not explore the details of specific database design, some examples of where good practice is evident were observed. `None of these related to storage of environmental information due to the fact that environmental water management is in its infancy. These were limited to the transaction type systems where consumption, entitlements, allocations and billing were integrated for water service providers’ customers (accounts). Although it is not currently in

Register

Allocation

operation, the stocktake identified that the design of Victoria's new water register is based on accounting principles and a specific chart of accounts.

Finding 47: It was clear that very little co-ordination of environmental water information storage is being undertaken, due mainly to the infancy of environmental water management

4.4 Reporting water information

Stocktake Form 5 was designed to gain an appreciation of which types of reports are currently being prepared and whether organisations have the capability to generate some of the envisaged water accounting report templates. The ability of water various information elements to be aggregated for various water entities through reporting mechanisms is also examined in this section.

4.4.1 Existing reports including water accounting information

Standard reports which organisations were observed to already be currently producing can generally be broken down into the following categories:

- Internal
  - Board reports
  - Statistical Reports (including Time series graphs)
  - Water Availability / Allocations
- External
  - Annual reports
  - Licence compliance reports
  - Water Availability / Allocations - Registers
  - Customer statements – Allocations, entitlements, current consumption etc
  - WSAA – water service provider report
  - ABS statistics – information supplied to ABS regularly
  - ANCID – Benchmarking
  - Public Information - Web sites

The reason for producing reports was mostly due to statutory obligations. Organisations generally indicated an expanding demand for reports by regulators.

There was also found to be a growing demand for access to information by the public, to which organisations were responding by publishing more information either on the web or in hard copy. Examples of this are Queensland's *Annual Water Statistics*, and Victoria's annual *State Water*

Report, and reports generated by water service providers to assist their customers in their business operations.

Best practice found in web access to current water information was:

- NSW DNR's website which provided close to real time access to licence and trading information, as well as river flows and storage levels
- NT DNREATA who are developing a web portal using Google Earth.

Finding 48: Organisations are already preparing a large number of reports containing water accounting information and reporting requirements are increasing to meet the information demands of regulators and the public.

4.4.2 Capacity to prepare proposed water cycle reports

This proposed report requires a range of information about the movement of water between the atmosphere and the land, and on and within the land surface.

There were found to be major information gaps in such things as evapo-transpiration, rainfall runoff and aquifer recharge. Additionally organisations indicated they had no strong reasons to seek this information.

The Water 2010 project by BRS has generated many of the missing information elements at a broad scale using long term average information and remote sensing information. There is the prospect that this kind of technique could be used to prepare annual water cycle reports.

Finding 49: No organisations indicated they were capable of generating the proposed water cycle report for any physical water entities.

4.4.3 Capacity to prepare proposed surface water reports (water balances)

Urban and rural water service providers indicated they could reshape the information they already assemble for other reports to prepare surface water reports for their delivery systems. The WSAA reports many already prepared include nearly all the information needed. In NSW the Dept of Energy, Utilities and Sustainability gathers similar information for small urban water supply providers who are not members of WSAA and publishes it in their annual Water Supply and Sewerage Benchmarking Report. See Appendix C for an example of a relevant table from this report.

Water resource managers indicated they could prepare surface water reports for many surface water management areas. Two examples were provided of reports very similar to the proposed surface water reports. The first is the water balance reports in Victoria's annual State Water Report. The report contains one of these for each surface water management area in Victoria. An example is provided in Figure 8 below.

Finding 50: Most organisations indicated that they could generate surface water reports (commonly called water balance reports) for most physical entities for which they are responsible (river basins, delivery systems, sewerage systems) at little additional cost.

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- **Figure 8: Campaspe River Water Balance Table from Victoria's State Water Report**

Water Account Component	Volume (ML)
Storage Volume	
Volume in storage at start of year	36,920
Volume in storage at end of year	32,860
Change in storage	-4,060
Inflows	
Catchment inflow	158,750
Irrigation return flow	0
Waranga Western Channel to Campaspe River	1,380
Treated effluent discharged back to river (1)	600
Sub-total	**160,730**
Diversions	
Urban diversions	12,710
Coliban Main Channel (Castlemaine urban and Coliban rural)	16,830
Irrigation district diversions (2)	23,870
Regulated licensed private diversions (2)	10,850
Unregulated licensed private diversions (2)	1,150
Catchment farm dams	28,780
Campaspe River to Waranga Western Channel	1,340
Sub-total	**95,530**
Losses	
Evaporation losses from major storages	12,340
Losses from catchment farm dams	14,720
In-stream losses to groundwater, floodplain and evaporation (3)	33,990
Sub-total	**61,050**
Water passed at outlet of basin	
Campaspe River outflow to River Murray	8,220
Volume available to the environment in the Campaspe Basin	8,220

(1) Assumes all effluent discharged to river if not reused

(2) From G-MW Annual Report

(3) Back calculated as the difference between inflows and outflows.

The second example (see Figure 9) was provided by State Water NSW, who are preparing water balance tables as part of their annual operating reports to the Independent Pricing and Regulatory Tribunal (IPART).

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■ **Figure 9: State Water NSW water balance table**

Valley	Border			
	Sources of water		Distribution of water	
	volume (ML)	% of total	volume (ML)	% of total
Storage volume				
Volume in storage at start of year	264,848			
Volume in storage at end of year	264,180			
Change in storage	**668**	**0%**		
Storage net evaporation			**10,266**	**3%**
Inflows				
Storage Inflows	68,441	21%		
Downstream tributaries - individually gauged	145,455	46%		
Downstream tributaries - gauged in main rive	104,503	33%		
Subtotal	**318,399**	**100%**		
Net Water diverted under water rights				
Domestic and stock rights			-	0%
Native title rights			-	0%
Subtotal			-	**0%**
Net Water diverted under access licences				
Domestic and stock				
High security			1,549	0%
General security			61,252	19%
Local water utility			-	0%
Major water utility			-	0%
Supplementary water			113,670	36%
Conveyance			-	0%
Subtotal			**176,471**	**55%**
Environmental water				
Net diversions to wetlands			-	0%
Other contributions to basic ecosystem health			-	0%
End of system flows			121,306	38%
Other outflows			11,024	
Subtotal			**132,330**	**41%**
Unaccounted difference			-	**0%**
TOTAL	**319,067**	**100%**	**319,067**	**100%**

The two example reports also illustrate attempts to volumetrically define ‘environmental’ water. In the Victorian example the end of system outflow is labelled as water available to the environment. The NSW example shows environmental water as end of system flows plus net diversions to wetlands.

These definitions have significant problems. For example, suppose the Campaspe basin were split into an upper and lower area. Nearly all the diversion of water occurs in the lower area. The outflow (and therefore the reported environmental water) for the upper area would be approximately 100,000 ML, and that for the lower would be the 8,000 ML already shown. On simple reading it would appear that environmental water has increased enormously just by splitting the reporting entity into two.

The problems with volumetrically defining environmental water remains to be resolved.

4.4.4 Capacity to prepare proposed groundwater reports

Several organisations reported that they could, with some investment, generate groundwater reports for some groundwater management units using models. However there is a structural problem with the report as envisaged, because it is general management practice to use sustainable the sustainable extraction limit rather than a volume in store. Organisations indicated they rarely attempted to calculate the actual volume held in aquifers, and argued that it was highly misleading to report this information in any case.

Additionally most of the other information needed for the groundwater report can only be estimated on an annual basis for GMUs where a sophisticated numerical groundwater model is in place. For other GMUs the information is only available as estimated long term average figures if at all.

Finding 51: The groundwater report as envisaged would not be able to be implemented, as the concept of groundwater 'stock' as conceived in the report is inconsistent with groundwater management practice which deals with sustainable extraction limits rather than volumes in storage. Additionally the groundwater flow information elements for the most part can only be estimated on an average basis rather than calculated annually.

4.4.5 Capacity to prepare proposed water access entitlement, water allocation and trade reports

This report is only relevant to organisations with responsibility for managing water access entitlements and water allocations (or similar entitlements within irrigation supply organisations).

It was conceived that these reports should be able to be prepared from a number of perspectives. For example water access entitlement reports should be able to be prepared for all the entitlements in an area (an organisational perspective) or for just those entitlements owned by a single person, or linked to a particular property (a customer perspective). In the Water accounting information requirements framework these different requirements were listed as *institutional entities* (see Figure 1).

Several organisations indicated that they could, with some investment, generate these reports, from both an organisational or customer perspective. Other organisations were constrained because the entitlements they managed were not consistent with NWI specifications. This particularly effected the trading reports.

Many of the parameters are published in different arrangements eg DNR's website reports of entitlements, allocations and trading information on a water source basis (see example in Figure 10); Queensland's *Annual Water Statistics* reports tables of similar statistics by management areas and regions.

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State Water and Sunwater provided examples of customer water allocation reports which contain many similarities to the proposed water allocation reports. These are included as Figure 11 and Figure 12.

While many organisations stated they were able to generate the trading reports, there was disagreement about the proposed definitions of 'trade' in the envisaged reports.

- **Figure 10: Example of DNR online trading information**

Water Trading Statistics

Statistics for water allocation assignments('temporary' trades) between water sources ('intervalley') and interstate

	Search
Water Source	All
Period (Water Year)	This water year 01-Jul-2005 to 30-Jun-2006
	Search Clear

	To Water Source					
From Water Source	Lower Namoi Regulated River	Murrumbidgee Regulated River	New South Wales Murray Regulated River	South Australia	Victoria	Total
Murrumbidgee Regulated River			16,249ML (51)	395ML (1)	5,104ML (51)	21,748ML (103)
New South Wales Murray Regulated River		16,646ML (12)		8,364ML (26)	34,607ML (272)	59,617ML (310)
Upper Namoi Regulated River	2,754ML (35)					2,754ML (3
South Australia			31,898ML (72)			31,898ML (72)
Victoria			10,196ML (28)			10,196ML (28)
Total	2,754ML (35)	16,646ML (12)	58,343ML (151)	8,759ML (27)	39,711ML (323)	126,213ML (548)

Note: numbers in brackets represent the number of transactions between the water sources

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▪ Figure 11: Example customer water allocation report - State Water

State water

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Page 1

WATER ACCOUNT STATEMENT

MACQUARIE AND CUDGEGONG REGULATED RIVERS WATER SOURCE

Statement Date:	22-Jun-2006 3:37 PM	**Reporting Period:**	01-Jul-2005 to 22-Jun-2006
Licence Status:	CURRENT	**Water Account Status:**	OPEN

Primary Holder:
Address:

Account Parameters

Licence Category: REGULATED RIVER (GENERAL SECURITY)
Tenure: Perpetual **Share Component:** 270.0 unit shares

	ML per Share	Volume
Carryover Limit	1.0000	270.0 ML

Transactions for 01-Jul-2005 to 22-Jun-2006

Date	Transaction	Transaction AWD	Transaction Carryover	Balance AWD	Balance Carryover	Balance Account
01-Jul-2005	Final Carry forward balance from previous water year			0.0	12.4	12.4
01-Jul-2005	AWD 0.0 ML per Share	0.0	0.0	0.0	12.4	12.4
15-Aug-2005	AWD 0.01 ML per Share	2.7	0.0	2.7	12.4	15.1
04-Nov-2005	AWD 0.02 ML per Share	5.4	0.0	8.1	12.4	20.5
11-Nov-2005	AWD 0.2 ML per Share	54.0	0.0	62.1	12.4	74.5
22-Nov-2005	AWD 0.02 ML per Share	5.4	0.0	67.5	12.4	79.9
30-Nov-2005	AWD 0.04 ML per Share	10.8	0.0	78.3	12.4	90.7
06-Dec-2005	AWD 0.07 ML per Share	18.9	0.0	97.2	12.4	109.6
22-Dec-2005	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	0.0	-1.0	97.2	11.4	108.6
23-Dec-2005	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	0.0	-1.0	97.2	10.4	107.6
24-Dec-2005	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	0.0	-1.0	97.2	9.4	106.6
25-Dec-2005	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	0.0	-1.0	97.2	8.4	105.6
26-Dec-2005	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	0.0	-1.0	97.2	7.4	104.6
27-Dec-2005	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	0.0	-1.0	97.2	6.4	103.6
28-Dec-2005	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	0.0	-1.0	97.2	5.4	102.6
29-Dec-2005	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	0.0	-1.0	97.2	4.4	101.6
30-Dec-2005	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	0.0	-1.0	97.2	3.4	100.6
31-Dec-2005	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	0.0	-1.0	97.2	2.4	99.6
31-Dec-2005	Evaporation Reduction 1.0 %		0.0	97.2	2.4	99.6
01-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	0.0	-1.0	97.2	1.4	98.6
02-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	0.0	-1.0	97.2	0.4	97.6
03-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-0.6	-0.4	96.6	0.0	96.6
04-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-1.0	0.0	95.6	0.0	95.6
05-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	93.6	0.0	93.6
06-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	91.6	0.0	91.6
07-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	89.6	0.0	89.6
08-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	87.6	0.0	87.6
09-Jan-2006	AWD 0.02 ML per Share	5.4	0.0	93.0	0.0	93.0
09-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	91.0	0.0	91.0
10-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	89.0	0.0	89.0
11-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	87.0	0.0	87.0
12-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	85.0	0.0	85.0
13-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	83.0	0.0	83.0
14-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	81.0	0.0	81.0
15-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	79.0	0.0	79.0
16-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	77.0	0.0	77.0
17-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	75.0	0.0	75.0
18-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	73.0	0.0	73.0
19-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	71.0	0.0	71.0

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20-Jan-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	69.0	0.0	69.0
24-Jan-2006	AWD 0.04 ML per Share	10.8	0.0	79.8	0.0	79.8
01-Feb-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	77.8	0.0	77.8
02-Feb-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	75.8	0.0	75.8
03-Feb-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	73.8	0.0	73.8
04-Feb-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	71.8	0.0	71.8
05-Feb-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	69.8	0.0	69.8
06-Feb-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	67.8	0.0	67.8
07-Feb-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	65.8	0.0	65.8
08-Feb-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	63.8	0.0	63.8
09-Feb-2006	AWD 0.02 ML per Share	5.4	0.0	69.2	0.0	69.2
09-Feb-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	67.2	0.0	67.2
10-Feb-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	65.2	0.0	65.2
11-Feb-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	63.2	0.0	63.2
12-Feb-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	61.2	0.0	61.2
13-Feb-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-2.0	0.0	59.2	0.0	59.2
14-Feb-2006	Usage for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520	-11.4	0.0	47.8	0.0	47.8
15-Feb-2006	Meter(s) read for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520			47.8	0.0	47.8
31-Mar-2006	Evaporation Reduction 2.0 %			47.8	0.0	47.8
01-May-2006	Meter(s) read for 80CA701146 at Dubbo (Gs421001) To Talbragar River SO 3520			47.8	0.0	47.8

Allocation Totals for 01-Jul-2005 to 22-Jun-2006

Allocation Totals

AWD ML per Share	0.4400 ML	Use Limits In	0.0 ML
AWD Volume	118.8 ML	Use Limits Out	0.0 ML
Allocation Assignments In	0.0 ML	Forfeits	0.0 ML
Allocation Assignments Out	0.0 ML	Available Water	47.8 ML
Miscellaneous Transfers In	0.0 ML	Potential Carryover	47.8 ML
Miscellaneous Transfers Out	0.0 ML		

Order & Usage Totals for 01-Jul-2005 to 22-Jun-2006

Usage Totals		Order Totals	
All Usage	83.4 ML	Processed Orders	104.0 ML
Usage/Orders Variance	-20 %	Outstanding Orders	0.0 ML
		Future Orders	0.0 ML
Controlled Flow Usage	83.4 ML		

Last Meter Readings

Work Approval	Section	Stream Order	Read Date	Meter No & Description	Reading Type	End Reading	Calibration Factor
80CA701146	Dubbo (Gs421001) To Talbragar River	3520	01-May-2006	1 - 100MM CP	FLOW METER	488.0	1.0

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■ **Figure 12: Example customer water allocation report - Sunwater**

Water Account Statement

Customer Account	Document	Date of Issue
		22 Jun 2006

John Smith

Statement Period	
01 Jul 2005	22 Jun 2006

Barker Barambah

Water Account: xxxxx   System: Barker Barambah CK & BP Dam   1 Jul 2005 to 22 Jun 2006

Allocation Water Summary

DATE	DESCRIPTION		VOLUME (ML)
01 Jul 2005	Opening Balance		0.00
01 Jul 2005	Announced Allocation	Medium Priority (34%): IWAxxxxxxi 888.000 ML @ 34	301.92
01 Jul 2005	Carryover	669 ML @ 90% (3MTH)	602.10
01 Jul 2005	Carryover	50.18ML @ 80% (6MTH)	40.14
01 Jul 2005	Announced Allocation	Medium Priority (34%): IWAxxxxxi 1464.000 ML @ 34	497.76
29 Jul 2005	Temporary Transfer	160.000 ML From Water Account #xxxxxx	160.00
01 Oct 2005	Announced Allocation	Medium Priority (47%): IWA xxxxxi 888.000 ML @ 13%	315.44
01 Oct 2005	Announced Allocation	Medium Priority (47%): IWAxxxxxi 1464.000 ML @ 13	190.32
06 Feb 2006	Temporary Transfer	58.750 ML From Water Account #xxxxxx	58.75
08 Feb 2006	Temporary Transfer	50.000 ML From Water Account #xxxxxx	50.00
20 Feb 2006	Temporary Transfer	35.000 ML From Water Account #xxxxxx	35.00
27 Apr 2006	Temporary Transfer	2.100 ML From Water Account #xxxxxx	2.10

Total Available Allocation Water:	**2,053.53**	
***Allocation Water Usage:**	**2,053.49**	DR
Remaining Allocation Water:	**0.04**	

*As per last recorded Meter Reading

Note: All totals are calculated to three decimal places prior to rounding for display.

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Finding 52: Most relevant organisations could with some investment generate water entitlement, water allocation and water trading reports as conceived. Some organisations would be able to generate similar reports, but were constrained by the fact that the entitlements/allocations they manage are not totally consistent with the NWI specifications.

4.4.6 Capacity to prepare proposed water use reports

.Samples of ABS Tables are shown in Figure 13. ABS advised that it was recently funded to commence to collect information down to a level of spatial location which would allow it to be reported in any sort of physical units – including SWMAs.

▪ **Figure 13: Water supply and use tables from ABS Water Account Australia**

2.9 WATER SUPPLY AND USE, Australia—2000–01

	SUPPLY			
	Self-extracted (a)	Mains water (b)	Reuse water (c)	Re disch
Industry	ML	ML	ML	
Agriculture				
Livestock, pasture, grains & other	—	—	—	
Dairy farming	—	—	—	
Vegetables	—	—	—	
Sugar	—	—	—	
Fruit	—	—	—	
Grapes	—	—	—	
Cotton	—	—	—	
Rice	—	—	—	
Total	—	—	—	
Services to agriculture; hunting & trapping	—	—	—	
Forestry & fishing	—	—	—	3
Mining				
Coal mining	—	2 247	—	
Oil & gas extraction	—	—	—	
Metal ore mining	—	3 973	—	
Other mining	—	—	—	
Total	—	*6 220*	—	*1*
Manufacturing				
Food, beverage & tobacco	—	—	—	
Textile, clothing, footwear & leather	—	—	—	
Wood & paper products	—	—	—	
Printing, publishing & recorded media	—	—	—	
Petroleum, coal, chemical & associated product	—	—	720	
Non-metallic mineral products	—	—	—	
Metal products	—	—	—	
Machinery & equipment	—	—	—	
Other manufacturing	—	—	—	
Total	—	—	*720*	
Electricity & gas(e)	—	12 682	4 506	47 6
Water supply, sewerage & drainage services(f)	—	12 764 958	511 337	1 8
Construction	—	—	—	
Wholesale & retail trade	—	—	—	
Accommodation, cafes & restaurants	—	—	—	
Transport & storage	—	—	—	
Finance, property & business services	—	—	—	
Government administration	—	—	—	
Education	—	—	—	
Health & community services	—	—	—	
Cultural, recreational & personal services	—	—	—	
Household	—	—	—	
Environment	72 431 152	—	—	
Total	**72 431 152**	**12 783 858**	**516 563**	**50 1**

2.9 WATER SUPPLY AND USE, Australia—2000–01 *continued*

	USE				
	Self-extracted (b)	Mains water (c)	Reuse water (d)	In-stream (e)	Water consumption (a)
Industry	ML	ML	ML	ML	ML
Agriculture					
Livestock, pasture, grains & other	3 471 109	1 905 485	191 879	—	5 568 474
Dairy farming	1 210 701	1 571 863	51 855	—	2 834 418
Vegetables	422 008	117 033	16 670	—	555 711
Sugar	555 668	753 129	1 875	—	1 310 671
Fruit	491 250	296 557	14 825	—	802 632
Grapes	345 371	364 190	19 576	—	729 137
Cotton	2 502 002	404 090	2 085	—	2 908 178
Rice	133 986	1 692 674	124 501	—	1 951 160
Total	*9 132 095*	*7 105 022*	*423 264*	—	*16 660 381*
Services to agriculture; hunting & trapping	2 770	1 027	104	—	3 901
Forestry & fishing	378 389	5 245	7 145	367 756	23 022
Mining					
Coal mining	106 472	14 701	2 687	49 175	72 439
Oil & gas extraction	17 862	1 346	—	9 146	10 061
Metal ore mining	306 883	31 362	2 754	52 659	284 367
Other mining	48 419	1 788	—	16 450	33 756
Total	*479 635*	*49 196*	*5 441*	*127 430*	*400 622*
Manufacturing					
Food, beverage & tobacco	122 804	116 986	1 719	—	241 509
Textile, clothing, footwear & leather	497	52 582	776	—	53 855
Wood & paper products	92 409	76 890	5 553	—	174 851
Printing, publishing & recorded media	81	48 107	—	—	48 188
Petroleum, coal, chemical & associated product	8 979	64 372	8 022	—	81 373
Non-metallic mineral products	15 630	8 894	233	—	24 757
Metal products	51 698	65 142	—	—	116 840
Machinery & equipment	3 156	108 442	234	—	111 832
Other manufacturing	572	12 285	—	—	12 857
Total	*295 825*	*553 700*	*16 536*	—	*866 061*
Electricity & gas(f)	49 116 399	122 937	4 991	47 543 867	1 687 778
Water supply, sewerage & drainage services(g)	12 767 205	1 768 650	23 056	—	1 793 953
Construction	3 414	14 665	—	—	18 079
Wholesale & retail trade	833	81 248	265	—	82 346
Accommodation, cafes & restaurants	5 283	45 794	734	—	51 811
Transport & storage	3 846	50 660	250	—	54 756
Finance, property & business services	852	85 437	56	—	86 345
Government administration	4 200	50 895	1 279	—	56 374
Education	10 955	34 826	719	—	46 500
Health & community services	2 611	38 165	64	—	40 840
Cultural, recreational & personal services	131 327	231 230	32 492	—	395 049
Household	95 512	2 085 768	167	—	2 181 447
Environment	—	459 393	—	—	459 393
Total	**72 431 152**	**12 783 858**	**516 563**	**48 039 054**	**24 908 659**

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Several water service providers indicated that they could produce water use reports as envisaged but only in relation to their customers. For example Central Irrigation Trust already publish crops and areas (see Figure 14) to which delivered volumes could be added.

- **Figure 14: CROPS and TYPES of IRRIGATION SYSTEMS in CIT districts**

The following tables show the areas of crops in hectares (Ha) and the type of irrigation systems in use in 2004/05

	Berri		Cadell		Chaffey		Cobdogla		Kingston		Loxton		Moorook		Mypolonga		Waikerie		Total	
Crops	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%
Vines	2,635	81%	57	17%	791	71%	2,730	84%	132	73%	2,006	63%	243	65%	80	22%	944	54%	**9,617**	**70%**
Citrus	307	9%	101	31%	111	10%	65	2%	30	17%	583	18%	91	24%	154	41%	599	34%	**2,041**	**15%**
Stone fruit	130	4%	87	27%	100	9%	44	1%	6	3%	42	1%	12	3%	57	15%	85	5%	**562**	**4%**
Pasture	8	0%			12	1%	47	1%			71	2%	1	0%	28	7%	5	0%	**171**	**1%**
Pome fruit	4	0%	30	9%	3	0%	3	0%			59	2%					9	1%	**108**	**1%**
Vegetables	31	1%	17	5%	43	4%	170	5%			53	2%	7	2%	10	3%	9	1%	**341**	**2%**
Nuts	9	0%	1	0%	48	4%	2	0%			108	3%					25	1%	**192**	**1%**
Tropical Fruit	1	0%					2	0%	5	3%	1	0%			10	3%	21	1%	**40**	**0%**
Others (e.g. Berries, Wood Lot)	102	3%	24	7%	4	0%	57	2%			190	6%	12	3%	18	5%	42	2%	**450**	**3%**
Vacant (unplanted)	22	1%	11	3%	6	1%	138	4%	8	4%	93	3%	8	2%	15	4%	14	1%	**315**	**2%**
Total	**3,249**	**100%**	**328**	**100%**	**1,118**	**100%**	**3,255**	**100%**	**182**	**100%**	**3,205**	**100%**	**372**	**100%**	**373**	**100%**	**1,753**	**100%**	**13,836**	**100%**

Irrigation System	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%
Under canopy	1,315	40%	273	83%	489	44%	965	30%	112	62%	1,181	37%	250	67%	257	69%	1,012	58%	**5,853**	**42%**
Overhead	1,237	38%	35	11%	36	3%	1,601	49%	27	15%	1,019	32%	35	9%	36	10%	251	14%	**4,276**	**31%**
Drip	363	11%	6	2%	471	42%	177	5%	34	19%	611	19%	61	16%	61	16%	192	11%	**1,977**	**14%**
Flood/Furrow	210	6%	4	1%	106	9%	241	7%	2	1%	114	4%	9	2%	3	1%	15	1%	**704**	**5%**
Micro sprinkler	58	2%	9	3%	1	0%	52	2%	6	3%	14	0%	13	3%	13	3%	274	16%	**439**	**3%**
Multiple systems	49	2%			14	1%	149	5%			27	1%	5	1%			3	0%	**247**	**2%**
Others (e.g. hose)	18	1%			2	0%	71	2%	1	0%	240	8%			3	1%	6	0%	**341**	**2%**
Total	**3,249**	**100%**	**328**	**100%**	**1,118**	**100%**	**3,255**	**100%**	**182**	**100%**	**3,205**	**100%**	**372**	**100%**	**373**	**100%**	**1,753**	**100%**	**13,836**	**100%**

Note:
Loxton data excludes Century Orchards

Some organisations reported that they are collecting or plan to collect water use information, for purposes of management planning. Water use purpose information is also gathered in some areas for land valuation purposes. This could be integrated with data on volumes supplied by water service providers. However the categories of water use mostly do not correspond to the categories ABS uses, except at the highest level.

Several definitions used by the ABS are inconsistent with common water industry usage.

Finding 53: The ABS is currently producing water use reports similar to those envisaged. They have included similar reports in their Water Account Australia publications, but not as yet for the SWMAs proposed in the AWRA 2000. Some water service providers are also publishing reports similar to those envisaged in relation to their customer's use of water. Terms, definitions, and use categories employed by the ABS are frequently different to those used by other organisations

4.4.7 Capacity to prepare proposed environmental rules reports

The key driver for compiling this information into reports is the reporting requirements set by regulators or statutory requirements. Several organisations indicated that they had no reason to prepare reports in the envisaged form. They state their current compliance reports addressed their needs; it is not easy to tell which rules in plans/licences were ‘environmental’ rules, and the cost to prepare the envisaged reports would be substantial.

Finding 54: No organisations produce anything like the proposed environmental rules reports at the moment. Generally the information is not held in any kind of database, being mostly in plans and compliance reports. While some organisations indicated that they may be in a position to generate these reports shortly, others did not see any value in making the investments required to do so.

4.4.8 Aggregation of reporting information

The proposed water accounting information requirements framework envisaged that certain types of reports could be rolled up (ie summed) to State and National level.

The stocktake demonstrated that:

- Some information elements can and have been rolled up or summed in state and national reports. However tables of statistics are not water accounts.
- Water balances, whilst being produced for specific catchments/basins, have not been summed to produce water balances at higher levels.
- The presence of significant information gaps would require additional care so as to not give the wrong impression when summing information.
- It does not make sense to roll up many of the information elements. For example share units in water access entitlements have totally different average likely seasonal allocations per unit depending on the water source to which the entitlement relates. Adding these gives very misleading figures.
- The benefits of rolling up information in this way are doubtful in any case, as in many cases the summed information does not help in achieving any of the desired outcomes.

Some information can be usefully rolled up. For example the ABS in the National Water Accounts roll up information on purposes of water use and economic benefits of that use to a state and national level. The MDBC also roll-up some information, at a river basin level, in the annual Water Audit Monitoring Reports.

The alternative to rolling up is to compile information by pulling together commonly formatted reports into one central website or publication. This is the approach Victoria has taken with its

State Water Report. No attempt is made to give single water balance for all of Victoria. Instead the report contains data in a similar form for each of the river basins in Victoria in the one document.

A further difficulty in aggregating reports would be the different water years used around the country. While most used the financial year a large number of areas used water years that started at a range of different times.

Finding 55: With the exception of the ABS information on water use, there is currently no attempt to roll up (sum) information to state and national levels. Whilst some aggregation is undertaken at basin scale (eg MDBC water audit monitoring reports) the most common method of aggregation observed was where several organisations compile data from different areas into tables of information in a central document or website.

4.5 General findings

The conduct of the stocktake meetings was structures so as to facilitate dialogue. As a result of this flexible process there were a number of insights gathered that do not specifically fit into the above report structure which was developed to address the key aspects of the working definition for water accounting. The following sections discuss some of the additional insights gathered.

4.5.1 Potential for reporting overload

Feedback from the stocktake was that additional reporting requirements would increase the already heavy workload for water organisations. Many of the organisations indicated that they were required to produce more and more reports by different regulatory bodies each year. Often the reports have many elements of similar content, but with differently defined elements or reporting entities.

Urban water suppliers reported that they are required to produce several reports for different bodies. The WSAA report is widely contributed to by urban water retailers and is being broadened to include NWI requirements for performance monitoring. Some state industry regulators are also moving to adopt this framework to replace their reporting requirements. While it focuses on service provision it includes many elements of the proposed water accounting reports. There is an opportunity to work within this framework to establish arrangements whereby urban water suppliers could cost effectively prepare some of the envisaged water accounting reports.

Similarly water resource regulators are increasingly requiring water licence reports from water service providers with many elements of water accounting reports included. Again the opportunity exists to work within this framework to cost effectively produce water accounting reports.

Finding 56: Many organisations indicated that the increasing demands for reports by regulators and the public was putting them into ‘reporting overload’, and there are opportunities for rationalising these reports by having common standard reports which could be used by many parties.

4.5.2 Cooperation of participating organisations

It was realised that participating organisations are busy, including as a result of the NWI, and an emphasis was placed on minimising interaction with organisational staff and maximising the effectiveness of time. Whiles some scepticism about NWI activity was encountered overall the degree of cooperation and participation by those involved in the stocktake was high.

Finding 57: Despite scepticism about various NWI activities expressed by some participants, the degree of cooperation and participation in the stocktake was high.

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4.5.3 Organisational capability

A small number of organisations expressed an opinion that staff are currently required to multi-task, particularly where requirements such as water reporting and data management processes are concerned. The emergence of water accounting as a discipline and associated requirements have significant implications for the capability of personnel in water organisations. Some dialogue indicated that the personnel currently involved in preparing water information may not have the appropriate skills, understanding and experience to undertake some aspects of water information management. A significant turnover of staff was observed. Training may be required to facilitate further development of relevant capability.

Regular comment on the cost burdens that organisations foreshadowed with the implementation of various NWI projects was forthcoming.

Finding 58: The personnel who are currently preparing water information may not have appropriate skills, understanding and experience to undertake some aspect of water information management and only two officers in dedicated positions focusing on water accounting were encountered during the stocktake.

Finding 59: Participating personnel are concerned that this and other NWI projects may impose significant cost burdens on their organisations.

4.5.4 Functional management levels

The terms of reference for this project referred to the levels of management for water information as resource, wholesale and retail.

In practice, these levels, particularly the wholesale level, were found to be difficult to consistently apply to all aspects of the stocktake when considering the complexity of the different assignment of management functions to organisations in jurisdictions. The organisational responsibilities for measuring, recording and reporting various information elements were different both between and within jurisdictions. This relates back to the fact that the water entity interrelations within the envisaged chart of accounts are more complex and cannot be consistently simplified to these perspectives only.

Finding 60: The envisaged functional management levels of resource, wholesale and retail are not likely to be useful, in the current form, in simplifying a national approach to a chart of water accounts.

4.6 Stocktake conclusion

While showing signs of some good practice, water accounting in Australia is at an immature phase and being developed in an ad-hoc fashion.

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4.7 Summary of stocktake findings

The key findings from each aspect of the stocktake findings are summarised in the following sections.

4.7.1 Measuring physical water parameters

Finding 1 *For all types of physical data the spatial location of measurement points (eg river gauges, bores, meters, etc) was in most cases known to a high level of accuracy – typically within 10m. The reason for this is the ready availability of GPS technology which enables locations to be determined cheaply and accurately.*

Finding 2 *The measurement of river levels and flows has well established standards and practices which are commonly in use.*

Finding 3 *No commonly used standards and practices for measurement of piped flow were found to exist except for measurement of piped delivery of potable water in the urban context.*

Finding 4 *Measurement of flow in artificial channels has established standards which apply to some methods of measurement but not to many commonly used methods of measurement. Many current methods used, such as dethridge wheels and formulas for flow at channel control structures, are considered inaccurate or less reliable and are gradually being phased out.*

Finding 5 *There are well established standards and procedures, maintained and published by the Bureau of Meteorology, for measurement of rainfall and evaporation. No organisations indicated they directly measured transpiration.*

Finding 6 *Organisations with standards and procedures for continuous recording of river levels applied them to continuous recording of groundwater levels. For spot levels (which represent the bulk of groundwater level information collection) standards and procedures were mostly absent.*

Finding 7 *Techniques for identifying farm dams and charting their surface areas at the catchment scale exist and have been extensively used in some areas. However the techniques are expensive to implement and are the subject of ongoing development.*

4.7.2 Assembling chart of accounts information

Finding 8 *For resource level reporting it was found that:*

- *Water information elements and reports could be most easily assembled for high priority management units;*
- *Across the country there is only a partial correspondence of these high priority management units to SWMAs and GMUs used in the AWRA;*

- *outside of these high priority management units the information is generally sparse or of much lower accuracy;*
- *the management units are still changing and evolving, particularly for groundwater; and*
- *few cases were found of fully integrated groundwater and surface water management and reporting units.*

Finding 9 *Water service providers generally assembled and reported extensive water information in relation to delivery systems and sewerage systems for which they are responsible. However water information for irrigation drainage systems was less common and almost non existent for stormwater drainage systems. Water reporting on environmental sites is at a very early stage of development.*

Finding 10 *Volumes in major storages at any time are readily available. Capacities (but not volumes at a particular time) in minor storages (farm dams etc) are available in some areas, and river and channel volumes are generally not available.*

Finding 11 *The volumes held in soil and in aquifers were generally not determined.*

Finding 12 *Rainfall information is readily available; evaporation is available for some major storages, but otherwise actual evaporation and transpiration volumes were not found to be assembled anywhere. Techniques for calculating evaporation and transpiration on a broad scale have been developed but so far have only been applied to estimate long term average figures.*

Finding 13 *Surface water inflows and outflows and rainfall runoff are available for high priority management areas. Outside of these areas the information is partial, but organisations are investing in increasing coverage.*

Finding 14 *Information on volumes of water moving between rivers/storages and aquifers was found to be available only as long term estimates for particular locations.*

Finding 15 *Long term rainfall recharge estimates for priority aquifers are generally available though their quality varies. Records of annual rainfall recharge volumes were not found. Volumes of water being artificially injected into aquifers were found to be available.*

Finding 16 *Lateral/vertical volumes of water moving between aquifers was generally not known, though average volumes were estimated for some priority GMUs.*

Finding 17 *Volumes of water extracted from rivers and aquifers are generally available. However the quality of the information is affected by accuracy problems with measuring large gravity offtakes and the absence of metering of extractions from most unregulated rivers and aquifers.*

Finding 18 *Volumes of water delivered by water service providers are readily available.*

Finding 19 Volumes returned to rivers and aquifers are generally available.

Finding 20 Information on the volumes of water used for various purposes of use was available. The ABS are the major gatherer of this information. While many water service providers gather some information also (and the ABS use their data) some are reducing their collection of this information and some are increasing it.

Finding 21 There is considerable variation in the categories of water use employed by organisations, and the quality of the information gathered is highly uncertain.

Finding 22 Most organisations could assemble water entitlement and water allocation information from registers or other databases.

Finding 23 The nature of water access entitlements varied substantially between jurisdictions. Major differences were found in terminology and in the extent to which entitlements were bundled with allocations and with work and use consents.

Finding 24 The nature of water allocations was substantially variable both between and within jurisdictions. There were a range of different types of carryover and capacity sharing in place in regulated (supplemented) river systems. The treatment of water allocations for groundwater and unregulated rivers was highly inconsistent.

Finding 25 The proposed water trade information elements were not fully accepted due to different views of how water trade is defined.

Finding 26 Environmental rules were generally only recorded in plans, licences and other documents, but a few organisations are developing databases of these rules to assist in compliance reporting.

Finding 27 There were significant differences in terminology and in the understanding of the meaning of several commonly used terms. Important terms which need agreed definitions are water use, water trade, regulated rivers and environmental water. Also the NWI agreed terms water access entitlement and water allocation were frequently not used or used in a way that was inconsistent with the NWI definition.

Finding 28 While several organisations prepare reports containing water information elements, there are generally no standards for assembling or deriving those elements. A major area is modelling where some guidelines and professionally accepted practices exist, but no formally accredited (Australian) standards.

4.7.3 Recording water information

Finding 29 The information stores being used for water information ranged from systems with little or no control of access or quality assurance to systems with high levels of security, access control and data integrity.

Finding 30	*Water service providers are increasingly adopting SCADA or other telemetry systems for rapid access to field information for operational purposes. The long term storage of the data collected using these methods is ad-hoc.*
Finding 31	*Time series physical water information (hydrographic data) is commonly stored and managed in what is effectively an industry standard system: Hydstra (or closely related Hydsys or Time studio).*
Finding 32	*Database applications used by small organisations were typically in MS Access, while products used by larger organisations were most commonly developed externally in Oracle or to a lesser extent Ingress languages.*
Finding 33	*Environmental rules are, with one exception, not stored in any kind of database system.*
Finding 34	*Smaller water service providers typically run basic systems which are driven primarily by customer billing, with storage of other information on paper, excel or simple Access applications.*
Finding 35	*Larger bulk water service providers typically run multiple data stores where the degree of integration is driven by billing ,the need to assess reliability of resources for allocation purposes and statutory requirements.*
Finding 36	*Information systems run by resource managers or state rural water service providers for storing information on entitlements and allocations were found to be custom built using high end relational databases.*
Finding 37	*A general lack of awareness of whether any standards existed or were applied to an organisation's data management activities indicates that any standards that have been adopted may not be being followed.*
Finding 38	*There is a general lack of standardisation and consistency in data storage, management and infrastructure, particularly where estimates of some information elements are generated using models.*
Finding 39	*Most organisations were found to operate with minimal external access to their data stores although the use of wide area networks was common.*
Finding 40	*Basic password protection of information systems has been adopted by most organisations.*
Finding 41	*A small number of organisations, mostly limited to urban and rural retail, were found to consciously reconcile transaction records on a consistent basis.*
Finding 42	*The integrity of data systems and the protocols for managing data were highly variable across organisations with very little evidence observed that documentation of relevant processes is in place.*

Finding 43 Although a small number of organisations demonstrated that their data stores display some aspects of accounting principles, there were no examples found of where a system had been consciously designed with a specific chart of water accounts in mind.

Finding 44 The application of some water accounting principles such as double entry accounting was seen to be inappropriate for information stores which record time series data for physical water elements where there is often minimal context (ie no conscious application of a physical or institutional water entity).

Finding 45 Some urban and rural retail organisations were found to maintain transaction based databases where basic customer water consumption and billing information is the primary focus.

Finding 46 The difficulty experienced by larger organisations with reporting is linked to the ad-hoc nature of the 'Data Assembly Processes'. The main cause of this is that databases have not been designed with a formal chart of accounts in mind. This deficiency already causes and is likely in the future to cause, significant compatibility issues for compiling and aggregating data at higher levels.

Finding 47 It was clear that very little co-ordination of environmental water information storage is being undertaken, due mainly to the infancy of environmental water management.

4.7.4 Reporting water information

Finding 48 Organisations are already preparing a large number of reports containing water accounting information and reporting requirements are increasing to meet the information demands of regulators and the public.

Finding 49 No organisations indicated they were capable of generating the proposed water cycle report for any physical water entities.

Finding 50 Most organisations indicated that they could generate the proposed surface water reports (commonly called water balance reports) for most physical entities for which they are responsible (river basins, delivery systems, sewerage systems) at little additional cost.

Finding 51 The groundwater report as envisaged would not be able to be implemented, as the concept of groundwater 'stock' as conceived in the report is inconsistent with groundwater management practice which deals with sustainable extraction limits rather than volumes in storage. Additionally the groundwater flow information elements for the most part can only be estimated on an average basis rather than calculated annually.

Finding 52 Most relevant organisations could with some investment generate water entitlement, water allocation and water trading reports as conceived. Some organisations would be able to generate similar reports, but were constrained by the fact that the *entitlements/allocations they manage are not totally consistent with the NWI specifications.*

Finding 53 *The ABS is currently producing water use reports similar to those envisaged. They have included similar reports in their Water Account Australia publications, but not as yet for the SWMAs proposed in the AWRA 2000. Some water service providers are also publishing reports similar to those envisaged in relation to their customer's use of water. Terms, definitions, and use categories employed by the ABS are frequently different to those used by other organisations.*

Finding 54 *No organisations produce anything like the proposed environmental rules reports at the moment. Generally the information is not held in any kind of database, being mostly in plans and compliance reports. While some organisations indicated that they may be in a position to generate these reports shortly, others did not see any value in making the investments required to do so.*

Finding 55 *With the exception of the ABS information on water use, there is currently no attempt to roll up (sum) information to state and national levels. On the other hand several organisations compile data from different areas into tables of information in a central document or website.*

4.7.5 General findings

Finding 56 *Many organisations indicated that the increasing demands for reports by regulators and the public was putting them into 'reporting overload', and there are opportunities for rationalising these reports by having common standard reports which could be used by many parties.*

Finding 57 *Despite scepticism about various NWI activities expressed by some participants, the degree of cooperation and participation in the stocktake was high.*

Finding 58 *The personnel who are currently preparing water information may not have appropriate skills, understanding and experience to undertake some aspect of water information management and only two officers in dedicated positions focusing on water accounting were encountered during the stocktake.*

Finding 59 *Participating personnel are concerned that this and other NWI projects may impose significant cost burdens on their organisations.*

Finding 60 *The envisaged functional management levels of resource, wholesale and retail are not likely to be useful, in the current form, in simplifying a national approach to a chart of water accounts.*

5 Analysis of water accounting as a discipline

5.1 Context

The stocktake process demonstrated that water accounting exists in some form in all water businesses. The scarcity of the resource, and our dependency on it, will mean that analysis and scrutiny of water accounting and reporting will more than likely increase in the future. Industry experts, water users, researchers, policy makers, investors and other users of water accounting reports must be able to understand the information provided. These report users and their needs must be identified. Water accounting and reporting should be driven by the requirements of users of this information, not by what is currently available.

The meaningfulness of reports derived from water accounting records and water information systems is debatable if each water business uses different methods for definition of entities on which it reports, is unclear about the objectives of water accounting and reporting or puts different emphasis on qualitative characteristics such as relevance, reliability, understandability, comparability and materiality (the acceptable level of error). Different water businesses have different approaches to how and when they recognise and record water accounting transactions, how transactions are measured, and methods used to assess or enforce compliance with agreed policies.

One of the aspirations of this project is that water accounting will evolve as a discipline as improved capability, methods and systems are developed to meet the demand for improved water accounting and reporting. This aspiration is consistent with the NWI Agreement.

The scope of water accounting and the nature, extent and status of any associated obligations at any time (or for any period) is a substantial issue. The stocktake findings demonstrated that development of water accounting across the nation, whilst showing signs of some good practice, is at an immature phase and is being developed in an ad-hoc fashion. The choices for coordination of the development could include, but are not limited to, the following:

- Jurisdictions continue with development of water accounting individually
- Adopt a disciplinary approach drawing on the experiences of Standards Australia, international water accounting standards development and the financial accounting discipline where appropriate.

A disciplinary approach is the most stringent way forward. It is the most likely to achieve a nationally consistent result and to maximise the benefits from the considerable efforts and resources being directed to water accounting.

Key drivers for water accounting to be established as a discipline include:

1. With the exception of the ABS, external users of accounting information cannot command information directly from the provider.
2. Policy makers and water markets will require that information is assembled and reported according to consistent standards.
3. Public confidence in water accounting is required, as the availability of the resource will have social, economic and environmental consequences as policy makers and water markets react to water accounting information.

The first point above is of particular interest. Financial accounting is supported by Australian Accounting Standards because investors, employees, creditors and interest groups cannot individually force an organisation to provide financial information to a consistent standard. Users of general purpose financial reports such as statements of financial performance, financial position and cash flows can have confidence in the information presented because these financial reports must comply with accounting standards. Water users, entitlement holders, water markets investors traders and brokers, environmental organisations, auditors, financiers, local governments, researchers, planners and policy formulators have a need for water accounting information that they cannot command from the organisations that could produce this information. Users of water accounting information have the right to expect that accounting information is compiled and reported according to required standards.

This is a significantly different approach to current arrangements for water.

Management accounting, in its financial context, is not subject to accounting standards. This is because management can command the information it needs and can interpret the information without reference to external accounting standards. Water accounting has similar issues. The operators of water businesses can command the water accounting information they require to manage the business.

If water accounting is to emerge as a discipline then water accounting information must serve the needs of external users of water accounting information as well as the management requirements of water businesses. The reason that the stocktake findings demonstrated that water accounting has been developed in an ad hoc fashion is because water accounting has been focused primarily on the needs of management and direct customers, rather than the needs of a full range of external users, and the information needs of external users has not been explicitly or systematically explained. In many cases, the water accounting needs of internal and external users will coincide. However in many other cases these needs will not coincide and a discipline is required to determine the extent to which and how best to meet the needs of external users.

The move to water accounting as a discipline will be an evolutionary process. Wherever practicable current examples of best practice should be used as starting points for further development and progress towards standardisation.

Water accounting standards may not be appropriate for all situations. Guidelines may be more suitable in some areas of water accounting where the industry lacks knowledge or is unable to gather the quality of information required by a specific standard. Standards may be voluntary or mandatory and can be voluntary for a period of testing and scrutiny by all users before being made mandatory. Transition arrangements can also be applied if there is significant time and/or cost associated with implementing the standard.

Any discipline, by its nature, involves a systematic approach to the achievement of its objectives. This chapter focuses on a proposed model for national water accounting and the development of a disciplined approach.

5.2 What is water accounting?

A working definition of water accounting is:

Water accounting is the application of a consistent and structured approach to identifying, measuring, recording and reporting information about water.

This is a broad definition. There is a theoretical boundary which separates water accounting from the rest of water management. Where that boundary is in practice is difficult to detect. The boundary can be wherever the nation and its water practitioners want it to be. The key aspect is perhaps not where the scope of water accounting ends, but whether agreed outputs are justifiably useful to water managers and to external users with a stake in water information which a focus on “water accounting” can produce. Notwithstanding, the scope of water accounting is recognised as an important concept.

Key features of water accounting include:

- Water accounting does not change who manages water.
- Water accounting will reflect events that occur.
- Water accounting will not decide what will happen; it will enable reporting of what has happened.
- Engineering, accounting, statistical and scientific experts will define guidelines and standards associated with identification and measurement of water accounting information.

Perhaps an analogy with a cricket match is useful. The score keepers, often a representative from each team, are the accountants or report preparers. The scoreboard is a general purpose report, as is a typical result that may be published in a newspaper. The score book is the accounting system with its standard recording of match transactions.

The managers are the team captains and coaches who devise and implement their tactics and strategies. They check the score from time to time and play within the rules of the game.

Other users, who do not have command of match information, like spectators, commentators and opponents of the competing teams also find the information in the general purpose reports useful.

The governors (or regulators) are represented by the umpires, the match referee and the institutional body who set the rules of cricket and the scoring system.

How far the analogy holds is a mute point. Hopefully it provides sufficient insight to recognise that water accounting is about recording and reporting what is happening, independent of management decision making, in a way which allows useful interpretation of general purpose reports by the full range of users.

5.3 Proposed National Water Accounting Process

The information collected in the stocktake was analysed to identify *best practice*, *information gaps* and *areas for improvement* in water accounting practices. *Best practice* examples and *identification of information gaps* were addressed in the stocktake findings.

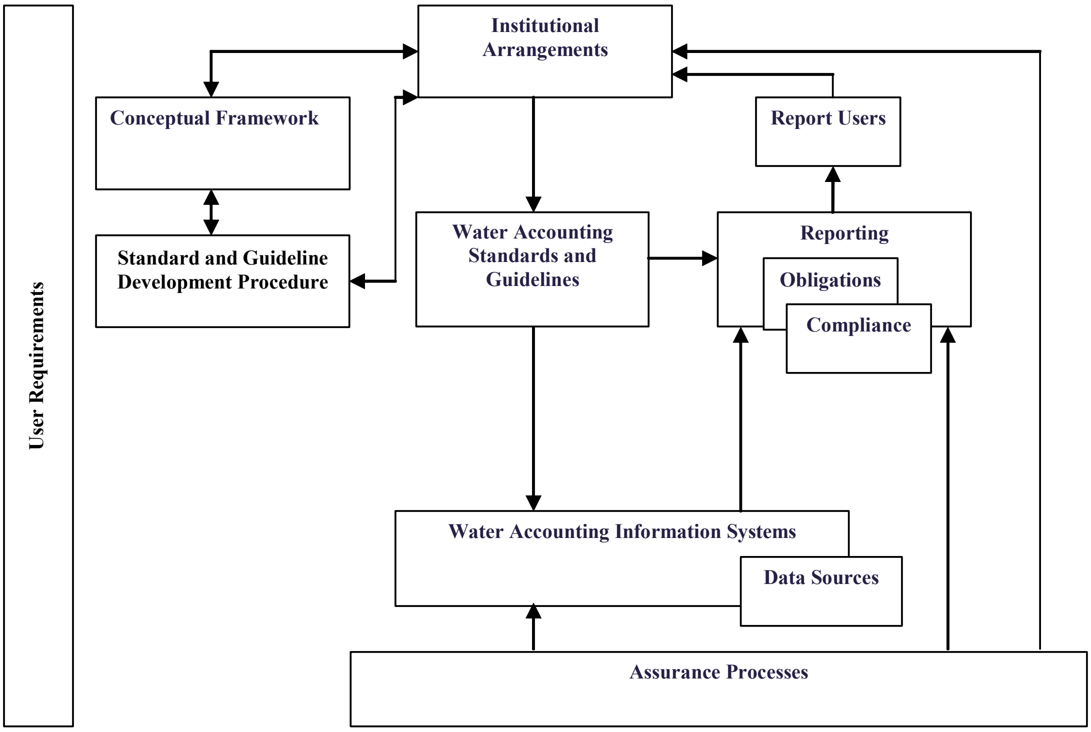
The stocktake examined water accounting practices, and did not look closely at the methods used to determine those practices. An obvious area for improvement is the establishment of a *national water accounting process* to provide orientation and assist those involved in developing water accounting as a discipline. A proposed national water accounting process was developed during the stocktake analysis process. Figure 15 illustrates this proposed process. The two way arrows are indicative of iterative process steps, while one way arrows are indicative of the general direction of the process flow. The process includes some 'one-way' feedback loops, which along with the 'two-way' iterative process steps are designed to supply continuous improvement.

The institutional arrangements will oversee the development of a *conceptual framework* for water accounting, the establishment and application of a *procedure for standard development* and the approval of water accounting standards.

The standards will in turn inform the reporting requirements and influence the design and implementation of the *water accounting information systems* that provide those reports. An assurance process should monitor the integrity of the water accounting information systems and the level of compliance with reporting obligations.

Report users will receive and analyse water accounting information mainly via reports and provide feedback to the institution overseeing the national water accounting model. It is essential that users of accounting information can influence water accounting and reporting. User requirements are seen as encompassing the whole model as the users of water accounting information are the reason for the focus on improved water accounting and reporting.

The user requirements, institutional arrangements, procedure for development of standards and guidelines and the conceptual framework provide fundamental intellectual infrastructure for the development of water accounting.



- **Figure 15 Proposed National Water Accounting Process**

This process is a useful starting point as it includes important aspects that were discovered and explored throughout the stocktake step of this project.

Standards for water accounting should be developed in accordance with best practice. The four pillars for the development of accounting standards and the integration of the standards within the proposed national water accounting model are:

1) Identification of water accounting users and their requirements
2) Structure of institutional arrangements
3) Procedure for development of standards

4) Conceptual framework

Without this intellectual infrastructure, water accounting will lack the rigor and logical consistency needed to produce useful water accounting information. Users of water accounting reports need to have confidence in the underlying methods and principles that have been used to prepare water accounting reports. User perspectives need to be represented in or influence various parts of the proposed model.

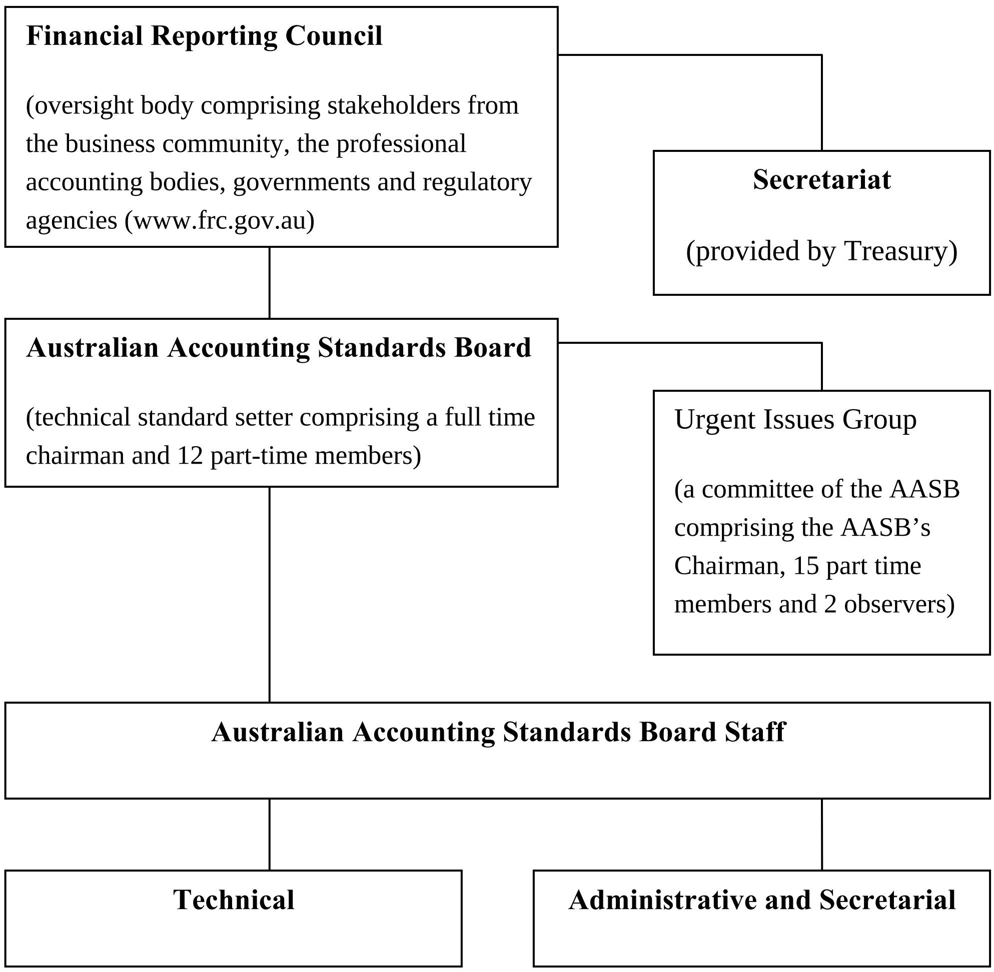
Application of the level of discipline inherent in the proposed national water accounting process will reduce cost in the long run, as it enables progressive building of knowledge and limits the need for revision and multiple iterations.

The *national water accounting process* should be adopted as a high priority in order to progress the disciplinary approach to water accounting

Each element of the proposed *national water accounting process* is discussed in the following sections.

5.4 Institutional arrangements

The development of water accounting standards will require an *institutional structure* to ensure appropriate governance and decision making. The creation of separate institutional arrangements should consider current institutions and roles and only proceed if a separate focus is warranted. An obvious model is that used for the setting of Australian (Financial) Accounting Standards as shown in Figure 16.



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- **Figure 16 Financial accounting institutional arrangements**

  Source: Australian Accounting Standards Board (AASB) www.aasb.com.au

Key features of these institutional arrangements include:

- Financial Reporting Council oversees Australian Accounting Standards Board.
- Treasurer appoints full time chairman of Australian Accounting Standards Board.
- Australian Accounting Standards Board is not bound by advice provided by Financial Reporting Council.
- Standards are mandatory for companies over a certain size.

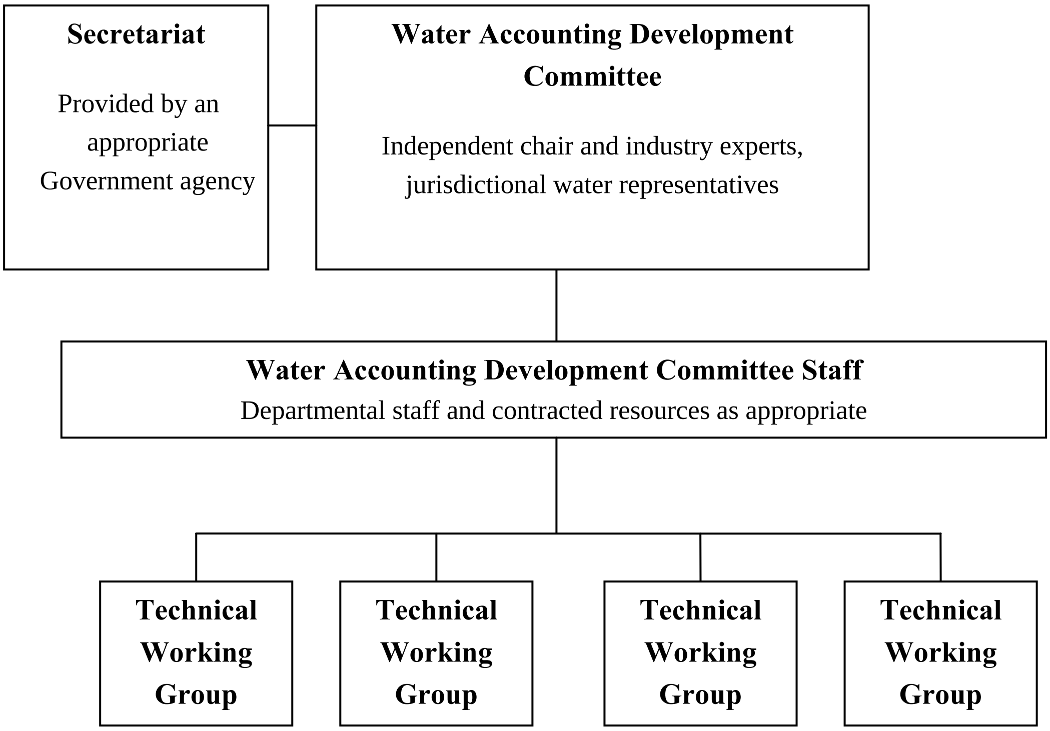
- Australian Accounting Standards are approved by parliament.
- ASIC is the independent regulator.
- Standard setting process gains credibility because accounting profession cannot control development of standards.

The above institutional structure equates with current practice and is a consequence of reforms implemented by the Government of Australia. The cost is met by Government.

A similar structure could be established for the institutional arrangements for the development of water accounting standards. However, it is recognised that water accounting is at an immature phase compared to financial accounting and that an interim arrangement is more appropriate for this circumstance. Although an ongoing structure similar to Figure 16 could evolve an interim arrangement during the development phase is appropriate with a transition to occur once development of water accounting has significantly progressed. This would enable experience to be gained and provide time to develop the most appropriate way to constitute and empower a more permanent structure.

A separate interim body, at a similar level to the NWI Committee, is seen as necessary to ensure adequate focus on a substantial development agenda, while retaining direct links to the NRMMC in relation to implementation of the provisions of the NWI Agreement. A *Water Accounting Development Committee* and a series of technical working groups as shown in Figure 17 is proposed.

The initial priority work may include development of a user requirements definition, a common chart of water accounts and the initial water accounting standards or guidelines. This work would be undertaken by dedicated technical working groups supported by departmental staff and contracted resources as appropriate.



▪ **Figure 17 Proposed interim water accounting institutional arrangements**

The chairman and members of the Water Accounting Development Committee could perhaps initially be nominated or appointed by the NWI Committee. It is suggested that the chairman be an independent part time role, with the other independent part time members coming from a mix of technical, accounting or academic backgrounds in, or predominantly from the water sector. The Interim Board could be linked to the Natural Resource Management Ministerial Council for resolution of any policy matters that may be required.

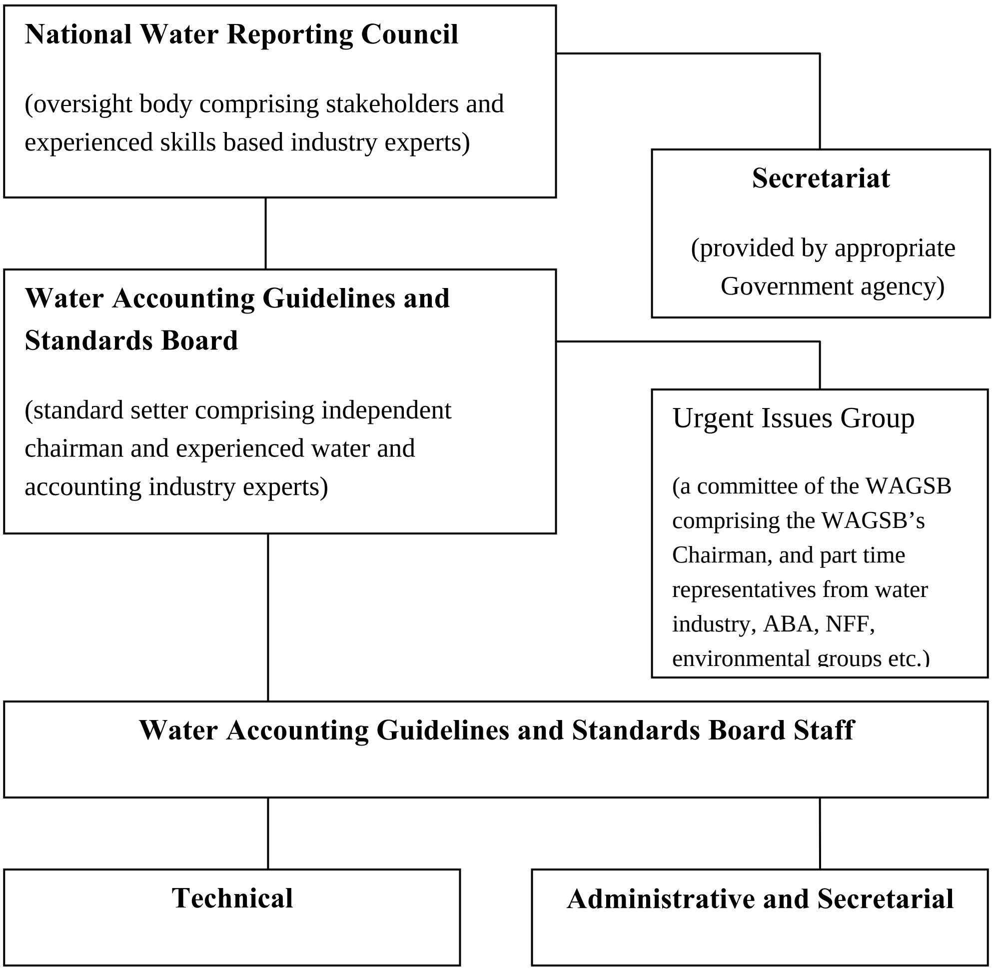
The composition of the technical working groups would be tailored to suit the particular undertaking, with potential membership being drawn from government agencies, water businesses, academia and industry groups such as National Farmers Federation, Australian Bankers Association and peak environmental groups

The interim development committee could be transformed into a structure similar to that used by the Australian Accounting Standards Board once the initial development work had progressed sufficiently and the need for a permanent structure was evident through an appropriate assessment.

The Urgent Issues Group is not seen as necessary until development of the discipline is more mature. A proposed structure of institutional arrangements for this more mature phase of water accounting is modelled on the AASB structure and is shown in Figure 18. How to constitute both the Council and the Board and the level of autonomy of the board will need to be resolved.

Situations will arise where decisions on treatment of certain water accounting issues will be required as a matter of urgency. Failure to resolve these issues will lead to inconsistent water accounting reports, with different preparers applying different solutions. An Urgent Issues Group could handle such issues and also respond to issues raised by individual or organisational report users in regard to water accounting requirements, issues raised by the assurance process, including independent audit findings, or new policy initiatives raised by Government.

The Australian Accounting Standards Board is a government controlled and resourced institution that is expert in managing the development of accounting standards. It may be possible to approach the AASB, and establish whether it can provide assistance or advice in regard to the institutional structure needed for the development of water accounting standards. Advice on institutional arrangements could also be sought from Standards Australia and integration with its arrangements may be an option. However the AASB is regarded as a more suitable reference body because it has greater expertise in determining the accounting and reporting requirements of external users.



- **Figure 18 Proposed mature water accounting institutional arrangements**

A dedicated interim institutional structure is considered necessary to oversee the initial phase of water accounting development work, with a transition to more permanent arrangement, similar to that for the Australian Accounting Standards Board being a future option.

5.5 Identification of user requirements

Report users are shown as the receivers of water accounting information in Figure 15. They are at the end of the process that involves establishing appropriate institutional arrangements, the conceptual framework, the standard setting procedure, the standards, water accounting information systems and assurance.

The purpose of any water accounting and reporting information system is to meet the needs of users. The stocktake process identified what current *water information systems* were available and the information that these systems could provide. An important gap that has been identified is that the users of water information and their needs have not been adequately addressed.

The water accounting information requirements framework developed and used for the purpose of the stocktake started with the desired NWI outcomes, identified proposed standard reports, described a range of water entities and information elements and recognised the data stores and processes needed to generate information elements. The development process was undertaken by the project team and EAP and hence excluded direct representation of a range of external user perspectives.

The development of a detailed *user requirements definition* is considered essential if we are to support the development of a meaningful national chart of water accounts and to identify water accounting standard development priorities. This development would help determine the scope and justification for water accounting. It would build on current starting points, including the work being undertaken by Victoria to scope the requirements for a register and the structure for data developed by the Australian Bureau of Statistics (ABS) and Bureau of Rural Sciences (BRS). The user requirements definition would include the following steps:

- Identification of key user representatives from water industry and those users who cannot command information for themselves;
- Reviews of relevant user requirements definitions, or similar documentation that has been developed by States and Territories during the development of water accounting or water information systems
- Workshops with user representatives to clarify requirements;
- Assessment of requirements, with particular emphasis on known current shortcomings such as accounting for environmental water, purpose of use and reporting formats;
- Documentation of requirements; and
- Confirmation of requirements, including sign off with representatives from water industry and those users who cannot command information for themselves.

Key deliverables from the user requirements definition would include:

- Clarification of the *scope* of water accounting and reporting
- *Why* particular water accounting information is required
- Whether water accounting information provision is *feasible* or *warranted*
- *How* it is proposed to provide access to this water accounting information
- *Who* will provide accounting information
- Frequency of provision of accounting information (*When*)
- *What* accounting information will be provided
- Expected *future* water accounting requirements
- A prioritisation and staging assessment

Such a task is required to inform the initial stage of water accounting development and could be carried out partially in parallel with or be linked to other processes designed to develop an agreed common chart of water accounts for water accounting and agreed reporting formats for key reports

It is envisaged that this task would take between three to four months and would cost in the order of $250,000 to $400,000.

An emphasis of this work should be on requirements of external users, those who cannot command water accounting information and therefore rely on others to provide this information. In addition to government agencies, users could include water users, entitlement holders, water market investors traders and brokers, environmental organisations, auditors, financiers, local governments, researchers, planners and policy formulators.

A proper analysis of user requirements would involve interaction with representatives from these groups. The user requirements should cover the potential scope of water accounting including four accounting themes of *water resource accounting*, *water market accounting*, *environmental accounting* and *purpose of use accounting*. The scope of these themes is covered in the following chapters. The process should also attempt to identify any future requirements, particularly since the stocktake and analysis process has focussed on what is available, rather than on what should be available.

An example of beneficial user involvement in such a process is where the ABS has a Water Statistics User Group which has guided the development of the ABS water accounts and has identified areas which can be improved. It has also ensured that key users of the ABS information are familiar and have confidence with the methods used to develop the accounts and are aware of the limitations of the data provided

A HIGH priority for water accounting development is the initiation of a comprehensive process to identify and assess the validity of the requirements of external users of water accounting information and to produce a detailed user requirements definition.

5.6 Conceptual framework

A *conceptual framework* is a coherent system of interrelated objectives that is expected to lead to consistent standards. It prescribes the nature, function and limits of … accounting and reporting. (Deegan (2004)[1]

A *conceptual framework* is a consistent reminder of the requirements needed to develop rigorous and relevant standards. Any conceptual framework for water accounting must complement the standard setting process and facilitate a high quality outcome.

Proposed key elements for the conceptual framework for water accounting are summarised in Table 6 below:

Table 6 Conceptual framework elements

Element	*Summary of purpose of element*	*Questions for standard setters*
Scope	Delineates scope of water accounting and therefore scope and applicability of water accounting standards and associated reporting	Is this water reporting within the scope of water accounting and therefore subject to water accounting guidelines or standards? Is this a guideline or a standard? Is guideline or standard within scope? Has scope of this guideline or standard been described adequately?
Reporting entities	Key components of chart of water accounts. Identifies *who* will prepare report (*report preparer*) and the *water entity* that is being reported on.	Who will prepare report? To which entities does the guideline or standard apply? Can the water entity be defined by report preparers?

[1] (Deegan, C., (2004)[1], *Australian Financial Accounting* 4th Ed McGraw-Hill Irwin: Australia)

		Is it feasible to report at this level? Can the common chart of accounts cope with this requirement?
Objective	A proposed objective of water accounting is "To provide relevant and reliable information to assist report users to make and evaluate decisions about various aspects of water resources and to enable water resource managers and relevant jurisdictions to transparently absolve their accountability."	What is the purpose of this guideline or standard? Does the guideline or standard meet the conceptual framework objective?
Relevance	Water accounting information that meets the information requirements of users and influences decisions by users. Water accounting information that contributes to the rendering of accountability by water resource managers and jurisdictions.	Does the guideline or standard meet the information requirements of users? Will the guideline or standard help users to determine whether water resource managers and jurisdictions have met their responsibilities?
Reliability	That quality of water accounting information which exists when that information can be depended upon to represent faithfully, and without bias or undue error, the transactions or events that it either purports to represent or could reasonably be expected to represent.	Is the guideline or standard defined well enough for users of reports to be able to rely on the accounting information represented in those reports?
Understandability	That quality of water accounting information which exists when users of that information are able to comprehend its meaning.	Is the meaning of the guideline or standard clear? Will preparers be able to base reports on this guideline or standard and will external users be able to understand the reports?
Comparability	That quality of water accounting information which exists when users of that information are able to discern and evaluate similarities in, and differences between, the nature and effect of transactions and events, at one point and over time, either when assessing a single water entity or a number of water entities.	Will users of reports be able to compare the same report for different water entities? Will users of reports be able to compare the same type of report when it is prepared for different water entities and is produced by different preparers? Will users be able to compare

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		reports for the same water entity at different points in time or for different periods of time?
Materiality	Used to assess the extent to which relevant and reliable information may be omitted, misstated or not disclosed separately without having the potential to adversely affect the decisions by users of water accounting reports.	Does the guideline or standard consider what is material? Is this guideline or standard consistent with the standard on materiality? [2]
Information elements	Key component of chart of water accounts Defines *what information* is included in reports for water entities. Information elements should be defined according to their categories. In a financial accounting sense, this would mean that all information elements are categorised as assets, liabilities, equity, revenue or expenses. In a water accounting sense, this would mean that any information element that represented stock, for example, was categorised appropriately and received a code (for use in the chart of accounts) that matched the appropriate category.	Can the common chart of water accounts cope with the information elements required by this guideline or standard?
Recognition Criteria	Used to ensure that information elements are properly categorised and that all new information elements align with definitions for categories of information elements. Recognition criteria may also determine when a transaction is recognised and by which reporting entity.	When will transactions associated with this standard be recognised? How will transactions associated with this standard be recognised? Can the transactions be matched to the appropriate information element?
Measurement	Users of water accounting information must be given information regarding the accuracy of measurement. Guidelines and standards should indicate the quality of measurement that is acceptable for	How will transactions associated with this guideline or standard be measured? Does the guideline or standard state why this level of measurement is

[2] It is assumed that a standard on materiality will be developed.

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	that guideline or standard.	required or accepted?
Reporting and compliance	Reports published for external users of water accounting information will require that the preparer declares in a note to the accounts whether they have complied with the relevant guideline or standards. If they have not complied, the preparer should state the reason for non compliance and give an indication of the impact of non compliance on the water accounting information contained in the report.	Has the guideline or standard clearly set out the reporting and compliance requirements? Does the guideline or standard provide an example of the reporting requirements? Does the guideline or standard require transitional arrangements in order to give report preparers sufficient time to gather information or adjust systems?
Monitoring and enforcement	The guideline or standard should identify how enforcement and monitoring of water accounting information will be achieved. Users of reports should have confidence that there is a binding requirement to produce the water accounting information as described in the guideline or standard. This requirement could be contained in the preparer's operating licence, for example. Reconciliations and independent audits may be used for monitoring and enforcement purposes, depending on the guideline or standard.	What level of monitoring and enforcement is required for this guideline or standard? Does the guideline or standard define monitoring and enforcements requirements?
Coherence and integratability	The information can be related to other information in a fashion that enables data from different sources on different topics to be joined.	What information needs to be integrated? Ie economic and social data, other aspects of environment (ie land use).

A *conceptual framework* for water accounting is essential if we want reliable, consistent water accounting information. *Best practice* for the development of water accounting standards will not be achieved without a *conceptual framework*. Such a framework ought to be developed progressively, with a concerted initial effort, but would not be a limitation on progress in other areas including moving toward identified *best practice* standard reporting.

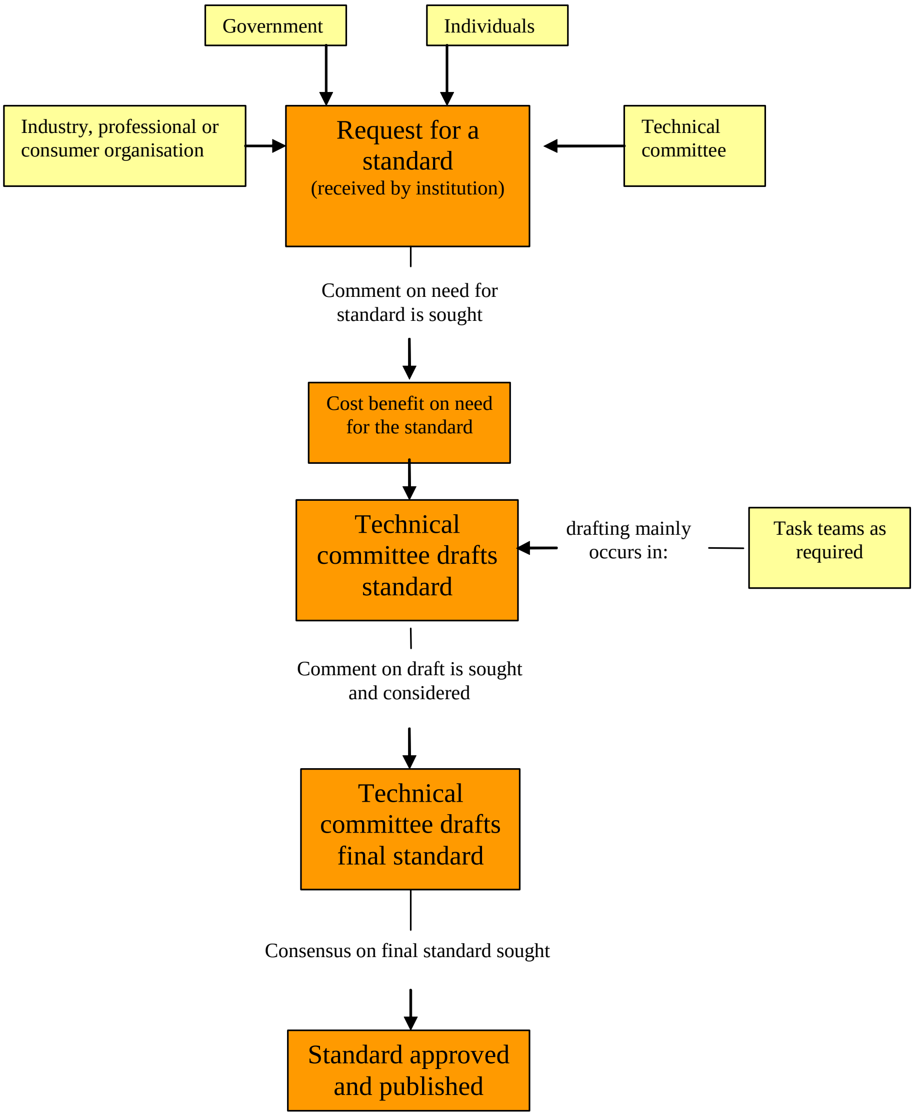
The theoretical aspects included in a *conceptual framework* for water accounting are expected to take some time to develop. Realistically the *conceptual framework* may not be fully developed for some years, and in the interim it is proposed that work on high priority accounting standards proceed in parallel with the development of the *conceptual framework*, and that lessons learned during the development of these standards influence the *conceptual framework*.

As a control mechanism, it is proposed that any water accounting standards developed prior to the conceptual framework reaching an acceptable level of maturity be compared with all other water accounting standards developed to that point, in order to ensure consistency and avoid conflicts between standards.

Progressive establishment of a *conceptual framework* will facilitate the development of consistent and relevant water accounting standards.

5.7 Procedure for setting of water accounting standards

There are advantages in having a structured, transparent procedure for the development of water accounting standards. While numerous development procedures could be adopted, the process used by Standards Australia has been examined briefly and appears to offer most of the aspects that will be important to the water industry. The procedure shown below in Figure 19 is a modification of the standards development process used by Standards Australia.



▪ **Figure 19 Standard setting procedure (Based on Standards Australia process)**

Key features of this standard setting procedure and its applicability to water accounting include:

- Individuals and a range of organisations can initiate the request for a standard.
- Cost-benefits analysis ensures that the needs of the users (beneficiaries) are weighed against the demands based on the providers of the water accounting information as it is the providers who must bear the ongoing cost of data gathering, recording and reporting.
- Water industry experts can be represented on the technical committee, sub committees and working groups to ensure that water industry experience is applied.

- User groups can be involved and given the opportunity to influence standards development, as well as the public (eg through the opportunity to comment on draft standards and guidelines)
- Procedure is suitable for development of technical standards, many of which are likely to be required for water accounting.

The above standard setting procedure will equate with best practice. The initiation of this procedure could be modified from receipt of a request to the institution determining the need for a standard based on the provisions of the NWI Agreement and its view of priorities. This would be appropriate to accelerate the initial phase of water accounting development.

A transparent standard setting procedure for standards development is needed as a high priority to allow consistent standards development.

5.8 Common chart of water accounts

Accounting systems cannot function without a chart of accounts. The chart of accounts for a water accounting information system should define ***what*** type of information must be gathered and recorded (equivalent to the information element defined in the stocktake phase of the project) and the ***level*** that the information element is to be aggregated and reported (equivalent to the water entity defined in the stocktake phase of the project) and ***who*** prepares the water accounting reports.

The stocktake demonstrated that although most jurisdictions have some form of reporting structure that they use for water accounting and reporting, most did not have a formal chart of water accounts. The significance of a formal chart of accounts cannot be understated as even if the chart of water accounts is not used to develop an accounting system, there are still significant advantages in standardising the types of information to be gathered and recorded and the entities for which that information is reported.

At this stage, Victoria is the only jurisdiction that has developed a formal chart of water accounts, which it plans to introduce for all accounting and reporting of water access entitlements, allocations, water extractions and deliveries and trading from 1 July 2007. An example extract from a draft of the chart of water accounts is included in Appendix E. It is also understood that the Australian Government BRS (Water 2010) and ABS (Water Accounts, Australia) have developed information (data) systems and presentation formats for national data from disparate sources.

It is proposed that a national chart of water accounts be developed based on input from all States and Territories. The chart of water accounts has a direct relationship with the conceptual framework.

The conceptual framework discussed in the Section 5.6 includes the *reporting entities (water entity and report preparer)* and the information elements. The *water entity* identifies the ***level*** that information is aggregated and reported at and the *report preparer* is ***who*** will prepare the reports.

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The information element defines ***what*** type of information will be gathered and recorded. Table 7 below shows the proposed chart of water accounts structure for water accounting.

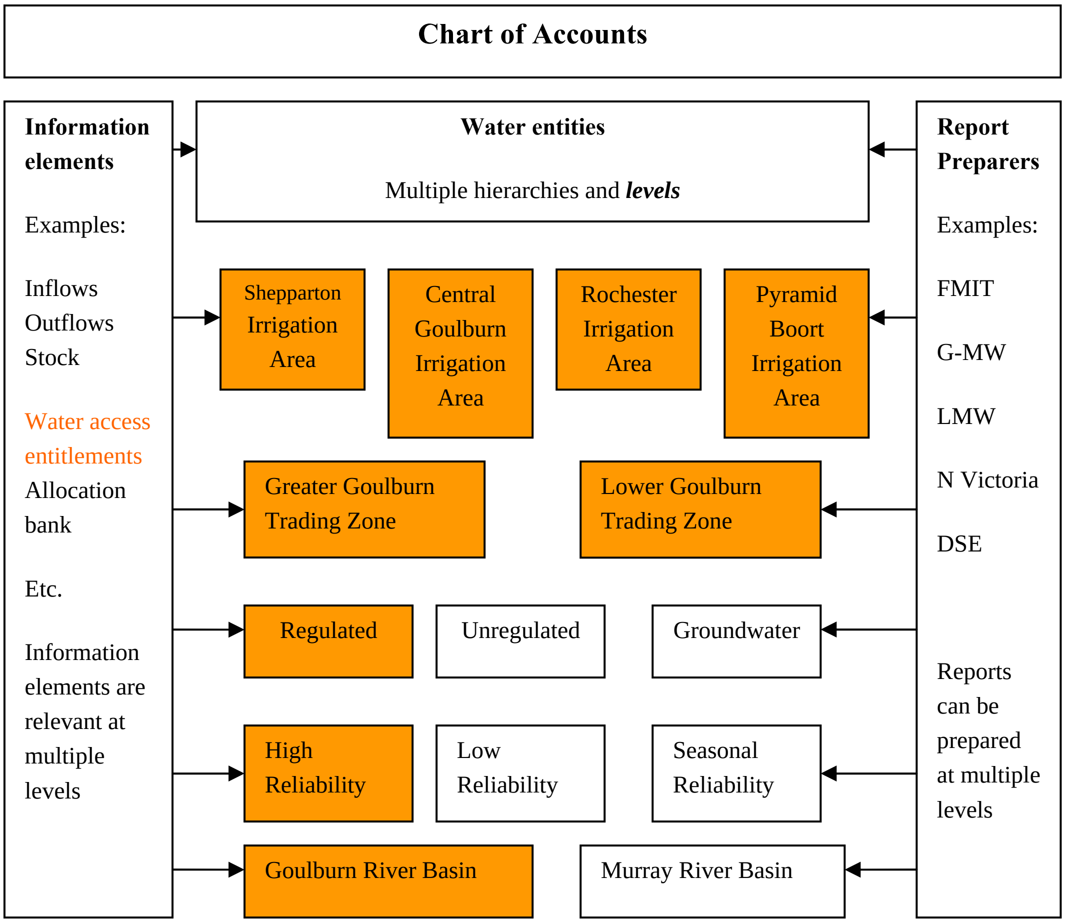
- **Table 7 Proposed chart of water accounts structure**

Conceptual framework	***Chart of water accounts***	***Examples from stocktake***
Information element	Information element ***What*** information will be gathered and recorded at the transaction level	Stock Inflows Outflows Water Allocation Water access entitlements Etc.
Reporting entities	Water entity ***Level*** that information elements are reported	Fitzroy River Basin Greater Goulburn Trading Zone Harvey Irrigation Area
	Report preparer ***Who*** will prepare the reports	Central Irrigation Trust State Water DNR MDBC

The stocktake findings indicate that an intuitive chart of water accounts has been developed in many participating organisations. It is natural when producing accounting information to think in terms of what information needs to be provided and at what level the information should be aggregated and who is responsible for preparing the information.

There are multiple ***levels*** in water accounting, and not all are hierarchical. Any chart of accounts must be developed with this in mind.

It should be possible for the preparer to report information at multiple levels using the same information elements. Figure 20 below shows how this can be done using an illustrative extract from the proposed Victorian chart of water accounts as an example.



- **Figure 20 Example chart of water accounts**

In the above example, report preparers could report on information elements for any water entities including particular river basin, reliability class, a water system type such as regulated, unregulated or groundwater, a trading zone or a delivery system such as Shepparton Irrigation Area. A flexible chart of water accounts, combined with a suitable water accounting information system should enable reporting on any permutation of these water entities, at any level by month and year, with the ability to drill down to the accounting transactions that support the account balance for the information element, water entity and report preparer combination.

The highlighted information in the above diagram shows how an enquiry that wanted to know how many high reliability water access entitlements there are in the Goulburn regulated system by trading zone and delivery system could be satisfied by this chart of water accounts structure.

Information elements can be grouped into categories in the same way as assets, liabilities, equity, revenue or expenses groupings apply in financial accounts. This is essential if double entry accounting is to be used. Even if double entry accounting is not used, it is important for preparers to understand the categories as external users will inevitably make intuitive judgements about these categories when examining water accounting reports.

Examination of the water accounting reports identified in the stocktake indicates that intuitive categorization of information elements into assets, liabilities, equity revenue and expenses has occurred to some extent. Formally recognising such categories in a chart of water accounts will improve water accounting capability in all jurisdictions.

The Victorian chart of water accounts is used as an example only and any development of a common chart of water accounts should pick up on starting points in jurisdictions and from nationally focussed work. The Australian Water Resources Assessment 2000 and the physical water entities as set out in Table 3 provides a starting point for water entities in the development of a common chart of water accounts, as does Appendix B for information elements.

Any transition to new water information systems for water accounting should not occur until the chart of water accounts has been agreed between States and Territories. The development of a national chart of water accounts also provides an opportunity to cater in a structured way for the diversity in water information terminology across Australia

The establishment of a common chart of water accounts for Australia is considered one of the highest priorities to facilitate consistent water accounting and reporting and integration with other data.

5.9 Accounting systems

The stocktake findings clearly demonstrated that most organisations operate ‘water information systems’ rather than ‘water accounting systems’. Water accounting systems are different from water information systems in that they utilise a dedicated structure (chart of water accounts) to organise information and also apply stringent systematic controls on the data within them to ensure consistency in data treatment and outputs.

Whether or not organisations choose to adopt a water accounting information system is perhaps not important. The importance should be on whether the *water information system* used to generate standard water accounting reports is structured and controlled so as to maintain consistent outputs which meet the agreed standard.

Implementation of water accounting information systems or the functionality that they offer is seen as the most rigorous method of addressing the issues of transparency and user confidence. The most important design feature of any water accounting information system should be the chart of water accounts. Investment in new water information systems for water accounting should not occur until a chart of water accounts structure is agreed by States and Territories. The chart of water accounts is a critical part of the intellectual infrastructure needed to design and build effective water accounting information systems. Reporting requirements cannot be achieved if the accounting system cannot accommodate the chart of water accounts. A common chart of water accounts will facilitate consistent water accounting and reporting.

The proposed national water accounting model and the conceptual framework will not be prescriptive in regard to the requirements for a water accounting information system. However, the functionality of the system would become explicit via the common chart of water accounts, reporting requirements and the assurance process.

Inadequacies in accounting systems can be manifested by:

a) Cost of producing information
b) Poor assurance results
c) Inability to comply with reporting requirements (often caused by inadequate development of chart of water accounts or a water accounting information system that cannot accommodate chart of water accounts)

Reports are the end product of an accounting system. A good accounting system should be capable of complying with accounting standards that have been set and ongoing adaptation of those standards. Generally, changes to standards should not require accounting system enhancements.

Some characteristics of good accounting systems are discussed below.

5.9.1.1 Internal controls

Internal controls should be in place to prevent errors. Where errors have occurred, internal controls should be capable of detecting and highlighting those errors in a timely manner.

5.9.1.2 Reconciliations

Reconciliation is the ability to verify account balances against supporting evidence. Part of the reconciliation process should include a requirement to periodically reconcile relevant accounts, full disclosure of identified discrepancies, a sign off of reconciliations and the inability to retrospectively change reconciliations.

The reconciliation of allocations issued against the water access entitlements from which they were derived could be a required reconciliation, for example.

5.9.1.3 Audit trails

An audit trail is a chronological sequence of audit records, each of which contains evidence directly relating to and resulting from transactions. Examples of audit records include the journal entry, modelled outputs or committee decisions. The audit trail becomes a log of all changes to an account. All relevant supporting evidence should be traceable from the audit trail. An important implication of maintaining an audit trail is that corrections do not override existing data to ensure the history of the change (and links to all supporting evidence) is not lost.

An audit trail is a powerful tool in achieving visibility and transparency of transactions. The maintenance of history and supporting evidence facilitates the verification and reconciliation of accounts. Accounting software systems provide for an audit trail.

5.9.1.4 Aggregation

The audit trail necessarily requires that information is entered at a transactional level into relevant accounts. The transactions aggregate to the account balance for an information element, such as inflows or outflows. These account balances (information elements) can then be included in a report for a water entity, say for example a trading zone. In some cases, water entities will be aggregated in order to view the information elements at a higher level, say for example, the aggregation of all trading zones within a river basin.

The ability to aggregate minimizes maintenance of the accounts, as data need only be entered into the system once. This also enhances the quality of data as the possibility of having conflicting data reported in different reports is eliminated.

The ability to aggregate is controlled by the chart of water accounts and the coding and aggregation levels embedded in the design of the chart of water accounts

5.9.1.5 Systematic data entry

Systematic data entry is critical to efficient accounting systems. Data entry must include the date of the transaction, a transaction description, the information element and water entities from the chart of water accounts, the user Id, and the volume of the transaction.

Any entry requires the source and destination of a transaction to be recorded. In doing so, the duality of a transaction is explicit and a built in error check is provided. This is one of the reasons why double entry accounting is used in financial accounting.

A double entry accounting system recognizes that water is never lost, although it may cross boundaries of information elements and water entities within the water accounting information system. It is important to note that the user or information provider does not necessarily need to identify the double entry transaction, as often the accounting system can automatically create the transaction. Similarly, the user does not need to see or understand the duality of the transaction (although the ability to analyze data is obviously enhanced if they can).

Systematic data entry can also contribute towards achieving national comparability and transparency as users do not need a hydrological or modelers' skillset to understand how data is managed.

Given that data need only be entered once; a change made in one area is automatically reflected in another; and changes to transactions are detailed in an audit trail; rather than increasing the work, double entry accounting at least halves the work.

5.9.1.6 Existing Data Standards

It is also considered a medium term priority that a number of standards be consciously adopted for relevant water information systems given the market transparency requirements related to entitlement trading. Some of these standards could include:

- Quality assurance – eg ISO 9000
- Records management eg AS ISO 15489
- Data management and interchange – eg AS ISO 9735.9-2003
- Information security management eg AGIMO

It should be noted that if new or modified water information systems are adopted then some of the above standards would be built into the software.

As water accounting development matures the quality accreditation of register systems is likely to arise as a consideration.

5.9.2 Starting points for *water information system* standardisation

The need to apply some of these information system characteristics to existing water information systems will be dependent on the degree to which exsiting information system functionality aligns with such characteristics and the opportunity to transition to new information systems will be influenced by the age of systems and investment cycles. .

Some organisations may choose to adopt off the shelf packages whilst some may choose to custom build or retrofit existing systems. All off the shelf accounting software packages utilize double entry accounting. The transaction structure, systematic data entry, audit trail, aggregation, chart of water accounts, report design and development etc are provided as standard functionality in accounting software packages. Internal controls, reconciliations and external audit are facilitated by the use of accounting software packages.

In house custom built accounting systems are now rarely developed by commercial and government sectors. The quality and years of research and development of accounting software packages has meant that any cost benefit analysis generally rules out in house development of accounting systems. Rather, standard packages are more likely to be customized to meet the business needs, and standard software packages are designed with this functionality and flexibility in mind. The requirement to independently audit financial reporting has also impacted on in house development of accounting systems, as the auditors inevitably have to spend more time confirming the integrity of custom built accounting systems compared with off the shelf packages that have been proven at other sites.

The specific needs for types of water organisations and some good starting points for addressing these system issues are discussed for each of four accounting themes in the following chapters.

A few targeted demonstrations of water accounting information system functionality, whether through progressive integration of functionality to current water information systems or via dedicated water accounting systems which link to current water information systems, is likely to provide the best way to make national progress in standardising water accounting practice.

5.10 Water accounting standards

The natural progression towards standardising water accounting practices is to develop a range of water accounting standards. The model in Figure 15 demonstrates that standards could be developed which apply to both **water accounting reports** and **water accounting information systems**. This would also require that standards for some aspects of water measurement and estimation may also be required in order for practitioners to be guided on how to populate specific information elements that are required within standard water accounting reports.

The important aspect is that the development of standards is controlled through development within an agreed conceptual framework, using an agreed process for setting of each water accounting standard and under the control of an agreed structure of institutional arrangements.

The standard development process should ensure that accounting standards are consistent and logical, because they will be developed from an ordered and agreed process. Relevant parties will be consulted and have input into the development of the standards.

Water accounting standards can explain and prescribe the treatment of various water accounting issues.

Typically, the standards will address the aspects included in the conceptual framework and could include: justification; explanation (including definitions); disclosure requirements (content); and examples. An example of a water accounting standard for materiality is shown in Appendix F.

It is envisaged that a significant number of water accounting standards could eventually be developed, and a number of strategic starting points are required to commence the water accounting standards development 'journey'.

Specific priorities need to consider the full scope of water accounting across the four identified water accounting themes.

5.11 Reporting, obligations and compliance

Water accounting standards will need to address standard reporting formats. The standard report templates prepared as part of the project have followed the following format:

- Scope

  This shows the physical and temporal coverage of the report.

  While the physical scope can be virtually anything it is expected that it will be a water entity such as a river basin, groundwater management unit, delivery system or trading zone which is defined in a chart of water accounts.

  It is expected that in most cases the temporal coverage will be a year (July to June) but it can be other periods.

  The scope also indicates the report preparer that is the organisation who prepares the report.

- Opening stock

  The opening stock shows the quantity of the relevant information elements for the water entity (eg water in storage, water access entitlements, or water allocations) which is present at the start of the period. The 'stock' can be the volume of water in storage, or the sum of water access entitlement shares, or the sum of water allocations, or other quantities as appropriate to the type of report.

  Some reports may not have an opening (or closing) stock because there is no significant or measurable quantity of stock eg reports for water entities such as unregulated river systems.

- Inflow or increase

  In general this shows all increases in the quantity of relevant information elements that have occurred during the period. For reports dealing with volumes of water it often represents the physical inflow of water into the water entity. For such things as water allocations it represents the creation of new water allocations (eg by 'announcement') or the movement of water allocations into the water entity being reported on.

- Outflow or decrease

  In general this shows all decreases in the quantity of relevant information elements that have occurred during the period. For example, where the quantity is water volumes, it includes such things as outflows, extraction of water, evaporation. Where the quantity is water allocations it includes decreases of those allocations through such things as extractions or end of year write-offs.

- Closing stock

  This shows the stock of the quantity of relevant information elements present at the end of the period, in a similar manner as the opening stock.

It can be seen the basis of this layout is the simple equation:

Change in stock = inflows – outflows or increases - decreases

The fundamental idea is that the report shows not only what quantity of stock exists at a certain time, but shows where it has come from and where it has gone to. Because the report must 'balance' users of the report can have confidence that all changes to the quantities are accounted for. It also enables the report user to see the different quantities in perspective, for example losses in a river system can be seen in the total context of inflows and outflows.

It is this sense of wholeness that gives the report format particular effect, and helps to ensure users have confidence in the information and a greater understanding of how all the information fits together. Reports for the same water entity over several time periods can be compared with confidence that like is being compared to like.

Such reports are also key in demonstrating accountability by managers of water resources, water access entitlements and water allocations. This is confirmed, for example, by the recent requirement imposed by IPART in NSW on State Water and the Sydney Water Corporation to prepare reports in this form. A similar style of report is commonly used in financial accounting for the same reason.

The contrast between this style of report and the tables of statistics commonly found in many published water reports is stark. For example separate tables of river flows and extraction volumes do not link information together meaningfully, and do not show where all the water has come from or gone to, and do not demonstrate the same accountability for the management of the resource.

Finally it is of note that some report types include an additional section called Internal Interchange. This is required where there are different types of stocks within the water entity, to show the quantities of the relevant information entities which have moved between those different types of stocks. For example if the water entity includes both rivers and aquifers then internal interchange can show the movements of water between rivers and aquifers.

The degree to which water accounting standards must be adhered to would be determined by reporting obligations and compliance.

Requirements for reporting and obligations and compliance responsibilities associated with reporting can continue to be developed.

Reporting obligations and compliance determines who is required to prepare water accounting reports, when, to whom and the degree to which reports must comply with water accounting standards.

Enforcing reporting obligations may be particularly challenging for the water industry, as (unlike financial accounting) there are limited market mechanisms to encourage compliance with reporting obligations. Additionally, it is anticipated that it is unlikely that financial penalties will be imposed upon those preparers that do not fulfil their reporting obligations. An absence of mechanisms to compel institutions to fulfil their reporting obligations exacerbates the need for accounting reports to have a perceived benefit for information preparers.

While there are no purely market mechanisms to encourage business to produce reports from a public transparency point of view, reports from within the industry to whom aspects of water management is devolved, is just as important as other government reporting. After all, the public is the primary stakeholder of water, given the management right for water is vested to governments. The importance of implementing clear and compatible reporting obligations at all levels of management (whether for private or government bodies), is central to being able to have meaningful public accounts. As such, it is reasonable to consider that governments should require the adoption of appropriate reporting by industry. This does not need to mean an extra reporting load and the opportunity to streamline some of the current reporting arrangements needs to be addressed

It is proposed that reporting obligations could be included, where appropriate, in licensing requirements for some preparers of water accounting reports.

Further recommendations on reporting obligations are presented in the discussions under each accounting theme.

Development of standards for water accounting reports should consider report templates and obligations for report preparers.

5.12 Assurance

The assurance process will enhance the degree of confidence in the reports for the intended users of the reports (other than the preparer).

Assurance requirements will be specific for different standards and in the proposed mature institutional arrangement (Figure 18), will inform the Water Accounting Standards Board and the Urgent Issues Group of areas that require attention.

The assurance process needs to be considered when reporting and compliance obligations for preparers of water accounting reports are being established.

5.13 Capacity building

The proposed development work to establish water accounting as a discipline as well as water accounting and reporting standards and guidelines clearly indicate that additional capacity will need to be developed within the water industry if we are to deliver national water accounting requirements.

Capacity building could include:

a) Development of technical skills

b) Acquisition of skills and experience in accounting

c) Training

d) Investment in new systems and forms of measurement

While a formal stocktake of water accounting capability was not part of the scope of this project it is clear that officers within jurisdictions are struggling to keep up with the reform agenda developed by the NWI. The intellectual infrastructure that will need to underpin water accounting cannot be developed in the timeframes required by the NWI using just existing resources.

The proposed *Water Accounting Development Committee* and associated technical working groups and subsidiary specialist technical committees or task teams will provide significant opportunities to build water accounting capacity. In particular an infusion of qualified accountants and the integration of their skills and perspectives with water industry practitioners and policy formulators is to be encouraged.

Consideration needs to be given to some specific national funding for water accounting positions, additional to current employment levels, within Australian government agencies and water organisations for the duration of the initiative to build enduring capability in order to deliver ongoing water accounting requirements

6 Analysis of water resource accounting

This theme relates to the identifying, measuring, recording and reporting of stocks and flows of water on and under the ground.

6.1 Description and scope of theme

Water resource management is about the societal allocation of water. Water resource accounting deals with the spatial and temporal variability of the resource. It can cover water in rivers, lakes, dams, aquifers, the soil profile, delivery systems and drainage systems.

The scope of this theme covers three common report types which describe water stocks and flows for a range of water entities. The definitions of these report types vary and need be standardised if there is to be consistent interpretation. The three typical report types that were proposed for discussion in the stocktake are:

- Water cycle – combined surface and groundwater resource including atmospheric interchanges (i.e. rainfall is an input rather then inflows to streams or aquifers)
- Surface water – typically relates to surface river or delivery systems and separates surface water from groundwater.
- Groundwater – water in aquifers or groundwater management units and movements in/out of the water entity.

Water resource accounting can cover any of these three report types as well as variations and combinations of them, including combined surface and groundwater interactions. Whatever report is being examined, it is necessary to clearly define the water entity to which the accounting report refers. For the surface water reports in particular, resolving definitional issues defines what water resources are to be included (perhaps based on practicability of measurement and information element availability) and hence determines the water entity to be the subject of reporting.

6.2 Objective

The desired water accounting outcomes relating to resource reporting are:

- To provide information on water resources in a way that can be understood by a non-technical audience
- To give water users and investors, and other interested stakeholders confidence that the reporting is consistent and reliable
- To inform water resource management and planning processes, and ensure their transparency
- As a basis for accountability for management of the resource

- To demonstrate the level of effect of actions of others (e.g. land use change, construction of farm dams etc) on water sources

Consistent with the outcomes, the following objective for water resource accounting is proposed:

The objective of water resource accounting is to provide relevant and reliable public information regarding the quantities, movements and availability of water, both spatially and temporally, for defined spatial water entities that are agreed by the users of the information to be important for water resource planning, management and public accountability.

6.3 Current drivers

The drivers for improved water resource accounting are:

- A need to be more consistent and transparent in the derivation of societal allocation (or water 'availability') information.
- A need to understand in a holistic way the total water resources of a river basin, groundwater province, or collection of basins and provinces, or for particular water entities within a wider entity.
- Increasing awareness of the need to better understand the extent to which water extractions are returned to rivers and aquifers; i.e. to distinguish between gross and net extractions or between depletive and non-depletive extractions.
- Public pressure to know "what is going on" in resource management.
- In a few areas, a perceived need to better understand the part of the water cycle between the point where rainfall hits the ground and the point where it appears in a surface stream or aquifer. This understanding may be useful in managing forest plantations and their effect on water volumes, and in holistic catchment management.
- A requirement to move towards meeting Clause 82 part iii) of the National Water Initiative, which is as follows:

  iii) water resource accounts that can be reconciled annually and aggregated to produce a national water balance, including:

    - a water balance covering all significant water use, for all managed water resource systems;
    - systems to integrate the accounting of groundwater and surface water use where close interaction between groundwater aquifers and streamflow exist; and
    - consideration of land use change, climate change and other externalities as elements of the water balance.

Most of these drivers relate to the need to improve the understanding of water system dynamics, which are dependant on modelling at various scales. The information elements generated from various models are generally not captured and reported to a broader audience. The value of interpretation from annual water accounts will have benefits and limitations that need to be understood.

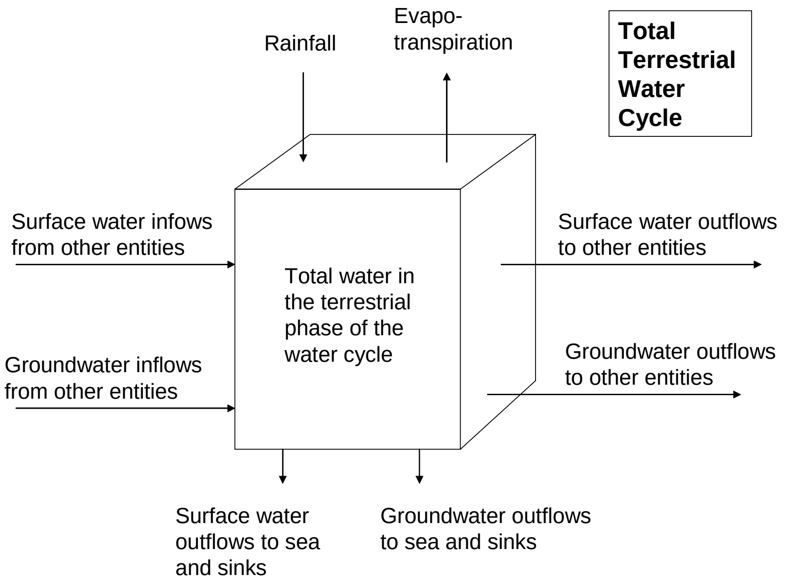
Climate change produces results that are external to the proposed water accounting framework because they take place in the atmospheric phase of the water cycle, not the terrestrial phase. Changes in climate will create changes in hydrology which will be reflected in water accounts and may then help with detecting trends, informing interested users and managing water resources.

6.4 Concepts and definitions

The existing views on water resource reporting vary significantly across the nation due to the range of perspectives adopted in defining the water entity to be reported on. Most current reports are surface water rather than water cycle reports in the purest sense and the particular water entity inclusions/exclusions are not necessarily defined well enough for reports to be comparable. The interplay between the geographic extent of surface physical water entities and information elements (stocks and flows) requires that simplifying assumptions will inevitably define the information elements of various accounts.

6.4.1 Water resource accounting

In concept, water resource accounting can be thought of as referring to the whole of the terrestrial phase of the water cycle including surface water and groundwater and atmospheric interchanges. In its most simple form, this can be shown as in Figure 21.



- **Figure 21 Water Cycle for terrestrial phase**

SKM

While an account of this type does represent the whole terrestrial water cycle, it is not necessarily very useful. It has a more "all encompassing" boundary and recognises the estimation of total rainfall and broad scale evapotranspiration. Water stored in and released from storages, diverted from rivers, delivered to customers, returned to rivers, and passing from surface water to groundwater are not shown. These are all considered to be "internal transactions" in the account as described in the Step 1 report.

The problem in comparing 'water resource' reports is that various organisations report on parts of the whole water cycle in different ways, as illustrated in Figure 22.

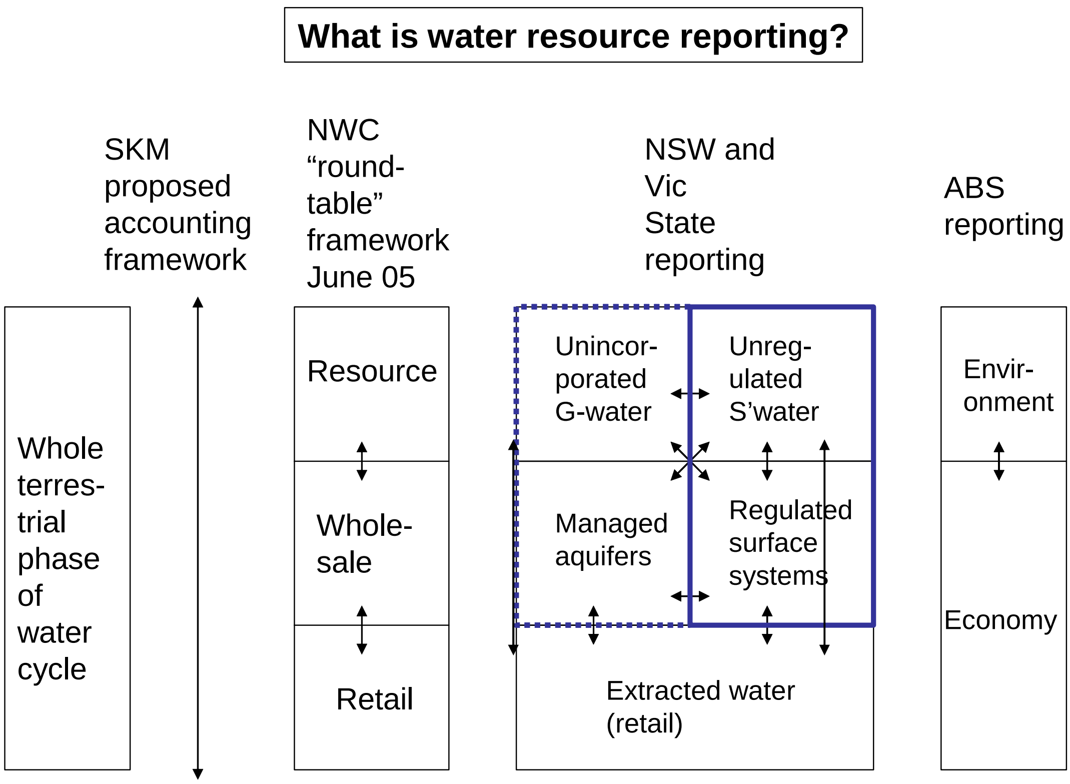


Figure 22 Potential interpretations of water resource reporting

It can be seen from Figure 22 that different organisations look at reporting on water resources through different lenses and, in concept at least, the relationship between them can be seen. Each perspective defines a unique water entity with different boundaries and interfaces and therefore exposes different transactions and information elements. It is a matter of what lens is the most useful, and this depends on the purpose of reporting.

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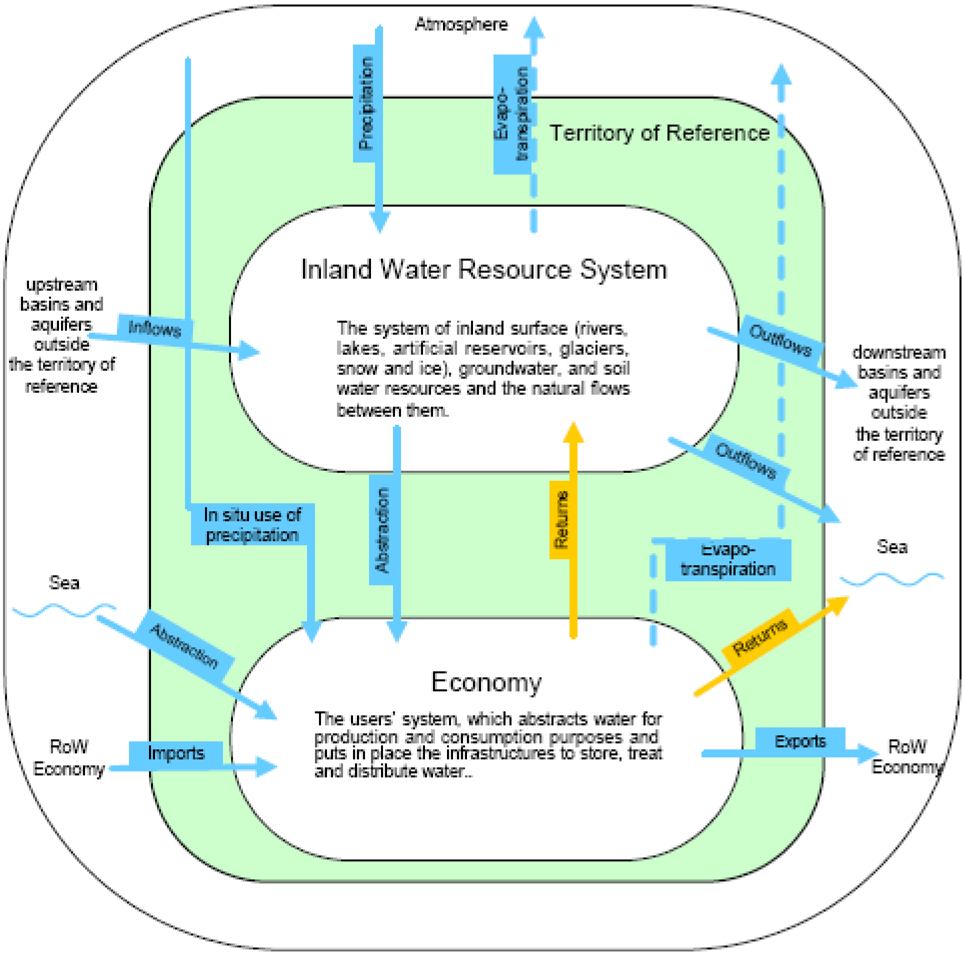
6.4.2 Environment vs economy, public and private water

In the UN publication *Integrated Environmental and Economic Accounting for Water Resources* (May 2006) a differentiation is made between water in the 'economy' and water in the environment. Water in the economy as described is in effect a subset of all the water on or under the ground. This is illustrated in Figure 23.

Figure 23: Separating water in the economy from total water



Source: *Integrated Environmental and Economic Accounting for Water Resources* (UN, May 2006)

SEEAWR covers all aspects of the water resource, but draws a boundary between water in the economy and water in the environment. Water can also be a part of the environment and economy simultaneously (ie it does not have to be an exclusive categorisation). While the line is clear in SEEAWR it is not certain that this internationally determined distinction is appropriate for the Australian circumstance. Many different presentations are possible using the SEEAWR.

Water resource accounting can deal with water in the 'economy' in different ways:

- It can be included with all the water undifferentiated. For example accounts for a catchment can show all water on the surface, regardless of whether it is in a private dam, or delivery system or a natural lake

- It can be totally excluded. For example a report for a catchment could exclude all water captured in storages on or off river on the basis that water in the economy is no longer part of the resource.

- It can be included but separately labelled within the accounts and reports. For example natural lakes might be differently labelled to water in man made storages.

Another possible approach is to think of reporting on water resources as reporting on all water that is under the control of the State, and not water that has passed into private control. This means in general terms that water resource reporting would cover what the NWC roundtable discussion identified as "resource" plus "wholesale" and what the UN framework identifies as "environment" plus the part of its "economy" classification that is in storage and regulated systems, but has not been delivered to a customer. If accounting for all significant water use is important then what customers use water for is relevant information.

Whether or not this kind of separation is an issue will depend on the nature of the water entity to which the accounts relate. For example if the water entity is simply a regulated river system, then implicitly only the storages and rivers relating to that system are included. Off river private storages are not an issue, and the main on-river storages are included. If on the other hand the water entity is all the surface water in a catchment it becomes more relevant to separate out that water which is in natural storages, that which is in private storages and that which is 'allocatable' water in public storages.

It is important for definitions to be developed to enable resource accounts for resource management units (eg SWMAs, GMUs) and the water supply and use accounts prepared by the ABS (see section 9.5) to be synchronised. This leads to a range of detailed conventions which need to be agreed in Australia. Such questions include: example:"

- What part of soil water (water in the unsaturated zone of the soil) is in the resource water entity and what part of it is in private hands? Possibilities are:
  - Treat all rainfall as an inflow to the resource water entity. This implies that soil water produced from rainfall on irrigated areas is part of the resource water entity but soil water produced from irrigation is not, as it left the resource water entity when it was extracted from a river or aquifer. That means that soil water is partly in the resource

water entity and partly in the irrigator water entity, which is a difficult concept. Soil water in dryland agricultural areas would be in the resource water entity and would pass to the dryland farmer when it was used to grow a crop.

    - Treat rainfall on irrigation areas as passing directly to irrigators. The only part of it that enters the resource water entity is the portion that returns via drainage. All soil water in irrigated areas is in the irrigator water entity.
    - Treat rainfall on irrigation and dryland farming areas as passing direct to farmers. All soil water in irrigation and dryland farming areas is then in the farmer water entity, and the only portion of the rainfall on those areas that enters the resource water entity is drainage to a river or an aquifer. The only soil water in the resource entity is in non-agricultural areas. (What then about commercial forests? What about National Parks?)

- Is water in minor storages – (farm dams, small urban storages) regarded as water already extracted from the resource water entity? If so, it is regarded as an outflow from the resource water entity as the storages fill. Alternatively is it regarded as being extracted from the resource water entity as it is extracted from the storage? Does the answer depend on whether the storage is an on-stream storage or a catchment (off-stream) storage?
- Similarly, how should water stored in large, generally State owned dams be regarded – as part of the resource water entity or already extracted from it? Present practice (and the assumption in this chapter) is generally to regard it as part of the resource water entity, and to count extractions as water leaves a river or stream, whether regulated or unregulated.
- How should "re-use" dams on irrigation properties be treated? In rainless periods they capture only water from irrigation runoff and are truly storing water for re-use. However during rainfall events they commonly store runoff from rain, which is an inflow either from the resource water entity or to the irrigation water entity (see above). This is especially true if the dam has a natural catchment.
- How should urban drainage be treated? In contrast to irrigation drainage it is a surface water inflow, not a re-use, even though use of it is often referred to as "re-use." The portion of it captured and consumed by domestic or communal rainwater storage, or consumed in urban wetlands constructed to strip nutrients, should be accounted as a primary use, not a re-use.
- Treatment of re-use in the urban and industrial context. Water is typically diverted by the water agency and supplied to its customers. A portion of it is returned to the agency as sewage, is treated and may then be returned to a river (i.e. to the resource water entity) and then re-used, or passed on to a re-user such as an irrigator without being returned first to the resource water entity. Domestic re-use of "grey" water is re-use without returning the water to the urban water agency. Careful treatment in accounts is needed to ensure that the

distinction between primary use and re-use is made, and that re-use is recorded without double-counting.

- Is it reasonable to regard sewage water entirely as a return from customers to the water agency that receives and treats it? Any stormwater in it is actually an inflow.

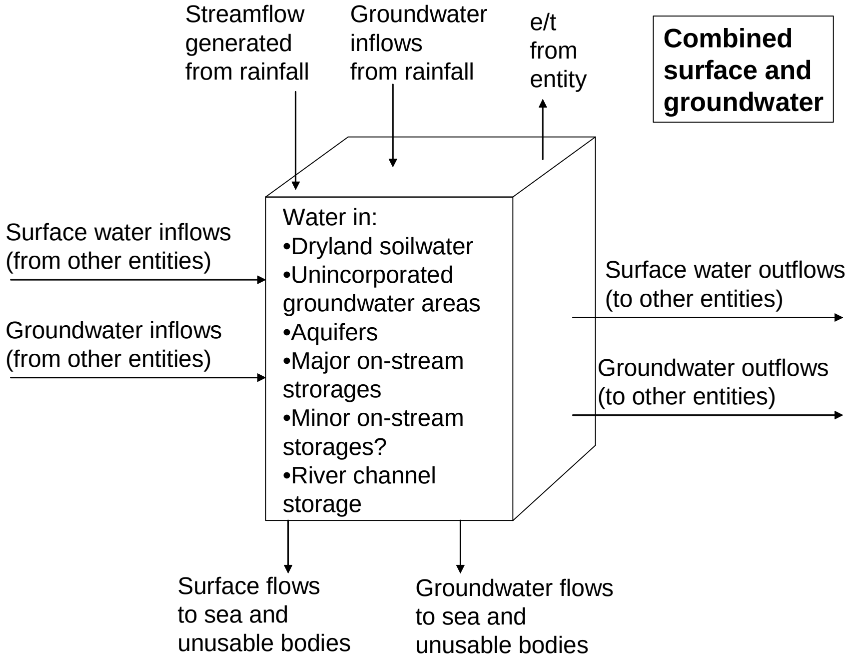
The physical reality in many of the above situations is complex, and simplifying assumptions and accounting treatment methods must be made in producing accounts. Such issues need to be dealt with through a standard development process to ensure that the benefits including from any simplifying assumptions are warranted.

In regulated river systems, it is also important to differentiate between allocatable water and other water to enable reconciliation of resource accounts with water allocation accounts. This is discussed in section 7.2.4.2.

Definitions need to be developed and agreed for the information elements to be used in water resource accounting, including the SEEAWR concepts such as water in the economy, for there to be consistency between the ABS water supply and use accounts and standard water resource accounting reports.

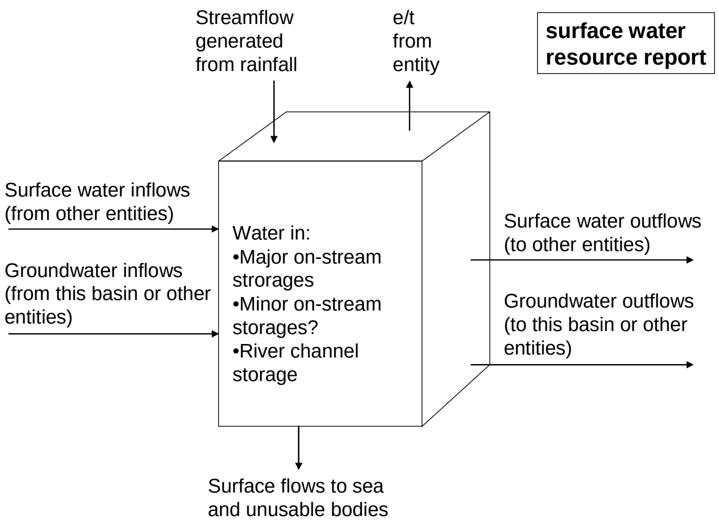
6.4.3 Modified water cycle reports

In principle, water resource reporting should aim to be for the combined surface and groundwater resources. That sort of report could be conceptualised as shown in Figure 24 below:



▪ **Figure 24 Modified water cycle reporting**

The simpler and more common form of water resource reporting, which separates surface and groundwater reporting, is referred to in this report as a "**surface water report**" typically applied to the water in the rivers of a particular basin. This can be conceptualised in Figure 25 as follows:



▪ **Figure 25 Surface water reporting**

In principle there is no difficulty in including all the information elements for the range of full water resource accounting in the accounting framework but recognising that in most parts of the country some of those information elements will remain unpopulated for a long time.

6.5 Reporting

6.5.1 Reporting obligations

Reporting obligations apply where external users have clear needs for information held by organisations, which they have no other way of obtaining except from those organisations. Given the outcomes desired under the NWI, and the existing demand for information it seems clear that organisations responsible for managing water resources should prepare reports to meet those requirements. Examples of such organisations are government departments such as NSW DNR, Qld NRM&W and Tasmania's DPIW.

Water service providers are generally not interested in water resource accounting though they are responsible for much of the measurement of water that makes it possible. They are generally interested in accounting for the use of the water that they extract from a river or aquifer; how much is "lost" by seepage, leakage, evaporation etc, and how much is delivered to customers and billed to them.

State Departments and State-wide storage management agencies have more interest in resource accounting. For example:

- NSW State Water produces "water balance tables" for regulated river systems as part of their annual operating report. Essentially these are "surface water reports" applied to the regulated waterways of the valley.
- The Victorian DSE produces an annual "State Water Report" which again is essentially a surface water balance for all the waterways in each river basin within the State. It includes reporting on groundwater use, separately from the surface water balance, but makes no attempt at a groundwater balance. It is understood that this year's report will contain a small section that contemplates how the report might be expanded to include some of the elements of a "water cycle report."

As was found in the stocktake, the information needed to assemble water resource reports is sparse outside of high priority management areas. Also many information elements needed for the full water cycle report are simply not available. The Australian Water Resource 2005 project will provide further insights in this regard

Obligations to prepare and publish standard reports should be addressed in the development of relevant water accounting standards and an obligation for water service providers to

provide annual surface water reports for delivery systems or to provide information to enable the production of such reports should be considered.

The stocktake demonstrated that there is currently no routine reporting of the whole terrestrial "water cycle". The general comment by urban and irrigation agencies was that they did not need it, they did not have the data necessary to define the required information elements, it would be expensive to produce, it would probably not be accurate enough to be meaningful, and if they were to be required to produce such reports they would expect to be funded to do so. These difficulties have been particularly evident through the Australian Water Resources Assessment 2005 project which is attempting to produce this type of report for 50 catchments across the nation. An example of a typical report is included in Figure 26. These reports are being prepared using data that has been provided by jurisdictional agencies which in many cases, as anticipated, has shown many information gaps. The areas where information gaps could be addressed are discussed specifically in Section 6.6.

Statewide agencies and Departments had more interest in water cycle type reporting, though there was still a strong element of questioning whether the benefits would exceed the costs.

However there are places where effort is already going into increasing knowledge of some elements that would be needed in water cycle reports. For example the CSIRO has quite a detailed understanding of surface / groundwater interaction in the Riverina part of the Murray Darling Basin, and groundwater managers are able to make such statements as "in this area there is almost no lateral movement of groundwater. It would be reasonable to assume that recharge comes only from irrigation water or rainfall on the surface above the aquifer and that discharge is only to the surface above the aquifer." However, care would need to be taken before proceeding with accounting development based on conceptual groundwater models

A pilot approach to develop full terrestrial water cycle accounting involving the need for estimates of broadscale evapotranspiration , could focus on areas where a clear purpose exists, such as to manage large scale tree plantations that are known to affect the water resource significantly.

File:WaterBalance_sheet_22_June_v2.xls, Sheet:Partial WaterCycleReport 1/08/2006

WATER CYCLE REPORT

		Surface Water (ML)	Groundwater (ML)	Total (ML)
Scope				
Period: 1 July 2004 to 30 June 2005				
Physical Water entity: Goulburn SWMA				
Jurisdiction Victoria				
Opening balance - water in store				
Major on-river reservoirs				
Eildon		672,500	-	672,500
Goulburn Weir		22,700	-	22,700
Sunday Ck		290	-	290
Onstream minor and farm dams (unknown - assume same at start and end of period)		57,200	-	57,200
Major off-river storages				0
Waranga Basin		205,445	-	205,445
Offstream minor and farm dams (assume zero as accounted for under catchment farm dam diversions)		0	-	0
Renewable non-saline groundwater (in GMUs) (< 3500 mg/l)		-2,819,568	0	-2,819,568
Renewable non-saline groundwater (outside GMUs) (< 3500 mg/l)		N/A	0	0
Renewable saline groundwater (assume zero)		N/A	0	0
Non-renewable groundwater (capable of being mined)		N/A	0	0
Soil - unsaturated zone		N/A	0	0
Snowpack (no snow)		0	-	0
River channels (assume zero - and same at start and end of period)		0	-	0
Total opening balance		-1,861,433	0	-1,861,433
Fate of Rainfall (not part of supply based water balance)				
Rainfall (sum of individual items = total entity rainfall)	16,007,000			
Rainfall to non-irrigated areas (forests, etc.)		14,028,000		14,028,000
Rainfall to irrigated areas		570,000		570,000
Rainfall to surface water runoff *(estimated, for example, as 25% of rainfall)*		3,180,000		3,180,000
Rainfall to groundwater recharge *(estimated, for example as 1% of total rainfall)*		0	229,000	229,000
Evapotranspiration				
Evapotranspiration from irrigated and non-irrigated areas (balancing item)		10,466,000		10,466,000
Inflow Surface Water				
Rainfall to surface water runoff (this is inflow in reservoirs, rivers, channels excl. baseflow)		2,367,700		
Discharge from Groundwater to Surface Water (e.g Gaining Streams)		N/A	-	0
Returns from economy inside entity (reuse of rainfall)				
Urban treated effluent		2460	-	2,460
Irrig drainage returns to Goulburn		0	-	0
Surface inflow from other entities (Broken Basin)		94,900	-	94,900
Returns from the economy outside of entity		0	-	0
Inflow Groundwater				
Rainfall to ground water recharge		-	229,000	229,000
Conveyance losses (seepage) (channels only)		-	115,200	115,200
Losing Streams		98,000		
Seepage from Surface water features (e.g dams, wetlands, etc)		N/A		
Inflow from aquifers outside of entity (small - assume zero)		0	0	0
Aquifer reinjection (e.g ASR, geothermal)		N/A		
Total inflow		2,563,060	344,200	2,907,260
Outflow Surface water				
Evapo-transpiration & interception from soil and aquifers				
From riverine wetlands	n/a	n/a	-	0
Extraction to the Economy inside entity				
Distributed water (excl. losses and unaccounted for water)				
Urban Diversions		27,890	-	27,890
Irrigation diversions		1,434,000	-	1,434,000
Self extracted water (irrigation, excl. losses)				
Catchment farm dams		45,000	-	45,000
Private diversions		34,600	-	34,600
Environmental extractions from Goulburn (consumed within Basin)		500	-	500
Subtotal extractions to economy from surface water	1,541,990			
System losses				
Evaporation from open water (major storages, rivers, channels)		66,400	-	66,400
Losses from catchment farm dams		9,700	-	9,700
Conveyance losses - Channels Only (seepage)		115,200		115,200
Seepage from Streams		n/a		
	191,300			
Surface flow out of entity				
Urban Diversions (to Yarra SWMA - Silver and Wallaby Creeks))		0	-	0
Irrigation diversions (to xxx SWMA)		0	-	0
Unregulated flow (floods)		452,400	-	452,400
Releases from dams to satisfy environmental commitments downstram of entity		0	-	0
Subtotal surface outflows	452,400			
	2,185,690			
Outflow Groundwater				
Discharge from GW to SW (baseflow)		-	0	0
GW discharge to Springs				
GW discharge to ET		8,581,740		
Extraction to the Economy inside entity				
Distributed water (excl. losses and unaccounted for water)				
Urban Diversions		n/a	0	0
Irrigation diversions		n/a	0	0
Self extracted water (e.g irrigation)				
Groundwater extractions		-	53,740	53,740
Stock and Domestic Use			3,366	
Subtotal extractions to economy from groundwater	57,106			
Aquifer flow out of entity		N/A		
Can be large if rainfall recharge is much bigger than extraction, assumed to be zero		-	0	0
Extraction to economy outside entity		0	0	0
Total outflow		10,768,330	57,106	10,825,436
Information on environmental flows (not part of water balance)				
Non-consumptive use discharged at entity outlet				
Releases from dams to satisfy environmental commitments downstram of entity	0			
As a result of meeting insteam environmental requirement within entity	n/a			
CHECK on WATER BALANCE				
Change in storage (inflows - outflows)		-8,205,270	287,094	-7,918,176
Change in Storage from ending storage - beginning storage		3,020,171	344,200	3,364,371
Unaccounted for Flow. Balancing item: (total inflows - total outflows) - (Ending - beginning storage))		11,225,441	57,106	11,282,547
Closing balance - water in store				
Major on-river reservoirs				
Eildon		940,080	-	940,080
Goulburn Weir		22,270	-	22,270
Sunday Ck		714	-	714
Onstream minor & farm dams		57,200	-	57,200
Major off-river storages				0
Waranga Basin		138,474	-	138,474
Offstream minor and farm dams (assume zero as accounted for under catchment farm dam diversions)		0	-	0
Renewable non-saline aquifers		-	344,200	344,200
Renewable non-saline groundwater outside GMUs		-	0	0
Renewable saline aquifers & groudwater (neglect - not part of water resource)		-	0	0
Non-renewable aquifers and groundwater (capable of being mined)		-	0	0
Soil - unsaturated zone		-	0	0
Snowpack (no snow)		0	-	0
River channels (neglect - assume same at start and end of year)		0	-	0
Total closing balance		1,158,738	344,200	1,502,938

- **Figure 26 National Water Resources Assessment 2005 example report**

6.5.2 Standard reports

A set of standard water resource reports was proposed in order to conduct the stocktake. These reports are intended to achieve the water resource accounting objective outlined above. Adoption of standard reports is designed to provide planners and the public with the information they need in a way they can understand and have confidence in.

The stocktake showed that many organisations are already preparing reports embodying many elements of the proposed standard reports. The proposed starting points for development of specific standards for these reports are discussed below.

6.5.2.1 Surface water reports

This report is simply a water balance report based on the equation:

Change in water stock = inflows – outflows

A template surface water report is shown in Figure 27. It can be applied to catchments, regulated river systems, delivery systems, drainage systems. Variations on the report are possible. One variation is shown in 7.2.6.2.1 where it is proposed that, where the water entity is a regulated river system, the allocatable stock be separated out within the report.

Template surface water report

Scope:

- Period: start and end
- Water entity
- Report preparer

Opening balance

Volume of water stock in:

- Reservoirs
- Off river storages
- River channels

Inflow

- Surface water inflow
- Inflow from aquifers
- Returns

Outflow

- Evaporation
- Surface water outflow
- Outflow to aquifers
- Extractions

Closing balance

Volume of water stock in:

- Reservoirs
- Off river storages
- River channels

- **Figure 27 Template surface water report**

6.5.2.2 Water cycle (water balance) resource reports

It will be difficult to move quickly to this form of reporting in any comprehensive way in the short to medium term, for the following reasons:

- difficulty in gathering data on almost all information elements associated with groundwater other than extractions by groundwater users
- differences, for good reason, between techniques for surface and groundwater management
- scepticism about benefits vs costs

However it should be possible to move forward by:

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- investigating data gathering techniques in depth (Remote sensing based application of the Surface Energy Balance ALgorithm for land or SEBAL for broadscale evapotranspiration techniques to better understand surface/groundwater interactions)
- pushing conjunctive surface /groundwater management, particularly in areas of known high connectivity
- concentrating initially on areas where there seems to be a practical need for full water cycle accounting; for example for managing the water resource implications of forest plantations, of for whole catchment planning.

A proposed template for this report is shown in Figure 28. Note that information elements cannot be considered final, as they will be effected by development of an agreed approach to information element definitions as part of a common chart of water accounts and including the concept of water in the economy (see section 6.4.2)   Inclusion of internal interchanges may be included to expose more information.

Template for Water Cycle Report

Scope:

- Period: start and end
- Water entity
- Report preparer

Opening stock,

Volume of water in:

- Surface water storages
  (major on-river reservoirs, farm dams, off-river storages, etc)
- Aquifers
  (Renewable and non-renewable, saline and non-saline)
- Soil (unsaturated zone)
- Snowpack
- River channels

Inflow

- Rainfall
- Surface inflow from adjoining physical entities
- Returns from the economy outside of the physical entity
- Inflow from aquifers outside of the physical entity

Internal Interchange

- Surface water to soil
- Surface water to streams
- Soil to aquifers (saline, non-saline)
- Aquifers (saline, non-saline) to surface water
- Extraction to economy inside the physical entity
- Returns from economy inside the physical entity

Outflow

- Evapo-transpiration
  (from soils & aquifers; from surface water & interception)
- Surface flow out of the physical entity
- Aquifer flow out of the physical entity
- Extraction to economy outside the physical entity

Closing stock

- (items as per opening stock)

Figure 28 Template Water Cycle Report

6.5.2.3 Groundwater resource reports

It was found in the stocktake that groundwater managers do not think in the same "water balance" terms that surface water managers do. Groundwater managers:

- think in terms of "sustainable yields;" based on a long term assessments and expressed as annual averages
- manage largely in terms of groundwater levels;
- recognise that lowering of groundwater levels may or may not (depending on the degree of connection between the aquifer and other aquifers or surface sources) increase the average annual recharge;
- are reluctant to talk in terms of the total volume in an aquifer, because most of it may be unusable or not make sense in water balance terms relative to the extraction
- are reluctant to talk even in terms of usable aquifer volumes, because using water heavily decreases levels, and may increase recharge and not reduce the sustainable yield;
- recognise that it is useful to distinguish between sustainable and unsustainable use (mining of groundwater), but do so by reference to yields rather than total volumes;
- are increasingly recognising the degree of inter-connection between surface water and groundwater, but reluctant to accept the simple statement that "an extra ML/year of sustainable groundwater use represents 1 ML/year less sustainable surface water use – it is just a matter of how long it takes to reach the new equilibrium" by arguing that (a) the extra groundwater use may come from a place where a reduction is OK, such as groundwater flow to the sea or to surface water where surplus is available or (b) it may be justifiable groundwater mining;
- nevertheless are increasingly considering the view that the above simple statement is useful as a precautionary principle, to be accepted unless one can demonstrate why it should not be, by focusing on the significance of the impact of connectivity.

Given the fact that groundwater stocks as accounting terms are generally considered to be not useful and not readily available, it is meaningless to attempt to do a water balance which aims to balance net inflows with change in stock. Also the stocktake confirmed that it is impossible to actually measure many of the parameters in the groundwater report that was proposed in Step 1. For these reasons it is not proposed to continue with the groundwater report as initially conceived.

On a long term basis, sustainably used aquifer systems are essentially systems where inflows equal outflows. When extraction of water commences from an aquifer, the head in the aquifer reduces until a new balance is reached by inflows (broad recharge, recharge from rivers, lateral inflows etc) increasing and/or outflows (outflows to rivers, wetlands, lateral outflows, etc) reducing. When decisions about sustainable extraction are made, it must be on the basis of some calculations/estimates/assumptions about how the new balance will be achieved. It should therefore be possible to populate a simplified water balance report with this information.

A modified groundwater report is proposed, which excludes stock and uses the best available estimates of the expected sustainable inflows and outflows. The production and publication of such a report would make it transparently clear to all where the water that is to be extracted is expected to come from.

It can be argued that production of such reports is more about water resource analysis and planning than water accounting. Nonetheless the need for such reports is apparent and it is therefore included for consideration as a potential starting point for the development of a groundwater accounting standard.

Template groundwater report

Scope:

- Date of assessment
- Water entity
- Report preparer
- Perspective (long term assessed behaviour in average annual terms)

Inflow

- Recharge from soil
- Recharge from rivers and lakes
- Recharge from economy
- Inflow from adjoining aquifers (lateral)
- Inflow from adjoining aquifers (vertical)

Outflow

- Evapo-transpiration
- Outflow to rivers and lakes
- Outflow to adjoining aquifers (lateral)
- Outflow to adjoining aquifers (vertical)
- Outflow to the ocean
- Sustainable extraction

▪ **Figure 29 Template groundwater report**

The Australian water Resource 2005 will provide relevant experience which may assist in the development of water accounting reporting standards.

The proposed surface water, groundwater and water cycle report templates are provided as starting points for consideration in development of water accounting reporting standards

6.5.3 Water entities for reporting

A set of water entities for reporting water resource information were defined as part of the Australian Water Resources Assessment 2000. These entities included SWMA's, GMU's and catchment boundaries and were used with the aim of becoming standard entities for water accounting purposes. These definitions along with the Australian Water Resources Assessment 2005 experience may help provide a starting point for the development of a chart of water accounts.

In addition, delivery systems and drainage systems can also be used for resource reporting.

Water entities are fundamental to a chart of water accounts and reporting and need to be well defined and agreed.

6.5.4 Report periods

It was found in the stocktake that most organisations preparing surface water (water balance) reports do so on a financial year basis in annual reports and reports required by regulators. While water years did vary, they generally fitted within the financial year.

However where the main report elements are long term estimates (eg for groundwater), then the reports should be prepared as often as those estimates are reviewed.

Making reports available on a financial year basis is a logical standard except for cases where most of the information is long term estimates, in which case the reports should be prepared each time the estimates are reviewed.

6.6 Measurement

6.6.1 Standards and methods

It is sometimes said that water accounting differs from financial accounting because all measurements of water are estimates. It is true that almost all measurements of water are estimates or indirect measurements, but so are many things that appear in financial accounts. Examples of this include goodwill of a business, depreciation, and market value of assets.

Almost all measurement of water is inferential. What is really being measured is a level, a number of rotations of a meter, the change in frequency of an electromagnetic wave etc. An information element such as a water volume or a flow rate is then assembled or estimated from those measurements.

It is possible to have a good water accounting system that includes items for which the volumes or flows reported are known to be estimates, even rough estimates. However the system should show in some way the likely accuracy of the estimate, and there is no point in producing accounts where the estimates are so poor that the accounts lack meaning.

Measurement of water is expensive. Technological improvements can be expected to lead to better results for the same cost or equal results for less cost, but it is unclear whether this is really being achieved as yet.

Australian Standards already exist for open channel flow measurement which addresses many types of river flow measurement as well as some types of flow measurement in artificial channels. There are also some Australian Standards for metering of potable water supply and standards for metering non-urban water supply are now being developed by the National Measurement Institute and Standards Australia. These are essentially technical standards addressing such things as the types, configuration, calibration and maintenance of fixed installations and instrumentation and the methods to be employed in measuring and deriving information.

There are, however, many significant gaps in these standards. Additionally, many of the existing standards have not been reviewed for many years and do not reflect improvements in knowledge and technology. While the urban water supply industry is currently actively supporting development of new standards for potable water supply metering through the Standards Australia framework, it appears that processes for review and development of standards for open channel flow has been dormant for many years. Several organisations reported an inability to support such processes in any case due to resourcing constraints.

The Standards Australia framework provides a useful process for development and review of technical standards for the measurement and recording of water levels and flows in rivers, artificial channels, pipes and water levels in bores.

6.6.2 Resolving 'balancing items' in reports

Extractions, flows in waterways, storage volumes and storage evaporation are relatively well estimated. However interactions between streamflow and groundwater, evaporation from stream surfaces, and flows into and out of riverine wetlands are difficult to measure . They are usually bundled, together with residual measurement errors, into a balancing item called "river losses" or something similar. These would seem to be the areas to work on in improving the surface water balance form of resource accounts.

It is possible to study the interaction between water in streams and groundwater by low flow analysis, but this technique is difficult to apply on regulated streams.

It is relatively straightforward to estimate evaporation from river surfaces.

It is possible to estimate evapotranspiration from large wetlands by using techniques such as SEBAL.

If all these techniques can be utilised, it should be possible to replace the ubiquitous balancing "river losses" in surface water accounts with estimates for each component plus an item for "unaccounted gains / losses" If component cannot be estimated with an acceptable level of confidence, it would have to be left in the balancing item. However the aim would be to reduce the balancing item as much as possible.

Targeted efforts need to be made and ultimately reflected in water accounting standards if the balancing items in surface water reports are to be further broken down.

6.6.3 Information elements in surface water resource accounts

In Step 1 of this project a set of definitions for water information elements and report entities were identified. These were tested during the stocktake, and in consequence some revisions were made.

The tables of information elements and definitions in Appendix B provide a starting point for the development of a common chart of water accounts.

Many of the information elements are relevant to both a surface water resource report and a combined surface and groundwater resource report. The following elements need to be derived or assembled either through direct measurement or estimation to prepare both the surface water accounts and water cycle accounts. In most cases the conclusions for this section are specific to the measurement and/or assembly of an information element.

6.6.3.1 Volumes in large storages

Storage volumes are obtained by reading storage levels and applying a table relating the level to a volume in store. They are very accurate for major constructed storages and are regularly reported through web sites. Consistency in the presentation of this information was variable and would benefit from development of guidelines for accounting treatment.

Estimates of volumes temporarily stored in riverine wetlands may be very rough. There are currently no agreed approaches to defining the degree of accuracy of volume estimates nor for the preferred intervals for reporting.

Development of guidelines for the water accounting treatment of information elements relating to the storage of water in dams will assist in in standardising water accounting practices across the nation

6.6.3.2 Volumes in small storages

These are much more difficult to measure with reasonable economy of effort. Some jurisdictions have estimates of farm dam capacities (as distinct from the water they hold), and attempts have been made to develop rapid estimation methods.

A range of techniques have been used and are being developed for using landsat imagery, in combination with other spatial information to capture information on such things as farm dams, evapotranspiration, crop areas etc. Various different approaches have been used, and research into improved methods continues both in Australia and overseas. These techniques offer considerable promise for plugging an important gap in water information, particularly with regard to monitoring and assessing the impact of land use change and farm dam development on runoff and aquifer recharge. Initially there is unlikely to be a need for detailed guidelines in this area other than to describe the treatment of this information element within accounts.

Targeted development and testing of techniques for broadscale assessment of evaporation, evapotranspiration, farm dam development and crop areas have potential to improve the range and quality of water resource accounting information elements.

6.6.3.3 Evaporation from storages and stream surfaces

Some large storages have associated evaporimeters, and evaporation from the storage may be estimated using the evaporimeter and a pan factor. In other locations, Bureau of Meteorology evaporimeters can be used for the same purpose.

Alternatively, if inflows and releases are well known, evaporation (really evaporation plus seepage and leakage) can be estimated from a water balance.

It would be possible to estimate evaporation from stream surface in the same way that storage evaporation is estimated, but it is rarely considered worthwhile. It is usually rolled into a balancing item.

Development of formal guidelines for water accounting treatment for estimation of evaporation from large storages would assist in standardising water accounting practices across the nation

6.6.3.4 Evapotranspiration from riverine wetlands

This information element is rarely estimated, and usually shows up as an increase in “river losses” when above-channel capacity river flows spill into wetlands.

Initially it would be useful to develop a guideline on how similar “river losses” should be treated in accounts.

Further development of techniques for measuring such evaporation would be developed in the medium term as part of the evolution of such a standard.

6.6.3.5 Surface water flows

There are hydrographic stations at selected locations in major catchments, which measure a large part of natural inflows with reasonable accuracy. Hydrographic and hydrologic techniques are commonly used to extend this information to the whole catchment. The degree of rigour used to derive these estimates is often dependent on the experience of the practitioner undertaking the work and the constraints such as time and budget that influence this work. In any case, although the information derived may be regularly reported, it is generally not systematically recorded in a water accounting system (chart of water accounts). Alternatively, inflows to a storage can be estimated from outflows and changes in storage volume.

Development of standards for water accounting treatment of inflow estimation, which address issues such as methods for data estimation, methods for tagging of information to define data quality and methods for recording information, will assist the in the standardisation of water accounting practices. Experience from within jurisdictions such as NSW can help provide a useful starting point.

6.6.3.6 Extractions from waterways and flows in waterways

A wide variety of measurement methods are used, including propeller meters and other meters for flow in pipes, rated structures (free overfall or drowned), ultrasonic and similar methods in open channels, and hydrographic ratings of constructed or natural controls in rivers.

Often there are two or more versions of the same item of data, and an accounting system needs to be clear about which version of the data it is using. For example releases from a storage for a day may be estimated for operational purposes by setting the level at the tailgauge at say 8 am and assuming that the flow corresponding to that level applies for the full 24 hour period. The daily volume may later be refined by integrating the readings from a continuous recorder. That volume may in turn be revised months later by a hydrographic decision to revise the rating curve at the tailgauge.

Development of water accounting information systems will need to address the issue of data handling and the transferring of operational data such as flows and extractions to a water account. The experience of jurisdictions such as NSW where protocols are in place could be used as a useful starting point.

The stocktake also identified potential deficiencies in the quality of data. This arises due to the fact that meters are generally not used to measure data and the methods, whilst being potentially inaccurate, are generally not tagged to the data. Accuracy of flow measurements ranges from a claimed 1-2% or better (often by those responsible for present measurement) to claimed errors of 15% or more (often by those promoting a different measurement method.).

Development of guidelines for consistent bulk water measurement and subsequent quality processing and recording of any measured or inferred data will assist in consistent presentation of information.

6.6.3.7 Flows to the sea (or out of a particular water entity)

These should be reasonably straightforward as they are just river flows. Similar standards and guidelines would address treatment of this information element in water accounts.

6.6.3.8 Flows to unusable water bodies

Where these are flows to surface water bodies such as unusably saline lakes, they should be easy to measure. Where they are seepage to unusably saline or polluted aquifers as distinct from usable ones, there may be difficulty.

This item picks up the proposed distinction between usable and unusable water bodies. The idea is that each water body will be deemed to be either “fit for purpose” or polluted to the extent that it is no longer regarded as a potential water source. It is recognised that this is simplistic, but the intent is to develop a water quantity accounting system avoiding, at least for now, the huge complexities of a system that formally accounts both for water quantity and quality. This could be avoided by including in an agreed chart of account some additional aspect which were not included in the information requirements framework adopted for the stocktake. Such categories could include sewerage or wastewater treated for recycling could be tagged to its quality classification.

Provision for more detailed classifications such as stormwater, wastewater, irrigation runoff and recycled water should be considered in the starting point for a chart of accounts.

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6.6.3.9 Movements between aquifers and surface water

This is often ignored and rolled into a balancing item in surface water accounts. In some locations (eg the Ovens valley in Victoria) there is a general recognition that surface / groundwater links are very strong, and that huge increases in apparent river losses in drought years are really transfers to groundwater that are then extracted by groundwater licensees. Current methods of managing this issue are generally crude. In some areas there is a general appreciation of which river reaches are "gaining" reaches (ie gain inflows from groundwater) and which are "losing" reaches (ie lose outflows to groundwater) and how a reach may change status from season to season.

Development of a standard is a high priority although it may initially only address the treatment of this element in the account (ie how it should be treated as a balancing item or included in another information element). The evolution of this standard would include significant technical input including detailed modelling to better understand where the priorities lie.

The chart of water accounts should be developed with sufficient scope to allow appropriate recording of surface water- groundwater interaction as practitioners develop further scientific methods of estimating interactions.

A targeted approach to further development of technical development of any related standards is required.

6.6.4 Additional information elements in full water cycle accounts

If we expand water resource reporting from the "surface water balance" type of report to the "water cycle" type of report, the measuring difficulties change and the following information elements need to be measured or estimated to prepare these accounts.

6.6.4.1 Rainfall

It will be necessary to know the total volume of rain (and other precipitation such as snow, hail and dew) that falls on the physical water entity. It may also be necessary to separate out the portion that fell on irrigation areas and (possibly) the portion that fell on dryland agricultural areas from the portion that fell on other areas.

This would appear tedious but not difficult to do. The Bureau of Meteorology maintains records at thousands of rainfall stations around the country, and techniques are available to convert the depth of rain at these stations to a volume over a defined area.

Development of water accounting guidelines for methods of rainfall volume estimation and recording would assist in standardising practice

It will also be necessary to separate rainfall in each geographic area into:

- The portion that simply evaporates from vegetation and the ground surface. Its volume is likely to be large. It is part of evapotranspiration;
- The portion that runs off, notionally without passing first to soil moisture. It is an inflow item in a surface water balance, and is already estimated in most cases;
- The portion that becomes soil water, from where it might seep back to become surface runoff or seep down to recharge an aquifer. However most of it (virtually all in semi-arid cropping and grazing areas) is eventually evapotranspired by pasture or a crop.

6.6.4.2 Soil water

This is likely to be huge, difficult to measure and complex to account for. It is also extremely important in many areas. For example is semi-arid cropping areas almost all the rainfall is stored as soil moisture and the evapo-transpired by crops without ever reaching a surface stream or an aquifer.

6.6.4.3 Evapotranspiration

This is all the water that is evaporated or transpired from the water entity. Most current water cycle reports do not adequately address this component, although it is a significant volume of water in the overall water cycle.

As with rainfall it will probably be necessary to separate it into two or three geographic portions. The volumes will be huge. They can potentially be estimated over large areas by a remote sensing technique known as SEBAL (Surface Energy BAlance for Land). This essentially estimates evapotranspiration by thermal sensing from satellites, and is said to be capable of producing results accurate within 10 -15%.

The development of guidelines to examine potential techniques for estimating evapotranspiration data and subsequently recording these data into evapotranspiration accounts is a high priority for providing better water cycle accounts.

6.6.4.4 Groundwater extractions

This is simple in concept but not necessarily in practice. A lot of groundwater extraction, particularly for domestic and stock water and in areas outside groundwater management areas, is unmetered. Resources required to meter all groundwater extractions are expensive and resources are limited which restrict coverage of metering. To enable this information element to be fully detailed, some form of estimation would need to be devised and/or management effort would need to be increased.

This information element is also important for groundwater accounting reports and is considered a high priority with respect to meeting the NWI requirements

Establishment and appropriate resourcing of a priority groundwater extraction metering program will assist water organisations to make significant gains in track groundwater extractions, and where extractions are not metered, development of guidelines for estimation of groundwater extraction need to be developed and applied to maintain consistency.

6.6.4.5 Returns to aquifers

This is water returned to aquifers by water users, either as seepage (via soil moisture) from irrigators and other water users or by deliberate injection by water users (for example where groundwater is extracted for heating purposes, regulating agencies may require it to be re-injected to avoid reducing groundwater levels.) It would be difficult to estimate – even if estimates of total recharge are available they would have to be separated into new recharge (from rainfall or lateral movement from other aquifers) and returned recharge.

6.6.4.6 Groundwater flow to sea

Some estimates may be available from closely managed areas, but comprehensive estimates are likely to be difficult. Water may be deliberately returned to under-sea aquifers; for example to replace extracted oil or gas or to prevent sea water intrusion. This is not really an outflow to the sea.

6.6.4.7 Groundwater interactions with other groundwater entities

This is difficult to estimate, but groundwater modellers do make these estimates. They are probably only meaningful in terms of annual averages

6.6.4.8 Groundwater flow to unusable water bodies

This would include both seepage to saline or polluted surface lakes and groundwater movement from a "usable" aquifer to an "unusable" one. It is likely to be difficult to estimate.

In addition to the above elements, there are some that are "internal transactions" to the water cycle report, but may nevertheless be needed to present a clear picture of interaction of parts of the water cycle. These include:

- movement between soil water and surface water (by seepage);
- movement between soil water and aquifers (by seepage to aquifers or by movement back to soil moisture induced by evapotranspiration from soil water);
- movement between aquifers and surface water (already discussed)

6.7 Recording water resource information

Water resource accounting will require the recording of a significant number of physical water information elements. Whilst some of these are directly measured and stored in dedicated databases, the stocktake findings demonstrated that many are either estimated, often using sophisticated models, or are unknown. As discussed in Section 5.9, water information systems exist and store some easily measured water information elements.

Whilst standards can be developed on how to treat water information or even the lack thereof in water accounts, the potential gaps in data and the ad-hoc storage of such information have significant implications for the development of water accounting information systems.

The Australian Water Resources Assessment 2005 project is currently assembling water reports using the water information elements developed during this project, for identified priority water entities across the country. As with such processes in the past, the information is being assembled by jurisdictions in an ad-hoc manner requiring a large amount of manual data extraction and processing.

Given the desire to be able to repeatedly gather, record and report such information in the future, an opportunity exists to adopt a more formalised accounting process.

Consistent with the stocktake findings, there are a number of information store types and a number of organisational information store configurations that could be either incorporated into or be modified to become an integrated water accounting information system.

The most common forms of assembling information elements does not record the results of a calculation in a systematic fashion. Often assemblers of the information have access to sufficient descriptors and knowledge about the data from the data stores to know everything about the information element that they need. They are in effect using a chart of water accounts perhaps without consciously knowing. However, this knowledge is often only with the individual not linked to the information element produced in a report and capability to consistently repeat the assembly process can easily be lost with personnel departures from organisations.

An integrated water accounting information system which could automate assembly of information elements would need to have the following design characteristics:

- a common chart of water accounts (as discussed in Section 5.8), incorporating a register of all the water entities.
- a full description of water entities and where details of water entity boundaries can be easily accessed and amended as necessary.
- transactionally based system with agreed frequencies for recording transactions.

- information element tagging according to quality and method of measurement and assembly.
- information system standards for aspects such as data management and interchange, access protocols and security.
- Standard reporting capability.

6.7.1 Starting points for standardisation

The development of a water accounting information system or the modification of existing water information systems to include water resource accounting functionality is likely to be complex and extremely costly. Development is more likely to be successful if a narrow focus is taken and additional functionality is integrated if and when it has been proven.

Development of a demonstration water resource accounting system, designed using a nationally agreed chart of water accounts, initially for several targeted water entities and with ability to expand in both scope of information and water entities would be a useful method of demonstrating the benefits.

Many small water service providers had a variety of ad-hoc systems, mostly excel sheets, for assembling and recording information for annual reports. The information is generally pulled together from operational data systems (eg SCADA platforms), time series data stores (eg HYDSYS), paper records and reports at the time that the reports need to be prepared.

The stocktake findings demonstrated that whilst the accounting principles that would improve the consistency of information within water information systems were recognised as being useful, there was little understanding of how these could be usefully applied to existing water information systems. Despite this, a number of stocktake examples of where small Microsoft Access databases had been custom developed to draw water information together to report key business performance indicators (both customer and resource based) demonstrated that adoption of water accounting principles is beneficial.

Development of a demonstration water accounting system for smaller retail water organisations, based on a accounting principles described in Section 5.9 and including a national a chart of water accounts would be useful to demonstrate the merits of recording water accounting information, other than for customer account keeping purposes, in a dedicated water accounting information system.

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6.7.2 Quality labelling

Much of the information which might be presented in water accounting reports varies substantially in accuracy/reliability, depending on the raw data available and the estimation or modelling methods used to derive the information from the raw data. Although data stores such as Hydsys incorporate quality labelling for the raw data, many of the data processing systems and reports observed in the stocktake made no attempt to label information in relation to its accuracy or reliability.

Best practice in quality labelling was observed in the Australian Water Resources Assessment 2000. Many information elements in the summary tables were accompanied by a ‘reliability class’ of A, B, C or D. For each situation the meaning of the reliability class was defined, generally as a textual description of the methods used to derive the information.

While these reliability class labels could only be considered as indicative, they do inform the reader in a straightforward and understandable way about how good the information is.

A number of aspects would need to be considered when labelling information elements including the adequacy of modelling or estimation techniques and time and scale dimensions. The development of such a classification system will need to be specific to each information element and should be included in the development of a standard as discussed in Section 5.6. This is not a trivial issue, and would have many challenges

Development of common information reliability labels relating to estimation method and circumstance for all information elements in water resource accounts, including objective criteria and error estimates where possible will assist users to understand the reliability of information being reported.

6.7.3 Quality assurance

In undertaking the stocktake it was apparent that only a few organisations have in place formal quality assurance systems for water level and flow measurement and recording. Such systems require documented standards, procedures and management systems to be in place which are intended to ensure consistent quality of information and continuous improvement. Formal quality systems accreditation enforces this by requiring the organisation to submit to annual audits to verify compliance.

Quality systems accreditation of organisations is not necessarily sufficient however. It is essential that the standards and procedures which the accreditation tests are best practice for water level and flow measurement and recording.

Implementation of accredited quality systems for best practice standards and procedures for measurement and recording of water levels and flows in rivers, artificial channels, pipes and water levels in bores is to be encouraged and becoming mandatory may be considered in the future.

The quality assurance associated with the assembly and recording of water resource information elements should be dealt with in relevant standards for the accounting treatment of those information elements.

7 Analysis of water market accounting

The theme of water market accounting includes aspects of water access entitlements accounting, water allocation accounting and trading of these market instruments. Analysis of water access entitlement accounting and water allocation accounting are addressed separately in this chapter.

7.1 Water access entitlements

7.1.1 Description and scope of theme

This theme relates to the identifying, recording and reporting of information regarding water access entitlements including trade in those entitlements. Information on water access entitlements is recorded in registers of those entitlements. Specifications for the information to be recorded in those registers, the recording of transactions, and access to information in those registers have already been addressed in the separate paper *Compatibility of Water Registers* (NWC, Sept. 2005) and no attempt will be made to duplicate that material here. It is assumed that registers of water access entitlements will move to meet these specifications where they do not currently do so.

This section expands on these specifications where necessary to facilitate water accounting outcomes.

It is of note that there are a variety of entitlements to water which are not strictly water access entitlements according to the NWI definition. Examples include state administered water licences which are not separated from land, and entitlements to water within irrigation companies in NSW and WA, and in trusts in SA. These entitlements have many of the characteristics of water access entitlements and should be treated the same in accounts as far as possible.

Water entitlements which do not strictly meet the definition of a water access entitlement under the NWI should be included within the scope of water accounting and treated in the same manner for water accounting purposes as water access entitlements to the extent possible.

7.1.2 Objective

The desired water accounting outcomes relating to water access entitlements are:

- To provide public accountability for entitlements issued
- To give water users and investors confidence
- To provide information on trade for planning and investors
- To inform water resource review and planning processes, ensure transparency of these processes.
- To support public and investor confidence in the trade of water access entitlements

Consistent with these outcomes, the following objective for water access entitlement accounting is proposed:

The objective of water access entitlement accounting is to provide relevant and reliable public information regarding the number and size of water access entitlements, and how they are changed and traded over time, to inform investors and planners and generate public and investor confidence in the issue and management of those entitlements.

7.1.3 Current drivers

The stocktake demonstrated that compliance with the NWI and meeting customer information needs and expectations is already driving change in this area.

- Robust registers are already in place in NSW and Queensland using existing land title registry systems and procedures. A similar arrangement is planned for Victoria. South Australia and Tasmania also have substantive registers of water entitlements.
- Reports in various forms are being prepared and published showing summary information about entitlements and entitlement trading to meet public demands for information access

7.1.4 Concepts and definitions

7.1.4.1 Nature of water access entitlements

Under the NWI water access entitlements are defined 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

Where

> ***consumptive pool*** *means the amount of water resource that can be made available for consumptive use in a given water system under the rules of the relevant water plan.*
>
> ***consumptive use*** *means use of water for private benefit consumptive purposes including irrigation, industry, urban and stock and domestic use*

It is of interest that the definition of consumptive use excludes consumptive use by the environment. By definition, any water provided for the environment through water plans to meet environmental outcomes, including that provide on a volumetric basis through entitlements, is not included in the consumptive pool. In practice, however, it is sensible to account for environmental (water access) entitlements in the same way as consumptive water access entitlements.

For example, in practice the environment has significant volumes of consumptive entitlement in the regulated Murray-Darling Basin. The 27.6 GL Flora and Fauna entitlement on the Murray in

Victoria is a consumptive (or extractive) right that receives allocations exactly in line with irrigation Water Rights. It is for accounting purposes exactly the same as a Water Right

The key issue here is defining what is meant by *a share of water from a specified consumptive pool*. The stocktake found that water access entitlement 'shares' are most commonly expressed as volumes. Uniquely in Australia, NSW has chosen to express most water access entitlements (regulated, unregulated or groundwater) as unit shares rather than as a volume. However in all States a water access entitlement is in reality a share of a specified resource, usually with a volumetric annual maximum.

Water access entitlements are in fact bundles of several different types of rights. For example, a water access entitlement on a **regulated (supplemented) river system** may simply be expressed as a volume in megalitres, but in fact this volume represents a combination of several rights:

- A maximum volume that may be extracted over a period (typically a year)
- The right to a share of the inflows to the system
- The right to a share of the system storage
- The right to have stored water released and delivered to a point on the river and/or to a point within a channel or pipe delivery system

In some cases these rights are more explicitly enunciated, eg the St George River system in Queensland, which operates on a full capacity sharing arrangement which sets out each entitlement holders right to a volume of storage and a share of inflows explicitly, and separate delivery contracts with the service provider are required. For others they are hidden, eg. the River Murray system, where rights to a share of storage and inflows are implicitly reflected in the annual allocation announcements, and rights to have water delivered are also implicit with holding the entitlement.

This combination of rights to a share of inflows and the capacity to store those flows must then constitute the 'consumptive pool' for the purposes of the NWI definition. It can be seen though that this simple 'consumptive pool' concept becomes more difficult to apply when the rights are separated.

For water entitlements on **unregulated (unsupplemented) river systems**, the entitlement is still often expressed in megalitres. However in this case there are no storage rights or delivery rights, and (with a few exceptions) there are no rights to a share of actual inflows. All that remains is a maximum volume that may be extracted over a period (subject to any conditions limiting the timing and rate of that extraction that are applied).

It is not at all apparent whether these unregulated river entitlements are water access entitlements consistent with the NWI. Whether having a maximum volume that can be extracted over a period constitutes a share of a consumptive pool is questionable. However, the interpretation that maximum extraction be considered as a defined consumptive pool can be recognised, given the intent in the consumptive pool definition through the reference “under the rules of the relevant water plan”.

NSW is the only jurisdiction that has consciously attempted to apply the consumptive pool approach to unregulated river entitlements. They have done this by calling the *maximum* water that can be extracted under the sum of those entitlements in an area the ‘available water’ (this is the NSW legislative term equivalent to consumptive pool). The entitlements are expressed as unit shares and annual ‘available water determinations’ are made granting the entitlements one megalitre of maximum-volume-that-can-be-extracted per unit share. Plans allow these annual determinations to grant less than one megalitre per unit share should actual extraction over multiple years exceed target volumes. The consumptive pool is thus water that may or may not actually appear, which is quite different to regulated rivers where the consumptive pool relates to actual inflows and water stored.

For water entitlements relating to **groundwater systems**, again the entitlement is commonly expressed in megalitres. In most instances this is simply a right to take up to a maximum volume per year. In only some cases are groundwater water access entitlements specified in terms of a right to a share of the ‘sustainable yield’ of the aquifer system which may vary over time (eg the NSW groundwater sharing plans provide for the groundwater entitlements to be expressed as unit shares). Where this is done the sustainable yield (or a defined part of it) is the ‘consumptive pool’. This is again quite a different thing to the consumptive pools for regulated river systems, but can be recognised as a suitable definition to apply.

An unfortunate side affect of the common practice of expressing entitlements of different types in different areas in megalitres is that it is often interpreted as a reliable right to take that volume every year, which is rarely the case. The average water extracted under these entitlements varies substantially from area to area. The common practice of publishing total entitlement volumes on a management area basis, under a heading which implies that this is the water that could be extracted, gives a false impression. This is made worse when the entitlement volumes across several different management areas and entitlement reliabilities are summed. Again, it needs to be recognised that the intent of water access entitlements is to specify the share of the water resource and that the primary place where this is to be recorded is in water access entitlement registers. What is then available each year, and what is extracted against this availability, should be recorded primarily in water allocation accounts.

Considering then that the rights embedded in water access entitlements are in fact many faceted and varied, it is clear that reporting these rights should represent these differences and not assume or infer consistency when this is not the case.

Also it is apparent that there is an increasing tendency to further unbundle these rights. For example Queensland in their capacity sharing model have partially unbundled the right to extract a maximum amount of water from the other rights by allowing it to be traded independent of the water access entitlement on a seasonal basis. Where full unbundling of these rights occurs it would necessitate that the reports, as per the proposed templates below, be expanded to include separate reporting of each of these rights.

7.1.5 Water systems

According to the NWI definition water access entitlements are a share in a *consumptive pool* in a given *water system*. *Water systems* must therefore be a set of waters (surface or groundwater) which are strongly hydrologically connected and are managed as a unit, so that a defined *consumptive pool* can exist. Regulated river systems such as the St George or the Namoi can be called water systems. In a number of locations a defined aquifer system or the surface water in a specified catchment has also been considered to be a *water system* with a *consumptive pool*.

Given that water access entitlements have shares in the consumptive pools in water systems, it is evident that each water access entitlement must specify both the quantum of the share and the *water system* to which the share relates.

7.1.5.1 Water Trade

In the past transactions called transfers (permanent or temporary) were synonymous with water trade. These transactions were effected by reducing a licence attached to one piece of land and increasing a licence attached to another, either permanently or for a fixed term (usually a year). Frequently money changed hands but not always, as the same person sometimes owned both pieces of land and was simply moving their water rights around.

With the separation of water access entitlements from land, there is considerable confusion about what constitutes a trade. Change of ownership and change of location are now separate transactions. For example, a water access entitlement can now be sold to another person, without any change in location. Registers record this as a transfer of ownership. It is a permanent transaction, but is not the same as ‘permanent transfers’ of the past.

In the information requirements it was proposed to define water access entitlement ‘trade’ more broadly as a change in owner of the water access entitlement and/or a change in location of the water access entitlement. However participants in the stocktake who were able to understand the concept had difficulty with understanding why such a definition of water access entitlement trade would be useful. Further consideration of the objectives of reporting on water trade information was needed.

There are essentially two groups of people interested in information about sales and movements of water entitlements. The first is actual or potential buyers and sellers of those entitlements. This includes lenders such as banks who need to know the sale potential of the entitlement when they provide loans which use the entitlement as security. What these people need to know is, for a particular area, how many entitlements are bought and sold (market depth), and what price they are being sold for. In the past many sales have not been part of these statistics because the sale of water and land together was not considered to be a water transfer. On the other hand transfers which occur as a result of legal actions such as divorce proceedings or execution of wills (*transmissions*) are not market activities and should be excluded.

The second group are planners, local government, social and economic researchers and infrastructure service providers. They are more concerned with movements in the location of water entitlements in order to monitor and manage actual or potential impacts on resources, other water users, delivery infrastructure and regional economies.

In the past there has been a perception that water transfer statistics are a measure of movements of water entitlements to higher value purposes. In fact that is only partly the case. Many permanent transfers in the past have been to bolster existing entitlements affected by either long term reductions or short term water shortages. While this is economically beneficial, it should not be misinterpreted to mean a change in the purpose of water use. Similarly many sales of land and water together have not resulted in any change in the purposes for which water is used. In the end it is only the direct gathering of information on how water is being used (see the water use accounting theme in Section 9) which will demonstrate whether water trading (in combination with a range of other policies, incentives and regulatory settings) is effective in achieving the desired economic benefits.

It is concluded that, to overcome confusion about what a trade of a water access entitlement is water access entitlement transactions should be defined using a unique terminology. The following definitions of water access entitlement transactions, which avoid the use of but qualify what is commonly referred to as “trade”, are proposed.

The following definitions for water access entitlement transactions provide unique terminology for transactions of different characteristics:

- A transfer is a change of ownership (regardless of whether or not location is changed) of which;
  - A transmission is a transfer by action of law (eg execution of will, court order)
  - An acquisition is any transfer which is not a transmission; and

- A movement is a change in the parameters which link the entitlement to a particular location or area.

The movements as defined can track changes in locations to which water access entitlements (as distinct from water allocations against the water access entitlement) are linked.

It is noted that a transfer and a movement can happen essentially at the same time but in accordance with the above definitions are separate transactions.

7.1.6 Reporting

The *Compatibility of Water Registers* paper provides for certain types of information to be made available for conveyancing purposes. It also specifies that both detailed and summarised (excluding personal details) are to be made publicly available, though no formats for this information are provided.

It is proposed to expand on this by specifying standard types of reports which should be prepared and provided to meet the water access entitlement accounting objective.

7.1.6.1 Reporting obligations

Each organisation with a responsibility for administering a register of water access entitlements meets the criteria for a report preparer. That is, they have responsibility for the management of the information and there exists information users who have a need for the information but are unable to command it themselves. Therefore it is proposed that these preparers be obliged to prepare and publish the standard reports set out below. (Note that these are in addition to the obligation to produce individual searches and certificates for conveyance purposes.)

The obligations of organisations responsible for administering a register of water access entitlements to prepare and make available standard water access entitlement reports will need to be addressed in relevant water accounting standards.

7.1.6.2 Standard reports

Two standard report templates relating to water access entitlements were proposed in the water accounting information requirements framework. These were:

1. Water access entitlement report.
   Sets out the types and quantity of share units held under water access entitlements, and the increases and decreases in them, for a designated physical water entity for a designated period.

2. Water access entitlement trade report.
   Quantifies trading activity in water access entitlements for a designated water entity and report preparer over a designated period.

The stocktake demonstrated that no organisations are currently preparing reports of this type. However those organisations managing registers of NWI consistent water access entitlements indicated that they believed that they could do so. It was also noted that some organisations are already publishing many of the elements of these reports to meet growing public demand or statutory requirements.

In consideration of the discussion on defining water trade in section 7.1.5.1 it is proposed to replace these with two reports which distinguish between transfers and movements and also address the need to incorporate 'tagged trade'. ('Tagged trade' is the name given to the system where water access entitlements can be used to take water in a different water system or state to the one to which they relate.)

The first proposed report is the Water Access Entitlement Source Report. It shows the quantity of entitlement shares in a source, regardless of destination location to which the entitlement is linked (tagged). It includes statistics on transfers – broken into acquisitions and transmissions.

The second report is the Water Access Entitlement Destination Report. It shows the quantity of entitlement shares from all sources linked to a physical water entity. Movement of water access entitlement locations into and out of the water entity (tagged trade) is shown. Transfers are not shown – these are addressed in the first report.

Note that it is possible that some water access entitlements shown in a source report (Figure 30) may not appear in any destination report (Figure 31). These will be those entitlements that are not linked to any site and are just being held for trading.

Generation of the proposed standard reports may be assisted by the development of additional capability within organisations responsible for administering registers of water access entitlements, and by modification of the register system.

The development of standards for the proposed Water Access Entitlement Source report and Water Access Entitlement Destination report should be developed as a priority to support water market and trading activities.

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Template water access entitlements source report

Scope:

- Period: start and end
- Water entity
- Report preparer

Opening stock

For each class/category of water access entitlement:

- share units stock

Increases

For each class/category of water access entitlement:

- New share units issued
- Share units created pursuant to non-tagged trade in (where relevant)

Reductions

For each class/category of water access entitlement:

- Share units cancelled
- Share units cancelled pursuant to non-tagged trade out (where relevant)

Transfers

For each class/category of water access entitlement:

- Share units acquired/number of transactions
- Share units transmitted/number of transactions

Closing stock

- (items as per opening stock)

Figure 30 Access entitlement source report

SKM

Template water access entitlement destination report

Scope:

- Period: start and end
- Water entity
- Report preparer

Opening stock

For each class/category/source of water access entitlement:

- Share units linked to the physical entity

Increases

For each class/category/source of water access entitlement:

- New share units issued linked to the entity
- Share units linked to the entity created pursuant to non-tagged trade in (where relevant)
- Share units moved in (tagged trade)

Reductions

For each class/category/source of water access entitlement:

- Share units linked to the entity cancelled
- Share units linked to the entity cancelled pursuant to non-tagged trade out (where relevant)
- Share units moved out (tagged trade)

Internal movements

For each class/category/source of water access entitlement:

- Share units linked to a new location within the physical water entity

Closing stock

- (items as per opening stock)

Figure 31 Access entitlement destination report

7.1.6.3 Report entities

As discussed in section 7.1.5, according to the NWI definition water access entitlements are a share in a *consumptive pool* in a given *water system*.

It is apparent then that the basic water entity for water access entitlement reports is the *water system*. These water systems sometimes correspond to surface water management areas but frequently they are a subset of surface water management areas For example, while regulated river systems in NSW are each a separate SWMA within the catchment area, regulated river systems in other states may not separated out from their catchment.

While it might be possible to generate Water Access Entitlement Source Reports for parts of water systems (eg zones within the water system) or groups of water systems, it makes most sense to generate them for whole water systems, as the common link in the source report is the source water system in which the shares exist, rather than the location where the water is extracted.

On the other hand, the 'destination' discussed in the proposed Water Access Entitlement Destination Report relates to the location where water is extracted. Usually this location is from some part of the source water system, but in some areas there are multiple connected water systems where it is possible for water to be extracted pursuant to a water access entitlement from a different water system than that to which the entitlement relates. Such entitlements are called 'tagged' entitlements. For example under the water trading arrangements being implemented in the southern Murray Darling Basin it will soon be possible for a person to extract water from the River Murray in South Australia under a water access entitlement which has a share in the Murrumbidgee Regulated River water system.

Where the entitlement is linked to a point in a delivery system, the destination can additionally be specified in terms of the point within the delivery system.

Commonly parts of water systems or delivery systems, or even areas spanning more than one water system are labelled as 'trading zones' or 'management zones'.

Destination report entities can thus be water systems or delivery systems or zones of various kinds.

Water entities, including water systems and trading or management zones, are fundamental to a chart of water accounts and reporting and need to be well defined and agreed

7.1.6.4 Reporting periods

It was found in the stocktake that most organisations are reporting on a financial year basis in annual reports and reports required by regulators. While water years did vary, they generally fitted within the financial year.

A financial year basis is an appropriate reporting period for water access entitlement source and destination reports.

7.1.6.5 Aggregation

Where water access entitlements relate to different water systems, or are of a different priority class, it makes little sense to sum them. To do so would be like adding the shares in one company to the shares in another company to give the total number of shares in both companies. This tells you nothing meaningful, as the two types of shares have totally different values. The same is true for water access entitlements.

7.1.7 Measuring

Water access entitlement information elements as outlined in Appendix A provide a starting point for inclusion in the development of a national chart of water accounts.

The biggest information gap found was that there are many types of entitlements not on formal registers where the information can be readily accessed.

Looking forward, it is also important to ensure new types of water entitlements are recorded on registry systems. These include entitlements to recycled water, stormwater and drainage water.

It is important that all types of water entitlements, those that currently exist and those that will emerge such as for recycled water, drainage water and stormwater, be migrated to robust public registers, as a priority.

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7.1.8 Recording

7.1.8.1 System features

A water accounting information system for water access entitlements is likely to be relatively easy to implement in its own right as there are not as many information elements as there are for other water accounting themes. The water access entitlement information elements proposed as a starting point in Appendix B are also relatively easy to measure. The information system requirement is essentially the development of a register with the predominant feature being provision for the recording of transactions. The majority of jurisdictions already maintain a register and there is already a project in place to address 'compatible registers'.

Despite these potential simplifications, the experience from Victoria demonstrates that the requirement to resolve issues such as complex entitlement parameters (unbundling) and the development of user requirements including the development of a common chart of water accounts have significant complexities. However these system design aspects, once resolved, provide the basis for integration of the register with the capabilities to incorporate many aspects of the other water accounting themes. The highest priority for system integration is with water allocation and development of the capability to reconcile the issuing and subsequent depletion of allocations against water access entitlements.

Extension of a water access entitlement accounting information system (water access entitlement registers) with information system requirements for other accounting themes is an extremely important capability to develop and this integration is discussed further in the recommendations.

Given the desired outcomes for water access entitlements accounting and the value of water access entitlements in areas where trading is established it is proposed that systems for recording and reporting water entitlements be very robust and meet high standards of system and information management, security and audit ability.

A water accounting information system of this type would need to have capabilities/characteristics similar to those discussed in section 5.9. It is also considered a medium term priority that a number of standards be consciously adopted for relevant information systems given the market transparency requirements related to entitlement trading. Some of these standards could include:

- Quality assurance – eg ISO 9000
- Records management eg AS ISO 15489
- Data management and interchange – eg AS ISO 9735.9-2003
- Information security management eg AGIMO

It should be noted that an opportunity exists to build some of the above standards into the software if new or modified information systems are adopted.

7.1.8.2 Reconciliations

The key matter to be reconciled in a transaction based water access entitlement registers is that the share quantities at any time should reflect the share quantities at a previous time plus the sum of the effect of relevant transactions.

The proposed standard reports are also reconciliation reports provided all the information elements are independently taken from the register, ie the end of year sum of shares must be extracted from the register, not generated by adding the sum of transactions to the opening balance. If this is done, then the opening balance plus the sum of transactions will equal the closing balance. Where it does not then the transactions and the system totals are not reconciled.

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7.2 Water Allocations

7.2.1 Description and scope of theme

This water accounting theme relates to accounting for the allocation of water and the use and trade of those allocations, at the resource or system level, at the bulk or wholesale level and at the end user or retail level. Whereas water resource accounting deals only with actual volumes of water, water allocation accounting deals in both water and allocations or commitments of that water.

It is of note that, in addition to the water allocations administered under state/territory legislation there are ‘water allocations’ within irrigation companies in NSW and WA, and trusts in SA, which nonetheless have most of the characteristics of water allocations as defined under the NWI.

‘Water allocations’ such as those within irrigation companies in NSW and WA and trusts in SA should be included within the scope of water accounting and for water accounting purposes be treated as water allocations as defined under the NWI to the extent possible.

7.2.2 Objective

The desired water accounting outcomes relating to water allocations are:

- To provide public accountability for allocations issued
- To give water users and investors confidence
- To provide information on trade for planning and investors
- To inform water resource review and planning processes, ensure transparency of these processes.
- To demonstrate cumulative effects of water trading in terms of movement of where water is being extracted and used
- To support public and investor confidence in the amount of water being traded

Consistent with these outcomes, the following object for water allocation accounting is proposed:

The objective of water allocation accounting is to provide relevant and reliable information regarding the volumes of water allocated and how allocations are used, moved and traded over time, to inform investors and planners and generate public and investor confidence in the management of those allocations.

7.2.3 Current drivers

The stocktake demonstrated that compliance with the NWI and meeting customer information needs and expectations is already driving change in this area.

- Information systems are being enhanced to meet higher expectations of water allocation holders and regulators for system integrity and reliability
- Customer water allocation reports being enhanced and made more readily accessible to better inform customers
- Systems being developed for more frequent collection of water extraction data.
- Improved techniques, equipment and standards being developed for measuring volumes being extracted.
- Systems being developed to overcome current difficulties in some locations in reconciling water allocations at different levels.
- Systems and reports being developed and enhanced to meet demands from customers and the public for transparent, auditable processes for allocating water at all levels.
- Trading reports being developed to meet demand from planners and the public for information on cumulative movement of water allocations, driven by concern about potential regional social, and economic and environmental impacts.

7.2.4 Concepts and definitions

Before proceeding to further analysis it is important to propose a number of terms and definitions. These are set out below.

7.2.4.1 Water allocations and water commitments

Water volumes allocated to entitlement holders are known (not surprisingly) as *water allocations*. Under the NWI *water allocations* are defined as:

the specific volume of water allocated to water access entitlements in a given season, defined according to rules established in the relevant water plan

Terminology confusion is commonplace within the water industry and arises in this theme. In some states water access entitlements are referred to as water allocations. Also water which is not related to a water access entitlement is often referred to as an allocation (eg environmental ‘allocations’ such as the Barmah-Millewa on the Murray system). The term ‘water allocation’ can also be read as a verb – the act of allocating rights to take water – or a noun – the right to take water itself. The NWI definition relates to the noun rather than the verb, and applies to water allocated pursuant to water access entitlements as opposed to other means.

Because of this definition it is proposed, in water accounting, to reserve the use of the term *‘water allocation’*, to mean only the right to take water issued to entitlement holders (ie the noun), and to reserve the verb ‘allocation’ to the act of creating those *water allocations* by announcement or determination. Where water is set aside for other purposes (eg end of system flows, environmental allowances, losses etc) it is proposed to use the term '*water commitments*' rather than 'water allocations' and to use the verb *commitment* for the creation of those *water commitments*. This should minimise confusion over use of the term 'water allocation'.

Water allocations are rights to take (or receive) water. While water allocations are normally expressed volumetrically, they are not truly water in the physical sense. For example water allocations can disappear by end of year write offs of 'unused' allocations (ie not carried over), and in some systems are reduced by volumes of water ordered whether it is actually taken or not. Water allocations do not obey the normal laws of physics – conservation of mass etc. They have their own sets of laws which vary from place to place (eg annual accounting, continuous accounting, capacity sharing and a whole range of variations within these are in use in Australia).

7.2.4.2 Regulated river allocatable stock and resource stock

In regulated (supplemented) river systems, the volumes of water which can be controlled by the public dams and other works is allocatable and is either *allocated* to entitlement holders (eg irrigators, towns etc) or *committed* to other purposes (eg, meeting end of system outflow requirements; meeting unlicensed domestic water demands; covering system losses; or for specific environmental requirements).Volumes of water which cannot be controlled by the works (eg flood inflows to dams which result in spills greater than downstream requirements; tributary inflows below the major dam which exceed re-regulation capacity) are not allocated or committed in the same way as controlled water.

That part of the *allocatable* stock which should, by virtue of water sharing rules, be allocated to entitlement holders and other consumptive users appears to fit the definition of *consumptive pool* used in the NWI. If water is being allocated in accordance with rules then it should be possible to reconcile this volume with the total of water allocations held pursuant to entitlements. Water resource managers do in fact determine the *allocatable* stock routinely in order to make decisions about allocation of water, but these volumes are not currently presented in public reports. By explicitly identifying and reporting *allocatable* stock volumes and reconciling them with actual water allocated, allocation decisions and processes become transparent, thus helping to engender stakeholder confidence and resource manager accountability.

In regulated river systems the '*allocatable stock'* of water is generally calculated as the water held in storage, plus any inflow volumes which are sufficiently certain that they can be treated as stock. For example, in the regulated Murrumbidgee River system the *'allocatable stock'* of water at the start of a year is the volume in storage plus the minimum inflows from the Snowy Scheme as set out in an agreement, plus the minimum catchment inflows expected for the coming year.

Thus *allocatable stock* differs from *resource stock* in that:

a) it includes some water that it not yet physically present, in the same way that receivables are treated as assets in financial reports, and

b) it excludes uncontrolled water, and

c) it excludes stock of water in private storages (eg farm dams etc).

The practice of allocating water that is not yet physically present is widespread but is probably declining. In doing this there is always the risk that the water may not turn up after all. This happened recently in the Werribee system in Victoria. There are however many areas where it is not done.

An alternative better practice is to allocate only what is present and at the same time provide water users with information on probable inflows. This is an increasingly common practice. It means that the water users make their own decision on how much water supply risk to take. This is a much more robust approach than allocating expected inflows, as it ensures the water users are fully informed of the risks they are exposed to. In some circumstances both minimum expected inflows are allocated and the probability of further inflows is advised.

A common past practice involved making extra high end user allocations, assuming under-use would ensure the total use of allocations is less than the bulk allocatable stock. This is likewise a dubious practice in the context of increased trade, increasing access to carryover and increasing levels of utilisation of allocation. It is not known if this practice still exists anywhere.

Adoption of best management practice methods for allocation on regulated systems will assist with increased consistency in water allocation accounting and reporting.

Transparency and consistency in similar circumstances in reporting the details, risks and basis of water allocations is to be encouraged

7.2.4.3 Regulated river allocated and unallocated stock and the consumptive pool

Allocatable stock can be classed as either *allocated/committed* or *unallocated*. It can be *allocated* to entitlement holders or *committed* to other purposes. Otherwise it is *unallocated*.

The *allocated* stock should be reconcilable with the total of water allocations at any time.

7.2.5 Allocation reporting levels

Water allocations can be accounted and reported at multiple levels – *resource, delivery system* and *end user*. These are illustrated in Figure 32. The term *delivery system* refers to any set of connected channels, pipes, storages used to deliver water to properties or other delivery systems. Though on regulated rivers the river itself is used as a water delivery conduit, it is proposed to exclude this from the definition of delivery system, as the river is also the resource and an environmental asset.

Water allocation accounts at the resource level would show the total volumes of all water allocations relating to the source water system. Delivery system water allocation accounts would only show the volumes from the source linked to the delivery system. End user water allocation accounts would only show the volumes linked to the particular end user. As is shown, end user water allocations can occur with or without delivery systems.

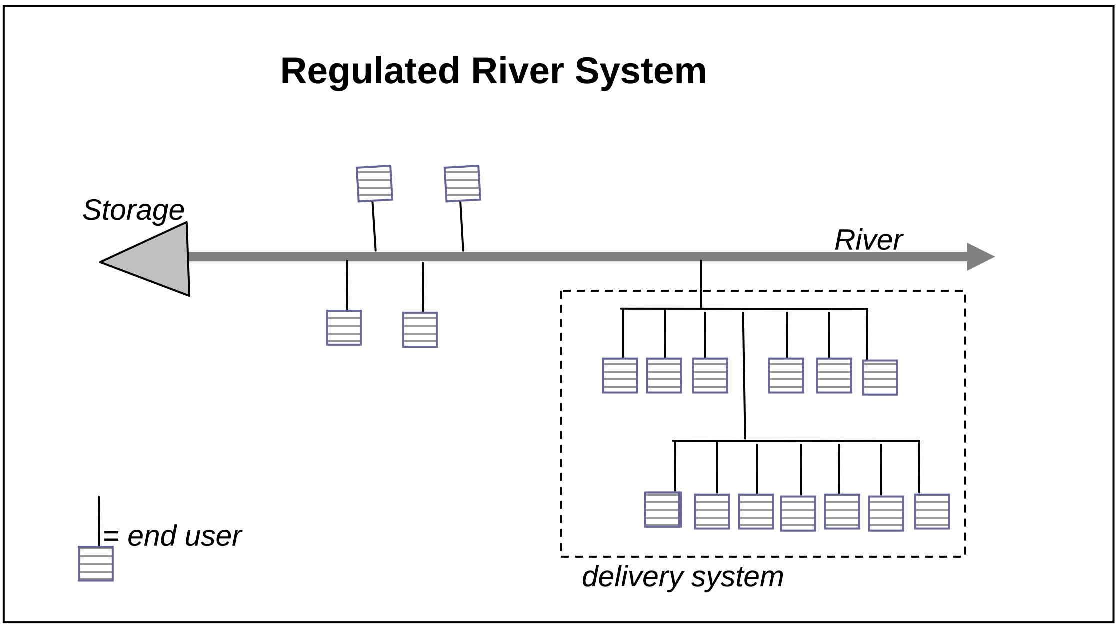

Figure 32 Allocation levels

Once the allocatable stock is allocated in bulk at the source water system level, it is then apportioned to individual water access entitlement holders (delivery system authority or end user) in proportion to the size of their entitlement. In the case of bulk delivery systems, there are three scenarios:

a) the delivery system authority holds the water access entitlements and the end users within the delivery system do not hold entitlements. Instead the supplier has service obligations. This is the normal situation for urban water supply systems.

b) the delivery system authority holds the water access entitlements and the end users within the delivery system hold entitlements within the authority's water access entitlements. This two tier entitlement system is the situation for private irrigation companies in NSW and WA and the Trusts in SA.

c) the end users within the delivery system hold water access entitlements, and the delivery system authority does not. Instead the end users have delivery service rights or contracts with the delivery system authority. This is the situation in most Queensland irrigation districts, and in all the Victorian systems. Note that often the delivery system authority will hold the water access entitlement to cover delivery losses.

7.2.5.1 Storage water allocations and limit water allocations

In regulated river systems most water allocations relate to *allocatable stock* - physical water either stored or receivable. This is because the entitlements to which they are linked include rights to a share of the system storage and inflows. For clarity it is proposed to refer to these as *storage water allocations*.

This is not the case for unregulated river systems. There is no *allocatable stock* at all. Consequently unregulated river entitlements can only be a maximum amount of water that may be diverted should inflows arise, and the water allocation accounting approach used for regulated rivers does not apply.

In most states entitlements to take water from unregulated rivers are expressed as a maximum volume per year. NSW has expressed the entitlements as unit shares and required volumes per share to be declared annually. These declared volumes have been labelled as *water allocations* also, though they are vastly different in their nature to the common regulated river water allocations. They are a maximum volume which may be taken should flows arise, and do not relate to any volumes in storage or receivable. NSW also allows for these maximum volume water allocations to be traded and to be carried over, in a similar manner to regulated river water allocations. Therefore to avoid confusion it is proposed to call these maximum-volume-water-allocations *limit allocations.*

It is impossible to develop accounting systems relating use of these *limit water allocations* to drawing down on a quantified stock, as is the case with common regulated river storage water allocations. The type of accounts that can be kept are simply records of volumes diverted as against maximum allowed volumes and these simpler type of accounts are proposed to be included in accounts.

In NSW water allocations under regulated river *supplementary* licences (not to be confused with Queensland's supplemented water allocations) are likewise *limit water allocations* even though they are on regulated river systems. They are a maximum amount that may be extracted should supplementary (uncontrolled) river flows occur. Queensland similarly has unsupplemented entitlements on supplemented systems, which likewise only give access to uncontrolled flows and likewise have *limit water allocations*. It is important therefore to recognise that both *storage water allocations* and *limit water allocations* occur in regulated river systems

In groundwater systems, the concept of stock is not used. The actual volume of water held in storage in the aquifer is not measured on an ongoing basis. Groundwater allocations are generally based on estimated long term sustainable extraction levels, rather than actual measurements of quantities of water present in the aquifers. For this reason applying a regulated rivers water allocation accounting approach to groundwater is also out of the question, though like unregulated rivers it is possible to construct accounts which record extraction versus maximum allowable extraction volumes.

In most states entitlements to take water from aquifers are expressed as a maximum volume per year. As with unregulated rivers, NSW has expressed these entitlements as unit shares and required volumes per share to be declared annually, calling the declared volumes *water allocations* (or available water determination) also. NSW also allows for these groundwater water allocations to be traded and to be carried over, in a similar manner to regulated river water allocations. However, as with unregulated rivers, it is impossible to relate use of these allocations to drawing down of a quantified stock. Despite the very different nature of the resource, these groundwater water allocations are in fact virtually the same as unregulated river limit allocations from an accounting point of view. It is therefore proposed to call them *limit water allocations* also.

In summary then, limit water allocation accounting is very different to storage water allocation accounting. Whereas storage water allocation accounting relates water allocations to allocatable water stocks, limit water allocation accounting simply records the use of uncontrolled water against defined maximum extraction limits. Recording both types of allocation is important to reconcile allocation accounts with resource accounts

7.2.5.2 Decreases of water allocations and commitments stock

Allocated or committed stock can be decreased in a number of ways, depending on local rules and arrangements. Decreases of stock in this context refers to any manner in which the allocated or committed stock volume is reduced. This may or may not involve the actual extraction or delivery for consumptive use of water.

Most commonly, water allocations are depleted when the allocation holder extracts the corresponding volume of water from the resource, or has it delivered to their property. In some areas water allocations are decreased when they are ordered (eg NSW), regardless of whether they are taken or not. Water allocations can also be decreased when they are written off at the end of a year, as a result of not being carried over. Various other expenditure rules apply in places where continuous accounting and capacity sharing accounting are in operation.

Likewise water commitments can be depleted by being released from storage, being delivered to a point or written off at the end of a year. Loss commitments are depleted by being realised. Again the ways in which commitments are depleted vary from area to area depending on local rules and the nature of the commitment.

7.2.6 Reporting

7.2.6.1 Reporting obligations

Reporting obligations apply where external users have clear needs for information held by organisations, which they have no other way of obtaining except from those organisations. Given the outcomes desired under the NWI, and the existing demand for information it seems clear that organisations responsible for managing water allocations should prepare reports to meet those requirements. Examples of such organisations are government departments such as NSW DNR, Qld NRM&W, (who may delegate some of the reporting obligations to particular water service providers such as Sunwater, State Water) and private water service providers such as Harvey Water, Murray Irrigation.

The obligations of organisations responsible for administering water allocations **to prepare and make available standard allocation reports will need to be addressed in relevant water accounting standards**

7.2.6.2 Standard reports

A set of standard reports are proposed. These reports are intended to achieve the water allocation accounting objective outlined above. Adoption of standard reports is designed to provide water users, investors, planners and the public with the information they need in a way they can understand and have confidence in.

The stocktake demonstrated that no organisations currently generate reports which transparently show the allocation and commitment of water at the resource level, and how this is appropriated down to allocations at the end user level. It is all in behind the scenes calculations. To generate the confidence that is desired in the processes it is clear that the reports must address this in addition to showing end-user information.

In the water accounting information requirements framework several reports were proposed. After further consideration a modified set of reports is now proposed, designed in particular to allow roll-up and reconciliation of water allocations and commitments at different levels.

7.2.6.2.1 Regulated river system reports

The proposed reports for regulated river systems are:

- A variation of the *proposed surface water report [regulated river system variation]* which differentiates between uncontrolled and controlled stocks and flows (see Figure 33)
- An *allocatable stock report* , which is a modified version of the earlier proposed availability report in project's Step 1 Status Report – Appendix A. The main differences are that it excludes uncontrolled stocks and includes water receivable. (see Figure 34)
- *General water allocations report and the general water allocations trade reports* which can be applied to reporting for a range of water entities relating to regulated rivers eg end-user, bulk delivery system, trading zone. These reports can also be used for storage allocations and limit water allocations.

With this suite of reports it will be possible to reconcile numbers between the different tiers. For example, the MDBC currently keeps accounts which distribute stocks and flows of River Murray water between NSW and Victoria. Bulk water allocation decisions are made each year to each state, which include not only water in stock but also water receivable, which are in turn translated into entitlement holder water allocations by the states. However these bulk allocation decisions are not reflected anywhere in the MDBC accounts, so there is no ability to formally reconcile entitlement holder water allocations made within states to the bulk allocation accounts in the MDBC.

For a straightforward regulated river system, the two river system reports (*proposed surface water report [regulated river system variation]* and *allocatable stock report*) will be reconcilable with reports for classes of water allocations and commitments.

7.2.6.2.2 Unregulated river systems and groundwater systems

For unregulated river systems and groundwater systems, it is proposed to apply the *general water allocations report* and the *general water allocations trade report* to '*limit water allocations*'. These can be used for reporting on a range of entities relating to unregulated river or groundwater systems eg end-user, trading zone.

Standards for the following proposed reports should be developed as a priority to support water market and trading:

- **surface water report [regulated river system variation]**
- **allocatable stock report**
- **general water allocations report and**
- **general water allocations trade reports**

Proposed surface water report [regulated river system variation]

Scope:

- Period: start and end
- Report preparer
- Water entity (regulated river system)

Opening balance

Allocatable stock

- Water in storage in dams
- Controllable water in rivers, weirs

Inflow

Inflows to allocatable stock

- Controllable surface water inflows
- Other controllable inflows (eg Aquifer discharge to rivers, returns)

Other inflows

- Uncontrollable surface water inflows

Outflow

Outflows from allocatable stock

- Controlled surface water outflows
- Minor outflows (eg evaporation, aquifer recharge from rivers)
- Extraction of water (water allocations)

Other outflows

- Uncontrolled surface water outflows
- Extraction of water (limit allocations)

Closing balance

- (items as per opening balance)

- **Figure 33 Proposed surface water report [regulated river system variation]**

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Proposed allocatable stock report

Scope:

- Period start and end
- Report preparer organisation
- Water entity (a regulated river system)

Opening allocatable stock

Total allocatable volumes	Allocated or committed volumes
▪ storage stock	▪ volumes allocated to each class of allocation
▪ receivable stock	▪ volumes committed to each type of commitment
	Unallocated volume
	▪ = total less allocated and committed volumes

Increases in allocatable stock

Increases in unallocated stock

- Controllable surface water inflows
- Other minor inflows (eg Aquifer discharge, returns)
- Increases in receivables
- Use (including write-off) of allocated and committed stock

Increases in allocated and committed stock

- allocation or commitment of unallocated stocks

Reductions in allocatable stock

Reductions in unallocated stock

- Controlled surface water outflow
- Other minor outflows (eg evaporation, aquifer recharge)
- Extraction of water
- Reductions in receivables (eg because it has turned up as an inflow)
- allocation or commitment of unassigned stock

Reductions in allocated or committed stock

- Use (including write-off) of allocated and committed stock

Closing allocatable stock

- (items as per opening stock)

- **Figure 34 Regulated river allocatable stock**

Proposed General Water Allocations Report

Scope:

- Period start and end
- Report preparer
- Water entity (surface water management area, delivery system, trading zone, groundwater management unit)

Opening stock

- Water allocation stock
  (differentiated by type of allocation)

Increases

- New water allocations accrued
- Water allocation moved in
  (both differentiated by type of allocation)

Reductions

- Use of water allocations
- Water allocation moved out
- Water allocation written off
  (all differentiated by type of allocation)

Closing stock

- Water allocation stock
  (differentiated by type of allocation)

- **Figure 35 General allocation report**

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Proposed General Water Allocations Trade Report

Scope:

- Period start and end
- Report preparer
- Water entity (surface water management area, delivery system, trading zone, groundwater management unit)

Opening stock

For each type of water allocation:

- Maximum net water allocation trade out permitted for period (if applicable)

Acquisitions

For each type of water allocation:

- Water allocations acquired
- Number of acquisition transactions

Divestments

For each type of water allocation:

- Water allocations divested
- Number of divestment transactions

Closing stock

For each type of water allocation:

- Maximum net water allocation trade-out remaining (if applicable)
  (differentiated by type of allocation)

- **Figure 36 Allocation trade report**

7.2.6.3 Reporting entities

As discussed in section 7.1.5, according to the NWI definition water access entitlements are a share in a *consumptive pool* in a given *water system*. *Water allocations* represent the realisation of that share from time to time from that consumptive pool. Thus water allocations, like water access entitlements are fundamentally linked to *water systems*.

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It makes little sense to generate the proposed regulated river system surface water report etc and regulated river system allocatable stock report for anything other than whole water systems, as they relate to the allocation of water at the source water system level.

On the other hand, the general water allocations and the general water allocations trade reports can usefully be generated for a variety of entities, including delivery systems and trading or management zones.

Water entities, including water systems and management or trading zones, are fundamental to a chart of water accounts and reporting and need to be well defined and agreed

7.2.6.4 Reporting periods

It was found in the stocktake that most organisations are reporting on a financial year basis in annual reports and reports required by regulators. While water years did vary, they generally fitted within the financial year.

In addition there is a need for year-to-date information to be available to inform allocation holders and investors of the status of water allocations as each season progresses.

A financial year basis is an appropriate reporting period for proposed standard water allocation reports whilst making monthly and year-to-date information available where specific user needs exist is likely to be warranted.

7.2.6.5 Aggregation

As with water access entitlement shares, the summing of water allocations of different kinds is frequently inappropriate, even though they are all expressed as a volume. For example it is meaningless to sum limit water allocations to storage water allocations, and even limit water allocations in one water system to those in another.

Also the fact that many water systems have different levels of carryover, from nil to partial to full continuous accounting and capacity sharing, makes a great difference to allocations when considered on an annual basis. For example, suppose there is a water system which has had a wet year but is moving into a dry year. If the system is using only annual allocations, the reports for the dry year might show a moderate allocation within the year, while the same system if operating on a continuous accounting arrangement might show a negligible allocation within the year. The difference is that in the annual allocation system, all unused water is re-allocated at the start of each year, while under a continuous accounting arrangement this is not the case.

Accounting for water allocations can only reflect the water allocation management processes.

Water allocations should only be summed and reported for allocations of like type. Reports of water allocations should always show whether the allocations are limit water allocations or storage water allocations, and the type of carryover rules that apply (perhaps by reference to a water plan).

7.2.7 Recording

7.2.7.1 System features

Given that desired outcomes for water allocation accounting and the value of water allocations in areas where trading is established it is proposed that systems for recording and reporting water allocations be very robust and meet high standards of system and information management, security and audit ability.

A water accounting information system for water allocations is likely to require significantly more complexity than that required for water access entitlements. The water allocation information elements proposed as a starting point in Appendix B could be expanded depending on the jurisdictional focus. There are two distinct water accounting applications that may require significantly different levels of information system complexity to address.

The simplest of these is related to the tracking of water allocation stocks once they have been determined/issued. The information elements of the water allocation accounting reports outlined lend themselves to this easily. Effective double entry ensures that allocations at all levels will be synchronised and reconcilable at all times. There are already some good practice examples of where such information systems, which include customer (allocation holder) accounts, transaction records for issued allocations and associated decreases of those allocations. Systems such as those operated by Sunwater and DSE (under development) which incorporate account keeping functionality should be used as starting points for improvement of industry water allocation accounting information systems.

The more complex information system application for allocations is related to the process for determination of allocatable stock which crosses into the area of water resource accounting. The water accounting information system for this area typically requires information on all of the information elements required to produce surface water or groundwater reports. Some examples were observed in the stocktake where links have been made between various water information systems but on the whole there has been little progress towards integration.

An example of where full information system integration is being attempted is in Victoria. The experience from Victoria demonstrates that the potential complexity of links between allocation water accounting information systems and other systems can be eliminated through the development of an Enterprise Resource Platform which uses a common chart of water accounts.

Once user requirements and a chart of water accounts were resolved these aspects provided the basis for integration of the register with the capabilities to incorporate many aspects of the other water accounting themes.

The integration of a water allocation accounting information system functionality with information system requirements for other accounting themes is an extremely important capability to develop and this integration is discussed further in the recommendations.

It is recognised that moving to a fully integrated information system may not be warranted for some organisations and so there are some important standards that would need to be developed to improve consistency and transparency. Some suggested starting point for this are discussed in the following sections and integrated further in the recommendations.

7.2.7.2 Starting points for standardisation

The degree to which water allocation information systems (such as the Victorian example) could be integrated with other jurisdictions will require that the difference in management methods for allocation be accomodated. The inherent complexity of the nature of entitlements, water allocations and accountabilities in some systems such as the southern MDB will remain problematic without management changes. These things will continue to require complex and difficult to understand accounting reports and transactions for investors and the public.

A management opportunity may exist to simplify both management and accounting complexity. The areas where resolution would assist in simplifying accounting treatments are discussed in the following sections. Processes will be needed to develop or clarify appropriate standards where information system integration is required.

7.2.7.2.1 System Standards

A water accounting information system of this type would need to have capabilities/characteristics similar to those discussed in section 5.9. It is also considered a medium term priority that a number of standards be consciously adopted for relevant information systems given the market transparency requirements related to entitlement trading. Some of these standards could include:

- Quality assurance – eg ISO 9000
- Records management eg AS ISO 15489
- Data management and interchange – eg AS ISO 9735.9-2003
- Information security management eg AGIMO

It should be noted that if new or modified information systems are adopted then some of the above standards would be built into the software.

7.2.7.3 Multi level allocation reconciliation

As mentioned earlier for regulated river systems with pooled water allocation processes, once the stock is allocated in bulk, it is then apportioned to individual water access entitlement holders in proportion to the size of their entitlement. The total of all those allocations to individual entitlement holders should thus sum to the total stock allocated at the resource level.

In some cases there are intermediate steps to this process. For example in the River Murray system stocks are first allocated in bulk to states. These state water allocations are then allocated to retail and bulk water access entitlement holders. Where there is an allocation to bulk water access entitlement holders, there is another level of allocation to retail entitlement holders within the bulk systems. Correctly functioning systems and procedures would result in water allocations at all these levels being synchronised at all times, but this is not currently always the case.

By developing accounts built around the proposed reports, it should be possible to synchronise and reconcile water allocations at all levels in real time.

7.2.7.4 Inter-authority and interstate trade reconciliation

Poor processing of trading transactions has already caused reconciliation problems, which do not engender confidence. This is particularly the case where allocations are cancelled in one system and created in another (eg across state borders, between water authorities) where sometimes only one half of the transaction is completed, or the cancelled and created volumes do not coincide due to operator error or there are significant time lags. In a good accounting arrangement the credits and debits in the reports produced by the different organisations should all reconcile at all times.

Such errors can be minimised by adopting tight transaction processing procedures, assisted by software which manages and records transactions in the way financial accounting packages do. Double entry (matching credits and debits) accounting is a particularly effective feature.

Where trading transactions require changes in multiple systems, double entry is hampered by the separation. The current manual credit and debit procedures used for trading between states and authorities in the southern Murray Darling Basin is fraught with reconciliation problems caused by poor processes for synchronizing credits and debits, which should be matched in both size and time of execution, but are often not. A range of options are available to improve this:

- Review and tighten current manual processes for executing trades (matching credits and debits) across authorities/states
- Implement automated inter-system communication protocols as part of trading execution

- Revise systems so that all are built on a common chart of water accounts
- Integrate all systems into one common platform, where the respective authorities have access only to data for which they are responsible.

The last option would clearly deliver the best accounting outcome and would drastically reduce handling costs, time of processing and chances of errors. Having related information in an integrated system where any piece of information is stored in only one location removes the need to copy, synchronise and reconcile information in two or more locations. For example, in such systems bulk water allocations at any time are determined by summing all the end user allocations, so the numbers will always reconcile.

7.2.7.5 Allocation and entitlement linkages

In the stocktake it was found that some authorities with responsibility for water allocations also maintained registers of water access entitlements on the same system. NSW and Queensland have established a different arrangement where water access entitlement registers are established on the same platform as land titles, and water allocation recording systems are separate and not directly linked. This necessitates the water allocations systems holding a copy of much of the information held in the entitlement register.

Maintaining a copy of a constantly changing dataset naturally incurs the risk that the copy will get out of synchronisation with the original dataset. While both NSW and Queensland have in place processes for keeping the copy up to date those processes rely heavily on manual transfer of information. Reconciliation processes also appeared to be ad-hoc.

Water allocation managers need to consider the merits of either enhancing or building new water allocation accounting systems or else consider adopting some standard processes to allow regular reconciliation of water allocations and reporting of those reconciliations.

The development of a prototype water accounting information system for allocations accounting may assist managers to consider the merits of adopting a common platform.

7.2.8 Measurement

Water allocation information elements as outlined in Appendix A provide a starting point for inclusion in the development of a national chart of water accounts.

The main problem identified in the stocktake is that there are still many areas where the extraction of water is not metered, or if metered the information is not collected. Where this is the case the basis for depletion of water allocations needs to be addressed.

Standards will need to be developed to cover the accounting treatment for the depletion of water allocations, specifically addressing circumstances where metering of extraction is not in place.

8 Analysis of environmental water accounting

8.1 Scope of environmental water accounting

The project has identified challenges in determining the scope of environmental water. Two of the main challenges identified include defining environmental water and the difference between accounting for environmental water (in the narrowest sense) in contrast to achieving accountability for management regimes that strive to achieve beneficial environmental outcomes.

The concept of "environmental water" is an elusive one, and means different things to different people, especially when water is flowing in a stream. The primary consideration for environmental water accounting is to account for the water provided to meet environmental outcomes specified under the relevant water plan.

A recent Environment Australia technical paper[3] defines environmental flows as flows which "maintain the health and biodiversity of a particular water-related entity, such as a river, wetland, groundwater system or estuary". This definition is consistent with statements in Australian policy and legislation in recent years. It also implies that flows can occur which do not maintain the health of the river or other water entity.

Defining what flows maintain health and what flows do not is frequently not so clear. As water passes down a stream, it may simultaneously be providing environmental benefits and be in transit for extractive (environmental or human) use further downstream. This makes it difficult to classify the flow as "environmental" or "non environmental". As the location and other parameters change the flow may be beneficial or harmful to the riverine environment.

Water which provides damage to parts of the ecosystem in part of a river system, such as cold/anaerobic releases from large dams, can be characterised as not maintaining river health, but even this water may become beneficial again after travelling a sufficient distance downstream.

As was discovered during Step 2 of the project (finding 27), there is inconsistency with the usage and understanding of the term 'environmental water'. It may be used to mean:

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[3] *Environmental Water Requirements to Maintain Estuarine Processes* Technical Report Number 3 Environment Australia, April 2002

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- Only water consumed (eg by evaporation, transpiration etc) by ecological processes. For example, in the case of water flowing into a floodplain wetland only the water that does not eventually return to the river is classed as environmental water.
- The residual of water not used for human consumptive purpose, including all losses and evaporation;
- Water that is set aside for environmental purposes, whether it actually achieves ecological benefits or not. (Examples of this are water access entitlements set aside for environmental purposes, and non-entitlement rights such as the Barmah Millewa forest watering rights on the Murray.);
- Water that is held in storage and released specifically to achieve environmental outcomes;
- Water that the environment has a right to, either rules based or entitlement based;
- Any water that achieves ecological benefits. For example it is argued by some that any water that flows down a river is ecologically beneficial, even if it is extracted at a point downstream for irrigation;

Sometimes proponents use a combination of these meanings, e.g. environmental water is water that is set aside for environmental purposes <u>and</u> actually achieves ecological benefits.

To achieve an accepted and consistent approach to environmental water accounting, the concepts, classifications and definitions of the characteristics or components of environmental water will need to be explicitly articulated and understood.

An important distinction needs to be made between 'accounting' in the narrowest sense and 'accountability'. Accounting (in the narrowest sense) refers to what is captured in the accounting system. Accountability is the ability to transparently discharge obligations. Accounting systems are a valuable tool to achieve accountability, partly by giving transparency to complex transactions. A suite of reporting tools, including those generated from accounts, is often necessary in discharging accountability.

Accounting systems capture one transaction and represent it in two accounts (the source and destination). Transactions are only captured once, as accounts are cumulative. That is, in an accounting system, water cannot be represented simultaneously as irrigator water **and** environmental water[4]. If water has been called out for irrigation, it would not be identified as

[4] However, water may change its characteristics (and therefore account) as it travels through a system.

environmental water, even if it has resulted in achieving a beneficial environmental outcome. However, the fact that irrigator water resulted in providing a beneficial environmental outcome may be apparent from analysing a suite of reporting tools – some of which are additional to the accounting system.

In many systems, particularly those that are unregulated and not overallocated, the majority of water that results in beneficial environmental outcomes is via indirect rules. Discharging accountability against these indirect rules may not necessarily be achievable via the accounting system. Rather a suite of reports, including performance indicators, references to water plans and compliance reports could assist with telling the broader story.

All environmental water management regimes should be accountable. The degree to which that accountability is served by an accounting system and water for the environment can be uniquely identified in the accounts (that is accounting in its narrowest sense) will vary and may be problematic. For many indirect rules regimes, it may not be feasible to uniquely identify water for the environment via an accounting system, but accountability may be discharged via an assurance process or the planning process, perhaps coinciding with and including respective references to water accounting reports.

The challenge in finding a definition of environmental water that is precise enough for accounting purposes is that there are many mechanisms that result, both directly and indirectly, in beneficial environmental outcomes. Not all of these mechanisms are capable of being documented (and therefore accounted for) or fall under human control. Mechanisms which could result in beneficial environmental outcomes include:

- Water made available in systems via the planning process; for example "*By limiting long-term extractions to an estimated 391,900 megalitres per year this Plan ensures that approximately 73% of the long-term average annual flow in this water source will be preserved and will contribute to the maintenance of basic ecosystem health.* (Water sharing plan for the Macquarie and Cudgegong regulated river water source, DIPNR);
- Operational rules such as minimum flow and translucent flow rules;
- Environmental rules based water (eg. Barmah-Millewa account), which are a well-specified right to water that can be called on to be released from storage into a river reach;
- Environmental access entitlements, which are a right to extract water from a river for environmental purposes;
- Water intended solely for human consumptive use, that may nevertheless have environmental benefits as it is passed downstream;

- Opportunistic use of water (e.g. Use of environmental allocation to top up flows in river to achieve the watering of a wetland);
- Favourable climatic conditions (rain events, low winds);
- Aquifer recharge.

Accounting (in the absence of interpretation) will not and cannot reflect all water that results in beneficial environmental outcomes. Some actions that are undertaken fully or partly on behalf of the environment, or which indirectly result in beneficial environmental outcomes, cannot be captured in accounts. For example an operational rule to not run a river at full capacity for an extended period to minimise bank erosion has environmental benefits and also reduces the cost of remedial works.

Accounting, whether of money or water, is sometimes a poor reflector of actions or intent. The accounts are constrained to reporting what happened, and are silent on why it happened, although a note to the accounts might assist interpretation.

An example from financial accounting

Consider a ladies fashion chain that is embarking on a marketing campaign for its Spring collection. The aim of the marketing exercise is to increase sales; and increase market share (ie, gain customers at the expense of competitors)

The Marketing Director wants to assess the effectiveness of the campaign. However, the accounting system can only show sales earned and marketing expense incurred in dollars. To analyse the success of the campaign, he will also require a myriad of information (most of which is difficult and expensive to obtain) which is not captured in the accounting system, including:

- Total market share at the beginning and the end of the campaign;
- Competitors’ marketing presence and spend;
- Conversion rate (no. of customers that purchased an item after entering a shop)
- Attachment rate (ie. no. of units purchased per customer) before, during and after the campaign;
- Sales by new versus existing customers;

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- Customer perceptions before, during and after the campaign;
- Customer demographics (ie. did the campaign attract targeted customers)

Even if the marketing director was able to capture all of this information, it would not be appropriate or sensible to include it all in the accounting system. In addition, the information may still not explain the sales result. Sales may have been affected by a range of factors that are not capable of measurement or control: the attitude of sales staff; the window displays; the appeal of the Spring range itself; what Jennifer Anniston wore on the cover of this week's New Idea, and so on.

The extent to which mechanisms that result in beneficial environmental outcomes are captured by an accounting system will depend on the nature of that mechanism. Some mechanisms are unable to be captured because they serve dual purposes (such as indirect rules), may not be understood in a timely manner (e.g. recharge to or from an aquifer), may never be explicitly recognised or recorded (e.g. actions arising from the operator's professional judgement), may not be able to be sufficiently classified (e.g. river 'losses'), or aren't identified as attributable as a right for the environment (e.g. water destined for human consumption downstream).

From a water accounting perspective, the environment can be considered as just another water user. In principle, even if it is not possible to agree on a precise definition of "environmental water" it should be possible to define the **rights of the environment to water**, account for water delivered to it (or not taken from it), and determine whether its rights have been respected. All of this can be included in the accounts. It is relatively straight forward and uncontentious to account for entitlement based water (environmental water shares) that is extracted for environmental purposes. The problematic issue is how to identify, classify and therefore account for instream water that might be intended to achieve, or result in beneficial environmental outcomes. Such water may consist of:

- Minimum flows (which may be rules based)
- Water for human consumptive use downstream;
- Water released under specific instream environmental rules;
- Water for environmental allocations downstream;
- Water to satisfy operational requirements (which may range from explicit rules to the operator's professional judgement);
- Flows from unregulated tributaries;
- "Rain rejections" from a rain event.

For in-stream water some actions, including some rules, may be capable of being identified, classified and included in the accounting system, and some may not. However, the total in-stream water, after entitlement based extractions, can and should be accounted for and disclosed. The interpretation of the total water used to achieve beneficial environmental outcomes can then be seen as a matter of analysis.

The reporting output from an accounting system can enhance and facilitate this analysis to the extent that classification and disclosure is relevant, reliable, understandable and comparable. Various reporting formats (including those which are an output of the accounting system) may also facilitate interpretation.

For the many systems where provision of water for the environment is from planned limits to diversions and other rules, accounting for the environment will be adequate if it can be demonstrated that the limits and rules have been adhered to.

Whilst an accounting system may not be capable of identifying, classifying and recording all water that is used to achieve beneficial environmental outcomes, the reporting outputs are an important part of a suite of tools that enable the interpretation of all water used to achieve environmental outcomes. That suite could include:

- Reports prepared from accounts;
- Notes to the accounts (which may include qualitative contextual descriptions);
- Notes to the accounts referencing relevant water plans and operational plans;
- Assurance reports which address compliance against environmental rules;
- Comparative information such as predictive data or modelled natural flows.

Identification of the potential suite of tools to determine the water that is used to achieve beneficial environmental outcomes will assist in determining the scope of environmental water accounting

8.2 Objective

A proposed objective for water accounting is to provide relevant and reliable information to assist report users to make and evaluate decisions about the availability, allocation and use of water resources and to enable water resource managers and relevant jurisdictions to transparently absolve their accountability.

The specific objectives of accounting for environmental water can be interpreted as:

- To provide information, where possible, on water that is provided under an environmental right;
- To provide information on environmental rights in a form that is useful to managers of environmental water;
- To enable managers of environmental water to report clearly on the use they have made of entitlements available from specific water recovery programs;
- To enable non-technical but interested stakeholders to understand how water is supplied to and used by the environment. Their information needs are likely to be simpler; for example total volume supplied to or used by a significant environmentally significant site.

The types of information that are useful to meet these objectives include:

- Water provided under certain environmental rules;
- Total water available in a period under environmental rules;
- Environmental inflows and outflows;
- Environmental water in storage and instream (by type);
- Total water in stream;
- Environmental water entitlements (by type);
- Environmental water allocations available and extracted or delivered;

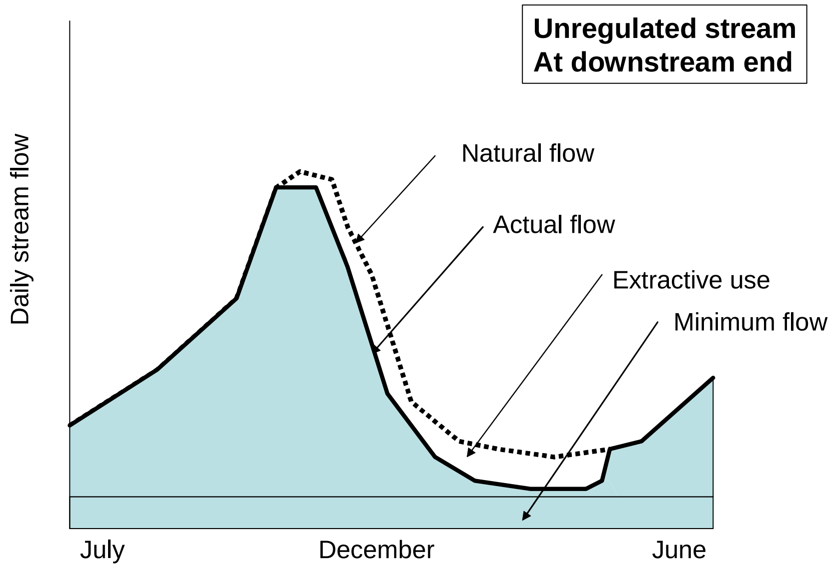
Not all of these information elements will be applicable to all environmental managers across all jurisdictions. This is explored in more detail later in the chapter.

8.3 Discussion of environmental water concepts

8.3.1 Unregulated streams

In an unregulated stream (unsupplemented in Queensland) there is no ability to store water and release it at a later date. Management must therefore concentrate on the rates at which human users are allowed to extract water, to ensure that enough is left for the environment.

Flows and extractions at the downstream end of an unregulated stream in a temperate climatic zone and where a minimum acceptable flow has been set, might be as shown in Figure 37:



▪ **Figure 37 Typical unregulated stream condition**

It can be seen that the main management issue occurs during the dry season, when stream flows approach the minimum acceptable. The management tools available are to:

- Limit extractive entitlements to a level where demand will not impinge upon the minimum acceptable flow, except perhaps in occasional dry seasons;
- Ration extractive users as necessary when the occasional dry seasons occur.

8.3.2 Regulated streams

On a regulated stream, the situation might look more like Figure 38 and Figure 39:

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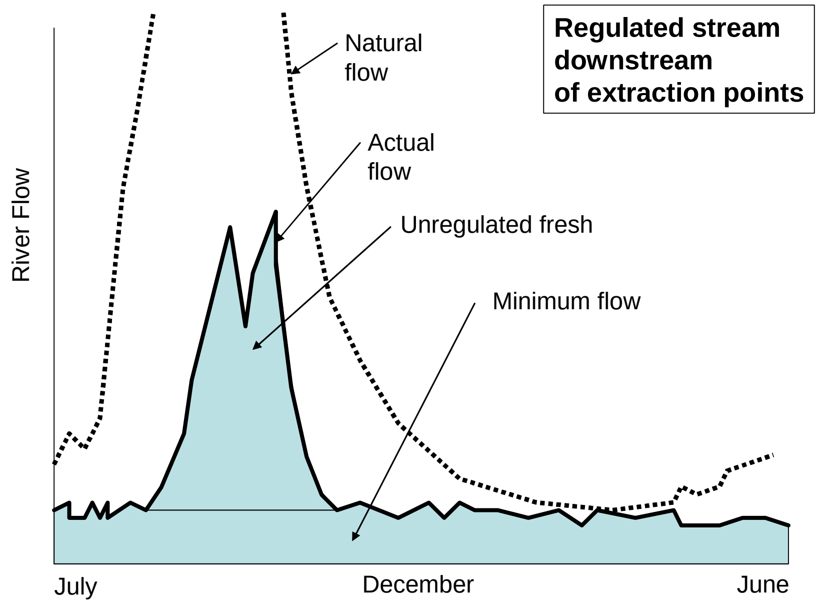
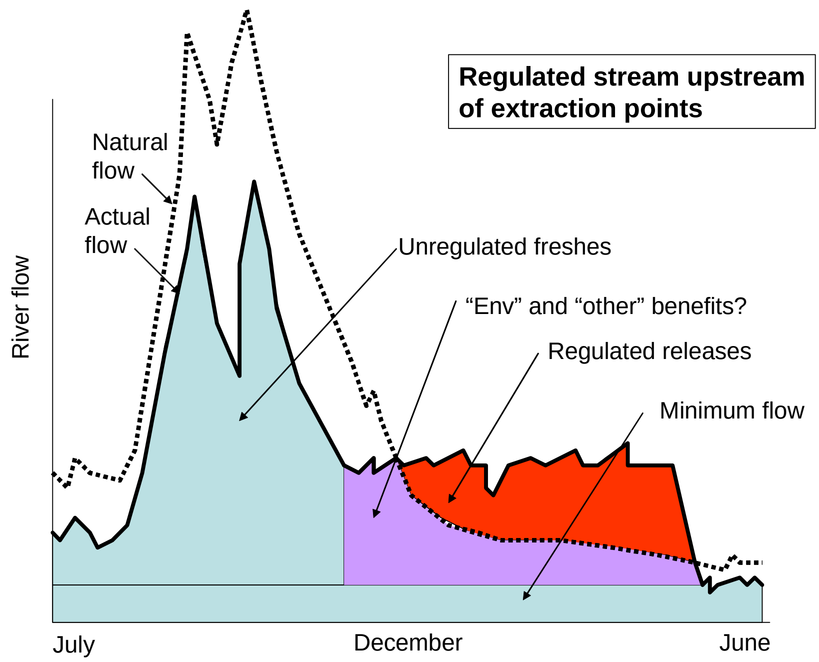


▪ **Figure 38 Typical unregulated stream after extraction**



▪ **Figure 39 Potential hydrograph analysis technique**

In this case the management issues are that:

- Winter and spring flows are less than natural at all locations downstream of the storage, especially peak flows, which may affect watering of riverine wetlands, river freshening flows etc;
- Summer and autumn flows downstream of the extractions will also probably be less than natural, and in stressed systems will tend to be maintained at the “minimum” level for long periods;
- Summer and autumn flows between the storage and the consumptive users will be higher than natural, which may have environmental disadvantages.

The management responses might include:

- Setting “translucent flow” type rules to introduce increased variability into the flows downstream of a dam;
- Introducing volumetric instream entitlements which environmental managers are able to call out of storages at times they judge to be environmentally beneficial. The call out might need to be of the form “release this flow pattern in addition to the flows you would have otherwise released” to ensure that the flow passes the consumptive users and reaches the downstream end of the stream;
- Introducing volumetric extractive entitlements by means such as water savings, negotiating with non-environmental entitlement holders to reduce their reliability of supply, or simply purchasing extractive entitlements on the market.

It can be seen from the above Figures x and y that it is possible to classify the water at a specific location in a stream as either “environmental” (blue), “other” (red) or perhaps “both” (purple). There are a number of ways of doing this:

- If the water was in the stream because of an environmental rule or because it was called out of storage by an environmental manager, it could be classified as “environmental.” Otherwise it could be classified as “other.” This classification would be relatively easy to determine.
- If the water was deemed to be environmentally beneficial it could be classified as “environmental.” The degree of subjectivity in this classification could be reduced by deeming all water less than the natural flow to be “environmental.” This is more difficult to do because it requires calculation or estimation of natural flows, but the calculations can be automated, and already are where environmental rules call for a certain flow “or natural, whichever is less” to be maintained at a particular point.

- Water that was in the stream solely because of environmental rules or action could be classified as “environmental.” If it was there solely because of human demands it could be classified as “other” and if it was there because of human demands but was also environmentally beneficial it could be classified as “both”.

The precise definition of environmental flows is difficult, and this is reflected by the stocktake findings which showed a general lack of consistency on the definition of environmental water.

It is not clear how useful classification along the lines suggested above would be, but if we do not make some classification of this type we are more or less accepting that “environmental water” will not be defined with precision. It must also be recognised that water may change from one classification to another as it moves along a stream. The classification relates to a single location on a stream, and to get a good picture of the adequacy of flows to meet environmental needs, many locations may have to be considered.

Water at a point in a stream could be classified as environmental, non-environmental or both, along the lines suggested in Figure 39 **locations where this is considered useful**

8.4 Types of environmental right

Even if it is not easy to define “environmental water” with precision, it is necessary to be clear about the *rights* of the environment to water and to identify them in the accounts accordingly. In principle there exist now, and will continue to exist in the future, two forms of primary right to surface water:

An **extractive right** is a right to extract water from a waterway. Measurement is at a point of extraction, and in a capped river basin it counts as part of the cap. This form of right is sometimes called “consumptive” or “share based.” The generic term “extractive right” is used in this chapter. It makes sense to add up the water extracted from a waterway or collection of waterways.

An **instream right (**non-extractive right**)** is a right to water at a particular point in a stream. Measurement is at a point in the waterway – often downstream of a structure or at the downstream end of a river basin. It does not count under a cap because the water has not been extracted from a waterway. It may nevertheless have been “called out” from a storage. This form of right is sometimes called “instream”, “rule based” or “non-consumptive.” The generic term “non-extractive right” is used in this chapter. It makes no sense to add up the instream rights along a waterway or collection of waterways, because the same water may satisfy instream rights at multiple locations.

Most human rights to water are extractive rights, though the rights of hydro-electric power generators and fish farms are essentially non-extractive. However, in some catchments water for the environment is held as both types of right, and will continue to do so in the future.

The environment can also hold rights to groundwater in an indirect way. Examples are:

- Extractive use of groundwater may be restricted because it is desired to keep aquifer levels high enough to ensure that water continues to seep to a surface wetland or stream. However data may be lacking, making it hard to know whether a wetland or stream is dependent on groundwater inflows.
- Groundwater management aimed at preventing seawater or polluted aquifer intrusion aims to protect water quality in the aquifer being managed, which has both environmental and other benefits.
- Groundwater can be managed (as in the Victorian Shepparton Groundwater Supply Protection Area and in NSW rice growing areas) largely to keep levels low enough to avoid detrimental effects both to agriculture and the environment.
- Groundwater pumping schemes along the Murray aim to reduce river salinity, again for both environmental and other reasons.

A suggested alternative, classification for environmental water is on the basis of whether it is deployable or not, regardless of whether it is used instream or extracted. Under such a classification it is asserted that all environmental water derived from deployable water can and ought be accounted for in water accounting reports. This classification viewpoint was described in Appendix H of the first draft final report.

8.4.1 Instream environmental rights

The environment holds a large portfolio of instream rights to water in all States. These are set out in various explicit or implied rules, which can be divided into three main types:

- **Indirect rules** that create an environmental right by limiting the volumes that may be extracted from a stream, either by limiting the entitlements issued or limiting extraction to something less than the entitlements might otherwise allow. In much of Australia this is the only form of environmental entitlement that has been necessary to date (The need for additional types of environmental entitlements increase in highly regulated, overallocated systems). This type of rule includes no right to call on stored water, and so is relevant to both regulated and unregulated water systems.
- **Passive rules** for regulated water systems are set out as operating rules that water system operators are required to adhere to. A common example is a rule that a minimum flow must be maintained at a particular location. It may be a simple single flow rate, or vary from month to month or in some other way. It may contain the condition “or natural flow, whichever is the lower” which makes compliance more difficult to achieve and monitor. Its distinguishing feature is that once the rule is set, environmental managers need to take

no action. The water system operator is responsible for adhering to the rule. These rules often require the system operator to use stored water. These rules often have a dual purpose. For example minimum flows simultaneously advantage both human consumptive users and the environment.

- **Active rules** generally only for regulated water systems that require decisions to be made by the environmental manager responsible for the entitlement. A good example is the Barmah-Millewa forest watering entitlement. It enables water to be stored in Hume and released to prolong a natural flood to enhance bird breeding, forest watering etc. The rules are set out formally and are quite complex, containing provisions for annual allocation, carryover, borrowing by irrigators, notional spill and so on. Formal accounts are kept. A decision to place an order on River Murray Water to make a release must be made by the responsible environmental manager, and the order is of the form “whatever you would otherwise have released plus this order” which can require some judgement by River Murray Water. This sort of rule usually include a right for the environmental manager to call on stored water.

Due to the different nature of rules, the rules that create instream environmental rights to water are documented in various ways and in various places. The water associated with some rules can be explicitly identified in water accounts, such as above Cap water (passive rule) and Barmah-Millewa releases (active rule). Water associated with other rules cannot be sensibly identified in water accounts – for example, many indirect rules or an operational rule that limits the days that a regulated river or channel may be run at full capacity. Where possible, water associated with rules should be identified in water accounts,

A register can be set up that summarises instream rules and includes a reference to the location of the full rule. This register should be strongly linked to water accounts where relevant and applicable, as should registers of extractive entitlements. Reporting against rules will be part of the compliance process in ascertaining whether the rule has been adhered to.

Registers or references to, instream environmental rights to water should exist in some form, and where feasible and applicable water associated with these rules should be identified in water accounts.

8.4.2 Extractive environmental rights

In most parts of Australia the environment has no formal extractive rights to water, as the environment’s rights have considered to be achieved via the management regime. However a major exception is the large and heavily regulated water systems of the Murray-Darling Basin, where the environment holds both instream and extractive rights.

An example of an extractive right is the Flora and Fauna Bulk Entitlement held by the Minister for the Environment in Victoria. This is a right to extract up to 27.6 GL per year from the Murray, originally to supply off-river wetlands in the Torrumbarry irrigation system that were once part of the Loddon floodplain but are now effectively cut off from it except during major floods. That entitlement is in the accounting sense exactly the same as an irrigation water right or water share. It can be, and has been, temporarily traded with irrigators. It can be, and has been, used to water a wetland in the Goulburn System, but to do so it had to make a temporary transfer – effectively trading with itself. Without that process the Goulburn Intervalley Account (which ensures at a bulk level the hydrological integrity of water trading between the Goulburn and the Murray) would not have been reduced and the Goulburn system would not have been able to supply the water without third party effects.

In principle from the accounting viewpoint, an extractive environmental entitlement is exactly the same as any other extractive entitlement.

Extractive environmental entitlements should as far as practicable be specified in the same way as extractive non-environmental entitlements, and should be treated the same way in water accounts.

8.5 Recording and reporting

8.5.1 Instream environmental rights

Across Australia non-extractive environmental rights are recognised and specified in various rules or plans. The rules are set out in such documents as:

- Storage operating rules;
- Water resource operating plans (Queensland);
- Water sharing plans and implementation documents (NSW);
- Bulk water entitlements (Victoria)
- Water allocation plans (South Australia)

Generally the approach to developing rules is to seek to maintain and restore natural flow patterns, or failing that to mimic them as much as possible. This is the basis, for example, of the NSW government river flow objectives (shown in Figure 40 below), which have in turn underpinned environmental rules in water plans.

River Flow Objectives	
Objective 1	protect natural water levels in pools of creeks and rivers and wetlands during periods of no flow
Objective 2	protect natural low flows
Objective 3	protect or restore a proportion of moderate flows, "freshes" and high flows
Objective 4	maintain or restore the natural inundation patterns and distribution of floodwaters supporting natural wetland and floodplain ecosystems
Objective 5	mimic the natural frequency, duration and seasonal nature of drying periods in naturally temporary waterways
Objective 6	maintain or mimic natural flow variability in all rivers
Objective 7	maintain rates of rise and fall of river heights within natural bounds
Objective 8	maintain groundwaters within natural levels, and variability, critical to surface flows or ecosystems
Objective 9	minimise the impact of in-stream structures
Objective 10	minimise downstream water quality impacts of storage releases
Objective 11	ensure river flow management provides for contingencies
Objective 12	maintain or rehabilitate estuarine processes and habitats

- **Figure 40 River flow objectives**

Reporting on success or otherwise in meeting these objectives could be achieved by means of graphs or diagrams comparing modelled flows, such as natural flows or pre The Living Murray First Step flows.

Queensland doesn't share the environmental management challenges experienced in the highly regulated, overallocated system of the southern connected basin. Queensland's water resource plans and resource operations plans, has defined its environmental objectives largely in terms of a range of target hydrologic parameters (eg mean annual flows, 1.5, 5 and 20 year ARI daily flow volumes, % of days less than trigger levels, 50% and 90% monthly flow exceedance levels, etc) at designated sites. These have been designed to achieve outcomes which favour natural ecosystems and essentially maintain or mimic natural flow patterns.

Accepting this paradigm, we may think of environmental flows as any flows which follow or mimic natural flow patterns. Recognising that returning 'working' rivers fully to their natural state is not a viable option, it has been accepted that some aspects (e.g. areas of wetlands, water quality parameters) of ecosystem health will not be recovered. Plans have been devised which target aspects which the community determines to be of the most value (e.g. the 'icon sites' on the Murray). They select the flow events or characteristics which best benefit those 'key' aspects and devise rules which protect or restore (in total or in part) aspects of flow which are most beneficial to them.

A lot of work is already going into reporting on environmental instream rights. Examples are:

- Bulk entitlement holders in Victoria have to report annually on any breaches of entitlement, which includes failure to comply with environmental rules
- Across the Murray-Darling Basin, the whole process of cap reporting and auditing is reporting on compliance with an indirect rule about instream environmental rights
- New South Wales, Queensland and South Australia all have processes for reporting on water resource / sharing / operating plans

In many cases this reporting can be, and is, on an annual basis. However in some cases annual reporting adds little, if any, value. An example is the Queensland practice of indirectly specifying environmental rights by deciding on a required flow regime at the downstream end of a valley and perhaps in other locations, and running models to establish an appropriate non-environmental entitlement and allocation regime. The success of this strategy can only be monitored by some sort of periodic analysis at intervals much longer than annually. Such periodic analysis can still be seen as reporting on indirect instream environmental rights, but on a timescale (which should be defined) less frequent than annually.

Standards for reporting of in-stream environmental rights to water will need to be developed as environmental water accounting matures.

8.5.2 Extractive environmental rights

In most jurisdictions, extractive environmental rights do not appear to be specified or needed. A major exception is the regulated rivers of the Murray-Darling Basin where:

- Extractive environmental rights already exist, as well as non-extractive rights;
- Recovery of water for the environment is usually from extractive rights, which in principle remain extractive rights when ownership is transferred;
- Water trade between valleys and jurisdictions is relatively well established, and it is recognised that if environmental managers want to transfer water from one trading zone to another they are essentially doing the same thing as a farmer transferring water between properties in different trading zones.

The Living Murray process is one of Governments investing hundreds of millions of dollars to recover water for the environment, to be used on "icon sites." Governments and other interest groups are certain to want ***some form of accounting showing what extra watering at these sites***

has been achieved by this expenditure. Where extractive environmental rights exist, the water accounts should present information in such a way to assist environmental managers being accountable for delivering environmental outcomes, which are determined by ecologists.

Specific reports for extractive environmental entitlements, allocation, use and trade should be available as they are for non-environmental water.

8.6 Environment as a unique holder of rights

Despite the accounting view that the environment should as far as possible be treated as just another water user, in practice it has some unique characteristics, especially in locations where it holds both extractive and instream rights. There are policy issue that have implications for water accounting. Examples are:

- Environmental managers are likely to want to use extractive rights in an instream fashion, which is clearly legitimate.
- Environmental managers may also wish to use instream rights in an extractive manner. Is there a problem here?
- While the difference between the two is understood in general terms, it can become blurred in practice. To what extent should a riverine wetland be considered to be instream, and does it change its status from time to time?

These issues particularly arise in the southern Murray Darling Basin and a case study exploring the issues involved including conversion between in-stream and extractive rights, is outlined in Appendix G.

8.7 Measurement

Flow gauging along rivers as well as extractions from rivers for environmental purposes are the main measurement requirements to provide the necessary information elements that will be needed for environmental water accounting.

The coverage of sites for environmental flow monitoring should be specified in individual plans and may need expansion to make environmental water accounting fully effective.

Flows into and out of wetlands along rivers are often difficult to measure but appropriate information elements are required if such flows are to be included in water accounts. The water accounting information system can readily accept the best available estimate by whatever process, but should attach some comment on the source and probable accuracy of the estimate. This can be done by notes to the accounts.

Actual consumptive evapo-transpiration of wetlands can possibly be estimated by techniques such as remote sensing based application of the Surface Energy BAlance for Land (SEBAL). This is different from the net flow into the wetland because:

- It takes no account of seepage
- It takes no account of changes in the volume of water in the wetland over the accounting period

It may be that in some or many cases a modelling approach will produce the best answers to some of these questions.

Methods of estimating flows into and out of riverine wetlands during floods, and physical evapo-transpiration and seepage from riverine wetlands, should be further investigated, with the aim of developing guidelines for estimating the relevant volumes to be used in accounts.

8.8 Recording

The information system requirements for recording environmental information elements are similar to those for water resource accounting for in-stream considerations and water market accounting where extractive rights exist.

In the case of in-stream environmental water, standards that relate to information elements should in most cases provide sufficient information to undertake appropriate analysis. Where the standards don't cover such information they should be expanded to do so.

In the case of extractive rights, the water market accounting standards could be modified to include additional entities or information elements to track dedicated water.

Any standards developed for these accounting themes should consider the environmental requirements as they relate to information element needs.

8.9 Opportunities for improvement

8.9.1 Consistency of language

This is difficult in many areas, not just in environmental water accounting or water accounting in general. The aim should be to move towards consistent use of terms, or at least towards understanding what terms are synonymous even if different terms are used in different jurisdictions. The recognition criteria suggested in the conceptual framework could be useful to achieve an understanding of synonyms.

8.9.2 Consistency of methods of estimation

There is a need to develop consistent methods of estimating information elements where actual measurement is not feasible or is unreasonably costly. However consistent does not mean uniform – there will still be a need for judgement to select the most appropriate method in a particular case.

8.9.3 Consistent presentation

While there has been a lot of work on trying to ensure that the needs of the environments for water are recognised and to some extent specified, consistent reporting on the results is in its infancy. There are two broad categories to consider.

Firstly, in circumstances where the environment holds no extractive rights, reporting is basically concerned with compliance with environmental rules. This comes in many different forms, and there may be no pressing need to change the form of reporting – merely to understand how it works and put it in some nationally consistent framework.

Secondly, in circumstances where the environment holds both extractive and instream rights, there is a major opportunity to develop a consistent and sensible accounting framework that applies across jurisdictional boundaries readily. It would be informed by, and depend upon, State registers and trading information. That requirement has elements of uniformity as well as consistency. Considerable resources will be needed to get this right, but it is more or less a greenfields opportunity to get it right from the start and minimise long term costs.

In the large regulated systems of the Murray-Darling Basin where the environmental managers holds both extractive and non-extractive rights, there is an opportunity to minimise long term costs by developing a single consistent accounting system, for both environmental and other water, that crosses jurisdictional boundaries

8.9.4 Annual plans

In the large connected regulated systems, the storage operators usually have annual plans of greater or lesser sophistication – River Murray Water is probably the most advanced because of the complexity (physically and institutionally) of its operations. Environmental managers are already major entitlement holders in the Murray system, and environmental entitlements and the associated management challenge will increase. However it is most unlikely that separate environmental capacity shares of storages will be issued or that a separate set of “environmental storage operators” will emerge to duplicate the existing operators. Nevertheless, environmental managers will want to influence not only delivery of their water, but which storage it comes from and which route it is delivered by.

There would seem to be significant advantages in developing a formal annual planning process in which storage operators and environmental managers both participate. Such a process should enable “win-win” arrangements to be maximised. It is recognised that this conclusion is not strictly about water accounting, and more about management, although a forum would provide an opportunity for water accounting issues and treatments to be addressed.

9 Analysis of water use accounting

9.1 Description and scope of theme

This accounting theme relates to the identifying, measuring, recording and reporting of information regarding the purposes for which water is used, the volumes that are used for those purposes, and the sources of those volumes. Water supply and use accounts, such as those currently produced at 4 yearly intervals by the ABS, provide a link between water resource management and the economy.

9.2 Objective

The desired NWI water accounting outcomes relating to water use are:

- To provide a basis for accountability for use of the resource
- To demonstrate the benefits of reforms
- To demonstrate to the public the positive benefits of use of water
- To inform water resource review and planning processes.

Water supply and use accounts can demonstrate the economic value being derived from the use of water. They are primarily useful for planning and policy making. Linked with other information such as water trading data, water supply and use accounts can show the economic benefits of water reforms over time.

The *Water Account Australia 2000-01* notes that this type of account can contribute to:

- A broader assessment of the consequences of economic growth
- An understanding of the contribution of sectors to particular environmental problems
- An understanding of the sectoral impacts of environmental policy measures

The SIEEAWR states that

"Only by integrating information on the economy, hydrology, other natural resources and social aspects can integrated policies be designed in an informed and integrated manner. Policy makers taking decisions on water need to be aware of the likely consequences for the economy. Those determining the development of industries making extensive use of water resources either as inputs in the production process or sinks for the discharge of wastewater need to be aware of the long-term consequences on water resources and the environment at large"

Consistent with these outcomes, the following objective for water use accounting is proposed:

The objective of water supply and use accounting is to provide relevant and reliable public information regarding the economic uses of water, to inform planners, policy makers and the public of the economic benefits being obtained from use of water of the economic effectiveness of current water management policies and regulatory arrangements (including water trading), of the possible economic impacts of changes in water management policies and regulatory arrangements, and conversely of the possible impacts on water resources of changes in the economy.

9.3 Current drivers

Water use information is currently being gathered and reported for a number of organisations for a variety of reasons:

- The Australian Government, via the Australian Bureau of Statistics (ABS), currently has scheduled the production of a national water accounts every four years. The driver for this is the need to understand the linkages between water resources and the economy to aid planning and high level decision making. The ABS has a Water Statistics User Group which advises the ABS on their data needs. It is possible that the accounts will be produced more frequently in the future and for small areas (e.g. surface water management areas) but this is dependant on additional resources being made available

- Some government bodies (eg NRM Boards in SA) gather this information for resource planning purposes.

- Some rural water service providers invest in gathering accurate information on crops grown and areas due to a direct linkage between the water service providers obligations to supply water and the water needs of the customer. However this is likely to be phased out as customer water entitlements are separated from their crop water demands.

- Some rural water service providers invest in gathering accurate information on crops grown in order to understand their customers. This is not however, very common.

- State Water in NSW is investing in increased irrigation water use collection in order to obtain better information for system simulation models used for planning and MDBC cap reporting.

- Urban water service providers generally differentiate between residential and non-residential uses of the water they supply, but only to the extent that they need to for billing purposes.

Some organisations who have collected this kind of information in the past are consciously reducing their collection of water use information as they do not see it to be related to their functions or are getting their data from other sources (e.g. the ABS water accounts)..

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9.4 Concepts and definitions

The UN's recently adopted SIEEAWR contains a glossary of terms and definitions. Generally these terms and definitions are consistent with the terms adopted in this project, but there are some exceptions.

Important definitions in the SIEEAWR which could usefully be applied to this and other accounting themes are the definitions for *abstraction, supply, use* and *return* of water. The information elements used in the stocktake are not totally consistent with these terms, nor are they always in common usage. For example, diversion and extraction are commonly used rather than abstraction.

It would be beneficial if terms and definitions used in Australia were aligned with international terms and definitions and such alignment should be considered in development of the proposed national chart of water accounts.

9.5 Reporting

9.5.1 Reporting obligations

The ABS clearly has been the agency primarily responsible for collecting and reporting this information. It would be difficult to impose obligations to collect this information on other organisations, when they do not already collect the data for other purposes.

However where organisations are collecting this information for other purposes, it is desirable to ensure this information is collected consistent with standards and definitions which would enable it to be integrated into ABS information systems and data presentations.

9.5.2 Standard reports

The template physical water supply and use tables outlined in the SIEEAWR (see Figure 41) are appropriate to be used as a basis for standard reports for this theme. These tables show the volumes supplied and used by various industry sectors.

These tables can be used, in conjunction with economic data, to generate the 'hybrid' supply and use tables shown in the SIEEAWR which show monetary benefits associated with the uses, and are thus the linkage into economic accounts.

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■ **Figure 41: Supply and Use tables from the draft IEEAW**

Physical use table

Physical units

		Industries (by ISIC categories)							Households	Rest of the world	Total
		1	2-33, 41-43	35	36	37	38,39, 45-99	Total			
From the environment	U1 - total abstraction (=a.1+a.2= b.1+b.2):										
	a.1- Abstraction for own use										
	a.2- Abstraction for distribution										
	b.1- From water resources:										
	Surface water										
	Groundwater										
	Soil water										
	b.2- From other sources										
	Collection of precipitation										
	Abstraction from the sea										
Within the economy	U2 - Use of water received from other economic units										
U=U1+U2 - **Total use of water**											

Physical supply table

Physical units

		Industries (by ISIC categories)							Households	Rest of the world	Total
		1	2-33, 41-43	35	36	37	38,39, 45-99	Total			
Within the economy	S1 - Supply of water to other economic units										
	of which: Reused water										
	Wastewater to sewerage										
To the environment	S2 - Total returns (= d.1+d.2)										
	d.1- To water resources										
	Surface water										
	Groundwater										
	Soil water										
	d.2- To other sources (e.g. sea water)										
S - **Total supply of water** (= S1+S2)											
Consumption (U - S)											

Note: Grey cells indicate zero entries by definition.

These tables should be capable of being generated with a more detailed breakdown of industries and water supply sources than shown. This is discussed further in section 9.6.1 (information elements).

Additionally it is important to report on areas of crops grown. ABS prepares tables of this information in its *Water Use on Australian Farms* reports. Other organisations also report this information. Areas of crops grown is important for water resource planning. The report is simply a table showing the areas of various crops grown in a defined area over a period.

9.5.3 Water entities

To best achieve the objective of water supply and use accounting, the water entities which are reported on must be able to be synchronised with water resource planning units. Reporting at the level of State is not sufficient. It is understood that the ABS is already moving to be able to report at a more spatially detailed level than in the past.

Standard water supply and use reports and crop area reports should be capable of being prepared for surface water management areas and trading zones, in addition to the common national statistical divisions

9.5.4 Reporting periods

To synchronise this information with economic data it is best that the reports be prepared on a financial year basis. This also fits with the general finding in the stocktake that most organisations are reporting on a financial year basis in annual reports and reports required by regulators.

9.5.5 Aggregation

Generally these accounts are capable of being aggregated to state and national level. It would also be beneficial if they are able to be aggregated to surface water divisions.

9.6 Measuring

9.6.1 Information elements

In Australia the industry classifications used for national accounting are the *Australian and New Zealand Standard Industrial Classification (ANZSIC) 2006*, (published by the ABS) which is an Australian and New Zealand adaption of the the *International Standard Industrial Classification of All Economic Activities* (ISIC). These classifications go from very broad divisions down to classes as shown in this example:

Division A	Agriculture, Forestry and Fishing
Subdivision 01	Agriculture
Group 013	Fruit and Tree Nut Growing
Class 0131	Grape Growing

Thus the industry groupings shown in the proposed standard reports could be be expanded to show further detail (ie by subdivision, group or class). In addition to an industry classification many organisations, including the ABS, also use an activity or product classification. That is, information can be presented for grape crops as well as for the grape growing industry. Grape can be grown by business classified to other industries (e.g. Food and beverage manufacturing industry). In the ABS Water Use on Australian Farms information is presented by crop types (an activity) rather than by industry. This is important for water resource planning where details of types of crops grown are needed.

NSW DNR developed a system of crop categories based mostly on plant physiology as part of the volumetric conversion process for licensed water use on unregulated systems. They report their intention is to make this the basis for capture of cropping/water use information via their WIX customer information exchange system currently being implemented. It would be beneficial if this classification could be reconciled with the activity classification used by ABS and a common approach adopted.

The sources of supply shown in the proposed standard reports should also be able to be expanded further. While it is adequate to know whether water comes from surface water or groundwater at a rolled up level, to be more beneficial for long-term water resource planning it is important to know whether the surface water is from regulated or unregulated rivers, farm dams capturing local catchment runoff, or overland flood flow harvesting works. Ideally it should also be capable of showing which river system or aquifer system the water comes from. This suggests that water supply sources shown in the template supply and use tables could be profitably divided into subdivisions and units, in a similar manner to which the water use classifications are divided.

It is clear that standard classifications of water use activity should be developed and adopted by all those collecting and reporting this information. These activities should ideally be consistent with ANZSIC classifications currently in use.

It would also be beneficial if tables of water supply sources could be developed by subdividing the source types shown in the SIEEAW supply and use tables into source subtypes and specific sources. These should be aligned with water entities to be included in the proposed chart of accounts for water.

9.6.2 Information gaps

A major information gap is data on the use of rainfall (normally stored in the unsaturated soil profile) for agriculture. This represents a major source of water and is a major contributor to economic benefits. Irrigation water use usually does not include water derived directly from rainfall which reduces the need to take water from rivers or aquifers, thereby skewing the results in wet years. Non-irrigated agriculture uses rain water solely. The SIEEAWR identifies this as a source which should be reported in order to get a correct picture of water supply and use.

Methods are needed to collect/derive this data for inclusion in water supply and use reports. These methods might range from look up tables based on average figures for crop types, climate zones and annual rainfall, to more sophisticated methods using landsat imagery and other spatial data.

9.6.3 Standards and methods

9.6.3.1 Agricultural water use information

The most common method used to gather the information needed for the proposed standard reports is by survey of the primary producer. There are significant doubts about the reliability of the information, as often the farmers may guess or estimate volumes of water. Methods for validation are important to maximise data quality.

There are opportunities to link survey data with land valuation and satellite imagery information for crops and areas, and water service provider information for volumes. The common reference point is the land where the water is being used.

It is therefore sensible that all water use survey data be recorded linked to a property reference. This will enable these other data collection methods to be readily used to validate or extend the survey data.

Except for those used by the ABS there are currently no generally adopted standards for collection of water use information. As there are likely to be a number of organisations involved in data collection, it is very desirable that common standards be used by all.

9.6.3.2 Urban water use information

Urban water supply providers generally hold much of the information on urban water use needed to generate the information required for water supply and use reporting. In many cases their information systems do not, however, hold sufficient information to enable the industry or activity breakdowns required. In some cases this information could be obtained from land zoning data to which most urban water supply authorities would have access but linking these data sources has proved problematic.

It would be beneficial if ways could be found to cost effectively enable and encourage urban water service providers to collect and report on supply and use in accordance with national standard industry and activity breakdowns to populate standard water supply and use reports

9.7 Recording

9.7.1 System features

Given the multiple parties collecting information there is an opportunity to develop a general platform to which water service providers as well as the ABS could add information. For this to work many of the issues discussed in the previous sections would first have to be resolved. In particular there would have to be commonly adopted water use and water supply source classifications, and standards for collecting the information.

The system would need to accommodate duplicate information from different sources, eg crop areas from surveys, from landsat imagery, and from land valuations. The common reference for such information would be a property identifier and time period. Procedures could then be developed to use this information for validation purposes.

The system would be most effective if it incorporated many aspects of the national chart of accounts for water. In particular water entities should be the same so that information from resource and water allocation water accounting information systems could be drawn upon and reconciled with information collected on water supply in surveys.

9.7.2 Reconciliation

Ideally the national water accounts published every four years by ABS should be able to be reconciled with the ongoing water resource assessment information which is planned to be reported through the Australian water resources assessment project. Particularly it should be possible to reconcile the supply figures in the national accounts with corresponding figures from water resource reports. This can only work if the information sets are linked by a common chart of accounts.

10 Recommendations

10.1 Context

The stocktake process demonstrated that water accounting exists in some form in all water businesses. The scarcity of the resource, and our dependency on it, will mean that analysis and scrutiny of water accounting and reporting will more than likely increase in the future. Industry experts, water users, researchers, policy makers, investors and other users of water accounting reports must be able to understand the information provided. These report users and their needs must be identified. Water accounting and reporting should be driven by the requirements of users of this information, not by what is currently available.

The stocktake findings demonstrated that development of water accounting across the nation, whilst showing signs of some good practice, is being developed in an ad-hoc fashion.

A disciplinary approach is the most stringent way forward. It is the most likely to achieve a nationally consistent result and to maximise the benefits from the considerable efforts and resources being directed to water accounting.

Key drivers for water accounting to be established as a discipline include:

1. With the exception of the Australian Bureau of Statistics (ABS), external users of accounting information cannot command information directly from the provider.
2. Policy makers and water markets will require that information is assembled and reported according to consistent standards.
3. Public confidence in water accounting is required, as the availability of the resource will have social, economic and environmental consequences as policy makers and water markets react to water accounting information.

If water accounting is to emerge as a discipline then water accounting information must serve the needs of external users of water accounting information as well as the management requirements of water businesses. The reason that the stocktake findings demonstrated that water accounting has been developed in an ad hoc fashion is because water accounting has been focused primarily on the needs of management and direct customers, rather than the needs of a full range of external users, and the information needs of external users has not been explicitly or systematically explained. In many cases, the water accounting needs of internal and external users will coincide. However in many other cases these needs will not coincide and a discipline is required to determine the extent to which and how best to meet the needs of external users.

The move to water accounting as a discipline will be an evolutionary process and may involve guidelines rather than standards in some situations.

Any discipline, by its nature, involves a systematic approach to the achievement of its objectives. The preferred solution focuses on a proposed national water accounting process and the development of a disciplined approach.

The project was conceived without knowing the status of water accounting in Australia and has primarily involved a stocktake of practices in state and territory government water agencies and sample water businesses as well as an analysis. The stocktake found that water accounting is at an immature phase and much of the analysis has focussed on intellectual infrastructure required to develop water accounting as a discipline and to ensure that developments, whether they relate to reports or systems, will be well conceived and effective.

In some identified water themes and aspects management concepts are not well developed and there is a divergence of views and approaches about the best management arrangements. Without well established management practices, or a shared view of effective management regimes it is difficult to invent and gain consensus to accounting concepts and treatments. This is the case with environmental water management and management of connected groundwater and surface water resources. Further joint work is required in such cases using open, inclusive processes such as is intended for the development of a water accounting user requirements definition and water accounting standards.

10.2 The way forward

Proposed principles to guide the development stage of water accounting in Australia are:

- Use appropriate starting points wherever practicable – pick up on relevant work undertaken nationally and within jurisdictions, best practice examples within water businesses and specific developments that have been documented during this project, as a cost effective base on which to build.
- Develop the essential intellectual infrastructure or theoretical base to ensure discipline and rigour in a manner which both learns from and informs practice and practicable developments, through targeted pilot projects which test the application of proposed standards and guidelines and maximises the integration of development work.
- Focus on agreed priorities for development of standards, build on current or proposed good practice reporting and support research and development projects that are effective or offer significant potential in developing national standards for identifying, measuring and recording water information.
- Involve stakeholder representatives and develop business cases as part of each project or priority action initiated to develop water accounting nationally.

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- Concentrate on development of a few demonstration water accounting information systems – make real progress on development of information systems with the intent of effective and expandable application of water accounting functionality.

These proposed principles have guided the development of recommendations in the following sections.

10.3 What is water accounting?

A working definition of water accounting is:

Water accounting is the application of a consistent and structured approach to identifying, measuring, recording and reporting information about water.

Key features of water accounting include:

- Water accounting does not change who manages water.
- Water accounting will reflect events that occur.
- Water accounting will not decide what will happen; it will enable reporting of what has happened.
- Engineering, accounting, statistical and scientific experts will define guidelines and standards associated with identification and measurement of water accounting information.

Recommendation 1: That the working definition of water accounting be adopted

10.4 Proposed National Water Accounting Process

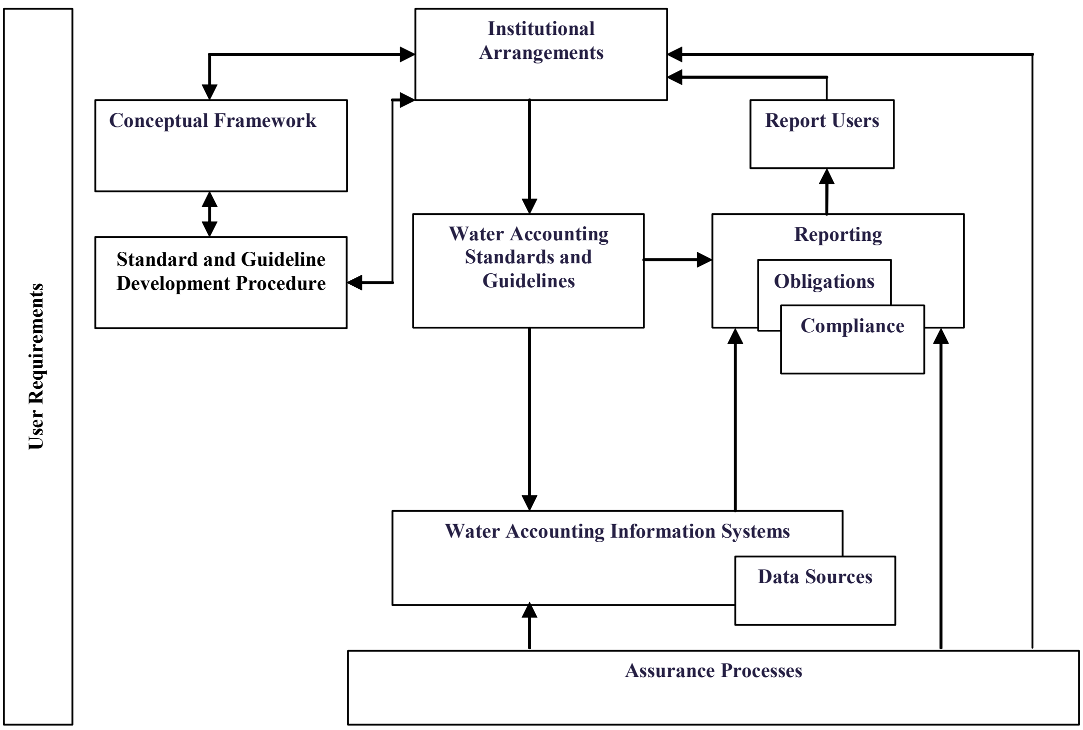
A proposed *national water accounting process* was developed during the stocktake analysis process and is shown in Figure 42. The two way arrows are indicative of iterative process steps, while one way arrows are indicate of the general direction of the process flow. The process includes some ‘one way’ feedback loops, which along with the ‘two way’ iterative process steps are designed to supply continuous improvement.

The *institutional arrangements* will oversee the development of a *conceptual framework* for water accounting, the establishment and application of a *standard development procedure* and the approval of water accounting standards.

The standards will in turn inform the reporting requirements and influence the design and implementation of the *water accounting information systems* that provide those reports. An assurance process should monitor the integrity of the *water accounting information systems* and the level of compliance with reporting obligations.

Report users will receive and analyse water accounting information mainly via reports and provide feedback to the institution overseeing the *national water accounting process*. It is essential that users of accounting information can influence water accounting and reporting. User requirements are seen as encompassing the whole process as the users of water accounting information are the reason for the focus on improved water accounting and reporting.

The user requirements, institutional arrangements, procedure for development of standards and guidelines and the conceptual framework provide fundamental intellectual infrastructure for the development of water accounting.



▪ **Figure 42 Proposed National Water Accounting Model**

Without this intellectual infrastructure, water accounting will lack the rigor and logical consistency needed to produce useful water accounting information. Users of water accounting reports need to have confidence in the underlying methods and principles that have been used to prepare water accounting reports.

Application of the level of discipline inherent in the proposed national water accounting process will reduce cost in the long run, as it enables progressive building of knowledge and limits the need for revision and multiple iterations.

Recommendation 2: That the process for developing and maintaining water accounting as a discipline be adopted as indicated in Figure 42***.***

10.5 Institutional arrangements

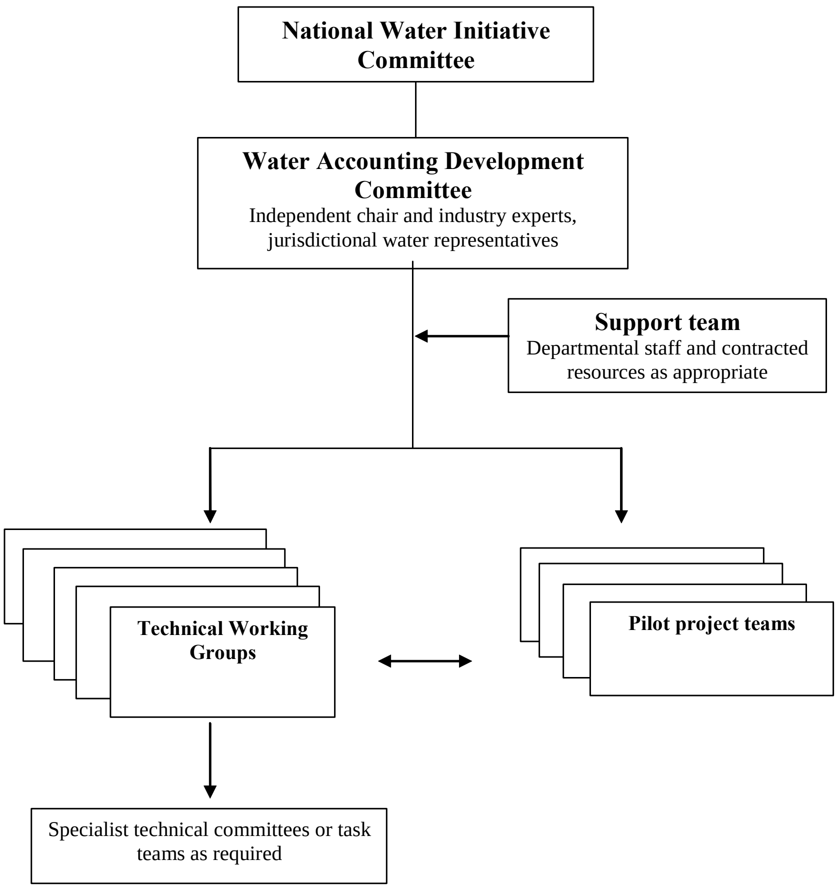
The development of water accounting and reporting standards and guidelines will require an institutional structure to ensure appropriate governance and decision making. The creation of separate institutional arrangements should consider current institutions and roles and only proceed if a separate focus is warranted.

A separate interim body, at a similar level to the NWI Committee, is seen as necessary to ensure adequate focus on a substantial development agenda, while retaining direct links to the Natural Resources Management Ministerial Council in relation to implementation of the provisions of the NWI Agreement. A *Water Accounting Development Committee* (WADC) and a series of technical working groups (TWGs) as shown in Figure 43 is proposed.

The WADC will have the primary coordination and integration steering role, will be the prime decision making body for determining standards and guidelines and will need to be above the detailed work. It may draw its effective power from the NWI Agreement during the initial phase of water accounting development, during which it is unlikely that the mandating of the application of water accounting standards will be required.

The initial priority work may include development of a user requirements definition, a common chart of water accounts and the initial water accounting and reporting standards or most likely guidelines. This work would be undertaken by dedicated technical working groups supported by departmental staff and contracted resources, as well as subsidiary specialist technical committees or task teams, as appropriate.

It is also proposed that all development work be progressively tested in practice through pilot projects aimed at demonstrating the application of proposed standards and guidelines and informing the essential disciplinary development work through iterative processes.



▪ **Figure 43 Proposed interim water accounting institutional arrangements**

The chairman and members of the *Water Accounting Development Committee* could perhaps initially be appointed by the NWI Committee. It is suggested that the chairman be an independent and part time role, with the other part time members coming from a mix of jurisdictional representatives and other independent professionals and experts from the financial accounting and water industries. The Committee could be linked to the Natural Resource Management Ministerial Council for resolution of any policy matters that may be required.

The composition of the technical working groups would be tailored to suit the particular undertaking, with potential membership being drawn from water businesses, government agencies, academia and industry groups such as NFF, ABA and the environment.

The interim institutional arrangements could be transformed into a more permanent structure once the initial development work has progressed sufficiently and the need for a permanent structure was evident through an appropriate assessment.

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While several models, including options of integration with existing accounting or standards institutions, could be considered, a proposed structure of institutional arrangements for this more mature phase of water accounting is modelled on the Australian Accounting Standards Board (AASB) structure. The AASB structure is a consequence of reforms implemented by the government of Australia and equates with current practice with the cost being met by government. Given the imperative of the NWI and the national and public interest in improved water accounting a model based on this structure is appropriate.

Recommendation 3: That a Water Accounting Development Committee be established with support from a well resourced dedicated team to oversee the development of water accounting.

The cost of implementing a WADC has been estimated based on provision of a Chair and some key dedicated support staff to oversee the technical working groups. Although funding of this institutional arrangement over an initial three year period would provide a basis for capacity building, it is likely that additional resources would be required to undertake the development work and pilot projects, and hence the needs for additional resourcing may emerge.

It is also likely that these dedicated staff will liaise with jurisdictional contacts throughout the development phase and as pilot projects proceed to support jurisdictions in building capacity. For these reasons, the costs for institutional arrangements have been combined with those for capacity building in the following section.

10.6 Capacity building

The proposed development work to establish water accounting as a discipline as well as water accounting and reporting standard s and guidelines clearly indicates that additional capacity will need to be developed within the water industry if we are to deliver national water accounting requirements.

Capacity building could include:

- Development of technical skills
- Acquisition of skills and experience in accounting
- Training
- Investment in new systems and forms of measurement

While a formal stocktake of water accounting capability was not part of the scope of this project it is clear that officers within jurisdictions are struggling to keep up with the reform agenda developed by the NWI. The intellectual infrastructure that will need to underpin water accounting cannot be developed in the timeframes required by the NWI using just existing resources.

The proposed *Water Accounting Development Committee* and associated technical working groups and subsidiary specialist technical committees or task teams will provide significant opportunities to build water accounting capacity. In particular an infusion of qualified accountants and the integration of their skills and perspectives with water industry practitioners and policy formulators is to be encouraged.

The cost to support either dedicated water accounting personnel or development of additional water accounting capability in targeted locations around Australia, matched to development projects or for fundamental capacity building, is estimated at $0.75M each year for the next 3 – 5 years. It should also be noted that capacity requirements specific to pilot project work, including participating jurisdiction requirements, are assumed to be included in the resourcing of those projects.

Recommendation 4: That capacity building, aligned with water accounting development priorities, be addressed as early as practicable.

10.7 Identification of user requirements

Report users are shown as the receivers of water accounting information in the proposed national water accounting process (Figure 42). They are at the end of the process that involves establishing appropriate institutional arrangements, the conceptual framework, the standard setting procedure, the standards, water accounting information systems and assurance.

The purpose of any water accounting and reporting information system is to meet the needs of users. The stocktake process identified what current *water information systems* were available and the information that these systems could provide. An important gap that has been identified is that the users of water information and their needs have not been adequately addressed.

The development of a detailed *user requirements definition* is considered essential if we are to support the development of a meaningful national chart of water accounts and to identify water accounting standard development priorities. This development would help determine the scope and justification for water accounting. It would build on current starting points, including the work being undertaken by Victoria to scope the requirements for a register and the structure for data developed by the Australian Bureau of Statistics (ABS) and Bureau of Rural Sciences (BRS). Development of the user requirements definition would include the following steps:

- Identification of key user representatives from the water industry and those users who cannot command information for themselves;

- Reviews of relevant user requirements definitions, or similar documentation that has been developed by States and Territories during the development of water accounting or water information systems
- Workshops with user representatives to clarify requirements;
- Assessment of requirements, with particular emphasis on known current shortcomings such as accounting for water for the environment, purpose of water use and reporting formats;
- Documentation of requirements; and
- Confirmation of requirements, including sign off with representatives from water industry and those users who cannot command information for themselves.

Key deliverables from the user requirements definition would include:

- Clarification of the *scope* of water accounting and reporting
- *Why* particular water accounting information is required
- Whether water accounting information provision is *feasible* or *warranted*
- *How* it is proposed to provide access to this water accounting information
- *Who* will provide accounting information
- Frequency of provision of accounting information (*When*)
- *What* accounting information will be provided
- Expected *future* water accounting requirements
- A prioritisation and staging assessment

Such a task is required to inform the initial stage of water accounting development and could be carried out partially in parallel with or be linked to other processes designed to develop an a*greed* common chart of water accounts for water accounting and *agreed* reporting formats for key reports.

It is envisaged that this task would take between three to four months as an initial project and would cost in the order of $250,000. It is also anticipated that a dedicated amount (nominal $50,000 on two occasions) would be required in subsequent years to review the definitions based upon other developments in water accounting. This work could involve additional consultation with interest groups where their interests have not necessarily been fully considered during the initial project or where developments in accounting treatment for some users may have implications for other user groups.

An emphasis of this work should be on requirements of external users, those who cannot command water accounting information and therefore rely on others to provide this information. In addition to government agencies, users could include water users, entitlement holders, water market investors traders and brokers, environmental organisations, auditors, financiers, local governments, researchers, planners and policy formulators.

A proper analysis of user requirements would involve interaction with representatives from these groups. The user requirements should cover the potential scope of water accounting including the four accounting themes of *water market accounting, water resource accounting, environmental water accounting* and *purpose of water use accounting*. The process should also attempt to identify any *future* requirements, particularly since the stocktake and analysis process has focussed more on what is available, rather than on what should be available.

Recommendation 5: That the detailed requirements of water information users be defined, assessed and reported to inform the scope and development of water accounting

10.8 Conceptual framework

A *conceptual framework* is a consistent reminder of the requirements needed to develop rigorous and relevant standards. Any *conceptual framework* for water accounting must complement the standard setting procedure and facilitate high quality water accounting standards.

The theoretical aspects included in a *conceptual framework* for water accounting are expected to take some time to develop. Realistically the *conceptual framework* may not be fully developed for some years, and in the interim it is proposed that work on high priority accounting standards proceed in parallel with the development of the *conceptual framework*, and that lessons learned during the development of these standards influence the *conceptual framework*.

A proposed conceptual framework for water accounting comprises the following components:

- Scope
- Reporting entities- water entities and report preparers (key component of chart of water accounts)
- Objective
- Relevance
- Reliability
- Understandability
- Comparability
- Materiality
- Recognition Criteria

- Information elements (key component of chart of water accounts)
- Measurement
- Reporting and compliance
- Monitoring and enforcement

As an interim step, while the *conceptual framework* is brought to maturity it is proposed that the components of the proposed conceptual framework be considered as each water accounting standard is developed.

As a control mechanism, it is proposed that any water accounting standards developed prior to the conceptual framework reaching an acceptable level of maturity be compared with all other water accounting standards developed to that point, in order to ensure consistency and avoid conflicts between standards.

A project should be initiated to allow development, in an iterative manner, of a conceptual framework for water accounting which will run for the duration of the development phase of water accounting.

The likely investment required to be $150,000 per year for the next 3 years

Recommendation 6: That a conceptual framework be progressively developed based on the starting point identified in this project and integrated with the development of the initial priority water accounting standards, to facilitate the development of consistent and relevant water accounting standards.

10.9 Procedure for setting of water accounting standards

There are advantages in having a structured, transparent procedure for the development of water accounting standards. While numerous development processes could be adopted, the process used by Standards Australia seems to be most appropriate.

Key features of this *standard setting procedure* and its applicability to water accounting include:

- Individuals and a range of organisations can initiate the request for a standard.
- Cost-benefits analysis ensures that the needs of the users (beneficiaries) are weighed against the demands based on the providers of the water accounting information as it is the providers who must bear the ongoing cost of data gathering, recording and reporting.
- Water industry experts can be represented on the technical committee, sub committees and task teams to ensure that water industry experience is applied.
- User groups can be involved and given the opportunity to influence standards development, as well as the public (eg through the opportunity to comment on draft standards or guidelines).

- The procedure is suitable for development of technical standards, many of which are likely to be required for water accounting.
- The above standard setting procedure will equate with best practice.

The initiation of the procedure could be modified from receipt of a request to the institution determining the need for a standard based on the provisions of the NWI Agreement and its view of priorities. This would be appropriate to accelerate the initial phase of water accounting development.

Recommendation 7: That a procedure for standard and guideline development be adopted by the Water Accounting Development Committee based on the standards development process applied by Standards Australia.

10.10 Common chart of water accounts

Accounting information systems cannot function without a chart of accounts. The chart of accounts for a *water accounting information system* should define ***what*** type of information must be gathered and recorded (equivalent to the information element defined in the stocktake phase of the project) and the ***level*** that the information element is to be aggregated and reported (equivalent to the water entity defined in the stocktake phase of the project) and ***who*** prepares the water accounting reports.

It is proposed that a national chart of water accounts be developed based on input from all States and Territories. The common chart of water accounts has a direct relationship with the *conceptual framework*.

The *conceptual framework* discussed in the Section 5.6 includes the *reporting entities (water entity and report preparer)* and the *information elements*. The *water entity* identifies the ***level*** that information is aggregated and reported at and the *report preparer* is ***who*** will prepare the reports. The *information element* defines ***what*** type of information will be gathered and recorded. Table 8 below shows the proposed chart of water accounts structure for water accounting.

Table 8 Proposed chart of water accounts structure

Conceptual framework	***Chart of water accounts***	***Examples from stocktake***
Information element	Information element ***What*** information will be gathered	Stock Inflows Outflows

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	and recorded at the transaction level	Water Allocation Water access entitlements Etc.
Reporting entities	Water entity ***Level*** that information elements are reported	Fitzroy River Basin Greater Goulburn Trading Zone Harvey Irrigation Area
	Report preparer ***Who*** will prepare the reports	Central Irrigation Trust State Water DNR MDBC

The stocktake findings indicate that an intuitive chart of water accounts has been developed in many participating organisations. It is natural when producing accounting information to think in terms of what information needs to be provided and at what level the information should be aggregated and who is responsible for preparing the information.

There are multiple ***levels*** in water accounting, and not all are hierarchical. Any chart of water accounts must be developed with this in mind. It should be possible for the preparer to report information at multiple levels using the same information elements

Examination of the water accounting reports identified in the stocktake indicates that intuitive categorization of *information elements* into assets, liabilities, equity revenue and expenses has occurred to some extent. Formally recognising such categories in a chart of water accounts will improve water accounting capability in all jurisdictions.

Any transition to new *water information systems* for water accounting should not occur until the chart of water accounts has been agreed between States and Territories. A project should be initiated, ideally following on from the user requirements definition work, to develop a common chart of water accounts for Australia which should pick up on starting points in jurisdictions and from nationally focussed work.

The advantage of a chart of accounts is that it introduces a unique coding structure for all water data which allows the flexibility to aggregate data according to pre-determined formulas. This not only makes procedures repeatable and auditable, but it allows processes to be incorporated into system design that may otherwise be time consuming and error prone. The coding structure, if common across the nation, will also mean that data transfer and interoperability issues will be significantly simplified.

The development of a national chart of water accounts will also provide an opportunity to cater in a structured way for the diversity in water information terminology across Australia, which includes environmental and water use terms and ideas including those from the international arena. The Australian Water Resources Assessment 2000 and the physical water entities as set out in Table 3 provide starting points for water entities in the development of a common chart of water accounts, as does Appendix B for information elements. Development of a 'common chart of water accounts project' is likely to require an investment of $250,000 per year over the next 2 years.

Recommendation 8: That a common chart of water accounts be developed based on the starting points identified in this project and including work within jurisdictions.

10.11 Arrangements for water accounting development

As discussed in Section 10.5, the WADC will have the primary coordination and integration steering role, will be the prime decision making body for determining initial water accounting standards and guidelines and will need to be above the detailed work.

Technical Working Groups (TWGs) would be established under the WADC. The TWGs would be the main work vehicles for both the essential work for the development of water accounting as a discipline as well as for the development of particular standards and guidelines.

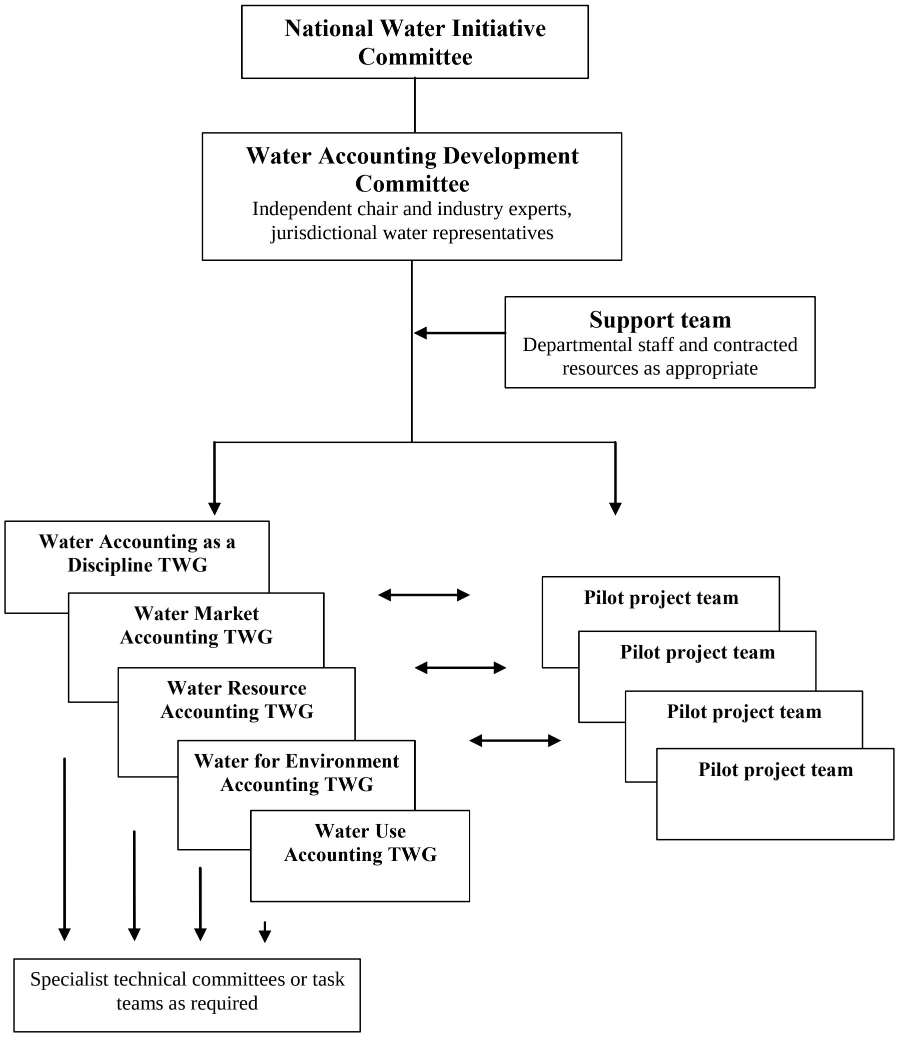
Five TWGs are proposed as a starting point configuration for WADC consideration as shown in Figure 44. One TWG is proposed for further developing the intellectual infrastructure necessary to establish water accounting as a discipline and one TWG is proposed for each of the four identified water accounting themes, which would focus on water accounting and reporting standard and guideline development.

For more focussed development work subsidiary specialist technical committees or task teams could be established as required by the TWGs. At the sixth and final meeting of the EAP an agreed view was reached that development work of the TWGs be tested through pilot projects in an iterative fashion to further inform the development work.

Depending on the nature of the issue to be addressed, the TWGs (or specialist technical committees or task teams) could include representatives of end users of water accounting information. Members of the TWGs (or subsidiary committees or teams) might include representatives of:

- Government agencies (including government departments, statutory and regulatory agencies);
- Water businesses (including urban and rural water supply businesses, and utility or infrastructure businesses);
- industry groups (including the National Farmers' Federation, the Australian Bankers Association, the Agricultural Finance Forum; and

- environmental and conservation groups.
- Academia (including universities and public or private research institutions);



- **Figure 44 Proposed institutional and resourcing arrangements**

The technical working groups would be supported by staff within the appropriate Australian Government agency or department (for example, NWC or DAFF) and would report to the WADC. Some common membership between TWGs and also the pilot project teams is one mechanism to assist coordination and integration.

While identified as separate projects or actions it is desirable that the development of the user requirements definition, the conceptual framework, the standards and guidelines procedure and the common chart of water accounts be overseen by a single TWG. This will assist with coordination and integration of the essential development work to progress water accounting as a discipline.

The EAP favours a pilot approach to test in practice and inform water accounting development. A series of pilot projects would be established to trial proposed water accounting standards and guidelines and to test and inform the development projects which focus on developing water accounting as a discipline.

The pilot projects could occur in multiple locations that would provide a good representation of how water accounting standards and guidelines could be applied nationally.

The pilot projects would also inform and test water accounting and reporting standards or guidelines for:

- water market accounting including water access entitlements, water allocations, use and trading;
- water resource accounting including surface water, groundwater, water cycle and connected surface and groundwater resources.
- Water for environment accounting including rules based and volumetric water; and
- Water use accounting (building on the work of the ABS Water Statistics User Group)

Pilot projects and associated project teams are likely to emerge either through being volunteered or from targeted search or negotiation and their scope of work will vary. The focus may be narrow (eg testing a specific standard report) or be much broader or integrated in scope (eg include a water accounting information system development component). A few water service providers will need to be involved as well as central government water departments or agencies.

The development pilot projects may involve partnership funding from the private sector and Australian, state and territory governments.

10.12 Priorities for development of water accounting standards

The development of standards and guidelines is seen as one of the key areas where water accounting practices can be significantly improved in this country and is included as a focus of the NWI Agreement. This is not surprising as jurisdictions and their agencies have undertaken their own development based on their own unique history, obligations and circumstances. Creating a well structured work plan for what is potentially a large body of work is problematic and so an organic adaptive approach is needed.

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Water accounting standards will address particular subjects and explain and prescribe the treatment of various water accounting issues. Typically, the standards will address the concepts that are listed in the conceptual framework and could also include: justification; explanation (including definitions); disclosure requirements (content); and example standard reports.

There is potential for many standards to be required for water accounting and development of standards is likely to take some years. This time horizon should not inhibit development and it is recommended the focus should initially be on the development of reporting standards as they directly relate to the information user requirements. Although the focus of this development should initially be quite targeted and narrow in scope, through time these standards are expected to grow in scope to cover aspects such as measurement and estimation techniques.

A conceptual framework would typically guide the standard development process for any disciplinary approach. Although this does not yet exist within water accounting, a number of proposed standard report templates have been developed and can be used along with best practice examples, in the interim, as a guide for water organisations.

The focus of standard development should initially be in agreed target areas where management approaches are settled and development of standards can be both rapid and most beneficial. While aiming for appropriate standards, trade-offs and the 80:20 principle will be particularly relevant in drawing together and standardising accounting treatment among various jurisdictional as well as some other external and more independent views.

A hierarchy of standards is proposed to avoid proliferation of unnecessary standards. As an initial guide, the following list of potential standards for the water market and water resource accounting themes, as shown in Figure 45, is proposed based on the proposed standard report templates:

Report Standards:

- Water access entitlement source
- Water access entitlement destination report
- General allocations report
- Allocatable stock report
- Surface water report [regulated river system variation]
- Surface water report
- Groundwater report
- Water cycle report

Information element standards – stand-alone accounting treatments for like groups of information elements which are referenced in report standards

Measuring standards – stand-alone standard (some of which exist) which are referenced in information element standards

- **Figure 45 Proposed water accounting standards hierarchy**

It is obvious that measurement standards, both existing and proposed, could fit into the above arrangement as priorities are recognised. Research and development opportunities to develop measurement standards should be encouraged although these have not been specifically addressed in this report.

Development of the following projects, which have been drawn from the list of proposed report templates, are seen to be priority starting points for development of standards:

- Water access entitlement reporting standard project

  The 'Water access entitlement reporting standard project' should focus on development of a national standard for the accounting treatment of all water access entitlements including trading. It encompasses both the *water access entitlement source report* and *water access*

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entitlement destination report. The standard should initially focus on agreement of standard report templates and information element definitions and then expand to cover the aspects listed in the conceptual framework. The treatment of water access entitlement trading will be directly influenced by the development and definition of water entities and so appropriate links between the 'common chart of water accounts project' and the development of the 'user requirements definition project' are to be developed.

The benefit of such a project is to demonstrate that standardisation of key water market principles can be standardised.

- Water allocation reporting standard project

  The 'water allocation reporting standard project' should focus on the development of a national standard for the accounting treatment of water allocations. It encompasses both the *general water allocations report* and the *general water allocations trade report*. This is a priority standard to be developed as it closes the loop with market based entitlements, allocations and trading issues. The standard should initially focus on agreement of standard report templates and information element definitions then expand to cover the aspects listed in the conceptual framework.
- Surface water reporting standard (regulated systems) project.

  The 'surface water reporting standard (regulated systems) project' should focus on the development of a national standard for the accounting treatment of water in regulated river systems. It encompasses both the *Surface water report [regulated river system variation]* and *Allocatable stock report* which are closely related and share several common parameters.

  The benefit of developing this report standard is that it expands partly into the theme of water resource management where standards will be required for growing numbers of information element standards. These information element standards are required if any report standards are to be meaningful and effective. It is also the linkage between resource allocation and trading and resource management on these river systems, where the focus of water market activity and thus where the most demand for transparency in management and allocation of water exists. Development of this particular standard will provide a basis to expand into standard development for surface water and water cycle reports.

Other reporting standard development projects which could be undertaken if these projects are determined to be successful and valuable are:

- Surface water reporting standard project
- Groundwater reporting standard project

These projects focus on the development of standards for resource reporting. Many of the information elements will already have been considered in the surface water reporting (regulated systems) standard.

For groundwater reporting specific challenges will relate to standards for recharge estimation and sustainable yield determination. These standards will also need to develop accounting treatments for groundwater- surface water interaction.

Recommendation 9: That nationally coordinated development projects which use a pilot approach in multiple representative areas and which progressively interact with and test other developmental work (user requirements definition, common chart of water accounts, conceptual framework and standards development procedure) be initiated by the Water Accounting Development Committee to progressively develop water accounting and reporting standards or guidelines for:

- ***water market accounting including water access entitlements, water allocations, use and trading; and***
- ***water resource accounting including surface water, groundwater, water cycle and connected surface and groundwater resource accounting.***

The cost to undertake some or all of these standard development project will vary significantly depending upon the level of development achieved with the intellectual infrastructure projects and other pilot projects.

A nominal budget allowance of $300,000 per year for the next three years, in addition to any in-kind contributions from jurisdictions participating in pilot projects, will need to be considered in developing project plans, prioritisation of projects and funding distribution between projects.

It should be recognised that resources may need to be varied as issues emerge and that some pilot projects may discover water accounting aspects may take significantly more time and resources for progress to be effective.

Further work is required to progress the key principles and concepts for management and accounting for water for the environment and the extent of the contribution from water for the environment accounting. This includes reconciling approaches to managing and accounting for environmental provision via water planning and indirect rules, which is the most prevalent method throughout Australia, as well as for the wider suite of provisions for the regulated and interconnected and over-allocated systems in the southern Murray Darling basin. Implementation of a dedicated technical working group is seen as a positive way to address the issues relating to water for the environment.

Specific issues that have been identified in this project and that could be included in the focus of such a forum include:

- A register should be kept of all instream environmental rights, showing where the right is fully documented, and arrangements, including timing, for monitoring compliance with the right.
- Where the right is "active" and includes a specified volume that an environmental manager is entitled to call out of storage, an appropriate environmental account should be kept.
- Where the right is "passive" but includes the necessity for a system operator to reserve stored water to ensure that it can be respected, the volume so reserved should be explicit.
- Extractive rights held by the environment should be accounted in the same way as other extractive rights, and reports should be available in the same way and format as they are for other extractive rights.
- Mechanisms for conversion between instream and extractive environmental rights should be developed to provide guidelines / standards for estimating the relevant volumes to be used in accounts.
- In particular, agreement should be reached on whether an indirect environmental right to instream water, created by agreed caps on extraction, includes a unilateral right for an environmental manager to extract the water for environmental purposes.
- Where effective reporting on compliance with environmental rights requires reporting at frequent time intervals, the accounting system should be able to deliver such reports

It is evident that a particular focus on water for the environment is warranted and a number of proposed starting points have been developed for further consideration.

Recommendation 10: That a technical working group be established to further develop and pilot accounting principles and standards for water for the environment and that the principles and standards resolve the accounting treatment of:

- ***Indirect rules,***
- ***Volumetric rights (extractive and in stream), and***
- ***Direct rules.***

The water use accounting theme chapter highlighted the principle role of the ABS in capture and reporting of information on water supply and use. It also noted that there are a number of opportunities to synergise ABS collection processes with the collection of information on water use by various other organisations across the country. This could be facilitated by undertaking further work which leads to all organisations adopting a common activity classification system. It was also noted that information collected from various other sources (eg landsat, land valuations) could be used to validate information obtained by survey. Development of a water use report standard requires additional integration with ABS work

Recommendation 11: That a technical working group, building on the ABS Water Statistics User Group, be established by the Water Accounting Development Committee to further develop water use accounting principles.

System standards should be addressed specifically through water accounting information systems projects. One of the important standards which belong to both reporting and system standards is that of quality tagging. Additional work may be required to fully address this issue with respect to standard development, and while a focussed task team may be required, the integration of quality tagging with other standard and guideline development work is favoured.

10.13 Water accounting information systems

Information sharing is seen as one of the key methods of achieving a higher degree of consistency, transparency and accountability within the water sector. Existing *water information systems* are not necessarily efficient at producing standard information or reports required by the wider audience.

The stocktake results clearly demonstrated that the *water information systems* used by many water organisations are developed for specific internal requirements and that the application of accounting principles would require modification or replacement of these existing *water information systems*. There were no *existing water information systems* that integrated the whole range of water accounting themes.

The Australian Water Data Infrastructure Project (AWDIP) is in its early stages of development and has a broad range of objectives. The significant aim of the project is to examine the merits of a data portal to enable users to readily access water information which could exist in many forms. Water accounting information is just one form of information that could be discovered by information users in this context. However, one of the aspects that would make water accounting information significantly easier to fit into such a portal is the use of a common chart of water accounts. Development of *water information systems* to include a common chart of water accounts would also line up with many of the other recommendations included in this chapter.

In considering *water information system* modification and/or replacement to incorporate a chart of water accounts, there are two types of existing *water information systems* that need to be understood: Those that record discreet transactions (record events such as trades of entitlements or allocations with a reasonably high degree of accuracy) and those that record time series data (record directly measured raw data eg. data logging). Many of the standard water accounting reports envisaged to be needed to meet user requirements require data from both of these types of information systems to be integrated. However the time series data is often integrated by summarising (usually by form of aggregation) either to:

- enable comparison of data sets that are recorded at different frequencies (eg continuously metered records of extraction from a river would need to be aggregated, to say an annual sum, to allow direct comparison with deliveries to a customer which may only be metered once a year at the end of season); or to
- provide a concise representation of the data at appropriate time steps (eg a daily report on a catchment water balance would be less useful than say a monthly summary of daily flows).

A number of water service providers have recently developed *water information systems*, with accounting capabilities, which track entitlements and allocations. The cost for development of existing *water information systems*, where they have recently been improved or upgraded, was observed to be expensive (several millions of dollars). These developments, observed in Queensland DNRMW, Sunwater and State Water NSW, have generally focussed on water markets where entitlements and allocations need to be tracked. It is not clear from the information collected during the stocktake whether these *water information systems* could be modified to incorporate a chart of water accounts. Although integration of these systems with *water information systems* that record either *information elements* or raw data was observed, the degree of integration was limited and significant work would be required to integrate to accommodate a full range of information elements and water entities.

Most jurisdictions have made significant financial investments in existing *water information systems*. Some of these have been developed coincidently with the NWI requirements. Rather than ‘pick a winner’ or oblige jurisdictions to reinvest in new systems development it is proposed that the NWI facilitate a range of nationally significant projects that will enable jurisdictions to reach a common view in regard to the ability of State and Territory water accounting information systems to meet water accounting and reporting requirements.

Joint ventures or partnerships that can make rapid advances in national water accounting and reporting should receive priority. It is proposed that projects be initiated to develop examples of water accounting information systems that demonstrate to a range of water businesses the potential benefits of applying accounting principles and that have the potential for rapid expansion to relevant parts of the industry. Projects that would be relevant for a range of businesses are:

a) Development of a demonstration water accounting information system for smaller retail water organisations with capability to integrate operational data, including gauging, measurement and customer deliveries, into a water accounting information system using fully automated monitoring and data gathering systems. (Water service provider system project)

   Beneficial outputs could include the automation of information assembly and generation of reports for routine reporting functions

b) Development of a demonstration water accounting system for water market information which includes capability to integrate water access entitlement transactions and allocation increases, decreases and trades, across jurisdictional boundaries. (Water market system project)

   Demonstration of feasibility of common water accounting, registration and water trading systems, identification of required improvements, demonstration of how water accounting for tagging and movement of allocations between states can occur.

c) Development of a demonstration water resource accounting system, specifically aimed at producing surface water reports, initially for several targeted water entities and with ability to expand in both scope of information elements and water entities (Water resource system project)

   Beneficial outputs could include surface water reports that can inform standard and conceptual framework development, surface water reports that can be compared with user requirements for water accounting and reporting and measurement of ability of accounting systems to produce surface water reports

Development of these or similar demonstration projects should be commenced as soon as it can be demonstrated that user requirement definitions and chart of water accounts prerequisites have been met. These projects are likely to require an investment in the order of $0.75M per year.

The characteristics of the demonstration systems should be based on accounting aspects including a common chart of water accounts (or subsets thereof), double entry transactions, reconciliations etc (as per standard accounting software packages). They should also address standards or guidelines for system operation, security and data handling or processing.

Recommendation 12: That demonstration water accounting information systems projects be supported as soon as the water accounting benefits have been determined.

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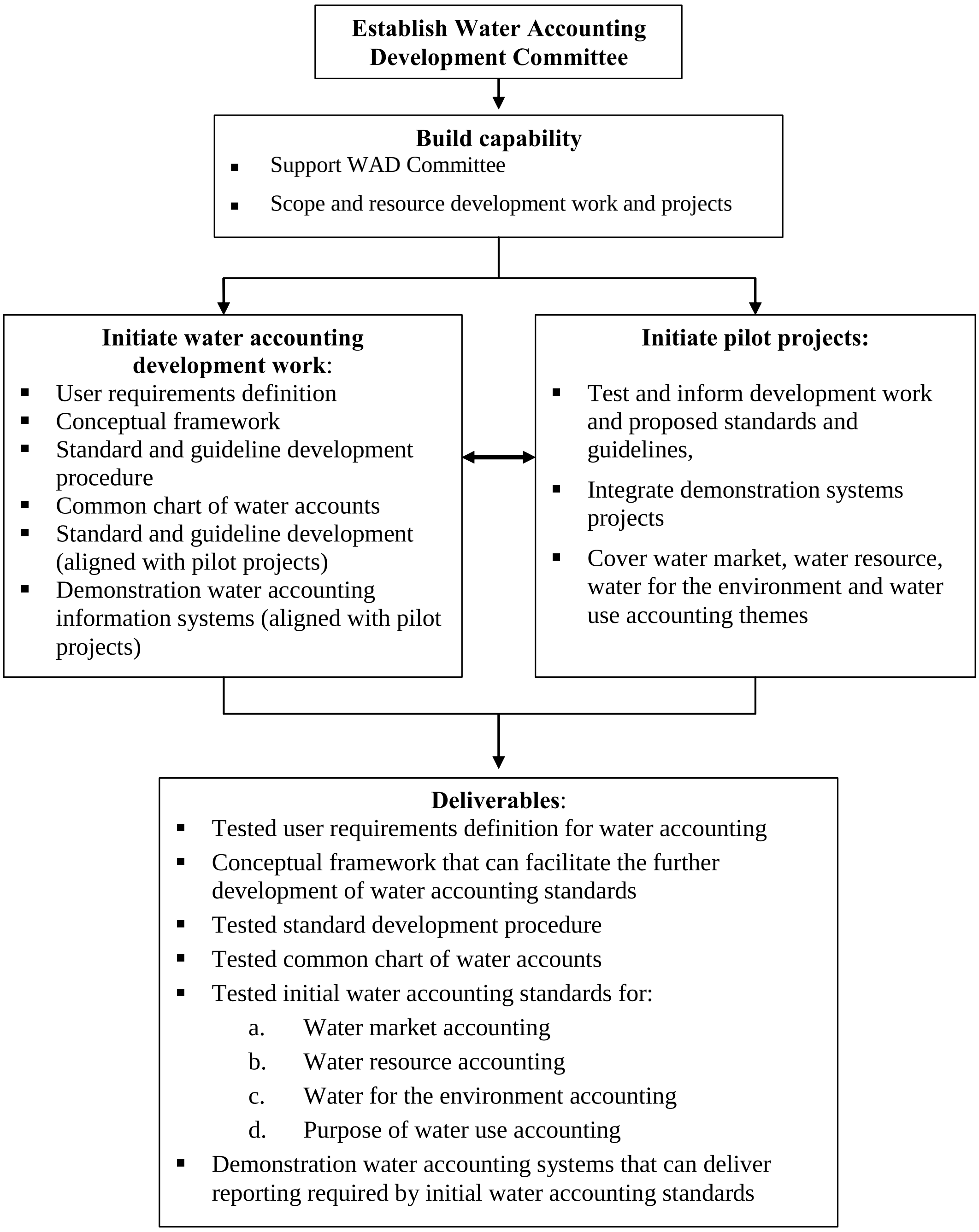
10.14 Work plan and resourcing estimates

The integration of water accounting development work over the next three years is problematic in that specific project plans have not yet been developed. This is a task to be undertaken by the Water Accounting Development Committee and associated technical working groups.

A preliminary work-flow plan, as shown in Figure 46, outlines the general hierarchy of tasks required to initiate development activities and has been developed through consultation with the EAP and in accordance with the following development principles:

- Use appropriate starting points wherever practicable – pick up on relevant work undertaken nationally and within jurisdictions, best practice examples within water businesses and specific developments that have been documented during this project, as a cost effective base on which to build.
- Develop the essential intellectual infrastructure or theoretical base to ensure discipline and rigour in a manner which both learns from and informs practice and practicable developments, through targeted pilot projects which test the application of proposed standards and guidelines and maximises the integration of development work.
- Focus on agreed priorities for development of standards, build on current or proposed good practice reporting and support research and development projects that are effective or offer significant potential in developing national standards for identifying, measuring and recording water information.
- Involve stakeholder representatives and develop business cases as part of each project or priority action initiated to develop water accounting nationally.
- Concentrate on development of a few demonstration water accounting information systems – make real progress on development of information systems with the intent of effective and expandable application of water accounting functionality.



▪ **Figure 46 Work-flow plan**

Development of cost estimates for water accounting development work has been based on the establishment of a Water Accounting Development Committee, with some resources, as well as some priority work packages designed to initiate the development of the necessary intellectual infrastructure. This infrastructure includes the development of a user requirements definition, a common chart of water accounts and a conceptual framework, without which further development is likely to stall.

Provision has also been made to undertake some pilot projects to test and complement this intellectual infrastructure as progress is made. It should be recognised that resources may need to be varied as issues emerge and that some pilot projects may discover water accounting aspects may take significantly more time and resources for progress to be effective.

An indicative cost estimate (shown in Table 9) and a time based chart (shown in Figure 47) have been prepared to provide a preliminary indication of what time and resources might be required to initiate water accounting development in Australia. These estimates could be further refined by the Water Accounting Development Committee once more specific project briefs have been established.

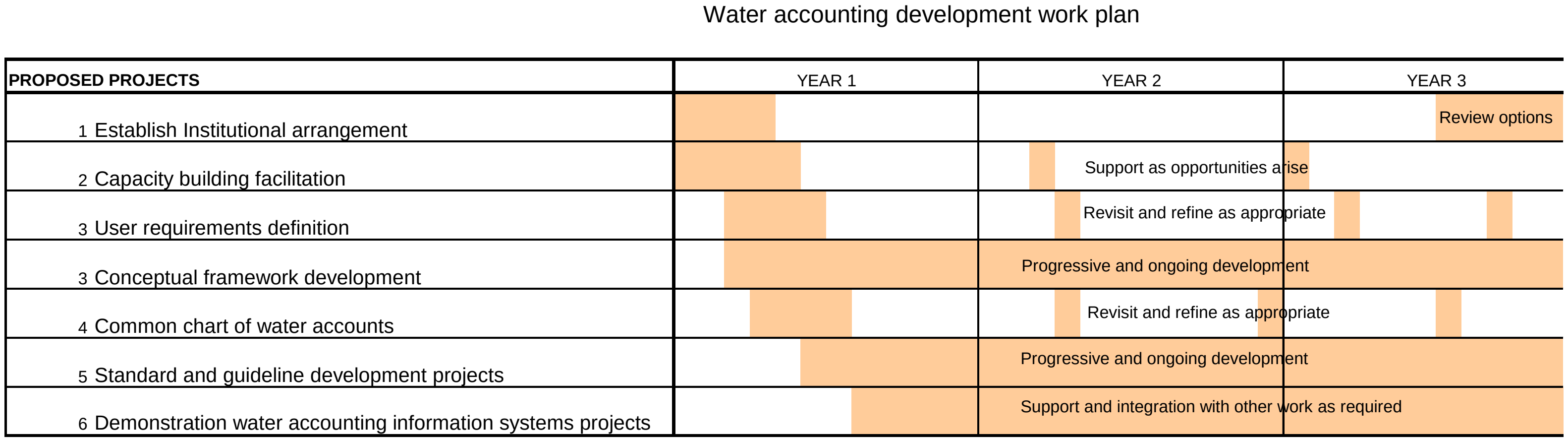
- **Table 9 Preliminary summary of resource estimates**

Development task	Year 1 ($M)	Year 2 ($M)	Year 3 ($M)	Total ($M)
Institutional arrangements*	0.75	0.75	0.75	2.25
Development of user requirements definition	0.25	0.05	0.05	0.35
Conceptual framework development	0.15	0.15	0.15	0.45
Common chart of water accounts development	0.25	0.25	0.00	0.50
Standards and guidelines development (including pilot projects)**	0.30	0.30	0.30	0.90
Demonstration water accounting information systems projects	0.75	0.75	0.75	2.25
Total	$2.45M	$2.25M	$2.00M	$6.70M

*This includes some provision for centrally coordinated capacity building rather than dedicated capacity building within state and territory jurisdictions

** While pilot projects are part of the development mechanism, the resourcing estimate is notionally based on central facilitation rather than dedicated resourcing at pilot project destinations where additional resources for capacity building will be required if development is to be accelerated.

Figure 47 Proposed time based workplan



Appendix A Glossary of Terms

Term	Meaning	Alternative terms
Allocatable stock	the volume of water which can be controlled by the public dams and other works in a regulated river system. Can include water which is 'receivable' but not yet present in the system.	
Allocated stock	That part of the allocatable stock which has been allocated to water access entitlements holders (ie the sum of water allocations)	
Committed stock	That part of the allocatable stock which has been committed for environmental or other purposes (ie the sum of water commitments)	
Environmental water	Environmental water can be either: • water which contributes to "maintaining the health and biodiversity of a particular water-related entity, such as a river, wetland, groundwater system or estuary" (Environment Australia definition), or • any right to water which is committed to be primarily used to contribute to environmental outcomes.	
Extraction	The taking of water from a water system	Abstraction, diversion
Groundwater system	a set of aquifers which are strongly hydrologically connected and are managed as a unit	Aquifer system
Information elements	The information elements are the individual elements, or lines of reporting, envisaged in the standard water accounting reports and are the key 'building blocks' of the envisaged national water accounting system. They include categories such as stocks, flows, water access entitlements, water allocations, environmental water rules and water use.	
Limit water allocations	Water allocations which specify a maximum volume that may be taken, and include no rights to volumes of water held in public water storages (ie no rights to allocatable stock)	
Movement	a change in the parameters which link a water access entitlement or water allocation to a particular location or area	
National water accounting process	A process developed to represent the fundamental intellectual infrastructure for water accounting development through iterative process steps and the general direction of process flow including feedback loops.	Model
National water accounts	The tables of water supply and use and related information for Australia prepared and published	

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Term	Meaning	Alternative terms
	periodically by the Australian Bureau of Statistics,	
Regulated river system	A water system which consists of rivers and storages/lakes and has one or more public storages in which water access entitlement holders have rights (implicit or explicit) to a share of the storage and the inflows to the system	Supplemented or controlled river system
Report preparer	An organisation which prepares water accounting reports	
Source	'source' refers to a source of water. A water system from which water is or may be abstracted is one type of source. Water access entitlements are fundamentally a share in a specified consumptive pool in a specified water system. This water system is the 'source' water system for the entitlement or for any water allocations which arise from it from time to time. Other types of water source include treated or untreated wastewater and desalinated sea water.	
Standard/s	A document that provides guidance on a range of issues related to its title or stated purpose	
Storage water allocations	Water allocations which relate to a share in allocatable stock in a regulated river system	
System	Organised method	
Tagged trade	'Tagged trade' is the name given to the system where water access entitlements can be used to take water in a different water system or state to the one to which they relate	
Trade	Can be a transfer and/or a movement of a water access entitlement or water allocation.	
Transfer	A change in the ownership of a water access entitlement or water allocation. There are two types of transfer. A transmission is a transfer by action of law (eg execution of will, court order), and an acquisition is any transfer which is not a transmission (eg a purchase)	trade
Unregulated river system	A surface water system which is not a regulated river system. Note that such systems can still have large storages in them and be heavily controlled, but not be classed as regulated (eg the Snowy)	Unsupplemented or uncontrolled river systems
Unallocated stock	That part of the allocatable stock which is neither allocated nor committed.	
Water accounting	the application of a consistent and structured approach to identifying, measuring, recording and reporting information about water	
Water accounting reports	General purpose reports prepared by organisations for the benefit of parties external to the organisation. As opposed to management reports which organisations prepare for their own operational purposes.	

Term	Meaning	Alternative terms
Water Information System	An electronic system or database which could store a range of water information or data.	
Water Accounting Information system	An electronic system or database designed specifically with a common chart of water accounts.	
Water commitments	rights to seasonal volumes of water created pursuant to rules in a relevant water plan, not related to water access entitlements.	
Water use	In its most general sense it means the employment of water for a purpose. Consumptive water use can be defined to occur when the water is lost from the terrestrial phase of the water cycle by evaporation, transpiration, incorporation into biomass or products, or flow into the ocean or a saline or unusable water body. Many uses of water are partially consumptive (eg many forms of irrigation), or non consumptive (eg hydroelectricity generation), meaning that water can commonly be used multiple times. Water can be used both consumptively and non-consumptively by natural ecosystems. SIEEAWR defines *water use within the economy* as water intake for production and consumption activities, but is silent on other forms of water use. Generally the term *water use* in this report can be taken to refer to water use within the economy as thus defined.	Water use is commonly interpreted as meaning the extraction of water from rivers or aquifers for a purpose.
Water Access Entitlement	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 (NWI)	Capacity share, entitlement, licence, allocation
Water Allocations (limit vs pooled)	the specific volume of water allocated to water access entitlements in a given season, defined according to rules established in the relevant water plan (NWI). There are generally two types of water allocations- storage water allocations and limit water allocations.	
Water entity	The level or unit at which information is aggregated and reported.	
Water system	a set of waters (surface or groundwater) which are strongly hydrologically connected and are managed as a unit	Water source

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Appendix B Information elements

(Note that items in italics have been added or modified as a result of the stocktake and analysis process)

	Information element	Frequ-ency	Definition	units
B.1	Water stock			
	Surface water stock			
1	Minor catchment storages	Annual	Volume of water in small storages (farm dams) which are not on defined waterways or watercourses, which are filled from local catchment runoff, not from extracted water or flood flows out of rivers.	ML
2	Minor on-stream storages	Annual	Volume of water in small storages (farm dams) on minor watercourses.	ML
3	Minor extracted water storages	Annual	Volume in minor off-river storages (farm dams, turkey nest dams etc) which primarily store water extracted from rivers or aquifers, or from flood water emanating from rivers.	ML
4	Major on-stream storages	Annual	Volume of water (including 'dead' storage) in significant on-river storages, typically managed by government authorities, councils or public or private utilities. Does not include minor weirs - volume in these included in river channel storage.	ML
5	Major extracted water storages	Annual	Volume in significant off-river storages which are part of water delivery infrastructure (typically managed by government authorities, councils, public or private utilities, irrigation companies etc) which primarily store water extracted from rivers or aquifers, or from flood water emanating from rivers.	ML
6	River channel storage	Annual	Volume of water in river channels. Includes the instantaneous volume of moving water, and any water in weirs which are not classes as major on-river storages or minor on stream dams.	ML
7	Artificial channel storage	Annual	Volume of water in artificial channels. Includes the instantaneous volume of moving water, and any water in structures which are not classes as off river storages on-river reservoirs or farm dams.	ML
8	Snowpack	Annual	Volume of water held as snow	ML
	Groundwater stock			
9	Soil water	Annual	Volume of water in the unsaturated zone in the soil profile	ML
10	Aquifers – renewable storage – non-saline	Annual	Renewable[1] part of the volume of water held in the aquifer	ML

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	Information element	Frequ-ency	Definition	units
11	Aquifers – renewable storage – saline	Annual	Renewable[1] part of the volume of water held in the aquifer	ML
12	Aquifers – non-renewable – non-saline	Annual	Non-renewable[2] part of the volume of water held in the aquifer	ML
13	Aquifers – non-renewable – saline	Annual	Non-renewable[2] part of the volume of water held in the aquifer	ML

B.2 Atmospheric interchange

Rainfall

14	Rainfall	Annual	Volume of water in all forms of precipitation falling on the physical entity	ML

Evaporation

15	Evaporation - catchment storages	Annual	Volume of water evaporating from catchment storages	ML
16	Evaporation - minor on-stream storages	Annual	Volume of water evaporating from minor on-stream storages	ML
17	Evaporation - minor extracted water storages	Annual	Volume of water evaporating from minor extracted water storages	ML
18	Evaporation - major on-stream storages	Annual	Volume of water evaporating from major on stream storages	ML
19	Evaporation - major extracted water storages	Annual	Volume of water evaporating from major extracted water storages	ML
20	Evaporation - rivers	Annual	Volume of water evaporating from rivers	ML
21	Evaporation - artificial channels	Annual	Volume of water evaporating from artificial channels	ML

Evapo-transpiration

22	Evapo-transpiration - aquifers	Annual	Volume of water evapo-transpiring from aquifers	ML
23	Evapo-transpiration - irrigated areas	Annual	Volume of water evapo-transpiring from irrigated land	ML
24	Evapo-transpiration - forested areas	Annual	Volume of water evapo-transpiring from forested land	ML
25	Evapo-transpiration - other areas	Annual	Volume of water evapo-transpiring from all land apart from that which is irrigated or forested	ML

B.3 Water flow

Surface water flow

26	Surface inflow	Annual	Volume of water flowing on the surface into the entity from adjoining entities. Includes river flows and overbank flows	ML
27	Rainfall runoff	Annual	Volume of rainfall runoff within the entity	ML
28	Surface outflow	Annual	Volume of water flowing on the surface out of the entity into adjoining entities. Includes river flows and overbank flows. Can be divided by purpose.	ML

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	Information element	Frequ-ency	Definition	units
	Surface - groundwater flow			
29	Aquifer recharge from rivers and storages	Annual	Volume of water seeping from rivers and storages (including lakes) into aquifers	ML
30	Aquifer recharge from artificial channels & pipes	Annual	Volume of water seeping from artificial channels into aquifers	ML
31	Aquifer discharge to rivers and storages	Annual	Discharge out of the aquifer into a streams, rivers or surface storages	ML
32	Aquifer discharge to artificial channels & pipes	Annual	Discharge out of the aquifer into artificial channels or pipes in distribution systems	ML
	Groundwater flow			
33	Aquifer recharge from soil	Annual	Volume of water infiltrating from the soil into aquifers	ML
34	Aquifer inflow from adjoining aquifers (lateral)	Annual	Flow into the aquifer from a laterally adjoining aquifer	ML
35	Aquifer inflow from adjoining aquifers (vertical)	Annual	Flow into the aquifer from a vertically adjoining aquifer	ML
36	Aquifer outflow to adjoining aquifers (lateral)	Annual	Flow out of the aquifer into a laterally adjoining aquifer	ML
37	Aquifer outflow to adjoining aquifers (vertical)	Annual	Flow out of the aquifer into a vertically adjoining aquifer	ML
	Extraction			
38	Extraction for environmental purposes	Annual	Extraction of water pursuant to an environmental water access entitlement. For the water cycle report to be separated into extraction for use within and without the entity.	ML
39	Extraction by delivery service providers	Annual	Extraction of water via pump, bore or gravity offtake from rivers (including on-river storages) or aquifers by delivery service providers[13]. For the water cycle report to be separated into extraction for delivery within and without the entity.	ML
40	Extraction by consumptive users	Annual	Extraction of water via pump, bore or gravity offtake from rivers (including on river storages), overland flows or aquifers by consumptive water users[5]. Includes water extracted under water access entitlements or unlicensed water rights. For the water cycle report to be separated into extraction for use within and without the entity.	ML

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	Information element	Frequ-ency	Definition	units
	Delivery			
41	Delivery by delivery service providers	Annual	Volumes of water delivered by delivery service providers[13] to consumptive users[5]. For the water cycle report to be separated into delivery within and without the entity.	ML
42	Delivery of treated waste water	Annual	Delivery of treated waste water to consumptive water users[5].	ML
	Returns			
43	Returns of unconsumed water to rivers or aquifers	Annual	Returns of unconsumed water from delivery service providers or consumptive water users[5] to rivers or aquifers. To be broken down into purpose for which the water was used, as per ABS standard classifications. For the water cycle report to be separated into returns from within and without the entity.	ML
44	Returns of unconsumed water to delivery systems	Annual	Returns of unconsumed water from consumptive water users[5] to delivery systems. To be broken down into purpose for which the water was used, as per ABS standard classifications. For the water cycle report to be separated into returns from within and without the entity.	ML
45	Returns of treated waste water	Annual	Returns of treated wastewater to rivers or aquifers. For the water cycle report to be separated into returns from within and without the entity.	ML

B.4 Water use

46				
	Distributed water	Annual	Total water use by industry and/or activity within the entity, broken down into ABS standard classifications, and cross tabulated with the source of the water.	ML

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	Information element	Frequ-ency	Definition	units
	Self extracted water	Annual	Total water use by industry and/or activity within the entity, broken down into ABS standard classifications, and cross tabulated with the source of the water.	ML
	Stormwater	Annual	Total water use by industry and/or activity within the entity, broken down into ABS standard classifications, and cross tabulated with the source of the water.	ML
	Re-use water	Annual	Total water use by industry and/or activity within the entity, broken down into ABS standard classifications, and cross tabulated with the source of the water.	ML
	Rainwater	Annual	Total water use by industry and/or activity within the entity, broken down into ABS standard classifications, and cross tabulated with the source of the water.	ML
47	In stream use	Annual	Volumes of water taken, used and returned to the water source with negligible loss. Typically hydro-electricity generation or fish farms. Does not include cases where the water is returned to a different SWMA from which it was extracted. Such cases are to be dealt with under extraction and returns. To be broken down into purpose for which the water it is be used, as per ABS standard classifications.	ML
48				

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	Information element	Frequ-ency	Definition	units
B.5	Water access entitlement			
	Stock			
49	Current share units - total, environmental or single owner	Daily	Sum of the share units[4] at a point in time, for each relevant class/category[6] of water access entitlement. To be available in total or for a single entitlement owner or for environmental entitlements	number
	Issue and cancellation			
50	New share units issued - total, environmental or single owner	Daily	Sum of new share units[4] issued by application, tender or otherwise (ie non-trade), for each relevant class/category[6] of water access entitlement. To be available in total or for a single entitlement owner or for environmental entitlements	number
51	Share units cancelled - total, environmental or single owner	Daily	Sum of the share units[4] cancelled without there being any corresponding replacement share unit issue anywhere else (ie non-trade), for each relevant class/category[6] of water access entitlement. To be available in total or for a single entitlement owner or for environmental entitlements	number
	Movement			
52	Share units moved in - total, environmental or single owner	Daily	Sum of the share units[4] moved in[11] to the entity, for each relevant class/category[6] of water access entitlement. Typically related to 'permanent' trade. To be available in total or for a single entitlement owner or for environmental entitlements	number
53	Share units moved out - total, environmental or single owner	Daily	Sum of the share units[4] moved out[12] of the entity, for each relevant class/category[6] of water access entitlement. Typically related to 'permanent' trade. To be available in total or for a single entitlement owner or for environmental entitlements	number
	Trade			
54	Maximum net share unit trade-out permitted for period (if applicable)	Daily	Maximum nett trade out of share units in a period, for each relevant class/category[6] of water access entitlement. The current NWI agreed minimum target is 4% of the total per year. Not all entities have such a limit	number
55	Share units acquired - total, environmental or single owner	Daily	Sum of the share units acquired[8] in the period, for each relevant class/category[6] of water access entitlement. To be available in total or for a single entitlement owner or for environmental entitlements	number

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	Information element	Frequ-ency	Definition	units
56	Number of acquisition transactions - total, environmental or single owner	Daily	Total number of acquiring transaction in the period. To be available in total or for a single entitlement owner or for environmental entitlements	number
57	Share units divested - total, environmental or single owner	Daily	Sum of the share units divested[9] in the period, for each relevant class/category[6] of water access entitlement. To be available in total or for a single entitlement owner or for environmental entitlements	number
58	Number of divestment transactions - total, environmental or single owner	Daily	Total number of divestment transactions in the period. To be available in total or for a single entitlement owner or for environmental entitlements	number

B.6 Water allocation

Stock

59	Current water allocation balances - total, environmental or single owner	Daily	For each type of water allocations the balance remaining at a point in time which have not been used or written off. To be available in total or for a single allocation owner or for environmental allocations	ML

Accrual and consumption

60	New water allocations accrued - total, environmental or single owner	Daily	Water allocations arising pursuant to seasonal determinations of water to be available under water access entitlements. To be available in total or for a single allocation owner or for environmental allocations	ML
61	Use of water allocations - total, environmental or single owner	Daily	For each type of water allocations, the reduction in the allocation balance resulting from extraction of water or ordering of water or any other ways by which the owner is determined to use the allocations. To be available in total or for a single allocation owner or for environmental allocations	ML
62	Water allocation written off - total, environmental or single owner	Daily	For each type of water allocations, the amount written off as a result of the operation of rules. To be available in total or for a single allocation owner or for environmental allocations	ML

Movement

63	Water allocations moved in - total, environmental or single owner	Daily	For each type of water allocations, the sum of water allocations moved in[11] to the entity. To be available in total or for a single allocation owner or for environmental allocations	ML

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	Information element	Frequ-ency	Definition	units
64	Water allocation moved out - total, environmental or single owner	Daily	For each type of water allocations, the sum of water allocations moved out[12] of the entity. To be available in total or for a single allocation owner or for environmental allocations	ML
	Trade			
65	Maximum nett water allocation trade out permitted for period (if applicable)	Daily	For each type of water allocations, the maximum nett movement out in a period. Not all entities have such a limit	ML
66	Water allocations acquired - total, environmental or single owner	Daily	Sum of the water allocations acquired[8] in the period, for each type of water allocations. To be available in total or for a single allocation owner or for environmental allocations	ML
67	Number of acquisition transactions - total, environmental or single owner	Daily	Total number of acquiring transaction in the period. To be available in total or for a single allocation owner or for environmental allocations	number
68	Water allocations divested - total, environmental or single owner	Daily	Sum of the water allocations divested[9] in the period, for each type of water allocations. To be available in total or for a single allocation owner or for environmental allocations	ML
69	Number of divestment transactions - total, environmental or single owner	Daily	Total number of divestment transactions in the period. To be available in total or for a single allocation owner or for environmental allocations	number

B.7 Environmental water rules

	Rules in place			
70	Rules schedule	Annual	Schedule of the current rules in place in the entity. To show name, description, reference to source of rule (plan), responsible authority	Text
	Rule changes			
71	Rules commenced	Annual	Schedule of new rules commence in the entity during the period. To show name, description, reference to source of rule (plan), responsible authority	Text
72	Rules terminated	Annual	Schedule of existing rules terminated during the period. To show name, description, reason for termination, reference to instrument of termination.	Text
73	Rules modified	Annual	Schedule of existing rules modified in the entity during the period. To show name, description, reference to source of instrument modifying the rule	Text

Rules activity

	Information element	Frequ-ency	Definition	units
74	Rules triggered	Annual	Schedule of all rules in the entity showing whether they were triggered or not during the year, with a reference to an report on compliance	Text
75	Rules complied with	Annual	Schedule of all rules in the entity showing whether they were complied with or not during the year with a reference to an report on compliance	Text
	Rules water commitments			
76	Current balance of committed water	Annual	Volume of water committed (set aside) in storages for environmental water rules at a point in time. Not applicable to all rules	ML
77	New water committed under rules	Annual	Additional volumes of water committed (set aside) in storages for environmental water rules. Not applicable to all rules	ML
78	Water delivered or protected under rules	Annual	Reduction in volumes of water committed (set aside) in storages for environmental water rules by release or delivery in accordance with the rules. Not applicable to all rules	ML
79	Write off of committed water under rules	Annual	Write off of volumes of water committed (set aside) in storages for environmental water rules pursuant to the rules. Not applicable to all rules	ML

Appendix C Water information systems

Jurisdiction	Organisation	Database Name/s	Type / Coding language	Purpose
Australian Capital Territory	Environment ACT	Water quality database	Access	Stores information on WQ, flows, rainfall etc to be made publicly availabel via web. Draws data from Ecowise Hydsys
		Water resources database	Access	Registry of entitlements
Queensland	DNRMW	IWUBS	ACCESS/SQL	Metering of unsupplemented use and billing (note Sunwater tracks supplemented)
		WERD	INGRESS	Water entitlements registration database
		ALLOCATION REGISTER	INGRESS	Water allocations granted and recorded under ROPs
		WRP/ROP Database	AQUIS	Surface water data, groundwater data recorded under ROPs
	Sunwater	Timestudio	Web based	Time series levels and flow data
		SWIMS R1		Storage volumes, diversions, stream flows etc
		SWIMS R2		Water consumption, access entitlements, water allocations, billing, ordering, accounts etc
	SEQ Water	Spatial Info	Arcview	GIS system
		Alert		Flood warning (rainfall, level, flow)
		Desktop applications	Excel/Access	Various

Jurisdiction	Organisation	Database Name/s	Type / Coding language	Purpose
	Brisbane Water	Groundwater Info	Excel	Aquifer extractions
		MOSAIC	-	SCADA (water, wastewater)
		Billing system	-	Customer details
	Gold Coast Water	KPI Indicators	ACCESS	Reporting tool to integrate various data sources
	Fitzroy River	MVRS	-	Meter reading, maintenance
		Pathways	-	Billing (data from MVRS)
		Excel	-	Meter reading, operational records, customer details, license details, ROP reporting
	North Burdekin Water Board	Attache	-	Water use , allocations
		Excel	-	Rainfall, bore levels, pump operation
		Billing system	ACCESS	
		Mapinfo	-	Farm maps, crop surveys, asset management, meter locations

Jurisdiction	Organisation	Database Name/s	Type / Coding language	Purpose
New South Wales	Department Natural Resources	HYDSTRA LAS GDS WOU	- SQL, ORACLE, CENTURA	Hydrologic data Access entitlements Groundwater data Water allocations, usage etc
	State Water	Water management Act water acc system HYDSYS	Oracle -	Allocations and usage etc Hydrologic data
	Hunter Water	HWC Source Customer Info system		Availability (level and rating - supply volumes) Consumption, billing etc
	Colleambally	GIS Entitlement Register IMS	Arcview ACCESS Ingress	Groundwater levels, crop types etc Entitlements, allocations etc Extractions, deliveries, allocations, entitlements etc
	Murrumbidgee Irrigation Cooperative	IMS Water Register	Ingress Excel	Extractions, deliveries, allocations, entitlements etc ??

Jurisdiction	Organisation	Database Name/s	Type / Coding language	Purpose
		Drainage Flows	Excel	??
	Murray Irrigation Limited	Entitlements register Ordering system	SQL SQL	Entitlements Use, extractions, allocations etc
Northern Territory	Dept Natural Resources, Environment and the Arts	Licensing database	Excel / Access	records license information as well as water extraction udner licenses and water use purposes, areas etc
	Power and Water Corporation	Water & Sewerage Performance Project Database (WSPP)	Oracle	all metered data, dam levels, evap, rainfall, sewerage etc
South Australia	Department of Land, Water and Biodiversity Conservation	HYDSTRA SA Geodata WILMA	- Oracle Oracle/Ingress	Time series hydrologic data Groundwater bore data Water licensing / trades / use etc
	South Australia Water			
	Renmark Irrigation Trust	dBase111	dos	Watercharges, consumption, access fees

Jurisdiction	Organisation	Database Name/s	Type / Coding language	Purpose
		plaindBase111		
	Central Irrigation Trust	BILLNOW GIS/ITTools	ACCESS ACCESS	Billing, delivery volumes, times, ownership, allocations, entitlements etc Property details, crops etc
	Sunlands Irrigation Trust	Waternow	ACCESS	Scheduling, deliveries, invoicing etc
Tasmania	Dept Primary Industries and Water	WIMS Hydstra	ORACLE	Water Information Management System (entitlements and allocations Time series water information
	Rivers and Water Supply Commission	Irrigation Scheme Database	ACCESS	Stores
	Hobart Water	SCADA	SQL	Level gauges, meters etc
	Hydro Tasmania	Timestudio	SQL	Time series hydrologic data

Jurisdiction	Organisation	Database Name/s	Type / Coding language	Purpose
Victoria	Department Sustainability and Environment	Data Warehouse GMS State Register	Ingress	Hydrologic Data Groundwater Data Entitlements/Allocations/Shares etc
	Melbourne Water	MOSAIC WATERWORKS HYDSYS	SCADA SQL	Operational data Records, billing, planning etc Hydrologic data
	Goulburn-Murray Water	SPM BICS IPM GROUNDWATER CONSUMPTION	INGRESS ACCESS	Delivery system operational data, storage etc Customer billing Allocations, planning, environmental rules Groundwater consumption metering
	Southern Rural Water	IPM		Allocations, planning, environmental rules
	Goulburn Broken Catchment Management Authority	Nil	Nil	Basic Excel and Word files on local directory

Jurisdiction	Organisation	Database Name/s	Type / Coding language	Purpose
Western Australia	Department of Water	WRL	ORACLE	Water Resource Licensing
		WIN	ORACLE	Water Information System (surface water and groundwater quality data, groundwater levels)
		DWAID	ORACLE	Divertible water allocation inventory database (register of allocation limits, surface water area and aquifer definitions)
	Water Corporation	ODDS	ORACLE	Operational data Storage System (levels, pumps, water quality etc)
		GRANGE	Guardian	Customer Information system (meter reads, leakage allowance, consumptive demands, billing)
		SAP BW		Business warehouse for corporate reporting
		EMS		Register of EPA license conditions
	Harvey Water	BILL	SQL	Entitlements, allocations, deliveries, trades
	AQWEST (Bunbury Water)	Customer Billing Sys	Informix	Property details, financial accounts, meter reads, billing
		SCADA		
	Busselton Water	AquaRate	SQL	Billing and Tariff application
	Gascoyne Cooperative	RITA	ACCESS/SQL	Water consumption, billing

Jurisdiction	Organisation	Database Name/s	Type / Coding language	Purpose
	Ord Irrigation Cooperative	Rubicon System	INGRESS	Operational flows, water usage, billing
Other	Murray Darling Basin Commission	HYDRO	Oracle	main repository of flow, diversion and salinity information provided by states and by MDBC resources, from direct measurement and from models. Initially built by modellers to provide data for modelling

Appendix D Examples of published water accounting information – urban water service providers

The following table is copied from the 2003-04 NSW Water Supply and Sewerage Benchmarking Report. Note that it contains most of the information needed to assemble water balance reports for the delivery system of each utility.

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Table 8 - 2003/04 Water Consumptions in Non-metropolitan NSW

	WATER UTILITY	SOURCE CATCHMENT	WATER CONSUMPTION - Potable Town Water Supply (ML)									WATER SUPPLIED - Town Water (ML)			RECYCLED WATER (ML)		CONSUMPTION (ML)		
			Residential (1)	Commercial (2)	Industrial (3)	Rural (4)	Institutional (5)	Bulk Sales (6)	Public Parks & Gardens (7)	Water Losses[2,5] (8)	Leakage[5] (9)	Potable Town Water Supplied =(1)+(2)+(3)+(4) (5)+(6)+(7)+(8) or total reported (10)	Non-Potable Town Water Supplied (for outdoor uses or industry) (11)	Total Town Water Supplied[6] (Potable + Non-potable - Recycled) =(10)+(11)-(13) (12)	For Non-Potable Town Water Supply[8] (13)	For Agricultural or Other Uses[9] (14)	Surface Water (15)	Ground Water (16)	Bulk Purchases (17)
1	Albury	Murray	6,032	1,245	605		380	1,112	64	1,049	629	10,500		10,500		4,910	10,170		
2	Armidale Dumaresq	Macleay	1,725	311			497		36	285	171	2,850	60	2,910		1,040	3,250		
3	Ballina (Reticulator)	Tweed/Richmond	2,623	510		46	235			697	247	4,110	370	4,430	46	266	131	14	3,965
4	Balranald (Dual Supply)	Murrumbidgee	207	5						24	14	240	1,200	1,440			1,430		
5	Barraba	Namoi	104	26					11	16	9	160	10	170		133	141		
6	Bathurst Regional	Castlereagh/Macquarie										6,810		6,810			6,810		
7	Bega Valley (Unfiltered)	Bega	1,888	990	100	204	239	13	135	397	238	3,970		3,970		575	1,800	2,330	
8	Bellingen (Unfiltered)	Bellinger	803	306				1	5	357	287	1,470		1,470			205	1,270	
9	Berrigan (Dual Supply)	Murray	838	80					45	201	70	1,160	1,100	2,260		85	2,260		
10	Bingara	Gwydir	171	14		6	5	45	80	42	22	360		360			363		
11	Bland	No WS														65			
12	Blayney	No WS														207			
13	Bogan	Castlereagh/Macquarie								92	55	920		920			761		160
14	Bombala	Snowy	283	9	8		9		1	37	21	350		350		35	348		
15	Boorowa	Lachlan										210		210					
16	Bourke (Dual Supply)	Darling	616							68	41	680	2,250	2,930		240	2,930		
17	Brewarrina	Castlereagh/Macquarie	370							41	25	410	800	1,210		160	1,500	100	
18	Australian Inland	Darling	3,012	251	1,192	64	178		7	781	329	5,490	560	6,050		897	1,480		5,113
19	Byron (Reticulator)	Tweed/Richmond	1,829	577		76		20		479	179	2,980	580	3,560		580	458		2,523
20	Cabonne	Lachlan				206				37	15	240	120	360		43	366	5	
21	Carrathool (Groundwater)	Murrumbidgee	166			104				82	49	820	880	1,700				792	509
22	Central Darling (Dual Supply)	Darling								17	10	170	530	700			633		
23	Central Tablelands	Lachlan	952	202	176	297	68	282	34	145	129	2,160		2,160			1,990	169	
24	Cobar (Dual Supply)	Darling	1,297						17	146	88	1,460	200	1,660		98	79		1,443
24-A	Cobar WB	Darling	1,511		2,494	23			17	207	255	4,250		4,250					4,150
25	Coffs Harbour (Unfiltered)	Clarence	3,895	1,016	175		128	69	141	603	459	6,030	120	6,030	120	373	3,890		1,971
26	Coolah	Castlereagh/Macquarie	280	30	10	10			20	39	23	390		390		220	50	308	
27	Coolamon	No WS														25			
28	Cooma-Monaro	Murrumbidgee								170	102	1,700		1,700			1,690	73	
29	Coonabarabran	Castlereagh/Macquarie								95	57	950		950		75	950		
30	Coonamble (Groundwater)	Castlereagh/Macquarie	1,289	171	14	10	12	4	133	181	169	1,810		1,810		154	9	1,810	9
31	Cootamundra (Reticulator)	Murrumbidgee	668	53	41		53		7	180	68	1,000		1,000		230			1,004
32	Copmanhurst (Unfiltered)	No WS																	
33	Corowa	Murray	1,998	100	795				200	344	206	3,440		3,440		461	3,290		
34	Cowra	Lachlan	1,277	131	395	359	18	10		366	153	2,560		2,560			2,600		
35	Crookwell	Lachlan	282							31	19	310		310			282		
36	Culcairn (Groundwater)	Murray	133	13	2	11	26	3	21	30	14	240		240		105		237	
37	Deniliquin	Murray	1,838	282	45	165	17	1	1	261	157	2,610	720	3,330		629	3,080		
38	Dubbo	Castlereagh/Macquarie	6,042	1,565	195		465		632	989	593	9,890		9,890		1,620	7,790	2,460	
39	Dungog (Reticulator)	Hunter	328	71		38	61	10		215	110	720		720		219	47		674
40	Eurobodalla (Unfiltered)	Clyde	3,100	1,100			244	104	288	537	322	5,370	220	5,590		219	4,970		
41	Fish River WS (Unfiltered, Bulk Supplier)	Castlereagh/Macquarie	216					4,705			524	4,920	6,730	11,700			12,180		
42	Forbes	Lachlan	1,273	262	71	6	87	329	57	232	139	2,320	90	2,410		10	2,260	92	
43	Gilgandra (Groundwater)	Castlereagh/Macquarie	507	160	80	25	15	20	120	103	62	1,030		1,030		313		957	
44	Glen Innes	Moonie/Macintyre	444	98	2		32		3	125	65	700		700			704		
45	Gloucester	Manning	323	67	48		14	25	5	76	34	560		560			559		
46	Goldenfields (Bulk Supplier)	Murrumbidgee						3,527		776	766	9,400	170	9,560			4,360	4,810	224
47	Goldenfields (Reticulator)	Murrumbidgee	2,190	398	99	2,022	151		232	566	339	5,660		5,660				2,130	3,527
48	Goldenfields (Combined)	Murrumbidgee	2,190	398	99	2,022	151	3,527	232	776	766	9,400	170	9,560			4,360	4,810	224
49	Gosford	Hawkesbury	12,164	1,528	594	23	480		226	1,934	1,494	16,900		16,900		152	16,820		138
50	Goulburn	Hawkesbury	1,245	222	261	3	297		7	559	156	2,590		2,590		1,770	2,660		
51	Grafton (Unfiltered)	Clarence	1,388	260	285	37	125		57	239	143	2,390		2,390		125			2,152

Appendix E Example chart of water accounts

H28

Row	Water Authority	B	Water System Source (River Basins)	D	Water System Type	F	Reliability	H
2	Victoria	100	South East Coast Division	200	Regulated	10	Victoria	10
3	Northern Water Authorities	110	East Gippsland	221	Unregulated	20	Very High	11
4	Goulburn-Murray Water	111	Snowy River	222	Groundwater	30	High	12
5	Coliban Water	112	Tambo River	223	Recycled	40	Medium	13
6	Lower Murray Water	113	Mitchell River	224	Stormwater	50	Lower	14
7	First Mildura Irrigation Trust	114	Thomson River	225	Drainage Diversion	60	Seasonal	15
8	Grampians Wimmera Mallee W	115	Latrobe River	226			NSW	20
9	Southern Water Authorities	120	South Gippsland	227				
10	Melbourne Water	121	Bunyip River	228				
11	Southern Rural Water	122	Yarra River	229				
12	NSW	200	Maribynong Rver	230				
13	SA	300	Werribee River	231				
14			Moorabool River	232				
15			Barwon River	233				
16			Lake Corangamite	234				
17			Otway Coast	235				
18			Hopkins River	236				
19			Portland Coast	237				
20			Glenelg River	238				
21			Millicent Coast	239				
22			Murray Darling Division	400				
23			Upper Murray River	401				
24			Kiewa River	402				
25			Ovens River	403				
26			Broken River	404				
27			Goulburn River	405				
28			Campaspe River	406				
29			Loddon River	407				
30			Avoca River	408				
31			Mid Murray River	409				
32			Mallee	414				
33			Wimmera-Avon Rivers	415				

Row	Trading Zone Source	J	Trading Zone Use	L
2	Northern Victoria Groundwater	1000	Northern Victoria Groundwater	1000
3	Spring Hill Groundwater 1001	1001	Spring Hill Groundwater 1001	1001
4	Spring Hill Groundwater 1002	1002	Spring Hill Groundwater 1002	1002
5	Spring Hill Groundwater 1003	1003	Spring Hill Groundwater 1003	1003
6	Spring Hill Groundwater 1004	1004	Spring Hill Groundwater 1004	1004
7	Campaspe Groundwater 1021	1021	Campaspe Groundwater 1021	1021
8	Campaspe Groundwater 1022	1022	Campaspe Groundwater 1022	1022
9	Campaspe Groundwater 1023	1023	Campaspe Groundwater 1023	1023
10	Campaspe Groundwater 1024	1024	Campaspe Groundwater 1024	1024
11	Campaspe Groundwater 1025	1025	Campaspe Groundwater 1025	1025
12	Katunga Groundwater 1061	1061	Katunga Groundwater 1061	1061
13	Katunga Groundwater 1062	1062	Katunga Groundwater 1062	1062
14	Katunga Groundwater 1063	1063	Katunga Groundwater 1063	1063
15	Katunga Groundwater 1064	1064	Katunga Groundwater 1064	1064
16	Katunga Groundwater 1065	1065	Katunga Groundwater 1065	1065
17	Northern Victoria Regulated	2000	Northern Victoria Regulated	2000
18	Greater Goulburn 1A	2010	Greater Goulburn 1A	2010
19	Boort 1B	2020	Boort 1B	2020
20	Broken: Nillahcootie-Casey's Weir 2A	2030	Broken: Nillahcootie-Casey's Weir 2A	2030
21	Broken: Casey's Weir-Goulburn River 2B	2040	Broken: Casey's Weir-Goulburn River 2B	2040
22	Lower Goulburn 3	2050	Lower Goulburn 3	2050
23	Campaspe 4A	2060	Campaspe 4A	2060
24	Coliban Channel System 4B	2070	Coliban Channel System 4B	2070
25	Campaspe Irrigation District 4C	2080	Campaspe Irrigation District 4C	2080
26	Loddon 5A	2090	Loddon 5A	2090
27	Bullarook 5B	2100	Bullarook 5B	2100
28	Hume to Barmah 6	2110	Hume to Barmah 6	2110
29	Barmah to Nyah 7	2120	Barmah to Nyah 7	2120
30	Torrumbarry 7A	2130	Torrumbarry 7A	2130
31	Nyah to SA Border 8H	2140	Nyah to SA Border 8H	2140
32	Ovens 9A	2150	Ovens 9A	2150
33	King 9B	2160	King 9B	2160
34	Northern Victoria Unregulated	3000	Northern Victoria Unregulated	3000
35	Goulburn Unregulated	3110	Goulburn Unregulated	3110
36	King Parrot Creek	3111	King Parrot Creek	3111
37	Yea River Catchment Unregulated	3112	Yea River Catchment Unregulated	3112
38	Broken Unregulated	3120	Broken Unregulated	3120
39	Lower Goulburn Unregulated	3130	Lower Goulburn Unregulated	3130
40	Campaspe Catchment Unregulated	3140	Campaspe Catchment Unregulated	3140
41	Coliban Unregulated	3141	Coliban Unregulated	3141
42	Lower Campaspe River	3142	Lower Campaspe River	3142
43	Upper Loddon Unregulated	3150	Upper Loddon Unregulated	3150
44	Lower Loddon Unregulated	3151	Lower Loddon Unregulated	3151
45	Upper Murray Unregulated	3160	Upper Murray Unregulated	3160
46	Barmah to Nyah Unregulated	3170	Barmah to Nyah Unregulated	3170
47	Ovens and King Unregulated	3180	Ovens and King Unregulated	3180
48	Kiewa Catchment Unregulated	3190	Kiewa Catchment Unregulated	3190
49	Kiewa Main Stem	3191	Kiewa Main Stem	3191
50	Southern New South Wales	4000	Southern New South Wales	4000
51	Hume to Barmah (NSW) 10A	4010	Hume to Barmah (NSW) 10A	4010
52	Murray Irrigation Limited 10B	4020	Murray Irrigation Limited 10B	4020
53	Southern Victoria Regulated	5000	Southern Victoria Regulated	5000
54	Werribee Bacchus Marsh	5031	Werribee Bacchus Marsh	5031
55	Macalister Irrigation Area	5041	Macalister Irrigation Area	5041
56	Latrobe	5043	Latrobe	5043
57	Wimmera Mallee	6000	Wimmera Mallee	6000
58	Wimmera Irrigation Area	6021	Wimmera Irrigation Area	6021

Row	Delivery Systems	N
2	Regulated Stream	1000000
3	Broken (Nill - Caseys)	4040200
4	Lake Nillahcootie	4040230
5	Broken (Caseys - G'RV)	4040300
6	Various Streams	4040380
7	Lake Mokoan	4040400
8	Broken Creek Upper	4040500
9	Major Creek	4040550
10	Campaspe Eppal-Weir	4060200
11	Eppalock Reservoir	4060230
12	Various Streams	4060260
13	Campaspe Weir-Syphon	4060300
14	Campaspe Syphon-Murr	4060400
15	Goulburn (Eildon - GW)	4050200
16	Lake Eildon	4050245
17	Lake Nagambie	4050246
18	Various Streams	4050286
19	Goulburn (GW - Broken)	4050300
20	Goulburn (BKN - McCoy)	4050400
21	Wakiti Lagoon	4050460
22	Goulburn (McCoy - MUR)	4050500
23	Cattanach Canal	4050650
24	Stuart Murray Canal	4050700
25	Waranga Reservoir	4050600
26	Bullarook Ck New-Hep	4070100
27	Bullarook Hep & Below	4070120
28	Hepburns Lagoon	4070132
29	Newlyn Reservoir	4070156
30	Tullaroop Creek	4070200
31	Tullaroop Reservoir	4070260
32	Cairn Curran Res	4070360
33	Loddon (Cc - Loan)	4070300
34	Loanecoorie Weir	4070450
35	Loddon (Loan - B'wtr)	4070400
36	Loddon Bridgew-Weirs	4070500
37	Serpentine Creek	4070560
38	King River	4035200
39	Lake William Hovell	4035255
40	Mitta Mitta River	4010200
41	Black Dog Ck - Lower	4090204
42	Blampieds Lagoon	4090212
43	Carralls Creek	4090216
44	Chinamans Creek	4090224
45	Gooramadda Creek	4090232
46	Lake Hume	4090240
47	Lake Moodemere	4090244
48	Lake Mulwala	4090248
49	Murphys Creek	4090252
50	Murray (Hume - Y'wong)	4090200
51	Ryans Creek	4090260
52	Sandy Creek	4090264
53	Sunday Creek	4090272
54	Travellers Creek	4090276
55	Wodonga Creek	4090280
56	Dicks Creek	4090310
57	Kynmer Creek	4090330
58	Murray (Y'wonga - Barmah)	4090300
59	Murray Lagoon D/S Y	4090340
60	Sharps Lagoon	4090350
61	Ulupna Creek	4090380
62	Deep Ck (Regulated)	4090425
63	Murray (Barmah - G'RV)	4090400
64	Camerons Creek	4090520
65	Murray (G'RV - Torrum)	4090500
66	Wells Lagoon	4090580
67	Murray (Torr - Lt. Mur)	4090600
68	Lt Murray (D/S Weir)	4140740
69	Murray (Conf - Nyah)	4140780
70	Murray (Lt. Mur - Conf)	4140700
71	Lt Murray (Pental Is)	4141600
72	Buffalo (D/S Lake)	4030200
73	Lake Buffalo	4030220
74	Maloneys Creek	4030325
75	Ovens (Buffalo - Wang)	4030300
76	Tea Garden Creek	4030335
77	Ovens (D/S Wang)	4030400
78	Various Streams	4030470
79	Unregulated Stream	2000000
80	Bridge Creek	4040150
81	Broken River (Upper)	4040100
82	Baddaginnie Creek	4040210
83	Broken River Trib	4040215
84	Catchment Of Broken (Nill - Caseys)	4040299
85	Chinamans Creek	4040220
86	Hollands Creek	4040225
87	Lima Creek	4040235
88	Lima East Creek	4040205
89	Ryans Creek	4040240

Row	Entitlement Type	P	Account
2	Regulated	100	Asset
3	Water Share	110	Water Share
4	SBA	120	Allocation Carryover
5	BE Extractive	130	Water-use Licence: Annual Use Limit
6	BE Loss	140	Water-use Licence: Holding Limit
7	Water Allowance	150	Water-use Licence: Salinity Impact Limit
8	Drainage Diversion	200	Allocation Bank
9	Drainage Diversion	210	Liabilities
10	Unregulated	300	Revenue
11	s51 Direct Diversion	310	Allocation Annual
12	s51 Catchment Dam	320	Allocation Purchase
13	s51 Direct/Catchment	330	Allocation Carryover
14	s51 Fish Farm - in-stream	340	Allocation Advance
15	s51 Power Generation - in-stream	350	Allocation Spill
16	BE Extractive	360	Expense
17	BE Loss	370	Allocation Use
18	Groundwater	400	Allocation Sale
19	s51 Groundwater	410	Allocation Write-off
20	s51 Mineral Water (GW)	420	Allocation Carryover
21	s51 Dewatering	430	O/P
22	s51 Private Right (D&S)	440	Water Share
23	BE Extractive	450	Owner

Sheet1

Page 1

Appendix F Example water accounting standard for materiality

WATER ACCOUNTING STANDARD No. XXX

MATERIALITY

1. PREFACE

Main Features of this Standard

Application Date

This Standard is applicable to annual reporting periods beginning on or after *start date*.

Main Requirements

The Standard:

(a) defines materiality;

(b) explains the role of materiality in making judgements in the preparation and presentation of water accounting reports; and

(c) requires the standards specified in other Water Accounting Standards to be applied when their effect is material.

If this standard had been revised from a previous standard, the changes would also be detailed here.

2. WATERACCOUNTING STANDARD No. XXX

a) Objective

1. The objective of this Standard is to:

    (a) define materiality;

    (b) explain the role of materiality in making judgements in the preparation and presentation of the water accounting reports; and

    (c) require the standards specified in other Water Accounting Standards to be applied when information resulting from their application is material.

b) Application

2. This Standard applies to each entity preparing a water accounting report in accordance with Water Accounting Standards.

3. This Standard applies to annual reporting periods beginning on or after *start date*.

4. This Standard may be applied to annual reporting periods beginning before *start date*.

SKM

5. When applied or operative, this Standard supersedes *any previous versions of this standard*

c) Purpose

7. In order to meet the objective of general purpose water accounting reporting, information provided in the water accounting report needs to be useful to users for making and evaluating decisions about the allocation of resources and possess the qualitative characteristics specified in the *Conceptual Framework*.

8. General purpose water accounting reporting involves making decisions about the information to be included in general purpose water accounting reports and how it is presented. In making these judgements, considerations of materiality play an essential part. This is because the inclusion of information which is not material or the exclusion of information which is material may impair the usefulness of the information provided to users.

d) Application of Materiality

9. The standards specified in other Water Accounting Standards apply to the water accounting report when information resulting from their application is material. Information is material if its omission, misstatement or non-disclosure has the potential, individually or collectively, to:

(a) influence the decisions of users taken on the basis of the water accounting report; or

(b) affect the discharge of accountability by the management or governing body of the entity.

10. The notion of materiality influences whether an item or an aggregate of items is required to be recognised, measured or disclosed in accordance with the requirements of a Water Accounting Standard. When an item or an aggregate of items is not material, application of the materiality notion does not mean that those items would not be recognised, measured or disclosed, but rather that the entity would not be required to recognise, measure or disclose those items in accordance with the requirements of a Water Accounting Standard.

11. In addition to guiding the application of the recognition, measurement and disclosure requirements, the notion of materiality guides the margin of error that is acceptable in the amount attributed to an item or an aggregate of items and the degree of precision required in estimating the amount of an item or an aggregate of items.

12. In deciding whether an item or an aggregate of items is material, the size and nature of the omission or misstatement of the items usually need to be evaluated together. In particular circumstances, either the nature or the amount of an item or an aggregate of items could be the determining factor. For example:

(a) in the context of error corrections or adjustments for events occurring after the reporting date, materiality based on amount alone is sufficient to require a correction or an adjustment to be made; and

(b) it may be necessary to treat as material an item or an aggregate of items which would not be judged material on the basis of the amount involved, because of their nature. Some examples of where this may apply include:

(i) A higher level of accountability is expected to apply to an organisation because of a perceived higher standard of care, for example the ownership of entitlements by a government on behalf of the environment;

(ii) Where for example a director of an irrigation company or trust personally holds water entitlements.

13. Different types of water information can achieve, or have an expectation of, different levels of precision, and therefore different materiality levels. For example:

(a) measurement of recharge from an aquifer to a stream can only be determined by modelling, and is therefore relatively difficult to measure with absolute precision. The level of materiality would therefore be relatively high;

(b) the ownership of water entitlements by individuals can be measured with absolute precision and should therefore attach a very low or zero level of materiality.

14. This paragraph might attempt to make explicit recommendations of types of data and levels of materiality on a relative basis. For example:

(a) *entitlements: zero;*

(b) allocations (measurement of actual extractions): amount or aggregate is compared with the more appropriate of:

(i) the recorded amount of water available;

(ii) the appropriate stock or commitment class total;

(iii) the net inflows or outflows for the current reporting period

(c) Modelling, etc.,

15. Quantitative thresholds used as guidance for determining the materiality of the amount of an item or an aggregate of items shall, of necessity, be drawn at arbitrary levels. Materiality is a matter of professional judgement influenced by the characteristics of the entity and the perceptions as to who are, or are likely to be, the users of the water accounting report, and their information needs. Materiality judgements can only be properly made by those who have the facts. In this context, the following quantitative thresholds may be used as guidance in considering the materiality of the amount of items included in the comparisons referred to in paragraph 14 of this Standard: *It is suggested that different percentages would apply to different types of water data.*

(a) an amount which is equal to or greater than *x* per cent of the appropriate base amount may be presumed to be material unless there is evidence or convincing argument to the contrary; and

(b) an amount which is equal to or less than *y* per cent of the appropriate base amount may be presumed not to be material unless there is evidence, or convincing argument, to the contrary.

16. In practice materiality judgements are typically made on the basis described in paragraph 14. However, further indications of materiality may be evident from making assessments of the items in an absolute and a relative context. This may necessitate disclosure of information in the water accounting report about items which are not considered material in amount in accordance with paragraph 14.

17. In absolute terms, consideration is given to the water accounting report as a whole. In particular, consideration is given to factors which may indicate deviations from normal activities such as the reversal of a trend, turning a net inflow into a net outflow or creating or eliminating the margin of a sustainable yield from an aquifer. For example, if the harvesting from an aquifer was considered to exceeding the sustainable yield, and as a result of remodelling the aquifer recharge is changed and, that harvesting is subsequently not considered to be exceeding the sustainable yield, the, information regarding the remodelling of aquifer recharge would be likely to be material, even though the changed recharge amount may not be otherwise material.

18. In relative terms, items are compared to any directly related items. The amount of an item may not be material when judged on the basis described in paragraph 14, but its size in relation to a related item may indicate that information about it is material. For example, the amount of water extracted for irrigation would be compared with the underlying allocation and the water entitlement. Such a comparison may indicate that information about the extraction is material because its amount is much

lower (or higher) than expected, having regard to the allocation announced and the underlying entitlement.

Appendix

Defined Term

Material	Omissions or misstatements of items are material if they could, individually or collectively, influence the decisions of users taken on the basis of the water accounting report. Materiality depends on the size and nature of the omission or misstatement judged in the surrounding circumstances. The size or nature of the item, or a combination of both, could be the determining factor.

Appendix G Murray Darling Basin case study

G.1 Background

The Southern connected Murray Darling Basin (SCMDB) contains the large regulated water systems of the Murrumbidgee, Murray and Goulburn basins, plus the smaller regulated Broken, Campaspe, Loddon and Lower Darling systems. They are all highly regulated. The tributary systems are managed by State water agencies and the main stem of the Murray is managed by River Murray Water on behalf of New South Wales, South Australia and Victoria.

Accounts have been kept for many years of the shares of the Murray resource available to each of the States. Water trading has been progressively freed up over the past two decades, and current moves to expand permanent interstate water trade will increase the complexity of water accounting. Water trade is governed by rules for trading between entitlement types and “trading zones” that aim to ensure that the water can be physically delivered without undue third-party effects.

Water resources in the SCMDB are widely regarded as “over-allocated” which really means that entitlements have been issued to a level that has created expectations of allocations that are now seen as ecologically unsustainable.

Management responses have included:

- Introduction of a “cap” on extractions throughout the Murray-Darling Basin, containing long term average extractions to 1993/94 levels.
- Specific programs to recover water for the environment, largely by “water savings” by decreasing delivery losses, but possibly also by market transactions.

The result is that the environment will hold an increasingly complex portfolio of rights to water. It is likely to hold extractive entitlements of high and medium reliability water in each trading zone and arising from a variety of programs. It will also continue to hold a variety of instream entitlements.

G.2 Classes of environmental water

A particular right might be categorised as;

- **Pre-existing water** – a right which existed prior to any cost recovery programs. An extractive example is the 27.6 “flora and fauna” BE in Victoria
- **Snowy recovery water –** this program arose from the Snowy Water Inquiry. Victoria and NSW undertook to recover between them 282 GL of entitlement. Of the first 210 GL recovered, two thirds is to go to the Snowy and one third to the Murray. The remaining 72 GL will go to the Snowy. As at 1 July 2005, it is understood that some 52 GL had been

recovered. An example is 11.2 GL saved on the Murrumbidgee by the Forest Creek water management plan.

- **Living Murray water** – The Living Murray is a program to recover "up to 500 GL" of water for the Murray, from within New South Wales, South Australia, Victoria and the ACT.
- **Donated water** – there have been examples of irrigators donating unused allocation to the environment, for example Sunraysia irrigators have donated water to be pumped to Hattah Lakes. It is likely that donations of entitlement (permanent donations) will be made in the future, and there is interest in ensuring that they will be tax effective.
- **Casual use by landholders** – there are examples of farmers who use some of their irrigation water to water a small private area of wetland "down in the back paddock" by either direct and intentional watering or by using the wetlend to catch irrigation drainage. While these activities may be beneficial to the environment, it will not be possible to account for them unless the landholder makes an effort to carefully separate his irrigation and environmental activities and obtain separate entitlements for each.

A significant example of environmental activity by landholders is the Banrock Wetland in South Australia, which is on land owned by Banrock Station (a winery) and has been managed by the Station for many years. Historically the wetland has been held artificially high in summer and autumn by the backwaters of Lock 3 and the need to retain water in it till the end of the irrigation season because it acts as a pumping pool for Banrock and a neighbour. Although Banrock has put money and effort into managing the wetland, it has not needed a water entitlement to do so, because the wetland is connected to he Murray and its water use is accounted as river loss.

It is now proposed to move the irrigation pumps to the Murray, which will reduce evapotranspiration from the wetland by an average of 650 ML/year, (which becomes a water saving) by enabling a more natural wetting and drying regime. However the wetland will still use an average of about 1.1 GL/year and a separate extractive entitlement will be needed, as the wetland is conceptually separate from the Murray (except when it is reconnected by natural floods).

Banrock will then be managing two separate water entitlements, one for irrigation use and one for environmental use (though it probably will not "own" the environmental entitlement.)

It will be necessary to account separately for the different classes of environmental water. For example the Living Murray process is an investment of hundreds of millions of dollars by several governments to recover water for the environment, to be used at six identified "icon sites". Governments and other interest groups are certain to want to know what extra watering at the icon sites has been achieved by this expenditure. They will also want to know the environmental outcomes, but that is a matter for ecologists to report on, not water accountants.

Consideration will need to be given to how to provide for separate identification of the various classes of environmental water in the Murray Darling Basin

G.3 Conversion between instream and extractive rights

G.3.1 Conversion of extractive use to instream use

Environmental managers are likely to want to use extractive entitlements in an instream fashion. This is legitimate, and the accounting process should be able to cater for it.

In theory, if an extractive allocation is used instream, it should remain undiverted in any location – in other words it should be "green to the sea." Thus a ML of extractive entitlement released from Hume may be more valuable than a ML of "Barmah-Millewa" water, which will reach the Barmah Forest where some will be consumed but most will return to the river and may be diverted for human use further downstream. (On the other hand, Barmah-Millewa water is fully callable from Hume, whereas water at Swan Hill is supplied partly from unregulated inflows below Hume.)

However it is unrealistic to expect to track a specific parcel of water all the way down a complex system. How do we achieve a "green to the sea" outcome within the realities of water regulation and measurement?

There are several ways that this conversion could be achieved. Examples are:

- A "dummy water user" could be placed at the lowest practical point in the system where measurement is available (say Wellington on the Murray?) and the required passing flow could be increased by the amount of "use" ordered. That use should be counted as a extraction under the Cap (or the non-environmental extraction under the Cap for that year should be reduced by the same amount, which has the same effect)
- A study could be undertaken to assess what, *on average*, would happen to a release from Hume under the conditions of the actual release. It might conclude that of an extra "Barmah-Millewa release of 1000 ML from Hume, on average 200 ML would be evapo-transpired in the Barmah Forest, a further 100 ML would be evapo-transpired in other riverine wetlands, 400 ML would be diverted for human use either directly or after storing in Lake Victoria and the remaining 300 ML would reach the sea. The water accounts could then just deem that the water had been used in that way. The release of 1000 ML would be accounted as having supplied 300 ML to wetlands and 300 ML to the Murray mouth, so only 600 ML of consumptive allocation would be used up to secure the release of 1000 ML from Hume. The

same proportions could be used every time an allocation was transferred from consumptive use to this particular form of instream use.

- A more accurate (and higher cost) method would be to undertake a modelling type analysis every time an allocation was transferred in this way, to estimate how the use should be accounted and how much extractive allocation should be deemed as having been used.

There are inaccuracies and difficulties with each of these approaches, but they are in concept correct and fair. The accuracy of implementation would improve over time as measurement accuracy and knowledge of river processes improved.

Mechanisms for conversion between instream and extractive environmental rights should be further investigated, with the aim of developing guidelines for estimating the relevant volumes to be used in water accounts

G.3.2 Conversion of instream use to extractive use

The reverse type of temporary trade, using an instream right to provide extractive use, is in principle not possible without “payback” of the extraction in circumstance where extractions from streams are capped. There are non-environmental examples of that – NSW irrigators have made use of Snowy advances at times, and the Barmah-Millewa arrangements explicitly provide for water to be “borrowed” by irrigators under some conditions without actual trade.

It may seem unlikely that this sort of arrangement would be of much interest to environmental managers. However, examples of instream rights being used in an extractive manner are occurring. Environmental managers in New South Wales and Victoria claim the right to extract “surplus” flows and use them for environmental purposes. Where the use is on riverine wetlands, this can be seen as simply manipulating flows within the river to increase river losses and produce a good environmental result, and so to be acceptable. However if the use is in a wetland remote from the source river, under an accounting framework that distinguishes between extractive and instream rights, it amounts to extraction of water purporting to be under an instream right, ignoring instream rights of downstream valleys.

This is a significant policy issue requiring resolution. If the practice is deemed to be acceptable, a significant exception would have to be built into the suggested accounting framework.

To determine an accounting treatment, it is important to agree on whether an indirect environmental right to instream water, created by agreed caps on extraction, includes a *unilateral* right by an environmental manager to extract water for environmental purposes. In other words, is a cap a cap on extractions or a cap on non-environmental extractions (bearing in mind that there will need to be proper processes for converting between the two

forms of environmental right, as distinct from a unilateral right to do so without considering downstream river reaches)

G.4 River loss or environmental use?

A physical location may at times be within a river system and at times be outside it. A good example is Hattah Lakes.

Hattah Lakes are connected to the Murray by a natural channel. They fill from floodwater during large Murray floods, but may then be disconnected from the Murray for several years over which they progressively evaporate. A control structure has been built on the inlet channel and this is usually closed when a flood peak has passed to prevent water returning to the river, thus prolonging the periods with water in the Lakes.

In recent dry years, pumps have been installed and water has been pumped over the control structure into the Lakes to increase water levels. This water has (correctly) been accounted for by using extractive allocation transferred from the Flora and Fauna BE and extractive allocation donated by Sunraysia irrigators.

However in periods of flood, the river expands to include Hattah Lakes. Gravity inflows in those periods currently turn up in water balances for the river entity as increased “river losses.” If thought appropriate, the net volume that flowed into Hattah (however estimated) could be re-badged by being identified as a separate sporadic flow from the river entity. It would be an outflow from the river entity and an inflow to the Hattah Lakes entity. If a stand alone account is required for the Hattah Lakes entity it would include both sporadic inflows from the river and inflows from extractive allocations.

Note that it is not that the “Hattah Lakes” physical identity changes location; rather the Murray main stem entity is considered to expand during times of flood. This is what phsically happens, so it appears reasonable to account in the way suggested.

The Banrock wetland in South Australia is a similar example.

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Appendix H Consolidated report templates

H.1 Surface water report template

Template surface water report

Scope:

- Period: start and end
- Water entity
- Report preparer

Opening balance

Volume of water stock in:

- Reservoirs
- Off river storages
- River channels

Inflow

- Surface water inflow
- Inflow from aquifers
- Returns

Outflow

- Evaporation
- Surface water outflow
- Outflow to aquifers
- Extractions

Closing balance

Volume of water stock in:

- Reservoirs
- Off river storages
- River channels

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H.2 Water cycle report template

Template for Water Cycle Report

Scope:

- Period: start and end
- Water entity
- Report preparer

Opening stock,

Volume of water in:

- Surface water storages
  (major on-river reservoirs, farm dams, off-river storages, etc)
- Aquifers
  (Renewable and non-renewable, saline and non-saline)
- Soil (unsaturated zone)
- Snowpack
- River channels

Inflow

- Rainfall
- Surface inflow from adjoining physical entities
- Returns from the economy outside of the physical entity
- Inflow from aquifers outside of the physical entity

Internal Interchange

- Surface water to soil
- Surface water to streams
- Soil to aquifers (saline, non-saline)
- Aquifers (saline, non-saline) to surface water
- Extraction to economy inside the physical entity
- Returns from economy inside the physical entity

Outflow

- Evapo-transpiration
  (from soils & aquifers; from surface water & interception)
- Surface flow out of the physical entity
- Aquifer flow out of the physical entity
- Extraction to economy outside the physical entity

Closing stock

- (items as per opening stock)

H.3 Groundwater report template

Template groundwater report

Scope:

- Date of assessment
- Water entity
- Report preparer
- Perspective (long term assessed behaviour in average annual terms)

Inflow

- Recharge from soil
- Recharge from rivers and lakes
- Recharge from economy
- Inflow from adjoining aquifers (lateral)
- Inflow from adjoining aquifers (vertical)

Outflow

- Evapo-transpiration
- Outflow to rivers and lakes
- Outflow to adjoining aquifers (lateral)
- Outflow to adjoining aquifers (vertical)
- Outflow to the ocean
- Sustainable extraction

H.4 Water access entitlement source report template

Template water access entitlements source report

Scope:

- Period: start and end
- Water entity
- Report preparer

Opening stock

For each class/category of water access entitlement:

- share units stock

Increases

For each class/category of water access entitlement:

- New share units issued
- Share units created pursuant to non-tagged trade in (where relevant)

Reductions

For each class/category of water access entitlement:

- Share units cancelled
- Share units cancelled pursuant to non-tagged trade out (where relevant)

Transfers

For each class/category of water access entitlement:

- Share units acquired/number of transactions
- Share units transmitted/number of transactions

Closing stock

- (items as per opening stock)

H.5 Water access entitlement destination report

Template water access entitlement destination report

Scope:

- Period: start and end
- Water entity
- Report preparer

Opening stock

For each class/category/source of water access entitlement:

- Share units linked to the physical entity

Increases

For each class/category/source of water access entitlement:

- New share units issued linked to the entity
- Share units linked to the entity created pursuant to non-tagged trade in (where relevant)
- Share units moved in (tagged trade)

Reductions

For each class/category/source of water access entitlement:

- Share units linked to the entity cancelled
- Share units linked to the entity cancelled pursuant to non-tagged trade out (where relevant)
- Share units moved out (tagged trade)

Internal movements

For each class/category/source of water access entitlement:

- Share units linked to a new location within the physical water entity

Closing stock

- (items as per opening stock)

H.6 Surface water system (regulated river system) report template

Proposed surface water report [regulated river system variation]

Scope:

- Period: start and end
- Report preparer
- Water entity (regulated river system)

Opening balance

Allocatable stock

- Water in storage in dams
- Controllable water in rivers, weirs

Inflow

Inflows to allocatable stock

- Controllable surface water inflows
- Other controllable inflows (eg Aquifer discharge to rivers, returns)

Other inflows

- Uncontrollable surface water inflows

Outflow

Outflows from allocatable stock

- Controlled surface water outflows
- Minor outflows (eg evaporation, aquifer recharge from rivers)
- Extraction of water (water allocations)

Other outflows

- Uncontrolled surface water outflows
- Extraction of water (limit allocations)

Closing balance

- (items as per opening balance)

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H.7 Allocatable stock report template

Proposed allocatable stock report

Scope:

- Period start and end
- Report preparer organisation
- Water entity (a regulated river system)

Opening allocatable stock

Total allocatable volumes	Allocated or committed volumes
▪ storage stock	▪ volumes allocated to each class of allocation
▪ receivable stock	▪ volumes committed to each type of commitment
	Unallocated volume
	▪ = total less allocated and committed volumes

Increases in allocatable stock

Increases in unallocated stock

- Controllable surface water inflows
- Other minor inflows (eg Aquifer discharge, returns)
- Increases in receivables
- Use (including write-off) of allocated and committed stock

Increases in allocated and committed stock

- allocation or commitment of unallocated stocks

Reductions in allocatable stock

Reductions in unallocated stock

- Controlled surface water outflow
- Other minor outflows (eg evaporation, aquifer recharge)
- Extraction of water
- Reductions in receivables (eg because it has turned up as an inflow)
- allocation or commitment of unassigned stock

Reductions in allocated or committed stock

- Use (including write-off) of allocated and committed stock

Closing allocatable stock

- (items as per opening stock)

Proposed General Water Allocations Report

Scope:

- Period start and end
- Report preparer
- Water entity (surface water management area, delivery system, trading zone, groundwater management unit)

Opening stock

- Water allocation stock
  (differentiated by type of allocation)

Increases

- New water allocations accrued
- Water allocation moved in
  (both differentiated by type of allocation)

Reductions

- Use of water allocations
- Water allocation moved out
- Water allocation written off
  (all differentiated by type of allocation)

Closing stock

- Water allocation stock
  (differentiated by type of allocation)

H.8 General water allocation trade report template

Proposed General Water Allocations Trade Report

Scope:

- Period start and end
- Report preparer
- Water entity (surface water management area, delivery system, trading zone, groundwater management unit)

Opening stock

For each type of water allocation:

- Maximum net water allocation trade out permitted for period (if applicable)

Acquisitions

For each type of water allocation:

- Water allocations acquired
- Number of acquisition transactions

Divestments

For each type of water allocation:

- Water allocations divested
- Number of divestment transactions

Closing stock

For each type of water allocation:

- Maximum net water allocation trade-out remaining (if applicable)

  (differentiated by type of allocation)