



**Environmental water: a critical review of Australian national and
selected jurisdictional policy to inform the development of
policy in the Northern Territory**

Kathryn Elizabeth Minahan

Bachelor of Arts (Hons), Diploma of Education (Secondary) (Monash University),
Graduate Diploma of Educational Administration (Deakin University), Graduate Diploma
of Tropical Environmental Management (Charles Darwin University)

Faculty of Education, Health and Science, Charles Darwin University

Submitted in fulfilment of the Research Project requirements for degree of Master of
Tropical Environmental Management

Date of submission: January 2007

C.D.U. LIBRARY

Statement of Authorship

I declare that this thesis is my own work and has not been submitted in any form for any other degree or diploma at any university or other institute of tertiary education. Information derived from the published and unpublished work of others has been acknowledged in the text and list of references.

Kathryn Elizabeth Minahan

January 2007

Acknowledgements

I gratefully acknowledge the assistance provided to me by Dr Penny Wurm and Dr Lindsay Hutley (CDU) in developing an approach to this topic and Peter Jolly (NRETA) for providing information about groundwater in the Northern Territory. Dr Naomi Rae (CDU) supervised the project, providing a wealth of information about water management, highly practical advice and much encouragement.

Table of Contents

Acknowledgements	3
Abstract	5
Chapter 1 Introduction.....	7
Chapter 2 Science of environmental water provision and the Northern Territory context	14
Chapter 3 Background to national environmental water policy.....	28
Chapter 4 Features of sustainable policy for environmental water provision ...	40
Chapter 5 Policy for environmental water in four states and the Northern Territory	Error! Bookmark not defined.
Chapter 6 Application to the Northern Territory situation.....	Error! Bookmark not defined.
Chapter 7 Conclusions	Error! Bookmark not defined.
References.....	Error! Bookmark not defined.

List of Tables

Table 1 The three basics of policy structure: legal, educational and institutional	46
Table 2 The major content of sustainability policy as outlined by Dovers 2006 ...	47
Table 3 Criteria with indicators for analysis of environmental water provision policy in a context of sustainability	52
Table 4 Summary of results: ranking of all jurisdictions on each criterion for sustainable environmental water policy.....	Error! Bookmark not defined.

Appendices

Appendix 1.....	Error! Bookmark not defined.
Appendix 2.....	Error! Bookmark not defined.
Appendix 3.....	Error! Bookmark not defined.

Abstract

Providing for environmental water needs is one aspect of national water management reform to which Australian jurisdictions have agreed and which is of great community interest. While demonstrating limited compliance with national policy requirements, Northern Territory policy for environmental water is underdeveloped. This desktop review aimed to identify effective features of environmental water provision policy in a context of concern about sustainability, with a view to inform the development of NT policy. The issue was backgrounded through brief exploration of scientific understandings about environmental water requirements and environmental water provision and the evolution of national policy. Environmental policy analysis is a relatively new field in Australia without established approaches or methodologies. It was argued that a focus on sustainability calls for new approaches to the structure and content of policy and Stephen Dovers' *Environment and Sustainability Policy* (2006) heavily informed the generation of nine criteria against which the environmental water policies of New South Wales, Queensland, South Australia and Western Australia were assessed. 32 policy documents available on the internet were analysed for evidence relating to each criterion via close reading with electronic keyword searches for a subset of the sample. The analysis found that jurisdictional implementation of national policy demonstrates different approaches and different stages, with some exemplary policy features across the sample able to inform recommendations for NT policy development. Partial implementation of sustainable features may reflect shortcomings of current national policy in its unclear balance between meeting environmental, economic and social needs, lack of full definition of the role of the community, and little emphasis on the educative component of policy. The role of public researcher revealed that these public policies were more easily accessible to community members in only one jurisdiction.

Chapter 1	Introduction	7
1.1	<i>The issue</i>	7
1.2	<i>The aim and objectives</i>	7
1.3	<i>Background</i>	8
1.4	<i>Themes</i>	9
1.5	<i>Methodology</i>	10
1.5.1	Perspective	10
1.5.2	Data selection	10
1.5.3	Data analysis	11
1.5.4	Attribution	12
1.5.5	Abbreviations	12

Chapter 1 Introduction

1.1 *The issue*

Provision of water for the environment in regions where water resources are being exploited for human consumption is now recognised as fundamental to the health of ecosystems and the future sustainability of these resources, and their dependent uses and industries. Government policy is overwhelmingly the vehicle for ensuring that environmental water needs are met. Users of water resources and the community more broadly, have expectations that policy provisions are effective for their goals and will thus ensure that their use of water will not cause environmental harm. Currently water resource policy provisions in the Northern Territory (NT) do not explicitly nor comprehensively account for provision of water for the environment as an essential aspect of environmentally sustainable development. Features of effective policy for environmental water provision in a context of concern for sustainability at national and state levels can inform the development of policy in the NT. Although the NT has lagged behind other Australian jurisdictions in reforming its water policy in response to global and national initiatives in the provision of water for environmental needs, it has the opportunity to adopt exemplary approaches where they can be demonstrated.

1.2 *The aim and objectives*

The overall aim of the review was to identify the features of policy which are most effective for environmental water in a context of concern for sustainability and with the view to inform the development of NT water resources policy with regard to environmental water provision.

Within this broad aim were seven specific objectives. The first objective was to identify several key scientific understandings essential to policy development about environmental water requirements and environmental water provision in Australia. Secondly was to describe significant features for the context of environmental water in the NT, both biophysical and socioeconomic, which are relevant to policy development. Thirdly, was to identify the major features of national policy and considered their effectiveness for environmental water provision. The fourth objective was to explore the features required of policy for environment in the current and developing context of concern for sustainability and

to develop a set of criteria for reviewing environmental water policy. The fifth objective was to apply these criteria to review environmental water policies as currently presented in four states and the Northern Territory. Sixthly was to recommend directions for policy development for environmental water provision in the NT in the light of the results of these reviews. The seventh objective was to draw conclusions for environmental water policy from the literature reviewed.

1.2 Background

The issue that this review addressed is complex and broad in scope. The review hence drew on two separate theoretical bases which are very briefly outlined here: policy analysis, and science as it relates to environmental water provision.

Policy made by governments at several levels increasingly drives environmental management because of the significant investment in and coordination of financial, material and human resources which are involved in addressing environmental issues. Analysis and review of policy has become a significant field of inquiry as organisations, including governments endeavour to meet expectations for accountability in achieving designated outcomes, whether because of international treaty obligations, the demands of their constituents or concerns for limited budgets. Environmental policy analysis in Australia is arguably a new field, because its recency and the scope of environmental and human issues with which it is concerned bring together knowledge systems and institutions in new ways. It integrates law, education, communication, history, psychology, economics and administration with the scientific fields of its substantive focus.

While the basic role of policy, the formulation of intentions into achievable directions for action may not have changed, the conditions for its formulation and enactment in environmental matters are now both more complex and more urgent. It is therefore important that policy be critically evaluated, but the paradigms or accepted models for carrying out such evaluation are clearly shifting. In addition to the multidisciplinary approach alluded to above, concerns about sustainability reframe the time-scales and impacts which need to be considered. The ultimate test of policy is its outcomes, but complexity and urgency narrow the possibilities for trial and error, so policy analysis paradigms must be applied before impacts may be clear.

A final aspect that new policy analysis paradigms must also take into account is its ultimate audience which is, in the case of government policy, the citizens who constitute the general community, as well as stakeholders in specific policy areas. It is thus vital that policy provide directions in terms which are meaningful to a broad audience and in forms which are accessible.

The science of environmental water provision is another complex field, because it incorporates hydrology and ecology in relation to variable ecosystems. These provisions compete with differing human demands for water and thus their differing impacts. The two key concepts which demonstrate the complexity of environmental water are *requirements* and *provisions*. (ANZECC 1996). The distribution of flora and fauna across Australian landscapes may be seen as a response to available environmental water, but it also demonstrates unique adaptations to the variable seasonal and inter-annual availability of water. Flora and fauna water requirements cannot be described in terms of a fixed quantity or quality. Describing ecosystem water requirements in practical terms requires detailed case-by-case investigation of the species assemblages, both flora and fauna, over time and over space in terms of specific attributes of their landscape positions, and often in relation to both surface and ground water. (Eamus and Froend 2000; Allen and Lovett 1997)

It is a given that understanding of environmental water requirements is extremely challenging, because knowledge is always incomplete. It stands to follow that the determination of environmental water provision is therefore even more contentious. Providing for environmental water can mean both abstaining from withdrawing water from a particular source, or controlling withdrawals from sources which are already exploited (in the case of groundwater) or regulated (in the case of dams and weirs on rivers and creeks). Provision of environmental flows in rivers has come to mean the release or supply of water for environmental purposes. Defining and fulfilling these purposes usually means not fulfilling others, as human knowledge has yet to recreate the complexities of stream flows which achieve geomorphological, chemical and ecological purposes for all reaches and all flora and fauna species dependent upon them.

1.4.1 Themes

Gaining an understanding of environmental water policy in Australia thus involved drawing on two substantial fields of knowledge. One review exercise cannot claim to do this

comprehensively, but an analysis of policy for the purposes of its further application within a geopolitical jurisdiction required reference to a selection of important ideas in these fields. This review explored references with three themes: a limited range of scientific literature related to environmental water, selected texts related to policy analysis for environment and a broad range of documents comprising national and jurisdictional policy for environmental water provision in Australia. Understandings from each of these themes informed the review.

1.5 Methodology

1.5.1 Perspective

Policy analysis is usually conducted by experts in a field of knowledge for other experts and also for a more general audience. The writer of this review therefore adopted two perspectives which shaped the methodology, the selection of data and the approach to its analysis. The first perspective was of the environmental policy analyst, who sought to interrogate the incorporation of scientific understandings into government policy. The second perspective was that of public researcher representing community interests, who wished to discover how environmental values are protected and how community interests are represented in policy for environmental water. This perspective is rarely voiced or discussed but is critically important for community support for environment policy. The issue of environmental water provision is of public concern, especially in the current situation of prolonged drought over much of Australia which has given rise to consistent public comment in all media. Insights gained from this approach are discussed in the concluding chapter.

1.5.2 Data selection

As environmental policy analyst, the writer accessed a range of scientific literature on environmental water provision and a small selection of texts on environmental policy. As public researcher and policy analyst, the writer explored only policy documents available electronically over the internet. Documents included national policy relevant to the development of environmental water provision, and legislation, strategies, frameworks and plans which together comprised policy sets for environmental water provision in four states and the Northern Territory. The restriction to internet-based data as a source meant that the most recent policy may not be represented, but reflected the situation available to the public, and provided insight appropriate for decision makers about the role of resources the community has at its disposal, which may manifest itself in the level of understanding and reasons underlying public sentiment. The final sets of documents consulted were uneven in

length, complexity and comprehensiveness, but this accurately reflected the availability of such texts. In all 32 documents were included in the analysis of jurisdictional policies.

This review is concerned with policy, that is, the formulation and statement of intention, more than its outcomes. Separating these two phases of the policy process is sometimes difficult. The outcomes of policy are presented in reports. In the case of environmental water provision, statements of intention for the nation have been completed by the Australian Government, and implementation of this policy is a work in progress in most states and territories. Jurisdictional progress in implementing the 1994 COAG Water Reform Framework was monitored by the National Competition Council which produced several reports. Since the National Water Initiative (NWI) of 2004 this task has been allocated to the National Water Commission, and is also reported in State of the Environment reports (2000 and 2006). These reports were consulted to verify policy details where necessary but they did not form the data set for policy analysis.

The selection of documents mirrored the governance of water management in Australia, where a federal structure means the Australian Government generates but does not implement policy. Strong historical and geographical differences in institutional arrangements within each state and territory account for great discrepancies in their rates and mode of implementation of national policy. Efforts were made to obtain the most recent versions of selected documents. Interviews to clarify or verify information presented were not conducted, given the broad range and geographic cover of documents and ethical and time constraints. The result is that the researcher applied a consistent analysis without some geopolitical areas being more informed than others.

The review was commenced with the awareness that Northern Territory environmental water policy is undeveloped in comparison with some states. This has been noted previously (EDO 2005). It was hypothesised that states which have made more progress in policy development could provide models for NT policy development and four states were selected on the basis of sharing some environmental similarities with the NT: for example NSW and Queensland rangelands, Queensland and Western Australian tropical savannas and South Australian and Western Australian arid lands. The validity of this hypothesis is discussed in the concluding chapter.

1.5.3 Data analysis

The data to be analysed consisted of written documents, which are statements of intention (policy), definitions and parameters concerning applicability in time and space (principles), statements naming human institutions, positions and roles, particular water resources and their quantitative and qualitative features.

Textual data carries meaning through language, and the language choices made within these documents are deemed as deliberate and therefore significant in representing intent. Analysis of policy documents can be undertaken using rigorous textual methodologies such as discourse analysis where there is a singular purpose (for example, Fairclough 1989; Dryzek, 1997) but such an approach was rejected because it is not applicable to documents of variable length, format, and text structure which are being analysed for several purposes. The method used for this policy analysis was close reading and note taking to detect key definitions, repetitions of core ideas, variations in emphasis, gaps and omissions. In recognition of the subjective biases possible from this approach, each major legislative document was additionally subjected to computerised keyword analysis. The presence, absence, frequency and context of keywords was recorded in order to provide an objective point of reference.

1.5.4 Attribution

Scientific analysis requires tighter referencing of statements than is possible in analysis of policy via textual analysis. Each statement attributable to a single text was referenced. Unreferenced statements are the result of the writer's research, analysis or wider knowledge.

1.5.5 Abbreviations

The following abbreviations will be used in this document when necessary: environmental water requirement/s (EWR/s), environmental water provision/s (EWP/s), groundwater dependent ecosystem/s (GDE/s), water dependent ecosystem/s (WDE/s).

Chapter 2 Science of environmental water provision and the Northern Territory context.....	14
---	-----------

2.1	<i>Science of environmental water provision</i>	14
2.1.1	Introduction	14
2.1.2	Environmental water requirements (EWRs)	16
2.1.3	Environmental water provision (EWP)	18
2.1.4	Conclusion	20
2.2.	<i>The Northern Territory Context</i>	20
2.2.1	Biophysical features: water resources	20
2.2.2	Biophysical features: water dependent ecosystems	21
2.2.3	Social and economic features	23
2.2.4	Implications of features of current NT context for environmental water policy	24
2.3	<i>Conclusion</i>	26

Chapter 2 Science of environmental water provision and the Northern Territory context

Policy to provide water for environment is one fundamental aspect of policy for the management of water resources in a sustainable context. It is informed by understandings about ecosystem use of water in identified environments. In order to create a picture of the realities to which this policy is directed, chapter 2 briefly addresses two topics: scientific understandings about environmental water, and features relating to water resources in the Northern Territory environment, which is the focal point of this review.

2.1 *Science of environmental water provision*

2.1.1 Introduction

The topic of environmental water provision and its expression in policy is complex, not least because of environmental issues, but because of the nature of water itself. In order to demonstrate some of the complexities and difficulties in ensuring that environmental water needs are met, a brief review of some of the scientific literature is provided. This review is not intended to be comprehensive, nor produce a scientifically rigorous analysis. It does however intend to convey an overview of the issue, and provide a point of comparison for the terms in which environmental water requirements are referred in policy documents. A small range of scientific reports on environmental water provision were reviewed to place this issue into context.

The objective of allocating water to the environment is primarily seen as needing to maintain ecosystems and key features or indicators of ecosystem health (ie, distribution patterns, productivity and functionality of flora and fauna) (ANZECC 1996). This requires the determination of water use by ecosystems such as instream habitats over rock, sand, clay or gravel, wetlands and riparian zones that may be permanent waterbodies, or seasonally or episodically inundated places. All the habitat types in water dependent ecosystems are characterised by a certain water regime and water quality. Water regime is understood as a flow regime, ie. the magnitude, frequency, timing, seasonality and rate of inundation and fall in water levels (Arthington and Zalucki 1998, p. 42).

The determination of environmental water requirements therefore requires identification of the biotic and abiotic characteristics of waterbodies and their catchment. Water budgets or water balances have been used to describe the location, residence time and amount of water throughout the hydrological cycle (abiotic characteristics). The biotic features are the ecosystem components and their use of water. These topics will be addressed briefly in order to illustrate some of the complexities of providing water for the environment.

Calculating a water balance for a region requires knowledge of rainfall, evaporation rates, transpiration rates of the dominant vegetation types, soil moisture storage, deep drainage to groundwater storage, surface run-on and surface run-off on a seasonal and annual basis. (Eamus *et al* 2006a, p. 64)

Surface and groundwater have been (and in some jurisdictions still are) treated separately as two sources and types of water. Simplified diagrams of the hydrological cycle often describe rainfall contributing to surface flow, then to streamflow, then to subsurface flows and finally to groundwater flows, then discharge back to the surface. Groundwater often constitutes the base flow of rivers as discharge water (gaining stream). At other times river water can recharge groundwater systems (losing stream). The low topographic relief of Australian landscapes means that ground and surface water catchments are rarely the same (Eamus *et al* 2006a, p. 75) and therefore managing for one catchment (typically surface water catchments) can fail to account for groundwater supplies and losses.

Although there is a wealth of information about the environmental water requirements of surface water systems (ie. rivers, streams, lakes, billabongs and floodplains), that of groundwater dependent ecosystems is surprisingly poorly documented. Many aquatic systems are supplied by both surface run-off from rainfall and groundwater discharge from confined or unconfined aquifers. The challenge of maintaining input from both sources and the cycle of water between them is now recognised (Boulton and Hancock 2006). The poor documentation of groundwater systems is in part due to the difficulties of measuring groundwater use by vegetation. Western Australia has made greatest progress in developing methodologies to assess the groundwater dependence of vegetation, with the dependence of the Perth region on groundwater for consumptive uses (Froend *et al* 2000).

Rivers, streams, wetlands and aquifers are the water bodies most often acknowledged in policy documents. Flows of water through the broader landscape have not received as much attention. These can occur when rainfall exceeds the rate of infiltration by the soil (Eamus *et*

al 2006a, p. 67), but also large amounts of water are stored in the sandy beds of 'dry' rivers and in vegetation throughout the landscape (Andrews 2006). Overland flows and subsurface flows are critical in supporting terrestrial vegetation, especially the flow-on zones where greater access to water has allowed the growth of species assemblages different from those in the adjacent landscape (Andrews 2006; Eamus *et al* 2006a, p. 65).

Another less acknowledged water body occurs where surface and groundwaters mix. Termed the hyporheic zone, some of its important ecological services are thermal, temporal and chemical buffering of water moving between groundwater and surface water. It provides habitat for microbial, macroinvertebrate, and fish, refugia for aquatic species and the supply of nutrients and organic ions to surface water systems (Eamus *et al* 2006a, p. 76). The environmental water requirements of the hyporheic zone and fauna have not been well documented or incorporated into water allocation plans.

2.1.2 Environmental water requirements (EWRs)

It is well known that structural and functional aspects of vegetation are correlated with patterns of rainfall distribution. The distribution, density and floristic variability of vegetation are determined by rainfall, evaporative demand and soil storage capacity. Actual plant water use will vary seasonally with these factors and solar radiation (Eamus *et al* 2006a, p. 14). Trees use more water than other kinds of vegetation, and vegetation can use all of the available water for a site, preventing any recharge to groundwater. Water only escapes the root zone to recharge groundwater when evaporation rates reach equilibrium (i.e. evaporative demand is satiated, a relationship established through studies of leaf area index and annual rainfall) (Eamus *et al* 2006a, p. 16).

Removal of vegetation can increase with the water infiltrating further when this water holding component of the landscape is removed. However, clearing land of vegetation can also increase surface run-off and decrease recharge where soils seal over and become impermeable to recharge. Where trees can access groundwater they frequently do, as demonstrated in plantation studies (Benyon *et al* 2006). Research in WA has shown that recharge is effectively nil under natural vegetation and higher under shallow-rooted annuals than deep-rooted trees (Froend and Zencich 2002).

The identification of sources of water used by plants from soil profile, river, groundwater and the capillary fringe can be determined by isotopic comparison between water in xylem sap

and water from soil profile, river or aquifer to determine source (Eamus *et al* 2006, p. 49) where isotope concentrations in these different sources are sufficiently different (McEwen and Leaney 1996)..

Some aspects of the effect of variations in river flows on their associated ecosystems have been well researched internationally and in Australia (Kingsford 2000). In Queensland, New South Wales and Tasmania information is available on rivers that have been dammed for water supply and the Daly River in the Northern Territory (Erskine *et al* 2003), although knowledge gaps exist in how to achieve river health when flow regimes have been significantly modified (Schofield *et al*, 2003, p. 31). Effects of surface water flows on vegetation not associated with rivers or streams have been determined from mapping of vegetation units and their relationship with average annual rainfall.

Only more recently has ecosystem dependence on groundwater resources been explored. The National Groundwater Committee published the 2004 paper *Knowledge Gaps for Groundwater Reforms*. An impediment to the integrated management of environmental water is the uncertainty about links between ecosystem health and available groundwater, making specification of rules and indicators for management of groundwater flows difficult (National Groundwater Committee 2004, p. 3).

Hatton and Evans' (1998) work was the first comprehensive attempt to classify types of ecosystem which have groundwater dependency. They identified four types of ecosystems with the main criterion for dependence being use of an annual water budget derived from groundwater: terrestrial vegetation, river base flow systems, aquifer and cave systems and wetlands, including mound springs. They acknowledged that the majority of groundwater dependent ecosystems are small with only a local extent. Schofield *et al* (2002, p 13) add two more types: estuarine and near-shore marine systems and the dependence of terrestrial fauna on groundwater.

The existence of ranges of dependency is recognised, but this is different from being able to quantify water requirements for groundwater dependent ecosystems. Schofield *et al* note that few case studies show environmental water requirements for groundwater dependent ecosystems that have been determined through direct field research (2002, p. 21). Exceptions are projects in the Daly River to explore riparian vegetation (O'Grady *et al* 2002) and aquatic vegetation (Rea *et al* 2003) and the work of Froend *et al* in Western Australian wetlands.

Noting the difficulty in applying standardised methodologies for determining EWRs because of the variability in dependence of vegetation, Froend and Zencich classified dependence on the basis of depth to groundwater for *Banksia attenuata*. They found that the greater the depth to groundwater, the more *Banksia* species tolerates water decline, because of an increase in alternative water sources due to a larger volume of soil exploitable by the root system. A critical factor here is the groundwater regime at the time of root establishment. This research only focused on depth to groundwater, and did not include other influential factors such as soil structure and texture (Froend *et al* 2002). However, in the complexity of plant-water relationships revealed, it demonstrated that EWR determination methodologies must recognise that 'requirements' vary according to abiotic and biotic factors within species as well as ecosystems and that a spectrum of requirements exists, from a water supply and quality that has poor outcomes to good outcomes.

2.1.3 Environmental water provision (EWP)

Provision of water for the environment was popularly recognised first as 'environmental flow', that is the supply or release of water from a managed river in order to achieve ecological objectives for particular river reaches, for example to allow flooding of riparian forests previously deprived of high flows due to allocation of river water for human purposes. From the previous discussion of the variable dependencies by ecosystems on the wide range of water sources in the Australian landscape, it is clear that environmental water provision means much more than 'environmental flow'. Provision of environmental water can occur by protecting catchments, to ensure that changes in land use do not negatively impact by either greatly reducing or greatly increasing the quality and quantity of surface flows. It includes activities relating to interception of surface and subsurface flows, such as drainage works and dams, which contribute both to rivers and groundwater recharge. In relation to groundwater, providing water can include creating buffer zones around groundwater dependent ecosystems and limiting the amount and the timing of extraction via licensing conditions.

Environmental water provision as an activity is therefore the outcome of a complex process which begins with the determination of ecological value (Bennet *et al* 2002, p.49), the determination of EWRs and the modelling of ways in which they can be met, balancing the economic, environmental and other interests involved (ARMCANZ 1996, Principles 2 and 5).

The role of science is to provide the understanding of ecosystem features and processes to inform the EWP process.

In relation to surface water management, Arthington *et al* (1998) evaluated environmental flow assessment techniques applied to rivers in eastern Australia. Methodologies recommended are holistic in that they consider multidisciplinary perspectives on river ecosystems (eg. hydrological, hydraulic, geomorphological, ecological and chemical), they recognise the temporal aspects of river flows and they consider spatial scales from reach to basin to catchment (Arthington *et al* 1998, p. 8). A best practice framework combines approaches which are 'bottom-up' (where the environmental flow regime is built up by flows for specific purposes starting from zero) and 'top-down' (where the 'flow regime is developed by determining the maximum acceptable departure from natural flow conditions') (Arthington *et al* 1998, p. 4). The best practice framework has ten stages, marked by background reporting on hydrological modelling and existing impacts, a scoping report on management constraints and requirements, technical reports on detailed studies of flow requirements and an options and impacts report after modelling of optional scenarios. Workshops are held at each reporting stage. Before the final workshops, social and economic evaluations and monitoring results are considered (Arthington *et al* 1998, p. 20).

Such a best practice framework is not currently available for provision of water to groundwater dependent ecosystems. In proposing a functional methodology 'for determining the groundwater regime needed to maintain the health of groundwater dependent vegetation' Eamus *et al* (2006b) refer to the framework developed by Arthington *et al* (1998). Eamus *et al* outline key questions to be addressed in identifying and managing GDEs. These follow similar stages to those described in the previous paragraph, of identifying for groundwater systems which species are dependent; their degree, patterns and processes of dependency; the groundwater attributes important to the GDEs; the safe limits of change in groundwater; the values assigned to the GDE and the acceptable limits of change (Eamus *et al* 2006b). An extensive monitoring program is proposed in order to inform management of GDEs. In determining actual allocations, GDEs present some critical issues. Firstly, GDEs show lags in response time to changes in water availability compared with surface water dependent ecosystems. Secondly, water requirements cannot be simplified into minimum depths to water table without considering duration, timing and rates of water availability. Thirdly, the ecosystem components within a GDE may have highly variable groundwater dependency. (Eamus *et al* 2006b, p. 112).

2.1.4 Conclusion

By touching on many issues which are themselves the subjects of intensive study, this brief review of some scientific understandings about environmental water *requirements* and environmental water *provision* demonstrates the uncertainties and the complexities that policy for environmental water must address.

2.2. The Northern Territory Context

Of all Australian jurisdictions, the Northern Territory environment has been least impacted by European settlement and this characteristic, together with its biophysical features, places it in a unique situation with regard to environmental water policy. It is perhaps unsurprising that its own development of policy has been limited, as it has yet to demonstrate the conditions of degradation on a scale which have made necessary the introduction of environmental water provision policy elsewhere.

This brief review aims to describe the significant features of the context for environmental water in the NT which should be taken into account in future policy development. Three sets of features which distinguish it from other jurisdictions will be addressed. These are firstly biophysical features, including climate, surface and ground water resources and water dependent ecosystems. Secondly its social features give an indication of the human resources which both impact upon and are available to manage water resources. Thirdly its economic features indicate where future demands for water consumption may be greatest. The implications of these features for environmental water policy are then discussed.

2.2.1 Biophysical features: water resources

The strongest determinant of water availability is climate, which over the NT has the distinct features of two different zones, high seasonality and relatively low inter-annual variability in the north and ephemeral episodic conditions in the south. The two different climate zones comprise northern and southern. The average annual rainfall in the northern zone varies from around 1600mm to 800mm, and in the southern zone from 200 mm to 600 mm (Australian Bureau of Meteorology 2006). However the annual average disguises inter-annual variability. In the far north, rainfall is reliable but varies in amount from well below to well above average according to the occurrence of extreme events (Taylor and Tulloch 1985). Rainfall occurs between October and April in the wet-dry monsoonal north, with little

rain between May and September. This zone experiences the effects of an average of five cyclones per year (based on 1969 – 1999 tropical cyclone data). The variability of rainfall in the southern zone is high to extreme (based on data from 1900 to 2003) and the pattern is erratic with slightly more rain from December to February (Australian Bureau of Meteorology 2005). The average annual areal actual evapotranspiration in the northern zone ranges from 1100 mm to 600 mm, and in the southern zone from 500mm to 100 mm. (Bureau of Meteorology 2005) The total annual average evaporation in the northern zone reaches 2800mm and in parts of the southern zone 3600mm (Bureau of Meteorology 2005). The average annual number of days with rainfall greater than 1mm in the northern zone is 40 to 75, and from less than 20 to 30 in the southern zone (Bureau of Meteorology 2005).

Water resources across the landscape are highly variable both temporally and spatially. Surface water in the northern humid zone drains through rivers and extensive floodplains to the Timor Sea and the Gulf of Carpentaria, with most of the annual discharge occurring from December to March and the mean annual runoff varying from 70mm to 470mm. In the arid zone rivers drain inland to ephemeral lakes and the runoff is much lower, from 0.1mm to 5mm annually (NLWRA 2000). The total mean annual flow of surface water in the NT is estimated to be 75, 400,000 ML (NLWRA 2000).

Groundwater sources are extensive, with the sustainable yield of groundwater estimated to be 22% of Australia's total at 6441 GL per year (NLWRA 2000), from a total annual recharge of 13,000,000 ML (INRM 2005, Appendix 5). In the most northern zone, recharge is distributed over the catchments, whilst sources of recharge in the most southern zone are from flood outs, creeks and rivers. Estimated annual recharge amounts range from 0.2 ML/Ha to 5 ML/Ha in the north and from 0.02 ML/Ha to 2.5 ML/Ha in the south (NLWRA 2000). Rates of recharge of groundwater sources in the northern zone may vary from annually to every 30 - 40 years (Eamus *et al* 2006, p. 182). In the southern zone recharge of groundwater is slow and the age of groundwater from some aquifers is ancient (NRETA 2006).

2.2.2 Biophysical features: water dependent ecosystems

Limited knowledge about ecosystem dependency on water in the NT is widely acknowledged (INRM 2005, LWRA 2000).

An important study reported in 1996 on distribution of plant species along a north-south transect between latitudes 12°30' north and 19°30' north (Egan and Williams 1996). Tree abundance declines and leaf retention strategies change, with a lower diversity in deciduous species at the southern end of this transect reflecting the north-south variation in rainfall distribution. While this is evidence of a strong relationship between vegetation and rainfall, which demonstrates the importance of surface water flows in maintaining the distribution and diversity of plant species, the extent to which vegetation accesses groundwater is not fully understood.

A study designed to answer this question was conducted over five years from 1993 in the northern zone (Eamus *et al* 2006a p. 185). It explored the likely impact of groundwater abstraction on four components of the Howard River East Basin: eucalypt woodland savanna, paperbark swamp, monsoon vine forest and aquatic systems of the river. It was found that eucalypt savanna and paperbark swamps met their transpiration needs from soil water supplied during wetting to field capacity in the wet season rather than groundwater, but it is uncertain whether they would access groundwater in times of lower than average wet season rainfall (Cook *et al* 1998, p. 5). Further analysis of this study came to the conclusion that 'the possibility that trees were accessing the capillary fringe above the water table could not be discounted' and that paperbark swamps utilised lateral groundflows (Eamus *et al* 2006a, p. 185).

Monsoon vine forests in the northern zone are associated with year round water availability, though some patches occur on free-draining sites (Russell Smith 1993, p. 23). Rainforest is associated only with permanent water sources such as springs or creek and river systems (Brock 1991 p. 18). Although these vegetation types comprise a very small proportion of the landscape, their importance for maintaining a broader range of flora species, as refugia for fauna during the dry season and for providing seasonal diversity in resources across the landscape cannot be underestimated.

Interactions between surface water and ground water use by vegetation were explored in an extensive study of the groundwater dependence and environmental water requirements of riparian vegetation along the Daly River (O' Grady *et al* 2002). Current and future development of the Daly River District for agriculture and horticulture will place increasing demands on water resources. Although the Daly River is one of the largest perennial rivers in a region with many ephemeral water courses, its base flow is maintained during the dry season by groundwater. The study found that vegetation use of groundwater was both

obligate and facultative, with obligate users closer to the river and groundwater sources (O'Grady *et al* 2006).

Groundwater supports terrestrial vegetation along the Daly River and is a critical resource for the existence of instream vegetation. Groundwater not only maintains water flow during the dry season, but its chemical qualities also create the light and nutrient conditions required by *Vallisneria nana*, which provides habitat for turtles, fish and macroinvertebrates (Rea *et al* 2003).

In the southern zone, possible groundwater dependent ecosystems are spring-fed wetlands, riparian vegetation (such as *Eucalyptus camaldulensis*), flora and fauna communities in aquifers, and near areas where groundwater is close to the surface (NRETA 2005).

Wetlands in the northern zone are well known and two regions are Ramsar listed. Wetlands in the southern arid zone are less well known, but highly significant sources of biodiversity. They may take the form of rockholes, soakages, claypans, spring fed pools or large salt lakes, with a few permanently wet but most usually dry. Ephemeral wetlands are considered significant: 'To be considered a wetland, an area must at least occasionally be wet long enough that it is used by plants and animals that require waterlogging or inundation during their lifecycles and are visible to the naked eye. Even if they are only filled once every few decades they may still be important for species conservation' (Duguid *et al* 2002, p. 51). Prior to the study of Duguid *et al* (2002) into arid zone wetlands, only four wetlands of conservation significance were recognised. The study identified another 47 wetlands of conservation significance (Duguid *et al* 2002, vii).

2.2.3 Social and economic features

The NT's population (2004) is approximately 200,000 people. Of these 54% live in regional centres, 21% in regions classified as remote and almost 25% in regions classified as very remote. The average population density is 0.1 person per square kilometer, (as compared with 8.4 in New South Wales, 2.2 in Queensland, 1.6 in South Australia and 0.8 in Western Australia) (ABS 2006).

The Indigenous population is 28.8%, and owns 44% of land area under the Aboriginal Land Rights (NT) Act 1976. This land includes national parks, some pastoral leases, and smaller amounts of community living areas (INRM 2005).

The population of the NT is projected to grow over the next 15 years, with highest projections for the Darwin region, and lower projections for Katherine, Tennant Creek and Alice Springs (ABS 2006).

The economy is dominated by government activity, including a significant defence presence. The mineral extraction industry provides 19% of gross state product, but only 2% of employment, tourism generates 5% of gross state product and approximately 8% of employment. Agricultural activity generates around 3% of gross state product and 3% of employment (ABS 2006).

An ongoing characteristic of the workforce is its high transience, which creates difficulties for retaining employees with skill and qualifications (INRM 2005).

2.2.4 Implications of features of current NT context for environmental water policy

It is acknowledged that accurate data on water use, both surface and groundwater, is lacking (LWRA 2000), but some generalizations can be made about future likely impacts. A low level of development means that currently fewer water resources of the NT are degraded in comparison with other Australian jurisdictions, and thus it would be expected that the health of many water dependent ecosystems is not currently under threat.

The level of development of both surface and groundwater resources in the NT is low. There are only two regulated rivers (Darwin and Katherine), and a small number of water supply dams. One of these dams supplies the majority of Darwin's domestic needs. Other dams service mines, or are recreational. Katherine is serviced by river water and, like Darwin, its water supply is also supplemented from groundwater sources. The remaining major population centres of Alice Springs and Tennant Creek rely on groundwater, as do most of the smaller communities (LWRA 2000). Currently, only the Alice Springs supply is regarded as being overallocated, but it is clear that further population growth in the Darwin region will place greater demands on surface and groundwater supplies.

Use of surface water for irrigation is approximately 12% of total use and for the cattle industry 6% of total use. Irrigation from surface water occurs from the Katherine and Daly Rivers (LWRA 2000). Groundwater use by industry, in descending order of amount, is for

irrigated agriculture and horticulture, the cattle industry and mineral extraction industry, (LWRA 2000). The narrow economic base of the NT and its high dependence on government activity means that further industry must be encouraged for economic survival. The apparent availability of water is attractive to investors in industries such as horticulture, agriculture and aquaculture, who need very clear guidelines about long-term availability and conditions of use.

Mining is an extremely important source of income and employment. Mining and petroleum activity are excluded from the provisions of the NT Water Act, the legislation which governs use of water in the NT. Mining activity which affects water resources is highly likely to continue, and even expand. Recent successful application for diversion of the MacArthur River by a mining company in order to maintain its activity in the NT (URS 2006) exemplifies the type of difficult choices between ecosystem protection and economic development which are likely to continue.

The tourism industry has developed around the existence of high quality natural resources, especially water dependent ecosystems such as the wetlands, springs, waterfalls and rivers of the northern zone and the springs and waterholes of the southern zone. Maintenance and future development of tourism provides high impetus for the conservation of these attractive natural resources. On the other hand, catering for the needs of visitors means greater provision of water for consumptive use.

Currently sparse or nonexistent information about the wide variety of water sources and their associated ecosystems presents a significant challenge for research and knowledge building. The preceding review of scientific understandings about environmental water demonstrates that significant research has already been conducted in the NT, and current low rates of degradation of its water resources make them highly important, perhaps unique, sites for further research.

The extremely low average population distribution means that there are only small numbers of people 'in the landscape' to manage water resources. Local experience and knowledge of water resources is highly dispersed. In contrast, scientific expertise and human resources for research and decision making are highly concentrated in the urban centres.

Current threats to environmental water are more strongly associated with groundwater use than surface water use. Groundwater abstractions in the northern zone impact upon base

flows of streams during the dry season. This could to population decline of the more water dependent species found in pockets of perennial water sources (eg. pig-nosed turtles (Georges *et al* 2003)).

2.3 Conclusion

The two topics addressed in this chapter demonstrate some of the practical realities involved in environmental water policy. Although some aspects of the science of environmental water requirements, particularly relating to surface water, are well understood, other aspects such as groundwater dependencies have been under-researched. This deficiency has been frequently acknowledged. Translating knowledge of ecosystem water requirements into ecosystem water provision is an altogether separate challenge, which is very difficult to meet. Policy development therefore needs to explicitly recognise scientific uncertainty and knowledge limitations.

The high rainfall and large estimates of groundwater reserves in the NT's northern zone can suggest that water is not limited. This is a misleading perception, for the extreme seasonality and variability of rainfall combined with high evapotranspiration rates and variable recharge rates place definite limits on water resources. Groundwater provides the base flow of the small number of perennial rivers and is the relied upon source for most communities, especially in the southern region. The increasing human dependence upon groundwater when its environmental dependencies are poorly understood is grounds for concern.

The current, largely unimpacted status of water dependent ecosystems in the Northern Territory means that there is the possibility of avoiding the situation where active water provision is needed. Growing pressures for greater economic development present both threats to and reasons to protect the NT's diverse water dependent ecosystems.

It can be concluded from the review that the mismatch between areas of need (high water use) and areas of expertise (knowledge providers and brokers) is a practical reality to be overcome for policy to achieve its objectives.

Chapter 3	Background to national environmental water policy.....	28
3.1	<i>Introduction to the national policy context.....</i>	28
3.2	<i>The evolution of environmental water policy.....</i>	29
3.2.1	Intergovernmental Agreement on the Environment (1992).....	29
3.2.2	National Strategy for Ecologically Sustainable Development (1992).....	29
3.2.3	National Water Quality Management Strategy (1992)	30
3.2.4	Council of Australian Governments Water Reform Framework (1994).....	31
3.2.5	National Principles for the Provision of Water for Ecosystems (1996) and (2002).....	31
3.2.6	Allocation and Use of Groundwater (1996).....	33
3.2.7	National Water Initiative (2004)	33
3.3	<i>Critical discussion on extent to which national policy ensures the meeting of environmental water needs.....</i>	35
3.2	<i>Conclusions.....</i>	37

Chapter 3 Background to national environmental water policy

This chapter sets the broad context for understanding 'environmental water' policy in Australia, through briefly exploring the requirements of national policy. Its objectives are to describe how national policy has evolved, to identify how provision for environmental water is embedded within broader requirements for the management of water resources using particular management approaches and to critically interrogate the status environmental water provision has been given within policy.

The methodology was to analyse the content of national policy documents for their definitions of environmental water, the prioritization of entitlements for environmental water and the collection of approaches which together provide for its management. Each policy document is analysed separately and direct quotes are referenced by page or section numbers or names. The analysis covers large amounts of written text so the content and features were sometimes summarised without specific attribution. Researcher comments are confined to the discussion and conclusion (sections 3.2 and 3.3).

3.1 Introduction to the national policy context

Australian policy on environmental matters is largely driven by national policy requirements as a result of the powers of the Commonwealth Government under the Constitution as a signatory to international agreements and treaties. Such power has been used to drive change and to bring about greater national consistency in approaches to some environmental matters, when they are perceived as important. Current national policy on environmental water provision is the result of a series of national policies developed since 1992. Prior to this time, state jurisdictions responsible for the management of water sometimes made provision for environmental water needs in their management regimes for regulated rivers, but no consistent policy existed (Allen and Lovett 1997). Use of groundwater for human purposes can only be regarded as extensive in the period since the Second World War, driven by the conversion of land uses to agriculture and horticulture and the availability of affordable drilling and pumping equipment. Requirements for policy to manage groundwater use and its environmental impacts have thus been relatively recent.

Australian jurisdictions, the states and territories, are required to implement these policies, but the rate and manner in which they do so can be highly variable.

Policy specifically for environmental water provision is found within documents from 1994, however the principles covered in several documents prior to this time are also still relevant. These principles have become a recurrent feature of policy documents since, such as interjurisdictional consistency and cooperation. While the concept of environmental protection appeared in government policy from the 1970s, the pre-1994 national documents introduced the public to the major concepts of an environmental discourse of sustainability, biological diversity and the precautionary principle.

3.2 *The evolution of environmental water policy*

3.2.1 Intergovernmental Agreement on the Environment (1992)

In May 1992 an *Intergovernmental Agreement on the Environment* was made between the Commonwealth, State and Territory Governments and the Australian Local Government Association (Department of Environment and Heritage 2005). This provided a foundation for cooperation and coordination between all jurisdictions on a range of policies related to the environment. It required cooperation between jurisdictions in implementing international policy. Section 3 of this agreement covers principles of environmental policy and includes integration of economic and environmental considerations in decision making processes, proper examination of matters which significantly affect the environment, the precautionary principle whereby lack of scientific certainty should not limit actions to prevent environmental impact, intergenerational equity and conservation of biological diversity and ecological integrity. There is no specific reference to water resource policy in the schedules which detail actions on a range of environmental issues.

3.2.2 National Strategy for Ecologically Sustainable Development (1992)

While the *National Strategy for Ecologically Sustainable Development* (NSES), endorsed by the Council of Australian Governments (COAG) at its first meeting in December 1992, did not use the term 'environmental water provision', the NSES has been significant in framing the discourse which has occurred since. The goal of this policy presented economic development and environmental concerns as reconcilable and coexistent. Its package of seven guiding principles included decision making which integrates long and short-term

economic, environmental, social and equity considerations, the precautionary principle, flexible policy instruments and broad community involvement.

The NSESD (1992) dealt specifically with water in Part 3, Chapter 18. Objective 18.1 which states requirements for an integrated catchment management approach, coordinating mechanisms for management, measures for public participation, legislative and policy frameworks to protect aquatic ecosystems, allocations to ensure maintenance of in-stream and floodplain environmental values and consideration of the whole hydrological cycle in planning. Objective 18.2 concerned management mechanisms, setting an agenda of reform in institutional arrangements, including pricing and water markets in order to improve transfer of entitlements, but also urging research and a national approach to inventories on wetlands, floodplains and riparian ecosystems.

In Part 4 which looked at future development, the NSESD included objectives related to conflict management, community awareness, education and participation. These provisions recognised the high potential for conflict that the shift to a sustainable approach to natural resource use could generate. To reduce this potential, NSESD recommended investigating non-legal approaches to conflict resolution, such as mediation, but also suggested the importance of provision of information, transparent decision making, explicit principles and access to appeals. The promotion of a high level of awareness of sustainability issues, of effective communication and avenues for participation were covered in Objectives 32.1, 32.2, 32.3.

3.2.3 National Water Quality Management Strategy (1992)

The National Water Quality Management Strategy (NWQMS) was introduced in 1992 as part of the NSESD (1992) to provide a nationally consistent approach to water management. Its focus on water quality was in recognition of the deterioration of many water sources because of pressures of economic and social development. Its thrust has been to maintain and improve quality whilst also maintaining the social and economic benefits provided by water sources. The beneficial use process of identification of the purposes for which water is valued originated from this strategy. The NWQMS was never fully incorporated into the Council of Australian Governments Water Reform Framework (1994) (ARMCANZ and ANZECC 1995) and remains a separate, parallel water policy and strategy, albeit now embedded into national water policy. The NWQMS does not provide water for environment,

but in drawing attention to water quality and quantity issues it also drew attention to sustainability of sources and the health of ecosystems which support this.

3.2.4 Council of Australian Governments Water Reform Framework (1994)

Following on from the NSESD(1992) arrangements for environmental policy regarding water were demarcated into the COAG *Water Reform Framework* of 1994, a policy which contextualised water issues in economic and social as well as environmental terms. The COAG *Water Reform Framework* addressed a wide range of issues related to water entitlements, charging, delivery, irrigation, assets and the institutions involved. For the first time formal recognition was given to the need for allocations of water to the environment as a 'legitimate user' (Section 4b) of water. The needs of the environment were placed ahead of other users in the requirement that manager satisfy themselves that 'the environmental requirements of the river systems would be adequately met before any harvesting of the water resource occurs' (Section 5(a) and new schemes or new allocations could only proceed if they were demonstrated to be ecologically sustainable and economically viable, in the context of addressing 'widespread natural resource degradation' (Section 1). The types of environmental water which it names are (1) river systems and groundwater basins, (2) 'areas of river which have a high environmental value or are sensitive for other reasons' and (3) 'environmental flow requirements'. It recommended consistent methodologies between jurisdictions to describe environmental flow requirements. Section 3e referred groundwater management arrangements to the Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ) and the determination of environmental water requirements to ARMCANZ and Australia New Zealand Environment and Conservation Council (ANZECC) for consideration and reporting.

The COAG *Water Reform Framework* (1994) addressed how these changes should be implemented in recommendations on institutional reform, consultation and public education. It recommended an integrated approach to natural resource management, integrated catchment management and community consultation, public consultation over change and public education about water use, water reform and water provision arrangements.

3.2.5 National Principles for the Provision of Water for Ecosystems (1996) and (2002)

In 1996 ARMCANZ and ANZECC published the *National Principles for the Provision of Water for Ecosystems*. This document covers the definition, aim, methods and management

of environmental water provisions. 'Environment' in the document refers to the natural components of aquatic ecosystems (p. 4). Water dependent ecosystems are 'those parts of the environment, the species composition and natural ecological processes of which are determined by the permanent or temporary presence of flowing or standing water' and include the instream areas of rivers, riparian vegetation, springs, wetlands, floodplains and estuaries (p.4). (ARMCANZ/ANZECC 1996, p. 4). Environmental water requirements are defined as 'descriptions of the water regimes needed to sustain the ecological values of aquatic ecosystems at a low level of risk' (p. 4). These descriptions are developed through the application of scientific methods and techniques or through the application of local knowledge based on many years of observation. Environmental water provisions are defined as 'that part of environmental water requirements that can be met', ie. provided through water planning processes (p. 4).

Following these definitions, the National Principles provide an overarching goal 'to sustain and where necessary restore ecological processes and biodiversity for water dependent ecosystems' (p. 5). Principle 1 recognises the conflict between ecological and consumptive uses that has resulted from the regulation of rivers and streams. Principle 2 advocates application of the best scientific information available in determining environmental water provision. Principle 3 recommends legal recognition for environmental water provision. Its rationale explains that water law developed to protect consumptive use, leaving environmental water as that available 'after all other users in the system have taken their share' (p. 8). Legal recognition is required both to enable allocation and to enable constraints on other uses to protect ecological values. Principle 4 recognises the existing rights of other water users, but advocates provision 'as far as possible' (p.8) to meet ecosystem water requirements. Principle 5 recommends actions to be taken in overcommitted systems where environmental water provision cannot meet environmental needs. Principle 6 advocates further allocation of water only after ecological values are met. In order to ensure management of environmental water provision, Principle 7 states that accountability in management should be transparent and clearly defined and Principle 8 that it be responsive to monitoring and improvements in understanding. Principle 8 is an explicit acknowledgement of uncertainty in knowledge about environmental water requirements and describes monitoring programs, with continuous or periodic review, as essential to the maintenance of ecological values. Principle 9 addresses other uses, noting that they may still contribute to ecological values. Principle 10 also addresses other uses, in advocating demand management and pricing strategies to sustain ecological values by reflecting the real costs of water. Principle 11 supports the need for further research, especially to

strengthen the case for maintaining or restoring water for environment. Principle 12 states that all relevant stakeholders should be involved in planning and decision making on environmental water provision. It notes that information and awareness are prerequisites for involvement and consultation

The National Principles were reviewed and restated in 2002, although this later version remains in draft and its current status is uncertain. The number of principles was increased from 12 to 20, with recognition given to both ground and surface water and inclusion of the needs of downstream ecosystems. The 2002 version introduced the concept of 'net ecological benefit' to be required from changes introduced by water market governance, water savings, demand management, pricing and metering, and through structural development or building works. An additional consideration in 2002 was the implications of broad scale land use changes.

3.2.6 Allocation and Use of Groundwater (1996)

In 1996 ARMCANZ published a policy position paper *Allocation and use of Groundwater* in recognition that previous water policies largely addressed surface water issues. Recommendation 6 is the main recommendation from this paper relevant to this review. It advises that groundwater management agencies identify sustainable yield, levels of allocation and use of aquifers and environmental water provisions in their management plans. This paper was an important first step in raising the profile of groundwater.

3.2.7 National Water Initiative (2004)

The *National Water Initiative* (NWI) of 2004 reformulated the terms of the COAG Agreement on a *Water Reform Framework* (1994). It does not replace the 1994 COAG *Water Reform Framework* but augments it. The overall objective is management of surface and groundwater resources to optimise economic, social and environmental outcomes through a nationally-compatible market, regulatory and plan-based system. It has a major emphasis on developing allocation systems which provide certainty of entitlements for all users, including the environment.

In relation to water for environment, several objectives of the NWI (2004) are significant. Objective (iii) gives statutory provision for environmental and other public benefit outcomes, Objective (iv) urges completion of the return of all currently over-allocated or overused systems to environmentally-sustainable levels of extraction. Objective (vii) requires water

accounting which is able to meet the information needs of different water systems in respect to planning, monitoring, trading and environmental management. Objective (x) recognises the connectivity between surface and groundwater resources and connected systems managed as a single resource. Key elements related especially to environmental water provision include (i) water access entitlements and planning framework (iv) integrated management of water for the environmental and other public benefit outcomes, (vii) knowledge and capacity building and (viii) community partnerships and adjustment.

The NWI (2004) places clear responsibility on all participating jurisdictions to develop consistent frameworks for water management. With reference to environmental water, its provisions state strong guidelines for a process to be followed. Actions to meet the guidelines are for statutory recognition of environmental water entitlements within a system of water access entitlements; planning processes which identify environmental considerations; identification, acknowledgement and protective management for surface and groundwater systems of high conservation value; 'firm pathways' for returning overallocated systems to environmentally sustainable levels and protection of entitlements from increased interception due to changes in land-use.

Approaches to be applied in following this process are integrated management, adaptive management, reflection of regional differences, judgements informed by 'best available' science, socioeconomic analysis, community input, stakeholder consultation and the building of knowledge and capacity.

The instruments to achieve these environmental water policy outcomes include: changes to legislation; public registers for water access entitlements; a register for environmental water; water plans which are statutory documents, and which follow guidelines provided in a schedule; monitoring programs for water plans; risk assignment frameworks; records of interceptions; compliance monitoring; accountable authoritative and resourced environmental water managers; and periodic audit, review and public report against the environmental benefit outcomes identified. A major policy instrument is the pricing and trading of water entitlements which, it is argued, will enhance the capacity of jurisdictions to meet environmental water entitlements through producing efficiencies and flexibilities in consumptive use. Consideration of the operation of a water market in relation to environmental water provision is beyond the scope of this study, and in any event its formulation in the NWI lacks detail.

Performance indicators for the NWI Agreement (2004) are to be developed.

3.3 *Critical discussion on extent to which national policy ensures the meeting of environmental water needs*

This review of national policy documents demonstrates that there has evolved a clear national direction for provision of water to the environment for the protection of water sources and the ecosystems which depend upon them. The national policies identify actions needed in relation to water resources and also management approaches for their implementation (integrated, catchment-based, adaptive, based on scientific knowledge and applying the precautionary principle). The foci of this direction have not always been consistent and changes in emphasis reflect the political interests involved.

From COAG (1994) to NWI (2004) there are significant changes in terminology. Firstly, water provision in COAG (1994) is referred to as 'allocation' whereas in the NWI it is termed 'entitlement'. This change reflects the greater concern with ensuring security of access to water resources in the NWI (2004). Secondly, the terminology which refers to environmental water became slightly more inclusive of all water in the environment, though references to groundwater are still fewer than those to surface water.

A step forward in the NWI (2004) is the recognition of the connectivity of ground and surface water resources (Section 79, i), c)) and of the need for further research on these interactions (Section 98). Another potentially positive feature of NWI in comparison with earlier policy is that it defines environmental outcomes as maintaining ecosystem function, biodiversity, water quality and river health targets (Schedule B(i) and (ii), p. 32). This goal will be as strong as the rigour and independence used in the choice of the targets. The actual examples it provides are limited, but the definition allows for broader inclusion of terrestrial vegetation and ecosystems which benefit from through-flow of water rather than permanent water bodies alone.

However, the NWI (2004) could be interpreted as a step backwards for the environment because the priority to be given to environmental water is still ambiguous.

Ambiguity derives from a number of its aspects. Firstly, unlike the COAG water reforms (1994) where the environment underpinned decision making, and in contrast to the *Principles for Provision of Water for Ecosystems* (1996), the NWI (2004) consistently refers to

environmental water in the context of 'environmental and other public benefit outcomes', rather than as a priority on its own. Integration of environmental with other concerns is seen as a part of the process of managing water as well as an outcome, but the means by which to achieve a balance between environmental and other public benefits is not directly addressed. In a section on recovery of water to achieve modified environmental and other public benefit outcomes, the final principle to be applied is 'selection of measures primarily on the basis of cost-effectiveness, and with a view to managing socio-economic impacts' (NWI, 2004, Section 79, ii), c)).

Secondly, although COAG (1994) and NWI (2004) both urge provision for environmental water at the highest level (i.e. legislation), its ultimate allocation is dependent upon the decisions made by 'the community' in management plans, and the degree to which this goal is realised must be variable.

At this point of the discussion, the role of 'community' in this policy deserves some consideration. 'Community' is problematic because it is not defined. Input from community is named as one source of information for 'settling the trade-offs between competing outcomes for water systems' (NWI 2004, s 36). In considering the impediments to managing environmental water provisions, Allan and Lovett (1997, p. 96) note the difference between community input and delegation of responsibility to the community, and the need for appropriate support before local communities are able to take on management responsibilities. Undoubtedly the major influence of government must still continue while the community, as a range of stakeholders, is defined and resourced. This is not addressed in any detail in national policy and processes for community representation are left to the managing jurisdictions. The community includes all the users and while 'community' may be interpreted as the general public, in legislation and policy it includes industry. Some user groups with vested interests may have a greater 'community' voice than other less organised sectors of the community. (Allan and Lovett 1997, p. 97).

Thirdly, environmental water is not completely exempt from trading. It may not be traded on the permanent market, but can be traded on the temporary market in conditions which are not in conflict with environmental outcomes. This may put pressure on environmental water managers to interpret those outcomes broadly.

Fourthly, although definitions of key environmental terms are provided, in the NWI (2004) the assumptions made about the relationship between humans and their environments remain

unexplored. There is no concept of environment as having intrinsic value unrelated to human use. One section appeals for special requirements 'to sustain high conservation value rivers, reaches and groundwater areas' (Section 79.i), f)). What is implicit here is that some ecosystems are less valuable than others, and that sustainability is a concept which does not apply to all places all of the time.

Another area of weakness in the NWI (2004) is its lack of provision for dealing with contentious issues. The NSESD (1992) contained a section on conflict management in relation to issues arising from ecologically sustainable decision making. Specifically it addressed reducing occasions for conflict and providing non-legal avenues for conflict resolution, including its minimization, through accessible, transparent, predictable and timely decision making. The NWI (2004) does not address conflict management explicitly. It outlines a strong regulatory framework, with specific provisions for community partnerships that engage water users and other stakeholders. It advises that partnerships should be built through transparent decision making, the availability of sound information and open and timely decision making (Sections 93, 95). The sections on adjustment (Section 97) and risk assignment (Sections 46 – 51) come closest to dealing with possible conflicts over allocations and provide a rule-managed approach, which may leave conflict management ultimately in the arena of local water managers.

Of further concern for the status of environmental water is that its only specific policy, the National Principles for Provision of Water to Ecosystems, was revised in a manner which drew attention away from its goal, and towards the range of other uses which may impact. On the one hand this can be seen as a realistic recognition of the water use context within which environmental water is to be provided. On the other hand, emphasis upon existing uses and users may have weakened its ecological intent for ecological outcomes.

3.2 Conclusions

Three sets of conclusions relating to the objectives for this review of national policy documents can be drawn

National policy for environmental water provision began first with recognition of environmental water requirements and evolved to give legal entitlement to environmental water for the purpose of achieving environmental and ecological outcomes. Internationally

this is an important achievement. However, there have been significant shifts in emphasis along with this progress.

The management of environmental water is embedded within a collection of approaches which include identification of beneficial uses and environmental outcomes, integrated management, judgements based on best available science and stakeholder consultation, the precautionary principle, community participation, reflection of regional needs and adaptive management. Specific institutional arrangements to be applied in implementation are public registers for water access entitlements, a register for environmental water, full accounting of environmental water, water plan monitoring programs, risk assignment frameworks, records of interceptions, compliance monitoring and accountable authoritative and resourced environmental managers.

Environmental water provision exists within a strong regulatory framework, but its priority may still be ambiguous because its value in providing ecosystem services is presented as instrumental (ie. available to serve human needs) rather than intrinsic. The level of ecosystem services for which it may be managed will depend upon the value awarded by the community to those ecosystems and thus its ultimate allocation rests on decisions made in the process of developing water management plans. The role of the community in environmental water provision is recognised in narrow terms and unless clearly defined and resourced could be a problematic step in environmental water provision. The theme of recognition of potential conflict generated by a shift to sustainable approaches which was introduced in the NSESD(1992) was not carried through to NWI(2004) except in legal terms that bypass other resolution approaches

Having described the existing national policy situation for environmental water in Australia, the next chapter considers how the nature of policy itself changes when environmental sustainability becomes the main focus, and what this suggests for the development of nationally compliant policy for environmental water by its jurisdictions.

Chapter 4 Features of sustainable policy for environmental water provision ...40

<i>4.1</i>	<i>Policy framing and features</i>	<i>40</i>
<i>4.2</i>	<i>Policy for the new context of sustainability</i>	<i>41</i>
<i>4.2.1</i>	<i>Justification</i>	<i>41</i>
<i>4.2.2</i>	<i>Structure of policy for sustainability.....</i>	<i>45</i>
<i>4.2.3</i>	<i>Content of policy for sustainability.....</i>	<i>46</i>
<i>4.3</i>	<i>Extent to which national policy meets these sustainability criteria.....</i>	<i>47</i>
<i>4.4</i>	<i>Recommended criteria for environmental water policy statements.....</i>	<i>50</i>
<i>4.5</i>	<i>Conclusion</i>	<i>52</i>

Chapter 4 Features of sustainable policy for environmental water provision

The aim of this chapter is to define policy, policy programs, policy statements, policy instruments and the components of policy with a view firstly to consider why policy within a discourse of sustainability is different from generic or traditional policy framing and secondly to identify the extent to which national policy for environmental water fulfils the requirements of sustainability policy. From this analysis it aims, thirdly, to synthesise a set of criteria for analysing what may currently be considered important features for environmental water policy in the context of sustainability. This study identified that such tools were unavailable yet essential to address the objectives of this thesis.

This review, discussion and identification of best practice in environmental water provision in Australia is concerned with the ways in which policy for environmental water provision can be framed and evaluated. The recent book by Stephen Dovers *Environment and sustainability policy: creation, implementation, evaluation* (2006) was a major source of information here because although there has been much written internationally on environmental sustainability and on environmental policy, few other texts focus on the framing of policy within the Australian context. Dovers (2006, p.10) quotes Walker (1992, p. 253) to point out that environmental policy research internationally is at an emergent stage and there are no established methodologies for analysis and evaluation. Policy research on environmental matters tends to be concerned with the establishment of policy in regions where it is lacking (e.g. Hirsch 2006), the analysis and evaluation of policy options for specific environments or ecosystems (Bowers 1998) or with the application of specific methodologies, such as multicriteria analysis (Vazquez 2003, Medda and Nijkamp 2003). In view of the lack of an established methodology for analysing and evaluating environmental water provision policy, the need for new criteria became apparent and Dovers provides one of the few texts concerning policy framing and development in the Australian context.

4.1 Policy framing and features

Policies are usually composed of three components which are widely recognised: a basis in law, an educative component and institutional or organizational provision (Dovers 2006, p. 90). Traditional or generic policy packages begin with legislation, which identifies the basis in

law and links with other legislation, may or may not include educational aspects (such as aspirational goals or specific provisions for addressing the change process required for implementation) and often includes details about institutional provision. Depending upon the complexity of the policy, the weight of institutional provision may be carried by the actual legislative document or may be housed in separate documents explaining regulations.

Policy is defined as the position taken and communicated on an issue, and is an avowal of intent (Dovers 2006, p.12). Policies are produced through a process which includes development, implementation and evaluation stages, which Dovers refers to as the policy cycle (2006, p.13).

The focus of this study is policy statements, which are a result of the development stage. Dovers provides a useful outline of the core content of a policy statement. It should address six areas of content: identify the mandate and authority, identify the problem, explain the problem context, state the policy direction, detail implementation and describe ongoing activities. (Dovers 2006, p.100). Policy programs are the manifestations of a policy and include on-ground projects (Dovers 2006, p.13). Policy instruments are the tools used to implement policy and achieve its goals, for example regulations (Dovers 2006, p.14). While there is reference to implementation and review or evaluation stages, the broader policy cycle is not examined in detail here.

4.2 *Policy for the new context of sustainability*

4.2.1 Justification

Policy for sustainability presents new challenges and demands for policy makers. This is a major reason why methodologies for analysis of environmental policy are not yet established. Dovers (2006 p. 43) argues that sustainability problems are different in kind from problems in other policy areas. He identifies a range of attributes which differentiate policy problems in sustainability from those in traditional policy areas. Many of these attributes have direct implications for policy for provision for environmental water so each was examined in that context.

- 1) *Spatial and temporal scale*. Hydrological processes occur at spatial scales which cross political and administrative boundaries, and at temporal scales which exceed human life spans. (Dovers 2006, p. 44) This presents a challenge both in terms of

understanding natural processes, and providing continuity in their management. It means that policies must be interjurisdictional.

- 2) *Possible ecological limits and thresholds.* The relationship between water availability and vegetation was discussed in Chapter 2. Wetland studies have demonstrated the relationship between alterations in water regimes and changes to floristic composition (Blanche *et al* 1999; Rea *et al* 2002). Ecological limits are being currently demonstrated in the drought conditions facing much of Australia (NSW SOE 2006; Harris 2006). Because of the incompleteness of knowledge and understanding, limits cannot easily be defined, implying the need for conservative strategies and application of the precautionary principle whilst researching and monitoring to extend understandings.
- 3) *Cumulative impacts.* While evident in the example given for 2) the challenge presented by cumulative impacts is especially illustrated in relation to groundwater extraction, because of the lack of visibility of processes occurring. The mix of private and public control over a wide range of surface and groundwater sources makes difficult the determination of total consumptive use, for example the proliferation of farm dams (Nevill 2003).
- 4) *Irreversible impacts.* Many of Central Australia's groundwater resources are known to have an ancient origin and cannot be replenished through rainfall (Harrington *et al* 2001; NRETA 2006).
- 5) *Complexity and connectivity.* In environmental water issues, complexity and connectivity is illustrated both in the features of the resources themselves, through the connectedness of groundwater and surface water and their interactions in supporting ecosystems (Eamus *et al* 2006a) and in the effects of human activity, where vegetation clearance and land use changes interact with hydrological regimes to impact on the biota of river systems (Harris 2006).
- 6) *Risk, uncertainty and poor information.* Incomplete knowledge and understanding has been acknowledged as a major impediment to provision of environmental water (Allan and Lovett 1997, p. 93), not least because of lack of comprehensive scientific research on water requirements of many ecosystems. Risk arises from the unintended consequences of management actions which are based on incomplete information.

- 7) *New moral dimensions, multiple values.* This issue was raised in Chapter 2 in relation to NSESD (1992) and in discussion of the implicit values in NWI (2004). Concern for sustainability in policy requires recognition of its impact on the future, and which species and ecosystems are valued (Dovers 2006, p. 46). In the provision of environmental water, policy needs to recognise that choices will be made in prioritising ecosystem goals and to provide a clear basis for doing so, including considering the readiness of the community (Allan and Lovett 1997, p. 82).
- 8) *Systemic causes.* The issue of environmental water provision has arisen because water consumption patterns have failed to take into account environmental needs (ANZECC 1996). Such consumption has often been supported by long-term initiatives to encourage economic development, which now need to be re-evaluated in terms of their environmental consequences. It is also the result of fragmented management, which suggests the need for more holistic and integrated approaches.
- 9) *Lack of research methods, policy instruments and management approaches.* In managing environmental water there is no lack of research methods, however there is little national consistency in approach to their use. (Allan and Lovett 1997, p. 94). The issue of institutional and regulatory arrangements for water policy has been extensively discussed in the context of developing countries which lack existing regulatory infrastructure. It has been argued (FAO 2003, ch. 6, Van Steenberg 2001) that effective water management may be achieved more quickly through promotion of 'bottom-up' approaches, building on existing local management, rather than introducing an institutional framework of legislation, government instrumentality, rules, regulations, charges and compliance mechanisms, as is present in Australia, which takes time to construct and then to change. In their conclusion to *Environmental Water Allocation: policies, principles, practices*, Schofield *et al* (2003) quote Maher *et al* (2002, p. 126) on the nature of the legislative framework required for implementing national environmental water policy. Against the traditional model of regulation using 'structures, statutory plans, administrative processes' is 'inclusive co-management, multiple mechanisms approaches, with a lower but critical profile for legislation'.
- 10) *Non-traded and non-valued assets.* The COAG Water Reform Framework (1994) and the NWI (2004) require realistic valuation and trading in water resources.

However there is only a beginning recognition of the services performed by ecosystems, and outside of production activity, no consistent approaches to their valuation. A 'non-use value' has been recognised by economists, but this has yet to translate into terms accepted for community use (Sinclair Knight Merz 2001, ch. 7).

- 11) *Ill-defined policy and property rights and responsibilities.* COAG (1994) and NWI (2004) both address reform in water management, a major aspect of which was to clarify and secure entitlements, as discussed in Chapter 3. Indigenous rights to water remain unexplored.
- 12) *Public and private costs and benefits.* Environmental water provision clearly has fundamental public and private benefits in ensuring healthy ecosystems, but the allocation of costs is still uncertain and contentious. COAG (1994) attempted to address the issue of externalities, but they are not mentioned in NWI (2004).
- 13) *Need for community involvement.* There is a large and growing literature on community engagement and capacity building for environmental sustainability (UNESCO 1997; DSE and DPI 2004). In order to create the conditions for active community adoption of policy changes in environmental water provision, policy statements need to allow for flexibility in approach, which is unlikely to be easily achieved through reliance on traditional institutional and regulatory provisions alone.
- 14) *Novelty.* Sustainable thinking is new, and placing environmental needs high on the policy agenda is a recent development. That ecosystems take care of their own water requirements without human intervention has been the taken-for-granted reality until recently, so generating awareness amongst people of the impacts of their water resource use may also require different policy approaches.
- 15) *Integrative/interdisciplinary research.* Dovers argues that the merging of environmental, social and economic issues demands new interdisciplinary approaches (Dovers 2006, p. 49). Concerns about environmental water requirements have highlighted deficiencies in knowledge which can only be addressed through multidisciplinary effort, at a range of levels. For example, Arthington *et al* (1998) advocated a multidisciplinary team using a staged workshop approach as a best practice framework for determining environmental flow requirements for river systems

The generic attributes clearly resonate for the topic of water. Although each attribute could be explored at length; the objective here was to verify the relevance and significance of Dovers' policy attributes for environmental water policy.

4.2.2 Structure of policy for sustainability

These attributes suggest that policy for sustainable environmental water management may need to be structured differently, as well as to contain different content, from traditional policy. Focusing first on policy structure, the points above have implications for the balance that is required of the legal, educative and institutional components of policy.

The issues of temporal and spatial scale and of complexity and connectivity within natural resources management call for a clear *legal* basis for integration across traditional management sectors, resolution of possible conflicts of legislation and a future orientation in specifying time limits. The legislative component should provide strong direction and forward vision in order to respond to urgency, new moral issues and possible conflicts.

If developing policy for sustainability is a new kind of policy making, it requires a greater emphasis on an *educative component*, in order to justify and legitimate an agenda of change. The attribute of novelty alone would appear to require this. A clear educative component is necessary to introduce new ways of valuing ecological services, to meet potential challenges of morality and conflict, to gain support for the considerable research effort needed to improve the knowledge base about ecosystem processes and to empower communities as a whole for involvement, not just particular sections of the community.

The *institutional component* of policy presents special challenges for sustainability. Conditions of uncertainty with regard to climate and economic conditions, and incompleteness of knowledge demand the possibility of flexibility in arrangements. Adaptive management relies on the application of continuous information from monitoring to inform actions, and an ability to respond reflexively which is not normally provided in a rule-managed situation. Integrated resource management and integration of knowledge systems also require new ways of organising people to share information effectively, which implies flexibility in roles and responsibilities.

This brief analysis of policy structure in terms of its legal, educative and institutional components is summarised in Table 1.

Structural components of all policy	Implications for policy for environmental water within a sustainability discourse
Legal	<ul style="list-style-type: none"> Strong direction and forward vision Integration across traditional management sectors Integration across temporal and spatial scales Resolution of conflicting legislation
Educative	<ul style="list-style-type: none"> Justifies and legitimates a change agenda Presents new ways of valuing ecological services Promotes continued and improved knowledge building Addresses challenges of morality and conflict Empowers communities for involvement
Institutional	<ul style="list-style-type: none"> Flexible for adaptive management Flexible for responsiveness to change Integrates resource management Integrates knowledge systems Promotes multiple mechanisms

Table 1 The three basics of policy structure: legal, educational and institutional

4.2.3 Content of policy for sustainability

The content for policy for sustainable environmental management may also be different from traditional policy. In his discussion on policy framing, Dovers develops this argument further to present a set of guiding principles for sustainability policy (Dovers 2006, p. 95-97), which he sees as addressing the challenges presented by a reorientation towards sustainability. Dovers' list of challenges with selected Guiding Principles relevant to environmental water provision policy is presented in Table 2.

This information is presented to demonstrate the wide range of new policy considerations which are generated when sustainability become the dominant framework. They will not all be considered in detail, but provide examples of what is possible, and therefore a point of reference for the actual development of policy for environmental water which has taken place.

Policy challenge	Guiding Principles
1) Long-term policy	Create informational, policy and institutional settings that allow development

	of long-term policy mandates and strategies
2) Inter- and intra-generational equity	Consider long- and near-term equity in decision making Emphasise equity impacts on disadvantaged or marginalised groups
3) Global dimensions	Consider regional and global implications of policy decisions for environment and human well-being Trade and economic policies should not encourage or subsidise unsustainable production or consumption
4) Policy integration	Policy and project decisions should be subject to an assessment regime to identify and minimise environmental and sustainability impacts Ensure environmental protection is embedded in economic and development planning from the earliest stages Consider costs and benefits of environmental protection, applying as appropriate, the principles of user-pays, polluter-pays and/or beneficiary-pays
5) Biodiversity and ecological processes	Express protection of biodiversity and ecological processes as priority goals across all policy sectors
6) Information focus	Ensure the maximum possible use, distribution and ownership of information in policy processes Utilise multiple knowledge systems as valid inputs to policy, including formal and informal, expert and community Enhance connections between information systems and policy processes Create and maintain broadly focused long-term environmental research and monitoring
7) Precaution	Require application of the precautionary principle in all decision making processes
8) Inter-jurisdictional	Identify aspects of problems that cross political and administrative boundaries
9) Participation	Identify groups in society likely or possibly interest in and/or affected by decisions Enable public participation in policy through multiple and flexible means Emphasise the participation and empowerment of marginalised groups
10) Innovative policy approaches	Require explicit consideration of a full menu of policy approaches and instruments Encourage and mandate use of and experimentation with non-traditional policy approaches
11) Substantive or material principles	Maintain spare assimilative capacity in environmental sinks, and spare capacity in renewable resource stocks

Table 2 The major content of sustainability policy as outlined by Dovers 2006

4.3 *Extent to which national policy meets these sustainability criteria*

It will be evident from Chapter 3 that national policy statements for provision of environmental water have addressed some of these challenges. The NWI (2004) includes: long-term timelines, intergenerational equity, an integrated approach between sectors and agencies, identification of the ecosystems being served by the policy, the precautionary principle, a strong focus on the need for interjurisdictional consistency and cooperation, and a stated interest in innovative approaches.

The challenges which are less clearly addressed are global dimensions, an information focus, participation and substantive or material principles. The global dimension of NWI (2004) in terms of the relationship between trade and economic policies and unsustainable production or consumption is not clear. (An example where this principle may apply is in the rice-growing industry). An information focus is addressed in terms of strong recommendations for research, monitoring and evaluation, but is weak in addressing use, distribution and ownership of information and community inputs. The challenge of participation is addressed through limited options, does not address participation of all marginalised groups, but does emphasise transparency and accountability of decision making.

Dovers' eleventh challenge of substantive or material principles requires closer examination. Its guidelines advocate maintaining 'spare assimilative capacity in environmental sinks and spare capacity in renewable resource stocks' (Dovers 2006, p. 97). The NWI (2004) requires that overallocation be addressed and stresses the criterion of water use within sustainable yield, but falls short of recommending spare capacity.

The prioritization of biodiversity and ecological processes is not always clear in national policy because environment is often identified only as one of a range of beneficial uses of water, as previously discussed in Chapter 3. The environmental outcomes sought as a result of the NWI (2004) are maintaining ecosystem function, biodiversity, water quality and river health targets. The level of function to be maintained is only referred to in relation to areas of high conservation value (NWI 2004, Section 25 (x) and Section 75 (f)). A sustainable level of extraction is that 'which, if exceeded would compromise key environmental assets, or ecosystem functions and the productive base of the resource' (NWI 2004, p. 29). This is a negative definition. Its validity rests on an assumption that precise levels of extraction can be identified which meet all environmental, ecosystem and consumptive needs. It is clear from the discussion in Chapter 1 that determining this level is not simple. The NWI (2004) advocates a balance between uses which may in practice be more precarious for

ecosystems than finely tuned, and would appear to be in conflict with principles Dovers suggests enact his eleventh challenge.

The NWI (2004) does not specify the optimal unit of management for water resources. In their recommendations for principles for environmental water legislation and policy, Schofield *et al* (2003, p. 35) propose the catchment (inclusive of both ground and surface water resources) as the focus of water management, with environmentally sustainable management as its primary object. They promote the suggestion of Maher *et al* (2002) that a single catchment-based agency should manage all natural resources, engage representatives from all stakeholder groups and incorporate consultation and on-going education. This approach to integration of groundwater, surface water and land management has been recommended by the National Groundwater Committee (2004). While outcomes of the environmental water provision policy will be experienced at local, regional and whole state/territory levels, its implementation and immediate impact will be experienced locally. Integrated surface and groundwater management at a level which is accessible to local users offers greater opportunities for information, participation and education.

In implementing the environmental water provisions of the NWI (2004), Australian jurisdictions agreed to a policy package with a range of essential components and this is now summarised. At the legislative level, statutory protection for environmental water, as part of a system of water access entitlements for all users, and statutory water plans are required. Management approaches to be used include identification of beneficial uses and environmental outcomes, integrated management, judgements based on best available science and stakeholder consultation, the precautionary principle, community participation, reflection of regional needs and adaptive management. Instruments to be applied in implementation are public registers for water access entitlements, a register for environmental water, full accounting of environmental water, water plan monitoring programs, risk assignment frameworks, records of interceptions, compliance monitoring and accountable authoritative and resourced environmental managers.

This adds up to a very strong regulatory framework, with the role of the community as a provider of inputs at specific stages rather than as a partner in implementation, and the role of education and capacity building applying to research, government and tertiary educational institutions rather than the broader community. The NWI (2004) establishes compulsory and therefore minimum features. However this agreed framework does not preclude the development of 'best practice' provision by the states and territories, which addresses

environmental water provision with priorities more in the spirit of the COAG 1994 Water Reform Framework and NSESD (1992).

4.4 Recommended criteria for environmental water policy statements

What features should characterise public policy statements for environmental water provision in the current context of concern for sustainability and why has it been necessary to identify them? National policy requires implementation of the COAG Water Framework (1994) and NWI (2004), but beyond its mandated elements Australian jurisdictions are able to, and have, customised their policy approaches for their particular circumstances. *The National Principles for Provision of Water for Ecosystems* (ARMCANZ 1996) is an instrument for guiding and evaluating action, not a policy analysis tool. Dovers' schemata, while extremely helpful in considering the scope of environmental policy for sustainability, are not tailored for analysing the subset of water policy which covers environmental water. However, drawing on critical and evaluative discussion points made in response to national policy, the major components required within a sustainability discourse and the extent to which national policy meets content requirements, (as covered by Dovers' principles for sustainability policy), a more limited set of criteria were derived.

Nine basic issues were identified, and a criterion statement developed for each, to express core elements which are desirable in policy for provision of environmental water if it is to really address the issue of providing water for ecosystems within a framework of sustainability.

- 1) Policy unambiguously gives highest priority to environmentally sustainable water management which first includes water for ecosystems.
- 2) Water for ecosystems is consistently conveyed as first priority in an integrated hierarchy of policy documents, from legislation to management approaches, to allocations with ecological condition indicators within water plans.
- 3) Environmental water requirements are identified thoroughly and defined inclusively, to avoid excluding water dependencies that are as yet poorly identified or understood.

- 4) Environmental water provision in terms of allocations is clearly stated in terms of quantifiable criteria, such as volumetric amounts which consider seasonal and annual variability, so far as ecosystem knowledge currently allows.
- 5) Policy allows for flexibility in institutional arrangements to facilitate genuine adaptive management.
- 6) Policy provides in its arrangement of management units for an integrated approach including land, groundwater and surface water.
- 7) There is a commitment to community information, participation and education needs at all stages of decision making.
- 8) Potentials for conflict have been considered and addressed including through processes for independent appeal of decisions.
- 9) Policies regarding environmental water provision are publicly accessible.

These criteria, with indicators, are summarised in Table 3

Criteria	Indicators
1) Policy unambiguously gives highest priority to environmentally sustainable water management which first includes water for ecosystems.	<ul style="list-style-type: none"> • Present in legislation
2) Water for ecosystems is consistently conveyed as first priority in integrated hierarchy of policy documents, from legislation to management approaches, to allocations with ecological condition indicators within water plans.	<ul style="list-style-type: none"> • Connections between legislation, strategies, plans and water allocations are evident
3) Environmental water requirements are identified thoroughly and defined inclusively, to avoid excluding water dependencies that are as yet poorly identified or understood.	<ul style="list-style-type: none"> • Water resources and dependent ecosystems include surface and groundwater, overland flows, ephemeral streams and lakes
4) Environmental water provision in terms of allocations is clearly stated in terms of quantifiable criteria, such as volumetric amounts which	<ul style="list-style-type: none"> • Provision recognises variability • Allocations are quantified to provide solid bottom line

Criteria	Indicators
consider seasonal and annual variability, so far as ecosystem knowledge currently allows.	
5) Policy allows for flexibility in institutional arrangements to facilitate genuine adaptive management.	<ul style="list-style-type: none"> • Feedback loops from research and monitoring evident • Strategies responsive to new information
6) Policy provides in its arrangement of management units for an integrated approach including land, groundwater and surface water.	<ul style="list-style-type: none"> • Integration enacted through institutional reform • Development of new connections across sectors or agencies
7) There is a commitment to community information, participation and education needs at all stages of decision making.	<ul style="list-style-type: none"> • Information, participation and education available at community level
8) Potentials for conflict have been considered and addressed including through processes for independent appeal of decisions.	<ul style="list-style-type: none"> • Decision-making transparent • Non-legal conflict resolution included • Appeal through independent agency
9) Policies regarding environmental water provision are publicly accessible.	<ul style="list-style-type: none"> • Environmental water provision is clearly explained • Accessible to public on internet

Table 3 Criteria with indicators for analysis of environmental water provision policy in a context of sustainability

4.5 Conclusion

Arguments to support the position that policy requirements for environmental management at the current time are different from policy requirements for management in the past derive from new perspectives that a focus on sustainability generates. The need for environmental sustainability calls for policy which is different in both structure and content.

Current national policy addresses some of those needs, but falls short in areas which may be critical for successful implementation, that is implementation which meets ecosystem outcomes: the priority it gives to environmental water, the level of ecosystem function which is the goal and the consideration of needs for information and participation by the community. The high degree of regulation it promotes may mitigate against the flexibility of approach needed for integrated and adaptive management and increased innovation.

While current national policy provides the legal benchmark for jurisdictional implementation of environmental water provision, it does not prevent the jurisdictional development of truly sustainable policy. It was suggested that the overall structure of policy needed a new balance between legal, educational and institutional components in order to facilitate changes to an orientation to sustainability, and a set of criteria were proposed to analyse the content of policy for environmental water provision. These criteria address the issues of priority and emphasis given to environmental water, its identification and practical provision and features of its management framework including the social aspects such as opportunities for community involvement, especially through the provision of information.

The next chapter explains the results obtained from applying these criteria in an analysis of the available environmental water policies of four states and the Northern Territory.

Chapter 5	Policy for environmental water in four states and the Northern Territory	2
<i>5.1</i>	<i>Methodology</i>	<i>2</i>
<i>5.2</i>	<i>Results.....</i>	<i>3</i>
5.2.1	Criterion 1	3
5.2.2	Criterion 2	4
5.2.3	Criterion 3	4
5.2.4	Criterion 4	5
5.2.5	Criterion 5	6
5.2.6	Criterion 6	6
5.2.7	Criterion 7	7
5.2.8	Criterion 8	7
5.2.9	Criterion 9	8
<i>5.3</i>	<i>Discussion of results.....</i>	<i>9</i>
5.3.1	Criterion 1.....	9
5.3.2	Criterion 2	10
5.3.3	Criterion 3	11
5.3.4	Criterion 4	11
5.3.5	Criterion 5	11
5.3.6	Criterion 6	12
5.3.7	Criterion 7	12
5.3.8	Criterion 8	12
5.3.9	Criterion 9	13
<i>5.4</i>	<i>Conclusion.....</i>	<i>13</i>

Chapter 5 Policy for environmental water in four states and the Northern Territory

The previous chapter synthesised a set of criteria for use in assessing policy created for the purpose of sustainable management of environmental water. This chapter explores the water management policies of New South Wales, Northern Territory, Queensland, South Australian and Western Australia against those criteria. The objectives were to discover the ways in which provision of environmental water is presented in state policy documents and to analyse the extent to which policies include features identified as important for sustainability.

5.1 Methodology

For each state and the territory, the relevant Act, major policy documents such as strategies, plans and guidelines, and several water management plans, where available, were examined for their references to environmental water provision. Each set of documents was searched to discover its major policy features, in terms of main structural components and content, for evidence of criteria as outlined in chapter 4.

It should be noted that reviews and reports of implementation of national water reforms can be found through a range of sources: Land and Water Resources Audit, State of Environment Reporting, the National Competition Commission Audit and most recently the National Water Commission Audit. While these sources were consulted to clarify the information presented with that found in the policy documents from each state, they did not inform the assessment against criteria for environmental water provision policy conducted here, because they are not policy documents.

Water allocation plans for areas geographically adjoining the borders of the NT were sought. In Queensland the Gulf Water Resource Plan had been prepared but not its Resource Operations Plan containing actual details of environmental water provision. In South Australia, the Arid Lands Region planning had commenced, but the Alinytjara Wilurara Natural Resources Management planning process was still in the conceptual stage. In Western Australia no plans were found for regions sharing a border with the NT. Western Australian documents concerning the Ord River addressed issues related to its management downstream from the dam.

Appendix 1 Table 4 lists the final range of documents which were consulted.

Two methodological approaches were used: close reading, and electronic key word and phrase searches. Close reading, even when guided by a set of criteria, is a subjective activity in which reader understandings can be influenced by textual features such as length, complexity, use of specialised vocabulary and intentions towards audience. Key word/phrase searches were applied to legislative documents (Acts) to provide a more objective point of reference. Electronic document searches were conducted to discover the presence or absence, frequency and context of use of the following terms: environmental water requirement, environmental water provision, water for ecosystems, water dependent ecosystems, groundwater dependent ecosystems, adaptive management, monitoring, integrated resource management, community, participation, education, consultation, conflict and appeal. This data was then compared with notes made whilst close reading. Descriptive summaries of the policy features for environmental water provision which were found within the legislation, policy documents and plans for each of the five jurisdictions are presented in Appendix 3. Results of the keyword search for each relevant Act are presented in Appendix 4.

Each jurisdiction was then assessed against each of the nine criteria identified in Chapter 4, according to the quantity and quality of evidence and an on-balance judgement. The assessment was expressed in terms of continua rather than other ranking devices in order to indicate this on-balance judgement. The key findings are included here.

5.2 Results

The evidence presented demonstrates both differences and similarities in policy, within varying stages of implementation of national water requirements. Each jurisdiction has either amended existing legislation, developed new legislation or is in the process of doing so. Each has developed new policy documents, with varying emphasis, complexity and scope. All are in the process of developing water management plans at regional or local levels, using different methodologies for estimating and incorporating environmental water needs. The results of applying the nine criteria are now critically discussed.

5.2.1 Criterion 1

Policy unambiguously gives highest priority to environmentally sustainable water management which first includes water for environment or ecosystems.

In legislation each state now gives highest priority to sustainable water use. The extent to which sustainable use prioritises environment and ecosystems is variable. NSW lists protection of water sources second before social and economic uses. Its principles reiterate protection. The Northern Territory legislation has no objects and water for environment is one amongst a range of beneficial uses. Queensland gives second priority to ecosystems. South Australia integrates all natural resources and gives their protection first priority. The Western Australian Act gives sustainable use and development first with protection of ecosystems and environments second.



5.2.2 Criterion 2

Priority of water for environment is consistently connected through an integrated hierarchy of policy documents, from legislation to management approaches, to allocations with ecological condition indicators within water plans.

The NSW Act (section 50) requires consistency with targets in State Water Management Outcomes Plan. Connections with Water Sharing Plans are currently variable. Northern Territory documents are sparse with links between legislation and management only through the concept of beneficial uses of water. Queensland documents show strong relationship to statutory provisions, have a consideration of environmental water in licence arrangements but consistent priority and actual allocations are not evident in all plans. South Australian regional plans and water sharing plans show a relationship with strategy and legislation, but actual bases for allocations are varied. Western Australian documents are in draft and draft policy requires links between policies and from legislation to plans.



5.2.3 Criterion 3

Environmental water requirements are identified thoroughly and defined inclusively, to avoid excluding water dependencies that are as yet poorly identified or understood.

NSW has a groundwater dependent ecosystems policy and environmental rules for rivers and aquifers. Plans identify environmental water requirements. Most recent water sharing

plans facilitate further identification of GDEs and WDEs and adjustment of allocations is possible during the life of the plan. The Northern Territory's one statutory water allocation plan does not include formal environmental water requirements of ground or surface WDEs, although an allocation to the environment is made for surface water. Queensland legislation includes frequent reference to ecosystems, and brief identification in plans. South Australia's most recent plans include either comprehensive identification of WDEs or statement of the need for research to identify WDEs. Western Australia has an Environmental Water Provisions policy and a comprehensive established process for identifying WDEs in plans.



5.2.4 Criterion 4

Environmental water provision in terms of allocations is clearly stated in terms of quantifiable criteria, such as volumetric amounts which consider seasonal and annual variability, so far as ecosystem knowledge currently allows.

NSW plans show variations. For some rivers environmental flow requirements are defined volumetrically, by season and by reach. Flows are classified and correlated to a reference point. Some plans include percentage allocations. Groundwater allocations may be subject to distance from GDEs and drawdown amounts. Plans show variable environmental water allocations from groundwater expressed as both percentages and volumes according to identified needs. The Northern Territory gives a percentage allocation as a guideline, and this is so far applied to surface water in one formal regional water resource strategy.

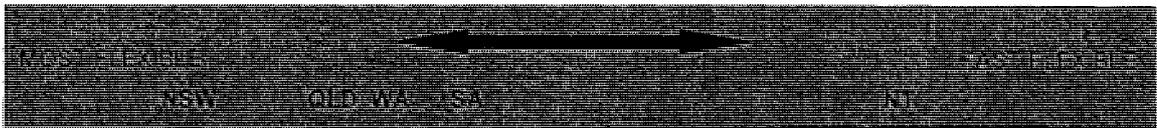


Queensland plans relate identified ecosystems to be protected from Water Resource Plans to Resource Operations Plans, but actual amounts allocated are not clear. South Australian plans are not all completed; some identify ecosystem requirements and clearly show basis of allocation in volumetric terms. Western Australian plans clearly identify EWRs and EWPs, the process and the basis on which allocations are made.

5.2.5 Criterion 5

Policy allows for flexibility in institutional arrangements to facilitate genuine adaptive management.

NSW legislation includes adaptive management; Water Sharing Plans are contingent upon results of research and monitoring. Northern Territory's INRM plan includes adaptive management but institutional arrangements are not explicit. Queensland legislation and the State Water Plan do not mention adaptive management nor new institutional arrangements. South Australian NRM legislation and the NRM plan include adaptive management, with an explicit role for new science. South Australian Arid Lands regional plan is explicitly dynamic. Western Australia sees adaptive approaches as important for implementing the GDE policy and adaptive management linked to monitoring is an element of the Water Policy Framework.



5.3.6 Criterion 6

Policy provides in its arrangement of management units for an integrated approach including land, groundwater and surface water.

Integrated management of resources is an object of the Act in NSW and of the State Water Management Outcomes Plan. Although this addresses integration of management of water resources, there is little information about integration with land management. Some plans deal only with surface water or groundwater and some deal with both. The Northern Territory Act does not include any references to integration, the Natural Resource Management Plan is explicitly integrated but has no statutory authority. Queensland's Act does not refer to an integrated approach, though surface and groundwater are included in catchment plans and links with the *Integrated Planning Act 1997* explicitly assess development applications for their impact upon water resources, eg. wetland flows, works on wild rivers. The Queensland Water Plan includes integration with other natural resources management in relation to specific project areas only. South Australia's integrated national resources management approach is supported through legislation, plans and in the establishment of new organisations with NRM regions, Boards and Committees. Plans can include both surface and groundwater, though some are separate. The Western Australian State Water Plan provides for integration of land and water planning, regional management, catchment councils which include representatives from a range of natural resource

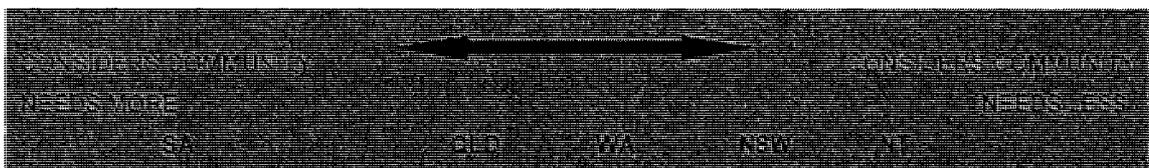
management agencies and management groups. There is an explicit focus on the interface with land use planning. However plans address surface and groundwater separately.



5.2.7 Criterion 7

There is a commitment to community information, participation and education needs at all stages of decision making.

NSW water is managed through water management areas, with water management committees and groundwater management committees. There is no reference to community participation or consultation in Northern Territory legislation, except through stakeholders. The development of draft plans in Alice Springs and the Daly River Catchment has included community consultation. In Queensland there is community involvement in planning through Community Reference Panels and consultation in the development of Resource Operations Plans. Public comment is requested. Legislation and policy documents do not include reference to education. The South Australian Act includes community information and participation. The State NRM plan includes community capacity building, ongoing learning and education, the promotion of active engagement, as well as seeking and valuing the skills, expertise and knowledge of local people. Active engagement is promoted by some NRM regions. Western Australia provides for community involvement in determining GDEs. Water Resource Management Committees are community based, with possibility for drawing on the expertise of specific stakeholder groups. The process of developing the draft Water Policy and State Water Framework invited community input and evaluation.



5.2.8 Criterion 8

Potentials for conflict have been considered and addressed through processes for independent appeal of decisions.

In all states and the territory potentials for conflict are addressed within a framework of rules and regulations. Acts and policy documents do not convey the contentious reality of water

allocation. Environmental water allocation is progressively being introduced so the types of conflicts it generates may not have fully impacted on current processes and provisions. This criterion has therefore been assessed on the basis of comprehensiveness of provision for appeal within legislation. It should be noted that information, education, consultation and participation processes may be also used to reduce conflict, but information available within policy documents was insufficient to assess on this basis.

The NSW process is closely regulated and clearly defined, and an environmental impact process is available. Compensation processes are available where allocations have been reduced, and appeal to the Land and Environment Court. There is strong provision for ministerial veto and intervention. Northern Territory documents provide no reference to appeal, and grievance procedures via the Water Review Committee operate through the Minister or the Controller of Waters, not an independent agency. Queensland documents identify transparent decision-making as a principle. The Queensland Act includes grounds for compensation and has a comprehensive section on review, appeal and arbitration. The South Australian NRM Act includes chapters on civil remedies and appeals. The Western Australian Act has a small section on appeal and policies evidence appeal through the Environmental Protection Act, though GDE policy states that the government of the day will ultimately decide when competing interests must be balanced.

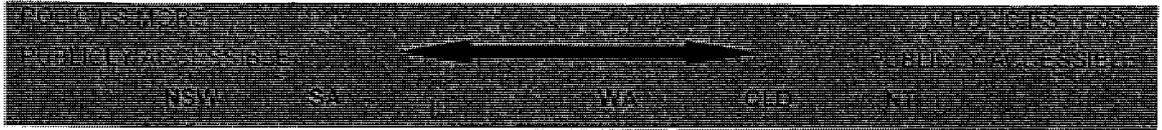


5.2.9 Criterion 9

Policies regarding environmental water provision are publicly accessible.

NSW policies are grouped coherently and are mostly available from the Department of Natural Resources site, which has a section for environmental water. The information reveals the complexity of environmental water provision by describing the water sources to which it relates, what their ecosystem needs are, how these can be determined and how they can be catered for. It applies this information to water sources in different regions. Northern Territory water management internet sources do not present a complete picture of environmental water provision. Queensland policies and programs are grouped together, making discovery of policies in relation to particular topics difficult. There is no dedicated link for environmental water. South Australian higher order policies are grouped, and others are within NRM region sites. The water resources overview of the Department of Water, Land and Biodiversity Conservation includes pages on water dependent ecosystems and

water for ecosystems. Western Australian information on environmental water is found within policies, without a dedicated section.



5.3 Discussion of results

Table 4 summarises the results of the assessment of five jurisdictional environmental water policies against nine criteria for sustainable environmental water policy and these are now discussed.

5.3.1 Criterion 1

South Australian and New South Wales documents give highest priority to environmental water in legislation. In Western Australia, Queensland and the Northern Territory the priority given to environmental water provision reflects some of the ambiguity of its status within the NWI (2004). The 'triple bottom line' of environmental, social and economic needs and outcomes is a core concept of sustainability policy, but the balance between environment, society and economy is an uneasy one. There are concerns that despite enshrinement in legislation, environmental water provision may still be subject to interpretation through legal challenge in courts (Millar, 2006). Any ambiguity in the priority being given to environmental water would appear to make erosion of this priority through legal interpretation highly likely.

At the administrative level, achieving a balance between environmental, social and economic benefits of water resources can also be undermined by interpretation. It is too easy for economic needs and outcomes which are easily quantifiable to outbalance those of environment and society which are less easy to quantify. Issues of society and environment may inform decision making, but economic costs may have the final influence. There is room for confusion about the meaning of 'balancing' environmental, social and economic aspects if they are all rated as 'considerations'(Papadakis and Grant 2002).

The apparent caution about making a full commitment to environmental needs as highest priority seems to be driven by concern for a perception that consumptive needs may not be met. Ambiguous commitment to environmental needs appears to evidence lack of real acknowledgement that environmental services underlie all social and economic benefits.

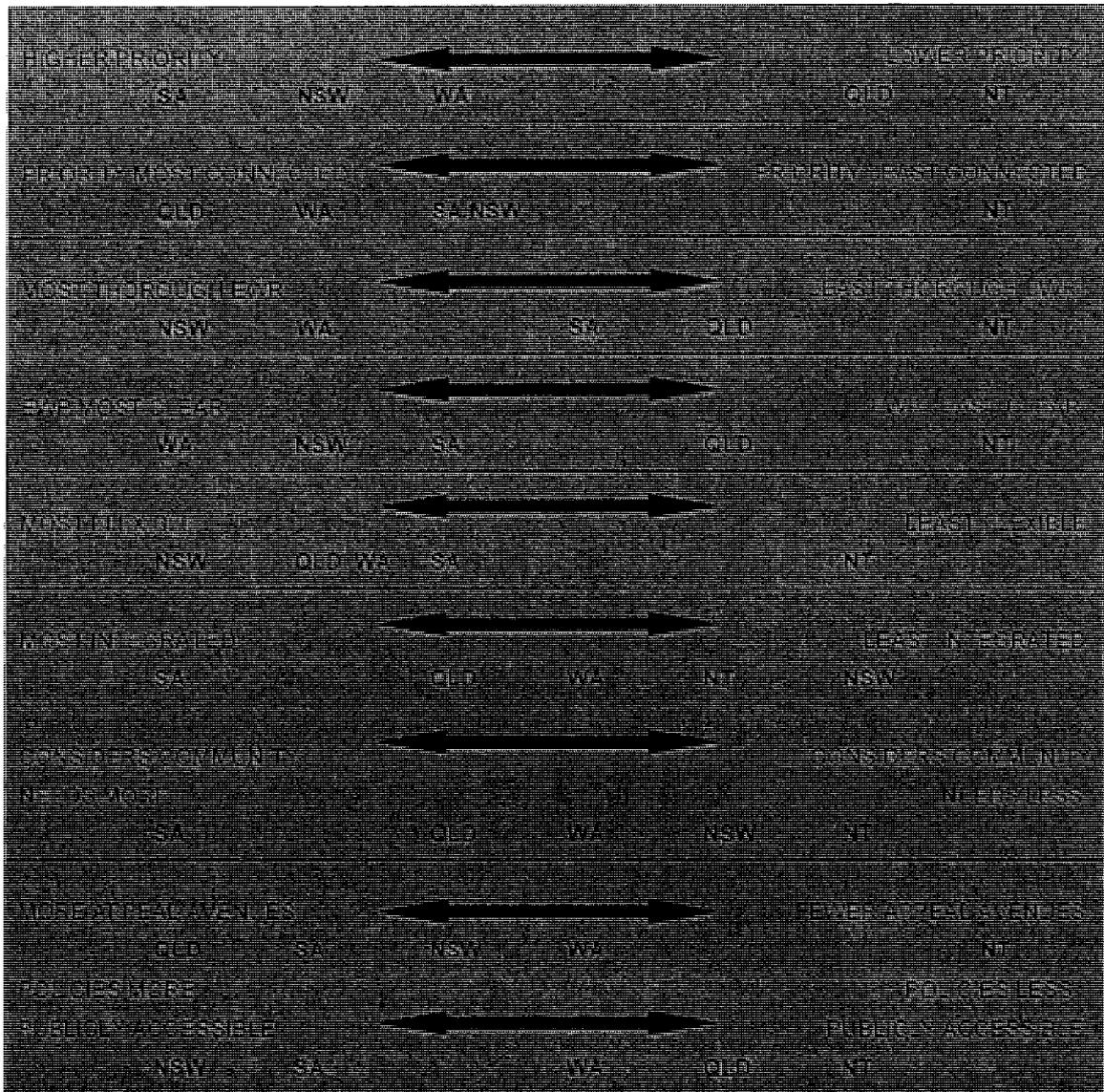


Table 4 Summary of results: ranking of all jurisdictions on each criterion for sustainable environmental water policy

5.3.2 Criterion 2

Conveying the highest priority of water for environment throughout the hierarchy of documents which constitutes public policy can be achieved in more than one way. Genuine connections which demonstrate fulfilment of legislative goals are shown through references which become more detailed and specific from higher to lower level policy, that is from legislation to strategies to actual allocation plans. Another way is via mandated proformas in which key elements are inserted to demonstrate connection between visions and goals at the highest level and performance indicators at the lowest. This kind of administrative

connection was evident in Queensland Water Resource Plans and Resource Operations Plans, which referred in detail to sections of the Act, but did not clearly convey to users how these translated into actions and amounts for specific water resources and their ecosystems at specific times.

A closer connection between intentions at the highest level and most practical levels was conveyed through South Australian and Western Australian plans, which actively explained how the policy was implemented, including difficulties with implementation.

Maintenance of consistency between levels of policy documents is clearly a challenge when requirements and responses to them are changing rapidly.

5.3.3 Criterion 3

The identification and definition of environmental water requirements in plans varied greatly from highly detailed descriptions to formulaic checklists. Although *National Principles for Allocation of Water to the Environment*, and *National Principles for Groundwater Dependent Ecosystems* provide a basis for identification and definition, there is no standard methodology being applied between jurisdictions. Within-jurisdictional consistency of approach has clearly increased from earlier non-statutory plans to the currently required statutory plans, both of which are still operating in some jurisdictions as they progressively update their approaches. Where plans freely acknowledged research and knowledge gaps in identifying local environmental water requirements, they were also able to explain adaptive decisions made to account for potential WDEs in the interim.

5.3.4 Criterion 4

Actual allocation of environmental water was transparent in some plans, but not in others. In some cases there is insufficient knowledge of the resource to identify allocations volumetrically. In more cases there is insufficient knowledge of the environmental water requirements. Where allocations cannot be made, exemplary practice is evident in the application of the precautionary principle, with conservative consumptive allocations and the establishment of monitoring provisions as a condition of licensing.

5.3.5 Criterion 5

Adaptive management featured as an important principle in most policy. The extent to which it is facilitated through institutional arrangements varied. Exemplary policy includes provision for research and monitoring and the ability to modify allocation decisions in

response. The discussion of environmental water requirements and provisions in South Australian and Western Australian plans indicates how current identification and allocation decisions are provisional until further knowledge through research and monitoring can provide a firmer basis.

5.3.6 Criterion 6

Evidence from most policy documents indicates an awareness of the need for integration of water and land management in order to effectively provide for environmental water. However, practical measures to ensure consistent integration were only evident in South Australian documents. On the other hand, integrated surface and groundwater management was evident in the plans of two states, while one had separate and integrated plans for different regions, and the other only separate plans. Both the connectedness of ground and surface waters, and integrated natural resource management are only recently strongly recognised in policy. Clearly there are great difficulties in achieving integration within institutional frameworks which are legitimated through separate legislation and with separate administrative hierarchies and processes. Using the region and sub-region as the management units for all natural resources is advantageous for commencing an integrated approach.

5.3.7 Criterion 7

Community information, participation and education as features of water management policy which are reflected in management units are most evident in the states which have most recently renewed their policies (South Australia and Western Australia). Only one state (South Australia) emphasised the importance of the skills, knowledge and expertise within local communities. In view of the community impact of decisions about environmental water, more emphasis upon information would be expected in policy. In view of the complexity of environmental water provision, more emphasis upon education would also be expected.

5.3.8 Criterion 8

The criterion of considering and addressing potentials for conflict within management of environmental water was included because implementing policy for sustainability involves dealing with highly contentious issues. Choices about allocating water for environmental benefit will mean not allocating water for economic and social benefit, with accompanying deprivation affecting people's livelihoods. National policy deals with this result using terms such as adjustment and compensation. State policies vary in the degree to which they make provision for appeals, and use environmental protection agencies as a part of their

allocation process. The issue of allocating water for environment has been addressed within a regulatory framework backed by law, and therefore conflict over water resource management is not explicitly acknowledged within policy documents except in legal terms. The personal, emotional, religious, aesthetic, moral and social dimensions in the best policy are slightly acknowledged through recognition of the importance of stakeholder and cultural interests.

5.3.9 Criterion 9

One state provides the most easily accessible and comprehensive explanation of environmental water provision at a state level with one other providing dedicated but less comprehensive information. The internet as a recognised source of public information is a recent phenomenon. The process of this review demonstrated that searching for clear information on this complex issue of environmental water is extremely time-consuming. The quantity of information provided is copious, but the status of policy presented within different sections of an internet site is not always readily apparent, neither in terms of recency nor authority. Unless community members already have close knowledge of local water management policies and processes, they are unlikely to be easily able to understand and interpret the significance of information concerning their local areas, nor to be sure that information provided constitutes all of the applicable policy.

5.4 Conclusion

When environmental water policies for five jurisdictions were evaluated against nine recommended criteria, no one jurisdiction provided complete evidence against all criteria, however some aspects of policy in each jurisdiction were regarded as exemplary and are listed following.

- 1) New South Wales' legislation thoroughly includes environmental water, a policy for groundwater dependent ecosystems, a clear allocation process through environmental rules for rivers and groundwater, plans can be adapted within their lives in response to research, and there is opportunity for community involvement in preparation of management plans. Policies are grouped clearly for internet access.
- 2) Queensland legislation has links to integrated planning, there is integrated management of groundwater and surface water through catchment management

authorities and land and water management plans may be applicable at landholder level.

- 3) South Australian legislation integrates all natural resource management and operationalises this through regional structures. Legislation and policy documents strongly value participatory and consultative processes, community knowledge and emphasise education. Water dependent ecosystems are thoroughly identified in some plans.
- 4) The Northern Territory Integrated Natural Resource Management Plan evidences commencement of a process of more holistic water resource management.
- 5) Western Australia has clear policy on environmental water provision, thorough identification of water dependent ecosystems and thorough processes for determining environmental water provision.

The hypothesis that the states could provide models for the development of Northern Territory environmental water policy has some degree of support in these strong features identified from their policies. Unfortunately lack of policy evidence relating to WDEs near shared border environments meant that examples pertain to management rather than environmental features of policy.

The unevenness of the evidence against the criteria indicates that there has been a partial adoption of sustainable features. The shifts and variations in language used in policy documents echoes the emphases dominant in national policy at the times of preparation of jurisdictional policies. These shifts in emphasis were particularly relevant for the way in which environmental water has been prioritised in jurisdictional policy.

Chapter 6	Application to the Northern Territory situation	16
6.1	<i>Summary of NT policy in relation to identified policy criteria</i>	<i>16</i>
6.2	<i>Recommendations for NT policy development referring to identified features of policies from four states.....</i>	<i>17</i>

Chapter 6 Application to the Northern Territory situation

With its low population and relatively low development of water resources, the NT is in a position to be proactive in its approach to protection of its water sources. Because of the current limited exploitation of water sources, and especially in the northern zone where rainfall is high and management of flooding is frequently an issue, many may argue that the concept of environmental water provision is of low relevance. However, it is precisely because of these conditions that the development of effective policy for environmental water provision at this stage has the highest chances of providing successful protective outcomes for water dependent ecosystems in the future, without the need for extensive restorative approaches.

The objectives of this chapter are to apply the findings of the analysis to the NT situation. The findings about current NT policy for environmental water are summarised and the features from four states which provide examples of exemplary policy for environmental water are identified in order to generate recommendations for development of NT policy.

6.1 *Summary of NT policy in relation to identified policy criteria*

The NT Water Act is a highly instrumental piece of legislation which provides a legal basis and institutional provision for water management. It contains no educative components, unless penalties for non-compliance are counted as educative. It contains no reference to the NT's context, in terms of its varied water resources nor does it refer to the range of complex ecosystems which they support. It refers to ecosystems once, as aquatic ecosystems which are one of a range of beneficial uses. There is no reference to adaptive management, integrated management, the precautionary principle, information, education or participation. The only references to community are to community government, a term specific to the NT for the governance of Indigenous Communities.

The Integrated Natural Resource Management Plan includes all of the terms quoted above. The INRM Plan was prepared under a Bilateral Agreement between the Northern Territory and Commonwealth Governments for delivering the Framework for the Extension of the Natural Heritage Trust. It is thus an expenditure plan, which identifies natural resources, termed assets, and targets for their management. Its approach explicitly acknowledges and incorporates integrated natural resource management, ecologically sustainable development, the precautionary principle and adaptive management. Its proposals and

targets address many of the actions that are required in order to identify and provide for environmental water. Although it includes the content areas desirable for all policy statements, it is not a statutory document and therefore its status as policy is unclear (Pers. Comm. Executive Officer INRM Board).

The NT has one completed water allocation plan, with others in draft. Draft plans have been prepared with community input at several stages and when endorsed will become statutory documents. The website of the Department of Natural Resources, Environment and The Arts provides information about the development of the plans, and basic information about the NT's water resources, including a brief section on environment within the surface water section.

The NT policy framework is thus currently skeletal and development of plans is slow, however the framing of the INRM indicates the adoption of many exemplary features of sustainable policy for environmental water.

6.2 *Recommendations for NT policy development referring to identified features of policies from four states*

What sustainable features of environmental water policy from New South Wales, Queensland, South Australia and Western Australia may be helpful in informing the development of more comprehensive policy in the Northern Territory? This question will be answered, taking into account the features of the current NT context raised in Chapter 2.

As so much of the NT's environmental water is currently unaffected by human activity, it deserves a status similar to that given to natural resources in South Australian legislation, which recognises intrinsic value beyond that of human use. Like South Australia, the aridity of much of the NT would suggest that environmental water should be acknowledged as underlying and therefore fundamental to social and economic benefits, rather than merely coexistent with them.

The priority to be given to environmental water needs to be stated clearly and unambiguously in legislation. Currently aquatic ecosystems have equal priority with all other beneficial uses. Whilst the term 'aquatic ecosystems' has been defined very broadly to include all ecosystems dependent upon water in the INRM, this is not clearly apparent in legislation.

There are few public documents to explain NT environmental water policy. Fact sheets clearly link actions with provisions of the Act, but comprehensive statements of policy do not exist. The NT is clearly in a position to adopt a strong focus on sustainability in the framing of policy documents, if there is the will to do so.

In the single currently existing water allocation plan, the identification of water dependent ecosystems is lacking. Further research is a widely recognised need which has been given prominence in mandatory reporting documents (LWRA 2000) and in the INRM. The strong contrast between water resources and climate in the NT's northern and southern zones and its high seasonality present special issues for identification of EWRs that are also shared with parts of Queensland and Western Australia more than other regions examined in this review, but water plans addressing these regions were not available for those states at the time of review. Several important research projects conducted in the NT (Cook *et al* 1998; Duguid *et al* 2002; O'Grady *et al* 2002) illustrate the complexity of determining EWRs for even a small range of NT ecosystems. The wide acknowledgement of a range of WDEs seen in some South Australian plans, and the rigour of techniques for identification of GDEs in Western Australia provide approaches which can be emulated.

In the currently existing water allocation plan, and the consultation draft for Alice Springs, environmental water allocation is acknowledged. However, further research is required to verify the 95% allocation in the arid zone and 80% allocation in the northern zone. Daly Basin studies have demonstrated the complexity of determining environmental water requirements in connected surface and groundwater systems (O'Grady *et al* 2002). The work from other states suggests that a variety of approaches are used, with New South Wales demonstrating most detail in EWPs in relation to surface water, and Western Australia having made most progress in EWPs for groundwater resources. Exemplary practice adopted in the absence of detailed research is to make conservative consumptive allocations whilst applying the precautionary principle. For most water management areas in the NT, the low extraction rates mean that this is possible.

The NT INRM endorses adaptive management, but without the ongoing research and monitoring to inform decision making, it may become maintenance of the status quo.

With a large land area and small population, an integrated natural resource management approach would seem not only desirable but possible, and this is the direction adopted with the INRM Plan. To further this approach, legislation for integrated natural resource management such as in South Australia would be a logical next step. Within the NT Water

Act surface and groundwater are dealt with separately and their management areas are also separate. The development of integrated catchment management for groundwater and surface water would also be desirable. Land and water management largely occurs through personnel in the same department so organisational barriers to integration may not be as strong as in the larger agencies of the states.

Management units for water in the NT are probably reasonably accessible for all but the remote and very remote population and can meet community information, participation and education needs for speakers of English. But there is limited legal recognition of those needs, and little scope for genuine community involvement through inclusive process and structures within the legislation to recognise the diversity of the NT population, with its significant proportion of Indigenous language users. Actual practice as demonstrated through the consultation process for the Draft Alice Springs Water Resource Strategy (NRETA 2005) is in some respects more consultative than legislation would suggest. If policy is a true expression of intent, it should reflect these important principles of inclusive consultation and participation.

The criterion for consideration and addressing of potentials for conflict were largely not met in state policies examined, so this criterion was assessed on the availability of independent appeal processes. Within the NT Water Act, there is no reference to 'appeal'. In the case of aggrievement, the review of a decision can be requested of the Minister, who may then review the decision or refer it to the Controller of Water or to a Review Panel. This process is not an example of independent appeal, as available in states through environment courts. Although there may not currently in the NT be the need for such conflict management measures, in face of the likelihood of much higher demand on water resources, a more transparent and independent process will be required.

The public accessibility of policies through the internet was found to be high for only one state. For the NT this research has clearly demonstrated that, without extensive research, it is not possible for community members to understand all of the differences in management units for surface water and groundwater and the requirements attaching to users from these two sources in different areas of the NT. Currently NT water management internet sources do not present a complete picture of environmental water provision. In view of the small number of people in government agencies servicing the water sector, the existence of accessible documented policy is vital for disseminating information.

On the basis of this analysis, a range of recommendations were identified to inform the development of NT policy for environmental water provision.

- 1) A highest priority status for environmental water in legislation
- 2) Clarification and documentation of policy regarding environmental water
- 3) Thorough identification of water dependent ecosystems, adopting approaches such as in New South Wales for surface water ecosystems and Western Australia for groundwater ecosystems
- 4) Verification through research of current environmental water allocations and application of the precautionary principle where environmental water requirements of ecosystems are not known
- 5) Legislation to support integrated natural resource management
- 6) Integrated management units for surface and groundwater management
- 7) Legislation which ensures processes of information, communication, education, consultation and participation in environmental water management for the whole community and thereby legitimates change processes
- 8) Recognition of potentials for conflict over environmental water and processes for independent appeal
- 9) Comprehensive and clear presentation of environmental water policy (or its stage of development) in publicly accessible forms such as the internet.

Chapter 7 Conclusions.....	22
7.1 <i>Methodological choices</i>	22
7.1.1 Policy versus report.....	22
7.1.2 Public researcher perspective.....	23
7.1.3 Analysis of policy as textual data.....	23
7.2 <i>Policy analysis and sustainability</i>	23
7.2.1 Legal components of policy.....	24
7.2.2 Educative components of policy.....	24

7.2.3	Institutional components of policy	25
7.3	<i>Environmental water policy</i>	26

Chapter 7 Conclusion

This review has targeted one overall aim, seven more specific objectives and in the process raised several hypotheses concerning the methodology applied, requirements of policy for sustainable development and policy for environmental water. Six of the objectives have been addressed in previous chapters. This chapter addresses the seventh objective by considering how the methodology contributed to the overall aim of identifying the features of policy which are most effective for environmental water in a context of concern for sustainability, what can be concluded about the requirements of policy for sustainable development and the extent to which current policy fulfils them.

7.1 *Methodological choices*

7.1.1 Policy versus report

The review focused on policy, and explored policy documents rather than reports. Policy documents deal with intentions whereas reports focus on what has been achieved. The two perspectives are quite different, and this becomes readily apparent when comparing the information gained from policy documents on environmental water for the four states studied, with their State of Environment (SOE) reports and Land and Water Report Audits. In SOE documents mandatory issues for reporting are explained in concise and technical language, which often reveals the rationale and justification for policy decisions, the relationships between policy and actions and between different institutions and organizations involved in implementation. On the other hand, policy documents can have advisory, subsidiary, or pending status and may have been prepared not only to address problems but also to meet the political need of being seen to be addressing a problem. The actual status of policy documents is not always clear and the simplification of language in policy, which is designed to meet the perceived needs of the broadest audience, can obscure important distinctions and connections.

A focus on policy documents enabled the exposure of issues that would not have been revealed through an examination of reports. These are the highly complex picture that policy presents to members of the community and the gap between policy and actual implementation. If the purpose of policy is to present intentions that chart a way through complexity, this is hardly being achieved in relation to environmental water provision. The topic is itself complex and policy is often embedded in layers of documentation. Unless

these layers are clearly signalled, as they are in the New South Wales website presentation, discovering what is intended and what has actually occurred can be difficult.

7.1.2 Public researcher perspective

The choice to examine mainly documents providing public policy was driven by the nature of the research issue which asked what environmental considerations a community member could expect to have been applied in water allocation policies in his or her local area. For users and community members to support policy for environmental water provision, they need to know how it applies to them including where their water is sourced, what demands are being placed on it and what environmental needs it meets. Even if under-resourcing prevents full implementation, they need to be aware of the policy-makers' intentions regarding environmental water. This review has revealed that currently policy statements in four out of five of the jurisdictions sampled do not provide a level of accessibility which can easily answer questions about environmental water provision in local areas or which fulfils an educative function.

It should however be noted that the situation is constantly shifting, and positive steps which have occurred since this review was commenced were the establishment of the national connected water and water websites which bring environmental water into greater prominence ([www.connectedwater](http://www.connectedwater.gov.au), www.water.gov.au).

7.1.3 Analysis of policy as textual data

The raw material of this review was policy texts. Analysis of these texts on the range of criteria developed was complex and involved qualitative judgements informed by quantitative analysis of one component of the data. Although this methodology also reflects that used by community members and policy makers as they evaluate policy for their own purposes, the application of a more quantifiable analytic approach would both make the task easier and its judgements more accessible to others. Such approaches are within the repertoire of the social sciences, but have potential to assist in the multidisciplinary field of policy analysis.

7.2 Policy analysis and sustainability

It was argued that policy making for sustainability places different requirements on its legal, educative and institutional components from traditional policy making. Each of these requirements will now be discussed.

7.2.1 Legal components of policy

Policy for environmental water in the four states examined is framed within strong legal provisions, which give it high but not necessarily first priority. Although environmental water has a better defined status than when Schofield *et al* (2003, p. 22) claimed that at best the environment still has to compete for its water needs with other users, whether this is manifest in practice is yet to be seen. Processes for identifying requirements and balancing beneficial uses do not provide complete assurance. Definitions incorporated into policies concerning sustainable yield as being a point at which there is acceptable stress to ecosystems or low deleterious impact may be too flexible to operate as effective standards for protection. These definitions do not provide the spare capacity referred to by Dovers (2006) as important for sustainability. In drought conditions the status of environmental water is probably still precarious. The complexity of determining ecosystem water requirements and the current variations in methodology for doing so mean that even the strongest legal intent may not be able to be fulfilled currently.

7.2.2 Educative components of policy

Educative components within the policies of these four states are not highly conspicuous. To be educative, policy needs to provide a vision of future possibilities and information about how these can be achieved. While the often appealing visual images of environments which accompany strategy and planning documents may perform some of this role, and there may be statements about the importance of providing information and encouraging participation and community input, the actions for achieving these were generally given low priority. This is in contrast to water supply agencies, which in recent years have conducted extensive campaigns about efficient water usage in domestic and urban contexts. It is also in contrast to the increased public awareness of rivers, streams and riparian management achieved through such initiatives as *Waterwatch*. It is true that initiatives in the Murray-Darling Basin have been accompanied by comprehensive and multi-level education campaigns, but these approaches have focused on surface water in iconic waterways. They have not drawn attention to those environmental waters which are mostly invisible – groundwater, throughflows and ephemeral water bodies. Lack of recognition of the role of environmental water in its broadest context promotes acceptance of the view that some ecosystems do not matter.

A genuine change in orientation towards greater sustainability will necessarily involve challenging past and existing assumptions about the relationship between human beings

and their environment. Only South Australia's policy explicitly challenges these assumptions in its recognition of the intrinsic value of natural resources including water. National policy does not present this relationship as problematic.

The ways in which the language of policy and science can assist or hinder the adoption of new orientations presents some interesting complexities here. While scientific understandings stress the interconnectedness of ecosystem processes and components, this is not always recognised in the values placed upon them culturally (in its broadest sense of incorporating the social, economic and aesthetic). An example is the special status awarded to 'high value ecosystems' such as a spring ecosystem, but the lack of recognition applying to scrubland which may provide its recharge. Scientific language at the same time categorises ecosystems and their processes, such as through the terms 'environmental water requirements' and environmental water provision' which have arisen from the need for precise definition of the water needs of ecosystems. However, 'in a broader sense almost the entire terrestrial environment can be considered a "freshwater ecosystem"' (UNESCO, p. 5) so the definitions may be suitable for specific aquatic ecosystems, but fail to account for the broader picture of interconnected water and thus implicitly support its differential valuation.

Further research into policy development for sustainability could focus on the extent to which it uses language to educate about the change it espouses.

7.2.3 Institutional components of policy

With the exception of the South Australian natural resource management approach, legislation and policy focused most on institutional provision through government agencies, with a strong emphasis on rules and regulations. Moves towards institutional components which really facilitate integrated and adaptive management, and management which connects with and empowers users through innovative approaches are evident in references to community participation. While it has undoubtedly been necessary to drive initial change in policy for environmental water from the top down, implementing provisions in the long-term may have greater chance of success with a higher level of local involvement. Another advantage of more localised implementation is that it can address the complexities of provision of water for a range of ecosystem requirements in a more immediate way, than distant managers following rule-based requirements which could be simplistic (MacKay 2006, p. 235).

Innovative approaches are seen as a challenge by Dovers (2006, p. 97) and alternatives to institutional implementation of policy are advocated by H MacKay (2006). Further impetus for localised and community-based approaches derives from the sheer size of the task of identifying and then monitoring the water dependence of ecosystems. It may not be feasible for government agencies to carry out all of this work. Most licensing conditions include compliance with environmental protection requirements and monitoring of water quality and quantity, and as discussed earlier, Western Australian licenses may require a range of environmental compliance activities. A licence to take water could be treated in the same manner as a licence to drive, with knowledge requirements to be met before issue.

7.3 Environmental water policy

A critical orientation has been taken so far, but it should be acknowledged that the concept of environmental water is a recent one, and so policy development has taken place over little more than a decade. In comparison with many other countries in which environmental water has no status, Australia has made significant progress in a relatively short period of time.

Eamus *et al* comment that 'The legislative requirements for allocating water to maintain ecosystem health, including groundwater dependent ecosystems, is [*sic*] in many cases more advanced than scientific understanding of the actual water requirements of those ecosystems.' (Eamus *et al* 2006a p. 206). This insight goes some way towards explaining the uneven policy development demonstrated by jurisdictions, but is also a characteristic of policy making in general in the current contexts of uncertainty which inhere to complex environmental matters and the ways in which humans deal with them. More specifically, it points to the interfaces between the generation of scientific knowledge, the politics of decision making that draw on that knowledge and the collections of administrative, managerial and organizational responses that can be applied. The need for examination of these interfaces has been recognised in recent years through such initiatives as the Social and Institutional Research Program of Land and Water Australia (www.lwa.gov.au/sirp).

Across the Australian jurisdictions explored in this review environmental water policy has many common elements, as all jurisdictions are required to be implementing national policy, but the extent to which it has actually been incorporated into state and territory policies varies greatly. Another type of study would be needed to determine whether this variation can be attributed to state and regional differences between demands placed on water resources, and the degree of contention about their allocation. Policy implementation has clearly been slower in lower population regions with lower demand and fewer regulated

resources, possibly because of the urgency for political and practical reasons to first address those surface catchments and groundwater sources which are over-allocated.

One aspect for further research is a comparison between the different jurisdictional approaches taken to implementation of new policy, which could be described as revision and rehabilitation or complete reform and renewal of existing policy. If the argument presented in this review is a valid one, then revision and rehabilitation of existing policy is unlikely to meet the needs for management of environmental water which addresses environmental sustainability. However, there are arguments both for and against incremental or completely reformist agendas for change which should be tested against reality.

This review has shown that the four states examined have policies which begin the implementation of the national policy which provides the basic framework for environmental water provision, but that only two of the five jurisdictions sampled have developed specific ecosystem water guidelines. It has also suggested that current exemplary policy should include not only specific intentions related to environmental water, but also supporting features driven by the current broader contexts of policy making for sustainability, that is meeting current needs without compromising those of the future, and policy making within uncertainty. Within these broader contexts, the quality of policy is important. Full implementation of environmental water policy in Australia means management of water resources on a level which in its geopolitical and scientific scope is so far unprecedented, so requires supporting features that address the ways in which people think, interact and communicate about water in the environment.

References

- Allan J and Lovett S 1997. *Impediments to managing environmental water provisions*, Bureau of Resource Sciences, Canberra.
- Andrews P 2006. *Back from the Brink, how Australia's landscape can be saved*, ABC Books, Sydney.
- Arid Areas Catchment Water Management Board 2005. Overview to the Catchment Water Management Plan Draft, South Australia Arid Lands Region, June 2005.
- Arid Areas Catchment Water Management Board 2006. Water Allocation Plan for the Far North Prescribed Wells Area. Prepared for the South Australian Arid Lands Regional Natural Resources Management Board, June 2006.
- ARMCANZ and ANZECC 1995 *National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia*
- ARMCANZ and ANZECC 1996 *National Principles for the provision of water for ecosystems*, Occasional Paper SWR No. 3, Commonwealth of Australia.
- ARMCANZ 1996 *Allocation and Use of Groundwater*, Occasional Paper Number 2, Commonwealth of Australia.
- Arthington, AH and Zalucki JM eds. 1998. *Comparative evaluation of environmental flow assessment techniques: review of methods*, LWRRDC Project GRU22 Final Report, LWRRDC, Canberra.
- ABS [Australian Bureau of Statistics] 2006. National Regional Profiles www.abs.gov.au/AUSSTATS
- Benyon RG, Theiveyanathan S and Doody TM 2006. Impacts of tree plantations on groundwater in south-eastern Australia, *Australian Journal of Botany*, 54, 181-192.
- Blanche SJ, Ganf GG and Walker KF 1999. Tolerance of riverine plants to flooding & exposure indicated by water regime. *Regulated Rivers: Research and Management*, 15, 43-62.
- Boulton AJ and Hancock PJ 2006. Rivers as groundwater-dependent ecosystems: a review of degrees of dependency, riverine processes and management implications. *Australian Journal of Botany*, 54, 133-144.
- Bowers J 1998. *Sustainability and Environmental Economics*. Addison, Wesley, Longman Ltd.
- Brock J. 2001. *Native Plants of Northern Australia*, Reed New Holland, Sydney.
- Brodie RS, Green R and Graham M 2006. *Blackwood river: refining ecological water requirements for the allocation planning process Nannup to Hut Pool*, CENRM 3/06V2. Centre of Excellence in Natural Resource Management, the University of Western Australia, March 2006.
- Chessman B & Jones 2001. *Integrated Monitoring of Environmental Flows: Design Report*, Department of Land and Water Conservation, Sydney

www.dlwc.nsw.gov.au/care/water/imef/new_design_report.pdf

Cook, PG, Hatton TJ, Eamus D, Hutley , L and Pidsley D 1998 *Hydrological investigation at Howard East*, Technical Report 41/98, CSIRO Land and Water.

COAG [Council of Australian Governments] 1994. Water Reform Framework. Australian Government, Canberra
Department of Environment and Heritage, *Environmental Water Requirements to Maintain Groundwater Dependant Ecosystems*, Environmental Flows Initiative Technical Report, Report number 2, Environment Australia, Canberra ACT

Department of Environment and Heritage 2005. *Intergovernmental Agreement on the Environment*, 1992.

<http://www.deh.gov.au/esd/national/igae/index.html>

Department of Infrastructure, Planning and Environment. *Environmental water requirements of the Daly River*, July 2004, Report 30/2004D. Northern Territory Government.

Department of Infrastructure Planning and Environment, 2002. *Titree Region Water Resource Strategy*, Northern Territory Government.

DSE and DPI [Department of Sustainability and Environment, Department of Primary Industries] 2004. *Effective community engagement*, workbook and tools. Victorian Government, Melbourne.

Department of Water 2003. Western Australia State Water Strategy. Government of Western Australia.

Department of Water 2005. *Local Area Management Plan for the Groundwater Resources of the Kemerton Subareas*, Water Resource Division, Water and Rivers Commission Western Australia.

Dovers S 2005. *Environment and Sustainability Policy*, The Federation Press, Sydney.

Dryzek J 1997 *The Politics of the Earth: Environmental Discourses*, Oxford University Press.

Duguid A, Barnetson J, Clifford B, Pavey C, Albrecht D, Risler J and McNellie M 2002. *Wetlands in the arid Northern Territory, A report to Environment Australia on the inventory and significance of wetlands in the arid NT*. Parks and Wildlife Commission of the Northern Territory, Alice Springs.

Eamus D and Froend R 2006. Groundwater-dependent ecosystems: the where, what and why of GDEs, *Australian Journal of Botany* 54 2, 91-96.

Eamus D, Hatton T, Cook P and Colvin C, 2006a. *Ecohydrology, vegetation function, water and resource management*. CSIRO Publishing, Collingwood, Victoria Australia.

Eamus D, Froend R, Loomes R, Hose G and Murray B 2006b. A functional methodology for determining the groundwater regime needed to maintain the health of groundwater-dependent vegetation. *Australian Journal of Botany*, 54. 97-114.

Egan JI and Williams RJ 1996. Lifeform distributions of woodland plant species along a moisture availability gradient in Australia's monsoonal tropics, *Australian Systematic Botany* ,9, 205-217.

Environment Australia Surface and Groundwater Management, Availability, Allocation and Efficiency of Use, Northern Territory Water Resources Overview
http://audit.ea.gov.au/anra/water/docs/state_overview/NT_ovpage.html

Environmental Defender's Officer NSW 2005. *Review of Northern Territory Water Law*.
www.edo.org.au

Department of Environment and Heritage. Environmental Water Allocation Prospectus and Plan, 2004/5 – 2008/9. Australian Government, Canberra.

Department of Land and Water Conservation 2002. *The New South Wales State Groundwater Dependent Ecosystems Policy*. A component policy of the New South Wales State Groundwater Policy Framework. New South Wales Government.

Department of Natural Resources. Environmental rules for aquifers. NSW Government.
www.naturalresources.nsw.gov.au

Department of Natural Resources. Environmental rules for rivers. NSW Government.
www.naturalresources.nsw.gov.au

Department Of Natural Resources. Water sharing plan for the Wandella Creek Water Source (as amended 1 July, 2004). Department of Infrastructure, Planning and Natural Resources. New South Wales Government
www.naturalresources.nsw.gov.au

Department Of Natural Resources. Water sharing plan for the Alstonville Plateau Water Sources (as amended 1 July, 2004). Department of Infrastructure, Planning and Natural Resources, New South Wales Government.
www.naturalresources.nsw.gov.au

Department Of Natural Resources. Water sharing plan for the Lower Macquarie Water Source 2003. Department of Natural Resources, New South Wales Government.
www.naturalresources.nsw.gov.au

Department of the Premier and Cabinet 2006. Western Australia Draft State Water Plan, October 2006. Government of Western Australia.

Erskine WD, Begg GW, Jolly P, Georges A, O'Grady A, Eamus D, Rea N, P Dostine, Townsend S & Padovan A 2003. *Recommended Environmental Water Requirements for the Daly River, Northern Territory, Based on Ecological, Hydrological and Biological Principles*. Supervising Scientist Report 175 National River Health Program, Environmental Flows Initiative, Technical Report 4 Environment Australia .

Evans R 2005. Double Accounting of surface water and groundwater resources – the tyranny of the time lag, Conference Paper *Outlook Conference 2005*.

Fairclough N 1995. *Critical Discourse Analysis*. Boston: Addison Wesley

Froend R H, Groom PK, Nicoski SJ and Gurner RP 2000. *Phreatophytic Vegetation and Groundwater Interactions on the Gnamagara Groundwater Mound*. A report to Water and Rivers Commission of Western Australia and the Land and Water Resources Research and Development Corporation. Edith Cowan University, Perth , Western Australia .

Froend R. H. and Zencich, S. J, 2002. Variability in vegetation groundwater use: challenges in determining vegetatio water requirements for water resource allocation and planning. Paper presented at the *International Association of Hydrogeologists Groundwater*

Conference: *Balancing the Groundwater Budget*. Vol. 1 Tuesday, Thursday Abstracts, Darwin.

FAO [Food and Agriculture Organisation of the United Nations] 2003. *Groundwater Management – the search for practical approaches*. Water Reports 25, Rome.

Georges A, Webster I, Guarino E, Thoms M, Jolley P & Doody S 2003. *Modelling dry season flows and predicting the impact of water extraction on a flagship species*. Final Report to the Northern Territory Department of Infrastructure, Planning and Environment. CRC for Freshwater Ecology and the Applied Ecology Research Group, University of Canberra.

Harrington GA, Herczeg AL and Cook PG 2001 *Groundwater sustainability and water quality in the Ti-Tree Basin, Central Australia*. CSIRO Land and Water, Technical Report 53/99 December 1999 Updated January 2001.

Harris G 2006. *Inland Water. Theme commentary prepared for the 2006 Australian State of the Environment Committee*, Department of Environment and Heritage, Canberra. www.deh.gov.au/soe/2006/commentaries/water/index/html

Hatton T and Evans R 1998. *Dependence of Ecosystems on Groundwater and its Significance to Australia*, Occasional Paper No. 12/98, Land and Water Resources Research and Development Corporation, Canberra, ACT.

Hirsch P 2006. Water governance reform and catchment management in the Mekong region, *The Journal of Environment and Development*, Vol 15, No. 2, pp 184-201.

INRM 2005. *Integrated natural resources management plan for the Northern Territory*, National Heritage Trust, Landcare Northern Territory, Northern Territory Government March 2005.

www.nt.gov.au/nreta

Kingsford RT 2000. Review: Ecological impacts of dams, water diversions and river management of floodplain wetlands in Australia. *Austral Ecology* ,25, 109-127.

Land and Water Australia 2001. *Australian Water Resources Assessment 2000. Surface water and groundwater - availability and quality*. National Land and Water Resources Audit c/o Land & Water Australia on behalf of the Commonwealth of Australia 2001

Maher M, Cooper S, and Nichols P 1999 *Australian river restoration and management criteria for the legislative framework for the twenty-first century, based on an analysis of Australia and international experience*. Report to LWRRDC: Brisbane, LWRRDC Occasional Paper No. 02.00

MacKay H 2006. Protection and management of groundwater-dependent ecosystems: emerging challenges and potential approaches for policy and management, *Australian Journal of Botany*, 54, 231-237.

McEwen K and Leaney F 1996. *Using the natural abundance composition of stable isotopes in sapwater, groundwater and soilwater to estimate water use by pine plantations near Mt Gambier, South Australia*. Consultancy Report No. 96-34, CSIRO Division of Water Resources, Adelaide.

McKay J 2006. Groundwater as the Cinderella of Water Laws, Policies and Institutions in Australia. Paper delivered at *International Symposium on Groundwater Sustainability*, Alicante, Spain, January 2006.

Medda F and Nijkamp P 2003. A combinatorial assessment methodology for complex policy analysis. *Integrated Assessment*, vol. 4, no. 3, 214-229.

Millar I 2006. *Testing the waters: legal challenges to water sharing plans in NSW*, Environmental Defender's Office New South Wales Ltd. Speeches and papers.
www.edo.org.au

NCC [National Competition Council] 2004. Assessment of governments' progress in implementing the National Competition Policy and Related Reforms 2004:Volume 2: Water. *Appendix B. Allocating water to the environment*. www.ncc.gov.au

New South Wales Water Management Act 2000. New South Wales Government.
www.naturalresources.nsw.gov.au.

National Groundwater Committee 2000. Reporting Jurisdictional Progress on Groundwater Reforms. Prepared by Salient Solutions Australia Pty Ltd. Department of the Environment and Heritage, Canberra.

National Groundwater Committee 2003. *Impacts of land use change on groundwater resources*. Issue Paper 3. Department of the Environment and Heritage, Canberra.

National Groundwater Committee 2004. *Improved Management and Protection of Groundwater Dependent Ecosystems*. Issue Paper 2, Department of the Environment and Heritage, Canberra.

National Groundwater Committee May 2004. *Knowledge gaps for groundwater reforms*. A strategic directions paper for water researchers, based on the outcomes of a national workshop held in Canberra 12 – 13 November 2003 hosted by the National Groundwater Committee.

National Groundwater Committee 2004. *Integrated Groundwater – Surface Water Management*. Issue Paper 1. Department of the Environment and Heritage, Canberra.

National Land and Water Resources Audit, Commonwealth of Australia, 2000 Report
http://audit.ea.gov.au/anra/water/water_frame.cfm?region_type=AUS®ion_code=NT

New South Wales Government NSW State Water Outcomes Plan.
www.naturalresources.nsw.gov.au.

NESD [National Strategy for Ecologically Sustainable Development] 1992. Ecologically Sustainable Development Steering Committee, December 1992

NSW SOE 2006. New South Wales State of the Environment 2006. Chapter 5 Water. Department of Environment and Conservation 2006.
www.environment.nsw.gov.au

Nevill J 2003. Managing the cumulative effects of incremental developments in the water resource industry *Environmental and Planning Law Journal*, vol.20, no.2, pp 85-94.

NRETA [Department of Natural Resources, Environment and the Arts] 2005. *Alice Springs Water Resource Strategy*, Northern Territory Government.
www.nt.gov.au/nreta

NWI [National Water Initiative] 2004. Intergovernmental Agreement on a National Water Initiative. Australian Government, Canberra.

North Adelaide and Barossa Catchment Water Management Board. Barossa Water Allocation Plan Review.

Northern Territory Water Act 1992. Northern Territory Government.

O'Grady A, Eamus D, Cook P, Lamontagne S, Kelley G and Hutley L 2002. Tree water use and sources of transpired water in riparian vegetation along the Daly River, Northern Territory,

O'Grady AP, Eamus D. Cook PG and Lamontagne S 2006. Groundwater use by riparian vegetation in the wet-dry tropics of northern Australia. *Australian Journal of Botany*, 54, 145-154.

Ord River Scientific Panel, 2000. *Recommendations for Estimation of Interim Ecological Water Requirements for the Ord River*, June 2000. Report to the Water and Rivers Commission,

Papadakis E. and Grant R 2002. Feedback to participants in the study on environmental policy in Queensland, December. State of Queensland, Department of Natural Resources and Water.

www.mrm.qld.gov.au/about/policy/documents/2037/page_3_1.html

Queensland Government 2000. Queensland Water Act 2000

Queensland Water Plan 2005 – 2010, Queensland Government

Queensland Government 2003. Water Resource (Moonie) Plan 2003. Natural Resources and Water. www.nwr.qld.gov.au/wrp/index/html.

Queensland Government 2006. Moonie Resource Operations Plan 2006. www.nwr.qld.gov.au/wrp/index/html.

Queensland Government 2006. Consultation Draft of the Water Resource (Mitchell) Plan 2006. www.nwr.qld.gov.au/wrp/index/html.

Queensland Government 2006. Consultation Draft of the Water Resource (Gulf) Plan 2006. www.nwr.qld.gov.au/wrp/index/html.

Rea N, Dostine P, Cook S, Webster I and Williams D 2003. *Environmental Water Requirements of Vallisneria nana in the Daly River, Northern Territory*. Department of the Environment and Heritage.

Roberts J, Young B. and Marston F 2000. *Estimating the water requirements for plants of floodplain wetlands a guide*. Occasional Paper No. 04/00 Land and Water Resources Research and Development Corporation, Canberra.

Russell-Smith JJ 1993. Monsoon Forest pp. 23-34 in J. Brock 2001. *Native Plants of Northern Australia*, Reed New Holland, Sydney.

Schofield N, Burt A and Connell D, 2003. *Environmental water allocation: principles, policies and practices*, Land and Water Australia, Canberra, ACT.

Sinclair Knight Merz Pty Ltd 2001. *Environmental Water Requirements of Groundwater Dependent Ecosystems*, Technical Report Number 2, Environment Australia, Canberra ACT.

Sinclair Knight Merz Pty Ltd 2006. *Towards a national framework for managing the impacts of groundwater and surface water interaction in Australia*, Malvern, Victoria, Australia.

South Australian Government 1997. Water Resources Act 1997

South Australian Government 2006. State Natural Resource Management Plan

South Australian Government 2004. Natural Resource Management Act 2004

South East Catchment Water Management Board 2001. Water Allocation Plan for the Naracoorte Ranges Prescribed Wells Area.

Taylor JA and Tulloch D 1985. Rainfall in the wet-dry tropics: extreme events at Darwin and similarities between years during the period 1870 to 1983, *Australian Journal of Ecology*, 10. 281-295.

UNESCO 1997, Thessaloniki Declaration – *Educating for a Sustainable Future: a transdisciplinary vision for concerted action*
<http://www.unesco.org/education/esd/english/international/thesdecl.shtml>

URS 2006, *McArthur River Mine Open Cut Project Public Environmental Report*,
www.nt.gov.au/nreta/environment/assessment/register/mcarthur/index.html

Van Steenberg F 2001. Local governance in groundwater systems, www.metameta.nl

Vazquez J Feas 2003. A methodology for policy analysis in water resources management, Paper to *European Summer School Political Economy of the Environment*.

WA State Water Plan Draft Water Policy Framework Discussion Paper

Walker KJ ed. 1992 *Conclusion: the politics of environmental policy*, in Walker KJ ed *Australian Environmental Policy: Ten Case Studies*, Sydney, UNSW Press.

Water and Rivers Commission 2002. *Managing the Water Resources in the Jurien Groundwater Area, WA, Interim Allocation Strategy*, January 2002. Resource Allocation Branch of the Resource Management Division, Western Australia.

Water and Rivers Commission 2005. *Local Area Management Plan for the Groundwater Resource of the Kemerton Subareas*, Department of Water, Western Australia.

Water and Rivers Commission 2005. *Draft Esperance Groundwater Area Water Management Plan*. Department of Environment, Western Australia.

Western Australian Government. *Rights in Water and Irrigation Act 1914*.

Western Australian Government. *Environmental Protection Act 1986*.

Appendix 1: List of policy documents

Appendix 1 provides a list of the documents consulted for evidence of environmental water provision policy from New South Wales, Northern Territory, Queensland, South Australia and Western Australia.

New South Wales

NSW Water Management Act 2000

State Water Outcomes Management Plan

State Groundwater Dependent Ecosystems Policy

Water Sharing Plan for the Wandella Creek Water Source (as amended 1 July, 2004, Department of Infrastructure, Planning and Natural Resources

Water Sharing Plan for Alstonville Plateau Groundwater Sources, (as amended 1 July, 2004, Department of Infrastructure, Planning and Natural Resources

Water Sharing Plan for the Lower Macquarie Groundwater Sources 2003

Department of Natural Resources

<http://www.dnr.nsw.gov.au/water/index.shtml>

Northern Territory

NT Water Act

Department of Infrastructure Planning and Environment, (2002. Titree Region Water Resource Strategy, Northern Territory Government

Department of Natural Resources, Environment and the Arts,(2005. Alice Springs Water Resource Strategy, Northern Territory Government.

Integrated natural resources management plan for the Northern Territory, NHT, LCNT, NT Gov, March 2005

<http://www.nt.gov.au/nreta>

Queensland

Water Act 2000

Queensland Water Plan 2005–2010, August 2005, Queensland Government

Understanding Water Resource Planning

Water Resource (Moonie Plan 2003

Moonie Resource Operations Plan 2006

Consultation Draft of the Water Resource (Mitchell Plan 2006

Consultation Draft Water Resource (Gulf Plan 2006

<http://www.nrw.qld.gov.au/wrp/index.html>

South Australia

Natural Resource Management Act 2004

Water Resources Act 1997

State Natural Resource Management Plan

Barossa Water Allocation Plan Review, North Adelaide and Barossa Catchment Water Management Board

SE Catchment Water Management Board, Water Allocation Plan for the Naracoorte Ranges Prescribed Wells Area, Water Resources Act 1997

Arid Areas Catchment Water Management Board, Overview to the Catchment Water Management Plan Draft, South Australia Arid Lands Region, June 2005

Water Allocation Plan for the Far North Prescribed Wells Area, prepared for the South Australian Arid Lands Regional Natural Resources Management Board, Arid Areas Catchment Management Board, June 2006.

<http://www.dwlbc.sa.gov.au/water/index.html>

Western Australia

Rights in Water and Irrigation Act 1914

Environmental Protection Act 1986

WA State Water Strategy

Water Policy Framework Discussion Paper

WA Draft State Water Plan, October 2006, Government of Western Australia, Department of the Premier and Cabinet, 2006.

Policy on Environmental Water Provision (no. 5 2000)

Local Area Management Plan for the Groundwater Resource of the Kemerton Subareas, Department of Water (Water and Rivers Commission, December 2005, Western Australia Water and Rivers Commission 2005, Draft Esperance Groundwater Area Water Management Plan, Department of Environment, Western Australia

Water and Rivers Commission, Managing the Water Resources in the Jurien Groundwater Area, WA – Interim Allocation Strategy, Jan 2002. Resource Allocation Branch of the Resource Management Division

<http://portal.water.wa.gov.au/portal/page/portal/dow>

Appendix 2

Descriptive Summaries of environmental water provision policy as presented in Legislation, Policy Documents and Plans for New South Wales, Northern Territory Queensland, South Australia and Western Australia

2.1 *New South Wales*

2.1.1 Legislation

The NSW Water Management Act 2000 was developed after the COAG (1994 agreement, and then amended in 2004 in line with NWI (2004). Its Objects in Chapter 1 place principles of ecologically sustainable development first, protection of water sources, associated ecosystems second and social and economic benefits third. Social and economic benefits also include environmental benefits. Remaining Objects relate to partnerships with the community, the equitable share of water, integrated management of water with other aspects of the environment, sharing of responsibility and the encouragement of best practice in management and use of water.

Chapter 2, Division 1, Part 5 identifies water management principles to apply in specific contexts. Contexts named are general, water sharing, water use, drainage and flood plain management, controlled activities and aquifer interference activities. Significantly the general section specifically lists protection and restoration of water sources, associated ecosystems and habitats before listing social and economic benefits. It also includes specific recognition of cumulative impacts and of the need for adaptive management. Principles relating to water sharing firstly reiterate protection of water sources and their dependent ecosystems, before secondly protecting landholder rights. All other sharing principles are subject to the provisions of these first two. Principles relating to aquifer interference activities describe activities to be avoided, including those which result in decline of native vegetation.

Water dependent ecosystems are named in Division 2, Part 7, Classification of water sources. The criteria of risk, stress and conservation value are to be used for classification, for both the water source itself and its dependent ecosystems.

Division 2, Part 8 concerns Environmental Water. Two types of environmental water are defined: planned and adaptive. Water is planned environmental water if it is committed under a management plan. Adaptive environmental water is committed under access

licences. Management plans are required to contain provision for identification, establishment and maintenance of planned environmental water, and for adaptive environmental water. These provisions together are termed environmental water rules. Environmental water rules do not need to specify that a minimum quantity of water be present in the water source at all times

Sections 8a, 8b and 8c refer to planned and adaptive environmental water respectively.

The Act is administered through the State Water Management Outcomes Plan. It is important to note that not all provisions of this Act have yet been implemented. The Act is largely implemented by the Department of Natural Resources through water management areas, which each have management committee and must prepare management plans. Public consultation is required in the development of management plans. Chapter 2 Division 2 Part 17 requires that management plans be consistent with other instruments. Plans must be approved by the Minister, and Division 9 Part 45 allows the Minister to amend or repeal a Water Management Plan. From July 1 2004, further provisions of this Act were implemented to allow new water sharing arrangements. Thirteen catchment management authorities were established to evaluate water sharing plans and catchment allocation plans. Catchment management authorities estimate environmental water, for allocation to environmental water trust funds for adaptive environmental water.

The State Water Outcomes Management Plan describes in detail the targets for water management, including water quality and river flow objectives and environmental outcomes with clear five-year targets for environmental management.

2.1.2 Policy Documents

In 2002 the NSW government approved a State Groundwater Dependent Ecosystems Policy. Its Introduction considers water in the whole environment, including the hyporheic zone, terrestrial vegetation, variations in dependency and the effect of extraction on variability of availability of groundwater. This policy is to be implemented through Water Management Committees and Groundwater Management Committees. Five principles are described. Firstly, the values of GDEs should be identified so that their protection can be considered on balance with other demands for groundwater. Identification is to take place through a Rapid Assessment Process. Secondly groundwater extractions should be within sustainable yield. In the absence of known threshold values a default value of 70% of long term annual recharge is set as sustainable yield, with 30% of groundwater allocated for the environment (p.22 Thirdly, known GDEs and especially those under threat have priority.

Fourthly, in acknowledgement of the limited scientific understanding of GDEs the precautionary principle is to apply and management is to be adaptive. Fifthly, impacts on GDEs should be minimised through following prescribed processes for groundwater allocation and using Environmental Impact Assessment processes.

Reference to this policy is not included in a listing of water for the environment, which refers to aquatic systems, the Murray Darling Basin, environmental rules for rivers, environmental rules for aquifers, wetlands, estuaries and environmental monitoring. Environmental rules for aquifers are developed by each region in response to their specific circumstances and are stated in the Water Sharing Plans. Environmental rules for rivers are determined from 12 objectives for river flows which were endorsed by the NSW government in 1999. Actual rules in Water Sharing Plans are determined by the specific objectives prioritised for each river valley by control authorities.

2.1.3 Plans

Water Sharing Plans are for a period of 10 years, with review after five years. Over thirty plans have been introduced, dealing with regulated and unregulated surface water systems. Some of these plans include groundwater management. The visions in these plans include consideration for ecosystems, however the priority given to water dependent ecosystems in the plans varies. While each plan establishes rules for environmental water allocation, actual planned water allocations have not been made for all plans at this stage (eg. *Water Sharing Plan for Wandella Creek Water Source*, *Water Sharing Plan for Alstonville Plateau Groundwater Sources*). Other plans include allocations and clearly foreshadow an increase in planned environmental water in the next implementation period without excluding the possibility of changes in planned environmental water allocations in response to further studies (*Water Sharing Plan for the Lower Macquarie Groundwater Sources 2003, Section 18, Note*).

Macro water plans are being prepared which apply to a number of water sources, especially unregulated rivers and groundwater across catchments or different types of aquifers.

2.2 Northern Territory

2.2.1 Legislation

The Northern Territory Water Act 1992 as amended at January 2004 'provides for the investigation, allocation, use, control, protection, management and administration of water resources, and for related purposes'. Beneficial uses of water were inserted in its most recent amendments in 2003.

Part 1 of the Act contains title, commencement, repeal and interpretation, which includes definitions. Environment is defined as 'all aspects of the surroundings of man, including the physical, biological, economic, cultural and social aspects'. Environmental harm is defined as 'harm, adverse affect or potential to environment' and can occur in the two categories of material and serious, depending upon whether prevention, loss or rehabilitation as a result of harm costs less than or more than \$50,000. Damage to aspects of environment of high conservation value, special significance or that is irreversible is classified as serious. Interpretation (3 designates beneficial uses, which are agriculture, aquaculture, public water supply, environment, cultural, industry and rural stock and domestic. The beneficial uses of water for environment are 'to provide water to maintain the health of aquatic ecosystems'. Section 4 gives the Minister power to declare a waterway. Section 5 exempts interference with or pollution of waterways in the course of mining or petroleum activity.

Part 2 of the Act vests all rights in water to the Northern Territory with public right to take for domestic and stock use. Owners or occupiers of land may take water for domestic, stock or garden purposes from contacting waterways or groundwater (subject to further provisions relating to pollution, waste, deterioration, inequitable distribution, loss, wastage or depletion and interference with drainage). Water extraction licenses are required for other uses of surface and groundwater.

Part 3 concerning Administration gives the Minister the authority to appoint the Controller of Water Resources, declare Water Control districts, declare the beneficial uses of water in a water control district and declare a water allocation plan. Section 22b point 5 (a states that, an allocation to the environment under a water allocation plan is to ensure in the water control district that water is allocated within the estimated sustainable yield to beneficial uses). Sustainable yield is not defined in this Act.

The Act gives extensive authority to the Controller of Water. Water Advisory Committees may be appointed by the Minister to advise the Controller. The Minister may establish a Water Resources Review Panel.

Further provisions of the act relate to water investigation, surface water, groundwater, water quality, development of water resources, fees and charges.

2.2.2 Policy Documents

Documents relating to water are the Integrated Natural Resource Management Plan (INRM, 2005), the Consultation Draft for the Alice Springs Water Strategy (DNRETA, 2006) and the Ti-Tree Water Resource Strategy (DNRETA, 2006). The Ti-Tree Water Resource Strategy is the only document with statutory authority.

The INRM, overseen by a Natural Resource Management Board, outlines an integrated approach to natural resources, of which inland waters is one of its five assets (p. 1). The plan has three guiding principles: the promotion and support for ecologically sustainable development, application of the precautionary principle, and promotion and support for adaptive management (p. 2). Further guiding concepts are prevention rather than rehabilitation, valuing local as well as scientific knowledge, maintaining healthy communities, investment in sustainable enterprise and local economies, finding new collaborative approaches, recognition of customary as well as production economies and integrated approaches (pp. 2-3). Three types of targets are required in natural resource management plans: aspiration, resource condition and management actions, ranging from short to long time frames respectively (p. 4).

National natural resource management targets are also acknowledged, ten matters for target are identified, and management actions are required relating to the identification and protection of critical assets, the development and implementation of water allocation plans, and the adoption of improved land and water management practices (p.8).

A chapter on inland waters describes the asset and its values, identifies a range of issues and threats, current management responses, resource condition targets and management action targets. Lack of baseline knowledge and research on environmental water requirements for rivers, groundwater systems and wetlands is acknowledged (p. 53). Altered hydrological regimes are recognised as a threat to water-dependent ecosystems (p. 54). The first resource condition target for 2020 is that water resources will maintain aquatic biodiversity, sustain water-dependent ecosystems, and support enterprise and domestic

use requirements (p. 56). Management action targets for 2008 include targeted research and monitoring programs, the determination of environmental water requirements for all wetlands of national significance and for surface and groundwater resources within each Water Control District, reporting on changes in water dependent ecosystems in five catchments that are subject to increasing development pressure and modeling of biophysical responses to groundwater extraction (p. 57). For 2008 it is planned to establish a cross-sectoral, community inclusive forum to recommend that planning, policy and management for inland waters adheres to NSESD principles (p. 60). The development or finalisation of water allocation plans for Alice Springs, Darwin, Gove, Katherine, Tennant Creek and Ti-Tree regions and prioritization of other regions is a 2009 target, as is the implementation of water allocation plans for all Water Control Districts (p. 58).

The Consultation Draft of the Alice Springs Water Resource Strategy 2005-2015 provides information on water management policies in the Northern Territory. It adopts the National Groundwater Committee definition of sustainable yield as 'The groundwater extraction regime, measured over a specified planning timeframe, that allows acceptable levels of stress and protects dependent economic, social, and environmental values'. In interpreting this definition, which includes the benchmark of allowing 'acceptable levels of stress', it explicitly recognises the trade-off between environmental, social and economic needs for water, and acknowledges that groundwater extraction may lead to 'some depletion' (p. 8) For the arid zone, allocations for environmental water are 95% of river flow and for aquifers no more than 80% of total storage over 100 years. Both of these allocations are contingent upon the state of scientific knowledge, which is absent in relation to environmental water requirements in this zone (p. 9). The strategy acknowledges the importance of GDEs in the arid zone, and the need to identify, map, quantify and assess their water requirements in order to provide a water allocation for them.

Alice Springs relies almost totally on groundwater from a number of aquifers for its water supply. Environmental allocations vary across aquifers from 0% to 70%.

In preparation of the Alice Springs Water Strategy, information has been provided to the community and a range of opportunities for community input have been available.

2.2.3 Plans

The first water allocation plan in the NT is the Ti-Tree Region Water Resource Strategy (NRETA, 2002). The region is entirely dependent upon groundwater for social and economic uses. No environmental allocations of groundwater were included as there is no

current knowledge of ecosystems reliant on shallow groundwater aquifers (p.10. 95% of river and wetland water is allocated for environmental use. Environmental water requirements were to be determined by 2003.

No statement about environmental water requirements in the northern zone is available via NT government internet sites. A report (Sinclair Knight Merz Pty Ltd, 2006, pp. 17, 83) states that the NT guidelines for the protection of GDEs in the northern zone are 80% of river flow at any time and any part of a river is allocated to the environment, with no more than 20% of flow divertible. At least 80% of annual recharge of aquifers is allocated for environmental use.

2.3 Queensland

2.3.1 Legislation

Water in Queensland is governed through the Water Act 2000. Chapter 1 of the Act deals with its title, commencement, definitions and authority. Chapter 2 called 'Allocation and sustainable management' deals with its purpose (section 2), which is sustainable management and efficient use of water. Sustainable management is defined as allowing for the physical, economic and social well being of people within indefinitely sustainable limits first, and protection of biological diversity and health of natural ecosystems second. Third is its contribution to a range of economic, environmental, social functions. In this third category, points (iii) and (iv) refer to environment, through the maintenance of water quality, and protection of water sources and resources from degradation respectively. Water for economic development should be managed in accordance with the principles of ecologically sustainable development. Other functions of the Act worth noting are fair allocation, community understanding, community participation and integration with other natural resources legislation.

Subsection (3 point (d)) includes release of water into the environment as an example of consideration of water applications and destinations after source.

Section 11 provides the meaning of principles of ecologically sustainable development.

Section 210 lists criteria for deciding application for a water licence. Five of the nine criteria may require the consideration of environmental matters: (c) existing water resource plan (e) the effect on natural ecosystems, (f) the effect on water sources, (g) sustainable management policies and strategies in the applicant area and (h) strategies and policies for

the catchment. All nine criteria must be considered by the chief executive. There is no statement about how they are to be prioritised or how conflicts between criteria should be resolved. However the Act contains processes at three levels for dealing with dispute: internal review, arbitration or appeal through courts.

The Water Act 2000 provides for the formation of community reference panels to represent cultural, economic, social and environmental interests.

2.3.2 Policy documents

The Queensland Water Plan 2005–2010 sets out a Water Management Framework. It was developed in response to the NWI (2004) requirements. The framework describes catchment based water resource plans for surface and groundwater management in the state's 35 catchment areas. Strategy 1 of 7 is securing water for the environment and for users. The second of its two priority points is to secure environmental flows to protect and restore rivers.

Water Resource Plans are required to include outcomes for ecosystems. Examples given are for rivers and wetlands. Water Resource Operations Plans provide the rules to implement the water resource plan, including targets for the environment. An action within Strategy 1 is legislative protection for wild rivers. Under Strategy 5, protecting water quality, is the protection and restoration of riparian and wetland areas in Regional Natural Resource Management (NRM) Plans. Also within strategy 5 is an action for healthy waterways. Strategy 7, investing in science and technology, includes monitoring flows, and impacts on ecosystems, and assessment and mapping of wetlands.

Individual landholders may prepare and in some cases are required to prepare a Land and Water Management Plan

2.3.3 Plans

The *Consultation Draft Water Resource Plan for Mitchell River Catchment* describes outcomes which include general, (concerning human use of water), general ecological outcomes for surface and groundwater together and for groundwater, and specific ecological outcomes. Section 19 lists the matters to be taken into consideration in environmental management rules, but actual environmental water allocations are to be identified in the Resource Operations Plan, as yet unwritten.

The *Consultation Draft Water Resource (Gulf) Plan 2006* lists water to support ecosystem processes as the fifteenth and last of its general outcomes, but covers general ecosystem outcomes for surface water and groundwater comprehensively, with specific ecological outcomes relating to identified river, marine, estuarine and floodplain environments. The Resource Operations Plan has not yet been prepared. Environmental flow indicators for rivers are specified, and allocations for water sources are given. The plan does not provide an amount of water that is allocated to environment, but its accompanying summary brochure states that total water use will not exceed just over 2 percent of overall median annual discharge to the Gulf of Carpentaria.

Water Resource Plans must include outcomes for the plan area, including ecological outcomes. In the *Water Resource (Moonie) Plan 2003* Part 3, section 9, points d,e,f and h, are concerned with retaining water for the environment, achieving ecological outcomes related to river and wetland habitats, and promotion of understandings about riverine and associated systems in the basin respectively. Environmental flow indicators are set for these objectives in terms of geographical points, times and percentages of available flow.

The *Moonie Resource Operations Plan 2006* covers rivers, springs and overland flows. It includes reference to environment in the Chapter 5, section 106 requirement to collect and record information on ecological assets linked to the ecological outcomes and the biological indicators of the ecological assets.

2.4 South Australia

2.4.1 Legislation

Legislation relating to water management is covered by the *Natural Resource Management Act 2004*, a fully integrated approach which will supercede previous sectoral legislation for natural resource management (including the *Water Act 1997*).

The first object of this act is to achieve ecologically sustainable development through an integrated approach to natural resources management. Six points describe the manner in which this should be done. The first three points relate to environment: the intrinsic values of natural resources, protection for biological diversity and support for rehabilitation and restoration and protection and sustainable use, restoration or rehabilitation of land and water resources.

The second object describes how ecologically sustainable development means providing for economic, social and physical well-being of people and communities and reiterates three points relating to natural resources: sustaining their future potential, safe-guarding their life-support capacities and avoiding and mitigating adverse effects.

The third object describes principles of ecologically sustainable development. Twelve principles include long as well as short-term decision making, the precautionary principle, risk evaluation, benefit of future generations, biological diversity and ecological integrity, environmental values and costs, remediation first by those responsible, public involvement in information and public contribution to decision making. Specific interests and stakeholders are named: Aboriginal, heritage, public, private and public sectors and local government.

Section 170 includes the effect of water use on ecosystems, and requires the Minister to take into account the needs of dependent ecosystems.

2.4.2 Policy documents

The Act is implemented through the *State Natural Resource Management (NRM Plan)*. The *State Natural Resource Management Plan* restates the objects of ecologically sustainable development within an integrated system, and identifies three key outcomes of which healthy ecosystems is the first. The Plan includes statements about the condition of South Australian natural resources, its risks and targets. Water management is one of the aspects of natural resource management, together with land, biological diversity and people.

The *State Natural Resource Management Plan* plan describes a vision and four goals which integrate outcomes and risks across each aspect of management. Goal 1 ('landscape scale management that maintains healthy natural systems and is adaptive to climate change') includes amongst a large number of actions the recognition and protection of water dependent ecosystems. Amongst the strategies for each milestone there are many that relate to aspects of ecosystem health, but none specifically refer to water for environment.

Goal 2 ('Prosperous communities and industries using and managing natural resources within ecologically sustainable limits') includes implementation of the NWI (2004) through water allocation plans and refers to Appendix B for their policy guidelines. Milestones are for all water resources to be managed within ecologically sustainable limits by 2010. River Murray goals have a separate target date of 2018 and specifically include water for

environmental flows, in line with the Murray-Darling Basin Intergovernmental Agreement 2004.

Appendix B is Guidelines for water allocation and management. 28 guidelines are divided between surface water, groundwater and environmental water. The terms 'groundwater dependent ecosystems' and 'environmental flows' are not included. Specific points to note are that for surface water 25% of annual adjusted catchment yield (after impact of dam storage is the indicator of sustainable limit of use. For watercourses, cease-to-flow in refuge pools is the critical ecological level. For groundwater sustainable yield is an extraction regime not a fixed volume and will vary across resources. Domestic and stock requirements must be included in resource use. Guideline 16 promotes first ensuring environmental benefit outcomes before other uses. Guideline 17 calls for equality between environmental water requirements and environmental water provision. Guideline 20 specifies that environmental water allocation will be included in water allocation plans and effected through operational or extraction constraints and through definition as a water allocation.

The *Natural Resource Management Act 2004* is being implemented through eight NRM regions, each with a NRM Board. A NRM Council advises the Minister. NRM Groups and advisory committees are active at the regional level. NRM Boards have advertised for community involvement in the preparation of plans.

2.4.3 Plans

NRM regional plans are still being prepared. Some existing operational plans are still operating under the provisions of the previous *Water Resources Act 1997*. The plan for Naracoorte in the South East Region includes assessment of the needs of dependent ecosystems through their general identification, location in land units, an estimate of their water needs as determined from most recent 'steady state' observations at a particular time and based on historical observations, some over a 30 year period. For each land unit a description is provided of the needs of karsts, hypogean systems, wetlands, streams and phreatophytes. In each section of the plan the environmental objectives were restated. However the actual calculations of environmental water needs were not based on specific estimates for each of these ecosystems. Water available for allocation is called the Volume for Licensed Extraction (VLA). This is calculated from the Permissible Annual Volume (PAV) minus allowances for decreased recharge due to area under forest plantation, for stock and domestic use and for environment. The allowance for environment was set at 10%.

The *Water Allocation Plan for the Far North Prescribed Wells Area*, prepared by the Arid Lands Catchment Management Board, only takes into account ecosystems dependent upon underground water, as other water dependent ecosystems have not been well investigated (p.12). The plan explains protective actions for the springs of the Great Artesian Basin which include: no new wells within 5km of a spring, monitoring of spring pressure, and the requirement for an Environmental Impact Report if pressure declines or unacceptable levels of drawdown at the boundary of the 5 km exclusion zone are noted. The first objective to be met by this Plan is provision for needs of water-dependent ecosystems and the actual allocation of water is that which will not create a predicted cumulative drawdown of more than 0.5m at a distance of 5 km from a spring (p. 42).

2.5 Western Australia

2.5.1 Legislation

Current dominant legislation is the *Rights in Water and Irrigation ACT 1914*. The Act was substantially amended in 2000 to address the 1994 COAG agreement and new policy documents developed to implement amendments. New legislation is planned for introduction to Parliament in 2007/8.

The Act provides for the management of water resources and its first object has two sections, firstly relating to sustainable use and development, and secondly relating to protection of ecosystems and the environment in which water resources are situated. Object (c) fosters consultation with and participation by local communities, and (d) is to 'assist the integration of management of water resources with the management of other natural resources'.

2.5.2 Policy documents

A State Water Plan is currently under development, and a Water Policy Framework has been drafted as a Discussion Paper, to be followed by a Water Planning Framework. The *Draft Water Policy Framework Discussion Paper* will be examined here.

The *Discussion Paper* begins with a vision which foregrounds sustainable development for three broad purposes and names maintenance and enhancement of the natural environment as the first, before quality of life and economic development. This framework explicitly uses a water cycle approach to recognise all elements of the natural cycle and its human interventions. It has six objectives. The first, to plan and manage water resources

sustainably, reframes many of the elements of NWI (2004). It includes a whole of water cycle approach which recognises connectivity of surface and groundwater and mentions integration with land use planning. The second objective (to protect water resources to conserve our environment), includes planning for ecosystem benefits, protection of high value water dependent ecosystems, protection of water quality and biodiversity, transparent process for determining environmental outcomes and use of best available scientific knowledge to achieve agreed environmental outcomes. Recognition of climate change must be reflected in water allocations to environment and other uses. Identification and documentation of high value assets is seen as a first step, with responsibility for protection shared between Government and community.

Objective 3, to build knowledge and capacity through science and innovation, emphasises accounting for all surface and groundwater resources, and metering of abstractions.

Objective 5, to enhance the security and certainty of water resources, reflects one of the NWI (2004) requirements that water to meet environmental requirements have an allocation equivalent to those for consumptive use and assigns risk arising from climatic variation across all uses and the environment.

After public consultation during 2006, these objectives were retained, however their order of presentation changed, with protection of ecosystems, water quality and resources becoming Objective 4 of 7. The Water Policy Framework within the *Draft State Water Plan* changed in emphasis, with greater focus on water for consumptive use and less on environment.

Western Australia published a *Policy on Environmental Water Provisions* (No. 5) in 2000. This policy was a response to NSESD (1992) requirements and refers to the *National Principles for Provision of Water to Ecosystems* (ARMCANZ 1996). It describes the principles and processes for determining how much water is allocated for the environment when allocating and reviewing water use rights. The processes provide for identification of environmental values, approval before implementation, setting up of local committees and consultation in plan development. The 17 Guiding Principles include a low level of risk, the best scientific information, research, consultative strategies including community involvement, adaptive management and monitoring. Significant points are identification of ecological values at regional, subregional and management area levels, use of existing process to determine environmental water requirements (EWR) and environmental water provision (EWP), that EWPs are not part of a market of tradeable water rights, and that water users are responsible for efficient use of water and for minimizing ecological damage.

Where EWP's cannot meet EWR's and for environmentally significant areas there is provision for review under the *Environmental Protection Act 1986*.

The process for determining EWR's involves investigating the requirements of the most sensitive components of the ecosystem which supports the identified ecological values. The water resource system is modelled with ERW's and then with all other users in order to determine the EWP. The amount of water available for consumptive use is calculated after inclusion of EWP's. The EWP is finalised after consideration of social and consumptive demands, public review and Ministerial approval for the allocation plan.

2.5.3 Plans

Currently only four plans are publicly accessible over the internet. The *Local Area Management Plan for the Groundwater Resources of the Kemerton Subareas* identifies wetlands and terrestrial vegetation as groundwater dependent ecosystems. For wetlands the criterion for determining the EWR is level of drawdown in three categories of depth of groundwater. This is set at a maximum allowable limit which is well below the critical level for impact on terrestrial vegetation. However the amount set applies to the whole aquifer, and licensees are required to identify and determine impact of abstraction on high-value GDEs, which may have different specific requirements. The assessment of licence applications varies with the amount of water to be abstracted. All levels are subject to some environmental assessment, from the lowest requirement on the licence applicant to supply a professional environmental impact assessment, to higher requirements for a monitoring plan, an analytical model of the groundwater system and regular reporting on trends in water levels and biological condition (pp. 17 – 18).

Appendix 3

Table 1 Results of key word/phrase search for terms related to criteria for environmental water policy: legislative documents from New South Wales, Northern Territory, Queensland, South Australia and Western Australia

Key word/phrase All word forms	Frequency of occurrence				
	NSW	NT	Queensland	SA	WA
environmental water requirement	environmental water 51	0	0	0	0
environmental water provision	0	0	0	0	0
water for ecosystems	0	0	0	0	0
Ecosystems	18	1	24	18	7
water dependent ecosystems	0	0	0	0	0
groundwater dependent ecosystems	0	1 groundwater	0	5 groundwater	0
adaptive management	1	0	0	0	0
Monitoring	8	9	19 in water plans and for reporting	12	6
integrated resource management	1 integrated management	0	65 integrated especially Integrated Planning Act	2 integrated management	2 integration
Community	4	5 Indigenous communities	34 Community reference panels	17	5
Participation	0	0	2	1 involvement	1
Education	0	0	0	3	0

Key word/phrase All word forms	Frequency of occurrence				
	NSW	NT	Queensland	SA	WA
consultation	12	0	10	19	6
conflict	0	0	3 between plans	6	4
appeal	33 to Land and Environment Court	0	112	4	13