



Water Rights Arrangements in Australia and Overseas

Commission
Research Paper

© Commonwealth of Australia 2003

ISBN 1 74037 131 3

This work is subject to copyright. Apart from any use as permitted under the *Copyright Act 1968*, the work may be reproduced in whole or in part for study or training purposes, subject to the inclusion of an acknowledgment of the source. Reproduction for commercial use or sale requires prior written permission from the Department of Communications, IT and the Arts. Requests and inquiries concerning reproduction and rights should be addressed to the Commonwealth Copyright Administration, Intellectual Property Branch, Department of Communications, IT and the Arts, GPO Box 2154, Canberra ACT 2601.

This publication is available in hard copy or PDF format from the Productivity Commission website at www.pc.gov.au. If you require part or all of this publication in a different format, please contact Media and Publications (see below).

Publications Inquiries:

Media and Publications
Productivity Commission
Locked Bag 2 Collins Street East
Melbourne VIC 8003

Tel: (03) 9653 2244
Fax: (03) 9653 2303
Email: maps@pc.gov.au

General Inquiries:

Tel: (03) 9653 2100 or (02) 6240 3200

An appropriate citation for this paper is:

Productivity Commission 2003, *Water Rights Arrangements in Australia and Overseas*, Commission Research Paper, Productivity Commission, Melbourne.

The Productivity Commission

The Productivity Commission, an independent Commonwealth agency, is the Government's principal review and advisory body on microeconomic policy and regulation. It conducts public inquiries and research into a broad range of economic and social issues affecting the welfare of Australians.

The Commission's independence is underpinned by an Act of Parliament. Its processes and outputs are open to public scrutiny and are driven by concern for the wellbeing of the community as a whole.

Information on the Productivity Commission, its publications and its current work program can be found on the World Wide Web at www.pc.gov.au or by contacting Media and Publications on (03) 9653 2244.

Foreword

This study is part of the Commission's program of benchmarking the performance of economic infrastructure industries. It follows an earlier review of the arrangements for setting drinking water quality standards. The present study compares the legal, organisational and regulatory arrangements for managing water rights, against accepted best practice principles.

Governments in Australia and overseas have been undertaking significant reforms to the institutions and processes for allocating and pricing water. In Australia, change has been encouraged by the Council of Australian Governments' Water Reform Framework, motivated by the need to ensure the long-term sustainability of both the water sector and the environment.

This study reveals significant differences among the benchmarked jurisdictions in the way that water rights are defined, allocated, regulated and administered. In some jurisdictions, water rights are the personal property of water users; in others, they are vested in the State. Such differences have implications for both the management of water rights and the efficiency of resource allocation.

Research for this study was undertaken within the Economic Infrastructure Branch, under the guidance of Commissioner Neil Byron. The Commission was assisted by many organisations and individuals, both in gathering the information for the study and reviewing the findings. The Commission is grateful for the advice and assistance provided by government and industry bodies. Further feedback from readers would be welcome.

Gary Banks
Chairman

October 2003

Contents

Contents	v
Abbreviations	viii
Overview	xiii
1 Introduction	1
1.1 The study	1
1.2 Processes	5
1.3 Report structure	5
1.4 Terminology	7
2 The water sector	9
2.1 The water cycle	10
2.2 Water supplies	10
2.3 Water use	17
2.4 Water and land impacts	24
2.5 Economics of water use	30
2.6 In summary	36
3 Legal framework	39
3.1 Evolution of water law	39
3.2 Current legislative framework	44
3.3 Water rights	49
3.4 Inter-jurisdictional arrangements	64
3.5 In summary	64
Attachment 3A:	67

4	Organisations involved in the water rights system	73
4.1	Overview of organisations	73
4.2	Coordination of resource management	80
4.3	Separation of functions	83
4.4	Reporting requirements	87
4.5	Resourcing	91
4.6	In summary	91
5	Definition of water rights	93
5.1	Universality	95
5.2	Predictability of volume and enforceability	98
5.3	Certainty of title	102
5.4	Duration	104
5.5	Exclusivity	106
5.6	Detached from land title and use restrictions	111
5.7	Divisibility and transferability	112
5.8	In summary	113
	Attachment 5A:	116
6	Government involvement in water allocation	135
6.1	Acquisition programs	137
6.2	Resource plans	139
6.3	Inter-jurisdictional arrangements	140
6.4	Agencies	142
6.5	Processes	145
6.6	In summary	155
	Attachment 6A:	158
	Attachment 6B:	181
7	Administering water rights	183
7.1	Organisations	183
7.2	Functions	189
7.3	Comparisons	193
7.4	In summary	202
	Attachment 7A:	204

8	Distribution management	219
8.1	Distributors and their reporting requirements	219
8.2	Water accounting	221
8.3	Water distribution	235
8.4	In summary	242
	Attachment 8A:	244
9	Pricing	251
9.1	Pricing infrastructure services	252
9.2	Pricing conveyancy losses	260
9.3	Pricing water rights management	260
9.4	Pricing environmental third-party effects	261
9.5	In summary	263
	Attachment 9A:	265
10	Monitoring and enforcement	269
10.1	Enforcement agencies	269
10.2	Monitoring procedures	276
10.3	Enforcement procedures	288
10.4	In summary	292
	Attachment 10A:	295
A	Participants	307
	Glossary	311
	References	321

Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
ACTEW	Australian Capital Territory Electricity and Water
AF	Acre-feet
ANAO	Australian National Audit Office
AOP	Annual Operating Plan
ARMCANZ	Agriculture and Resource Ministerial Council of Australia and New Zealand
BoM	Bureau of Meteorology
BoR (US)	Bureau of Reclamation (United States)
CBDA	California Bay–Delta Authority
CES	Cooperative Extension Service
CMA	Catchment Management Agency
CNA	<i>Comisión Nacional del Agua</i> , National Water Commission (Mexico)
CNR	<i>Comisión Nacional de Riego</i> , National Irrigation Commission (Chile)
CoAG	Council of Australian Governments
CONAMA	<i>Comisión Nacional del Medio Ambiente</i> , National Commission for the Environment (Chile)
CPA	<i>Catastro Público de Aguas</i> , Public Water Cadastre (Chile)
CRP (Queensland)	Community Reference Panel
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSO	Community Service Obligation

CVPIA	<i>Central Valley Project Improvement Act 1992</i> (United States)
CWMB	Catchment Water Management Board (South Australia)
DEAT	Department of Environmental Affairs and Tourism (South Africa)
DGA	<i>Direccion General de Aguas</i> , Directorate General of Water (Chile)
DLA	Department of Local Affairs (Colorado)
DSD	Department of Social Development (South Africa)
DSE	Department of Sustainability and Environment
DIPNR	Department of Infrastructure, Planning and Natural Resources (NSW)
DWAF	Department of Water Affairs and Forestry (South Africa)
DWLBC	Department of Water, Land and Biodiversity Conservation (South Australia)
DWR	Department of Water Resources (California)
ECs	Electrical Conductivity units
EIA	Environmental Impact Assessment
EPA	Environment Protection Authority
EPA (California)	Environmental Protection Agency (California)
ESCAP (UN)	Economic and Social Commission for Asia and the Pacific (United Nations)
ESD	Ecologically Sustainable Development
ESDSC	Ecologically Sustainable Development Steering Committee
EWA	Environmental Water Allocation
F&WS	Fish and Wildlife Service (United States)
GL	Gigalitre
GPRA	<i>Government Performance Results Act 1993</i> (United States)
HIZ	High Impact Zone
HLSGW	High Level Steering Group on Water
IAC	Industries Assistance Commission

IACSEA	Independent Advisory Committee on Socio-Economic Analysis
IAG	Independent Audit Group
IBWC	International Boundary and Water Commission
IC	Industry Commission
ICM	Integrated Catchment Management
IDMP	Irrigation Drainage Management Plan
ISF	In-stream flow
LAO	Legislative Analyst's Office (California)
LIZ	Low Impact Zone
LWMP	Land and Water Management Plan
MAF	Million Acre-Feet
MDA	Murray–Darling Association
MDBA	Murray–Darling Basin Agreement
MDBC	Murray–Darling Basin Commission
MDBMC	Murray–Darling Basin Ministerial Council
ML	Megalitre
mm	millimetre
NCC	National Competition Council
NCWCD	Northern Colorado Water Conservancy District
NHT	National Heritage Trust
NLWRA	National Land and Water Resources Audit
NR&M	Department of Natural Resources and Mines (Queensland)
NRC	National Research Council Water Science and Technology Board, Committee on Western Water Management
NTUs	Nephelometric Turbidity Units
OECD	Organisation for Economic Cooperation and Development
OSE	Office of the State Engineer (Colorado)
PC	Productivity Commission
QCA	Queensland Competition Authority
RIS	Regulatory Impact Statement

ROL	Resource Operations Licence
ROP	Resource Operations Plan
RWA	Rural Water Authority
SCA	Sydney Catchment Authority
SCEH	Standing Committee on Environment and Heritage
SoI	Secretary of the Interior (United States)
SWC	Sydney Water Corporation
SWRCB	State Water Resources Control Board (California)
TER	Tax equivalent regime
UCRC	Upper Colorado River Commission
UMN	<i>Union Mundial para la Naturaleza</i> (Chile)
UN	United Nations
US	United States of America
USGS	US Geological Survey
UWA	Urban Water Authority
VICA	Valley Industry and Commerce Association (California)
WACC	Weighted Average Cost of Capital
WCB	Water Conservation Board
WAP	Water Allocation Plan (South Australia)
WEF	Water Education Foundation (California)
WMC	Water Management Committee (NSW)
WMP	Water Management Plan
WRMP	Water Resource Management Plan (ACT)
WRP	Water Resources Plan (Queensland)
WRPC	Water Resources Planning Committee
WSP	Water Sharing Plan
WUA	Water User Association (Chile)

OVERVIEW

Key points

- Governments manage water resources by issuing 'rights' (licences, allocations, entitlements) to control water use. Water rights vary enormously, within and between jurisdictions, in their duration, security, flexibility, divisibility and transferability.
- There are two basic systems used to ration the (variable) supply of water in the jurisdictions studied:
 - (a) Governments devise plans to share the volume that is available for consumption among the holders of each class of right. Water rights are defined in volumetric terms, with a statement of the probability that the nominal volume will be delivered in full in any given year.
 - (b) Governments and courts recognise historic claims to access fixed volumes of water on a strict priority basis determined by the length of time each right has been held.
- Governments generally also seek to ensure that sufficient water is available for a variety of environmental purposes.
- In jurisdictions using the 'planning' approach, governments explicitly set out to achieve a balance between the economic, social and environmental objectives of the community, despite uncertain community preferences and environmental effects.
 - Thus in the Australian jurisdictions studied, licences can be varied to obtain additional water for the environment. The timing and volume of water requested by right holders may also be varied administratively.
- In those jurisdictions with secure and tradeable permanent water rights, such as California and Colorado, agencies obtain additional water for the environment by purchasing existing rights from the current right holders; harvesting additional water; or investing in water savings programs.
- Both systems have strengths and weaknesses: in particular, the benefits of clear private rights versus the flexibility of governments to manage the resource.
- The economic, social and environmental interests of those affected by water resource management decisions are more likely to be satisfied if sound governance arrangements and processes are in place.
- Restrictions on water trading and 'exchange rate' problems can adversely affect the efficient transfer of water rights to higher valued uses.
- Subsidies and differences in the level of cost recovery in the pricing of infrastructure potentially reduce the efficiency of water trading.
- Water rights arrangements are complex, with many inter-relationships and dependencies in their provisions. It is important that care be taken in seeking to adjust any one component of a system, as there would usually be ramifications for the integrity of the system as a whole.

Overview

Why this study?

The system of defining, monitoring and enforcing the right to use water is critically important in a country like Australia, where rainfall is low or highly variable. Water rights play a pivotal role in facilitating the efficient use of water, including the ongoing transfer of water to more highly valued uses. A well-defined system of rights is also the key to achieving a balance between the economic, social and environmental interests of the nation in managing water resources.

Water is an important economic input, with irrigated agriculture contributing about one-quarter of the value of Australia's total agricultural production. However, it is widely acknowledged that the current rate of water use in some Australian river systems is not commercially or environmentally sustainable. There is also evidence that much water is not used efficiently.

Against that background, and with strong governmental support, this study was undertaken by the Commission to increase awareness of the similarities and differences in the complex water rights systems operating across Australia and overseas.

Coverage of the study

Five Australian jurisdictions that share the Murray–Darling Basin — NSW, Victoria, Queensland, South Australia and the ACT — were included in the study, along with five overseas jurisdictions — California and Colorado in the United States, Chile, Mexico and South Africa. The overseas jurisdictions have climatic and land use similarities with Australia, and have established water rights trading. A number of them also have arrangements for inter-jurisdictional sharing of water, as in Australia.

The systems studied were examined by dissecting them into their key organisational and process components. Features of those components were then compared, to highlight their relative strengths and weaknesses (see box 1).

Box 1 The approach to benchmarking in this study

A form of ‘process benchmarking’ was used for this study. In process benchmarking, aspects of organisation and process are examined and compared, to provide an informational basis for identifying potential improvements. For this study, key organisational arrangements and processes of water resource management were compared against identified best practice attributes.

A comparison of strengths and weaknesses of individual attributes of a system does not necessarily lead to clear-cut findings:

- A conclusive assessment of the best arrangement for any component of the systems compared requires trade-offs involving social and political judgements, which the Commission is not in a position to make.
- Further, it is not possible to arrive at a ‘best practice’ model of resource management by looking at individual components of the systems, because of the inter-relationships between most of the components compared.

Despite these limitations, process benchmarking can offer a structured way to simplify comparisons between very complex arrangements. The information presented in such a fashion can increase awareness of the policy options available to improve water rights arrangements. It should also facilitate informed debate on any new policy initiatives put forward.

Much of the information contained in this report was sourced from legislation and policy documents. Terminology varies considerably across jurisdictions. Consequently, terms that have literal meaning are used in this report, for ease of exposition. Some common terms are set out in box 2.

Legal frameworks

The right to the use, control and flow of water is vested in the government in all of the jurisdictions studied — and in some jurisdictions, this extends to the ownership of water itself. In most jurisdictions, individual right holders do not ‘own’ water resources as property. Rather, they acquire a right to use an amount of water at a particular time and place, and to retain the benefits of that use.

That said, in the Australian jurisdictions studied, and in Mexico and South Africa, water rights can be withdrawn or altered — without any statutory guarantee of compensation in most cases. Whether there is a common law right to compensation for confiscation or modification of a water licence, and under what circumstances, has not been settled in Australia.

Box 2 Water right systems: some key terms

Adaptive management — The process of continually reviewing and setting aside water for environmental purposes as conditions change over time, such as in the understanding of environmental needs.

Appropriation — The act of diverting water from a natural surface stream or body and applying it to a statutorily recognised ‘beneficial’ use.

Environmental flow requirements — Minimum and maximum flow targets, for certain locations, times of the year and periods.

Return flows — Water that returns to its original source after its extraction and use, mostly by irrigators and non-consumptive users.

Supply reliability exchange rates — Exchange rates to adjust for differences in the supply security of water in different locations.

Water bank — An institutional arrangement for depositing and lending water.

Water right — A legal authority to take water from a water body and to retain the benefits of its use. The nature of such rights varies greatly. They are referred to in different jurisdictions as licences, concessions, permits, access entitlements, or allocations.

In contrast, water rights cannot be withdrawn nor can the benefit derived from their use be diminished in California and Colorado, provided that the water continues to be put to beneficial use. Water rights are also permanently conferred in Chile. In these jurisdictions, the title to the water is recognised as private property that cannot be impaired by other users or the state.

Constitutional responsibilities

Many of the jurisdictions studied are moving toward an integrated approach to land and water management, in recognition that water-related outcomes cannot be achieved in isolation. This integrated approach is generally pursued through the establishment of catchment-level resource plans.

In Chile, Mexico and South Africa, the national government has primary responsibility for both water resource and environmental management. In Australia, these are mainly state government responsibilities — with the Commonwealth Government responsible only for environmental matters that are of national significance.

In the United States, the allocation of water resources is the responsibility of state governments. However, the Federal Government has wide-reaching environmental

protection responsibilities. This separation of responsibilities has been a factor in the sometimes separate management of water rights and the environment.

Classes of rights

There are many types of rights, including surface water rights (the right to access water in streams and rivers) and groundwater rights. Within these types of consumptive rights there are further classes of rights.

In all of the jurisdictions studied, water rights are available for stock watering and domestic purposes (for reasonable use at most times) to those who have direct access to water — either because of ownership of land adjacent to a stream (in the case of riparian rights) or from the ownership of overlying land (in the case of groundwater).

In most of the jurisdictions studied, water rights are classified into several priority classes. A water right confers on its holder access to a share of the water available to that class. Water rights are defined in volumetric terms, with a statement of the probability that the nominal volume will be delivered in full in any given year. Under these water sharing arrangements, some water is available to all right holders in most seasons. In the event of water shortages, low priority water right holders bear equally the shortage of water availability.

In contrast, rights (other than riparian) in California and Colorado are defined for access to a specific volume of water. Water is supplied to right holders in order of their date of appropriation — ‘first in time’ has priority — until all available water is taken. In effect, there is a large number of rights, differentiated by their priority. Under these arrangements, the initial risk of water being in short supply is borne mostly by right holders with later-dated rights.

Water resource management

Some of the key elements of water resource management in the jurisdictions studied are described in this overview and the main differences in the arrangements are summarised in table 1.

Table 1 Water rights arrangements at a glance — by jurisdiction, 2003

<i>Characteristic</i>	<i>NSW, Queensland, South Australia, ACT, South Africa</i>	<i>Victoria, Mexico</i>	<i>California, Colorado, Chile</i>
<i>Legal framework</i>			
Government power to reduce or cancel rights	Yes, compensation may not be required	Yes, compensation may not be required	No, government must purchase right
Power to limit rights after issue	Yes	Yes	No
<i>Government involvement in water resource management</i>			
Administrative re-allocation of water between uses	Yes, by adjusting consumption volumes	Yes, by adjusting consumption volumes	No, government must purchase, harvest or save water
Agency responsible	Water resources agency	Water resources agency	Environmental agency
<i>Environmental protection mechanisms</i>			
Separate allocation for the environment	No (Qld, ACT), some specific purpose (NSW, South Africa)	Some for specific purpose	Yes
Environmental flow requirements (targets)	Yes	Yes, environmental allocations (Mexico)	Yes, for environmental allocations
<i>Water rights</i>			
Classes of main consumptive rights	One or two – ‘high’ and ‘low’ security	One – ‘high’ security ^a	Many (US), two – ‘high’ and ‘eventual’ (Chile)
Rationing variable supply	Adjust volume for consumptive use	Adjust volume for consumptive use	Ration by priority of right (US). Volume adjusted (Chile)
Water received	Shares of water allocated to class of right	Shares of water allocated to class of right	Fixed volume, subject to priority of right (US). Shares allocated to class of right (Chile)
Duration of rights	Fixed (South Africa NSW), ongoing (Qld, South Aust., ACT)	Ongoing but subject to review	Perpetual (subject to ongoing beneficial use in US jurisdictions)
Terms reviewable	Yes	Yes	No
Downstream rights to return flows	No	No	Yes (except Chile)
<i>Trading</i>			
Water rights linked to a particular source	No, except South Africa	No, except Mexico	Yes
Local restrictions on trading	Yes	Yes	Yes
Adjustments for seepage and evaporative losses	No (unknown for South Africa)	No (unknown for Mexico)	Yes

^a Victorian ‘sales’ water is low priority.

The jurisdictions can be broadly categorised into three groups. Although there are similarities among the jurisdictions studied, the main defining difference is the degree of certainty of the benefits attached to water rights — that is, the duration of the right and the predictability of the volume of water received (to most right holders). Many of the differences arise because the governments of some jurisdictions — California, Colorado and Chile — do not have the power to alter water rights once they are issued.

Government involvement in water allocation

Historically, water in Australia and in many other countries was obtained by a potential user applying to a state water resources agency for a licence to extract water. Governments had the power to control water use by restricting the number of licences issued and the quantity of water that could be lawfully extracted. The issuance of licences was not always administered adequately. The most important example is that water in some systems (such as the Namoi River in NSW) has become over-allocated to consumptive uses, so that the extraction of the total licensed volume would leave little or no water for the environment or for downstream users.

In California and Colorado, rights were issued on the basis of users' appropriation of that water — provided that the act of appropriation did not impair the existing right of an existing water user. In many rivers, downstream water users appropriated the return flows of upstream water right holders. Over time, many rivers (including the Colorado River) were over-appropriated — more water rights were issued than there was water available.

Allocation between consumptive and non-consumptive uses

The over-allocation of water in most jurisdictions has resulted in efforts by governments to re-allocate or to encourage the re-allocation of water to non-consumptive (environmental) uses. In most Australian jurisdictions, planning is undertaken by the water resources agency to allocate water between consumptive and non-consumptive uses, based on an assessment of economic, social and environmental benefits and costs.

In California, Colorado and Chile, the environment is protected outside the system of rights. There is no planning to allocate water administratively. In California and Colorado, environmental agencies develop plans to identify any additional volume of water required to protect the environment, and obtain this water by purchasing water rights, harvesting additional water or investing in water savings programs. For example, US\$90 million was spent to purchase water rights to restore riverine

health and protect fish populations in the San Francisco Bay–Delta in 2001–02. In addition, environmental interest groups have purchased and donated water rights.

In NSW, Queensland, South Australia, the ACT and South Africa, additional water for the environment can be obtained by reducing the volume of water attached to existing water rights. All Australian governments have the option to purchase water rights or invest in water savings programs.

Adaptive management

An inherent problem with planning is the need to identify and weigh up the disparate interests within the community in the absence of market signals to reveal preferences. Consequently, there is community representation on advisory and decision-making bodies involved in water resource planning in most of the jurisdictions studied.

The resource management approach, such as that adopted in NSW, Queensland, South Australia, the ACT and South Africa, recognises that it is not possible to strike an efficient allocation with certainty. This approach to ‘adaptive management’ provides the water resources agency with the flexibility to address regulatory error, new scientific evidence, and changing community values. Adaptive management also has the advantage that large changes to allocations can be implemented gradually, in order to reduce adjustment costs.

Water resources are managed adaptively in all of the jurisdictions studied. However, only NSW, Queensland the ACT and South Africa make explicit provision for plans to be revised under a statutory planning cycle.

A problem with the adaptive management approach is that it can adversely affect investment and location decisions. The risk that governments may intervene in the future to reduce the water made available to right holders, or even to revoke rights, may impede investments that need to be amortised over long periods (longer than the term of the right).

In the NSW, Queensland and ACT systems, the potentially adverse effect of adaptive management on investment has been mitigated, to some extent, by locking in resource plans for a 10-year period. The NSW and Queensland Governments are not required under legislation to pay compensation if water is administratively re-allocated at the start of the next statutory planning cycle.

In California and Colorado, private investment is not affected by adaptive management because water rights are secured as legal property, and cannot be impaired without compensation — right holders sell at the value of their right.

Re-allocation by water trading

Australia's average rainfall is easily the lowest of the four continents covered in the study. Low rainfall, combined with very high evaporation rates, leads to low surface water flows and seasonal river systems. Despite Australia's low and variable rainfall, the per capita consumption of water in this country is the third highest within the OECD.

When water is in short supply, as it is in many parts of the jurisdictions studied, water trading has been encouraged as a means of efficiently re-allocating water among right holders. The trading of water rights (permanent trades) or of water flows (temporary trades) facilitates re-allocation of water from lower to higher valued uses, increasing the benefits obtained from the scarce resource.

Water trading is most effective if there are no barriers to trade and there are low transaction costs. Prices also need to be signalled in open markets or regularly tested so that right holders are in a position to assess the 'opportunity cost' of retaining their water or right — the difference between the market price of water and the cost of supply.

Other possible arrangements for re-allocating water include:

- Auctioning the right to extract a specific volume of water seasonally (auctioning of short- and long-term rights is being introduced for new rights in Queensland, the ACT and, in some instances, Chile).
- Administratively setting a price intended to reflect its scarcity value. 'Abstraction charges' (ACT) and 'drought surcharges' (Colorado) are collected from urban water users and are similar to resource rents and royalties. They signal the scarcity value of the water.

The price of a water right depends on factors such as the difference between the amount a water user is willing to pay for water and how much water users have to pay for the management of water rights and for water delivery. The price of a water right is a key determinant in the efficient allocation of water. If the prices charged for infrastructure services (for example, dams and channels) are not economically efficient, the prices of water rights will be distorted and trading will not ensure that water is allocated to society's highest valued uses.

Water for the environment

In Queensland, there are no allocations for the specific and exclusive use of water to protect and maintain the environment. In NSW, Victoria, South Australia and the ACT, there are environmental allocations to address specific environmental

concerns in addition to limits on what consumptive users can take so that environmental flow requirements can be met.

In Queensland, water allocated to consumptive uses and other non-consumptive in-stream flows is distributed to right holders in a way that also meets a river's environmental flow requirements. This approach avoids the necessity of making a separate environmental allocation.

One disadvantage of this approach is that right holders may not get water when it is specifically required, or environmental flow requirements may not always be met. Another is that changes in the use of water brought about by trading (particularly upstream) could necessitate a re-allocation of water in certain parts of river systems in the longer term.

In California, Colorado, Mexico, South Africa and Chile, a specific allocation of water is generally made to protect the environment. Generally, where allocations are made and are issued as a water right, they are potentially tradeable.

A right is issued for most environmental allocations in California and Colorado. In Australia, this is uncommon. Exceptions include the Victorian bulk entitlements, such as those for the Murray Wetlands and the Barmah–Millewa forest. These entitlements provide for any unused portion of the allocation to be temporarily traded and the revenue used to cover the cost of infrastructure services.

In most of the Australian jurisdictions studied, it is difficult to determine whether environmental flow requirements are achieved. There is limited reporting of any monitoring that takes place. This could be a significant shortcoming where the distributor provides water to users on a commercial basis.

In contrast to the Australian jurisdictions, there are agencies in the US jurisdictions studied that are dedicated solely to managing environmental allocations. For example, the Colorado Water Conservation Board has the sole authority to own, distribute and enforce Colorado's instream flow and lake level rights. It is required to report regularly on the volume of water provided for the environment.

Definition of water rights

The water rights in each of the jurisdictions studied were examined on the basis of criteria that *ideally* define efficient water rights (see box 3). However, it has to be recognised that there are trade-offs among the criteria as well as implementation issues that militate against an ability to satisfy all the criteria simultaneously.

Consumptive rights in all of the jurisdictions studied are now divisible and transferable. This promotes trading of some or all of the water available under the right on a temporary basis, or even trading of the right itself.

Universality

Universality is achieved when there is a complete and integrated management of every water source within the water rights system — including surface, groundwater and overland flows. No jurisdiction has a universal water rights system. Most jurisdictions do not integrate the management of surface and ground water sources, and few jurisdictions integrate the management of overland flows in upper catchments with surface water.

Box 3 Criteria for efficient water rights

Efficient water rights would *ideally* possess the following attributes:

- universality — all available water resources (as far as practicable) are covered by the system of rights;
- predictability of volume — users have a reasonable expectation of the volume of water that they can extract from a source;
- enforceability — the right can be protected from encroachment by others;
- certainty of title — there is legal recognition and protection of rights;
- duration — the time period over which users possess the right is specified;
- exclusivity — at the margin, the benefits and costs of possessing and exercising a water right accrue to the owner;
- detached from land title and use restrictions — the right is separate and free of any requirements to hold land or any restrictions on how the right may be exercised; and
- divisibility and transferability — the right may be sub-divided and is freely tradeable to others.

It may not always be efficient to ensure universality is achieved, because the cost of implementing the necessary controls may exceed the benefits. However, water rights could be compromised over time if a water rights system falls too far short of universality. For example, rights to surface water could lose their value if the uncontrolled growth of private dams or plantation forests diverted overland flows before reaching streams and rivers.

Predictability of volume

The management of water resources and the operation of water rights systems is complicated by the variable supply and demand of water, which is difficult to predict. This is a particular problem in Australia, because of the great year-to-year variability in rainfall.

As mentioned, in most jurisdictions, the water resources agency manages seasonal variability by adjusting the volume of water that is to be shared among right holders. In several jurisdictions, the *time* of extraction can also be delayed to satisfy both downstream consumptive demands and environmental flow requirements (maximum and minimum flows at specific times and locations).

In California and Colorado, the variability of water supply is managed by recognising prior appropriations (including for the protection of the environment) and turning on and off low priority right holders' access to water.

Enforceability

Effective and efficient enforcement is critical to any system of rights if the benefits are to be protected from encroachment. In the jurisdictions studied, monitoring and enforcement is generally undertaken by agencies with multiple and conflicting interests, potentially compromising the function.

Water right enforcement agencies do not seem to be strongly accountable for their performance. There is little reporting on compliance strategies or enforcement outcomes in all of the jurisdictions studied.

Certainty of title

The integrity of a system of rights depends on procedural fairness and sound administration that prevents rights being used for purposes other than those intended. In the US jurisdictions studied and in Chile, courts are actively involved in enforcing water rights and maintaining the integrity of the system and procedural fairness. In Australia and the other countries studied, procedural fairness is tested on a more *ad hoc* basis under administrative and common law.

In all of the jurisdictions studied, registration systems have been (or are being) introduced. Some are being modeled on the high security Torrens Title system used for land.

Duration

There is great variation across jurisdictions in the nature of the right to access water — ranging from an annual permit that can be revoked or modified, to secure ‘perpetual’ rights in California, Colorado and Chile.

As mentioned, perpetual or long-term rights improve the certainty of users’ benefits over time. Lesser terms may create disincentives for efficient investment in activities in which water is used, depending on the renewal process. However, short-term water rights allow for an adaptive management approach to the re-allocation of water for environmental purposes.

In NSW and Mexico the majority of water rights apply for a defined fixed term. The water resources agency has the option of not renewing water rights at the end of the statutory period. In Queensland, South Australia and the ACT, the majority of rights are issued as ‘ongoing rights’. There are statutory provision for them to be reviewed and modified as part of a planning process.

The long-standing bulk entitlements in Victoria are regarded as ongoing rights. The Victorian Government does have the power to change the volume of water allocated to a bulk entitlement, but only under defined circumstances.

Generally, the water resources agency that develops resource plans and acquisition programs also reviews these plans and programs. This has the potential to affect the integrity of the reviews. It is also likely to be a less transparent process than if a separate agency undertook the review.

Exclusivity

Rights have the characteristic of exclusivity if, at the margin, they limit third-party costs or benefits arising from exercising the right to a socially acceptable level. If water rights do not have this characteristic, right holders may be unaware that they are causing damage to other water users or to the environment.

One environmental third-party effect results from the over-extraction of water from water bodies. As already noted, this is addressed through the provision of environmental flows.

Another third-party effect is that arising from the change in water quality — such as the use of water in irrigation and its subsequent discharge. However, arrangements for addressing these effects — which can be environmentally significant — were not examined in this study. In all of the jurisdictions studied, these effects are addressed separately, rather than by placing conditions on consumptive rights.

In some of the jurisdictions, there are policies to introduce prices that reflect third-party environmental damage and restoration costs. For example, the Council of Australian Governments has agreed that, prior to the establishment of the new water right systems, prices should be set to signal environmental costs to water users. However, none of the Australian and overseas jurisdictions studied have introduced environmental damage charges.

Trading water and water rights

As noted, for water trading to be effective it needs to overcome a number of impediments to trade — both natural and artificial. One natural impediment is the conveyancy loss that occurs with long-distance trading. In the River Murray system, traded water rights are assigned to a new location without any adjustment for water losses between the original and new locations. The pooling of distribution losses affects decisions relating to the irrigation of crops and pastures. In contrast, right holders in California and Colorado receive water net of any losses.

Another impediment to trade is the treatment of differences in hydrological characteristics that exist between catchments and jurisdictions. In the Australian jurisdictions studied, water rights are defined in terms of the catchment or supply system into which they traded. Third-party effects on other water users are created when water rights are traded between catchments. Exchange rates are applied to the transferred water right to address those effects, but the calculation of such exchange rates is complex and currently lacks transparency.

In the overseas jurisdictions studied, a water right is permanently defined for a particular source. Third-party effects on other users do not arise when water rights are traded between supply systems, and there is no requirement to calculate and apply supply reliabilities. This suggests the possibility of water users assembling a portfolio of water rights, from different sources, with different reliabilities, rather than having all rights converted to a ‘uniform currency’ via complex exchange rate calculations.

Another possible impediment to efficient trading that exists across all the jurisdictions studied, is the limited universality of the water rights systems. Trading may be distorted, if users have opportunities to exploit other water sources, say by harvesting overland flows. This has the potential to affect the value of existing rights as well as the efficient management of the whole resource.

Other artificial barriers to water trading are common across the studied jurisdictions. These include embargoes and limits on trades from irrigation areas and from the jurisdiction. For example, in Victoria there is a 2 per cent limit on the

volume of water that can be permanently traded out of the state in any year. Similarly, no water rights may be traded outside the South Australian Renmark Irrigation Trust area.

One of the reasons given for these restrictions is that trading could lead to higher prices for water and higher infrastructure service charges to remaining users.

Restrictions placed on the volume of water traded out of some irrigation districts are a potentially serious impediment to the efficient use of water. These restrictions can limit the opportunity for existing right holders to sell water when others value it more highly, limiting the scope for efficient structural change.

There is a wide variety of transactions costs associated with water right trading. In California and Colorado, trade in water rights has been constrained by the legal notification and approval requirements that accompany the transfer of a water right. As trades in water rights must not injure the vested rights of other water right holders, and because downstream users often depend on the return flows of upstream users, there are often high transaction costs as parties negotiate to prevent, minimise or compensate for the injury to downstream right holders. Recently, some of these costs have been ameliorated with the establishment of water banks that borrow and lend water.

Finally, inefficiencies in the provision of infrastructure services, environmental flows and non-consumptive flows potentially reduce the benefits of holding water rights. Congestion in rivers and artificial channels are common in all jurisdictions and can result in economic and environmental costs — such as delays in delivery and the flooding of environmental and private land. A number of methods have been developed to prioritise access to the distribution network during congestion. In the US jurisdictions studied, priority (seniority) of the right is the basis for prioritising the timing of delivery if congestion occurs. No jurisdiction studied has sought to manage the congestion in natural and artificial channels separately from the management of water rights.

1 Introduction

Historically, water rights were administered in Australia and other countries on the basis of a patchwork of statutes and common law riparian rights. The rights that these arrangements bestowed were not always well defined. The environmental consequences of regulating rivers and taking water were rarely adequately considered. Consequently, water use in some areas has degraded the environment and water has not always been used efficiently.

In February 1994, the Council of Australian Governments (CoAG) endorsed a strategic framework for the efficient and sustainable reform of the Australian water industry. One of the key elements the framework addressed was water rights. The CoAG agreed that each member government would clearly specify rights in terms of ownership, volume, reliability, transferability and, if appropriate, quality (CoAG 1994).

In recent years, Australian governments have been implementing new systems of water rights, separating water rights from land title and recognising the need to provide water for the environment (NCC 2001a). Further, governments have sought to encourage more efficient use of water resources by trade. Irrigation accounts for around 75 per cent of the 24 000 GL of water used in Australia every year, with most of this occurring in the Murray–Darling Basin (NHT 2001a).

Water reform in Australia is proving to be complex because of the need to balance divergent economic, environmental and social objectives. There are also inter-jurisdictional implications to be resolved because water use in one area of the Murray–Darling Basin affects the quantity and quality of water available in other areas downstream.

1.1 The study

This study of water rights arrangements in Australia and other countries is part of a series of international benchmarking studies into the performance of economic infrastructure industries. It follows a similar study into the arrangements for setting drinking water standards and studies into other areas of infrastructure provision.

The report is informational. It does not contain recommendations or normative findings. The information is presented in a way that the Commission hopes will improve the precision with which water rights issues are categorised and debated.

The report may also increase awareness of the policy options available to improve water rights arrangements — which could potentially lead to more efficient and equitable use of scarce water resources and improve environmental outcomes. It should also facilitate robust informed debate when new policy initiatives are put forward.

The regimes studied were examined by dissecting the water rights arrangements in the Australian and overseas jurisdictions studied into their key elements. Features of these elements were then compared in a best practice framework to highlight their relative strengths and weaknesses. The information included in this report relates to those arrangements that exist as at May 2003.

It is not possible to identify a ‘best practice’ system of water rights arrangements by selecting the best approach to each element of the arrangements benchmarked. Given the inter-relationships between the elements, a change to any element of these complex arrangements would have to be thoroughly examined in order to evaluate whether the benefits would outweigh the costs.

Indeed, it is unlikely that there is a single best practice model of water rights arrangements. The choice of arrangements depends, to some extent, on the economic characteristics of water; the unique features of each jurisdiction, including its legal frameworks and existing organisational arrangements; and catchment hydrology within jurisdictions.

Scope

The features of the water rights arrangements studied were compared in terms of a number of attributes. These attributes relate to matters such as objectives, accountability, transparency, responsibility, measurement of social costs and benefits, cost effectiveness and consultation.

An effective rights system must cover all major sources of a resource. This is particularly the case where rights are designed to achieve sustainable use and protect the environment. For this reason, all major sources of water — surface water, groundwater and overland flows — and the rights pertaining to each source were examined.

The physical and economic characteristics of water are described to provide contextual information for the arrangements that exist in each of the jurisdictions

studied. Similarly, the legal frameworks were examined and described to provide contextual information on the statutory basis of arrangements. Each jurisdiction has its own history and legal traditions that underpin the development of its water rights law.

Arrangements

The following elements of water rights arrangements were examined in this study:

- organisational arrangements in water resource management;
- definition of water rights;
- allocation of water between competing uses by both acquisition programs and allocation plans;
- administration of water rights, including the issue of new rights, changes to existing rights, and the transfer of rights between users;
- management of water distribution for right holders, non-consumptive uses and the protection of the environment;
- pricing the infrastructure used to store and distribute water to right holders, and environmental third-party effects; and
- monitoring and enforcement of water rights and environmental allocations.

Organisational arrangements were examined because of the central role of agencies in fulfilling the functions required in respect to water rights arrangements — namely, allocation, administration, distribution, monitoring and enforcement. Some aspects of the governance arrangements of government agencies and advisory bodies were included in this discussion because of their role in facilitating the effective management of natural resources.

The nature and definition of water rights was a focus of the study because it has important implications for other elements of the water rights arrangements, and the effectiveness and efficiency of the arrangements as a whole. In particular, water rights were examined in terms of the extent to which they display properties considered conducive to efficient resource management and use.

In examining the approaches to water allocation, a particular emphasis of the study was the effectiveness of the arrangements in addressing third-party effects associated with water harvesting, extraction and distribution. The impounding and extraction of water — by affecting the flow of rivers, groundwater levels and salinity — can have third-party effects on other water users and the environment.

Third-party effects are also created from the use of water and the subsequent discharge of water contaminated with salt, fertilisers and pesticides. Water rights were generally not specified in terms of water quality. Instead, water quality is commonly addressed through a variety of instruments such as land use controls, discharge permits and voluntary best management practices. Though they are not discussed in detail, the report describes their use within each studied jurisdiction's water rights arrangements.

Processes such as the administration and enforcement of rights were also included because they are as important as the way rights are defined in many respects. Legal disputes over ownership can arise if the integrity of the rights system is undermined by ineffectual or ad hoc administration.

The integrity of water rights depends on procedural fairness being afforded and sound administration that prevents rights being used in ways and for purposes other than those intended. Enforcement is essential because water theft compromises the benefits obtained from holding a water right and environmental protection.

The pricing of infrastructure services for the storage and delivery of water, the pricing of water as a scarce resource, and the pricing of environmental third-party effects, were examined because they affect water usage and water trading.

There was a particular focus on the implications of the water rights arrangements for water trading. Trading, along with the allocation of water to consumptive use and the definition of water rights, is central to the efficiency of the arrangements as a whole. Trading can ensure that water continues to be allocated in a way that maximises the benefits of its use.

Jurisdictions

Australian jurisdictions that share the Murray–Darling Basin — NSW, Victoria, Queensland, South Australia and the ACT — were examined. Other jurisdictions were excluded for no other reason than to keep the scope of the project manageable.

Five overseas jurisdictions were also studied: namely California and Colorado in the United States, Chile, Mexico and South Africa. These jurisdictions were chosen because they have climates similar to Australia's and have established water rights for the purpose of trading.

Each overseas jurisdiction also has arrangements for sharing inter-jurisdictional waters, as there are in Australia. In the interests of manageability, only the inter-jurisdictional arrangements governing the Colorado River were examined.

1.2 Processes

The Commission consulted in Sydney, Melbourne, Brisbane and Canberra with government agencies, peak bodies and industry prior to finalising the study scope and approach. The purpose of these discussions was to ensure that the Commission addressed issues that were relevant and did not duplicate the work of others. There was widespread support for the study during these consultations.

In July and August 2002, operational issues were discussed with catchment and water authorities and irrigation companies and trusts in Barmera, Berri, Deniliquin, Mildura and Shepparton as well as in Bundaberg, Rockhampton and Emerald. These visits were conducted to ensure that the Commission had a clear understanding of how the arrangements operate in practice.

A list of all the organisations that the Commission consulted is included at appendix A.

In the course of the study, the Commission made a presentation to the Community Advisory Committee of the Murray–Darling Basin Ministerial Council on the study approach and some of the key similarities and differences of the arrangements in the jurisdictions studied. In order to ensure that all those with an interest in the study could access this information, the presentation was posted on the Commission’s Internet site.

Desk research was the principal method used for obtaining information on the relevant regulatory processes, and for comparing them against best practice attributes. Information was obtained mainly from primary sources, publications and discussions with key personnel.

Government agencies were consulted to check the factual content of the report. A forum was held in July, which provided an opportunity for industry experts to discuss the draft of the report and to check facts and interpretations.

The water rights arrangements of the jurisdictions studied are detailed in the study’s annexes, which are available from the Commission’s Internet site.

1.3 Report structure

The fresh water cycle and the nature and economic significance of the water industry is described in chapter 2. The role of water pricing, water rights and economic instruments in promoting economic efficiency and environmental

sustainability are described as background to the comparisons that follow in the report.

The evolution of water law and the current legal frameworks are described in chapter 3, along with the policy objectives that underpin current arrangements. The legal basis of water rights and resource management in each jurisdiction is described.

A broad overview of the organisations involved in establishing, administering and implementing water rights arrangements in each of the jurisdictions studied is presented in chapter 4. The governance arrangements are described and compared in terms of a number of aspects of external governance that are relevant to government agencies. More detailed comparisons of governance arrangements are included in later chapters that relate to specific water resource management functions — allocation, administration, distribution, and monitoring and enforcement (chapters 6, 7, 8, and 10).

The definition of water rights in each of the jurisdictions studied is described in chapter 5. They are then compared in terms of the attributes of ideal property rights.

The arrangements for planning and management of water resources are described in chapter 6. Current policies, acquisition program evaluation and resource management plans are described and compared on the basis of established guidelines for regulatory impact statements.

The administration of water rights is described in chapter 7. The chapter includes a comparison of the processes used to issue new rights, modify existing rights and approve temporary and permanent transfers. The comparisons are undertaken on the basis of elements of the administration process — application, consultation, assessment, decision notification, appeals, and registration.

Water distribution management processes are described in chapter 8. The processes described are the storage, release and delivery of water to right holders and the environment. The role of water distributors includes accounting for water, and ensuring that water is distributed efficiently, the environment is protected and right holders receive their water.

The pricing practices of storage and channel operators are described in chapter 9. Also included in chapter 9 are discussions of regulatory prices oversight; the pricing of water rights management; and the pricing of environmental third-party effects.

The procedures for monitoring and enforcing compliance with water rights and environmental allocations are described in chapter 10. The organisational arrangements and practices of enforcement agencies are compared. The areas of

monitoring covered are water rights, environmental allocations, and inter-jurisdictional agreements.

1.4 Terminology

There is no consistent terminology between jurisdictions used to describe water rights arrangements. Even within jurisdictions, stakeholders use different terms to describe the same concept.

The Commission has endeavoured to use consistent terminology in the report where arrangements are compared across jurisdictions. Consequently, some of the terms used will differ from those in common use in individual jurisdictions.

In choosing between terms, the term that is simplest to understand from normal English usage was used — the literal meaning. A glossary can be found at the end of this report (page 311).

2 The water sector

Water is valuable as an input into economic production and essential to sustaining life. However, using water can have detrimental effects upon the ecological health of the source from which the water is taken as well as the area to which it is applied. There can also be detrimental effects if water is denied to particular areas, such as wetlands or swamps. Where these detrimental effects occur they can be pervasive and difficult to reverse.

Rainfall and the hydrology of catchments determine the overall volume of water available. The volume of water available can vary substantially over time and by location. To improve the reliability of supply, rivers and streams are regulated using dams and weirs.

The finite nature of the resource, its variability of supply and its importance to ecological health and economic wellbeing have led governments to establish controls to the access and use of water.

The extraction of water has been controlled to ameliorate the inefficiencies that arise when individuals have unrestricted access to a natural resource. By controlling the access of water through water rights — or limits to historic rights to extract water — it is possible to ensure that access is sustainable.

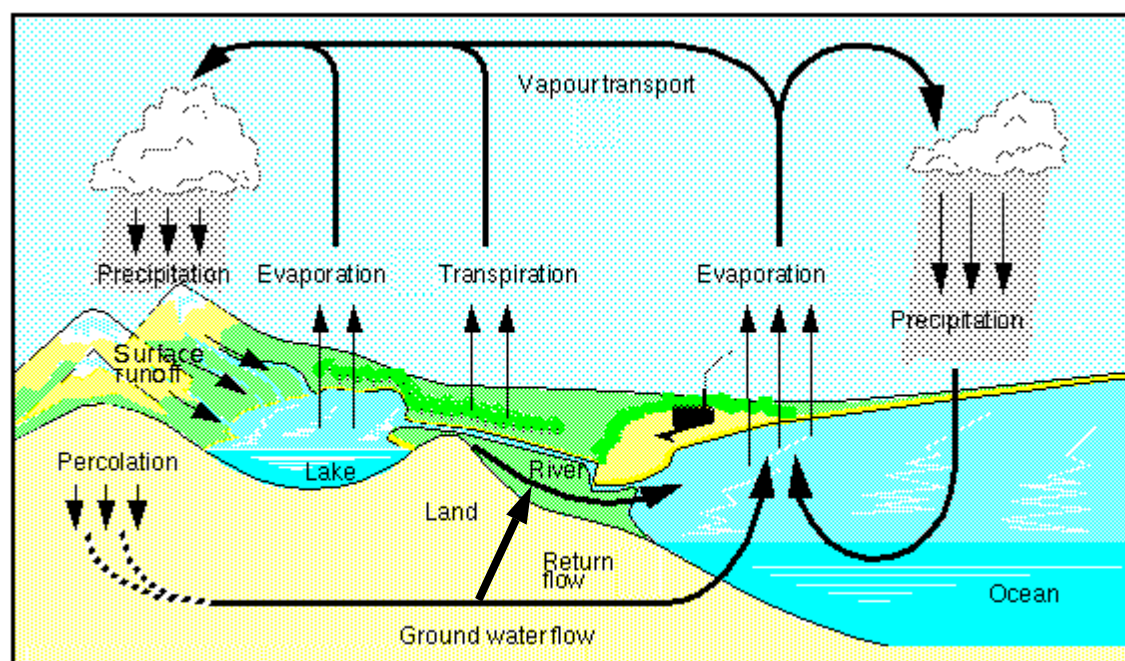
Recently, integrated catchment management and adaptive management approaches to allocating water have been adopted in Australia and other countries to plan water use and facilitate resource management. In doing so, governments have sought to balance the benefits and costs of water use by including environmental needs in planning frameworks or programs that re-allocate water amongst existing and future water right-holders.

Information is presented in this chapter as context to the water rights arrangements in the jurisdictions studied. Included is information on the nature of the resource, the characteristics of water supplies, water uses and the consequences of that use. Finally, some of the economic issues of resource management are raised that are relevant to the comparisons in later chapters.

2.1 The water cycle

The water cycle is a continuous sequence of water evaporating into the earth's atmosphere where it condenses and returns to the earth as rainfall (see figure 2.1).

Figure 2.1 The water cycle



Source: University of Washington (undated).

A particular feature of the cycle is that overland flows, surface water (water in streams and rivers) and groundwater flows can be interconnected. For example, some river water seeps through the riverbed and percolates down to become groundwater. The slower the waters flow in the river, the greater is the proportion of water that seeps into the ground.

The inter-relationships among overland flows, surface water and groundwater can make it difficult to manage water resources and predict water availability. Taking water from one source or area can affect the availability of water in other sources or areas.

2.2 Water supplies

The water cycle governs the availability of water supplies. The frequency and volume of rainfall received and the rate at which rainfall evaporates or runs off land to fill rivers and aquifers determine the volume of water that is available for use.

With variable rainfall patterns, the volume of water available for use changes over time. Also, high evaporation rates and low rates of surface runoff reduce the rate at which rivers and aquifers recharge when rainfall occurs.

Surface water supplies

Surface water supplies — water in streams and rivers — are spread unevenly across the five Australian jurisdictions (NSW, Victoria, Queensland, South Australia and the ACT), and are highly variable on an annual and seasonal basis.

Generally, the volume of surface water available in Australia:

- Declines from north to south. For example, streamflows in Queensland average around 160 000 GL per year, while in Victoria they average around 20 000 GL (NHT 2001b).
- Declines from coastal areas to inland areas. For example, streams in the west and north of Queensland cease to flow for 6 months of the year, while streams along the east coast flow all year. Similarly, in NSW, the inland rivers have lower annual flows than the rivers located along the coast (NHT 2001b).
- Fluctuates seasonally as well as annually. For example, most streams in South Australia are temporary and often flow for less than six months of the year. Similarly, in Victoria, 60 per cent of annual stream discharge occurs in 4 months of the year (NHT 2001b).

Variability in surface water supplies is also experienced in the overseas jurisdictions studied. Like Australia, these jurisdictions also have largely arid or semi-arid climates with rainfall patterns that vary annually, seasonally and geographically (see table 2.1).

The Murray–Darling Basin is the largest surface water system in Australia. It straddles five Australian jurisdictions, and is the catchment for two of Australia’s major rivers — the Darling River and the River Murray — and their many tributaries, including the Namoi, Murrumbidgee and Lachlan rivers in NSW and the Campaspe and Goulburn rivers in Victoria.

Table 2.1 Rainfall patterns, annual variability and evaporation rates — overseas jurisdictions

	<i>Rainfall patterns</i>	<i>Annual variability</i>	<i>Evaporation rates</i>
California	Receives most of its rainfall (around 75 per cent) during the summer months, and very little at other times of the year. More than 70 per cent of this rainfall occurs in the north of the State.	Rainfall is highly variable year to year, causing flooding and droughts. The El Niño and La Niña effects are partly responsible for these variable rainfall patterns.	California loses around 65 per cent of its precipitation through evaporation. Evaporation rates increase north to south.
Colorado	Rainfall is fairly consistent through the year, although it peaks between June and August.	High variability in rainfall on an annual basis.	Information not obtained.
Chile	Rainfall is heaviest in the south, at around 3000 mm per year. Annual rainfall declines from south to north with very arid conditions prevailing in the northern most regions. Virtually no rainfall occurs in this area. Receives its highest rainfall during the winter months (May to August). Rainfall during this period can be three times higher than at other times of the year.	Highly variable from year to year. For example, in 1998, rainfall in Chile in May totalled 65 mm, while in 1992, it was 115 mm. Rainfall patterns are influenced by the El Niño and La Niña effects.	Information not obtained.
Mexico	Majority of rainfall is received between June and October in the far south of the country. The northern and central areas of the central plateau are dry and arid. These areas receive on average less than 500 mm a year, compared with over 1000 mm in the south.	Rainfall is variable on an annual basis, particularly in the north of the country. The El Niño and La Niña effects result in droughts and floods.	Evaporation rates are high over most of Mexico.
South Africa	Climate varies from arid and semi-arid in the west to sub-humid along the eastern coastal areas. For example, the area around Durban receives, on average, over 800 mm a year compared with less than 200 mm west of Kimberley.	Rainfall is highly seasonal and highly variable on an annual basis. Variations in annual rainfall are more pronounced in the more arid areas, where extended droughts often occur.	Evaporation rates are very high, exceeding 1000 mm per year over much of the country. Evaporation rates increase from east to west.

Sources: DWR (1998); WEF (2000a); Western Regional Climate Center (undated); Different World (2002); CNA (2001); Tyndall Centre (2001); Basson (1997).

The Murray–Darling Basin rivers meander across flat floodplains and have low flows compared with the rivers located on the coastal plains. The basin’s mean annual runoff has been estimated to be the lowest of the world’s major river systems

(Pigram 1986). Many of the rivers naturally dry to a series of pools during dry spells, and are prone to severe flooding because of their low banks and relatively small capacity. For example, before dams were constructed, the River Murray did not supply a reliable flow of water, and during droughts, it was reduced to a chain of saline ponds (MDA 2001).

The rivers that comprise the basin provide most of the water supplies used by the inland areas of NSW, Victoria and South Australia. Use of water in the Murray–Darling Basin is extremely high, and estimates suggest that diverted use of the basin’s water resources is twice the estimated mean annual flow (NHT 2001a).

Regulating flows and diverting water

Infrastructure such as reservoirs and dams have been constructed to store water that, in Australia, is relatively plentiful during the winter and spring in the southern states or summer in the northern states, and hold it over until the summer and autumn months when demand is highest. There are:

... about 120 dams on the Murray–Darling Rivers alone, and [Australia has] the highest per person water storage of all countries. All 22 coastal drainages between Fraser Island in Queensland and Lakes Entrance in Victoria are impounded. Only a few Australian rivers remain hydrologically unaffected by human activities. There are few viable dam sites left (ABARE 1996).

Many of these reservoirs and dams have large capacities — the Hume and Dartmouth Reservoirs on the River Murray have a combined capacity of 6944 GL — to ensure a reliable supply of water in the face of annual and seasonal fluctuations.

In general, the high variability of stream discharge and the necessity to provide for long periods of low flow, coupled with the generally high rates of potential evaporation ... have required the construction of much larger storages for the purpose they serve than equivalent situations elsewhere in the world (Pigram 1986, p. 59).

The size and number of storages in Australia partly reflects the demand for adequate and reliable supply of water. Many of the inland storages were constructed primarily for irrigation purposes. Some significant examples include the Burrinjuck Dam on the Murrumbidgee River (NSW), Keepit Dam on the Namoi River (NSW), Eildon Dam on the Goulburn River (Victoria), Hume Dam on the River Murray (NSW and Victoria), Fairbairn Dam on the Nogoa River (Queensland) and the Burdekin Falls Dam near Townsville (Queensland).

Storages constructed along the coastal areas are largely used to supply the large urban and metropolitan populations situated along the coast. Examples include the

Prospect and Nepean Dams that supply Sydney and the Thompson, Yan Yean and Winneke Reservoirs supplying Melbourne.

The capacity of reservoirs and dams in the overseas jurisdictions is often substantially greater than those in Australia. For example, the Hoover Dam on the Colorado River is capable of storing around 35 000 GL — or the equivalent of two years of median Colorado River flow.

The way in which the water in reservoirs or dams is managed can affect the reliability of supply to users. Decisions about how the stored water is to be allocated can determine the variability of the volume that users receive. For example, conservative allocation that saves some of the volume to satisfy next year's requirements reduces current supply but reduces the risk that water will not be available in the next year.

In the jurisdictions studied, diversionary facilities have also been constructed to transport water from its source to its place of use.

In Australia, the largest diversionary facility is the Snowy Mountain Scheme that redirects water away from the Snowy River into the Murrumbidgee and Murray rivers (see box 2.1). In Colorado, the Colorado–Big Thompson Project diversionary scheme is capable of diverting around 380 GL of water every year from the Colorado River system.

In California, an extensive network of canals and aqueducts has been constructed to transport water from its source in the north of the state to the south where its use is concentrated. The channels of the Central Valley Project are capable of transporting 11 500 GL of water a year.

Other smaller diversionary facilities include irrigation channels and urban reticulation systems. In regulated surface water systems with a large storage facility, irrigation channels are typically situated downstream of the dam. Water released from the storage is diverted away from the surface water channel and, in some cases, transported large distances away from the river.

On some unregulated rivers (rivers where there is no large-scale dam causing large changes to river flows downstream), irrigation channels are used in much the same manner as those on regulated systems. However, in this case, the volume taken out of the river relies on the natural flow of the river for supply.

Urban reticulation systems transport water from the urban water storage facility through pipes to houses and commercial businesses.

Box 2.1 The Snowy Mountain Scheme

The Snowy Mountain Scheme has 145 kilometres of interconnected tunnels and 80 kilometres of aqueducts, which collect and divert most of the inflows to the Snowy Mountains area. On average, the scheme diverts approximately 1100 GL of Snowy River water each year westward to the Murray and Murrumbidgee valleys.

The Murray–Darling Basin Commission estimates that the Snowy Murray Diversion provides on average around 8 per cent of the flow to the River Murray. However, during dry periods, the contribution from the Snowy Mountains Scheme can volume to around 35 per cent of the total flow. Similarly, the Snowy Tumut Diversion contributes on average 25 per cent of the total flow to the Murrumbidgee River, which can increase to around 60 per cent during dry periods.

The Snowy Mountains Scheme has resulted in much of the water that would otherwise have flowed from the Snowy River to the ocean being redirected to the west of the Great Dividing Range. This has led to an increase in the inflow of water to the Murray–Darling Basin. The changes to environmental flows from the Snowy Mountains Scheme have brought about physical changes to some rivers in the Snowy Mountains region.

Source: SnowyHydro Limited (2002)

Diversionary facilities have a finite capacity and may be subject to congestion. Congestion in surface water courses and channels can create a net social cost if excluded users could have put the water to a more valuable purpose than the user that received water. However, the capital cost of increasing the facility's capacity, in order to reduce the social costs of congestion, may be prohibitive. In these circumstances, efficient rationing of the facility's capacity is required.

Congestion can also limit the extent of trading in water rights. The volume moved in response to a trade cannot exceed the capacity of the diversionary facility. Consequently, the volume traded may be limited or the movement of water in response to trading must be staggered over time.

Trading may also be prevented if river systems and diversionary facilities are not interconnected. South Africa has attempted to maximise the trading opportunities between users by constructing a series of canals and aqueducts that interconnect its river systems.

The way water is distributed in each of the jurisdictions studied is discussed in chapter 8.

Groundwater supplies

Groundwater supplies are generally less variable than surface water supplies, and evaporation rates are negligible. Once the volume of water and the recharge rate of an aquifer is known, water users can predict with a degree of certainty the volume of water that will be available to them.

Uncertainty over the volume of groundwater may only become an issue over the long-term if groundwater sources are depleted because of overuse — when the rate of extraction exceeds the rate at which an aquifer recharges.

Although Australia has one of the world's largest systems of aquifers (NHT 2001b), the potential of many of them to meet demand sustainably is quite limited. Rates of aquifer recharge are often quite low. For example, the natural rate of recharge for many of NSW's aquifers is about 0.1 per cent of the storage (Boughton undated).

Groundwater supplies form a significant proportion of total supply in four of the eight jurisdictions for which data were available (see table 2.2). There are instances in all of the jurisdictions where groundwater is the only source of supply for some townships or irrigation purposes.

Table 2.2 **Groundwater use — Australian and overseas jurisdictions**

	<i>Estimated groundwater use^a</i>	<i>Proportion of total use in jurisdiction</i>
	Gigalitres	Per cent
NSW	1008	12
Victoria	622	9
Queensland	1622	44
South Australia	419	33
ACT	5	7
California	15 500	30
Colorado	3143	16
Chile	na	na
Mexico	28 000	37
South Africa	na	na

na Not available. **Note** Australian data are for 1996–97. Data for California and Colorado are for 1995. Mexico data are for 2000. ^a Estimates because there is unlicensed use of groundwater that remains unquantified.

Sources: NHT (2001b); USGS (1999); CNA (2001).

Twenty-five per cent of the groundwater management areas located in the five Australian jurisdictions studied are over-allocated, with another 14 per cent at a

high state of development.¹ The greatest incidence of over-allocation occurs in NSW and Queensland where 40 and 34 per cent of groundwater management areas located in these two jurisdictions are over-allocated respectively (NHT 2001b).

Groundwater systems in California and Mexico also have a high rate of use. In California, groundwater use exceeds natural recharge rates by around 1600 GL per year (WEF 1998). In Mexico, over-extraction of groundwater sources in arid areas has reached critical levels (CNA 2001).

2.3 Water use

Water use can be classified as in-stream (used within a source), consumptive (not fully returned to the stream), and non-consumptive (fully returned to the stream). In-stream uses are usually non-consumptive; for example, fishing and swimming.

Water used by the electricity and gas industries for cooling can affect water quality. However, the influence on the volume of water available within a source is generally small compared with other uses.

In contrast, consumptive uses reduce the volume or quality of water available to other uses:

The water may be wholly or partially processed, contaminated or otherwise undergo transformation so as to be taken out of the resource process, at least for a period. Some of the water withdrawn in this way may be returned to the atmosphere by evapotranspiration, some may be incorporated into finished products, and some may return to the circulation system as drainage water or groundwater (Pigram 1986, p. 4).

It is difficult to make direct comparisons of water use patterns across the jurisdictions studied, because water use data are often inconsistent and unreliable. Water use data are largely estimates, because water use is not always metered. For example, in California, metered data are not always available for self-extracted use, even for water supplied through public supply systems. Also, the categories of water uses for which data are compiled are inconsistent. For example, some jurisdictions, such as those in Australia, compile water use data according to the type of crop grown, such as sugar or rice. Other jurisdictions amalgamate such data under the single category of agriculture.

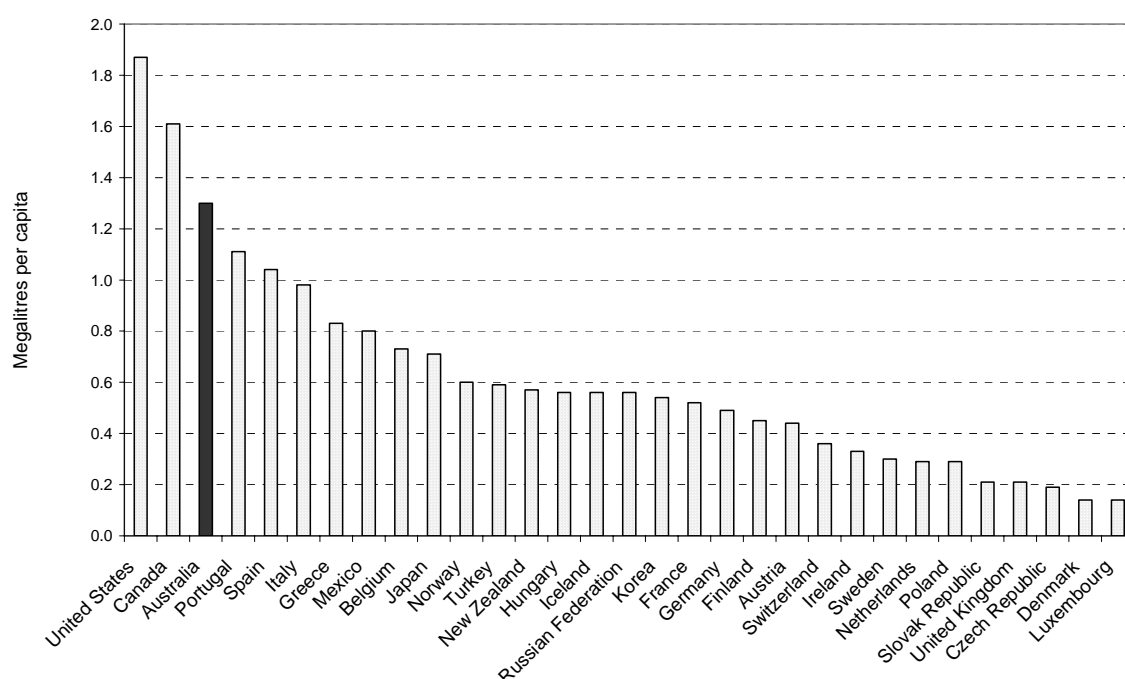
¹ Over-allocation refers to situations where the volume of water entitled to be taken from a source has reached a level where environmental damage occurs and future supplies to users are jeopardised.

Australian jurisdictions

Australia as a whole has the third-highest level of per capita water extraction in the OECD. Only the US and Canada have higher per capita water consumption (see figure 2.2).

Australia's rainfall is the lowest of the six inhabited continents. As noted in section 2.2, low rainfall combined with very high evaporation (particularly in inland Australia) leads to low surface water flows and seasonal river systems (BoM 2003).

Figure 2.2 Water extraction per capita — OECD countries, 1999



Source: OECD (2003).

In 1996–97, approximately 19 000 GL of water was used by the five Australian jurisdictions.² Approximately 75 per cent of this use occurred in NSW and Victoria (see table 2.3). The highest use on a per capita basis also occurs in those two states (see figure 2.3). Eighty two per cent of the total volume of water used by the five jurisdictions is sourced from surface water supplies.

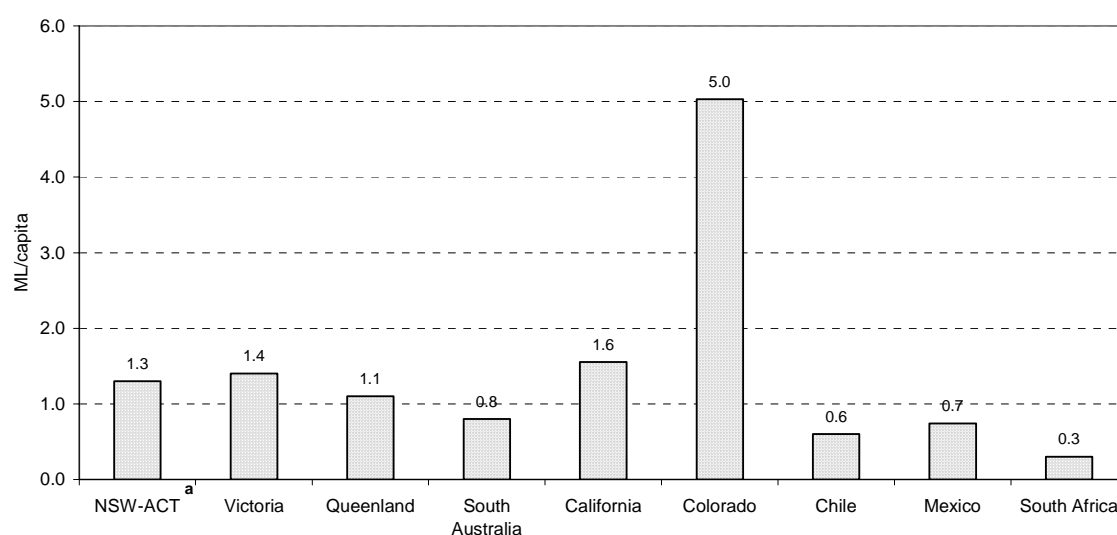
Agriculturalists are the largest users of water in the five Australian jurisdictions studied (see table 2.3). Water use under the Australian Bureau of Statistics'

² This figure excludes the in-stream use of water by the electricity and gas industries. Quoted use can often be higher than 19 000 GL because of the inclusion of in-stream uses by these industries.

category of livestock, pasture, grains and other agricultural accounted for around 44 per cent of the volume of water used in the five jurisdictions. Around 84 per cent of water use within the livestock, pasture, grains and other agricultural category occurred in NSW and Victoria.

Water use contributes significant economic and societal benefits. For example, irrigated agriculture contributed 26 per cent (or \$7 billion) of the value of total agricultural output (around \$28 billion) in 1996–97 (ABS 4610.0 (2000), p. 15).³ In 1998–99, the agricultural industry employed over 300 000 people, with on average 177 000 people employed in processing agricultural products into food, beverage and tobacco products (ABS 4613.0 (2001), p. 28).

Figure 2.3 Water use per capita — Australian and overseas jurisdictions, various years



Note Data for the Australian jurisdictions are for 1996–97. For California and Colorado, data are for 1995. Mexican and South African data are for 2000. ^a Water use data for NSW and the ACT are not available separately. The ACT accounts for around one per cent of combined use by NSW and the ACT.

Sources: ABS (*Water Account for Australia: 1993–94 to 1996–97*, Cat. No. 4610.0); USGS (1999); LAO (1996); DLA (2002); CNA (2001); Fernández and Medina (2000); DWAF (2002), p. 23; DSD (2000), p. 73.

³ These figures are for Australia as a whole. Data were not available at the jurisdictional level.

Table 2.3 **Consumptive water use — Australian jurisdictions, 1996–97**

Gigalitres											
	Livestock, pasture, grains & other agri.	Vegetables	Sugar	Fruit	Grapevines	Cotton	Rice	Electricity and gas	Household	Other	Total
NSW–ACT ^a	3405	194	0	279	242	1417	1643	23	580	385	8168
Victoria	3549	107	0	172	218	0	0	1192	419	365	6022
Queensland	725	122	1176	91	4	423	0	69	419	612	3641
South Australia	640	65	0	115	172	0	0	1	131	90	1214
Total	8319	488	1176	657	636	1840	1643	1285	1549	1452	19 045

Note Water use = mains water use + self-extracted water use. Electricity and gas is net of in-stream use of water, such as the generation of hydroelectricity. ^a The ACT accounts for around one per cent of total use in NSW and ACT.

Source: ABS (*Water Account for Australia: 1993–94 to 1996–97*, Cat. No. 4610.0).

Table 2.4 **Consumptive water use — California and Colorado, 1995**

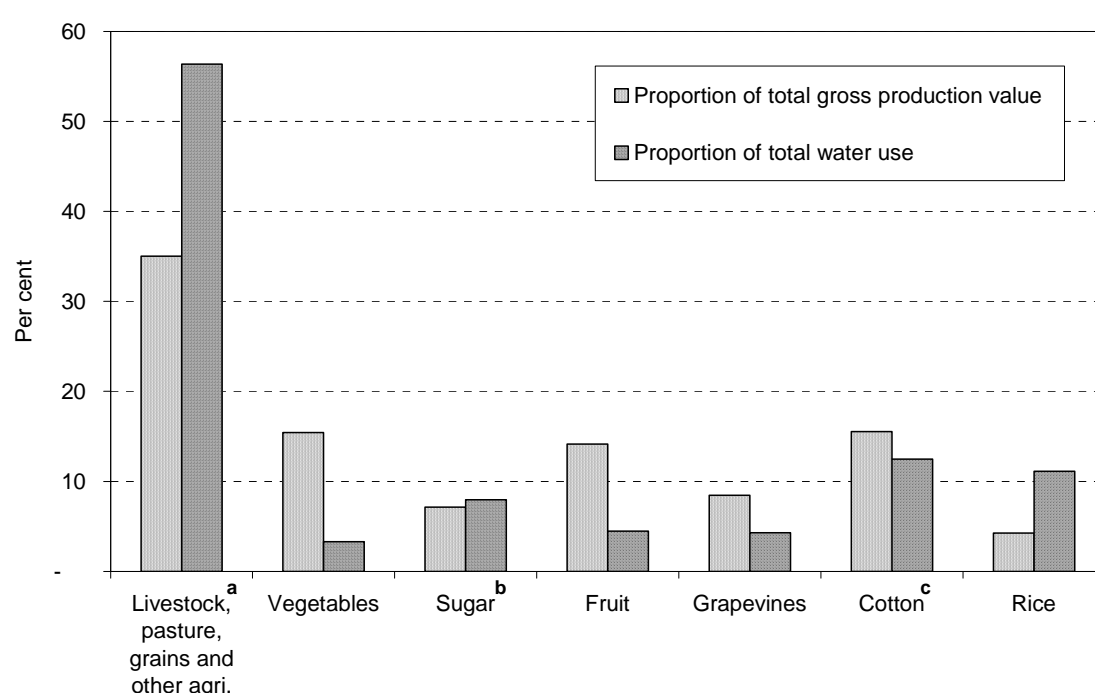
Gigalitres									
	Commercial	Domestic	Industrial	Thermo- electric generation	Mining	Livestock	Irrigation	Public supply	Total
California	1906	5293	1134	291	105	635	39 922	866	50 152
Colorado	151	702	197	177	71	82	17 596	124	19 100
Total	2057	5995	1331	468	176	716	57 518	991	69 252

Note Water use = self-extracted freshwater use + deliveries from public suppliers. Public supply is consumptive use of water by the public supply industry and equals total freshwater extracted by the public supply industry minus total water deliveries.

Source: USGS (1999).

While the irrigated livestock, pasture, grains and other agriculture sector contributed about 35 per cent of the value of irrigated agricultural output, about 55 per cent of the water available for irrigated agriculture was used to produce this output. By comparison, fruit and vegetables used about 5 per cent of water used for irrigated agriculture. However, this sector produced about 15 per cent of the value of output of irrigated agriculture (see figure 2.4).⁴

Figure 2.4 Proportion of gross production value and of total water use by the major use categories — irrigated agriculture, Australia, 1996–97



Note Gross production value is for Australia as a whole, rather than the five jurisdictions studied. Gross value of production is based upon work undertaken by Derek Poulton in 2000 for Goulburn–Murray Water. The proportion of gross production value is calculated by dividing the gross production value for each category of user by the total gross production value for the seven categories of use combined. The proportion of total use is calculated by dividing the volume of water used by each user group by the total volume used by the seven user groups combined. ^a Gross value comprises stock products from irrigated agriculture (excluding milk) (gross production value of \$148 million), milk products from irrigated agriculture (estimated gross production value of \$1259 million) and irrigated crops (estimated gross production value of \$1133 million). ^b Sugarcane used in crushing. ^c Cotton lint (includes the value of cottonseed).

Source: ABS (*Water Account for Australia: 1993–94 to 1996–97*, Cat. No. 4610.0).

⁴ Gross production values used in figure 2.4 are for Australia as a whole and not the five jurisdictions included in this study. Gross production values for the Australian Bureau of Statistics' water use categories were not available at a jurisdictional level.

The disparity between some sectors in the volume of water that they use and the contribution they make to the productive value of water highlights the importance of mechanisms such as effective trading (and instruments like water rights that facilitate trading) to re-allocate water to its highest valued use.

Data are not readily available on how water use in the five Australian jurisdictions has changed over time. A water use survey was undertaken in 1985 for the year 1983–84. However, making direct comparisons between 1983–84 and 1996–97, when the latest survey was conducted, is fraught with difficulties.

Observed differences in water use between the two years may arise because of variations in the methods employed to estimate water use within each river basin. For example, a direct comparison cannot be made for the Murray–Riverina Basin because of a change in the boundary definition of that basin (NHT 2001b). Also, metering of water use had become much more widespread by 1996–97. Therefore, changes in water use may simply reflect more accurate measurement.

Further, the seasonality and variability of the climate can complicate comparisons. As noted by the Department of Primary Industries and Energy (Commonwealth):

The above-average rains in the first half of 1983–84 greatly reduced irrigation demands, and, by mid-season, virtually unrestricted supplies of water were made available to farmers (for example, 200 per cent of water rights in the Goulburn–Murray Irrigation District). The drier conditions in the latter half of the year somewhat compensated for this, but total usage for the year was generally far less than average. Rural usage was also less than average, again due to the early wet conditions and sensitivity about excessive water use following the 1982–83 drought (NHT 2001b).

With these caveats, water use in the five jurisdictions may have increased by about 50 per cent (from around 14 000 GL) between 1983–84 and 1996–97. The greatest increase in use occurred in NSW and Queensland. Water use increased by 58 per cent in NSW (predominantly in the area of the Murrumbidgee River) and by 88 per cent in Queensland (principally in the Belyando–Suttor area on the North–East Coast of Queensland and the Border rivers area along the Queensland–NSW border) (NHT 2001b).

The MDBC has compiled data over a much longer period on water use in the Murray–Darling Basin (excluding Queensland). These data show that total annual diversions within the basin have increased from around 3000 GL per annum in 1930–31 to around 11 000 GL per annum in 1990–91 (MDBC undated(d)).

Expansion in irrigation has been the major factor contributing to the growth in water use in Australia, particularly prior to the early 1970s with development of the rice and horticulture industries, but also in the 1980s and 1990s with major expansion of the cotton industry (ABARE 1996).

Further development of water resources in the Murray–Darling Basin is restricted by the Murray–Darling Basin Cap. Under the Murray–Darling Basin Agreement (1992), the signatory jurisdictions agreed to cap their consumptive use of water from the river systems of the Murray–Darling Basin.

Different volumes are allocated to each jurisdiction under the Cap. For NSW and Victoria, the Cap is set at the volume that would have been used in 1993–94, given the water infrastructure that was in place at the time.

Overseas jurisdictions

Water use in the overseas jurisdictions displays similar patterns of use to that in Australia. In each of the overseas jurisdictions examined, irrigation and dryland agricultural activities accounted for between 60 and 92 per cent of total water use (see tables 2.4, 2.5 and 2.6). Data on water use in Chile were unavailable.

Colorado had the highest per capita consumption of all the jurisdictions studied (see figure 2.3). Colorado’s per capita consumption rate was relatively high because of its sizeable irrigation sector but relatively small population.⁵

Table 2.5 Consumptive water use — Mexico, 2000

Gigalitres

<i>Agriculture</i>	<i>Public supply^a</i>	<i>Industrial^b</i>	<i>Cattle</i>	<i>Total</i>
56 210	8291	6129	1553	72 183

^a Mains water supply. Does not include industrial or commercial connected to network. ^b Includes industrial and commercial use sourced through mains.

Source: CNA (2001), p. 46.

Table 2.6 Consumptive water use — South Africa, 2000

Gigalitres

<i>Irrigation</i>	<i>Urban</i>	<i>Rural</i>	<i>Mining and Bulk Industrial^a</i>	<i>Thermal power generation</i>	<i>Forestry</i>	<i>Total</i>
7836	3332	572	756	296	488	13 280

^a Only includes mining and bulk industrial use that is not counted as part of urban use.

Source: DWAF (2002), p. 23.

⁵ Colorado’s population level was only 10 per cent of California’s, but its use of irrigation water was 44 per cent of California’s.

2.4 Water and land impacts

Although the development and use of water resources produces economic and social benefits, it can also result in the degradation of the ecological and physical health of water sources. It can also degrade land to which the water is applied and create discharges that impact on other users (third-party effects). Frequently, the effects of using water occur at some distance from the point of extraction and years after the use occurred.

Third-party effects are pervasive, and can arise from any number of sources. The Australian High Level Steering Group on Water has suggested that third-party effects can be usefully categorised as:

- *storage and extraction* third-party effects caused by the extraction, harvesting, diversion or storage of water;
- *return* third-party effects caused by the return of contaminated water and/or wastewater to the hydrological cycle; and
- *stormwater and overland run-off* third-party effects caused by land-use practices that change the rate, volume, quality and timing of flows (HLSGW 2000).

Although these categories are useful for conceptualising the various impacts that water use can have, the interconnectedness of the hydrological cycle and its relationship to other natural resources make it difficult to classify all third-party impacts under these categories. For example, land-use practices that result in the clearing of native vegetation change the natural pattern of the hydrological cycle as more water is absorbed into groundwater systems, altering the volume and quality of return flows.

Storage and extraction effects

The storage and extraction of water disrupts the natural pattern of the water cycle and therefore affects the environment and other water users.

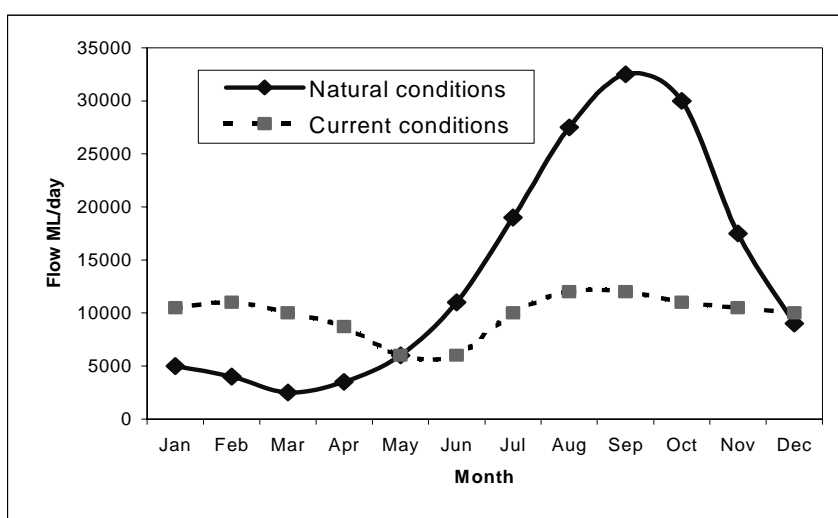
Dams alter the natural flow pattern downstream of rivers. Typically, the natural low river flows of the summer and autumn are replaced by high flows for the supply of irrigation and urban centres. For example, at the Yarrawonga Weir, downstream of the Mulwala Canal and Yarrawonga Channel — the two major irrigation off-takes — the flow of the River Murray is more evenly spread over the year than it otherwise would be under natural conditions (see figure 2.5). Similarly, the dams and reservoirs constructed along the Colorado River have delayed the natural high flow period that occurred during the spring until the summer, when downstream water demand is at its highest (WEF 2001).

Dams also cause river levels to change rapidly, both up and down. Releases are usually made intermittently in response to calls made upon the water by downstream users. In the Murray–Darling Basin, these changes in flow rates are much greater than what occurs under natural conditions (MDBC undated(d)).

The water released from storages is usually cold and de-oxygenated because it is released from the lower levels of the storage in many cases. For example, summer irrigation releases from Burrendong Dam to the Macquarie River are estimated to be at least 10 degrees colder than normal river temperatures (EPA (NSW) 2000).

The construction of dams, locks and weirs also restricts fish movement, separating some populations of aquatic organisms and creating a still-water environment. Still-water environments are generally not suited to native fish, and also favour the development of blue-green algae and other water quality problems (EPA (NSW) 2000).

Figure 2.5 **Median monthly flows — River Murray downstream of the Yarrawonga Weir**



Source: MDBC (undated(c)).

Altered river patterns have had a dramatic impact upon the natural ecology of rivers. For example, in NSW, the altered hydrology resulting from:

...physical barriers and continued development of land has degraded riverine ecosystems. For example, there has been a large decline in fish at Euston Weir, with golden perch numbers decreasing by 75 per cent and silver perch by 94 per cent in the last 50 years, at least in part due to changes in river flows. Other effects of changed hydrology include threats to biodiversity [endangering native fish and animal species, such as the Murray Cray and platypus], and the encouragement of introduced species [such as the European carp] (EPA (NSW) 2000).

Similarly, the regulation of flows along the Colorado River has:

... adversely affected native fish by causing alterations in their habitats, restricted or prevented spawning migration, provided favourable conditions for many new fish species and caused their populations to be depleted to the brink of extinction (WEF 2001, p. 3).

The consumptive use of water impacts upon the natural hydrology of rivers and reduces the volume of water available to others. For example, over two-thirds of water in Murray–Darling Basin rivers is extracted, reducing the median annual outflow to the sea to only 21 per cent of the natural median flow (MDBC undated(d)).

The frequency of severe drought flow levels will increase as a result of the diversion of such large amounts of water. In the River Murray, severe drought flow levels will increase from five per cent under natural conditions to 61 per cent under 1994 development conditions (ABARE 1996).

The consumptive use of water by one individual can also affect other in-stream and consumptive users, particularly if the taking of water remains unrestrained. In the absence of controls, high-levels of short-term use and overuse and depletion of the resource can occur.

Generally, water use is highest during the summer and autumn when crop irrigation takes place and increases in urban use also occur. As noted in section 2.2, reservoirs and dams facilitate this pattern of use by storing the water when it becomes available and releasing it when it is needed by users.

Extraction and storage effects are directly relevant to the efficient allocation of water between consumptive and non-consumptive uses. The costs stemming from these effects have to be taken into account if rights and the re-allocation of water through trade are to result in an improvement to the efficiency of water use.

The third-party effects arising from extraction and storage can be reduced by reserving water for the environment and implementing dam release schedules to return some of the natural flow of rivers.

Return effects

The use of water changes its chemical and physical properties. Returning contaminated water to the hydrological cycle reduces the quality of the water into which it is dispatched. Without treatment, contaminants can damage the environmental health of the source and can make the water unsuitable for use by downstream users. The Productivity Commission (PC 2003) recognised at least

eight dimensions of water quality: sediment and turbidity; nutrients; agricultural chemical residues; acidity/pH; salinity; BOD; and temperature.⁶

In Chile and South Africa, contaminated return flows have posed a threat to human health because the quality of drinking water has deteriorated (Fernández and Medina 2000; Schur undated).

Stormwater and overland runoff effects

Land-use practices can have dramatic impacts on the volume and quality of water sources. The clearing of native vegetation, the application of large volumes of water to naturally saline soils and poor drainage practices can all create adverse impacts upon the riverine and aquifer environment and other users.

Clearing native vegetation to create pastures and irrigation districts can produce major changes in the water cycle. Land clearing causes groundwater levels to rise, bringing to the surface salts found naturally in the soil, resulting in the visible symptoms of soil salinity.

The removal of deep-rooted native vegetation and its replacement largely by shallow-rooted annual crops and pastures has resulted in a significant reduction in water use and increased quantities being added to groundwaters. As the groundwaters rise, naturally-occurring salts ... are dissolved and brought towards the surface, where the salt is concentrated by evaporation (MDBC undated(f)).

Intensive irrigation compounds the problem by adding large volumes of water to the soils, often without adequate drainage facilities to carry away any of the excess water.

Salinity can severely damage the built and natural environment. It causes:

... sick or dying trees, declining vegetation, the appearance of salt-tolerant weed-like plants, ... salty bare patches where all of the vegetation has died, and saline pools in creek beds. As salinity impacts on any remaining native vegetation and the wildlife that depends on it for survival, the loss of biodiversity escalates. Salinity also reduces the productivity of crops and the sustainability of agriculture. ... Where there are buildings, fences, roads and other infrastructure, they can be damaged by saline soil and water. Foundations can crumble, and roads degrade, increasing the risks of accidents and causing large repair bills (CSIRO 2001).

Salinity-affected land can also cause deterioration of the quality of surface water sources. The salts dissolve in surface water run-off and increase the salt loading of

⁶ BOD is used as an index of organic pollution, including sewage. It measures the amount of dissolved oxygen (in milligrams per litre of water) that would be taken from the water through the decomposition of organic matter by microorganisms (PC 2003).

surface water sources. The problem can be compounded where natural conditions or artificial regulation of surface waters result in flow rates being inadequate to flush the salts out to sea.

Salinity has become an increasingly important problem in each of the Australian and overseas jurisdictions studied. High salinity levels affect all users — agricultural, domestic and industrial (see boxes 2.2 and 2.3).

Box 2.2 Salinity in the Murray–Darling Basin

The Murray–Darling Basin Commission’s (MDBC’s) Salinity Audit estimated current and future water salinity levels for the Murray–Darling Basin on the basis that no new management practices were introduced to control the problem. The Audit predicted very steep increases in the salinity of the rivers of the Murray–Darling Basin.

- By 2020, the salinity of the lower River Murray (as measured at Morgan) will exceed 800 ECs — the World Health Organisation’s recommended standard for desirable drinking water — 50 per cent of the time. In the next 50 to 100 years, the salinity level will exceed the recommended standard almost permanently.
- The Macquarie, Namoi and Bogan rivers will exceed 800 ECs within 20 years, and will exceed the 1500 EC threshold for irrigation crops and environmental damage within 100 years.
- The Lachlan and Castlereagh rivers will exceed 800 ECs within 50 years, while the Condamine–Balonne, Warrego and Border rivers will exceed this threshold by 2020.
- The Avoca and Loddon rivers already exceed the 800 ECs threshold, and some reaches of these rivers will face further increases in salinity.

A 1999 MDBC study of the cost impacts of salinity found that under current conditions, the cost of one EC unit increase in river salinity at Morgan in South Australia lies in the range of \$93 000 to \$142 000 per year. Already the total economic impact is estimated at \$46 million a year, and will rise further with the projected increases over the next century.

The Salinity Audit was not able to provide estimates of the extent of land salinity or how salinity might impact upon the environment because data on these areas are not well developed. However, Goss, Powell and Newman (2000) have provided some information on the salinity hazard to land within the basin. Their data show the current extent of shallow and rising watertables within the basin, and they predict that the basin will have 3 to 5 million hectares of salt-affected land in the cropping and grazing regions over the next 50 years.

Source: MDBMC (1999); Goss, Powell and Newman (2000).

Box 2.3 Salinity in the overseas jurisdictions

California

Southern California has experienced serious long-term salinity problems. Each year over 600 000 tons of salt is deposited, half of which is imported from outside water sources, such as the Colorado River. The remainder comes from local sources such as urban runoff and irrigated agriculture.

Salinity is also a major problem in the main agricultural areas in central California (the San Joaquin and Imperial Valleys). In these areas, crop irrigation is causing groundwater tables to rise, bringing natural salts present in the soils to the land surface.

Colorado

Salinity is an increasingly important problem in Colorado. Cooperative Extension Services estimated that almost one million acres (or 400 000 hectares) of land is affected by excess salts.

Chile

Salinity problems occur in the lowest areas of the valleys and in the north of the country. Although the extent of the salinity problem has not been adequately assessed, one estimate suggests that around 33 000 hectares of land has been affected.

Mexico

Between 20 and 30 per cent of the 5.5 million hectares of land irrigated in Mexico is salt-affected to some degree. In some irrigation districts, such as in the Ciudad Juarez Valley irrigation district (northern Mexico), 70 per cent of land is affected.

Soil salinity in Mexican irrigation districts is due to poor water management, including excess application of water, the use of low quality water and inappropriate or non-existent drainage systems. Along the coastal areas, winds and tides creating salty breezes up to 10 kilometres inland also cause salinity. The salt is deposited on the soil surface and is washed into surface water sources by surface runoff.

South Africa

Salinity is a threat to groundwater supplies in the eastern and southern Cape and the dry, western section of the Northern Cape and the Northern Province. Some surface water sources are also highly saline, including the Western and Eastern Cape rivers.

Source: WEF (2001); Pomento and Wolcott (2001); CES (1998); FAO (2000); UMN (2000); DEAT (1999).

Land-use practices in upper catchments can also alter the volume of water available to surface and groundwater right-holders. For example, increased urbanisation increases surface run-off, and in most cases, this run-off is redirected from natural water courses. Dryland forest plantations draw water from overland flows, preventing such flows from reaching water users downstream. These third-party

effects have implications for the organisational and other arrangements governing the management of catchments, water resources and rivers.

2.5 Economics of water use

In the absence of regulation and controls, water can be characterised as an open access resource.⁷ Water resources provide some benefits that are non-excludable. For example, a healthy river has an aesthetic and in-use benefit for which it is difficult to charge users.

These characteristics of water mean that markets may not always function effectively to ensure that the resource is used and allocated in a way that maximises the private benefits of the resource to society.

Water rights and their definition

The creation of water rights is one way that the inefficiencies that would result from open access to water resources can be ameliorated. Water rights limit the volume of water that any individual can take, and place obligations upon the individual that protect the rights of others. Water rights may also specify a range of other requirements, such as when water may be used.

In the jurisdictions studied, water rights were initially exclusive to land-holders adjoining a stream (riparian rights). Some jurisdictions later permitted individuals and companies to claim title over river waters, and those claims were eventually recognised (see chapter 3).

During the nineteenth and twentieth centuries, legislation replaced common law as the basis for defining and enforcing water rights. In many jurisdictions this resulted in the extinction of riparian rights and liabilities. In Australia, governments have asserted the right to manage and allocate water rights (see chapter 3). The processes used by each of the jurisdictions studied in administering water rights are discussed in chapter 7.

⁷ Open access resources are not owned by anyone and provide benefits that are non-excludable and feature congestion (and, at times, rivalry) in consumption. For example, benefits from accessing the resource often can be shared by many (such as aesthetic and conservation values of water), but in the presence of uncontrolled taking of water, can lead to an over-exploitation of the resource as individuals maximise their own welfare without taking into account the congestion costs imposed on others (PC 2001a).

Among other things, if water rights are to facilitate a more efficient use of a resource, rights must be well-defined and effectively enforced. Water right-holders should be reasonably able to predict the volume of water that they will receive under a right and have confidence that their right is secure from encroachment by others. If water rights are poorly defined, right-holders have little incentive to undertake complimentary long-term investment sometimes required to make best use of water.

In environments where available water supplies are unpredictable, such as in the studied jurisdictions (see section 2.2), it may not be possible to define all water rights in terms of a fixed volume of water that can be extracted. Instead, rules have been established that govern how the supplies available in any one year will be allocated to the rights on issue.

Most of the jurisdictions studied have dealt with the variability of water supplies by specifying rights as a share of the available resource or by allocating water according to a pre-determined priority ordering.

The definition and enforcement of rights in the studied jurisdictions are discussed in chapters 5 and 10 respectively. How the studied jurisdictions allocate variable water supplies to the rights on issue is discussed in chapter 6.

Trading

Making rights tradeable can improve the efficiency of the initial allocation of rights by allowing water to move to new and more valuable uses over time. It also provides incentives for users to improve their water use efficiency and gain by selling any water savings into the market.

Trading also signals to users what is the highest marginal value private use and gives producers of low valued goods the ability to exit the water market and to be compensated with the proceeds from the sale of their rights. Those who can put water to its highest valued use will bid up the price for water to the point where producers of low valued goods are better off to sell their right.

Water rights can be traded temporarily or permanently. Temporary trading occurs when right-holders sell off all or part of their seasonal assignment for a period of time, such as an irrigation season, but the seller retains the title to the right and has first call on any future assignment made to that right. Temporary trading can also include the leasing of the right for two or more years, the sale of an option to

purchase future water assignments.⁸ Permanent trading is when the right-holder rescinds ownership of the title to a right and all current and future allocations made to that right.

In 2001–02, 990 GL of water was traded by right-holders in the Murray–Darling Basin. Of this, 913 GL (or 92 per cent) was traded temporarily and the remaining 77 GL (or 8 per cent) was traded permanently (see table 2.7).

Table 2.7 Permanent and temporary trades — Murray–Darling Basin, 2001–02

	<i>Permanent trade^a</i>		<i>Temporary trade</i>	
	<i>Total sold</i>	<i>Net inter-state trade inwards^b</i>	<i>Total sold</i>	<i>Net inter-state trade inwards^a</i>
	ML	ML	ML	ML
NSW	24 834	184	636 550	625
Victoria ^c	42 979	-1 664	161 970	-2 059
Queensland	0	0	26 220	8 695
South Australia	9 396	1 480	88 118	-7 261
ACT	0	0	0	0
Total	77 209		912 858	

^a Permanent inter-state trade occurs only along the River Murray system south of Nyah in Victoria. ^b The sign convention used is that a negative value indicates a trade out of the states and a positive value indicates a trade into the state. ^c Temporary transfers in Victoria, includes temporary trade in both water right and sales entitlement.

Source: Based upon data supplied by the Murray–Darling Basin Commission, 5 August 2003.

The volumes traded in any one year can be influenced by a variety of factors, particularly the existence of drought conditions. When drought conditions prevail, the level of trading could be expected to increase as users who can temporarily suspend their use of water, such as annual crop irrigators, sell their water rights to users whose demand for water is ongoing, such as perennial crop irrigators.

Most permanent trading occurred within jurisdictional borders. However, 1.7 GL (or 2 per cent of the 77 GL traded permanently) was traded along the River Murray from Victoria and into South Australia and NSW. There was no permanent trading of water by users in Queensland or the ACT.

Of the volume of water traded temporarily within the Basin, 9.3 GL (or 1 per cent) was traded inter-state. Victorians and South Australians were net sellers of water into NSW and Queensland.

⁸ In Australia, temporary trading is limited to the sale of the current year's assignment of water.

Natural impediments to trade sometimes limit the effectiveness of the market in re-allocating water to its highest valued use. Trading can be impeded if water sources are not hydrologically connected. In this instance, the cost of transporting water to its new location of use — by either trucking the water or by constructing a connecting channel — can outweigh the benefits of trade.

Further, trade amongst users of a single source may be constrained if the buyer and seller are at some distance from one another — for example, at opposite ends of a river. Some water will be lost to seepage and evaporation (conveyancy losses) when it is traded downstream to the buyer. In certain cases, the volume lost will be sufficient to make the right valueless to the buyer, and thus trade will not occur.

The way that conveyancy losses are accounted for can affect the locational decisions of users. Where individuals internalise the cost of water lost in conveyance — either in the price they pay for water or by reducing the volume of water they actually receive — then an incentive is created for users to locate closer to the source and to seek other means of reducing those losses (see chapters 8 and 9).

Accurate data are not available on the size of losses along the rivers of the Murray–Darling Basin (MDBC, pers. comm., 5 August 2003).

Allocations to the environment and recreational use

Markets may fail to ensure an efficient allocation of the resource because some users may not have access to the market (for example, recreational users) or there has been inadequate consideration given to environmental costs.

In order to address these market failures, some governments have introduced arrangements that ensure that sufficient water is made available to recreational uses and the environment. One approach has been for governments to re-allocate water administratively between consumptive and non-consumptive uses. In those jurisdictions where governments do not have the power to ‘claw back’ water rights administratively, the approach has been to use acquisition programs under which water is bought back from consumptive users on behalf of the environment and recreational users.

Whichever legal system is in place, a determination must be made of the appropriate volume of water to devote to recreational and environmental uses. Determining the volumes of water that should be set aside and the flow regimes for the environment is complicated by the lack of robust scientific information on what

the environment needs and uncertainty about the net benefit of water use for competing purposes.

In the absence of robust scientific information, some governments have sought to adaptively manage water resources. Under adaptive management, governments recognise the possibility of having to change the volume of water set aside for environmental purposes over time as the understanding of environmental effects evolves and as the perceived public priority for environmental protection changes.

The Precautionary Principle and the concepts of Ecologically Sustainable Development (ESD) and Integrated Catchment Management (ICM) have also been applied in protecting the environmental health of water resources (see box 2.4). These concepts place sustainability at the core of decisions over how water should be allocated and aim to ensure sufficient water is allocated to the environment notwithstanding uncertainty about the flows required to limit environmental damage.

Determining an appropriate allocation between recreational, environmental and consumptive uses requires a trade-off between the preferences of individuals in the community. For aesthetic or recreational purposes, some individuals may value maintaining the environment in a pristine state, and thus engaging water in off-stream uses may be viewed as highly costly. Conversely, others may emphasise the value derived from using water for consumption and production activities, and may view water not used as wasteful.

The procedures used to determine how water will be allocated to environmental and recreational uses, as well as consumptive uses, are discussed in chapter 6.

Pricing water infrastructure

The cost of water infrastructure results from the construction, maintenance and operation of the infrastructure that stores and transports water. This infrastructure includes dams, weirs, irrigation channels and urban distribution systems and treatment facilities that purify water and make it suitable for use or re-use.

Water transportation and storage facilities are usually constructed on a large scale. It is generally more cost effective (and practical) for one large dam or channel to serve a large number of users, rather than have each user construct their own facilities.

The large, lumpy capital investments incurred in constructing water storage and transportation facilities result in them exhibiting economies of scale — that is, average costs fall as the number of users of such facilities increases. Once constructed though, the economic cost of using the infrastructure is relatively low.

Box 2.4 Ecologically Sustainable Development, Precautionary Principle and Integrated Catchment Management

Under *Ecologically Sustainable Development*, economic development must be balanced against the protection of biological diversity, the promotion of equity within and between generations and the maintenance of essential ecological processes. It has seven guiding principles:

- decision-making processes should effectively integrate both long and short-term economic, environmental, social and equity considerations;
- lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation (the Precautionary Principle);
- the global dimension of environmental impacts of actions and policies should be recognised and considered;
- the need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised;
- the need to enhance and maintain international competitiveness in an environmentally sound manner should be recognised;
- cost effective and flexible policy instruments should be adopted; and
- broad community involvement should be facilitated on issues.

The Precautionary Principle, in turn, is based upon six guidelines:

- Start with an objective risk assessment, identifying at each stage the degree of scientific uncertainty.
- Stakeholders should be involved in decisions over the management options that may be envisaged, and the procedure used must be as transparent as possible.
- Measures must be proportionate to the risk that is to be limited or eliminated.
- Measures must include a cost-benefit assessment (advantages and disadvantages) with an eye to reducing the risk to a level that is acceptable to all the stakeholders.
- Measures must be able to establish responsibility as to who must furnish the scientific proof needed for a full risk assessment.
- Measures must always be of a provisional nature, pending the results of scientific research performed to furnish the missing data and perform a more objective risk assessment.

Under *Integrated Catchment Management*, land, water and other natural resources are managed as a coordinated system for an entire water catchment. Cooperative partnerships are formed between different levels of government and non-government agencies, and community-determined economic, social and environmental values are incorporated.

Sources: PC (2000); ESDSC (1992); Bellamy, Ross, Ewing and Meppem (2002)

Prices efficiently allocate infrastructure services between users if the price that each additional user pays is equal to the additional cost incurred in supplying that user with the infrastructure service (marginal cost pricing). In the case of fixed assets with little or no value in alternative use, the marginal cost is approximately the incremental cost of operating and maintaining the infrastructure.

Setting prices at marginal cost is likely to result in insufficient revenue to recover the capital cost of infrastructure. On the other hand, setting a price above marginal cost so that average revenues are equal to average costs can result in inefficient use of the infrastructure by denying access to users who are willing to pay the marginal, but not the average, cost. Pricing issues are discussed in chapter 9.

2.6 In summary

Water resources have economic and social benefits. Along with sustaining human, animal and plant life and its cultural and aesthetic value, water is a valuable input into production.

The arid and semi-arid environment typical of much of Australia — and of the overseas jurisdictions studied — increases the value of reliable access to a resource that is variable and at times in scarce supply. In these circumstances, it is vital that water resources are used and allocated efficiently: that is, water resources are managed and used in a way that maximises their value to society.

Governments in the Australian and overseas jurisdictions studied have systems of water rights that are designed to manage access to water resources. Water rights specify how much water an individual can take from a source and may also specify when and how water may be used. By controlling access, water rights ensure more efficient and sustainable levels of use.

Governments have made rights tradeable in order to assist in re-distributing water to uses that maximise the benefits of the resource. Tradeable rights allow water to move to new and more valuable uses over time by facilitating exchange and signalling the value of water in its highest valued use.

The existence of tradeable water rights may not be sufficient to ensure that water is always allocated to its highest valued use. Sometimes there are barriers that constrain the extent of trading and markets can fail to ensure that sufficient water is allocated to recreational uses and the environment.

Some governments have introduced arrangements that ensure that sufficient water is allocated to recreational uses and the environment. One approach has been to use

planning instruments that allocate sufficient volumes of water to the environment and recreational uses before other needs are satisfied. Another approach has been to use market acquisition programs to re-allocate water away from consumptive uses toward in-stream uses.

3 Legal framework

Water resources in most of the jurisdictions studied were originally subject to common and civil law traditions. However, increasing competition for scarce water resources and the potential for conflict between water users compelled governments to introduce or revise legislation governing access to water.

Typically, the roles and responsibilities of the organisations involved are defined in water legislation (see chapter 4). Water legislation also defines the ‘rights’ of users and their privileges and obligations (see chapter 5). How water rights are to be enforced and the sanctions for breaches of the obligations of water right-holders are also typically defined in water legislation (see chapter 10).

In jurisdictions where governments are involved in the allocation and re-allocation of water among consumptive and non-consumptive uses, the government’s broad objectives are generally set out in legislation (see chapter 6). Guidance is also provided on the processes to be followed in allocating and re-allocating water.

Administration processes (see chapter 7) and related procedures for distributing water between uses and among users, are generally established by a combination of legislation, regulation, guidelines and standards. These procedures typically include the definition of priorities attached to rights, and the operating requirements for the management of infrastructure (see chapter 8).

Legislation also guides the structure of pricing arrangements for the delivery of water (see chapter 9).

The legal frameworks of the countries studied are described in this chapter. This information provides essential context for later chapters.

3.1 Evolution of water law

Since the Institutes of Justinian (AD 535), water law has generally vested the primary right to surface water in the public (*res communes*). Individual water users were conferred the right to ‘use’ water but do not own the resource.

Under Roman law the right to ‘use’ water belonged only to those who had access to the water, specifically to those owning land adjoining or abutting the water source. Those who could not gain access without committing a trespass, were not conferred a water right, except if the water was in the ‘public domain’ (Getches 1997).

Under Roman law, groundwater located under privately-owned land was considered to be private property. Consequently, landholders were allowed to totally deplete their groundwater resources irrespective of any third-party effects (Caponera 1992).

Riparian Doctrine

The common and civil law traditions of the jurisdictions studied are based on the Riparian Doctrine. The basis of the doctrine is that the owner of land bordering a water body acquires certain rights to the use of the water if that use does not interfere with its use by other riparian landholders. The right is quasi-usufructuary — a right to the use of water and to the benefits of that use.¹

The Australian jurisdictions, California and South Africa adopted the English common law Riparian Doctrine, which embraced the major principles underlying the earlier Roman law. Mexico and Chile both inherited the Spanish civil law Riparian Doctrine, which was directly based on earlier Roman law. Colorado water rights were also based in English common law, but the Riparian Doctrine was extinguished in 1876.

In the 1820s, English common law recognised the ‘natural flow’ concept. Every riparian landholder had an equal right to use water from a water source and an obligation not to reduce the volume of water flowing to downstream users (Getches 1997).²

In 1833, the English common law Riparian Doctrine was expanded to incorporate the principle of ‘reasonable use’.³ Reasonable use modified the natural flow concept by allowing each riparian landholder the right to make all reasonable uses of the waters, so long as those uses did not interfere with the reasonable uses of other riparian landholders (Getches 1997).

¹ *Usufruct* is defined as the right of enjoying a thing, the property of which is vested in another, and to draw from the same all the profit, utility and advantage which it may produce, provided it be without altering the substance of the thing. A quasi-usufruct right refers to things which are altered, consumed or changed by the usufructuary (Black 1968).

² *Wright v. Howard* (Eng. 1823).

³ *Mason v. Hill* (Eng. 1833).

The mutuality of rights was recognised under English common law by restricting the exercise of the right of access to what was reasonable. Kent described ‘reasonableness’ thus:

All that the law requires of the party by or over whose land a stream passes is, that he should use the water in a reasonable manner, and so as not to destroy, or render useless, or materially diminish or affect the application of the water by the proprietors above or below on the stream. He must not shut the gates of his dams and detain the water unreasonably, or let it off in unusual quantities, to the annoyance of his neighbour (Kent undated, quoted in Fisher 2000, p. 69).

The ‘reasonableness’ requirement represents a mutual recognition of rights, and by implication, represents a liability or obligation. In summary, according to Fisher (2000), the Riparian Doctrine confers rights of access to water but there are clear limitations (liabilities). The liabilities are the rights of other riparians to:

- have the water flow through the stream past the property of the riparian proprietor in its natural flow;
- use the flowing water for ordinary purposes;
- use the flowing water for other purposes that are connected to the use of the property and reasonable in the circumstances;
- have the water flow without sensible diminution;
- have the water flow without sensible increase;
- have the water flow without sensible alteration in its character; and
- have the water flow without sensible alteration in its quality.

These rights are vested in every riparian landholder and each is subject to the correlative liabilities in respect of all other riparian landholders.

More recently, concerns regarding scarcity and over-allocation of water to consumptive uses have resulted in the alteration of riparian rules by statute and case law. Currently, none of the studied jurisdictions only employs the Riparian Doctrine.

Doctrine of Prior Appropriation

The Doctrine of Prior Appropriation was established to serve the practical demands of nineteenth century water users in the western states of the US.⁴ It originated in the customs of miners on federal public lands who accorded the best rights to those

⁴ Appropriation is the act of diverting water from a natural surface stream (or extracting tributary groundwater), from a specified location and for a specified beneficial use.

who first used water.⁵ It was later extended to farmers and other users, including those who privately owned land. Appropriative rights were recognised under the common law of local courts.

The doctrine was given legislative recognition by the US Federal Government in the 1860s and 1870s.⁶ In California, appropriative rights were recognised alongside riparian rights in 1866. In 1876, appropriative rights were formally recognised in Colorado's Constitution.

Water is considered to be a public resource in jurisdictions with appropriative rights. Individuals could claim a right to use water if they could demonstrate that water was put to beneficial use. Beneficial use was originally defined as the application of water for agricultural and mining purposes, although it has since been broadened to include household consumptive, commercial, recreational and environmental purposes.

The traditional elements of a valid appropriation are:

- the intent to apply water to a beneficial use;
- an actual diversion of water from a natural source; and
- the application of the water to a beneficial use within a reasonable time.⁷

The date of the appropriation determines each user's priority to use water, with the earliest user having a superior right. A user whose appropriation is first-in-time has the highest priority and therefore their right to make beneficial use of water is superior to holders of all latter appropriations.

The place where water is applied to a beneficial use does not have to be adjacent to the source. Further, the place of use does not even have to be within the source's watershed in some jurisdictions (Getches 1997).

A consequence of beneficial use is that right-holders must continue to apply water to beneficial use or risk forfeiting that right ('use-it or lose-it'). For example, in Colorado, abandonment proceedings are undertaken every ten years by the Office of the State Engineer to examine whether water has been properly applied.

⁵ Water was essential in the hydraulic or placer mining processes used at that time to extract gold from the ground.

⁶ The US federal *Mining Act of 1866*, the *Placer Law of 1870* and the *Desert Land Act of 1877* recognised the Doctrine of Prior Appropriation.

⁷ These elements are evident in the Colorado Doctrine of 1876.

Groundwater

Underground stream water — water that flows consistently in a well-defined and natural underground channel — was generally subject to the law of surface water (riparian or appropriative common law). However, most groundwater is percolating water in the interstices of rock formations.

The evolution of the law applying to percolating groundwater was initially based on overlying land ownership. Under English common law ‘absolute ownership’ applied. Owners of land had the right to extract water resources beneath their land, irrespective of the impact on others (Ashley and Smith 2001).

In most jurisdictions studied, constraints have been placed on extraction of groundwater to address third-party effects resulting from the depletion of groundwater resources. For example, in NSW, extraction was restricted where the activity had a detrimental effect on the quality of water used by others.

In the US, recognition of the failures of the ‘absolute ownership doctrine’ in controlling third-party effects led California to adopt the ‘correlative doctrine’. Under this doctrine, landholders enjoy equal rights to an underlying aquifer. In times of drought, all claimants are required to reduce extractions proportionately to their previous use (Getches 1997). The correlative rights doctrine was first introduced in California in 1903.⁸

The Doctrine of Prior Appropriation has been applied in both California and Colorado to percolating (tributary) groundwater. However, in California, the correlative rights of overlying landholders are superior to appropriative rights.

Statutory systems

From the mid- to late-1800s, all jurisdictions had begun a program of replacing earlier common law riparian, appropriative and groundwater regimes with statutory systems. In the US, statutes were enacted to give legislative recognition of appropriative rights and to govern the administrative procedures for the appropriation of water.

Early Australian statutes facilitated a system of public management of water resources, with the right to the use and control of water in rivers and lakes being vested in the State. One of the earliest models is the *Water Rights Act 1896* (NSW), which provided that:

⁸ *Katz v. Walkinshaw* (Cal. 1903) (reversed).

The right to use and flow and to the control of the water in all rivers and lakes which flow through or past or are situated within the land of two or more occupiers, and of water contained in or conserved by any works to which this Act extends, shall, only to the restrictions hereinafter mentioned, vest in the Crown (Water Rights Act 1896, quoted in Fisher 2000, p. 6).

This legislation was primarily aimed at promoting water use, such as irrigation. For example, the *Water Conservation Act 1881* (Victoria) provided for trusts to finance, construct and control local irrigation districts.

More recently, water management objectives have been driven by the need to manage sustainably a scarce resource and the need for protection of ecosystems dependent upon water. For example, concepts of Ecologically Sustainable Development, Integrated Catchment Management and the devolution of planning responsibilities were introduced into Australian jurisdictions and South Africa water legislation in the 1980s and 1990s. These concepts are outlined in chapter 2.

Concern over environmental issues in the US has led to in-stream uses being legally recognised as a beneficial use. For example, section 1243 of the Californian Water Code provides for the use of water for recreation and the preservation and enhancement of fish and wildlife resources as a beneficial use of water.

Similarly, in Colorado, the definition of beneficial use includes the appropriation by the State of minimum flows in natural streams and lakes for the preservation of the natural environment (Title 37-92-103 of the Colorado Revised Statutes). Water left in the stream for such purposes cannot be diverted to other beneficial uses.

3.2 Current legislative framework

In most of the jurisdictions studied, governments have the power to issue water rights, to influence the allocation of water resources, and regulate water works and water use. These powers are provided for by legislation.

A jurisdiction's legislative framework for water generally covers the following areas:

- *Water* — the definition of the rights of water users and their liabilities to others and the administration of water rights. The legislation may also provide a framework for allocating water between uses and users.
- *Environment* — the environmental concerns arising from the taking, use and return of water. The legislation typically includes regulations on water use and return flows. These regulations can relate to specific water users or groups of water users.

-
- *Infrastructure* — the provision of works (such as dams, pumps and channels), the management of water infrastructure (such as in irrigation districts) and the incorporation of local water user associations.
 - *Inter-jurisdictional* — agreements between the governments of jurisdictions regarding the sharing of water resources. The legislation can describe the arrangements for shared catchments or river basins.

The nature of each jurisdiction's legislative framework is, in part, shaped by:

- the division of legislative powers between various levels of government to manage water resources and to protect the environment; and
- Constitutional provisions relating to the protection of property and individual rights.

The rules governing the operation of the bureaucracy and its interaction with individuals, also have influenced the drafting and administration of legislation within each jurisdiction. However, the detailed interaction between specific water-related legislation and these broader influences was beyond the scope of this report.

Other pieces of legislation have the potential to impact upon water allocation and use. For example, in Queensland, Water Resource Plans are subordinate legislation and under Administrative Law, the Governor can abolish or replace a plan at any time. A discussion of the administrative law of each jurisdiction studied is beyond the scope of this report.

Water and environmental responsibilities

In Australia, legislative power over water and the environment rests with the states, reflecting the federal division of powers established by the Commonwealth Constitution.⁹ Fisher stated:

It can confidently be stated that power over water and water resources is, within the Constitutional context of the Australian federation, a matter for the States (Fisher 2000, p. 37).

However, the Commonwealth Government is responsible for environmental matters of national significance.¹⁰

⁹ Section 100 of the Australian Constitution states that 'the Commonwealth shall not, by any law or regulation of trade or commerce, abridge the right of a State or of the residents therein to the reasonable use of the waters of rivers for conservation or irrigation'.

¹⁰ The *Environment Protection and Biodiversity Conservation Act 1999 (Cwlth)* outlines the Commonwealth Government's responsibilities for environmental matters of national significance. The Commonwealth Government is also responsible for external affairs and as

In the US, responsibility for water rights rests mainly but not solely with the state governments. The federal government can exercise certain federal rights to water.¹¹ In contrast, there is a significant role for federal legislation in environmental protection. The US Department of the Interior is responsible for addressing a number of environmental third-party effects associated with regulating, extracting, using and returning water through its federal environmental protection legislation.

The responsibility for both water rights and environmental protection in Chile, Mexico and South Africa lies with the national government.

Differences in the responsibilities assigned to the various levels of government have implications for the management of water resources and environmental protection. In jurisdictions where the main responsibility for water resource management rests with a single level of government, such as in the Australian jurisdictions studied, Chile, Mexico and South Africa, there tend to be fewer pieces of legislation. In particular, the primary water legislation defines water rights, provides the framework for allocating water between consumptive and non-consumptive uses, administering and monitoring and enforcing water rights (see tables 3A.1 and 3A.2).

In California and Colorado, where the responsibilities for water and the environment are divided between various levels of government, the legislative framework is complex. For example, in the US, there is a plethora of federal environmental legislation alone — such as the *National Environmental Policy Act 1969*, the *Wild and Scenic Rivers Act 1968*, the *Endangered Species Act 1973*, the *Fish and Wildlife Coordination Act 1965* and the *Clean Water Act 1977*.

Constitutional protection of water rights

The Constitutional provisions protecting property and individual rights, including that of water, also differ across jurisdictions. These arrangements have implications for the legislative arrangements regarding environmental protection. In the Australian jurisdictions studied, right-holders may not be able to seek compensation if the jurisdiction were to reduce the value of water rights.

First there is no general right to claim compensation when a state acquires a property right of an individual. ... Secondly, pre-reform mechanisms allowing access to water, for example licences, are not proprietary interests because they were not secure ... these rights to take water could be amended, varied, suspended cancelled or revoked

such may influence natural resource management by implementing Australia's international obligations.

¹¹ However, the M^cCarran Amendment to the federal *Reclamation Act 1902* recognised the primacy of State Governments to the administration of water rights.

under previous Acts. Thirdly it is doubtful that these rights would fulfil a strict test of property because they were not widely transferable (Tan 2002, p. 34).

In NSW and Queensland, legislation prohibits the payment of compensation for injury to right-holders for reduction in the value of water rights resulting from the preparation or revision of water allocation plans, except where this occurs during the statutory life of the plan (see box 3.1).

Box 3.1 Proscription of compensation in NSW and Queensland.

In NSW, under section 87 of the *Water Management Act 2000*, compensation by the Government will not be paid for injury to licence holders for reductions to their water allocations if the variation in a bulk access regime is the result of:

- the introduction of a management plan that has been made in relation to a water management area for which a bulk access regime has not been established or for a water management area for which a draft management plan has been submitted to the Minister; or
- an amendment by the Minister of a management plan, if the amendment is in accordance with section 42 of the *Water Management Act*.

In Queensland, under sections 985(1) and 986 of the *Water Act 2000*, compensation is not payable under the Act except as provided for, and an owner of a water allocation is only entitled to be paid reasonable compensation by the State for a reduction in the value of an entitlement if:

1. a change reduces the value of the allocation; and
2. the change is made within 10 years after the Water Resource Plan is approved.

Sources: *Water Management Act 2000* (NSW); *Water Act 2000* (Queensland).

Privately held water rights in California, Colorado and Chile are protected through their respective Constitutions, placing some constraints on legislative power. Water rights are the property of individuals in perpetuity and cannot be removed or modified by a government without the consent of the water right-holder. They also have statutory ‘no injury’ provisions that protect water users against injury arising from other water users exercising their water rights.

The governments of these jurisdictions as a result do not have the power to administratively re-allocate water resources or modify existing water rights. Governments in these jurisdictions re-allocate water through the acquisition of water rights, harvesting additional water or investing in water savings.

In Mexico, under the Constitution, water held as private property cannot be expropriated without compensation. However, a right of the Nation to regulate private water rights is recognised under Article 27 of the Constitution of Mexico.

Addressing environmental issues

A common objective in all jurisdictions is to protect and conserve species and ecosystems, protect and conserve the environmental and heritage values of rivers and to protect catchments. These objectives are addressed in two ways:

- Using the primary water legislation to establish environmental flow requirements and, in some cases, environmental allocations and water rights, as in the Australian jurisdictions, Colorado, Mexico and South Africa.
- Using environmental protection legislation to control the taking, use and return of water that adversely affect the environment. This is mainly undertaken by the US Federal Government and in Chile (under the *Environmental Framework Law 1994*), but is also undertaken by Australian Commonwealth Government under its *Environment Protection and Biodiversity Conservation Act 1999*.

Governments in all of the jurisdictions studied regulate the construction of water-related infrastructure (such as dams, pumps and weirs) and the management of distribution services (such as the creation of public irrigation and drainage districts). The regulation of infrastructure development potentially affects the allocation and use of water by placing constraints on the works used to extract water resources. The regulation also affects the future development of water-related infrastructure and, hence, the availability of water.

Regulation of water infrastructure construction addresses a range of environmental effects that arise from the diversion and storage of water. Examples include the works approval provisions in the *Integrated Planning Act 1997* (Queensland), and section 404 provisions of the US federal *Clean Water Act 1977* (as administered by the US Army Corps of Engineers).

Inter-jurisdictional arrangements

Each of the jurisdictions studied has inter-jurisdictional agreements, treaties or compacts.¹² In most cases, the agreements cover the division of waters, but rarely do they specify environmental flows, nor do they address water quality or overall catchment health. The exception is the *Murray–Darling Basin Agreement 1992*,

¹² Compacts are inter-state agreements ratified by the US Congress.

which includes provisions for managing the basin for its emerging dryland and irrigation salinity problems.

Inter-jurisdictional legislation affects allocation decisions by placing obligations on jurisdictions about how common water resources are shared. For example, the Murray–Darling Basin Agreement (1992) provides for a cap on diversions from the rivers in the Murray–Darling Basin. It also specifies arrangements for the sharing of water among the states and territories of the basin for consumptive use.

3.3 Water rights

Water rights may be locally referred to as rights, licences, permits, allocations or entitlements. A water right is a legal authority to take water from a water source. It can be conditional on location of extraction and use; the nature of the use; the rate of extraction and time of use; and so on (ESCAP (UN) 2000).

Water rights are granted for specific users (such as irrigators), for specific uses (household consumption and environmental flows), for an individual, or for a group of users (such as bulk licences). The individual characteristics of the different types of water rights available within the jurisdictions studied are discussed in chapter 5.

A defining feature among all the jurisdictions studied, is that the control of water is vested with the State or the public (see tables 3A.3 and 3A.4). Individuals only possess a right to the access and use of water and do not own the water. The exceptions are certain groundwater in California and Mexico which, because it underlies private land, is deemed to be private property. Even though water rights are rights to the use of water, in California, Colorado and Chile these rights are the property of the individual.

In the Australian jurisdictions, control over water is vested in the state governments. In Mexico, control over water is vested in the national government.

In California and South Africa, ownership of water resources is vested in the public and the Government acts as a public trustee. In Colorado, the control of water is vested in the State until it is divested to individuals through the act of appropriation.

In Chile, ground and surface water are national goods of public use. However, rights to use the water may be conferred to individuals. These rights are protected as private property by the Constitution of Chile.

In addition to the public control of water, there is statutory recognition of the access and use of water for specific uses, without requiring some form of administrative

approval. Statutory rights that generally do not require some form of administrative approval include the right to use surface and groundwater for: stock and domestic purposes; camping; the watering of travelling stock; and for emergencies such as the protection of life and property against fire.

The most significant of these rights are ‘stock and domestic’, which are commonly granted by statute to owners of land adjoining a surface water source or to land above a groundwater resource (see tables 3.1 and 3.2). In some of the jurisdictions studied, holders of stock and domestic rights are required to obtain licences or permits to construct the necessary infrastructure to extract water.

Table 3.1 Stock and domestic rights — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
NSW	Conferred by statute on owners of land fronting any river, lake or estuary. Volume of water is determined by use. Rights allow landholders to take water from an aquifer underlying the land for domestic or stock use. There are also stock and domestic licences, which are granted administratively for water use on land not adjoining a natural water source. Stock water does not include the irrigation of crops for feed.
Victoria	Conferred by statute on owners of land adjoining a water course for stock or domestic use. Statutory right to harvest overland flow for stock and domestic use.
Queensland	Conferred by statute on owners of land adjoining a water course for stock or domestic use. Rights extend to groundwater and overland flow water that has been collected into a dam. These rights (including the taking of groundwater from a declared subartesian basin) can be modified by a Water Resource Plan.
South Australia	Conferred by statute on owners or lawful occupiers of land on which the water occurs.
ACT	Conferred by statute on an occupier of land on or immediately adjacent to which there is a waterway.

Sources: Annexes B to F.

Statutory water rights that are granted administratively to water users by the State account for the bulk of consumptive water use. These rights can be grouped into a number of broad categories including surface water rights, water harvesting rights, groundwater rights and indigenous water rights.¹³

Stock and domestic rights granted by statute are available in all jurisdictions studied.

¹³ The terminology used for defining water rights can vary significantly among jurisdictions. Consequently, the definitions of surface water rights and harvest rights used in this report may not precisely correspond with those used in each jurisdiction.

Table 3.2 Stock and domestic rights — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
California	The taking of water for stock and domestic purposes is available under riparian rights and groundwater rights. In addition, the California Water Code establishes a procedure for any person to obtain an appropriative water right for a small domestic or livestock stockpond, upon registering the use with the State Water Resources Control Board and thereafter applying the water to reasonable and beneficial use with due diligence. These registrations are limited to 4500 gallons (17 KL) per day of direct diversion or 10 acre-feet per year (12.3 ML) of water storage
Colorado	Small capacity and domestic well permits are available for household, small scale irrigation, stock watering and commercial purposes. Requires permit for the well.
Chile	Wells may be constructed for stock and domestic use of groundwater. Stock and domestic rights may not be allowed if they cause injury to other water rights.
Mexico	Surface national waters may be freely exploited, used or developed by manual means for residential or stockraising purposes, provided that these neither are deviated from their bed nor produce a change in the quality or a significant decrease in volume, in accordance with the regulations.
South Africa	Conferred by statute for reasonable domestic use, small non-commercial gardens or the watering of stock, with the condition that the use is not excessive in relation to the capacity of the water resource and the needs of other users.

Sources: Annexes H to L.

Surface water rights

Surface water rights refer to the right to extract and use surface water from regulated or unregulated watercourses. This group of rights differs from stock and domestic rights, because they are generally granted administratively by the State or a court to water users (see tables 3.3 and 3.4). Included in this group of rights are in-stream rights — for uses other than environmental.

Some surface water rights may be conferred on bulk water uses such as urban water suppliers and irrigation districts. Typically in these cases, individual water users enter into contracts for the supply of water by the entity. For example, private irrigation companies in NSW, government irrigation schemes in Victoria and irrigation trusts in South Australia hold bulk licences on behalf of their members. Similarly, in California and Colorado, water districts are primary holders of water rights and members can hold water supply contracts.

Californian common law riparian rights are accompanied by a Constitutional requirement for reasonable and beneficial use. The administration of the rights is governed by the Californian Water Code. However, riparian right-holders are not required to hold a licence.

Table 3.3 Surface water rights — Australian jurisdictions, 2003

<i>By right</i>	<i>Description</i>
NSW	
Access Licence	Administratively granted and specifies the share of the resource and the rate of extraction. Licences can only be granted pursuant to a statutory Water Sharing Plan which declares a Bulk Access regime — the consumable share of the total resource in a water source. These water rights can only be taken via an approved water supply work and can only be applied to land consistent with a water use approval.
Victoria	
Bulk Entitlements	Administratively granted. A Bulk Entitlement specifies the right to collect and use water directly from a waterway. Bulk Entitlements can also be granted to authorities that are supplied from the works of another authority. The right applies to authorities such as rural water authorities and electricity generators.
Water Right	Rights are conferred upon entry into the water rights register. The rights impose an obligation upon relevant authorities to supply landholders a volume of water specified in a registry. Rights are specific to irrigation districts and depend upon ownership of land within the district.
Take And Use Licence	Administratively granted for water from a waterway, spring, soak, dam or the works of an authority. Rights are generally not held within irrigation districts.
In-Stream Use Licence	Administratively granted by the Minister on the application of another Minister or a person nominated by another Minister. Licence is issued for the in-stream use of water.
Queensland	
Water Allocation	Water Allocations are administratively granted. Water Allocations generally arise from the conversion of existing entitlements. Future Water Allocations may be granted through mechanisms, such as auctions. There are no constraints on ownership and these rights are transferable. There may be a requirement for right-holders to obtain separate use approvals.
Water Licence	Licences can be administratively granted to the State, a local government, a water authority, a resource operations licence holder, an owner of land adjoining a water source, and other entities prescribed under a regulation. Licences are required to extract water for purposes other than for domestic use and for the watering of stock.
South Australia	
Water Licence	Administratively granted and only applicable in prescribed areas. A licence can be issued as a Holding Licence or a Taking Licence.
Unlicensed Water Right	Conferred by statute and only applicable in non-prescribed areas.
ACT	
Licence To Take Water	Administratively granted and may have a number of conditions attached to the right. Licences To Take Water are specific to locations.
Allocation	Administratively granted as a volumetric right to a volume of water. Allocations are prerequisites to acquire Licences To Take Water.

Sources: Annexes B to F.

Table 3.4 Surface water rights — overseas jurisdictions, 2003

<i>By right</i>	<i>Description</i>
California	
Federal Reserve Rights	Rights created by executive order, legislation, court decree or treaty in the creation of a federal reservation. May apply for a variety of purposes and to fulfil the intent of the reserve.
Appropriative Rights	Administratively granted, through licences and permits. The licence or permit is effected through the beneficial taking and use of water.
Riparian Rights	Riparian rights are based in common law, with an accompanying Constitutional requirement for reasonable and beneficial use. Riparian rights may apply to springs and standing pools which have no natural outlet from the land. Not limited by type of use.
Colorado	
Federal Reserve Rights	Rights created by executive order, legislation, court decree or treaty in the creation of a federal reservation. May apply for a variety of purposes and to fulfil the intent of the reserve.
Water Rights	Water rights are conferred through the appropriation of water, which is legally recognised by a water court decree. There is also provision for in-stream rights for purposes other than environmental.
Storage Rights	Conferred by the act of appropriating and storing surface water in the off-irrigation season, which is legally recognised by a water court decree. Does not confer a right to use water.
Chile	
Water Rights	Water rights can be granted administratively for consumptive uses and non-consumptive uses. They can also be defined as permanent (high priority) or eventual (low priority).
Traditional Rights	Non regularised rights which are based on the customary use of water or rights granted before 1981.
Mexico	
Concessions (Surface Water)	Administratively granted through the issuance of a licence. A concession granted by the Secretariat of Environment and Natural Resources through the National Commission of Water is needed for the exploration or use of waters by individuals or enterprises. ^a
South Africa	
General Authorisation	The State may permit the use of water by publishing general authorisations. General authorisations may be restricted to a particular water resource, particular category of persons, a defined geographic area or a period of time. The use of water under a general authorisation does not require a licence. However, an authorisation must be registered with the responsible agency. Water taken from a surface water resource must be registered if 50 cubic metres or more is taken per property on any given day.
Licence	Administratively granted for the taking of water from a water resource. Licences authorising the use of water for irrigation may be transferred.
Existing Lawful Use	An existing lawful water use is a water right derived from an act repealed by the <i>National Water Act 1998</i> which has not yet been terminated. Existing lawful uses must be declared by the responsible water authority.

^a Government agencies require an 'allocation' to exploit or use of water. Allocations may be granted by the National Water Commission. Allocations are governed by the same obligations that apply to concessions and a grantee is considered a concession holder for the purposes of the *National Water Law 1992*.

Sources: Annexes H to L.

Californian appropriative rights and surface water rights in the Australian and South African jurisdictions are granted administratively. Most of these rights are granted for consumptive use.

In Colorado, water rights are conferred by both the act of appropriation and the legal recognition of the appropriation by a water court. The framework for the administration of these rights is governed by statute. Rights are also available in Colorado for certain in-stream uses (other than environmental).

Harvest rights

Harvest rights refer to the right to harvest (collect and store) overland flows (water flowing across land but not yet in a defined watercourse). Harvest rights allow water to be held on private property.

Where overland flow would naturally drain into a watercourse, the harvesting of overland flows has the potential to affect the reliability or security attached to the rights held by surface and groundwater users.

In general, harvesting of water is permitted for stock and domestic purposes without the need for government consent (see tables 3.5 and 3.6). However, in some jurisdictions, harvest rights are granted administratively in areas where there is an identified need to regulate overland flow. Separate approval for the infrastructure or works necessary to capture the water is also required in some jurisdictions.

NSW harvest rights are not licensed if captured flows are less than 10 per cent of the average volume of rainfall run-off. In Victoria, all water harvesting activities are licensed, with the exception of stock and domestic rights (see table 3.1). Approval to harvest water in Queensland is only required in areas where there is a recognised need to regulate overland flow. In South Australia, harvest rights are administratively granted in prescribed areas.

In Colorado, harvest rights are conferred by the act of diverting and storing overland flow, which is legally recognised by a water court decree. However, a harvest right does not confer a right to use water.

Table 3.5 Harvest rights — Australian jurisdictions, 2003

<i>By right</i>	<i>Description</i>
NSW	
Harvestable Rights	A licence is not required if captured flows are less than 10 per cent (or greater if prescribed) of the average volume of rainfall run-off. Captured overland flows must be used in accordance with a harvestable rights order.
Victoria	
Take And Use Licence	Administratively granted for the taking and use of water from a private dam.
Registered Licence	Administratively granted for the taking and use of water from a private dam.
Queensland	
Water Licence	Licences are administratively granted to owners of land. They are only applicable where Water Resource Plans have identified the need to regulate overland flow. In areas where a licence is not required, there are limits on the height of dam banks.
Water Allocation	Rights are administratively granted where Water Resource Plans have identified the need to regulate overland flow. In areas where a water allocation is not required, there are height restrictions on dam walls. ^a
South Australia	
Dam Permit	Administratively granted to build or enlarge a dam in a prescribed surface water area and in the Mount Lofty Ranges Watershed.
Harvest Right	Conferred by statute in non-prescribed areas. No permit required to build or enlarge a dam, but development must be carried out in accordance with an approved management plan of a relevant local council or Catchment Water Management Board.
ACT	
Licence To Take Water	Administratively granted for the taking and use of water. A water control permit, valid for 12 months, is necessary for the construction of the proposed storage.
Allocation	Administratively granted and is a prerequisite for obtaining a water licence.

^a There may also be statutory entitlements defined under a Water Resource Plan.

Sources: Annexes B to F.

Table 3.6 Harvest rights — overseas jurisdictions, 2003

<i>By right</i>	<i>Description</i>
California	Depending on the diversion, the farmer generally needs to secure an appropriative water right from the State Water Resources Control Board.
Colorado	Storage rights are conferred by the act of diverting and storing overland flow, which is legally recognised by a water court decree. Does not confer a right to use water.
Chile	Article 10 of the <i>Water Code 1981</i> allows landholders to store and use overland flow that falls or gathers on their property. The storage of water must not injure the rights of third parties.
Mexico	
Concessions	Administratively granted through the issuance of a pertinent licence.
South Africa	
General	The State allows a general authorisation for the storing of water. General
Authorisation	authorisations must be registered.
Licence	Administratively granted for storing water.
Existing Lawful	An existing lawful water use is a water right derived from an act repealed by
Use	the <i>National Water Act 1998</i> which has not yet been terminated. Existing
	lawful uses must be declared by the responsible water authority.

Sources: Annexes H to L.

Groundwater rights

Groundwater rights refer to the right to access water naturally occurring in an aquifer. These rights are vested in the government and administratively granted or vested in individual water users (see tables 3.7 and 3.8).

In some of the jurisdictions studied, government approval is required for the construction of a well or bore but no formal application is required to access the water.

Groundwater rights are generally granted administratively in the Australian jurisdictions, with the exception of those used for stock and domestic purposes (see table 3.1). However, groundwater licences or permits are not required to access groundwater in non-prescribed areas in South Australia or in Queensland, where there is no identified need to regulate groundwater.

Groundwater rights for bulk water users are available in Victoria. These rights are administratively granted for the collection and use of water by authorities.

Table 3.7 Groundwater rights — Australian jurisdictions, 2003

<i>By right</i>	<i>Description</i>
NSW	
Access Licence	Administratively granted and specifies the share of the resource and the rate of extraction. Licences can only be granted pursuant to a statutory Water Sharing Plan which declares a Bulk Access regime — the consumable share of the total resource in a water source. Water can only be taken under an Access Licence using an approved water supply work and can only be applied to land consistent with a water use approval.
Victoria	
Bulk Entitlements	Administratively granted. A Bulk Entitlement specifies the right to collect and use water directly from a water source. The right applies to authorities such as rural water authorities and electricity generators.
Take And Use Licence	Administratively granted for the taking and use of groundwater. Stock and domestic rights for groundwater are conferred by statute.
Queensland	
Water Licence	Licences are administratively granted and are applicable where Water Resource Plans or subartesian area declarations have identified the need to regulate groundwater.
Water Allocation	Water Allocations arise from the conversion of existing entitlements and are applicable where Water Resource Plans have identified the need to regulate groundwater.
South Australia	
Water Licence	Administratively granted and is only applicable in prescribed areas. A licence can be issued as a holding licence or a taking licence.
Unlicensed Water Right	Conferred by statute and is only applicable in non-prescribed areas.
Permits for aquifer storage and recover schemes	Administratively granted for the recharging of aquifers. Water quality conditions are attached to the permit.
ACT	
Licence To Take Water	Administratively granted as a right to take water from the ground.
Allocation	Administratively granted as a right to a volume of groundwater. Water allocations are prerequisites for licences.
Bore Construction Permit	Administratively granted for a period of 12 months for the construction of a bore.

Source: Annexes A to F.

Table 3.8 Groundwater rights — overseas jurisdictions, 2003

<i>By right</i>	<i>Description</i>
California	
Federal Reserve Rights	Rights created by executive order, legislation, court decree or treaty in the creation of a federal reservation. May apply for a variety of purposes and to fulfil the intent of the reserve.
Appropriative Rights (some types of groundwater)	Conferred by licence or permit only if it is a sub-surface flow of a river.
Correlative Rights (some types of groundwater)	Granted under common law and apply to land overlying water source.
Colorado	
Federal Reserve Rights	Rights created by executive order, legislation, court decree or treaty in the creation of a federal reservation. May apply for a variety of purposes and to fulfil the intent of the reserve.
Water Rights	Rights are conferred by the act of appropriation of tributary groundwater and legally recognised by a water court. ^a
Well Permits	Administratively granted by the State Engineer. ^b
Chile	
Water Rights	Consumptive and non-consumptive rights are administratively granted for the taking of water from groundwater resources.
Traditional Rights	Non regularised rights which are based on the customary use of water or rights granted before 1981.
Mexico	
	Administratively granted through the issuance of a licence. A concession granted by the Federal Executive through the National Water Commission is needed for the exploration or use of national waters by individuals or enterprises. The exploitation or use of national waters by government agencies will be made by means of allocation. National groundwater can be freely extracted, except when, by public interest, the Federal Executive regulates its extraction and use. Government can establish zones of prohibition or declare an area as a reserve.
South Africa	
General Authorisation	The government allows a general authorisation for the taking of groundwater. Water taken from groundwater sources must be registered if 10 cubic metres or more is taken per property during any given day.
Licence	Administratively granted for the taking of water from groundwater resources.
Existing Lawful Use	An existing lawful water use is a water right derived from an act repealed by the <i>National Water Act 1998</i> which has not yet been terminated. Existing lawful uses must be declared by the responsible water authority.

^a In the Denver Basin, there are non-tributary groundwater rights based on the overlying land area. ^b Well permits based on a modified appropriation system are granted by the Colorado Ground Water Commission in designated basins in the eastern plains of Colorado.

Sources: Annexes H to L.

Californian correlative groundwater rights are primarily based in common law. Right-holders are permitted only to pump water sufficient for reasonable and

beneficial use.¹⁴ Groundwater rights may also be conferred by appropriation. As mentioned earlier, these appropriative rights are subordinate to correlative rights.

In Colorado, appropriative rights must be recognised by a water court if the source is tributary groundwater. The Doctrine of Prior Appropriation does not apply to non-tributary groundwater. In these cases, the Office of the State Engineer confers well permits. The framework for the administration of Colorado groundwater rights is defined by statute.

Indigenous rights

All of the jurisdictions studied contain indigenous populations that predated European settlement. The use of water by such peoples prior to settlement was based on customary laws and traditions. In some of the jurisdictions studied, the current water law regimes define and incorporate these customary rights within the governing legislation. Jurisdictions where explicit recognition of indigenous rights has been made include NSW, California, Colorado and Chile (see tables 3.9 and 3.10).

In other jurisdictions, indigenous rights are not recognised. In Queensland, indigenous beliefs and values in the allocation planning process, such as in the water resource planning process for the Barron and Burnett catchments.

Table 3.9 Indigenous rights — Australian jurisdictions, 2003

<i>By right</i>	<i>Description</i>
NSW	
Native Title Rights	Granted by statute and allows native title holders to take and use water without the need for a licence or use approval. Volume is prescribed by regulation.
Victoria	None
Queensland	None
South Australia	None
ACT	None

Sources: Annexes B to F.

¹⁴ Except where rights to groundwater sources have been adjudicated with the agreement of users.

Table 3.10 Indigenous rights — overseas jurisdictions, 2003

<i>By right</i>	<i>Description</i>
California	
Federal Reserve Rights	Federal Reserve Rights vested in the federal government and conferred on Indian Nations on the creation of reservations whether by treaty, act, court decree or executive order. The volume of allocated water is limited by the primary purpose to which the reserve was first established.
Colorado	
Federal Reserve Rights	Federal Reserve Rights vested in the federal government and conferred on Indian Nations on the creation of reservations whether by treaty, act, court decree or executive order. The volume of allocated water is determined by proceedings in a State water court and is limited by the primary purpose to which the reserve was first established.
Chile	
Traditional Rights	Rights available to customary users of water. These are progressively being regularised by the Directorate General of Water and legally recognised by local courts.
Mexico	None
South Africa	None

Sources: Annexes H to L.

Allocation of water for environmental purposes

Two approaches were observed among the studied jurisdictions for the provision of water for environmental purposes — prescribing environmental flow requirements and allocating of water for the specific and exclusive use of the environment (see tables 3.11 and 3.12).

Environmental flow requirements constitute a set of rules and targets that define the distribution of water in a watercourse. Requirements comprise base flows, flow events (flooding, drying events), the timing of flows, and minimum and maximum flows at certain check points along a river. They may also include water quality requirements, such as in South Africa. Environmental flow requirements are established on the basis of hydrological modelling and environmental impact studies. In determining these requirements, the principal objective is to mimic, to some extent, the natural flow pattern of the watercourse.

Environmental flow requirements act as constraints to the distribution of water along a river or the maintenance of water levels in a lake. For example, in South Australia, the storage manager is required to ensure that the flow pattern of the river meets the environmental flow requirements.

Environmental flow requirements have been established in most of the jurisdictions studied. The exceptions are Colorado and Chile.

The second approach is to set aside a volume of water for environmental purposes. These volumes can be specified as a fixed volume or as a share of the river. These allocations can be specified as environmental water rights (that therefore possess a separate legal title and are transferable) or can be specified as a non-transferable allocation.

In NSW, Victoria, South Australia, California, Colorado and Chile, an allocation of water has been set aside for the environment. In these circumstances, the environment does not necessarily have a prior right to the water.

Environmental allocations in some cases have frequency and timing conditions. However, these only apply to the water distributed under the right and not to the flow pattern of the whole watercourse. For example, in Colorado, in-stream flow and lake level rights are defined in terms of their flow and lake height requirements.

In California and Colorado, environmental allocations are attached to some federally-owned nature reserves. Environmental allocations are also available in Colorado on private or state-owned land, in the form of in-stream flow rights. In California, there is a potential for environmental allocations to be granted in areas outside of federally-owned areas under the Public Trust Doctrine and the beneficial use requirements of consumptive water rights.¹⁵ Environmental allocations can also be required by federal environmental protection legislation, such as allocations determined under endangered species recovery programs or threatened species conservation programs.

¹⁵ Under the Public Trust Doctrine, the potential value of a proposed or existing water diversion must be balanced against the impact that the diversion has upon the Public Trust. Public Trust occurs where certain resources are held to be the property of all citizens and subject to continuing supervision by the State. Water allocated to the environment through the Public Trust Doctrine is determined by state courts.

Table 3.11 Environmental allocations — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
NSW	
Environmental Health Water	Conferred by statute. Water committed exclusively to ecosystem health. May be either surface or groundwater. Can only be established via a statutory management plan.
Supplementary Environmental Water	Conferred by statute. Water committed for specified environmental purposes at specified times or in specified circumstances. Can only be established via a statutory management plan.
Adaptive Environmental Water	Water that is committed to a specific environmental purpose by a rightholder. Can only be established via a statutory water management plan.
River Flow Rules	River flow rules vary from catchment to catchment and include restrictions on extraction and the matching of dam releases to inflows. Can only be established via a statutory management plan.
Victoria	
Bulk Entitlement	Administratively granted for exclusive environmental use. Entitlements have been granted to meet specific environmental needs.
Environmental Flows	Specified in a Stream Flow Management Plan or included as obligations within a Bulk Entitlement Order.
In-stream Use Licences	While there are legislative provisions for in-stream licences, no licence has yet been allocated for environmental purposes.
Queensland	
Environmental Flow Objectives	Environmental Flow Objectives are defined in Water Resource Plans. The plans simultaneously set out environmental flow objectives and their associated performance indicators for the catchment, and water allocation security objectives.
South Australia	
Environmental Allocation	Administratively granted and only applicable in a prescribed water resource area. Granted in recognition of the environment's right to water in prescribed areas — may be defined in volumetric terms. An allocation is held by the Lower Murray Swamps.
Environmental Flows	Conferred by statute and only applicable in prescribed areas. Determined prior to allocation for consumptive use.
ACT	
Environmental Flow Guidelines	Administratively granted and determined prior to allocation for consumptive use.

Sources: Annexes B to F.

Table 3.12 Environmental allocations — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
California	
Federal Reserve Rights	Vested in the federal government and conferred on the creation of a nature reserve, whether by agreement, act, court decree or executive order. The volume of associated water is determined by proceedings of state courts and is limited by the primary purpose to which the reserve was first established.
Wild And Scenic River Flows	The federal <i>Wild and Scenic Rivers Act 1968</i> and the <i>California Wild and Scenic Rivers Act 1972</i> preserve the natural flow patterns of designated rivers by restricting or prohibiting the construction of water works. Wild and scenic river flows define the unimpaired flow of a river (calculated to be unaffected by stream diversions, storage, imports or exports of water and return flows).
Environmental In-Stream Flows	Water maintained in a stream or river for in-stream beneficial uses such as fisheries, wildlife, aesthetics, recreation and navigation. In-stream flows may be established by the terms and conditions in a water right permit, hydropower licence, by court order or by agreement between interested parties. Required flows on most rivers vary by month and year type.
Colorado	
Federal Reserve Rights	Vested in the federal government and conferred on the creation of a nature reserve, whether by agreement, act, court decree or executive order. Volume of associated water is determined by proceedings of a water court and is limited by the primary purpose to which the reserve was first established.
Environmental In-Stream Flow Rights	Conferred by the act of appropriation and legally recognised by decree of a water court. Only the Government may own environmental in-stream flow rights. Unlike diverted water rights, in-stream flow rights extend through a designated reach of a stream rather than for a single point. In addition, in-stream flow rights are sometimes separated into two or more flow rates to cover requirements during different seasons.
Natural Lake Level Water Rights	Conferred by the act of appropriation and legally recognised by decree of a water court. Only the Government may hold natural lake level water rights. The right is to the natural surface water level or volume of a lake.
Chile	
Ecological Volumes	A volumetric allocation set aside by the administering body to ensure minimum flows. Not currently constituted as a water right.
Mexico	
Water Programming	Allocation plans are required by statute to consider the preservation of water resources and water planning must be based on the natural water replenishment levels. The state may regulate the extraction and use of national waters and establish restricted areas and reserves to meet the public interest.
South Africa	
Ecological Reserve	State determines the volume and quality of water resources needed to meet environmental needs. The basic human needs reserve is determined prior to the ecological reserve and the ecological reserve is determined prior to the allocation of water for licences. Defined within the ecological reserve are quality, volume, pattern and timing of in-stream flows, the character and condition of in-stream and riparian habitat and the character, distribution and condition of aquatic biota. Water quality includes the physical, chemical and biological characteristics of the water.

Sources: Annexes H to L.

3.4 Inter-jurisdictional arrangements

Inter-jurisdictional issues arise where water sources — such as river and groundwater basins — span jurisdictional boundaries. The agreements and legislation governing the sharing of water between jurisdictions and the obligations that such agreements impose upon governments have a significant impact on water resource management within the jurisdictions concerned.

Inter-jurisdictional arrangements cover, in addition to water allocation, such matters as data collection, the sharing of costs, the monitoring of water use and pollution, the operation and maintenance of infrastructure, and the conservation of the environment.

The key inter-jurisdictional agreements among the jurisdictions of the Murray–Darling and Colorado River basins are outlined in tables 3A.5 and 3A.6.

3.5 In summary

In each of the jurisdictions studied, the characteristics of water — such as its multiple and joint use, and the inherent uncertainty of future supplies — have shaped the legal framework for water rights.

In each jurisdiction there is a similar legal approach underpinning water rights. The right to control water is vested in the State, on behalf of the public. Water users do not own water resources as property but rather acquire a right to the use and to the benefits of that use.

In all jurisdictions, a principal water act or code governs the definition of rights and the allocation of water resources. Water rights are conferred by statute or granted administratively — on application to take water or by recognising a prior appropriation.

The key difference between the legal frameworks of the jurisdictions studied relates to the ability of the government to change existing rights. In the Australian jurisdictions studied, Mexico and South Africa, the terms and conditions of rights can be modified by government. Such changes generally occur through the revision of allocation plans (see chapters 5 and 6). Moreover, in some jurisdictions, changes can be made without compensation — although some provisions exist that allow right-holders to seek compensation if rights are changed during the duration of associated water allocation plans.

Two jurisdictions — NSW and Queensland — prohibit the payment of compensation for changes to rights following a scheduled review of an allocation plan.

In California, Colorado and Chile, while water rights confer a quasi-usufructuary right to water, Constitutional and statutory provisions ensure that the titles to these rights are the property of individuals. In these jurisdictions, the government can not modify existing water rights. The primacy given to the rights of right-holders is further reinforced by ‘no injury’ provisions in legislation that prohibit any activity that might injure an existing water user’s right (see chapter 5).

A second difference is the federal–state division of responsibilities for water and the environment. In Australia, both water management and environmental protection are mainly the responsibility of the states and territories. The Australian Commonwealth Government is generally only responsible for environmental matters that are of national significance.

In California and Colorado, water resource management is the responsibility of the State Government. However, the US Federal Government has wide-reaching responsibilities for environmental management and protection. Responsibility for environmental protection in Chile, Mexico and South Africa rests with the national government.

The legal frameworks of the jurisdictions studied offer a variety of instruments that enable users to access and use water resources. These instruments comprise rights that do not require any administrative approval and others granted administratively for the extraction, storage and use of water. These rights can be grouped into a number of broad categories, including stock and domestic, surface water rights, harvest rights, groundwater rights, and indigenous water rights.

All jurisdictions have administratively granted water rights for access and use of surface water. Most of these take the form of licences. Two exceptions are South Africa, where the use of water under a general authorisation does not require a licence and Chile, where traditional water rights have generally not been registered.

There is no consistent approach to licensing the harvest of overland flow among jurisdictions studied. In NSW, Victoria, ACT, California, Colorado and South Africa, rights are administratively granted. In Queensland and South Australia, licences are only required in catchments or areas that have been identified as stressed — such as prescribed areas in South Australia or where identified by Water Resource Plans in Queensland.

The right to extract or use groundwater is administratively granted in most of the jurisdictions studied. The taking or use of groundwater in Queensland and South Australia only requires a licence in catchments or areas that have been identified as stressed. In California some groundwater rights are available under common law.

The major non-consumptive use of water is the allocation of water for environmental protection purposes. In most of the jurisdictions studied, there are statutory provisions requiring the adequate protection of the environment.

In most of the jurisdictions studied, environmental flow requirements have been established. The exceptions are Colorado and Chile, which set aside a volume of water for an agency to manage. Environmental flow requirements generally act as constraints in the distribution of water to users. For example, in South Australia, the storage manager ensures that the total flow regime does not violate environmental flow requirements.

An allocation of water defined in volume or share terms is set aside for the environment in some of the jurisdictions studied. In these jurisdictions, the environment may have an equal right to the release of water along with other water users. For example, supplementary environmental water in NSW commits water exclusively to specific environmental purposes.

Attachment 3A

Table 3A.1 **Key water-related legislation and agreements — Australian jurisdictions, 2003**

<i>Jurisdiction</i>	<i>Allocation</i>	<i>Environment</i>	<i>Infrastructure</i>	<i>Inter-jurisdictional</i>
NSW	Water Management Act 2000	Water Management Act 2000 Catchment Management Act 1989 Environmental Protection Act 1979	Water Management Act 2000	NSW Queensland Border Rivers Act 1947. Murray–Darling Basin Act 1992
Victoria	Water Act 1989	Water Act 1989 Catchment and Land Protection Act 1994 Environmental Protection Act 1994 Heritage River Act 1992	Water Act 1989 Catchment and Land Protection Act 1994	Murray–Darling Basin Act 1993 The Victoria South Australia Border Groundwaters Agreement (1985)
Queensland	Water Act 2000 Water Resource Plans	Water Act 2000 Environmental Protection (Water) Policy 1997	Integrated Planning Act 1997 Water Act 2000	NSW Queensland Border Rivers Act 1946 Lake Eyre Basin Agreement Act 2001 Murray–Darling Basin Act 1996
South Australia	Water Resources Act 1997	Water Resources Act 1997 Environmental Protection Act 1993	Water Resources Act 1997	Lake Eyre Basin (Intergovernmental Agreement) Act 2001 Murray–Darling Basin Act 1993; Groundwater (Border Agreement) Act 1985
ACT	Water Resources Act 1998	Water Resources Act 1998 Environmental Protection Act 1997	Land (Planning and Environment) Act 1991	n.a.

n.a. Not applicable.

Sources: Annexes B to F.

Table 3A.2 Key water-related legislation and agreements — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Allocation</i>	<i>Environment</i>	<i>Infrastructure</i>	<i>Inter-jurisdictional</i>
US Federal	Water Resources Planning Act 1983	Clean Water Act 1977 Land Policy and Management Act 1976 Endangered Species Act 1973 Wild and Scenic Rivers Act 1968 National Environmental Policy Act 1969 Fish and Wildlife Coordination Act 1965	Water Resources Planning Act 1983 Water Resources Development Act of 1996 Reclamation Act 1902	na
California	Californian Water Code 1943 Riparian and Appropriative doctrines. State Constitution	Public Trust Doctrine Central Valley Project Improvement Act 1992 Ecosystems Restoration Program Porter-Cologne Water Quality Control Act 1969 California Environmental Quality Act California Wild and Scenic Rivers Act 1972. CALFED Bay-Delta Authority Act 2003	Californian Water Code 1943	The various laws, decrees and regulations under the Law of the River, including the Colorado River Compact 1922, Boulder Canyon Project Act 1928, California Limitation Act 1929, Utilisation of Waters of the Colorado and Tijuana Rivers and of the Rio Grande Treaty 1944, Arizona versus California U.S. Supreme Court Decision of 1964 and Supplemental Decree 1979 and Interim Surplus Guidelines 2000 California Seven Party Agreement 1931
Colorado	Water Right Determination and Administration Act 1969 Ground Water Management Act 1965 Constitution	Water Administration and Determination Act 1969 Water Quality Control Act Colorado Wilderness Act 1993	Title 37 Colorado Statutes (Irrigation, conservancy and conservation districts – Articles 41 to 48; Reservoirs and waterways – Articles 86 to 89)	The various laws, decrees and regulations under the Law of the River, including the Colorado River Compact 1922, Boulder Canyon Project Act 1928, Upper Colorado River Compact 1948 and Utilisation of Waters of the Colorado and Tijuana Rivers and of the Rio Grande Treaty 1944. Arkansas River Compact and La Plata River compact. Equitable apportionment decrees — Wyoming v. Colorado and Colorado v. New Mexico.

(Continued next page)

Table 3A.2 (continued)

<i>Jurisdiction</i>	<i>Allocation</i>	<i>Environment</i>	<i>Infrastructure</i>	<i>Inter-jurisdictional</i>
Chile	National Constitution Water Law 1981 National Water Resource Policy 1998	National Water Resource Policy 1998 Environmental Law 1994	Water Law 1981 Irrigation Law for Major Works No. 1,123 of 1981 Irrigation Law for Minor Works No. 18,450 of 1985	
Mexico	Article 27 of the Mexican Constitution 1917 National Water Law 1992	National Water Law 1992 General Law of Ecological Equilibrium and Environmental Protection 1988 and 1996 Ecological Criteria on Water Quality 1989	National Water Law 1992 Federal Rights Law 1982 and its reforms Federal Revenue Law 1997, 1998, and 1999 Public Works (Water Infrastructure) Improvement Law 1990	1944 International Treaty between Mexico and the US
South Africa	National Water Act 1998	National Water Act 1998, National Environmental Management Act 1998, Environment Conservation Act 1989	National Water Act 1998, Water Services Act 1997	Protocol on Shared Watercourse Systems 1995,

na Not applicable.

Sources: Annexes G to L.

Table 3A.3 Vesting of water rights — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
NSW	All rights to the control, use and flow of waters in rivers, lakes, aquifers and water conserved by works under the control of the Minister and all water occurring naturally on or below the surface of the ground are vested by statute in the State. Basic rights are vested by statute and allow a person to take water for stock and domestic purposes.
Victoria	The State has the statutory right to the use, flow and control of all water in a water way and all groundwater. This includes water in rivers, creeks, streams or watercourses, private dams, natural channels or channels formed by the alteration or relocation of a waterway in addition to lakes, lagoons, swamps and marshes. Stock and domestic rights are vested by statute and allow a person to take water to which that person has access by a public road or public reserve or because that person occupies land on which the water flows.
Queensland	All rights to the use, flow and control of all water are vested in the State by statute. Waters include water in a watercourse, lake or spring, groundwater, overland flow water or water that has been collected in a dam. Stock and domestic statutory entitlements are vested by statute and allow a person to take water for stock and domestic purposes.
South Australia	All rights to the use, flow and control of all water are vested in the State by statute. Authority is not needed to take or use water from a non-prescribed resource. Water resources are defined as a watercourse or lake, surface water, groundwater and effluent. Stock and domestic rights are vested by statute and allow a person to take water for stock and domestic purposes.
ACT	The rights to use, flow and control of all water resources, except those under National Land, are vested in the State by statute. Rights to water under land controlled by a lessee before 11 December 1988 are vested in the lease holder.

Sources: Annexes B to F.

Table 3A.4 Vesting of water rights — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
California	Ownership of all water within the State is vested in the people of California through the Californian Water Code.
Colorado	Under the State's Constitution, water in its natural state is vested in the State and individuals have the right to appropriate and use water based on the first-in-time first- in-right priority system. Includes surface and groundwater.
Chile	Ground and surface water are national goods of public use, and private parties can hold water rights over those waters. Water rights are permanently vested in water users by the administering agency under the <i>Water Code 1981</i> . These rights are protected as private property by the Constitution. In addition to these water rights, a significant proportion of water rights are not formalised. These rights are established under previous legislation or customary use.
Mexico	All surface and groundwater defined in the article 27 of the Mexican Constitution, except that which flows through a single property or lies beneath it, belongs to the Nation.
South Africa	The State is the public trustee of South Africa's water resources. The National Government, acting through the Minister, has the power to regulate the use, flow and control of all water in South Africa. Water resources include watercourses surface water, estuary and aquifers.

Sources: Annexes H to L.

Table 3A.5 Key water-related legislation and agreements — Murray–Darling Basin, 2003

<i>Agreement</i>	<i>Jurisdictions</i>	<i>Description</i>
Council of Australian Governments Water Reform Framework 1994	Commonwealth, States and Territories	Provides overarching guidelines for each State and Territory regarding water resource management. Includes the National Water Quality Management Strategy and the National Heritage Trust (1997).
Environment Protection and Biodiversity Conservation Act 1999	Commonwealth, States and Territories	Provides that any action that might have a significant impact on a matter of national environmental significance must have Commonwealth approval.
National Action Plan for Salinity and Water Quality 2000	Commonwealth, States and Territories	Addresses problems associated with salinity and water quality in priority regions in Australia. Plan provides a natural resource management framework and outlines financial obligations.
Murray–Darling Basin Agreement 1992	Commonwealth, NSW, Victoria, SA, Queensland and ACT	Sets out the composition of inter-jurisdictional organisations and the procedures to be followed for natural resource management, the sharing of water between jurisdictions, water distribution, asset management, financial disbursements and implements a cap on the extraction of water.

Source: Annex A.

Table 3A.6 Key water-related legislation and agreements — Colorado River Basin, 2003

<i>Agreement</i>	<i>Jurisdictions</i>	<i>Description</i>
Colorado River Compact 1922	7 Colorado River Basin States	An agreement between the 7 Colorado River Basin states, later approved by the US Federal Government to share the waters of the Colorado River.
Boulder Canyon Act 1928	Federal legislation, Lower Colorado River Basin States	Approved the <i>Colorado River Compact 1922</i> at the federal level and authorised the construction of the Hoover Dam and related irrigation facilities in the lower Basin.
California Limitation Act 1929	Federal legislation, California	Held California's use of the Colorado River to the 4.4 million acre feet (5427 GL) apportioned to it under the <i>Colorado River Compact 1922</i>
Utilisation of Waters of the Colorado and Tijuana Rivers and of the Rio Grande Treaty 1944	US Government and Mexico Government	Provides for the allocation of the Colorado River between the US and Mexico.
Upper Colorado River Compact 1948	7 Colorado River Basin States	Apportioned the Upper Basin's allocation under the <i>Colorado River Compact 1922</i> between the four upper basin states.
Colorado River Storage Project 1956	Federal legislation, Upper Colorado River Basin States	Provided a comprehensive upper basin-wide water resource development plan and authorised the construction of Glen Canyon, Flaming Gorge, Navajo and Curecanti dams for river regulation and power production, as well as several projects for irrigation and other uses.
US Supreme Court Decree 1963	US Supreme Court, Lower Colorado River Basin States	Settled a dispute between Arizona and California stemming from Arizona's desire to build the Central Arizona Project so it could use its full Colorado River apportionment.
Colorado River Basin Project Act 1968	Federal legislation, 7 Colorado River Basin States	Authorised construction of a number of water development projects in both the upper and lower basins, including the Central Arizona Project. It also made the priority of the Central Arizona Project water supply subordinate to California's apportionment in times of shortage, and directed the Secretary to prepare, in consultation with the Colorado River Basin States, the Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs.
Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs 1970	Federal Government, 7 Colorado River Basin States	Provided for the coordinated operation of reservoirs in the upper and lower basins and set conditions for water releases from Lake Powell and Lake Mead.
Interim Surplus Guidelines 2000	Federal Government, 7 Colorado River Basin States	Allows California to keep using more than its Colorado River entitlement as its reduces its use until 2015.

Source: Annex G.

4 Organisations involved in the water rights system

A large number of government agencies, community bodies, tribunals, courts, and private sector organisations and businesses are involved in the establishment and administration of water rights. Their functions include policy development, allocating water between consumptive and non-consumptive uses, administering water rights, distributing water among water right-holders, and monitoring and enforcing rights.

The purpose of this chapter is to provide an overview of the types of organisations involved in each of the jurisdictions studied and their respective functions. This overview provides contextual information for later chapters that cover particular aspects of the water rights systems.

The relationships and interactions between the various organisations, both within and between jurisdictions, play an important role in ensuring that water rights systems are effective and efficient. Further, many activities, beside water extraction, affect the health of water sources. Consequently, the relationships between organisations involved in water resource management and organisations involved in the management of other natural resources were examined.

The governance arrangements examined include the separation of functions to reduce potential conflicts of interest, and the reporting requirements and resourcing of government agencies. With such a heavy reliance on public administration in some of the jurisdictions studied, governance arrangements are important. Agencies have more incentive to act consistently with the community's economic, social and environmental objectives, if they are held accountable for their performance.

4.1 Overview of organisations

Among the jurisdictions studied, the number of organisations involved in the water rights systems and the functions they perform, varies considerably.

The range of functions generally undertaken by organisations is described in box 4.1, and tables 4.1 and 4.2 summarise which organisations perform these

functions in each of the jurisdictions studied. For more detailed discussions of the roles of organisations in allocation, administration, distribution and monitoring and enforcement, see chapters 6, 7, 8 and 10.

Box 4.1 Functions of organisations involved in water resource management

The following functions are generally undertaken by organisations involved in water resource management in most of the jurisdictions studied.

Policy development — prepare legislation and formulate planning guidelines, define rights, and set conditions, standards and regulations.

Allocation — allocate water between consumptive and non-consumptive uses through the use of resource plans or acquisition programs.

Administration — issue, register or recognise water rights, change or transfer water rights in accordance with resource plans and acquisition programs, guidelines, regulations and standards.

Distribution — determine and assign the available water each season to water right-holders and the environment, and divert, store, and deliver this water. Undertaken in accordance with water rights, legislation, resource plans, acquisition programs, guidelines, regulations and contracts.

Monitoring and enforcement — ensure compliance with water rights, and determine if environmental allocations have been met and desired environmental outcomes are being achieved.

In addition to these five functions, there are also organisations that have regulatory oversight responsibilities in relation to the water rights systems in the jurisdictions. These organisations are responsible for monitoring or regulating the activities of the other organisations involved in the system.

For example, in most jurisdictions, government departments or independent government price regulators are charged with monitoring or regulating the prices charged by water infrastructure service providers (see chapter 9). In some jurisdictions, an organisation may also be responsible for establishing trading rules and regulating trade in relation to water rights.

Each of the jurisdictions studied has many government agencies and private sector organisations involved in its water rights system. Similar types of organisations undertake similar functions in each jurisdiction. For example, the policy development and allocation functions are generally the responsibility of government departments and advisory bodies.

Among the jurisdictions studied, there are some notable differences in the arrangements and responsibilities of the organisations involved. These differences stem largely from the different legal frameworks of the jurisdictions and mainly relate to the roles of government departments and courts (see chapter 3).

In particular, the extent to which the use of water is effectively conferred on individual water users determines the role of courts in administering water rights and the degree to which governments plan the allocation of water.

In California, Colorado and Chile, where rights are effectively conferred upon individual users, courts have primary responsibility for administering water rights (Colorado), clarifying existing water rights to groundwater (California) and recognising traditional water rights (Chile). The courts are important forums for adjudicating disputes between water right-holders. In the other jurisdictions studied, the role of the courts is generally limited to hearing appeals against governmental decisions made in regard to the administration of rights.

In jurisdictions where the effective control of water is exercised by the jurisdiction, water resource management tends to be more centralised — that is, the functions tend to lie with a central government department rather than between a number of smaller, often specialised organisations.

In each of the Australian jurisdictions, a Minister has final responsibility for water management. Each Minister is assisted by a government department, which typically has responsibility for developing and administering policies in relation to all natural resources. In contrast, California, Colorado and Chile have adopted a less centralised approach, with responsibility often resting with water-specific organisations. In Colorado and Chile, the environmental third-party effects arising from the storage and regulation of water flow are addressed by organisations other than the water agency.

The division of federal–state responsibilities for water and the environment has influenced the types of organisations involved and their functions (see chapter 3). In Australia, state governments have primary responsibility for the implementation and administration of water rights systems. The Commonwealth Government’s role is largely confined to dealing with issues (mainly environmental) of national significance and facilitating cooperation between the states through the Murray–Darling Basin Ministerial Council and other such cooperative agreements and bodies.

The separation of roles between state and federal agencies in the US is not as clear. The agency with controlling authority depends upon the source of the water and whether the supplying infrastructure is state or federally-owned.

Table 4.1 Overview of the functions of organisations involved in the water rights system — Australian jurisdictions, 2003

<i>Organisation by jurisdiction</i>	<i>Policy development</i>	<i>Allocation</i>	<i>Administration</i>	<i>Distribution</i>	<i>Monitoring & enforcement</i>
NSW					
Dept. of Infrastructure, Planning and Natural Resources	✓	✓	✓		✓
Water Advisory Council	✓ ^a	✓			
Water management committees ^b		✓			
Land and Environment Court			✓ ^c		✓ ^d
State Water				✓	
Irrigation corporations and urban water suppliers				✓	✓ ^e
Audit panel					✓ ^f
Victoria					
Department of Sustainability and Environment	✓	✓	✓ ^g		
Entitlement committees		✓			
Consultative committees		✓			
Victorian Civil and Administrative Tribunal			✓ ^h		
Urban water authorities				✓	
Rural water authorities		✓ ⁱ	✓	✓	✓ ^j
Resource manager					✓ ^k
Queensland					
Department of Natural Resources and Mines	✓	✓	✓	✓ ^l	✓
Technical reference panels		✓ ^m			
Community reference panels		✓ ⁿ			
Referral panel		✓			
Land Court			✓ ^o		
SEQ Water and water authorities				✓	✓ ^p
Sunwater				✓	✓ ^p

(Continued next page)

Table 4.1 (continued)

<i>Organisation by jurisdiction</i>	<i>Policy development</i>	<i>Allocation</i>	<i>Administration</i>	<i>Distribution</i>	<i>Monitoring & enforcement</i>
South Australia					
Department of Water, Land and Biodiversity Conservation	✓	✓ ^q	✓		✓
Water Resources Council	✓				
Catchment water management boards		✓			
Water resources planning committees		✓			
Environment, Resources and Development Court			✓ ^r		✓
SA Water				✓	
Irrigation authorities				✓	✓ ^s
ACT					
Environment Protection Authority	✓	✓	✓	✓ ^t	✓
ACTEW				✓	
Administrative Appeals Tribunal			✓ ^u		

^a Advises Minister on future direction of water policy. ^b Water management committees may be established as community advisory committees under s. 388 of the *Water Management Act 2000*. ^c Appeals only. ^d Has jurisdiction to hear any unresolved enforcement disputes. ^e The irrigation corporations and urban water suppliers monitor compliance within their districts, but there are no formal monitoring and enforcement arrangements. ^f Has a role in ensuring resource plans are being implemented. ^g Registration only. ^h Appeals only. ⁱ Under bulk entitlement orders only. ^j Monitor and report own water use. Monitor and enforce water rights in its jurisdiction. ^k Bulk entitlements only. ^l In relation to unregulated rivers. ^m Advisory only. ⁿ Advisory only. ^o Appeals only. ^p Self-monitor environmental flows and monitor their supply contracts with customers. ^q Development of the State Water Plan. ^r Appeals only. ^s Monitor water rights of their members. ^t In relation to unregulated rivers. ^u Appeals only.

Sources: Annexes B to F.

Table 4.2 Overview of the functions of organisations involved in the water rights system — overseas jurisdictions, 2003

<i>Organisation by jurisdiction</i>	<i>Policy development</i>	<i>Allocation</i>	<i>Administration</i>	<i>Distribution</i>	<i>Monitoring & enforcement</i>
California					
Department of Water Resources	✓	✓ ^a		✓ ^b	
State Water Resources Control Board		✓	✓		✓
Secretary for Resources	✓	✓			
Resource agency		✓			
California Bay-Delta Authority		✓ ^c			
State courts		✓ ^d	✓ ^e		✓
Bureau of Reclamation (US)				✓	
Rural and urban water supply authorities				✓	✓ ^f
Colorado					
Division of Water Resources (Office of the State Engineer)	✓		✓	✓ ^g	✓ ^h
Water Legislative Review Committee	✓				
Colorado Water Conservation Board	✓	✓ ⁱ	✓ ^j		✓ ^k
Groundwater Commission	✓		✓ ^l		✓
Water courts			✓		✓ ^m
Bureau of Reclamation (US)				✓	
Water districts				✓	✓ ⁿ
Irrigation districts				✓	✓ ^o
Chile					
Directorate General of Water	✓		✓		✓
National Commission for the Environment	✓	✓	✓ ^p		✓
Directorate of Public Works	✓				
National Irrigation Commission	✓				
Courts			✓ ^q		
Water user associations				✓	✓ ^r

(Continued next page)

Table 4.2 (continued)

<i>Organisation by jurisdiction</i>	<i>Policy development</i>	<i>Allocation</i>	<i>Administration</i>	<i>Distribution</i>	<i>Monitoring & enforcement</i>
Mexico					
Secretariat of Environment and Natural Resources	✓	✓			
National Water Commission	✓	✓		✓	✓
River basin technical committees		✓			
Underground water committees		✓			
Mexican Institute of Water Technology		✓			
River basin advisory groups		✓			
Water Consultative Council		✓			
Water user groups		✓		✓	
Irrigation districts				✓	
South Africa					
Department of Water Affairs and Forestry	✓	✓	✓		✓
Catchment management agency		✓	✓		
National Water Advisory Council	✓	✓			
Water Tribunal		✓	✓ ^s		
Water boards				✓	
Water user Association				✓	
Irrigation boards				✓	

^a Development of the State Water Plan. ^b Owner of infrastructure. ^c The Authority may buy rights, but does not have a role in initial allocation. ^d The Courts may influence policy in so far as they interpret the Code. ^e Appeals only. ^f Authorities monitor their supply contracts with customers. ^g In relation to unregulated rivers. ^h A monitoring role only. ⁱ Purchases water rights in collaboration with other federal and state agencies. ^j In relation to in-stream rights for environmental flows. ^k Works with the Attorney-General to pursue litigation and protect in-stream flow rights. ^l Delegates this function to the Office of the State Engineer. ^m Enforcement role. ⁿ Monitor the supply contracts or water rights of its members. ^o Monitor the supply contracts or water rights of its members. ^p In relation to water quality. ^q Administer applications for legalisation of water rights issued prior to 1981. ^r Consisting of monitoring committees, canal associations and water communities. Each is responsible for monitoring and enforcing water rights of its members. ^s Appeals only.

Sources: Annexes G to L.

Geographical and hydrological features have also been influential in shaping the types of organisations involved, and their respective responsibilities. For example, where jurisdictions within a country, or jurisdictions in different countries, share

water resources, inter-jurisdictional organisations may be established to oversee the development of sharing agreements.

4.2 Coordination of resource management

Each of the jurisdictions studied has a number of organisations involved in the water rights system, as can be seen in tables 4.1 and 4.2. Not only are there multiple functions, but in many of the jurisdictions, each function is performed by more than one organisation. Consequently, some degree of coordination among the various organisations is necessary if the system is to work cost-effectively.

When responsibility for the achievement of an outcome is shared between two or more organisations, it can be difficult to hold any of the organisations accountable for poor performance.

The assignment of responsibility to a single organisation for the achievement of an outcome can be achieved in one of two ways. First, a single organisation can fulfil all functions. However, this gives rise to potential conflicts and trade-offs (see section 4.3). Alternatively, a single organisation can be held accountable for ensuring that the organisations collectively achieve the outcome.

Generally, coordination at the highest level — either the national or state level — is undertaken by a government department. However, the extent of coordination is usually limited to developing broad policies for water resource management. This is the case in all of the jurisdictions studied except California, Colorado and Chile, where the various organisations involved in water resource management cooperate to ensure that environmental outcomes are achieved.

Integrated catchment and natural resource management

Many of the outcomes that governments seek to achieve through water resource management cannot be achieved in isolation from the management of other natural resources, because the different resources are inter-related. For example, a commonly held objective across all jurisdictions — ‘environmental sustainability’ — can only be achieved through an integrated approach to water and land-use management and environmental protection.

For successful achievement of outcomes, both vertical and horizontal coordination is required. Vertical coordination involves different layers of government, community and private sector organisations. Horizontal coordination involves different resource management agencies within one level of government.

Integrated management of land and water is usually facilitated at a catchment level. The Standing Committee on Environment and Heritage described ‘catchment management’ as an approach to land and water management that:

... involves integrating ecological, economic and social aspects of natural resource management around an identified catchment system. It aims to integrate these considerations in the way that best ensures long-term viability whilst at the same time serving human needs (SCEH 2000).

Each of the Australian jurisdictions has made a commitment to integrated management of land and water (Bellamy et al. 2002). Generally, regional catchment-based authorities in each jurisdiction have been charged with the responsibility of developing strategies or plans for the management of resources within their respective catchments. These organisations vary in structure, and the strategies and plans developed by them vary in terms of formality, legislative support and integration with other resource management plans.

In Victoria, catchment management authorities prepare Regional Catchment Strategies and Regional Management Plans, which are aimed at coordinating land and water management within the catchment. However, these authorities do not have a formal role in the development of Bulk Entitlement Orders, or Stream Flow and Groundwater Management Plans, which are the responsibility of Entitlement Committees.¹

In Queensland, catchment management associations and regional strategy groups are invited to prepare integrated management plans. However, these plans do not have a statutory basis and depend on voluntary participation. Organisations responsible for the management of land-use and vegetation and for developing Water Resource Plans operate independently from these catchment management bodies.

In South Australia, water is managed on a catchment basis through the development of Catchment Water Management Plans and Water Allocation Plans by catchment water management boards. Unlike the integrated management plans in Queensland, these plans have statutory backing and there is a more formal process of coordinating all government and community activities. However, catchment plans for water resource and land management are currently developed in parallel rather than integrated.²

¹ Catchment management authorities may have representation on the entitlement committees, but this is not specifically required under the legislation.

² Proposed new natural resource management legislation for South Australia would bring together the plans, policies, programs and activities that currently exist in different areas of natural resource management into a single system. The new approach is intended to ‘create a

In California, integrated catchment management is not approached through development of ‘whole of catchment plans’ as in some of the Australian jurisdictions. Several coordination mechanisms are used. First, the California Bay–Delta Authority, comprising representatives from state and federal agencies, is responsible for implementing the CALFED Bay–Delta Program in the San Francisco Bay Delta. Second, the California Biodiversity Council has been established to facilitate and improve ‘coordination and cooperation between the various resource management and environmental protection organisations at federal, state, and local levels’ (CBC 2003). Third, the California Environmental Protection Agency, incorporating the State Water Resources Control Board (SWRCB), coordinates the environmental management of all natural resources.

In Chile, cooperative agreements, memoranda of understanding and joint committees are employed to coordinate policy development. River basin committees, comprising representatives of the water resources agency (the DGA), the Directorate of Public Works (DOH), the environmental protection agency (CONAMA), irrigation development agency (CNR) and water user associations, develop policy guidelines for the purpose of coordinating policy development in each basin.

Inter-jurisdictional arrangements

For water sources that cross a number of jurisdictions, inter-governmental coordination helps ensure accountability. Coordination clarifies the responsibilities of each jurisdiction and increases government accountability for outcomes. The policies of an upstream jurisdiction inevitably affect economic and environmental outcomes in downstream jurisdictions.

One option for coordinating objectives and accountability across jurisdictions is to establish inter-jurisdictional organisations for that role. Inter-state agreements have been established for this purpose in some of the jurisdictions studied.

The Murray–Darling Basin Commission is an inter-state basin organisation responsible for overseeing and facilitating the implementation of the *Murray–Darling Basin Agreement 1992*. Similarly, the Dumaresq–Barwon Border Rivers Commission is responsible for the implementation of the *New South Wales–Queensland Border Rivers Agreement 1946*, an inter-state agreement between NSW and Queensland.

collaborative framework in which better integrated and more sustainable natural resource management planning, decision-making and service delivery can evolve over time’ (DWLBC 2003, p. 3).

Inter-jurisdictional agreements and organisations also exist in relation to groundwater sources. For example, the Border Groundwaters Agreement Review Committee is an inter-jurisdictional organisation established under the Border Groundwaters Agreement 1995 between South Australia and Victoria.

Where resources are shared by countries, arrangements have to be in place to resolve conflicts over the management of shared resources. Generally, international agreements are entered into and inter-jurisdictional organisations set up to ensure the implementation of the agreements.

The International Boundary and Water Commission (IBWC), which was established by Mexico and the US, is an example of an inter-jurisdictional organisation involved in the management of resources shared by countries. The IBWC oversees compliance with the terms of the *Utilisation of Waters of the Colorado and Tijuana Rivers and of the Rio Grande Treaty 1944* between Mexico and the US. The IBWC, together with the US Secretary of the Interior, US Bureau of Reclamation (BoR (US)) and the Upper Colorado River Commission, is responsible for water flow and use within the Colorado River Basin.

Inter-jurisdictional organisations have also been established between South Africa and its neighbouring countries in accordance with the Protocol on Shared Watercourse Systems entered into by 11 African nations.

4.3 Separation of functions

In addition to multiple organisations performing the same function, there are some organisations that perform more than one function (see tables 4.1 and 4.2).

Conflicts of interest can arise when organisations perform more than one role. Organisations may trade-off the performance of one function against another function because of convenience or perhaps bias towards particular stakeholders. If such a trade-off occurs, it may result in a less than optimal outcome in the way that water resources are managed.

Examples of where conflict can potentially arise can include the following:

- Organisations that are responsible for both the development of policy and its administration may have an incentive to develop policy that conforms to the organisation's current structure or core competencies, rather than policy that is in the community's best interest.
- The role of a water distributor may conflict with other organisational roles such as water allocation and policy development. Water distributors are generally

infrastructure service providers that operate under primarily commercial objectives and therefore they may have an incentive to encourage water use, in order to increase revenues. This may be inconsistent with other roles such as water allocation and policy development, where the protection of a public resource may be the primary objective.

- The role of monitoring and enforcement can conflict with policy formulation, allocation and distribution. If a water distributor is responsible for monitoring its own right or the flows allocated for environmental protection, the enforcement effort may be compromised and appropriate sanctions not applied.

In considering whether functions should be separated, the benefits of increasing the likelihood that water resources will be managed consistently with the community interest, have to be weighed up against any costs. These costs typically include transaction costs, dilution of expertise or the loss of economies of scale in administration.

There are arrangements other than separation of functions, which can reduce the potential for conflicts to arise from responsibility for more than one function. These arrangements include separating responsibility for the functions between divisions within the organisation and the establishment of ‘chinese walls’ between these divisions.

In recent years, Australian governments have moved toward the separation of functions. The separation of distribution from regulatory and enforcement roles has occurred in most infrastructure areas, generally as part of a corporatisation or privatisation process. For example, in each of the Australian states, the provision of electricity services is undertaken by an organisation that is separate from the organisation responsible for regulating the industry.

Policy formulation and allocation

In all of the Australian and overseas jurisdictions studied, policy development and allocation are not clearly separated from administration, monitoring and enforcement.

In NSW, Queensland, and the ACT, the department (or Environmental Protection Authority in the ACT) has primary responsibility for developing policy, preparing resource plans, administering water rights, and monitoring and enforcing water rights and environmental flows. Similarly, in South Australia, the Department of Water, Land and Biodiversity Conservation undertakes the policy development, administration, and monitoring and enforcement functions, although it does not prepare resource plans. In Victoria, rural water authorities are involved in four of

the five functions — allocation, administration, distribution, and monitoring and enforcement.

In South Africa, the Department of Water Affairs and Forestry has both policy development and water allocation functions in addition to administration, monitoring and enforcement. The catchment management agencies in South Africa, once established, will assume the allocation and administration functions. In Mexico, the National Water Commission (CNA) performs all of the five functions.

In California, Colorado and Chile, the role of organisations in the allocation of water is different to the other jurisdictions (see chapter 6). In these jurisdictions, organisations do not develop resource plans that affect the administration or monitoring and enforcement of water rights. Consequently, there is less scope for conflict between the allocation function and administration, monitoring or enforcement. In the other jurisdictions, a potential conflict arises because the resource plans developed by the organisation can affect the way the organisation administers, monitors or enforces water rights and environmental allocations.

In Colorado and Chile, potential conflicts may arise between the policy development functions and administration, monitoring or enforcement. However, in these jurisdictions, the courts have a greater role in administration, which also reduces the potential for conflict to arise.

In Colorado, the Office of the State Engineer (OSE) is responsible for policy development and the administration of surface water and groundwater rights — although its role in administering surface water is limited. Administration of surface water and some groundwater rights is undertaken by the state water courts.

In Chile, courts administer water rights issued prior to 1981 and the DGA administers all other water rights. The DGA also undertakes the policy development, and monitoring and enforcement functions.

None of the jurisdictions studied completely separates both the policy development and allocation functions from both the administration and monitoring and enforcement functions. However, administration in a number of jurisdictions is only a small part of the water rights system and the potential conflicts of interest associated with this are unlikely to pose a significant problem.

Distribution

The distribution of water in regulated rivers can create a conflict of roles. In NSW, South Australia and the ACT, the distribution of water in regulated rivers has been separated from other roles. However, in Victoria, rural water authorities, which

distribute water to irrigators, also have administrative and monitoring and enforcement roles. In Queensland, resource operations licence holders have both distribution and monitoring roles.

Not all of the Australian jurisdictions studied have separated the distribution function from other functions for unregulated rivers. However, the performance of distribution functions relating to unregulated rivers is less likely to conflict with the performance of other functions because it involves mainly questions of access, rather than provision and sale of infrastructure services. In contrast, distribution of water in regulated rivers is generally a revenue raising activity, which can create incentives that conflict with the performance of other functions that have the protection of a resource as their primary objective.

In Colorado, distribution is the responsibility of a number of organisations including the BoR (US), irrigation districts and water districts. The OSE (Colorado) also has a role in distribution, but does not own or operate infrastructure. Therefore, the potential for conflict to arise between the OSE's (Colorado) role in distribution and its role in policy development, administration and monitoring and enforcement is small.

In South Africa and Chile, distribution is undertaken separately from other functions. In contrast, distribution has not been separated in California, where the Department of Water Resources owns distribution infrastructure and is responsible for policy development.

Monitoring and enforcement

There are two types of monitoring undertaken in relation to water resource management and each gives rise to potential conflicts of interest with other functions.

The first type (discussed in chapter 10) involves ensuring that water is distributed in accordance with rights and resource plans. This includes monitoring and enforcing environmental allocations and flows.

A conflict of interest may arise when monitoring and enforcement is undertaken by a water distributor. Distributors — driven by commercial objectives — may distribute water in a manner inconsistent with rights and resource plans. For example, distributors may be in a position to distribute water to consumptive users at the expense of meeting environmental flow requirements.

Generally, monitoring and enforcement has been separated from the distribution role in the jurisdictions studied. However, as noted above, there is some overlap between distribution and monitoring and enforcement in Victoria and Queensland.

Similarly, the OSE (Colorado) and the CNA (Mexico), have both monitoring and distribution roles. Also in Chile, monitoring committees, which are comprised of representatives from the organisations responsible for distributing water (canal associations and water communities), have a role in monitoring and enforcing compliance.

The second type of monitoring (discussed in chapter 6) is periodic evaluation of the achievement of outcomes, through the review of water acquisition programs or resource plans. This process of review is essential in order to evaluate the assumptions that had to be made during the planning process about community preferences and the effects on the environment of regulating rivers and extracting water.

Potential conflict of interests may arise if the government agency that develops the policy and resource plans or acquisition programs for the jurisdiction is also solely responsible for reviewing those policies, plans and programs. An organisation in this situation may have an incentive to reaffirm the existing policy rather than recommend change and expose any inadequacies of a policy, plan or program it developed. However, there are also potential benefits if an organisation both develops and reviews programs and plans, because of the specialised knowledge and information required. The potential conflicts may be mitigated through an independent audit of the review.

The review of policies, plans and programs is not undertaken by a separate organisation in any of the jurisdictions studied. For example, in Queensland, South Australia and the ACT, resource plans are reviewed by the department that also has primary responsibility for developing the plans in each of these jurisdictions. Generally, the reviews form the basis of future policies and are jointly undertaken by organisations involved in the policy development, acquisition program and resource planning process.

4.4 Reporting requirements

Reporting is important to transparency. Without appropriate reporting, it is difficult to hold organisations accountable for their actions and performance. Transparency provides incentives for an organisation to work efficiently and achieve outcomes consistent with the public interest.

In this section, the reporting requirements of government organisations (primarily departments) that are involved in water resource management are described and compared.

To be effective, reporting should cover:

- internal governance arrangements, including community participation and consultation mechanisms; and
- performance towards stated objectives and targets, including financial performance.

Disclosing internal processes in an annual report is one way of achieving accountability. However, the transparency of decision making processes (such as allocation decisions) is enhanced by opening them up to public scrutiny. Detailed information about requirements for notification and transparency of decision making processes in the administration of water rights is provided in chapter 7.

Effective performance reports contain sufficient information to allow the legislature, the public and other stakeholders to make informed judgements on how well agencies are achieving their objectives (ANAO 1996). Ideally, they are balanced and include candid accounts of both successes and shortcomings. Accountability is strengthened when reports are available to the public.

The Organisation for Economic Cooperation and Development (OECD) suggests that, for accountability, organisations should be required to report financial and non-financial performance, and compliance with all applicable laws, regulations and government directives:

Public organisations should be required by law to publish annual reports on their activities and achievements, including their financial accounts. The reports should include comparisons of actual with budgeted revenue and expenses and of actual non-financial performance compared with targets set for the organisation in its planning agreement with the government. As far as possible, financial statements should follow a consistent set of government accounting principles and the reports of commercial organisations should comply with generally accepted private sector accounting principles. The annual report should include statements of compliance with all applicable laws, regulations and government directives (OECD 2002, p. 272).

In general, state and federal government agencies in Australia are required under legislation to report financial and non-financial performance to their respective State or Federal Parliament. In recent years, many governments have introduced reporting frameworks based on outcomes and outputs. Consequently, the reporting requirements of organisations have changed from a focus on cash-based budgeting to accrual budgeting. An example of the statutory reporting requirements for government organisations in Australia is provided in box 4.2.

Box 4.2 Statutory reporting requirements for Queensland Government agencies

The preparation of annual reports by Queensland Government departments, statutory bodies and government-owned corporations is required under the *Financial Administration and Audit Act 1977* and the *Financial Management Standard 1997*.

Financial Administration and Audit Act 1977

Section 39 of the *Financial Administration and Audit Act 1977* provides that departmental annual reports must contain, among other things:

- information required by the appropriate Minister to enable the Minister to assess the efficiency, effectiveness and economy of the department;
- information required under a financial management standard;
- a list of statutory bodies for which the appropriate Minister is responsible under the Minister's portfolio; and
- a copy of each set of general purpose financial statements prepared for the financial year under section 40, and the certificates and Auditor-General's report under that section for the statements.

Financial Management Standard 1997

Section 95 of the *Financial Management Standard 1997* stipulates that government agencies (other than government-owned corporations) must include the following information, among other things, in their annual reports:

- the constitution, goals and functions of the agency, including the agency's statutory objectives, functions and powers, and its goals and outputs as identified in its strategic plan;
- a review of the progress in achieving the agency's statutory obligations;
- a review of the agency's progress towards achieving its goals and delivering its outputs for the year, including details about the agency's actual performance in relation to its goals and outputs measured using the performance measures in the agency's strategic plan; and
- a review of the proposed forward operations of the agency, including its forward plans, proposed changes to operations and the need to continue current operations.

(Continued next page)

Box 4.2 (continued)

Other reporting requirements

In addition to the general statutory requirements for annual reports outlined above, some agencies might have more specific requirements under other Acts or directions. For example, the Queensland Environmental Protection Agency has additional reporting requirements under the *Environmental Protection Act 1994* and the *Nature Conservation Act 1992* and is required by the Treasurer to submit quarterly reports on its performance.

Each of the departments is also required to publish a Ministerial Portfolio Statement which is a forward-looking document outlining its budgeted financial and non-financial performance for the forthcoming year. The Queensland Government states these documents 'complement agency annual reports' and are used by stakeholders to obtain 'information on key strategies and prospective outcomes, and financial performance' of government agencies.

Queensland Government-owned corporations are also governed by the *Government Owned Corporations Act 1993* (Qld) and the *Corporations Act 2001* (Cwlth).

Source: Department of the Premier and Cabinet (Queensland) (2002).

Similarly in the US, the reporting requirements of federal government agencies, including the Department of the Interior and the Environmental Protection Agency, are governed by the federal *Government Performance and Results Act 1993* (GPRA). There are three stages of reporting under the GPRA:

- multi-year strategic plans that outline the long-term goals of the agency;
- annual performance plans that establish performance goals to be achieved, measures to gauge performance, the strategies and resources required, and procedures to verify and validate performance information; and
- annual performance reports that report on the degree to which the agency met its performance goals.

Government agencies in the other jurisdictions studied are also subject to statutory reporting requirements. For example, in California, the SWRCB is required under the *Water Code 1943* to publish biennial progress reports. In South Africa, the *National Water Act 1998* stipulates that water management organisations must submit both business plans and annual reports.

Although each of the organisations in the jurisdictions studied has reporting obligations, this in itself is not sufficient to ensure accountability. Reporting performance toward achieving objectives will only be an effective accountability tool where objectives are defined well enough to enable performance to be assessed.

4.5 Resourcing

An organisation cannot effectively be held accountable unless it is given sufficient authority and resources to fulfil the functions for which it is responsible. If resourcing is insufficient, the organisation can justifiably argue that it cannot be held accountable for outcomes that are not achieved.

An organisation is adequately resourced if it has sufficient funding, staff and infrastructure to enable it to:

- perform its functions and achieve its objectives efficiently;
- monitor its progress towards achieving its objectives, including whether internal governance processes have been complied with; and
- review the effectiveness of its objectives in meeting over-arching policy outcomes.

For a system of water rights to allow for the efficient allocation of water, each agency or body must be able to perform its functions. The adequate resourcing of organisations responsible for enforcing water rights is particularly important. For example, if enforcement is inadequate, water theft might result in the value of users' rights being undermined. It also has the effect of increasing the costs to those who have to buy water, and possibly increasing the incentive for further theft.

It was not the intention of the Commission to assess or compare whether organisations were adequately resourced to fulfil their functions and achieve their objectives. Instead, information is provided on the extent that critical activities such as monitoring and enforcement are undertaken and whether administrative costs are recovered (chapters 6, 7, 8, 9 and 10).

Providing organisations with the resources necessary to monitor their progress towards meeting objectives is an important aspect of effective governance. This is particularly so with complex arrangements such as those for water, where objectives are not always clearly defined or measurable and their achievement is not readily identifiable.

4.6 In summary

There have been major reforms to water right arrangements over recent years in Australia. In some jurisdictions, such as NSW and Queensland, these reforms have increased reliance on administrative re-allocation of water to manage water use in the presence of uncertain environmental consequences of water consumption.

Many of the organisations involved in water resource management perform more than one of the functions listed in box 4.1. For example, in many jurisdictions, government departments undertake multiple and sometimes conflicting functions, and responsibilities for distribution and monitoring and enforcement are not always separated. This has the potential to result in trade-offs being made between the various functions, possibly leading to water resource management outcomes that are not in the public interest.

None of the jurisdictions studied have completely separated responsibilities for each of the different functions. However, the possibility of improved outcomes that might result from separation needs to be balanced against any increased transaction costs associated with separation.

A water rights system that allocates water efficiently requires a high degree of coordination between the various organisations involved. In most jurisdictions, a coordinated approach is generally facilitated through broad water management policies. A single agency, such as a government department, is responsible for ensuring that these policies are followed.

Further, many jurisdictions are moving toward an integrated approach to land and water management, recognising that water-related outcomes cannot be achieved in isolation. An integrated approach to land and water management, generally at a catchment level, is being pursued either through the establishment of catchment management plans, or specialised agencies that facilitate greater coordination and cooperation between the different resource management agencies. That said, none of the jurisdictions studied has a fully integrated approach to natural resource management and, as a consequence, it is difficult to hold any organisation accountable for environmental outcomes.

Among the jurisdictions studied, coordination at the inter-jurisdictional level has been facilitated through the establishment of either inter-jurisdictional organisations or agreements.

Public and private agencies can be held accountable to stakeholders for their actions if they have clearly stated objectives and they report their performance towards these objectives. Most of the jurisdictions studied have statutory reporting requirements for both public and private entities.

The organisations involved in water resource management in the jurisdictions studied are reported in more detail in chapters 6, 7, 8 and 10.

5 Definition of water rights

Different types of rights have been established by each of the jurisdictions studied (see chapter 3). These rights can be loosely categorised into six broad classes, according to their specified use, the source of the water, or in some cases, the potential users:

- stock and domestic;
- surface water rights (including in-stream use for hydroelectric generation);
- harvest rights for overland flows;
- groundwater rights;
- indigenous; and
- environmental flow or allocation requirements;

All water rights allow the holder to access water. Water rights are specified in terms of a volume or share of the water that a right-holder may take. This volume or share may also specify when and at what rate such water can be accessed. Without such limits, water resources are liable to be used inefficiently or overused, reducing the potential benefit to the community from the use of water (see chapter 2).

Water rights include a priority of access that a right-holder has relative to other right-holders. Specifying priority of access is one means by which the year-to-year variability of water supplies are rationed between users and uses.

Water rights have a specified duration. In some jurisdictions, the specification of water rights is linked to resource planning arrangements. For example, in NSW, Queensland, the prescribed areas of South Australia, and the ACT, the resource planning processes determine the volume of water available to water right-holders (see chapter 6).

In some jurisdictions, water rights confer on holders rights to construct the necessary works to extract water, to use water and to the timing of the delivery of that water. These ancillary rights can be exercised once the acquisition of a water right is approved. In a number of jurisdictions, separate approval processes are required to put into effect the necessary works to extract water, to use water and to make use of the channel capacity.

Finally, water rights also impose liabilities on their holders not to injure other right-holders. These liabilities are generally intended to protect third parties — such as other right-holders or the environment — but their scope of application varies across jurisdictions. In some cases, such liabilities are an important aspect of the enforcement of water rights.

Clear and unambiguous specification of water rights contributes to the efficient use of the resource. For users to be able to make efficient water use and investment decisions, they must have a reasonable expectation of the benefit that will be received over time.

Lack of clarity over the privileges and obligations attached to a right affects the value of the right:

... for market participants to estimate the value of a water right, they must be able to form expectations about the benefits associated with owning the right and the degree to which the right is protected from impairment by others. When property rights in water are ambiguous, buyers and sellers cannot ascertain the nature of the privileges and duties that are being transferred (Saliba and Bush 1987, p. 56).

The following criteria, based on the attributes of efficient rights, were used to compare how water rights have been defined in each jurisdiction:¹

- universality — all available water resources are covered by the system of rights;
- predictability of volume — users have a reasonable expectation of the volume of water that they can extract from a source;
- enforceability — the right can be protected from encroachment by others;
- certainty of title — there is legal recognition and protection of rights;
- duration — the time period that users possess the title to a right is specified;
- exclusivity — at the margin, the benefits and costs of possessing and exercising a water right accrue to the owner;
- detached from land title and use restrictions — the right is separate and free of any requirements to hold land or any restrictions on how the right may be exercised; and
- divisibility and transferability — the right may be subdivided and is freely tradeable to others.

¹ They were based upon criteria for efficient water rights developed by the National Competition Council in consultation with the Department of Agriculture Fisheries, and Forestry Australia, the Australian Bureau of Agricultural and Resource Economics and various State and Territory government agencies (NCC 2001a).

Water rights that possess these attributes will be conducive to the efficient use of water. They would prevent one person's use from imposing uncompensated costs upon third parties, and would not impede investment. Rights that meet all these criteria would also allow and facilitate trade in water and rights between users.

It is not possible to identify 'best practice' water rights from an examination of the degree to which existing rights satisfy the best practice attributes. Defining water rights often requires a trade-off between these attributes. For example, under adaptive management, rights may have to be modified over time. However, this requirement can affect certainty of title and predictability of volume over time.

The way water rights are most efficiently defined will vary between jurisdictions and possibly within jurisdictions. To be efficient, water rights have to reflect different environmental sensitivities, hydrological conditions, consumer needs and community standards.

5.1 Universality

A system of water rights has the characteristic of universality when the entire resource is encompassed by the rights to its use. Water rights arrangements that are universal ensure rights of access are protected and allow for the sustainable management of the resource.

Water sources are often physically linked — overland flows form streams and rivers, which in turn can contribute toward the recharge of groundwater sources (see chapter 2). If water sources are not managed as a whole, those sources left outside the rights system may become depleted through overuse. This may reduce the security of the rights to other water sources interconnected with the source left outside the rights system. This in turn can affect existing investments and future investment decisions.

Comparisons

To be universal, a water rights system should take in water present in major surface water channels and groundwater sources, such as aquifers. It should also encompass overland flows — rainwater that has fallen to the ground but not yet reached a channel or aquifer.

Surface water channels and groundwater sources

Most of the jurisdictions studied require users to obtain a right before taking water located in a surface water channel or a groundwater source, such as an aquifer (see tables 5A.1 and 5A.2).

In four of the studied jurisdictions, the extraction of water from certain major water sources is not controlled by water rights. These include non-prescribed surface and groundwater sources in South Australia and major groundwater sources in California and Mexico. In Queensland, the extraction of groundwater is restricted only when a Water Resource Plan (WRP) is prepared or the subartesian basin is declared.

In these four jurisdictions, water can be taken from the unregulated source the user owns or occupies, such as land overlying the aquifer or adjacent to the surface water channel. For example, in non-prescribed areas of South Australia, owners or occupiers of land can take an unlimited volume of water from either surface or ground water sources (*Water Resources Act 1997* (Sth Aust.), s. 7).

In Queensland, South Australia and Mexico, authorities can introduce measures to protect an unregulated source from overuse and degradation. Authorities in Queensland can introduce pumping controls under a WRP where the need has been identified, or if by regulation, the subartesian area is declared.

In South Australia, unregulated water sources in danger of overuse can be prescribed and brought within the water rights system. Once a water source is prescribed, use becomes subject to possession of a water right and the level of extraction is regulated (*Water Resources Act 1997* (Sth Aust.), s. 8).

Similarly, the Federal Executive of Mexico can regulate extractions if it is in the public interest to do so or if a source is at risk of degradation. Restricted areas or reserves can also be established within which access to a source is subject to set extraction limits (*National Water Law 1992* (Mex.), Title 5).

In California, authorities can only regulate groundwater pumping if the source is of a particular type or users agree to government oversight. In some areas, unregulated groundwater pumping has caused unsustainable levels of water use and a host of accompanying problems.

These range from lower water tables and increased energy costs for pumping, to land subsidence, poor water quality caused by contamination from intrusion of sea water or other contaminants and a reduction in the storage capacity of some basins (WEF 2000b, p. 13).

Colorado and the ACT are the only two jurisdictions studied in which there is conjunctive management of surface and groundwater. In Colorado, this is limited to tributary groundwater (for which surface water rights can be issued). Non-tributary and designated groundwater have separate management regimes. In the ACT, surface and groundwater are managed as though they are the same resource. Groundwater licensed before 1998 is, however, not subject to the provisions of the *Water Resources Act 1998* (ACT).

Overland flows

The coverage of overland flows — rainwater that has fallen to the ground but not yet reached a surface water channel or aquifer — by the water rights system varies between the jurisdictions.

Users in the ACT, Mexico and South Africa cannot harvest overland flows without a licence (see tables 5A.1 and 5A.2). In some other jurisdictions, whether overland flows are included within the water rights system depends upon either:

- the volume collected (NSW and California);
- the use to which the water is put (Victoria); or
- whether there is a governing water allocation plan that requires the licensing of overland flows (Queensland and prescribed areas in South Australia).

In NSW, users must obtain a licence to collect overland flows if the user intends harvesting more than 10 per cent of average run-off. Similarly, in California, the harvesting of overland flows must be licensed if 10 acre-feet (approximately 12 ML) or more is impounded. In Victoria, unlicensed collection of overland flows is limited to stock and domestic purposes.

In Chile, some areas of Queensland and non-prescribed areas of South Australia, overland flows are not limited and can be harvested freely without possession of a licence.

Harvesting of overland flows can indirectly occur through land-use change in upper catchments. South Africa is the only jurisdiction among those studied that requires a license (for a stream flow reduction activity) when establishing dryland forest plantations.

Water right systems that give coverage to overland flows are potentially superior to those that leave them outside the system. The volume of flow captured by users can be controlled, leaving water available to drain into watercourses or aquifers and

provide a more predictable supply to other users who hold rights to surface and groundwater sources.

Controlling the volume of overland flows harvested is crucial where water is in short supply and rights are traded. As the value of water rises, there is a greater incentive for users (in jurisdictions that do not regulate overland flows) to intercept water before it gets into a surface or ground water source. In extreme situations, the volume of water diverted may be enough to eliminate a surface or ground water source.

5.2 Predictability of volume and enforceability

Predictability of volume is achieved when users have a reasonable expectation of the volume of water that they can extract from a source in any given year. In order to maintain predictability, it is necessary to enforce rights so that they remain free from encroachment by others. For a right to exist in law, there must be a correlative liability on others not to interfere in the use of a right and a responsibility on the right-holder not to interfere in the rights of others (Fisher 2000).

If users do not have a reasonable understanding of the volume of water that they will receive under a right, investment may be discouraged.

Decisions about water use and investment in irrigated farming, particularly over the longer term, are strongly influenced by irrigators' expectations about the quantity of water that their statutory water rights or entitlements represent, and the expected market value of the quantity (Goesch and Hanna 2002, p. 373).

Predictability also sustains the value encapsulated in the possession of a water right, enabling right-holders to raise capital against that value. Where rights are transferable, financial institutions may be able to use the value of the right as collateral because the right can be sold on the market if borrowers default on their debts.

In any year, the volume received against a right is governed by the total volume of water available and the way in which the available water is allocated between consumptive and non-consumptive uses. The volume of water received varies, depending on rainfall and storage facilities.

Predictability can also be affected by environmental management programs that protect or restore the environmental health of water sources. For example, an adaptive management approach to water allocation may result in the re-allocation of water away from consumptive uses and towards environmental protection. Any such re-allocation would reduce the volume of water available to right-holders.

Adaptive management can reduce right-holders' confidence about the water that they will receive under their right over time. This perceived insecurity may adversely affect investment decisions and reduce the value of the right, if there is no guarantee of delivery or provision for compensation.

That said, the flexibility to change the volume of water made available for consumptive uses in favour of environmental considerations may be consistent with overall efficiency. Re-allocating water toward environmental uses may more closely reflect community preferences. These preferences may not be adequately represented in a tradeable rights market (see chapter 2).

Comparisons

The predictability of the volume of water available to a right-holder can be affected by year-to-year variations in rainfall, environmental management programs that aim to restore the ecological health of water sources and the existence of unexercised rights.

Year-to-year predictability

Groundwater rights usually have a high level of predictability on a year-to-year basis. Groundwater users can expect to receive all of their expected volume most of the time, provided the level of extraction from groundwater sources remains within sustainable levels. Uncertainty over the level of supply may only arise when future reductions in the level of extraction are required to ensure that the use of groundwater sources is sustainable.

Each jurisdiction studied experiences a climate in some areas that is essentially arid or semi-arid, where rainfall is unpredictable and of varying volumes (see chapter 2). Therefore, the ability to form a reasonable expectation of the water that is available under a surface water right depends upon the ability to predict the weather. However, the way that surface water rights are specified in the jurisdictions studied can affect the way that the risk of unpredictable water supplies is spread across right-holders.

Expressing surface water rights as a share — as in NSW, Queensland, Chile and Mexico (see tables 5A.3 and 5A.4) — allows the risks of a shortage to be spread across all users. All right-holders will receive some level of supply in lower than average rainfall years, although it may still be difficult to predict the exact volume. For example, an individual who holds a one per cent share of the available flow is guaranteed to receive that one per cent, regardless of whether the one per cent converts to 10 litres or 10 ML.

This approach contrasts with those of the US jurisdictions, where rights are specified as a volume. In the US jurisdictions, a right-holder's likelihood of receiving the specified volume depends upon their place in the time-based order of priority. For example, in a lower than average rainfall year, a user holding a right that is dated earlier than the rights of others will have their right fulfilled first. In this case, the risk of lower than average rainfall is borne primarily by low priority users (later claimants).

In Victoria, surface water right-holders possess water rights and licences to take water, and an entitlement to sales water. Water rights and licences are defined for a nominal volume of water and possess a high degree of predictability. These give right-holders a high degree of confidence of a minimum volume of supply. Most water rights and take and use licences can be expected to be fully met 96 years out of every 100 years (DNRE 1999).

Sales water entitlements are specified as a share of the water right or take and use licence. Sales water is offered only after water right and surface water licence obligations have been met. When sales water is available, water right and surface water licence holders receive a percentage of the volume specified on their water right or surface water licence up to a maximum allocation. For example, an individual can hold a water right equal to 10 ML and a right to sales water of up to 100 per cent, which allows the individual to receive up to another 10 ML when sufficient sales water is available.

Environmental management programs

Most of the Australian jurisdictions, South Africa and the two US jurisdictions studied have introduced an adaptive management approach to resource planning and acquisition programming. Under adaptive management, there is explicit recognition that the volume of water set aside for the environment might have to be changed over time as the understanding of environmental needs evolves or the value placed by the community on preserving and restoring the environment changes (see chapter 2).

The way that adaptive management is implemented in most of the Australian jurisdictions and South Africa may create greater uncertainty for consumptive users than in the US jurisdictions.

In NSW, Queensland, prescribed areas of South Australia and the ACT, adaptive management changes are implemented administratively by adjusting the volume of water available for consumptive uses over time in order to achieve specified environmental objectives. If the volume of water available to the environment is

initially insufficient, then water is re-allocated away from consumptive uses and toward environmental uses. For example, as the 10-year Water Sharing Plans in NSW are renewed, the volume of water available to consumptive users could be reduced if arrangements in the preceding period were not sufficient to restore, or sustain riverine or aquifer health.

In the US jurisdictions studied, water rights may be purchased if additional water is required for the environment and there is insufficient water available for appropriation. In California, for example, the Bay–Delta Authority buys water from willing sellers (or diverts surplus water) and releases it as needed to restore riverine health and protect fish populations in the San Francisco Bay–Delta.

Environmental considerations can also affect the predictability of volume on a daily basis. Each of the Australian jurisdictions studied provides for environmental flow requirements that can restrict the exercise of a water right. In this instance, the daily rate at which a user can extract their yearly allocation may be adjusted or delayed in order to meet or comply with environmental flows.

The approach in the Australian jurisdictions contrasts with that used in California, Colorado and Chile where consumptive water rights cannot be restricted if water is available to right-holders. In these jurisdictions, the relevant agency must hold rights of sufficient priority and volume to meet environmental flow requirements (see chapter 8).

Unexercised rights

A latent source of uncertainty in some jurisdictions is the existence of unexercised rights. In the Australian jurisdictions, unexercised rights are those that were issued in the past but have never been or have only occasionally been used.² In California and Colorado, Federal Reserve rights (such as those held by Native Americans) have not been utilised to their full potential in some areas. It is unlikely that appropriative rights in California and Colorado can remain unexercised because of the requirement that water be used beneficially.

Unexercised rights do not present a problem where sufficient water is available or where the issuing agency has made provision for their eventual activation. However, where this provision has not been made, the activation of these rights in the future can reduce the supply of water to other right-holders.

² In Australia, unexercised rights are often termed sleeper or dozer licences.

Enforceability

For all the privileges and obligations to accrue to the right-holder, appropriate monitoring and enforcement arrangements must be established to protect the right from encroachment.

It is unlikely that the enforceability of the rights issued in each of the jurisdictions studied differs greatly. Enforcement agencies in each of the jurisdictions would have similar levels of information on the volume of water that right-holders within their jurisdiction are supposed to be taking. Even where rights are specified as a share of the water available for consumptive use, enforcement agencies would be made aware of the volume that a share converts to at the start of each water cycle year.

There may be, however, higher administrative costs incurred in enforcing rights that are specified as shares. The information burden in the Australian jurisdictions is potentially higher than in the US jurisdictions because the enforcement agency must be made aware each year of the allocations made to each right.

The benefit of enforcing a right must be traded off against the costs incurred in establishing that a breach or an encroachment upon a right has occurred and in undertaking the enforcement action. Enforcement issues are discussed in further detail in chapter 10.

5.3 Certainty of title

Certainty of title refers to the legal recognition and protection of rights, which preserve the integrity of the right for the purpose it was intended. It also reduces the opportunity that individuals have to misrepresent the true nature of the right and defraud the right-holder.

Preventing fraud supports trade in water rights. For buyers to be willing to purchase water rights in the market, they must have confidence that what they are purchasing will allow them to extract water from a source.

Comparisons

There are various approaches to registering the ownership of a right, ranging from a Torrens Title system, as used in the registration of land ownership, to a system similar to a share register.

Under Torrens Title, a central register records the details of a water right. These details can include the rights and liabilities of a right, any changes that are made to the right, and any financial interests in the right (such as mortgages). A certificate of title is issued to the right-holder as an authorised copy of the information recorded in the register, but, in any dispute, what is recorded in the register is deemed correct.

Torrens Title systems provide users and potential users with a high level of certainty of title to a right.

Under such a system, the residual risk of misrepresentation of an interest is so low that governments are prepared to guarantee its integrity (Young and McColl 2002, p. 23).

Further, the credibility and integrity of the information recorded in the register is robust because formal procedures must be followed when altering the information contained in the register (Young and McColl 2002).

Torrens Title systems have been or are being introduced into NSW, Queensland and Mexico (see tables 5A.5 and 5A.6). South Australia is intending to replace its current system with a Torrens Title (NCC 2001e). In NSW, the register of water rights is linked to a register of water availability determinations and an account of water allocations held by access licence holders. Similarly, in Queensland, a Water Allocations Register is maintained in the Queensland Resource Registry. In Chile, a water right registry is maintained in the Real Estate Titles Office of each township. A water right only obtains legal standing if it is registered in the office.³

In Victoria, the ACT, California and Colorado, conventional registration systems are used. Under these approaches, information on the rights and liabilities attached to a water right are recorded both in the registry office and on the licence. Records of interests on the water right are not kept. A register of rights may be held at a central location or by an irrigation district, but information contained in the register does not guarantee legal ownership of the water right.

There are several concerns regarding the administration of titles and registers that can influence the efficiency of water rights arrangements. First, in a number of jurisdictions, such as NSW, Colorado, Chile and Mexico, information in registries and titles offices is not complete. For example, it has been estimated that in the 1990s, approximately 50 to 65 per cent of water rights in Chile were legally registered. An incomplete registry or titling system creates uncertainty as to the

³ Except where traditional and customary use of water is recognised by Chilean courts as a water right.

actual ownership, and increases transaction costs when ownership has to be demonstrated during water right trades or disputes between water users.⁴

Second, where there is inter-jurisdictional trading of water rights, differences in titling and registry practices could potentially distort permanent trading, in favour of the rights in jurisdictions that have a more certain specification of title.

The use of different registry systems may become a potential barrier to trade when water resources cross international boundaries. For example, trading of rights along the Colorado River may be inhibited or distorted by the different types of title used in California, Colorado and Mexico.

Third, the lack of centralisation of titles and registries can raise the transaction costs associated with title searches and ultimately restrict the efficiency of water right trading. In Australia, the management of title at the jurisdictional level can increase the transaction costs involved in completing a trade. As part of an inter-state trade, a buyer in one jurisdiction would incur additional costs in seeking to verify the validity of an inter-state seller's title to a right. Similarly, in Chile, real estate title offices are maintained in local townships, and there are no centralised records in the province or the region.

Environmental rights to water are generally not specifically assigned to any agency or individual. The exception to this is Colorado, where the Water Conservation Board has sole custody of environmental rights. It also maintains a registry of in-stream flow and lake-level rights in the State.

Assigning environmental rights to a specific authority could potentially assist in protecting the integrity of the environmental allocation. It may also encourage responsible management of environmental flows because there is a single point of accountability.

5.4 Duration

The duration of a right — the length of time a right-holder can exercise a right — affects the confidence that right-holders have over their ability to take water in the

⁴ Incomplete or inaccurate recordings of water rights can undermine guarantees offered by the Torrens Title system. Normally, a person who is recorded as the owner of a Torrens title cannot have the title challenged or over-turned. The title is indefeasible because the State guarantees it. However, any person who suffers a loss as a consequence of omission (for example, because water rights were incorrectly listed or described by the Titles Office), may have a case to bring a claim against the Titles Office.

future. Rights may be held in perpetuity or for a specific period of time, at the end of which the holder must apply for a renewal or extension of the right.

Security of tenure to a right is conducive to economic efficiency over time. To make investments for which costs are recovered over a long period of time, users must have confidence that they will have access to water over the long-term.

If rights are of limited duration (or if the resource plans authorising them are of limited duration), specifying clear and unambiguous terms of renewal of the water right or the plan can increase certainty for right-holders. Right holders can form a reasonable expectation of whether their right or the authorising plan will be renewed or not, according to the renewal terms. The terms that right-holders must meet to have their right renewed are discussed in chapter 7.

The potential for an issuing authority to cancel or suspend a right during its term — for reasons other than enforcement — also creates uncertainty for users. If an issuing authority has the power to cancel or suspend rights, right-holders may have less confidence in their ability to take water in the future, and may have less incentive to invest in water use activities.

Comparisons

In some of the jurisdictions studied, water rights are all issued in perpetuity. Other jurisdictions use a mixture of perpetual and limited tenure rights (see tables 5A.7 and 5A.8).

Rights held in perpetuity, such as those in California, Colorado and Chile, provide users with more certainty than limited tenure rights. With perpetual rights, the right-holder is guaranteed access to the resource over the long-term, provided there is sufficient water after all higher ranked users have been fully satisfied.

Governments that have issued rights of only limited duration (or which have water resources plans of a limited duration) have sought to reduce some of the consequent uncertainty by issuing rights for extended periods of time. For example, in NSW, Queensland and the ACT, the term of the licence or resource plan is approximately 10 years. In Mexico and South Africa, the licence term is calibrated to the needs of the water activity proposed.

Rights of limited tenure provide governments with the flexibility to manage water resources in response to unexpected changes, whether climatic or economic. Governments can re-allocate rights between users by not renewing all or part of a right when it comes up for renewal and re-allocating that right to another purpose.

The experience in the US jurisdictions suggests that it is also possible to achieve flexibility in the management of water resources under perpetual rights. In the US jurisdictions, governments can re-allocate water between competing uses by buying back rights. For example, the Colorado Water Conservation Board has the authority to purchase water rights to supply the flows necessary to meet the objectives of the Instream Flow Program (see chapter 6).

Generally, authorities in the jurisdictions studied do not have the power to cancel or suspend a right during its term (or during the term of a resource plan) for reasons other than enforcement, without compensating the right holder (see chapter 3). In California and Colorado, a right may be lost because its holder has not exercised the right and put the water to a beneficial use (the ‘use-it or lose-it’ principle). However, both these provisions form part of the conditions attached to the right and thus a breach of these conditions is an enforcement issue (see chapter 10).

In Mexico and NSW, authorities have the scope to compulsorily acquire rights if it is in the public interest. These provisions augment the degree of flexibility that authorities have over the management of resources, with a corresponding reduction in the security of the water right.

5.5 Exclusivity

Water rights are exclusive if, at the margin, they ensure that the benefits and costs of accessing and using water accrue to the right-holder.

The access and use of water creates costs and benefits. right-holders incur the costs of pumping water from a source and can retain the income generated by applying water to an economic activity, such as crop irrigation. However, the storage, extraction and use of water can also inadvertently impose costs and benefits on others (third parties). For example, storing water in dams and extracting water from a source can damage the ecological health of rivers, the costs of which are borne by the community as a whole rather than by the user alone (see chapter 2).

If right-holders bear only part of the costs of their actions or cannot capture all the benefits of their access and use, then water will not be allocated or used in a way that maximises its value to the community. Water use will occur that results in net economic costs even though users regard their activity as profitable. Further, too little water will be allocated to environmental and recreational uses because the benefits of doing so cannot be captured by the individual.

It may not be practicable or efficient to price for the third-party effects caused by the storage and extraction of water. Uncertainty over the level of environmental impacts created makes it difficult to establish an efficient price (see chapter 9).

Comparisons

Many of the costs and benefits of exercising water rights relate to the storage and extraction of water. The discharge of contaminated water is sometimes regulated within a water rights framework. There are also a number of liabilities on right-holders that also address third-party effects.

Storage effects

Dams, weirs and locks increase the benefits that accrue from holding a water right. They are used to change the natural flow patterns of rivers to more closely match demand patterns for water, consequently increasing the productive value of water. For example, irrigation dams store water when it becomes available and hold it over until the irrigation season. As a result, crop yields are higher and are worth more to the water user.

The alteration of natural river flow patterns, by storing and releasing water, can degrade the ecological health of river systems. Fish life-cycle patterns are disrupted and water quality problems, such as blue-green algae, can emerge (see chapter 2). Most of these costs are borne by the community as a whole, rather than the right-holder alone.

Over recent years, measures have been introduced in the jurisdictions studied to reduce some of the third-party costs caused by dams. Environmental flow requirements and dam release schedules have been established to restore some of the natural pattern of river flows around dams. For example, in the Colorado River Basin, the *Grand Canyon Protection Act 1992* (US Government) requires releases from Glen Canyon Dam to meet environmental, Native American, cultural and recreational interests (WEF 2001).

The extent to which these measures achieve an efficient trade-off between the benefits and costs of dams depends upon the effectiveness of organisational arrangements and the planning processes used to develop environmental protection measures (see chapter 6).

Most jurisdictions have introduced separate licensing and approval arrangements to control the construction of infrastructure necessary to take or control water — as in NSW and Queensland (works approval), the ACT (licence to take water), Chile

(approval to construct or modify a *bocatoma*). In each case, the approving authority considers the potential environmental impact of the infrastructure.

In South Australia, the method by which water is to be taken from a source (such as a well or pump), is stated on the application of the water right.

In California and Colorado, the construction of water works is also part of the specification of a water right. In Colorado, the water court does not consider the potential impacts on river flows except to the extent that it may injure existing water rights. Instead, US Federal Government legislation seeks to address any potential adverse environmental consequences resulting from the construction of water works (see chapter 7).

Extraction effects

Each of the jurisdictions studied uses restrictions on the volume of water that can be accessed by right-holders to address the third-party effects of extracting water from a source. Governments set limits on the volume of water that an individual can take under a right and thus aim to control the total volume taken from a source.

Despite these restrictions, water sources in many of the jurisdictions studied are considered over-allocated with unsustainable levels of use. For example, 44 per cent of surface water areas and 51 per cent of groundwater management units in NSW are over-allocated (NHT 2001c).⁵ Similarly, California's groundwater sources are over-allocated by 2 GL per year (DWR 1998).

The costs of over-allocation are borne by the community as well as by the right-holder. These costs can include poor riverine health that affects tourism and declining water quality that increases the cost of purifying water for drinking purposes and makes the water available increasingly unsuitable for use in agricultural and industrial processes.

In order to achieve an efficient balance between extractive use and environmental protection, governments in the jurisdictions studied have limited extractions, and introduced environmental flow requirements and environmental allocations. Environmental flow requirements constitute a set of rules and targets that define the

⁵ Over-allocation refers to situations where the volume of water taken from a source has reached a level where significant environmental damage occurs and future supplies to users are jeopardised.

flow of a river to better meet a set of economic, social and environmental objectives (see chapter 3).⁶

Where resource planning takes place, the third-party effects (including environmental costs) can be traded-off against the economic and social benefits of water use. Catchment planning committees and central water resource planners attempt to make such trade-offs, often with limited information (see chapter 6).

Whether right-holders should be compensated when environmental allocations reduce the volume of water made available to users has arisen as an issue in some of the Australian jurisdictions studied, but this is beyond the scope of this report. It is noteworthy, that because water rights in Colorado and California are judicially or constitutionally protected property rights, government agencies commonly have to buy water for environmental purposes from the marketplace.

Return effects

The use and the subsequent discharge of water can also create third-party effects on both the environment and other water users (see chapter 2). Discharges by point source polluters are usually managed through pollution discharge permits rather than the water rights framework and thus are not discussed here.

Contaminated water can also be discharged as a result of irrigation practices, such as saline groundwater intrusion into surface streams. Among the Australian jurisdictions, the administering agency can approve the use of an issued or transferred water right subject to the application of a farm management plan (see chapter 7).

In many cases, the same volume of water may be used by more than one user; for example, as water returns from irrigation land to be re-used by downstream irrigators or the environment. The clarity of ownership to return flows is important for the efficient allocation of water.

Under the Doctrine of Prior Appropriation in California and Colorado, downstream right-holders can appropriate (and thereby lay legal claim to) the return flows of upstream water users. This is possible if the downstream water user can demonstrate that the return flow is being put to a beneficial use and the upstream right-holders would not be injured by the appropriation.

⁶ Theoretically, efficient allocations to the environment are those where the marginal environmental costs of using water equal the marginal benefit, so that the total cost of using water does not exceed the benefit of water use.

Once constituted, the downstream right-holder creates an obligation on upstream water users to limit their activities in a way that does not injure the rights of downstream water users. An upstream right-holder would not be able to transfer their entire water right or increase the efficiency of water use in a way that reduced their return flows. Costly negotiations between right-holders often follow applications to transfer water rights (see chapter 7).

In contrast, in all of the other jurisdictions studied, downstream water users do not have any legal title to any return flows that may be used to fulfill their water right. Consequently, any changes in the pattern of use or transfers of water right can detrimentally reduce the volume of water available to downstream water users.

Obligations

Water rights are typically subject to a number of obligations and conditions that limit the ability of a holder to exercise that right. These are sometimes intended to address third-party effects by allowing injured parties to seek legal redress.

In all of the jurisdictions studied, there is a general liability not to take more water than is authorised, to take water only in the manner authorised, and to honestly meter and record extractions. These liabilities are typically included in the terms and conditions of the water right and, if breach, are subject to the sanctions imposed by the responsible enforcement agency (see chapter 10).

In California, Colorado and Chile, where water rights are constitutionally protected as property, there is also a general liability on water users not to injure the water rights of others (see chapter 3). This ‘no injury’ provision is broadly defined and can be enforced in a court of law.⁷

In California, the Public Trust Doctrine effectively confers a liability on a water user not to exercise their right in a manner that contravenes community values. The doctrine typically is enforced during applications to issue or transfer water rights (see chapter 7).

In the other jurisdictions, water users do not face an equivalent general liability — apart from the ACT and then only in relation to the environment.⁸ That said, in

⁷ As an illustration of the wide-ranging nature of the ‘no-injury’ provision in Colorado, water users are obliged not to discharge contaminated waters in case they impair the beneficial use of downstream right-holders. Junior (low priority) right-holders are obliged to allow senior right-holders access to water distribution infrastructure during periods of congestion (see chapter 8).

⁸ In the ACT, all persons (including water users), have a general duty of care to prevent harm to the environment (Environment Protection Act 1997 (ACT), s. 22).

Victoria, Queensland and South Africa, injured parties can seek compensation for personal and other injury arising from others breaching their obligations and water right conditions (Water Act 1989 (Victoria), s. 16; Water Act 2000 (Queensland), s. 784; National Water Act 1998 (South Africa), s. 152). However, in NSW, South Australia, Mexico and the ACT, water legislation does not explicitly provide for injured parties to seek compensation for breaches of obligations or conditions of water rights.

5.6 Detached from land title and use restrictions

The ability of a water right or the water received under a water right to be transferred unencumbered is a fundamentally important characteristic of efficient rights.

The flexibility and efficiency of any re-allocation of the resource through trading will be diminished if water rights are tied to land title or use conditions. Where such conditions apply, rights can only be exercised in a certain location and for particular purposes, even though there may be a higher valued use for the resource elsewhere.

Tying water to land and use also reduces the opportunity for intermediaries to enter the water market and facilitate trade. Intermediaries, such as water brokers, can reduce the costs of transacting water trades, and can therefore assist in allocating water to its highest valued use.

Comparisons

In each of the jurisdictions studied, the degree to which rights are separate from land title and use restrictions depends upon the type of right held (see tables 5A.9 and 5A.10).

In most jurisdictions, rights such as stock and domestic and indigenous rights are attached to land title and can only be exercised for limited uses. For example, in NSW, an owner or occupier of a landholding may take water without a licence from any river, estuary or lake to which the land has frontage, or from any aquifer underlying that land, for domestic consumption and stock watering.

In most of the jurisdictions studied, major surface and groundwater rights are separate from any requirements to hold land title. However, there are instances where major water rights remain linked to land. In non-prescribed areas of South Australia and in areas of Queensland where a Resource Operations Plan has not been established, rights are riparian in nature. However, in these areas, water use is

small in relation to the volume of the resource available and therefore it is unlikely that the lack of control would affect trading of rights.

Under the Victorian *Water Act 1989*, water rights and take and use licences are separate from land title. Rural water authorities generally require that an individual own or occupy land within an irrigation district before issuing them with a water right. This allows right-holders within the district to trade amongst themselves, but restrains the extent to which water may be traded out of the district.

Among the Australian jurisdictions studied, some major surface and groundwater rights specify the purpose for which the water right will be used. Victorian water rights and take and use licences, Queensland water allocations and South Australian ‘take licences’ require the water user to specify the purpose to which the water will be put. Similar requirements exist in Mexico and South Africa.

In California and Colorado, appropriative water rights are defined for a particular type of use. In these jurisdictions, downstream water users that make use of the return flows of upstream users, acquire a legal claim to those return flows. Upstream users can only change the use of their water right if they can obtain the approval of the downstream users, and in the case of California, that of the responsible authority.

Use restrictions in California and Colorado restrict the ability of upstream water users to make any changes that might increase the value of their water use. More recent changes to facilitate flexibility, include amending the volume specified on a water right to become net of any return flows created by a water use activity.

In contrast, in NSW and the ACT, access licences and water allocations respectively do not specify the use to which the water will be put. Similarly, permanent and eventual water rights in Chile do not specify the purpose to which the water will be applied. Consequently, there is no restriction on water users to increase the value of their water use.

5.7 Divisibility and transferability

If efficiency is to be achieved through trade, rights must be transferable. In order to maximise the benefits of trade, the right also has to be divisible. Water rights are divisible if right-holders can subdivide their right into parts and sell or lease either all or part of their right.

Comparisons

The extent to which rights are divisible and transferable in each jurisdiction depends upon the type of right (see tables 5A.11 and 5A.12).

Generally, rights such as stock and domestic and indigenous rights are not divisible or transferable, or may only be transferred with the title of the land to which they are attached. As noted in section 5.6, an inefficient allocation of water may result if water cannot be transferred to its highest valued use without incurring sizeable transaction costs.

In most jurisdictions studied, the major use rights, such as extractive licences, are divisible and transferable. However, there are often barriers that limit or prevent their transfer. These barriers may include:

- The transaction costs incurred in organising and settling a trade, such as the statutory procedures users must abide by to effect a trade.
- Physical constraints that prevent water from being transported to another locality. For example, parties to a trade may be located in different and unconnected hydrological systems, or the physical capacity of the river or irrigation channel may not be able to accommodate an increase in flow from other areas.
- Artificial restrictions that limit the number of users with whom an individual can trade. For example, in some Australian jurisdictions, the volume of water that may be traded out of irrigation districts is limited. Some governments have also limited inter-jurisdictional trading of water rights in order to maintain jurisdictional control over water resources.

Restrictions that limit the transferability of water rights in the jurisdictions studied are discussed further in chapters 7 and 8.

5.8 In summary

Water users in the studied jurisdictions must obtain a right before accessing water. However some water sources remain outside the rights system in California, Chile, Mexico, some areas of Queensland and non-prescribed areas of South Australia.

Rights in each jurisdiction are quasi usufructuary in that they allow the right-holder to use water and retain any benefit from doing so, but the holder does not own the water.

In the US jurisdictions, surface water rights are specified as a volume. In contrast, right-holders in NSW, Queensland, Chile and Mexico receive a share of whatever water is available for consumptive use. In most cases, rights in South Australia are specified as a volume, while in Victoria, right-holders possess both a volumetric and share-based component to their right.

The implication of this difference is that the risk of lower than average rainfall is distributed differently under the two systems. Under conditions of scarcity in the US jurisdictions studied, appropriative right-holders either receive water or secure no water at all depending upon their positioning in the time-based priority ordering. Consequently, the risk of a shortage is initially borne by low priority users. In contrast, the risk of a shortage in the other jurisdictions is spread among users because, even in low rainfall years, right-holders will at least get some water.

Another implication of the different way in which rights are specified is that, in the US jurisdictions, rights are usually attached to a particular type of use. Right holders cannot change the use to which water is put without approval of other water users, because this may affect the volume of return flows and hence the volume of water available to other right-holders.

Differences in the way rights are specified affects the implementation of adaptive management and the way the costs of this are distributed. In over-allocated systems, specifying rights as a share makes it easier for governments to re-allocate water to the environment by reducing the total volume of water available for consumption.

Governments in the US jurisdictions must purchase rights if they wish to increase allocations to the environment and surplus water is unavailable. In this case, the costs of adaptive management are borne by the community and right-holders receive compensation when their right is purchased.

Major water rights in NSW, Victoria and Mexico are issued for given periods of time and may be withdrawn at the conclusion of that period. In Queensland, South Australia and the ACT, water rights are perpetual but can be reduced following a review of the resource plan. In the US jurisdictions, appropriative rights are perpetual, but water rights can be fully or partly forfeited if not put to beneficial use. In Chile, water rights are perpetual.

Most jurisdictions studied still have some rights that remain attached to land title. This can affect the extent to which these rights are divisible and transferable, because they are only permanently tradeable through the sale of the land to which they are attached. However, these rights are usually small in terms of the volume of water they represent and most major use rights in all jurisdictions are detached from land title and are divisible and transferable.

Some jurisdictions — NSW, South Australia, Chile and Mexico — have introduced or are intending to introduce a Torrens Title system for registering water rights. Torrens Title systems provide the right-holder with greater certainty of title than alternative systems, because it is difficult to misrepresent a right and thus there is little opportunity for fraud.

Inter-jurisdictional differences in the way water right titles are registered potentially create distortions in the patterns of permanent trade and can increase transaction costs. Where water sources are shared between jurisdictions, buyers may favour, and thus bid up the price of, those rights registered under a Torrens Title system.

Attachment 5A

Table 5A.1 Water sources covered by the water rights system — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Water sources covered</i>
NSW	Any river, lake or estuary or any place where water occurs naturally on or below the surface of the ground. Includes overland flows collected in a dam only where the volume collected exceeds 10 per cent (or greater if so prescribed) of average runoff.
Victoria	Water in a waterway or bore. Unlicensed collection of overland flows is limited to stock and domestic purposes. Uses over and above this must be licensed.
Queensland	Water in a watercourse, lake or spring, and underground water. Groundwater sources may only be included within the rights system where a Water Resource Plan has identified a need to regulate the extraction of water. Overland flows are only licensed where a Water Resource Plan identifies this as a need. Otherwise, the collection of overland flows is only limited by dam height specifications. ^a
South Australia	Water in a watercourse, lake or well and water overflowing land collected in a dam or reservoir in prescribed areas. Use of water in non-prescribed areas is subject to common law rights.
ACT	Water in a waterway (defined as a river, creek, stream or other channel, a lake, pond, lagoon or marsh), groundwater and overland flows.

^a Currently, there is a moratorium on the development of on-farm dams.

Sources: Annexes B to F.

Table 5A.2 Water sources covered by the water rights system — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Water sources covered</i>
California	Water in any natural stream or watercourse, a subterranean stream and any sub-surface flow to a stream or watercourse. Use of other forms of groundwater are subject to common law rights. Overland flows must be licensed if the user intends impounding 10 acre-foot (approx. 12 ML) or more.
Colorado	Any natural stream, reservoir, or lake, tributary groundwater and overland flows. Designated groundwater and non-tributary groundwater are managed under separate management schemes. Rights to store overland flows are conferred by the act of appropriating and storing surface waters when available.
Chile	All surface and underground waters. Rights to overland flows are customary and not licensed.
Mexico	All surface waters that belong to the nation except that which flows through a single property. All groundwater that belong to the nation may be freely extracted, except when the Federal Executive, for reasons in the public interest, regulates their extraction and use or establishes restricted areas or reserves. Capturing overland flows require the possession of a pertinent licence.
South Africa	All surface and groundwater sources and overland flows.

Sources: Annexes H to L.

Table 5A.3 Specification of water rights — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Right</i>	<i>Measure</i>	<i>Reliability and priority</i>
NSW	Environmental Water	Flow rules and/or volumes are specified in Water Sharing Plans.	Has first priority in water use, except in severe water shortages.
	Domestic and Stock Rights (surface water)	Not specified but limited to certain uses.	Has second priority in water use, except in severe water shortages.
	Native Title Rights	Not specified but limited to certain uses.	Has second priority in water use, except in severe water shortages.
	Access Licences ^a (surface and groundwater)	Share and extraction rate, except local and major urban suppliers that have a specified volume. Share and extraction rate in any year is determined by the rules of Water Sharing Plan. Plans specify the share of the resource available to users once environmental and stock and domestic requirements have been met. Licenced water shares can only be taken via an approved water supply work and can only be applied to land consistent with a water use approval.	<p>The following priorities must be observed in relation to licences:</p> <ul style="list-style-type: none"> • local water utility licences, major utility licences, and domestic and stock licences have priority over all other licences; • regulated river high security licences have priority over regulated river general security licences and regulated river supplementary water licences, and • regulated river general security licences have priority over regulated river supplementary water licences. <p>Water allocations must be diminished at a lesser rate for higher priority licences than lower priority licences.</p>
Victoria	Bulk Entitlements	Nominal volume	Varies between bulk entitlements. Entitlements are perpetual. Priorities between right-holders for access to water can be qualified by the Minister if a water shortage is declared.
	Stock and Domestic Rights (surface and groundwater)	Not specified but limited to certain uses.	Has first priority in use.
	Water Rights (surface water)	Nominal volume	Varies between river systems but generally high (around 97 per cent of water right) because shortages are met by adjusting sales water claims. Priorities are proportionate unless qualified by the Minister if a water shortage is declared.

(Continued on next page)

Table 5A.3 (continued)

<i>Jurisdiction</i>	<i>Right</i>	<i>Measure</i>	<i>Reliability and priority</i>
Victoria (cont.)	Take and Use Licences ^b (surface water)	Nominal volume	Varies between river systems but generally high on regulated systems (around 97 per cent of licence volume) because shortages are met by adjusting sales water claims. Priorities are proportionate unless qualified by the Minister if a water shortage is declared.
	Sales Water (surface water)	Percentage of water right or take and use licence (surface water) up to a maximum allocation.	Depends upon the availability of water in the river system and thus the volume allocated to water rights or licences varies between systems and from year to year.
	In-Stream Use Licences (surface water)	Nominal volume	Varies between river systems but generally high on regulated systems (around 97 per cent of licence volume) because shortages are met by adjusting sales water claims. Priorities are proportionate unless qualified by the Minister if a water shortage is declared.
	Take and Use Licences (groundwater)	Nominal volume	Depends upon aquifer. Priorities are proportionate.
Queensland	Stock and Domestic Rights (surface and groundwater)	Not specified but limited to certain uses.	Varies according to the rules of the Resource Operations Plan, but usually high priority.
	Water Licences ^d (not subject to a ROP) ^c	May be area of land irrigated, flow conditions or volume.	Not specified.
	Water Allocations, and Water Licences (subject to a ROP)	Share of the available resource once environmental and stock and domestic needs are met.	Determined by rules of Resource Operations Plan and security level of allocation held. For example: <ul style="list-style-type: none"> • high class A priority group has priority over high class B priority group; • high class B priority group has priority over medium priority group; and • medium priority group has priority over the risk priority group. Rules and security levels may vary between Water Resource Plans.
South Australia	Stock and Domestic Rights (surface and groundwater, in prescribed areas)	Not specified but limited to certain uses. ^e	First priority after environment.

(Continued on next page)

Table 5A.3 (continued)

<i>Jurisdiction</i>	<i>Right</i>	<i>Measure</i>	<i>Reliability and priority</i>
South Australia (cont.)	Unlicensed Water Rights (surface and groundwater in non-prescribed areas)	If resource becomes over-committed, the Minister may restrict use by prescribing the resource. Otherwise, water may be freely taken provided there is no detrimental effect on other users.	Not specified.
	Water Licences (surface or groundwater, for taking or holding, in prescribed areas)	Nominal volume ^f	Full licence entitlements are usually available each year. Minister may restrict water use because of drought, water quality concerns or ecological reasons. Licences are restricted proportionately unless an alternative scheme has been made by the Governor as recommended by the Minister.
	Environmental Allocations	Nominal volume or share	Some allocations (such as those for the Lower Murray Swamps) possess the same (high) reliability as Water Licences.
ACT	Stock and Domestic Rights (surface and groundwater)	Not specified but limited to certain uses.	In most sub-catchments, Stock and Domestic right-holders have first priority to water.
	Licences to Take Water (surface and groundwater)	Nominal volume or rate of flow that may be taken.	Not defined in terms of priority.
	Allocations (surface and groundwater)	Nominal volume or rate of flow that may be taken.	Minimum environmental flows have priority of other uses (except Stock and Domestic). Commercial and irrigation uses have second priority. Recreational uses have last priority.

^a Access licences are held by irrigation companies in irrigation districts. Individuals within each district hold water shares in the company. ^b Licences may also be issued for in-stream use. ^c Resource Operations Plan (ROP). ^d Area-based licences are being converted to volumetric. ^e In areas where the Murray–Darling Basin Cap applies, stock and domestic rights are given a volumetric allocation. In other areas, stock and domestic use is not quantified. In prescribed areas, stock and domestic use may be licensed but this has not occurred. ^f In the Eyre Peninsula, Southern Basins and Musgrave Water Allocation Plans, Water Licences (for taking water) are specified as a share of the available resource.

Sources: Annexes B to F.

Table 5A.4 Specification of water rights — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Right</i>	<i>Measure</i>	<i>Reliability</i>
California	Federal Reserve Rights (surface and groundwater)	Determined by the primary purpose for which land and water were put. ^a	Priority depends on when the reserve was established.
	Riparian Rights (surface water)	Determined by need but limited by beneficial and reasonable use, and by a duty to refrain from interfering with other riparians.	Depends upon availability of water and type of use. Shortages are shared proportionately between riparian users. Riparian use has priority over appropriative.
	Appropriative Licences (surface water) ^b	Volume determined by purpose for which right was obtained. Volume specified is net of return flows. Purpose must be beneficial and reasonable.	Depends upon availability of water, time of diversion and type of use. Prior appropriators have priority over latter appropriators. State law requires that domestic use and then irrigation use is satisfied first. ^c
	Correlative Rights (groundwater)	Limited by beneficial and reasonable use, unless rights have been adjudicated by a court.	Users must share equally in the available resource.
	Appropriative Groundwater Rights (groundwater)	Limited by beneficial and reasonable use, unless rights have been adjudicated by a court.	Only available if there is surplus water available within a groundwater source after correlative right users have taken their supply.
Colorado	Federal Reserve Rights (surface and groundwater)	Determined by the primary purpose for which land and water were put.	Depends upon availability of water. Priority depends on when the reserve was established.
	Water Rights ^d (surface and tributary groundwater) ^b	Volume or extraction rate depending upon type of source. ^e Volume specified is net of return flows. Determined by purpose, which must be a beneficial use.	Depends upon availability of water and priority date. Prior appropriators have priority over latter appropriators. State law requires that domestic use and then irrigation use is satisfied first. ^c
	Well Permits (other groundwater) ^f	Volume determined by beneficial use.	For designated groundwater, depends upon date of appropriation. Prior appropriators have priority over latter appropriators. For non-tributary groundwater, water is shared equally.
Chile	Water Rights ^g (surface and groundwater)	Specified as a volume by time unit but is actually a share of the available flow or resource.	Permanent water rights are fulfilled prior to eventual water rights. Permanent water rights have a minimum reliability of being met in full 85 out of 100 years.

(Continued on next page)

Table 5A.4 (continued)

<i>Jurisdiction</i>	<i>Right</i>	<i>Measure</i>	<i>Reliability</i>
Chile (cont.)	Traditional Rights (surface and groundwater)	Usually expressed as a share of the available flow or resource.	Depends on local practice.
	Ecological volumes	Specified as a volume by time unit but is actually a share of the available flow or resource.	Usually specified as a minimum environmental flow that is met prior to all other flows.
Mexico	Stock and Domestic Rights (surface water)	Not specified but must not cause a significant decrease in volume.	Has first priority in use after environmental allocation.
	Concessions (surface water)	Specified as a volume but is actually a share of the available flow.	Concessions are granted taking into account the availability of water. Any shortages are handled by adjusting all concessions proportionately.
	Groundwater	Not specified ^g	Not applicable
South Africa	Human and Ecological Reserve	Volume.	Has highest priority.
	General Authorisations	Volume determined by the nature of the use and the capacity of the resources to accommodate the use without significant degradation.	Urban water use has the highest priority, followed by commercial (including irrigation) and then recreational use.
	Licences	Volume or share of the flow determined by nature of the use and the capacity of the resources to accommodate the use without significant degradation	Urban water use has the highest priority, followed by commercial (including irrigation) and then recreational use.

^a The extent to which this requirement may limit use, may be tempered by a Californian Supreme Court ruling that riparian rights exist on Federal Reserve lands abutting state water ways. ^b Includes subterranean streams and the sub-surface flow of surface water sources. ^c State preference laws are rarely applied because it would upset the system of priorities based upon time of diversion. There is also the possibility that the application of preference laws would be a taking of property and would require compensation (Getches 1997). ^d Water rights may also be used for in-stream environmental purposes. These rights are held by the Colorado Government. ^e In the Northern Colorado Water Conservancy District, Colorado–Big Thompson ‘Units’ are specified as a share of the available resource rather than as a volume. ^f Wells not exceeding 15 gallons a minute are exempt from administration, but still must acquire a well permit. Well permits based on a modified appropriation system exist in designated basins on the eastern plains of Colorado. These are granted by the Colorado Groundwater Commission. ^g Can be for permanent and eventual access, and for consumptive and non-consumptive uses. ^h Use must not cause material injury to prior vested water rights, and only be for ordinary household purposes, fire protection, the watering of poultry, domestic animals, and livestock on farms and ranches and for the irrigation of not over one acre of home gardens and lawns but not used for more than three single-family dwellings.

Sources: Annexes H to L.

Table 5A.5 Recording water right titles — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Right</i>	<i>Title record</i>
NSW	Environmental Water	Recorded in gazetted Water Sharing Plans.
	Domestic and Stock Rights	Attached to land title record.
	Native Title Rights	Attached to land title record.
	Access Licences ^a	Torrens Title like register administered by Land and Property Information. ^b Register records: <ul style="list-style-type: none"> • licence; • licences applied for, granted, renewed, transferred, surrendered, suspended or cancelled, and any legal or equitable interest held in a licence; • details of the share and extraction components; • links to approved works; • the expiry date of licence; and • relevant links to water sharing plan.
Victoria	Bulk Entitlements	Register maintained by the Department of Sustainability and Environment. Updated as amendments occur.
	Stock and Domestic Rights	Attached to land title record.
	Water Rights (surface)	Register kept by rural water authority. Specifies owner, land to which it attaches, and total volume of water. Annual sales water allocation for the season specified.
	Take and Use Licences (surface and groundwater)	Rural water authority must keep a record of licences on issue.
Queensland	Stock and Domestic Rights	Not attached to land title record except if it requires a licence.
	Water Licences (not subject to a ROP ^c)	No explicit requirement for a registry. Issued and managed by NR&M.
	Water Licences (subject to a ROP)	Registry of licences held by NR&M in the Water Entitlements Registration Database.
	Water Allocations (subject to a ROP)	Water allocation register that operates as a module of the Queensland Resource Registry. Records the owner's details, volume, reliability, location, purpose and the resource operations plan under which the water allocation is managed.
South Australia	Stock and Domestic Rights (in prescribed areas)	Attached to land title record.
	Unlicensed Water Rights (in non-prescribed areas)	Attached to land title record.
	Water Licences (to take or hold, in prescribed areas)	Minister keeps a register in the form in which the Minister thinks fit. The register records provisions for transfers and sale of water allocations and any third-party interests. ^d

(Continued on next page)

Table 5A.5 (continued)

<i>Jurisdiction</i>	<i>Right</i>	<i>Title record</i>
ACT	Stock and Domestic Rights	Attached to land title record.
	Licences to Take Water, and Allocations	Environment Protection Authority has established a register of allocations and licences granted and transferred.

^a Access licences are held by irrigation companies in irrigation districts. Individuals within each district hold water shares in the company. ^b Land and Property Information is a NSW State Government Business Enterprise providing land, property and valuation information and services. These services were previously provided by the Land Titles Office, the Land Information Centre and the Office of the Valuer General. ^c Resource Operations Plan (ROP). ^d A Torrens Title system for water licences and on-line internet access to water licensing information is planned.

Sources: Annexes B to F.

Table 5A.6 Recording water right titles — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Right</i>	<i>Title record</i>
California	Federal Reserve Rights (surface and groundwater)	Described in treaty, act, court decree or executive order that created the reserve. May be attached to land title.
	Riparian Rights (surface water)	Statement of Diversion and Use must be filed when first used and every three years thereafter.
	Appropriative Licences (surface water) ^a	Record of licences held by County Recorder. Records volume of water, source, use, location and period of time
	Correlative Rights (groundwater)	Statement of Diversion and Use must be filed when first used and every three years thereafter.
	Appropriative Rights (groundwater)	Statement of Diversion and Use must be filed when first used and every three years thereafter.
Colorado	Federal Reserve Rights (surface and groundwater)	Described in treaty, act, court decree or executive order that created the reserve. May be attached to land title.
	Water Rights (surface and tributary groundwater) ^a	The register maintained by Office of the State Engineer records titles to groundwater rights. It records the owner, the volume or rate of water to be extracted, the point of diversion, the beneficial use to which the water will be applied, description of the land, and a priority date. ^b
	In-stream Flow Rights	Register maintained by its trustee, the Colorado Water Conservation Board. As above.
	Well Permits (other groundwater)	Register maintained by Office of the State Engineer. Records the owner, the volume or rate of water to be extracted, the point of diversion, the beneficial use to which the water will be applied, description of the land, and a priority date.
Chile	Water Rights (surface and groundwater)	General system of real estate title registration. Records the owner, the source, the volume, the type of right, and the division of the right where more than one user possesses the right.
	Traditional Rights	Not titled, but may be registered (regularised) if filed with the Directorate General of Water.
	Ecological Volumes	Not titled, but registered with the Directorate General of Water.
Mexico	Stock and Domestic Rights	Attached to land title.
	Concessions (surface water)	Public Registry of Water Rights in which the titles to concessions are registered, and their respective modifications and changes. It records the owner, volume, and the tenure.
	Groundwater	No record.
South Africa	Human and Ecological Reserve	No record.
	General Authorisations	Details are kept in a register.
	Licences	Details are kept in a register.

^a Includes subterranean streams and the sub-surface flow of surface water sources. ^b Senate Bill 278 was introduced into the Colorado Legislature this year to extend registration to surface right-holders.

Sources: Annexes H to L.

Table 5A.7 Duration of rights — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Right</i>	<i>Duration</i>	<i>Cancellation</i>
NSW	Environmental Water	10 years by virtue of them being established in a 10 year Water Sharing Plan.	The Minister may revoke or amend environmental water rights by revoking or modifying a Water Sharing Plan.
	Stock and Domestic Rights	Perpetual	The Minister may temporarily suspend a right if it is in the public interest.
	Access Licences ^a	20 years for local and major utility licences, and 15 years for all other types of licences.	<p>The Minister may suspend or cancel an Access Licence for the following reasons:</p> <ul style="list-style-type: none"> the holder has failed to comply with the licence conditions, or has been convicted of an offence against the provisions of the <i>Water Management Act 2000</i>; or any charges payable in respect of a licence have not been paid. <p>The Minister may compulsorily acquire Access Licences if of the opinion that the public interest requires it.</p>
Victoria	Bulk Entitlements	Perpetual	The Minister may temporarily suspend, reduce, increase or otherwise alter any rights if the Minister has declared that a water shortage exists in the area or supply system concerned. A water shortage may be declared if the Minister thinks the volume or quality of water available in the area or system is or will be inadequate for any reason.
	Stock and Domestic Rights (surface and groundwater)	Perpetual	As above.
	Water Rights (surface water)	Perpetual	As above.
	Take and Use Licences (surface and groundwater)	Up to 15 years	As above. The Minister (or rural water authority) may revoke a licence if in the opinion of the Minister (or rural water authority) there has been a failure to comply with any condition to which the licence is subject.
	In-stream Use Licences	Up to 15 years	As above.
Queensland	Stock and Domestic Rights	Perpetual	Can be limited where subdivisions may lead to proliferation.
	Water Licences (not subject to a ROP ^b)	Up to 10 years, sometimes longer for stock purposes.	Licences may be cancelled by the Chief Executive, although holders have a right of review and appeal.

(Continued next page)

Table 5A.7 (continued)

<i>Jurisdiction</i>	<i>Right</i>	<i>Duration</i>	<i>Cancellation</i>
Queensland (cont.)	Water Licences (subject to a ROP)	For a specified period. Water Resource Plan subject to 10 yearly reviews.	May be varied, amended or cancelled by the Department of Natural Resources and Mines. Licences may be forfeited if conditions are not complied with.
	Water Allocations (subject to a ROP)	Ongoing. Water Resource Plan subject to 10 yearly reviews.	May be cancelled if the conditions of the allocation are not complied with.
South Australia	Stock and Domestic Rights (in prescribed areas)	Perpetual	No provisions.
	Unlicensed Water Rights (in non-prescribed areas)	Perpetual	No provisions.
	Water Licences (in prescribed areas)	Perpetual	The Minister may cancel a Water Licence (for taking or holding water) if the holder contravenes or fails to comply with its conditions, or in the case of taking water, takes water in excess of the specified entitlement.
ACT	Stock and Domestic Rights	Perpetual	No provisions.
	Licences to Take Water	Perpetual	A licence may be cancelled if an allocation on which to base the taking of water does not exist or licensee does not have lawful access to the place from where water is to be taken.
	Allocations	Ongoing subject to a 10 yearly review of the Water Resource Management Plan.	No provisions governing cancellation of an allocation but an allocation may be reduced, either wholly or in part, if it is necessary or desirable to do so: <ul style="list-style-type: none"> • because a reduction in the flow of the waterway makes it necessary; • to prevent a reduction, or further reduction, in the quality of water; or • to prevent damage, or further damage, to an ecosystem that depends on the water in a waterway.

^a Access licences are held by irrigation companies in irrigation districts. Individuals within each district hold water shares in the company. ^b Resource Operations Plan (ROP).

Sources: Annexes B to F.

Table 5A.8 Duration of rights — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Right</i>	<i>Duration</i>	<i>Cancellation</i>
California	Federal Reserve Rights (surface and groundwater)	Perpetual	No provisions.
	Riparian Rights (surface water)	In perpetuity provided use is beneficial and reasonable.	May be lost if source is adjudicated and riparian right is not exercised, or through prescription. ^a
	Appropriative Licences (surface water) ^d	In perpetuity provided use conditions met, including beneficial and reasonable use.	May be lost through abandonment, ^b statutory forfeiture ^c or prescription. ^a
	Correlative Rights (groundwater)	In perpetuity provided beneficial and reasonable use.	May be lost if source is adjudicated and right is not exercised, or through prescription. ^a
	Appropriative Rights (groundwater)	In perpetuity provided beneficial and reasonable use.	May be lost through abandonment ^b , statutory forfeiture ^c or through prescription. ^a
Colorado	Federal Reserve Rights (surface and groundwater)	Perpetual	No provisions.
	Water Rights ^e (surface and tributary groundwater ^d)	Perpetual provided beneficial use maintained.	Abandonment ^a proceedings every 10 years.
	Well Permits (other groundwater)	Perpetual provided beneficial use maintained	Abandonment proceedings every 10 years. ^a
Chile	Water Rights (surface and groundwater)	Perpetual	Government can only expropriate rights temporarily in particular emergencies, such as droughts. In this situation, compensation must be paid.
	Traditional Rights	Perpetual	No provisions.
	Ecological Volumes	Perpetual	No provisions.
Mexico	Stock and Domestic Rights	Perpetual	No provisions.
	Concessions (surface water)	Between 5 and 50 years. The holder may ask for an extension of time equal to the previous concession term.	May be suspended if the holder does not make the required payments, refuses inspections, or does not abide with the terms of the concession. May also be forfeited if the right has not been developed after three consecutive years. Water Rights indemnified subject to the General Act Governing National Assets or the ruling of a court.
	Groundwater	Perpetual	No provisions.

(Continued next page)

Table 5A.8 (continued)

<i>Jurisdiction</i>	<i>Right</i>	<i>Duration</i>	<i>Cancellation</i>
South Africa	Human and Ecological Reserve	Perpetual	No provisions.
	General Authorisations	Specific to each concession.	Responsible authority may suspend or withdraw an entitlement if holder fails to: <ul style="list-style-type: none"> • comply with any condition of the entitlement; • comply with the Act; or • pay the appropriate charges.
	Licences	Depends upon nature of use, but there is a maximum of 40 years with a review every 5 years.	Responsible authority may suspend or withdraw an entitlement if holder fails to: <ul style="list-style-type: none"> • comply with any condition of the entitlement; • comply with the Act; or • pay the appropriate charges.

^a Prescription occurs when an appropriator maintains continuous use for five years, that use is adverse to any prior vested rights and the owner of the vested rights does not take action in the courts against the appropriator. ^b Abandonment occurs if rights are not exercised for an extended period of time. Non-use is not sufficient for abandonment because the right-holder must intend to abandon the right. However, an unreasonable period of non-use will create a rebuttable presumption of intent to abandon. ^c Statutory forfeiture occurs where the right-holder has not exercised the right for beneficial and reasonable purposes. ^d Includes subterranean streams and the sub-surface flow of surface water sources. ^e Includes Instream Flow and Lake Level Rights.

Sources: Annexes H to L.

Table 5A.9 Separate from land title and use restrictions — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Water right</i>	<i>Separate from land title</i>	<i>Separate from use</i>
NSW	Stock and Domestic Rights	X	X
	Native Title Rights	X	X
	Access Licences ^a (surface and groundwater)	✓ ^b	✓ ^c
	Works and use approvals	X	X
Victoria	Stock and Domestic Rights	X	X
	Bulk Entitlements	✓	✓
	Water Rights	✓ ^d	X
	Take and Use Licences (surface and groundwater)	✓ ^d	X
	Sales Water	✓ ^d	✓
	In-stream Use Licences	✓	X
Queensland	Stock and Domestic Rights	X	X
	Water Licences (not subject to a ROP ^e)	X	X
	Water Allocations (subject to a ROP)	✓	X
	Water Licences (subject to a ROP)	X	✓ ^f
South Australia	Stock and Domestic Rights	X	X
	Unlicensed Water Rights (in non-prescribed areas)	X	✓
	Water Licences (taking and holding, in prescribed areas)	✓	✓
ACT	Stock and Domestic Rights	X	X
	Licences to Take Water	✓ ^g	X
	Allocations	✓	✓

^a Access licences are held by irrigation companies in irrigation districts. Individuals within each district hold water shares in the company. ^b Under the supply contract arrangements within each irrigation district, an individual must be a shareholder of the irrigation company to obtain a water share. To be a shareholder, individuals must own land within the irrigation district. ^c Major utility and local urban supply licences may only be used for the supply of urban water. ^d The *Water Act 1989* (Victoria) does not specify that a person must be a landholder to be granted a water right or licence to take water (surface). However, rural water authorities generally only approve applications if the applicant is an owner or occupier of land within the irrigation district to which the application applies. To hold a water right, a person must be the owner or occupier of a landholding within the irrigation district. While water rights may be transferred between owners or occupiers, rights remain attached to the landholding specified in the register and the register is updated to reflect the transfer. ^e Resource Operations Plan (ROP). ^f Water licence may include a condition about the purpose for which the water may be taken. ^g While legally separate from land title, generally Licences to Take Water are site specific.

Sources: Annexes B to F.

Table 5A.10 Separate from land title and use restrictions — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Water right</i>	<i>Separate from land title</i>	<i>Separate from use</i>
California	Federal Reserve Rights (surface and groundwater)	X	X
	Riparian Rights (surface water)	X	✓ ^a
	Appropriative Licences (surface water) ^c	✓ ^b	X
	Appropriative Licences (groundwater)	✓ ^b	✓ ^a
	Correlative Rights (groundwater)	X	✓ ^a
Colorado	Federal Reserve Rights (surface and groundwater)	X	X
	Water Rights (surface and tributary groundwater) ^c	✓ ^b	X ^a
	In-stream Flow Rights (surface)	✓	X ^a
	Well Permits (other groundwater)	✓	X ^a
Chile	Water Rights (surface and groundwater)	✓	✓
	Traditional Rights	✓	✓
	Ecological Volumes	X	X
Mexico	Stock and Domestic Rights	X	X
	Concessions (surface water)	✓	X ^d
	Groundwater	X	X
South Africa	Human and Ecological Reserve	X	X
	General Authorisations	Information not obtained	X
	Licences	✓	X

^a Use must be beneficial. ^b Some rights are attached to a specific district. ^c Includes subterranean streams and the sub-surface flow of surface water sources. ^d Water use may be changed with the approval of the National Water Commission.

Sources: Annexes H to L.

Table 5A.11 Divisibility and transferability — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Right</i>	<i>Divisible</i>	<i>Transferable</i>
NSW	Environment Health Water	Yes	Only within the environment.
	Supplementary Environmental Water	Yes	On loan only and must be repaid.
	Adaptive Environmental Water	Yes	Yes
	Stock and Domestic Rights	No	No
	Native Title Rights	No	No
	Access Licences ^a (surface and groundwater)	Yes	Licences are transferable if provided for by the relevant water sharing plan. However, major utility or local water utility licences may only be traded for a maximum of one year. Water shares within an irrigation district are only transferable to others within the district.
Victoria	Bulk Entitlements	Yes	Bulk entitlements may be transferred to either another rural water authority, the owner or occupier of a holding in an irrigation district, the holder of a take and use licence or persons outside the State of Victoria.
	Stock and Domestic Rights	No	No
	Water Rights (surface water)	Yes	Water rights may only be transferred to land owners or occupiers within the irrigation district. They may only be transferred out of the district if they are first converted to another type of right.
	Take and Use Licences (surface and groundwater)	Yes	Yes
	Sales Water	Yes	Yes
	In-stream Use Licences	Yes	Yes
Queensland	Stock and Domestic Rights	No	No
	Water Licences (not subject to a ROP ^b)	No	Can be transferred to other land in accordance with <i>Water Regulation 2002</i> .
	Water Allocations (subject to a ROP)	Yes	Transferable subject to the rules of the resource operations plan.
	Water Licences (subject to a ROP)	No	No
South Australia	Stock and Domestic Rights (in prescribed areas)	No	No
	Water Licences (in prescribed areas)	Yes	Yes

(Continued next page)

Table 5A.11 (continued)

<i>Jurisdiction</i>	<i>Right</i>	<i>Divisible</i>	<i>Transferable</i>
South Australia (cont.)	Water Rights (surface and groundwater in non-prescribed areas)	No	Transferable within an irrigation district. It is possible to trade outside the district if irrigation authority agrees.
ACT	Stock and Domestic Rights	No	No
	Licences to Take Water	Yes	As above.
	Allocations	Yes	Allocations and licences may be transferred if the transfer complies with the Water Resources Management Plan at the receiving location. If an allocation is transferred to a new holder, a new licence application request for the new allocation holder is required.

^a Access licences are held by irrigation companies in irrigation districts. Individuals within each district hold water shares in the company. ^b Resource Operations Plan (ROP).

Sources: Annexes B to F.

Table 5A.12 Divisibility and transferability — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Right</i>	<i>Divisible</i>	<i>Transferable</i>
California	Federal Reserve Rights (surface and groundwater)	No	No
	Riparian Rights (surface water)	No	No
	Appropriative Rights (surface water) ^a	Yes	Yes but no water rights are granted to the party receiving the water. All water rights are held by the original right-holder. Water use within the new place of use is considered water use under the original permit or licence.
	Correlative Rights (groundwater)	No	
	Appropriative Rights (groundwater)	No	
Colorado	Federal Reserve Rights (surface and groundwater)	No	No
	Water Rights (surface and tributary groundwater ^a)	Yes	Yes
	Well Permits (other groundwater)	Yes	Yes
Chile	Water Rights (surface and groundwater)	Yes	Yes
	Traditional Rights	Yes	Yes
	Ecological Volumes	Yes	No
Mexico	Stock and Domestic Rights	No	No
	Concessions (surface water)	Yes	Yes
	Groundwater	No	No
South Africa	Human and Ecological Reserve	No	No
	General Authorisations	No	No
	Licences	Yes	Yes

^a Includes subterranean streams and the sub-surface flow of surface water sources.

Sources: Annexes H to L.

6 Government involvement in water allocation

In most jurisdictions studied, governments have sought to influence which uses and users can access water in one of two ways:

- specifying the priorities and securities of water rights to various classes of uses; and
- influencing the allocation of water rights between uses.

Water rights are specified in terms of priority and security (the predictability of volume of water received under a right) (see chapter 5). Each year, the available water is assigned to water users on the basis of these priorities, securities and other legal requirements. These annual assignment processes are discussed in chapter 8.¹

There were two observed methods by which governments have sought to re-allocate water away from existing consumptive uses to redress environmental damage and unsustainable use of water. In California, Colorado and Chile, water rights are purchased or surplus water set aside for environmental protection or restoration — *an acquisition programming approach*. In the other jurisdictions, water is re-allocated by reducing the volume of water to be received by consumptive water rights — *a resource planning approach*. Which of these applies is determined by the legal and constitutional arrangements prevailing in each jurisdiction.

Under the acquisition programming approach, water is generally re-allocated by purchasing water rights, harvesting additional water, or investing in water saving programs. In California, Colorado and Chile, governments can pursue only these three options as they do not have the power to alter the benefits obtained from holding water rights (see chapter 3).

In California and Colorado, acquisition programming is undertaken or required by agencies with environmental protection responsibilities — such as the US Fish and Wildlife Service. While these agencies are broadly motivated to protect the

¹ In the jurisdictions studied, the volume of water assigned to a user in any given year is variously referred as an allocation, seasonal allocation and seasonal assignment.

environment, their approaches also have regard for the broader economic and social interests of the community.

Resource planning is typically undertaken by the water resource agencies although this authority is sometimes delegated to local water user groups. Generally, their objective is to allocate water between consumptive and non-consumptive uses to strike a balance in the economic, social and environmental interests of the community. The water resources planner has the power to re-allocate water administratively. When they use this power, it has the effect of altering the benefits obtained from holding the right (see chapter 5).

Water resource planners can also harvest additional water (where it is available), purchase water rights or invest in water saving programs. For example, the Snowy Water Agreements, which the New South Wales, Victorian and Commonwealth Governments are a party to, make a commitment to invest \$375 million over 10 years to increase flows in the Snowy River and to provide further dedicated environmental flows in the River Murray (Vanderzee and Turner 2002).

In all of the jurisdictions studied, governments generally do not intervene to re-allocate water between private right-holder's. Instead, private right-holders are encouraged to trade their water rights to the highest valued use. However, most governments have some role in approving transfers of or changes to water rights (see chapter 7).

Most trades are of annual assignments of water (or leases of the water right) rather than the permanent trades of the water rights themselves. For example, in the Murray–Darling Basin in Australia, 912 GL of annual assignments of water were traded and 77 GL of water rights were traded permanently in 2001–02 (see chapter 2).

In California, during the period 1997 to 2001, only 40 transfers of water rights were approved by the State Water Resources Control Board (Water Transfer Workgroup 2002).² Instead, most transfers of water were of water supply contracts.

In Chile, most water trades were of annual assignments between neighbouring irrigators of the same water user association. There have been only a small number of permanent trades of water rights (Bauer 1997).

Finally, governments are also involved in sharing water resources between jurisdictions through inter-governmental agreements and programs.

² Based on a water year as defined in California — 1 October through to 30 September. Transfers included 36 short-term transfers and 4 long-term transfers.

In this chapter, the agencies involved in acquisition programming and resource planning are described and the composition of agencies responsible for allocative decisions is discussed. The processes by which these agencies determine appropriate environmental flows are compared on the basis of widely accepted practices in regulation and environmental assessment.

6.1 Acquisition programs

In California, Colorado and Chile, environment protection agencies are responsible for regulating activities that would endanger or restore species and habitats. They protect the environment by determining the volume of water required. In California and Colorado, environment protection agencies either acquire the water or require others to set aside water to meet environmental objectives. In Chile, water required for the environment is obtained primarily by investment in water infrastructure.

The acquisition programs considered here are those primarily concerned with re-allocating water for environmental purposes. In California and Colorado, program objectives include the conservation or restoration of threatened or endangered species. These programs may result in the protection of identified wetlands or limits on extractions from rivers hosting specific endangered fish varieties.³ The programs tend to be specific to the river or water body in which environmental concerns were triggered, such as the CALFED Bay–Delta Program (see table 6A.1).

Acquisition programs have also been used for non-environmental objectives. For example, in California, the Dry Year Water Purchase Programs allow the Department of Water Resources to acquire water for use by water agencies in times of drought.⁴ These programs are not considered in this study.

The goals and objectives of broader policies and programs have also been incorporated into acquisition programs. For example, the Californian Water Acquisition Program was developed to meet the water acquisition needs of the *Central Valley Project Improvement Act 1992* and the Environmental Water Account Program has consideration for the objectives of the CALFED Bay–Delta Program.

³ An exception to this is the Colorado In-stream Flow Program. An objective of this program is to preserve the environment to a ‘reasonable degree’. Recommendations of environmental flows under this program do not depend on the listing of endangered or threatened species.

⁴ The program is designed to allow water agencies to meet their supply obligations in periods of drought. In 2001 and 2002, 171 GL and 28 GL of water was purchased respectively under the program.

That said, acquisition programs are principally concerned with ensuring that water is allocated for environmental purposes in the most cost-effective manner. Environmental objectives are identified in environmental protection regulation and the role of agencies (subject to the regulation) is to obtain the necessary rights — whether by new appropriations, purchase or donations — at the lowest cost to society.⁵

Acquisition programs in the US are undertaken in compliance with state or federal legislation, such as the federal *Endangered Species Act 1973*, and the federal *Central Valley Project Improvement Act 1992*. For example, the US Federal Fish and Wildlife Service has the authority to prohibit any federal agency or federally endorsed activity that would threaten any of the listed endangered species, unless it ensures that the species are protected (federal *Endangered Species Act 1973*). This prohibition applies to the US Bureau of Reclamation (BoR (US)), a federal agency and the owner of most storages in the western states of the US, including Colorado.

In California, acquisition programs occur principally under the Ecosystem Restoration Program and the Environmental Water Account Program (in the CALFED Bay-Delta Program) and the Water Acquisition Program and Anadromous Fish Restoration Program (under the *Central Valley Project Improvement Act 1992*). The Environmental Water Account Program has a set goal of obtaining 234 GL of water annually for environmental purposes.⁶

The processes used to ascertain the volume of water to be acquired for environmental purposes is broadly similar to the processes used in jurisdictions that employ resource planning. Responsible agencies determine the volume and flow requirements needed to satisfy environmental demands through a process of resource and impact assessment. Agencies responsible for these programs have regard for community preferences, in that programs are made transparent and community consultation is undertaken. The programs may also be changed during their life and are subject to systematic review.

In California and Colorado, there are also programs (other than acquisition programs) aimed at investing in new or repairing existing water infrastructure to reduce conveyancy losses, to free water for re-allocation to in-stream uses and the

⁵ There is also a potential in California for water to be allocated to environmental flows through application of the Public Trust Doctrine. The doctrine confers on the Californian public a right to use water resources for a number of non-consumptive purposes including environmental preservation (California State Lands Commission 1993). In some programs, where surplus water is available, environmental flows are obtained from the additional appropriation of water.

⁶ Under this program, an addition 234 GL of water will be obtained for environmental flows through negotiating additional pumping by dam operators at times beneficial to fish populations.

environment. For example, investments in the Government Highline Canal are expected to create an annual 34 GL of water savings, which will provide flows for protected fish. These types of programs are not considered in this study.

In California, Colorado and Chile, water may also be allocated for environmental uses by setting aside surplus water. This can be effected by the water rights administrator constituting an environmental water right or reserving the water for the environment. This process is described in chapter 7.

6.2 Resource plans

Resource plans are statutory instruments that provide water resource agencies with the authority to allocate water between competing uses. Resource planning is undertaken in the Australian jurisdictions studied, Mexico and South Africa.⁷

Resource plans are developed to meet a range of policy objectives that include meeting the needs of non-consumptive uses (such as the environment and recreational users), as well as ensuring certainty of supply to consumptive users. In preparing resource plans, water resource agencies are required by the guiding legislation, to consider the environmental, economic and social benefits and costs of the proposed allocations.

When resource plans were first introduced, a common objective of the first plan in all jurisdictions studied was to convert the definition and allocation of water rights to the new legislation. For example, Queensland Water Resource Plans include provisions for the conversion of pre-existing licences to transferable water allocations. Similarly, in Victoria, the bulk entitlement conversion process was primarily concerned with converting pre-existing entitlements to the new set of entitlements of the *Water Act 1989* (Victoria).

Resource plans are prepared with an expectation that water might or will be re-allocated administratively between consumptive and non-consumptive uses from time-to-time. Periodic reviews of resource plans can be undertaken and contingency arrangements established to address water scarcity during periods of drought.

Resource plans are generally prepared for all surface and groundwater sources, including overland flows.

⁷ Water resource plans include but are not limited to Stream Flow Management Plans, Water Allocation Plans, Water Catchment Management Plans, Water Management Plans, Water Resource Management Plans, Water Resource Plans and Resource Operations Plans, and Water Sharing Plans.

There is typically a hierarchy of resource plans (see tables 6A.1 and 6A.2). Initially, the planning framework is established under jurisdiction-wide legislation. These frameworks include provision for the development of strategic plans that, in turn, guide operational plans. The exception is Victoria, where Bulk Entitlement Orders, Stream Flow Management Plans and Groundwater Management Plans do not form part of a planning hierarchy.

Strategic resource planning occurs in Mexico and South Africa at a national level. Subordinate to the national plans are regional plans. In Mexico, regional planning is undertaken at a river-basin level and in South Africa at the catchment level within river basins.

Strategic plans generally are broad in nature and may cover riverine health and integrated resource management, having regard for the social and cultural values held by communities. They may also include a framework for the issuing of water rights and establish the objectives, criteria and rules for the management of flow and use of water. Strategic plans are commonly accompanied by operational plans for the implementation of the objectives and outcomes stated in the strategic plan.

Operational plans are usually specific to catchments. Operational plans cover the management of diversions and flows. They may also define rules which govern the distribution of water.⁸ For example, in Queensland the operational requirements necessary to realise the objectives stated in Water Resource Plans are defined in Resource Operations Plans. The rules contained in a Resource Operations Plan include water trading rules, infrastructure operating rules, environmental flow management rules, and monitoring requirements. These plans may be developed on a whole-of-catchment basis or for specific areas within a catchment.

In NSW, catchment level Water Sharing Plans similarly incorporate the environmental rules, flow requirements to satisfy water rights, and the water transfer rules. The plans also include procedures for the administration of water rights and constraints on the development of water works (sections 20 and 21 of the *Water Management Act 2000* (NSW)).

6.3 Inter-jurisdictional arrangements

Inter-jurisdictional allocation of water typically occurs through inter-governmental water sharing agreements (see table 6A.3). Re-allocation of water among right-

⁸ Water distribution involves the collection, storage, release and delivery of water to users (see chapter 8).

holders in different jurisdictions can also occur through trading, providing the transfers meet with the broad terms of the agreements.

The agencies involved in the Australian inter-jurisdictional arrangements studied, are typically state water resource regulators or Commonwealth agencies. In the Colorado River Basin, a range of agencies are involved — the BoR (US), and state and federal agencies with environmental responsibilities.

Inter-jurisdictional allocation in Australia is primarily concerned with establishing how much water can be diverted by each jurisdiction sharing a water resource. For example, the *Murray–Darling Basin Agreement 1992* limits the diversions from the rivers in the Murray–Darling Basin by placing caps on the extraction of water for each river valley and jurisdiction.

In the Australian jurisdictions studied, state and territory governments are generally responsible for determining how the environment is to be protected when allocating water between consumptive and non-consumptive uses. The exception is the Murray–Darling Basin Commission’s (MDBC’s) Living Murray Initiative, where environmental flow targets are set for rivers in the Murray–Darling Basin. These targets are adopted in the development of resource plans of the participating state or territory.

In the US, the Colorado River Basin is managed and operated under a number of compacts, federal laws, court decisions and decrees, contracts, and regulatory guidelines collectively known as the Law of the River. The principal governing acts and compacts are the *Colorado River Compact 1922*, *Upper Colorado River Basin Compact 1948*, *Boulder Canyon Project Act 1928* and the US Supreme Court Decree of 1964.

The Law of the River requires water to be apportioned among the participating states and establishes priorities attached to each apportionment.

In addition to the Law of the River, there are a number of inter-jurisdictional recovery and conservation programs. For example, the purpose of the Recovery Implementation Plan for the Upper Colorado River is to increase river flows when needed by fish and to improve and develop river habitats. These programs must comply with all federal environmental laws, state water laws, riverine water laws and inter-state compacts.

6.4 Agencies

The functions of the agencies responsible for the development and implementation of resource plans and acquisition programs are set out in tables 6A.4 and 6A.5.

The activities of the agencies involved can be broadly categorised in terms of the functions that make up the acquisition and planning process. All of these functions can be undertaken by a single organisation. Alternatively, the organisation responsible for the allocation decision coordinates input from other organisations.

The planning and programming functions are:

- *Assessment* — measuring current water resources, the physical characteristics of water resources, the health of the environment, and assessing socio-economic and environmental impacts of different allocations.
- *Consultation* — facilitating community involvement in the planning and programming processes.
- *Determination* — setting water re-allocation objectives and developing resource plans and acquisition programs. This may entail the coordination of input from scientific and consultative agencies.
- *Review* — reviewing the method used in resource and impact assessment in addition to the performance of the resource plan or acquisition program in terms of meeting any stated outcomes and general effectiveness of the plan or program.

In the Australian jurisdictions studied, Mexico and South Africa, the ultimate responsibility for determining water allocations lies with a government minister. Generally, the minister's role is one of providing approval to plans developed by the agencies involved. Ministers may have the power to veto plans, require amendments to be made to plans or refer plans back to planning agencies for revision.⁹

In California, amendments to the *Central Valley Project Improvement Act 1992* must be passed by the legislature and changes to the CALFED Bay-Delta Program have to be agreed to by all participating agencies. In South Africa, the Minister does not have statutory power to amend or revoke a plan outside of the 5 yearly review.

⁹ In general, Australian jurisdictions make statutory provision for the responsible minister to amend or revoke water resource plans. The minister may initiate an amendment if it is in the public interest. The exception is Victoria, where the Minister for Water may only amend a Bulk Entitlement on the application of the Authority holding the entitlement or another Authority with the support of another Minister. In Queensland, under statute, the Governor-in-Council makes Water Resource Plans.

In NSW, Queensland and the ACT, most or all of the functions are undertaken by one state government agency. For example, in NSW, the Minister, supported by the Department of Infrastructure, Planning and Natural Resources, is the principal body responsible for developing Water Sharing Plans. Under the *Water Management Act 2000* (NSW), the Minister for Natural Resources can establish water management committees (representative of the community) to develop Water Sharing Plans (NSW Water Management Act 2000, s. 14). Instead, the Minister has established community advisory committees to develop draft Water Sharing Plans but the Minister can revise plans without the consent of the committees (NSW Water Management Act 2000, s. 388).

In Queensland, the Department of Natural Resources and Mines has a major role in the assessment, consultation, determination and review of resource plans — both Water Resource Plans and Resource Operations Plans. In the ACT, the Environmental Protection Authority undertakes all these functions.

In Victoria and South Australia, the consultation, assessment and determination functions are undertaken by catchment-based management bodies — Entitlement Committees in Victoria and Catchment Water Management Boards in South Australia. In Victoria, the state agency responsible for resource management provides coordination and support for the catchment-based bodies.

The organisational arrangements in California differ from those in the Australian jurisdictions studied. In California, a greater number of agencies undertake assessment and determination functions. Under the CALFED Bay–Delta Program, responsibility is shared between the state and federal governments.

Determination and review functions are generally undertaken by the same organisation in the jurisdictions studied. Ideally, the organisation reviewing the performance of a resource plan or acquisition program should be separate from the organisation which drafts or implements the plan or program (see chapter 4). This removes the possibility of vested interests impacting upon the integrity of the review. It is also more likely to be a more transparent process.

There are two broad community consultation approaches among the jurisdictions studied. In some jurisdictions, community advisory committees are established — such as Water Management Committees in NSW, Community Reference Panels in Queensland and the Californian Advisory Committee and Californian Extended Review Forum.

In other jurisdictions, community representatives have a role in decision making through representation on the boards of the agencies responsible for resource planning. These jurisdictions are Victoria (Entitlement Committees and Consultative Committees), South Australia (Catchment Water Management

Boards), South Africa (Catchment Management Agencies) and Mexico (Basin Councils).

Composition of agencies involved in determination and consultation

It is important that the agencies determining allocations are impartial and adopt a whole-of-economy approach. If the agencies and bodies responsible for making allocation decisions are predominantly comprised of particular interest groups, the process may not result in efficient outcomes, but rather outcomes that favour one interest group.

It is also important that the consultation process involves input from all interested parties, including those from outside the catchment. For example, estuarine industries are often located outside inland catchments but are not necessarily involved in those decision-making processes that might directly affect their well-being.

The composition of determination and consultation agencies in the jurisdictions studied is listed in tables 6A.6 and 6A.7 respectively.

In Australia, there is a general recognition of the need for a balanced representation of stakeholders in determination or advisory organisations. The exceptions are Victoria and South Australia.

In Victoria, Consultative Committees prepare draft Stream Flow Management Plans. Consultative Committees are required by statute to be comprised of at least 50 per cent primary producers appointed on advice from the Victorian Farmers' Federation. Under these arrangements, primary producers can strongly influence Consultative Committees. There are no mandatory rules, in Victoria, for community representation on the Entitlement Committees involved in the development of Bulk Entitlement Orders. The extent of community representation in these committees is unclear and may vary between catchments.

In South Australia, the Minister for Environment and Conservation appoints members of Catchment Water Management Boards on the basis of skills, not representation. The only statutory representational requirement is that one or more board members must also be a member of the catchment community. This creates a potential for boards to be comprised of members who have interests that are not representative of the community.

In Mexico, the community has representation on the Water Consultative Council and on individual Basin Councils. Similarly, Catchment Management Agencies in South Africa are appointed on a representational basis.

There is less catchment-based representation in the programming processes in California. This may arise because state and federal government organisations develop and implement state-wide acquisition programs. It may also arise because, under acquisition programs, additional water for the environment is purchased from water right-holders. Since the rights of right-holders are not modified, there may not be necessary to involve right-holders in decision-making.

6.5 Processes

In this section, the processes of resource planning and acquisition programming of each jurisdiction studied are compared in terms of the potential for efficient outcomes. It is not the objective of this study to assess the actual efficiency of allocation decisions — given that many of the environmental and economic relationships, hydrological cycles and climatic conditions are complex, not fully understood in many cases and are different for each jurisdiction.

The criteria on which these processes are compared are based on the established guidelines for regulatory impact statements (RISs). As mentioned earlier, resource plans are generally subordinate legislation and act as regulation. The Council of Australian Governments defined regulation requiring a RIS as:

...the broad range of legally enforceable instruments which impose mandatory requirements upon business and the community as well as those voluntary codes and advisory instruments ... for which there is a reasonable expectation of widespread compliance (CoAG 1997, p. 4, quoted in ORR 2002, p. 56).

In contrast, federal US and Californian acquisition programs are based on environmental impact assessments (EIAs). The guidelines for EIAs, established by the US *National Environmental Policy Act* (1969), share some common elements with the RIS guidelines adopted in Australia. As a result, the RIS criteria described in attachment 6B were used to assess the processes for preparing both resource plans and acquisition programs .

Resource assessment

Ideally, the resource planning and acquisition programming cycle should begin with the identification of the problems and issues related to water resources. There should be an accurate assessment of the characteristics of current water resources and use, such as the flow characteristics of both surface and groundwater; the behaviour and nature of important water uses; and the capacity of water infrastructure.

All of the jurisdictions studied seem to assess comprehensively the state of their water resources and riverine ecology. All jurisdictions assess the quality and volume of water, the health and needs of dependent ecosystems, patterns of water use, and capacity of hydraulic works.¹⁰

The point at which the resource assessment occurs within the planning hierarchy — either at the strategic or operational level — varies between jurisdictions. For example, in NSW no specific environmental research is undertaken for the State Water Management Outcomes Plan. In contrast, in South Australia, specific resource assessment occurs at all levels of resource plans, including the State Water Plan.¹¹

The methods used for resource assessment should be consistent across catchments, and ideally within a basin. This facilitates the coordination of acquisition programs or resource plans that apply to a shared resource. Consistency can be achieved through the provision of jurisdiction-wide guidelines.

Assessment guidelines exist in all of the jurisdictions studied, apart from South Australia. For example, in NSW, broad policy guidelines are contained in the Water Policy Advisory Notes and more specific scientific guidelines are contained in the Pressure Biota Habitat and Multi-Attribute River Assessment Framework. This framework contains a consistent method for the identification of significant riverine bio-physical attributes and for evaluating river ecosystem responses.

Specification of desired objectives

The scope of planning differs between jurisdictions. In Australia, planning objectives are generally expressed in the form of goals for consumptive and non-consumptive uses. Goals for consumptive uses generally include the provision of increased security for water right-holders. Goals for non-consumptive uses include such things as recreation, navigation and riverine health, and may be related to specific flora or fauna.

In contrast, the objectives of the CALFED Ecosystem Restoration Program are narrower, focused primarily on environmental goals. For example, the general goal of the Environmental Restoration Program is to improve aquatic habitats and more specifically to:

¹⁰ The Productivity Commission was unable to establish the extent to which resource assessment had occurred in regard to Mexican Basin Plans.

¹¹ The State Water Plan (South Australia) must assess the state and condition of water resources. It identifies water uses and regional water quality and the pressures impacting on water resources, including dryland salinity and recharge.

Improve and increase aquatic and terrestrial habitats and improve ecological function in the Bay–Delta system to support sustainable populations of diverse and valuable plant and animal species (CALFED 2000).

It should be noted that the objectives of the broader CALFED Bay–Delta Program also include goals related to consumptive uses, such as improved water supply reliability. This objective is achieved through new water resource development projects and improvements to water use efficiency, and not by water acquisition.

Where planning is undertaken at a number of levels, the objectives of high level strategic plans, such as the California Water Plan and the State Water Plan (South Australia), tend to be broad in nature. The mid-level resource plans such as Catchment Water Management Plans (South Australia) are more specific, with identified outcomes, indicators and targets.

One of the outcomes of strategic resource plans can be the objectives of operational plans. These objectives generally relate to the environment (such as stating desired ecological outcomes) or to the security attached to water rights. For example, the National Water Program (Mexico) includes a number of objectives to guide the regional water programs. In Queensland, the Water Resource Plans establish the environmental and water rights security objectives for Resource Operations Plans (see box 6.1).

Most jurisdictions have resource plans or acquisition programs that contain clearly specified objectives. For example, in California, the objectives associated with the *Central Valley Project Improvement Act 1992* and CALFED Ecosystem Restoration Program are clearly specified and include targets. Objectives relate to ecosystem restoration, catchment management, water supply reliability, storage, conveyance, water quality, water use efficiency and conservation. In addition, objectives relating to the governance of water agencies are defined.

The exception in Australia is the ACT, where objectives are not published within resource plans. However, the ACT plans include a restatement of the objectives of the *Water Resources Act 1998* (the governing legislation) and the Territory Plan.

Impact assessment

Under a RIS based framework, allocation options should be identified and the impacts of decisions assessed. As with resource assessment, it is important that impacts are assessed using a consistent method with agreed values across catchments within a jurisdiction. This allows for a better coordination of plans that govern shared resources.

Box 6.1 Specified objectives in Water Resource Plans (Queensland)

The draft *Water Resource (Border Rivers) Plan 2002* contains a number of stated objectives which are described as outcomes. For example, ecological outcomes consistent with maintaining a healthy riverine environment, floodplain or wetland include:

- maintaining pool habitats, and native plants and animals associated with the habitats, in watercourses;
- maintaining natural riverine habitats that sustain native plants and animals;
- maintaining the natural abundance and species richness of native aquatic biota and native riparian vegetation;
- maintaining active river-forming processes, including sediment transport;
- improving wetland inundation to provide for ecological processes; and
- reducing the adverse impact of infrastructure on natural hydraulic bank erosion processes.

To meet these outcomes, the plan includes objectives and performance indicators for environmental flows and for the security attached to water rights (water allocations). For example, one environmental flow objective is that within five years, the end of system flow be not less than the lesser of the following:

- 60 per cent of the end of system flow for the pre-development flow pattern; or
- the end of system flow for the November 1999 development flow pattern.

Performance indicators for the environmental flow objectives include: end of system flow; low flow; summer flow; wet season flow; and 2-year average recurrence interval daily flow.

Part 5 of the Water Resource Plan describes the strategies to be adopted for achieving the stated outcomes. These strategies provide for the preparation of Resource Operations Plans and any allocative decisions made under the plan. They also provide guidelines for the conversion of existing entitlements of unregulated and regulated water resources, the control of overland flow, and planning for unallocated water resources.

Source: Water Resource (Border Rivers) Plan 2002 (consultation draft).

Given the uncertainty of identifying and quantifying all economic, environmental and social impacts, it is important that assumptions made about these impacts are transparent.

A well-established method for assessing economic, environmental and social impacts is benefit–cost analysis.¹² Alternative assessment frameworks include socio-economic and environmental impact studies that consider the social and environmental impacts in isolation. Where separate impact studies have been conducted, resource planners should consider the findings of all studies.

Uncertainty regarding environmental impacts arises because of the imperfect scientific methods used in their determination. Most jurisdictions recognise this and apply the Precautionary Principle. In essence, under the principle, some preventative action should be undertaken to address potential environmental harm even though risks are being more precisely evaluated (see box 2.4).

In determining environmental impacts, it is particularly important to predict flows over time. In addition, the inter-relationships between water resources, such as surface water, groundwater and overland flow, need to be considered to ensure efficient allocation of water (see chapter 5).

Social impact assessment is generally used to examine the effect of a proposed allocation on a community. Apart from the impacts on communities of changes in agricultural production and incomes, social impacts considered may include the effects on non-consumptive water uses such as fishing, navigation and tourism. Social impacts may also encompass changes affecting cultural values such as indigenous beliefs and requirements, and may extend to a community's aesthetic values.

The methods employed to assess impacts in the jurisdictions studied are listed in tables 6A.8 and 6A.9 respectively.

In all the Australian jurisdictions, except Victoria, there are statutory requirements to consider the social and economic impacts of allocation decisions. In most Australian jurisdictions, economic and social outcomes were assessed using either economic or social impact analysis. But in no jurisdiction were comprehensive benefit–cost analyses undertaken.

In Victoria, economic or social assessments of bulk entitlement orders are not conducted. Any re-allocation of water to the environment is negotiated by the water authority with its stakeholders. However, a water authority may choose to undertake an economic assessment to inform its position and the negotiations.

¹² Benefit–cost analysis is based on a systematic categorisation of impacts of allocation decisions as benefits and costs, valuing the benefits and costs in dollar terms and then determining the net benefits to society of the proposal relative to the status quo (Boardman et al 1996).

It also appears that economic or social impact analysis may not be undertaken in the drafting of Victorian Stream Flow Management Plans. For example, the Kiewa River Stream Flow Management Plan Consultative Committee did not conduct a socio-economic study in the development of the plan.¹³ The reasons given by the Committee for not conducting this analysis are listed in box 6.2.

Box 6.2 Analyses in the Kiewa Stream Flow Management Plan

The need for a socio-economic study was discussed by the Consultative Committee during its deliberations. The Committee came to the conclusion that such a study was beyond the scope of the plan for the following reasons:

- The cost of the study would be prohibitive to do in any meaningful way.
- A range of assumptions needs to be made. Not only for the cost to water users in making on-farm adjustments, revenue losses, and impact to the economy, but also in putting values on tourism, recreation, fishing, and environment and so on. This would inevitably lead to public debates and disagreement about the assumptions.
- Depending on the method used, a range of markedly different outcomes can result.
- Government support is required to fairly share the cost of implementing the plan. The Consultative Committee's support for the recommendations in the plan is conditional on this issue.
- As other Stream Flow Management Plans are conditional on financial support, it makes more sense for the government to undertake the socio-economic evaluation of such plans and develop fair cost sharing rules.

Source: Kiewa Stream Flow Management Plan (2002, s. 10.1.4).

The method used in the assessment of impacts is not consistent between jurisdictions, or in some cases, between catchments within jurisdictions. For example, in NSW socio-economic assessments are informal processes where different options are discussed and the preferred option chosen. In Queensland, impact studies appear to follow a more formal process.

The identification of the preferred option may be achieved through the assessment of the impacts of a range of alternatives. In the jurisdictions studied, alternative options are typically analysed in trying to identify preferred option for both resource plans and acquisition programs .

In Victoria, alternatives are analysed to determine preferred operating rules in Bulk Entitlement Orders and Stream Flow Management Plans by considering

¹³ Other examples include the King Parrot Creek and Yea River Catchment Stream Flow Management Plans.

environmental threats to the resource. Alternative allocation options are also identified and analysed during the drafting of Queensland Water Resource Plans. The assessment of alternative options is used extensively in the California State Water Plan, *Central Valley Project Improvement Act 1992* and the CALFED Bay–Delta Program.

A preliminary analysis of benefits and costs was undertaken by the MDBC in the development of the Living Murray Initiative. As of May 2003, the MDBC was undertaking further assessment of social and economic impacts based upon analysis of identified alternative allocation options.

The extent to which the impacts of allocation decisions are assessed in Mexico could not be ascertained. In South Africa, water is allocated on a strict ‘priority of use’ basis. Water for human consumption is accorded the highest priority and the water for general economic and recreation uses are accorded the lowest priorities (DWAF 2002). It is unclear what impact assessments were conducted in determining the optimal allocation between uses in South Africa.

Transparency

Transparent planning and programming processes allow stakeholders to evaluate whether the processes are rigorous and are likely to lead to more widespread public acceptance of any decisions. Transparency may be achieved by making the basis of decisions publicly available.

There are statutory obligations to publish decisions, research, draft recommendations or plans, submissions and the resource plans or acquisition programs themselves in most jurisdictions. Obligations to publish impact assessments, such as regulatory impact statements, socio-economic impact studies and environmental impact studies, enhance transparency.

Each of the jurisdictions studied has statutory requirements to make resource plans and acquisition programs available for public viewing. However, there are differences between jurisdictions in the range of planning documents published. For example, in Queensland, the Department of Natural Resources and Mines is required to make publicly available issues papers, draft Water Resource Plans, technical reports, impact statements and reports on the issues raised during consultation. In the ACT, planning authorities are only required to publish the draft Water Resource Management Plan.

In addition to the publication of the details, relevant data, assumptions and estimates of acquisition programs, there is a statutory requirement that Californian planners

publish records of decision.¹⁴ A record of decision is a succinct statement of the decision made, its background, other alternatives considered, the basis for the decision, the environmentally preferable alternative, measures to minimise environmental harm, and public involvement in the decision making process. The record must also identify any adverse environmental effects which cannot be avoided should the proposal be implemented.

Across the jurisdictions studied, all or most of the relevant research supporting allocation decisions is published. However, it is not always clear how the competing needs of water uses were balanced in the final allocative decision. This lack of transparency is exacerbated by the absence of comprehensive analysis of each of the alternative options (see tables 6A.8 and 6A.9).

Consultation

In the absence of market (demand) signals to indicate preferences, consultation allows for the identification of economic, social and environmental issues at a community level, and assists planners in balancing the water use interests of the community.

Consultation increases the transparency of the planning process. It may also facilitate acceptance within local communities of the introduction of new resource plans or amendments of existing plans. The arrangements for consultation within the jurisdictions studied are listed in tables 6A.10 and 6A.11.

There is recognition in all jurisdictions of the need for consultation in the resource planning and acquisition programming processes. Three principal means are used to consult with the community. Two of these are: the establishment of advisory committees; and the direct representation of the community on allocation decision making bodies are two. Another is to invite public submissions.

In NSW, Queensland and California, advisory bodies were established to provide a forum for community consultation. Similarly, a number of reference groups were established during the drafting of the initial State Water Plan in South Australia.

No advisory or planning body (representing the community) was established in the ACT during the development of the Environmental Flow Guidelines and the Water Resource Management Plan.

¹⁴ The record of decision is a statutory requirement pursuant to section 102(2)c of the *National Environmental Policy Act* (1969) and Council of Environmental Quality regulations.

User groups and the community are represented on planning bodies responsible for the determination of allocations in Victoria (Stream Flow Management Plans and Groundwater Management Plans), South Australia, Mexico (Regional Water Programs) and South Africa (Catchment Management Strategies) (see table 6A.4). These bodies have a direct role in the determination of allocation decisions. The organisational issues resulting from the establishment of planning bodies based on stakeholder representation are discussed in section 6.4.

In all of the jurisdictions studied, public submissions are invited in the development of plans. Two rounds of submissions are invited in the drafting of Water Resource Plans (Queensland), Stream Flow Management Plans and Groundwater Management Plans (Victoria) and Water Allocation Plans (South Australia). The initial round takes place prior to the drafting of the plan and the subsequent round at the completion of the plan. However, no provision was made for the general public to comment or lodge submissions during the drafting of the State Water Management Outcomes Plan in NSW.

The intended scope of submissions appears to be greatest in the drafting of the California Water Plan, for which public submissions are invited on the draft plan and on all the estimates and assumptions used in drafting the plan.

Review

Many of the factors that influence the decisions of resource plans and acquisition programs can be expected to change over time. These factors include efficiency in consumptive use, in-stream water use, environmental conditions, society values regarding the environment, hydraulic works and government policies (such as cost recovery).

There is a strong case for reviewing resource plans and acquisition programs as scientific methods improve to more accurately determine environmental flows, and as community preferences change. However, the potential for governments to change allocations may also affect investment decisions, because the probability of intervention reduces the level of certainty right-holders have over their access to water.

The requirements to review resource plans are presented for the Australian and overseas jurisdictions studied in tables 6A.12 and 6A.13 respectively.

Comprehensive monitoring and periodic reviews allow managers to identify and address any shortcomings in the preparation of resource plans and acquisition programs.

There are statutory requirements to undertake periodic reviews in most of the Australian jurisdictions studied. The exception is Victoria, where there is no statutory requirement for Bulk Entitlement Orders or water management plans to be reviewed. However, according the Victorian River Health Strategy 2002, the environmental water provision of Bulk Entitlements will be progressively reviewed from 2003 on the basis of expected environmental outcomes. There are also planning guidelines for the review of Victorian water management plans.

Major reviews of resource plans in NSW (Water Sharing Plans), Victoria (Stream Flow Management Plans), South Australia (State Water Plan and Catchment Water Management Plans), the ACT, California, Mexico and South Africa occur every 6 years or less. Water Resource Plans in Queensland are reviewed every 10 years.

The review arrangements for the South African Reserve are unclear. Although the Reserve is binding and the *National Water Act* (1998) does not require a review, the Department of Water Affairs and Forestry has indicated an intention to continually review and update the Reserve.

The effectiveness of Implementation Programs in NSW, Water Resource Plans in Queensland, Catchment Water Management Plans in South Australia and the CALFED Bay–Delta Program in California are monitored and reported annually — on the extent to which they are meeting their stated objectives. Annual monitoring results are also published for the *Central Valley Project Improvement Act 1992* (California).

In the Australian jurisdictions studied, California and Colorado, indicators of desired outcomes are used as performance measures. The exception is the ACT, where resource plans do not include explicit performance outcomes.

There are extensive performance indicators for the CALFED Bay–Delta Program. Each performance measure is matched to a program objective, and indicators are used to track progress towards meeting the objective. Included in the specification of indicators are one or more metrics by which the indicator can be measured, and a mechanism for isolating the effects of CALFED actions from other factors affecting the metric.

To a large extent the review process is driven by the term of the resource plan and acquisition program. The term and the flexibility to modify a plan or program during its term is set out in tables 6A.14 and 6A.15.

6.6 In summary

In all of the jurisdictions studied, individual right-holders are permitted to trade water and water rights. Such trading permits water to be allocated to society's highest valued uses.

Resource plans and acquisition programs are prepared by governments to determine how much water is to be allocated between consumptive and non-consumptive (mostly environmental) uses. The preparation of these plans and programs is complex because of uncertainty about the benefits of water use, the cost to the environment and the public interest in environmental protection.

The uncertainty surrounding the outcomes that might arise from resource plans and acquisition programs has led most jurisdictions to introduce legislative provisions for the planning and programming decisions to be regularly reviewed. These are undertaken as part of an adaptive management strategy in the Australian jurisdictions studied, California, Colorado, Mexico and South Africa.

The ability to re-allocate water between consumptive and environmental uses potentially allows less stringent application of the Precautionary Principle when dealing with uncertainty. Governments could set aside even more water for the environment at the outset if they feel constrained in making changes to the allocation of water between consumptive and environmental uses. The extent that it increases the risk that a right-holder's water allocation may change, flexibility can discourage investment to the detriment of dynamic efficiency.

In some jurisdictions, the adverse effects posed by the risk of administrative re-allocation of water have been mitigated to some extent by fixing the tenure of plans. In this way, increased certainty is provided, at least for a limited period.

A difference in the extent of government involvement among the jurisdictions studied, is that the resource plans of the Australian jurisdictions, Mexico and South Africa are intended to make the allocation of water by balancing a range of economic, environmental and social objectives. In California and Colorado, any government intervention is undertaken specifically to protect or restore environmental health — not to make allocations between consumptive uses.

In California, acquisition programs are undertaken by government environment protection agencies, whose primary objective (unless instructed otherwise) is not to balance wide-ranging competing interests but to protect the environment. Further, these agencies have an advocacy role that conflicts with balancing the interests of non-consumptive and consumptive uses.

Resource planning, to the extent that it balances wide ranging objectives, has the potential to produce socially efficient outcomes. However, effective resource

planning depends on the quality of the data, rigour of the process and the way uncertainty is addressed.

The processes of resource planning and acquisition programming are broadly similar in the jurisdictions studied. Generally, comprehensive benefit–cost studies were not conducted in the Australian jurisdictions studied. Instead, the environmental and social consequences of potential allocations were typically assessed using environmental or social impact studies. Other differences of note include:

- Economic or social assessments are not conducted for Bulk Entitlements in Victoria. In the ACT, there was no published economic or social assessments of Environmental Flow Guidelines and Water Resource Management Plans.
- The method used in the assessment of impacts may not be consistent between jurisdictions, or in some cases, between catchments within jurisdictions.

In California, impact assessments appear to have been undertaken more rigorously and comprehensively than in other jurisdictions. Assessment guidelines required alternative acquisition options to be identified and evaluated in respect of broader CALFED objectives. Alternative water management strategies were evaluated to identify the most cost effective manner in which to acquire water.

In most jurisdictions, there is balanced community representation on advisory and decision making bodies. However, this might not be the case in Victoria, where consultative committees are required by statute to be comprised of at least 50 per cent primary producers. Nor in South Australia, where Catchment Water Management Boards are appointed on the basis of skills not representation. This creates a potential for boards to be comprised of members who have interests that are not broadly representative of water users and the community.

In general, there is greater legislative scope for the water resources agency to amend or change plans in Australia than there is in most of the overseas jurisdictions. This allows these jurisdictions greater scope to re-allocate water administratively to environmental uses. In the Australian jurisdictions studied, the responsible minister is empowered under legislation to amend or revoke resource plans — for example, if it is in the public interest. However, in Victoria the Minister for Water may only amend a Bulk Entitlement with the support of another minister. In Queensland, the Minister for Natural Resources must amend a Water Resource Plan if, following a report on the plan, the plan’s objectives are no longer appropriate for its area, or if the objectives are not being met.

In contrast, the opportunities to re-allocate water to environmental uses are more limited in California and Colorado. If additional water is required it must be obtained by appropriating the water (where it is available), purchasing water rights, or investing in water saving programs.

The degree to which plans are reviewed varies between and within jurisdictions. Periodic reviews occur in all Australian jurisdictions studied. In most of these jurisdictions there are statutory requirements to undertake reviews. The exception is Victoria, where there is no statutory requirement for Bulk Entitlements or water management plans to be reviewed. However, there are guidelines for reviewing Stream Flow Management Plans every 5 years.

In the jurisdictions studied, determination and review are generally undertaken by the same organisation. There is a case for the organisation reviewing the performance of an acquisition program or resource plan to be separate from the organisation that develops the acquisition program or resource plan (see chapter 4). This removes the possibility of vested interests impacting upon the integrity of the review. It is also likely to be a more transparent process.

Attachment 6A

Table 6A.1 **Planning framework for allocation — overseas jurisdictions, 2003**

<i>Instrument by jurisdiction</i>	<i>Role and scope</i>
Colorado River Basin	
US Bureau of Reclamation recovery and conservation programs	US Bureau of Reclamation is required under endangered species protection legislation to mitigate for impacts of operations upon fish, plant and other habitat. Planning instruments identifying water needs for habitat protection and habitat enhancement programs must identify water sources from within the existing framework governing water use.
California	
California Water Plan	Strategic plan aimed at addressing the state's future water needs. Under the Plan, strategies and options are identified and evaluated to meet future needs, establishes monitoring criteria to measure the effectiveness of implemented options, and evaluates the status of other major programs on California's water resources (CALFED and the <i>Central Valley Project Improvement Act 1992</i>).
Central Valley Project Improvement Act (Anadromous Fish Restoration Program)	Purpose is to place the conservation and restoration of fish and wildlife on a par with water supply and power generation. Prohibits execution of new Central Valley Project water supply contracts until environmental restoration actions are completed. Re-allocated around 1000 GL annually (700 GL in dry years) to restore valley fisheries. Restore annual in-stream flows in the Trinity River and Central Valley wildlife refuges.
CALFED Bay-Delta Program	Program provides for the comprehensive management of water resources in the Bay-Delta area. Included under the program are subprograms that deal with water quality, water supply reliability, water use efficiency, storage and conveyance. Outlines environmental flow objectives which are achieved through the Ecosystem Restoration Program and the Environmental Water Account Program.
Ecosystem restoration (CALFED)	Acquires water from sources throughout the Bay-Delta's watershed to provide flows and habitat conditions for fishery protection and recovery, and increases in Delta outflows during key periods.
Colorado	Water resource planning is generally not conducted. Water is appropriated where available. Otherwise water is acquired for environmental purposes through participation in a number of federally approved inter-jurisdictional recovery and conservation programs. These programs are the Upper Colorado Basin Endangered Species Recovery Program, the San Juan Recovery Implementation Program, the Platte River Endangered Species Partnership, and the Lower Colorado River Multi-Species Conservation Program.

(Continued next page)

Table 6A.1 (continued)

<i>Instrument by jurisdiction</i>	<i>Role and scope</i>
Chile	Water resource planning and acquisition programs are not conducted. Water is allocated for environmental purposes through administrative procedures concerning the granting of water rights. Such procedures include the requirement for environmental impact studies to accompany applications for new works approvals. Minimum flow requirements have also been set by the Directorate General of Water and are described in administrative guidelines. ^a
Mexico	
National Water Law 1992	Governing legislation. Establishes a system for the planning, allocation and use of water.
National Water Program	Strategic plan at a National level that defines the principles, objectives and strategies that guide the regional resource plans. The National Plan of Development and the National Program of Environment and Natural Resources guide the program.
Regional Water Programs	Operational plans drafted at a river basin level. Responsible for the allocation of water between users. Programs permit the granting of rights to the exploration or use of water as well as its control and preservation.
South Africa	
National Water Act 1998	Governing legislation. Establishes a system for the planning, allocation and use of water. Extends to the use, flow and control of all water in South Africa.
National Water Resource Strategy	Strategic plan which provides the framework for the management of water resources for the country as a whole. The strategy provides quantitative information about the present and future availability of and requirements for water in each of the 19 water management areas. The strategy also quantifies the proportion of available water in each water management area.
Catchment Management Strategies	Strategic plans for the regional management of water resources. The strategies must not be in conflict with the national water resource strategy. Sets out guidelines and procedures for the catchment management agency. Strategies must contain water allocation plans.
Reserve	The reserve consists of two parts – the basic human needs reserve and the ecological reserve. The reserve refers to both the quality and volume of water resources. The allocation of water for the reserve is enforced in catchment management strategies.

^a Minimum flows are described in the Manual of Standards and Procedures for the Administration of Water Resources 2002.

Source: Annexes G to L.

Table 6A.2 Planning framework for the allocation and use of water — Australian jurisdictions, 2003

<i>Instrument by jurisdiction</i>	<i>Role and scope</i>
Murray–Darling Basin	
The Living Murray Initiative	The Living Murray Initiative sets target environmental flows for the River Murray and its tributaries. Target flows are implemented through the water resource plans of the participating states. Any changes to environmental flows and existing water rights require the agreement of the states.
NSW	
Water Management Act 2000	Governing legislation. Establishes a system for the planning, allocation and use of water. Extends to the use, flow and control of all water in the state.
State Water Management Outcomes Plan	Strategic plan setting both long-term and 5 year management targets for water resource management. Stated outcomes and targets apply to regulated and unregulated river systems, groundwater systems, estuaries and coastal waters. Targets include limits on diversions, environmental water provision, groundwater dependencies and water use efficiencies.
Water Management Plans (water sharing plans) ^a	Principal water management plan for allocation. Strategic plan giving local application to the objectives stated in the State Water Management Outcomes Plan.
Implementation Programs	Operational programs which interpret the objectives and strategies expressed in water management plans and determine how and when the plan will be implemented.
Victoria	
Water Act 1989	Governing legislation. Establishes a system for the planning, allocation and use of water. Extends to the use, flow and control of all water in the state.
Bulk Entitlement Order	Operational plan which quantifies urban supply system and rural water authorities' entitlements and their obligations to supply water rights, licences and statutory rights (stock and domestic). The order also sets out the environment's entitlement to water.
Stream Flow Management Plans	Operational plan managing rights to water on unregulated rivers.
Groundwater Management Plans	Plans are developed for declared groundwater supply protection areas. Plan includes an allocation policy for unallocated water, arrangements for transferring water rights and tariff arrangements to recover the costs associated with the implementation of the plan.
Queensland	
Water Act 2000	Establishes a system for the planning, allocation and use of water. Extends to the use, flow and control of all water in the state. ^b
Water Resource Plans	Establishes the strategic guidelines for allocation at a catchment level, including desired outcomes, and security arrangements. Water resource plans are drafted on a catchment by catchment basis and may apply to all water resources within the catchment.
Resource Operations Plans	Outline the operational rules of the Water Resource Plans. Resource Operations Plans apply to the catchment or water resource plans to which they are associated.

(Continued next page)

Table 6A.2 (continued)

<i>Instrument by jurisdiction</i>	<i>Role and scope</i>
South Australia	
Water Resources Act 1997	Governing legislation. Establishes a system for the planning, allocation and use of water. Extends to the use, flow and control of all water in the state.
State Water Plan	Strategic plan providing overarching policy. The State Water Plan assesses the state and condition of the water resources, identifies existing and future risks of degradation of water resources. The plan includes proposals for the use and management of water resources, an assessment of the monitoring of changes in the state and condition of the water resources.
Catchment Water Management Plans	Strategic all-of-catchment plans. Identifies key water resource management issues and determines principles and objectives governing Water Allocation Plans. Plans also direct the implementation of Water Allocation Plans and assess the environmental, economic and social characteristics of catchments.
Water Allocation Plans	Operational documents that apply to prescribed areas within catchments. Determine environmental allocations and allocate water for consumptive use. Provide trading rules.
Local Water Management Plans	Outside of catchment water management board areas, local government can address the management of waterbodies and associated ecosystems through Local Water Management Plans. Plans are not mandatory and relate to the performance of functions and the exercise of powers by local councils. ^c
ACT	
Territory Plan	Determines environmental flow regimes for individual subcatchments and assesses the community's values for priority of ecosystem management.
Water Resources Act 1998	Governing legislation. Establishes a system for the planning, allocation and use of water. Extends to the use, flow and control of all water in the Territory.
Environmental Flow Guidelines	Sets the principles for environmental flow by catchment type.
Water Resource Management Plan	Determines the allocation between environmental and extractive use. The Water Resource Management Plan has a territory wide jurisdiction.

^a In areas that are not water management areas there may exist Minister's Plans. Minister's Plans are only temporary vehicles used until Water Management Plans are formulated for the area. It is envisaged that Water Management Plans will be in place for all areas by 2005. ^b Water includes watercourse, lake, spring, underground and overland flow water. ^c Although allowable under the Act, as of August 2003 none have been prepared.

Source: Annexes A to F.

Table 6A.3 Use of administrative and market transactions — inter-jurisdictional arrangements, 2003

<i>By agreement</i>	<i>Administrative allocation</i>	<i>Market mechanisms</i>
Murray–Darling Basin		
Murray–Darling Basin Agreement	Administrative instruments used include the Cap and the water sharing provisions.	Pilot inter-state water trading along the River Murray downstream of Nyah (Victoria).
NSW–Queensland Border Rivers Agreement	Agreement governs the sharing of water and associated capital costs between the two jurisdictions.	The agreement can be adjusted to account for transfers between jurisdictions.
Lake Eyre Basin Intergovernmental Agreement	n.a	n.a
Groundwater Border Advisory Review Committee	Administrative determination of the volume of water available for extractive use and for each state (Victoria and SA)	Prevailing state market mechanism.
Colorado River Basin		
Law of the River	A series of laws and agreements allocate water between the basin states and Mexico. No provision for environmental flows.	Inter-state water trading not a feature of the arrangements.
US Bureau of Reclamation recovery and conservation programs	Programs do not have the authority to re-allocate water administratively.	Programs plan to employ existing water markets to re-allocate water to meet the needs of endangered species and critical habitats.

na not applicable

Source: Annexes A and G.

Table 6A.4 Organisational roles in resource plans — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Determination</i>	<i>Assessment</i>	<i>Consultation</i>	<i>Review</i>
Murray–Darling Basin	MDBMC ^a , MDBC ^b	MDBC	MDBMC, Independent Community Reference Panel	MDBC, Independent Sustainable Rivers Audit Group
NSW	Minister ^c and DIPNR ^d	Minister, DIPNR	Minister and DIPNR supported by community advisory committees ^c	Water Advisory Council, Minister
Victoria	DSE ^e , Entitlement Committee and Consultative Committees, Water Authorities	DSE, Entitlement Committee and Consultative Committees	DSE Entitlement Committee and Consultative Committees	Minister
Queensland	NR&M ^f	NR&M, Technical Reference Panels	NR&M, Community Reference Panels	NR&M, Minister
South Australia	CWMB ^g and WRPC ⁱ	CWMB and WRPC	CWMB, WRPC, Constituent Councils and local groups (such as Local Action Planning Committees ^j)	DWLBC ^h CWMB, WRPC and Water Resources Council
ACT	EPA ^k	EPA	EPA	EPA

^a The Murray–Darling Basin Ministerial Council. ^b The Murray–Darling Basin Commission. ^c The *Water Management Act 2000* allows for plans to be made either by the Minister or by a water management committee. In the latter case the functions of the Minister are performed by the water management committee. ^d Department of Infrastructure, Planning and Natural Resources. ^e Department of Sustainability and Environment. ^f Department of Natural Resources and Mines. ^g Catchment Water Management Boards. ^h Department of Water, Land and Biodiversity Conservation. ⁱ Water Resources Planning Committees. ^j Local Action Planning Committees develop local action plans which identify priority issues for resource management and are incorporated into catchment Water Management Plans. ^k Environmental Protection Authority.

Source: Annexes A to F.

Table 6A.5 Organisational roles in resource plans and acquisition programs — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Determination</i>	<i>Assessment</i>	<i>Consultation</i>	<i>Review</i>
Colorado River Basin	Bureau of Reclamation, US Fish and Wildlife Service, State governments, Program steering committees	Bureau of Reclamation, US Fish and Wildlife Service, International Boundary and Water Commission (US Department of State)	Program steering committees, Sub-committees where required..	Program steering committees
California	Resource Agency SWRCB ^a , California Bay-Delta Authority, Bureau of Reclamation and DWR ^b	SWRCB, California Bay-Delta Authority, Bureau of Reclamation and DWR	SWRCB, California Bay-Delta Authority, Public Advisory Committee (CALFED) Advisory Committee (California Water Plan), Extended Review Forum and DWR	DWR, California Bay-Delta Authority and Bureau of Reclamation
Colorado	n.a.	n.a.	n.a.	n.a.
Chile	n.a.	n.a.	n.a.	n.a.
Mexico	Secretariat of Environment and Natural Resources, CNA ^c	CNA, River Basin Technical Committees, Underground Water Committees, Mexican Institute of Water Technology	CNA, River Basin Advisory Groups, The Water Consultative Council, Water user groups	
South Africa	DWAF ^d and CMA ^e	DWAF and CMA	DWAF, CMA, and the National Water Advisory Council	DWAF and CMA

na Not applicable. **a** State Water Resources Control Board. **b** Department of Water Resources. **c** National Commission of Water. **d** Department of Water Affairs and Forestry. **e** Catchment Management Agency.

Source: Annexes G to L.

Table 6A.6 Composition of agencies involved in determination and consultation — Australian jurisdictions, 2003

<i>Organisation by jurisdiction</i>	<i>Composition</i>
Murray–Darling Basin	
Murray–Darling Basin Ministerial Council (MDBMC)	Council comprises the Ministers responsible for land, water and environmental resources from New South Wales, Victoria, Queensland, South Australia and the Commonwealth. The Australian Capital Territory is also represented on the council as a non-voting member. The chair of the Community Advisory Committee also attends all Ministerial Council meetings. ^a
Murray–Darling Basin Commission (MDBC)	MDBC is the executive arm of the MDBMC and comprises an independent president (appointed by unanimous vote of the MDBMC), two voting commissioners from each of the participating states and Commonwealth. The chair of the Community Advisory Committee in an observing role.
Community Advisory Committee	Committee comprises an independent Chairman and 28 members, namely: <ul style="list-style-type: none"> • twenty three state representatives chosen on a catchment or regional basis — nine from New South Wales, five from Victoria, four from South Australia, four from Queensland, and one from the Australian Capital Territory; and • a representative nominated by each of five special-interest organisations: the National Farmers Federation, the Australian Conservation Foundation, the Australian Local Government Organisation, the Australian Landcare Council, and an indigenous representative nominated through the Indigenous Land Corporation.
Community Reference Panel	Members are from the southern connected basin.
NSW	
Minister	
Department of Sustainable Natural Resources	State government agency which is accountable to the responsible Minister.
Water Management Committees	Equal representation of environmental protection groups, water user groups, local councils and indigenous persons. Others represented include catchment management boards, the Department of Land and Water Conservation and a nominee of the responsible Minister. As far as practical members of the board must reside within the water management area. Committees are accountable to the responsible Minister.

(Continued next page)

Table 6A.6 (continued)

<i>Organisation by jurisdiction</i>	<i>Composition</i>
Victoria	
Department of Sustainability and Environment	State government agency which is accountable to the responsible Minister.
Entitlement committees	There are no mandatory rules for representation. The composition may vary between catchments. Committees would typically have representatives from Department of Sustainability and Environment, relevant Water Authorities, Environment Victoria, Victorian Farmers Federation, Rural Water Authority Water Service Committees, community representatives, indigenous representatives (in some cases), other industry groups and Catchment Management Authorities.
Consultative committees	At least 50 per cent of members must be primary producers. Must comprise representatives from authorities directly affected. Must contain a reasonable gender balance and represent all relevant interests. Committees are accountable to the responsible Minister.
Rural water authority	State government agency which is accountable to the responsible Minister.
Queensland	
Department of Natural Resources and Mines	State government agency which is accountable to the responsible Minister.
Community reference panels	Reports to the Department (NR&M). Advisory panel with no decision making capabilities. Representatives from cultural, economic and environmental interests in the relevant area. Thus, the Community Reference Panel will comprise members from a number of stakeholder groups including industry, conservation groups and indigenous groups.
South Australia	
Department of Water Land and Biodiversity Conservation	State government agency which is accountable to the responsible Minister.
Catchment water management boards	Boards have community, agency and scientific representation. The responsible Minister, on the basis of skills (not representation), appoints community members. Boards must consist of at least 5 members but not more than 9. One or more board members must be a member of the catchment community. Boards are accountable to the responsible Minister.
Water resources planning committees	The members of the committee are appointed by the responsible Minister and must collectively have knowledge of water resource development and management, experience in the use of water resources, and experience in the conservation of ecosystems. Committees are accountable to the responsible Minister.
ACT	
Environment Protection Authority	Statutory position occupied by a public servant who is accountable to the responsible Minister.

^a The Community Advisory Committee is established by and reports to the Murray–Darling Basin Ministerial Council. The committee advises the council on natural resource management issues and the views of basin communities.

Source: Annexes A to F.

Table 6A.7 Composition of agencies involved in determination and consultation — overseas jurisdictions, 2003

<i>Organisation by jurisdiction</i>	<i>Composition</i>
Colorado River Basin	
Secretary of the Interior	Secretary of the Interior, represented by the US Bureau of Reclamation and the US Fish and Wildlife Service, must approve proposed recovery and conservation program.
Program steering committees	The precise composition of committees differs across programs although there tends to be a wide representation of federal and state government, indigenous, environmental and water user interests.
California	
State Water Resource Control Board	Consists of five full time salaried members, each appointed for a four-year term by the Californian Governor. The Senate must confirm their appointment. Accountable to the Californian Governor and the State Senate.
Advisory Committee (California Water Plan)	Composed of private sector representatives of urban, environmental and agricultural water interests, and representatives of state, and local government. Members are appointed by the Department, on the basis of geographic and cross-sectional representation. Committee has no decision making ability. Reports to the Department of Water Resources.
Extended Review Forum (California Water Plan)	Membership is open to the public. Forum has no decision making ability.
Department of Water Resources	State government agency that is accountable to the Californian Governor and the State Senate.
California Bay–Delta Authority (CALFED)	Authority includes representatives from six state agencies, six federal agencies, seven public members, one member of the Bay–Delta Public Advisory Committee and four non-voting ex officio members of the legislature. Accountable to the Federal and State Senates.
Public Advisory Committee (CALFED)	May consist of 20 to 30 members. Membership includes representatives of indigenous groups, stakeholder groups and environmental justice representatives. Selection is based on skills and to reflect geographic diversity of interests. Committee is required to be balanced and diverse.
Department of Interior	US Federal Government agency accountable to the Federal Senate.
Colorado	n.a.
Chile	n.a.

(Continued next page)

Table 6A.7 (continued)

<i>Organisation by jurisdiction</i>	<i>Composition</i>
Mexico	
Secretariat of Environment and Natural Resources	Federal Executive which operates through the National Water Commission and has the authority for administering and protecting the national waters.
National Water Commission	Federal Government agency that is accountable to the Secretariat of Environment and Natural Resources.
Water Consultative Council (National Water Program)	Council members are appointed based on skills and knowledge. Composed of five working groups: economy and finance; legal framework; communication and education; technology and management; and environmental.
Basin councils	Councils are composed of representatives of the Secretariat of Environment and Natural Resources, the National Water Commission, federal agencies, state and municipal governments, water users and the energy sector. Water uses are appointed on the basis of representation and include agricultural use, urban public use, industrial use and cattle use. The purpose of the councils is to formulate and to execute programs and actions for the administration of water. The Councils are accountable to the National Water Commission
South Africa	
Department of Water Affairs and Forestry	National government agency accountable to the responsible Minister.
Catchment management agencies	The Minister appoints the governing board. Appointments are made on a representational basis to provide balance between differing water use sectors, gender and demography. Appointments may also be based on skills.
National Water Advisory Council	Council is established by and responsible to the Minister. Council is not a statutory instrument.

na Not applicable.

Source: Annexes G to L.

Table 6A.8 Impact assessment — Australian jurisdictions, 2003

<i>Instrument by jurisdiction</i>	<i>Description</i>
Murray–Darling Basin	
The Living Murray Initiative	Detailed assessment of the environmental impacts of different flow scenarios. Scenarios are based on three reference points for average water recovery — 350, 750 and 1500 GL. These include assessment of the impact of existing regulation of flow patterns. Preliminary assessment of the economic, social and environmental costs and benefits for an increasing environmental flow. Subsequent analysis is based on the use of scenarios.
NSW	
State Water Outcomes Plan	Not relevant as this plan does not focus on particular source. It sets broad guidelines for the development of Water Sharing Plans.
Water Sharing Plans	Legislative requirement to consider social and economic interests. The Minister approached socio-economic assessments by undertaking informal processes where different options were discussed and the best option chosen. The NSW Government commissioned ACIL Consulting to undertake an independent report into the expected state-wide economic impact of the draft <i>Water Sharing Plans</i> . The assessment was based on surface water and groundwater sources that support about 80 per cent of the state's water extractions.
Implementation Programs	None, impacts considered in Water Sharing Plan. Guidelines may become available as plans are developed.
Victoria	
Bulk Entitlement Conversion Process	The extent to which bulk entitlement orders consider social and economic impacts is unclear. The environmental impacts of water allocations are considered. Hydrological modelling may be used to assess the impacts of revised operating rules on flow regimes and on water supply yields and security. Scenarios are used to determine preferred operating rules. No explicit social assessments are conducted. Economic assessments are generally not conducted. In some cases relevant water authorities may undertake economic assessments.
Stream Flow Management Plans	Legislative requirement to consider environmental, social and cultural impacts. Environmental impacts are considered. Assessment of the impacts that environmental flows have on existing use and reliability of supply is undertaken. It appears that analysis of social and economic impacts is not undertaken. However, this may vary across plans.
Groundwater Management Plans	Assessments are undertaken in accordance with the established guidelines. The main assessment undertaken is the sustainable yield of the aquifer. In some cases social and environmental impact studies are undertaken. Scenario planning relating to the threats to the resource is undertaken. Impacts on water levels of different pumping rates are also assessed.

(Continued next page)

Table 6A.8 (continued)

<i>Instrument by jurisdiction</i>	<i>Description</i>
Queensland	
Water Resource Plans	Legislative requirement to consider impacts on cultural, economic and social values (including future requirements); the support of natural ecosystems; effects on water not covered by the plan. Usually socio-economic studies and environmental impact studies (these may vary from catchment to catchment). Some of the factors considered include the direct economic impact for principal water users, economic flow on benefits, and social and cultural heritage impacts. Scenarios are used in accessing the impacts of differing flows.
Resource Operations Plans	Impact analysis is conducted during the drafting of the water resource plan.
South Australia	
State Water Plan	n.a.
Catchment Water Management Plans	Legislative requirement to consider economic, environmental and social values. No guidelines on the approaches to be used, but there are a number of accepted approaches.
Water Allocation Plans	Legislative requirement to consider economic environmental and social impacts and that the rate of the use of water is sustainable. Must also consider the future needs of occupiers of land and future capacity of land. The extent to which these impacts have been considered is unclear.
ACT	
Environmental Flow Guidelines	Legislative requirement to consider the environmental impacts.
Water Resource Management Plans	Legislative requirement to consider the environmental, economic and social impacts of allocations. Hydrological modelling of environmental requirements. Assessment was undertaken on the impacts on urban water supply. Not in terms of rural or minor industrial use.

na Not applicable.

Source: Annexes G to L.

Table 6A.9 Impact assessment — overseas jurisdictions, 2003

<i>Instrument by jurisdiction</i>	<i>Description</i>
Colorado River Basin	
US Bureau of Reclamation recovery and conservation programs	Three types of impact assessment are undertaken: biological assessments, biological opinion and incidental take statement, and an environmental impact statement. Scenario analysis is undertaken. Economic impacts are assessed to the extent that the economic effects of allocations on tourism, flood control benefits and tax earnings. The third-party impacts on water users through resulting changes in water quality and volume are also considered.
California	
California Water Plan	Scenarios are used to consider alternative futures and management options.
Central Valley Project Improvement Act	Scenarios are considered in the environmental impact analysis including a no-action alternative. Impacts considered are principally environmental. The principal environmental concern is the restoration of anadromous fish (such as salmon). However, there is a degree of consideration of the impacts on low income or minority groups, as required by executive order 12898 concerning environmental justice. These impacts include social and economic.
Ecosystem Restoration Program (CALFED)	As with all CALFED programs, scenarios are considered under the Water Management Strategy Evaluation Framework. Scenarios evaluated in respect of CALFED objectives and solution principles. Economic and environmental impacts evaluated. Seeks to identify all trade-offs from alternative water management strategies. Consider systems operations, water quality, urban economics, groundwater and agricultural economic impacts.
Colorado	n.a.
Chile	n.a.
Mexico	
National Water Program	No comprehensive benefit–cost assessment or any impact assessment for water allocations. Costs were calculated based on supply and demand analysis relating to infrastructure programs for the period 2001–2025.
Regional water programs	Regional costs were calculated based on supply and demand analysis relating to infrastructure programs for the period 2001–2025.
South Africa	
National Water Resource Strategy	Information not obtained
Catchment management strategies	Unclear on the use of benefit–cost type assessment. Does not appear to be any scenario type analysis conducted. However, there is a statutory requirement to consider the socio-economic impacts of the authorisation or not of water uses.
Reserve	No impact assessment done for the Human reserve, which is set at 25 litres per person per day. Unclear on the use of impact assessment in the setting of the environmental reserve.

na Not applicable.

Source: Annexes G to L.

Table 6A.10 Consultation — Australian jurisdictions, 2003

<i>Instrument by jurisdiction</i>	<i>Process</i>
Murray–Darling Basin	
The Living Murray Initiative	After liaison with the states, community consultation is undertaken through the invitation of public submissions and by undertaking meetings with local communities. An Independent Community Engagement Panel was appointed to monitor progress of the community engagement process. The Community Advisory Committee was established, and has an ongoing role, to provide information on the communities views to the Murray–Darling Basin Ministerial Council. The Community Reference Panel provides feedback from a range of stakeholder perspectives.
NSW	
State Water Management Outcomes Plan	Discussions held with key stakeholders including the Peak Stakeholder Reference Group, other government agencies and the Water Advisory Council. No provision made for the general public to comment or lodge submissions.
Water Sharing Plans	Statutory requirement for two rounds of submissions during drafting and the establishment of Water Sharing Plans. Submissions are open to the public. Environmental protection groups, water user groups, local councils and indigenous people are represented in community advisory committees.
Implementation Programs	Under statute the Minister must consult with the water management committee that developed the relevant water management plan, and must publish the existence of the program and make it publicly available.
Victoria	
Bulk Entitlement Conversion Process	The specifics of requirements for community consultation are unclear. There is a requirement to have representation from all relevant stakeholders where conversions are undertaken for major water supply systems. The consultation process may involve formal meetings to identify issues. The Department of Sustainability and Environment circulates drafts to relevant stakeholders for comment prior to finalisation.
Stream Flow Management Plans	Statutory requirement for the invitation of submissions regarding applications for declaration of a Water Supply Protection Area and the establishment of consultative committees. Submission are open to the public. At least half of the consultative committee members must be farmers owning or occupying land in the area and are appointed in consultation with the Victorian Farmers Federation. Representatives of agencies or authorities directly affected by the plan must be represented.
Groundwater Management Plans	Statutory requirement for the invitation of submissions regarding applications for declaration of a Water Supply Protection Area and the establishment of consultative committees. Submissions are open to the public. At least half of the consultative committee members must be farmers owning or occupying land in the area and are appointed in consultation with the Victorian Farmers Federation. Representatives of agencies or authorities directly affected by the plan must be represented.

(Continued next page)

Table 6A.10 (continued)

<i>Instrument by jurisdiction</i>	<i>Process</i>
Queensland	
Water Resource Plans	Statutory requirement for two rounds of submission during development and the establishment of community reference panels (CRPs). Submissions are open to the public. CRPs are comprised of community stakeholders, local government, infrastructure providers and other state government departments. CRPs are advisory only.
Resource Operations Plans	Same statutory process as water resource plans.
South Australia	
State Water Plan	In preparing draft plan in substitution or a draft amendment the Minister must invite submissions. Submissions are open to public and must occur prior to and at completion of the draft plan. A number of reference groups were established during the drafting of the initial State Water Plan. Representation in these groups included government departments, Catchment Water Management Boards and Water Resource Planning Committees.
Catchment Water Management Plans	Consultation occurs prior and after the drafting of the proposal statement by planning bodies. Two rounds of submissions and public meetings are held — prior to preparing a draft plan and upon finalisation of the draft. Statutory requirement to consult each of the constituent councils, land owners (where land may be acquired), South Australian Water Corporation (where relevant) and the public. All government departments and agencies with a direct interest in the plan must be able to make comment on the proposal statement.
Water Allocation Plans	Public meetings are held and submissions are invited before the preparation of the draft and upon completion of the draft. Statutory requirement to consult the constituent councils or councils in whose area or areas the water resource is situated and the public. All government departments and agencies with a direct interest in the plan must be able to make comment on the proposal statement.
ACT	
Environmental Flow Guidelines	Submissions are invited for the draft plan. Submissions are open to the public.
Water Resource Management Plans	Submissions are invited for the draft plan. Submissions are open to the public.

Source: Annexes A to F.

Table 6A.11 Consultation — overseas jurisdictions, 2003

<i>Instrument by jurisdiction</i>	<i>Process</i>
Colorado River Basin	
US Bureau of Reclamation recovery and conservation programs	Across all programs, written and oral submission are invited. Consultation is mandatory under the <i>National Environmental Policy Act 1969</i> , which requires the preparation of scoping reports as part of the environmental impact assessment process.
California	
California Water Plan	Submissions are invited on the draft plan. Consultation also occurs through the establishment of the Advisory Committee and the Extended Review Forum (neither have decision making powers). The assumptions and estimates used in the drafting of the plan are made open to public inspection and submissions are invited. Public hearings are conducted prior to release of the final update.
Central Valley Project Improvement Act	A series of public workshops were conducted to discuss the administrative proposals advanced by the Department of the Interior.
CALFED Bay Delta Program	Consultation occurs through the establishment of the Public Advisory Committee (with no decision making powers), public information meetings and public workgroup meetings. Submissions are also invited for various subprograms.
Ecosystem Restoration Program (CALFED)	Ecosystem restoration subcommittees of the Public Advisory Committee (with no decision making powers) are established. Consultation also occurs through public information meetings and public workgroup meetings. Submissions are invited on the draft environmental impact statements and reports.
Colorado	n.a.
Chile	n.a.
Mexico	
National Water Program	Consultation occurs through the Water Consultative Council providing comment on the draft plan. The River Basin Advice Groups, including technical committees and groundwater committees. Further consultation occurred through consultation forums and through the invitation of public submissions during the drafting process.
Regional water programs	Consultation occurs through the establishment of River Basin Advisory Groups.
South Africa	
National Water Resource Strategy	Statutory requirement to invite submissions on the draft strategy. No requirement to establish advisory bodies or forums.
Catchment management strategies	Statutory requirement to invite submissions on the draft strategy. Consultation occurs through appointments to the governing board, which are made on a representational basis. No requirement to establish advisory bodies or forums. However, there is a statutory requirement to consult the Minister, any interested government agency, and any person or organisation which may be effected by the plan.
Reserve	Statutory requirement to invite submissions on the preliminary determinations of the reserve. No requirement to establish consultative organisations or forums.

na Not applicable.

Source: Annexes G to L.

Table 6A.12 Review of resource plans — Australian jurisdictions, 2003

<i>Instrument by jurisdiction</i>	<i>Review requirements</i>
Murray–Darling Basin	
The Living Murray Initiative	Annual reviews. As of May 2003, the Initiative is under development and it is not clear what review requirements will be adopted in the final Initiative. However, there is a Council commitment to adaptive management.
NSW	
State Water Management Outcomes Plan	The Minister is to ensure that the work and activities of the Department are reviewed at intervals of not more than 5 years for the purpose of determining whether they have been effective in giving effect to the water management principles of the State Water Management Outcomes Plan.
Water Sharing Plans	In the fifth year of operation a plan must be reviewed in terms of whether provisions remain adequate and appropriate for achieving the objectives of the Act. Every 10 years plans must be remade. There are no rollover provisions.
Implementation Programs	Reviewed annually to ensure that they are effective in meeting the objectives and strategies of the water management plan.
Victoria	
Bulk Entitlement Order	There is no statutory requirement to review orders. However, some bulk entitlements include review provisions and the Victorian River Health Strategy sets out the bases for future reviews.
Stream Flow Management Plans	Although there is no statutory requirement to review plans the Stream Flow Management Plan Framework requires plans to be reviewed every 5 years, or if appropriate at any time earlier than 5 years.
Groundwater Management Plans	Although there is no statutory requirement to review plans, the Groundwater Planning Guidelines allows for the determination of review requirements.
Queensland	
Water Resource Plans	There is a statutory requirement for the Minister to report periodically on each Water Resource Plan including a summary of the findings of research and monitoring for the plan and an assessment of the effectiveness of the implementation of the plan in meeting the plan's objectives. When a Water Resource Plan expires a review process will occur as replacement Water Resource Plans are drafted.
Resource Operations Plans	Resource Operations Plans (ROP) contain a number of general outcomes related to the rules defined by the ROP. Monitoring is conducted to assess outcomes. Outcomes monitored include ecological outcomes. Reporting arrangements are defined within the ROP. For example, the ROP for the Burnett Basin requires reporting on the ROP monitoring program to be included in the Minister's annual report on the Water Resource Plan.

(Continued next page)

Table 6A.12 (continued)

<i>Instrument by jurisdiction</i>	<i>Review requirements</i>
South Australia	
State Water Plan	Water Resources Council reviews the plan every 5 years to determine the extent to which it has been implemented and the extent to which the plan has achieved the objectives of the Act. Annual reporting by the Minister on the extent to which it has been implemented and the extent to which the plan has achieved the objectives of the Act
Catchment Water Management Plans	Catchment water management boards undertake an annual review of plan relating to implementation, and the estimated expenditure and source of funding. The board must also review the plan at least once during each period of five years following adoption. The Water Resources Council also reviews the plan every 5 years to determine the extent to which the plan has achieved the objectives of the Act
Water Allocation Plans	The Water Resources Council at the direction of the Minister must assess the extent to which the plan has been implemented and has achieved the objective of the Act. The plan must be amended to reflect any changes to be made to the State Water Plan after each 5 year review.
ACT	
Environmental Flow Guidelines	The Environmental Protection Authority is required to monitor the water resources. This allows Environmental Flow Guidelines to be reviewed at no greater than 5 year periods.
Water Resource Management Plans	The Water Resource Management Plan 1999 states that the plan will be reviewed within 3 years of the date of its approval. The Act requires that any revised plan will undergo the same public consultation and the same Ministerial approval as the original plan.

Source: Annexes A to F.

Table 6A.13 Review of resource plans and acquisition programs — overseas jurisdictions, 2003

<i>Instrument by jurisdiction</i>	<i>Review requirements</i>
Colorado River Basin	
US Bureau of Reclamation recovery and conservation programs	Each of the programs are for a defined period after which they are subject to a review. All the programs are based on the principle of adaptive management which requires periodic review and amendment of programs.
California	
California Water Plan	Plan is reviewed and updated every five years.
Central Valley Project Improvement Act	Not later than three years after the date of enactment the Secretary shall prepare an environmental impact statement, analysing the direct and indirect impacts and benefits of implementing the Act. There is also a 10 year evaluation of the success of Central Valley Project Improvement Act programs. Annual reports are published on the results of ecosystem level monitoring.
CALFED Bay–Delta Program	The program is reviewed and reported on annually to determine progress in meeting the implementation of the program.
Ecosystem Restoration Program (CALFED)	Unclear. The Restoration Program has adopted an adaptive management structure which requires continual monitoring of both the science underlying the plan and the policy objectives of the plan.
Colorado	n.a.
Chile	n.a.
Mexico	
National Water Program	Plan is revised every 6 years.
Regional Water Programs	Programs are revised every 6 years.
South Africa	
National Water Resource Strategy	Strategy must be reviewed at intervals of 5 years. No statutory requirement for periodic review within the 5-year cycle.
Catchment Management Strategies	Strategy must be reviewed at intervals of not more than 5 years. No statutory requirement for periodic review within the 5-year cycle.
Reserve	The reserve is binding and the Act does not allow for a review. However, to date only provisional estimates of the ecological reserve have been presented and the department has indicated an intention to continually review and update the reserve.

na Not applicable.

Source: Annexes G to L.

Table 6A.14 Flexibility — Australian jurisdictions, 2003

<i>Instrument by jurisdiction</i>	<i>Duration</i>	<i>Flexibility to change plans during their life</i>
Murray–Darling Basin		
The Living Murray Initiative	7 years	Unclear. There are no statutory guidelines on the ability of the Commission to amend the Initiative during its tenure. However, any such amendment would most likely require the consent of the Ministerial Council.
NSW		
State Water Management Outcomes Plan	5 years	The plan is made by the Governor for five years. Under administrative law the Governor can abolish the plan and replace it at any time.
Water Sharing Plans	10 years	The Minister can amend a plan at any time if it is in the public interest.
Implementation Programs	10 years	Department can change programs to address the adverse findings of an annual review of implementation programs.
Victoria		
Bulk Entitlement Order	Ongoing	The Minister or Governor-in-Council may amend the bulk entitlement at any time by an order. Amendment may only occur on the application of the authority holding the entitlement or another authority with the support of another Minister.
Stream Flow Management Plans	Ongoing	The Minister may amend or revoke an approved plan. In doing so the Minister is obliged to invite submissions and take advice from consultative committees.
Groundwater Management Plans	Ongoing	The Minister may amend or revoke an approved plan. In doing so the Minister is obliged to invite submissions and take advice from consultative committees.
Queensland		
Water Resource Plans	10 years	The Minister may amend or replace a Water Resource Plan during its tenure, if it becomes evident that the plan is not providing its required outcomes or in light of new knowledge. Minister must replace a Water Resource Plan once it has expired.
Resource Operations Plans	Ongoing	The chief executive must amend a Resource Operations Plan (ROP) if it is inconsistent with its associated Water Resource Plan. Amendments can be made to a ROP without consultation if allowed by the amendment processes stated in the ROP. Amendments other than those outlined in the ROP can be made only after a consultation.

(Continued next page)

Table 6A.14 (continued)

<i>Instrument by jurisdiction</i>	<i>Duration</i>	<i>Flexibility to change plans during their life</i>
South Australia		
State Water Plan	Ongoing	Plan must be amended if found upon review to not meet its statutory requirements.
Catchment Water Management Plans	Ongoing	A board may propose amendments that are required for consistency with the State Water Plan within the 5 year review period. May also propose amendments at any time that the board considers desirable. Minister considers any submissions made before adopting amendment.
Water Allocation Plans	Ongoing	A Water Allocation Plan may be amended at any time. Any amendments must follow the same process as that required to prepare a new Water Allocation Plan. A plan must be amended to reflect any changes made to the State Water Plan.
ACT		
Environmental Flow Guidelines	5 years	Statute allows the Authority to prepare a draft variation of the Environmental Flow Guidelines. There may be requirements to undertake consultation in preparing the draft. Minister has the power to accept the draft, suggest or specify revisions or require further consultation. However, Guidelines state they may be amended to reflect changes in the science used to assess environmental flows. These guidelines are also required to be advised after 5 years of implementation.
Water Resource Management Plans	3 years	Statute allows the Authority to prepare a draft variation of the Water Resource Management Plan. There may be requirements to undertake consultation or to make public the variations in the Gazette and in a newspaper. Minister has the power to accept the draft, suggest or specify revisions or require further consultation. This plan is to be revised after 3 years of implementation.

Source: Annexes A to F.

Table 6A.15 Flexibility — overseas jurisdictions, 2003

<i>By instrument</i>	<i>Duration</i>	<i>Flexibility to change plans during their life</i>
Colorado River Basin		
US Bureau of Reclamation recovery and conservation programs	Varies from 15 to 50 years depending on the program	All plans are based on the principle of adaptive management in which the approaches and methods used may be altered. Programs may be modified or amended as necessary to meet the stated goals of the program.
California		
California Water Plan	5 years	Unclear.
Central Valley Project Improvement Act	Ongoing	Plan is a federal Act and changes to the Act would have to be made under the process for amending legislation.
CALFED Bay-Delta Program	30 years	Programs may be changed during tenure dependent on the full agreement of all participating agencies. Governor or the Secretary of the Interior after notice to and consultation with the CALFED representatives may revise the plan schedule as a conclusion to an annual review.
Ecosystem Restoration Program (CALFED)	Ongoing	Plans may be changed during tenure dependent on the full agreement of all participating agencies. Compensation is not required as increased allocations of water for environmental purposes are achieved through an acquisition program.
Colorado	n.a.	n.a.
Chile	n.a.	n.a.
Mexico		
National Water Program	6 years	Unclear. Strategic plan outlining the objectives relating to individual administrative regions. There is no statutory constraint to change a plan.
Regional Water Programs	6 years	Unclear. However, the National Commission of Water promotes modifications to allocations resulting from the 6 year review of a program.
South Africa		
National Water Resource Strategy	Ongoing	Plan may be amended as a result of a 5 yearly review, amendments can only take place after mandatory consultations with stakeholders. There does not appear to be any allowance for the Minister to revoke or amend a plan outside of the 5 yearly review process.
Catchment Management Strategies	Ongoing	Plan may be amended as a result of a 5 yearly review, amendments can only take place after mandatory consultations with stakeholders. There does not appear to be any allowance for the Minister to revoke or amend a plan outside of the 5 yearly review process.
Reserve	Ongoing	Once the reserve is determined for a water resource it is binding on all authorities or agencies when exercising any power or performing any duties under the National Water Act. Preliminary determinations of the reserve may exist where water resources have not yet been classified. Such determinations may be superseded by further preliminary determinations or by a final determination,

na Not applicable.

Source: Annexes G to L.

Attachment 6B

The criteria on which water acquisition programs and water resource planning processes are compared are based on the established guidelines for regulatory impact statements (RIS) (ORR 1998). The RIS process is a basis for quality control in the setting of regulation. The criteria include:

- *Identification of problems and issues and the specification of desired objectives* — the nature of the problem is defined so that it is clear what is to be addressed and the objectives of the regulatory initiative should be clearly stated.
- *Identification of options* — all of the viable options are identified within the water acquisition program or water resource plan. This should include options for alternative water sharing arrangements between uses.
- *Impacts are assessed* — a rigorous assessment is undertaken of the proposed acquisition program or resource plan in terms of its impact on all water users. This includes a comprehensive treatment of the relevant economic, environmental and social effects.
- *Transparency* — the objectives of resource plans and acquisition programs are defined as desired outcomes and are transparent. In addition, the program or planning process should be transparent to allow stakeholders (internal and external) to evaluate whether the program or plan has met its obligations.
- *Consultations* — consultations are provided for in the acquisition program evaluation or resource planning process.
- *Performance-based* — ideally, resource plans and acquisition programs have objectives expressed in terms of outcomes to provide flexibility in the way in which they are achieved.
- *Review* — regular review of acquisition programs or resource plans take place to ensure their continued effectiveness, given changes in need and preferences.

The RIS process is used throughout Australia and many other developed countries. As of 2001–02, all Australian jurisdictions, except the Northern Territory, were using RISs. By 2000, 20 OECD countries were using RISs. Fourteen of these countries — including Canada, the United Kingdom and the United States of America — employed wide ranging RIS requirements broadly similar to those employed by the Australian Commonwealth Government (ORR 2002).

7 Administering water rights

The administration of water rights encompasses issuing new rights, modifying existing rights and approving the temporary and permanent transfer of water rights. The processes associated with these functions are:

- *Consultation* — giving public notice of applications and advertising for submissions.
- *Assessment* — consideration of the application, any submissions received and any administrative guidelines or rules in place. It also includes the collection of any further information required for assessment.
- *Decision notification* — making the decision and announcing it to all relevant parties.
- *Hearing appeals* — hearing and determining the outcome of any appeals made regarding an administrative decision.
- *Registration* — maintaining the register and any other administrative records, including updating records of any approval made.

The arrangements — defined to include the organisations involved as well as their processes — are compared in this chapter to identify key differences and their implication for resource management and administrative efficiency. Processes employed in approving the construction and operation of water infrastructure (dams, weirs, pumps, bores and wells) and in approving the use of water are noted but were not compared in detail.

7.1 Organisations

In this section, the arrangements for the administration of rights are compared in terms of roles and scope of responsibilities. An overview of the nature and types of organisations involved in the establishment and administration of water rights is given in chapter 4.

Roles and responsibilities

The roles and responsibilities of the organisations involved in administration in the Australian and overseas jurisdictions studied are reported in tables 7A.1 and 7A.2 respectively.

Government water resource agencies are primarily responsible for administering water rights in the jurisdictions studied, with the exception of Victoria, California (for most types of groundwater), Colorado (for surface and some groundwater) and South Africa.¹

In Victoria, Melbourne Water and rural water authorities (RWAs) administer all rights with the exception of bulk entitlement orders, which are administered by the Minister for Water. RWA board members are selected by the Minister based on their skill and expertise and not representation of particular stakeholder groups. In practice, many board members are irrigators.

In California, most groundwater is unregulated except where rights have been adjudicated by the state courts. In other cases, the State Water Resources Control Board (SWRCB) is responsible for administering surface water rights and some groundwater rights. The members of the SWRCB are appointed by the Governor to fill five positions, four of which require specific skills — attorney, professional engineer, water quality manager, and civil engineer.

In Colorado, the seven district water courts (in the case of surface water and tributary groundwater) and the Office of the State Engineer (OSE) (in the case of other groundwater) are responsible for administering water rights. The OSE also has a role in assisting the water courts to administer surface and tributary groundwater rights.

The administration of water rights in South Africa is the responsibility of catchment management agencies for their defined water management area. However, where catchment management agencies have yet to be established, administration is currently undertaken by the Department of Water Affairs and Forestry.²

Every jurisdiction has conferred water rights to water supply organisations (storage operators and water districts) and water user associations (irrigation trusts and districts, private companies, canal associations and water communities). In many

¹ In some Australian jurisdictions, ministerial responsibilities and functions are delegated to government departments.

² The catchment management agencies are statutory authorities governed by a board with members representing the broad stakeholder groups of the relevant water management area and experts. Board members are appointed by the Minister.

cases, these entities have provided water rights, water supply contracts or company shares to their members. Water supply organisations and water user associations are also responsible for administering applications for the issue, modification and transfer of these instruments by their members. These issues are not considered in this study.

Consultation, assessment and decision making

Generally, the same organisation is responsible for consulting with the public, assessing the application, and deciding or adjudicating on the application. For example, in NSW, the Department of Infrastructure, Planning and Natural Resources is responsible for consultation, assessment and decision making. In California and Mexico, the SWRCB and the National Water Commission (CNA) have these responsibilities, respectively.

Appeals

Responsibility for hearing and adjudicating appeals is usually given to an independent body. This body is generally a court of law or tribunal. In each of the Australian jurisdictions, the institution responsible for hearing appeals is independent from the main agency administering water rights. For example, in Victoria the Civil and Administrative Tribunal is responsible for hearing and adjudicating appeals.

Similarly in California and Chile, the institution responsible for hearing appeals — the courts in both jurisdictions — is independent of the main body administering water rights. In South Africa, appeals are heard by the water tribunal, which is independent from the catchment management agencies.

In Colorado, where applications for water rights are first lodged with the water referee of a district water court, appeals to the decision of the water referee are lodged with the water judge of that court. Appeals to the decision of the water judge are lodged with the Colorado Supreme Court.

Registration

Registries of water rights are maintained in all jurisdictions studied (see chapter 5). Every agency responsible for administering water rights maintains a record of water rights issued, changed and transferred.

NSW, Queensland and Chile also maintain a separate registry in a titles office. In Queensland, the Department of Natural Resources and Mines maintains a database

of granted water allocations and interim licences. A separate registry, the Water Allocations Register, is maintained by the Queensland Resource Registry. Similarly, the Directorate General of Water (DGA, Chile) maintains both a database of water rights and use (the Public Water Cadastre), but all water rights must be filed in the Water Rights Registry of the local Real Estate Titles Office.

Inter-jurisdictional arrangements

Where inter-jurisdictional arrangements for water rights exist, there may also be inter-jurisdictional organisations that play a role in the administration of water rights. For example, the Murray–Darling Basin Commission (MDBC) plays a role in the administration of water rights along the River Murray and the lower arm of the Darling River. The MDBC’s role is limited to approving inter-state trades of water rights according to whether water can be physically delivered to the inter-state destination.

The MDBC comprises an independent President (appointed by unanimous vote of the Murray–Darling Basin Ministerial Council), two voting commissioners from each of the signatory governments and a non-voting commissioner from the ACT Government.³ Apart from the President, commissioners are normally the chiefs or senior executives of the relevant state agencies responsible for the management of land, water and environmental resources.

Scope of responsibilities

Where jurisdictions have a single agency with responsibility for all aspects of the administration process, there is greater scope for consistency in administrative decisions. Having a single agency may also reduce the costs of administration through scale economies in processing applications. Further, the holders of different types of rights have the convenience of having to deal with only one agency.

In NSW, Queensland, South Australia, the ACT, Chile and Mexico, the administration of water rights is undertaken by a single agency. Administration is centralised in NSW, Queensland and South Australia, but procedures are based on locally determined administration rules and guidelines, such as those determined in their resource planning processes. Regional offices of the DGA (Chile) and CNA (Mexico) are responsible for administering water rights.

³ The Commonwealth, NSW, Victoria, Queensland and South Australia are signatories to the Murray–Darling Basin Agreement. The ACT is a non-voting signatory.

Many RWAs operate in Victoria, although each operates within its defined catchment area. Each RWA is responsible for administering water rights for surface water (regulated and unregulated) and for groundwater. Similarly, in South Africa independent catchment management agencies with similar responsibilities and operating procedures are being established to undertake administration.⁴

In California, Colorado and Chile, more than one agency is involved in the administration process:

- In California, surface water is administered mainly by the SWRCB. Although most groundwater is unregulated, groundwater users (within the counties of Riverside, San Bernardino, Los Angeles and Ventura) can ask either a local court or the SWRCB to adjudicate groundwater rights, and to protect the water supply from deterioration (WEF 1998).
- In Colorado, separate administrative processes are employed for surface and groundwater. However, where there is a strong hydrological relationship between surface and groundwater, administration is undertaken by a district water court. Otherwise, groundwater administration is undertaken by the OSE (who also administers designated groundwater rights on behalf of the Colorado Groundwater Commission).
- In Chile, local courts are actively involved in recognising the legal title of traditional water rights. These proceedings operate in parallel to the procedures of the water administrator, the DGA. It is claimed that coordination is an issue as these legally recognised rights are not always subsequently filed with the registry (DGA 1999).

Persons wishing to appropriate, change or transfer in-stream flow or lake level rights in Colorado must first apply to the Colorado Water Conservation Board (CWCB) before proceeding with an application to a water court. The CWCB has exclusive authority to possess in-stream flow and lake level rights for environmental purposes. It can also impose conditions on applications for in-stream flow and lake level rights for other (recreational) purposes.

Third-party effects on the environment, such as those arising from dredge and fill material created from the construction of weirs and dams and the change in the natural flow of the river or stream, are addressed in California and Colorado through a complex arrangement of US federal legislation.

⁴ As an interim measure, the Department of Water Affairs and Forestry, in South Africa, undertakes the administration of water rights where a catchment management agency has yet to be established.

A separate federal government approval process is often required prior to a formal application for a water right. As the respective state-based administrators are only required to consider matters such as whether the proposed application will injure existing rights, federal approval is also required if the application involves the construction of any significant waterworks (see box 7.1).⁵

Box 7.1 US Federal Government environmental requirements

Under Section 404 of the US *Clean Water Act 1972*, any applicant that seeks to construct or modify water-related infrastructure — which is necessary for an application for a water right — must seek approval from the US Army Corps of Engineers. The US Army Corps of Engineers — a federal agency whose activities can influence the impoundment, extraction and control of water — must:

- Under the *National Environmental Policy Act 1969*, prepare environmental impact statements for every major federally-sponsored activity. Such activities include constructing, funding, licensing and operating infrastructure.
- Under the *Fish and Wildlife Coordination Act 1965*, consult with the US Fish and Wildlife Service, when preparing environmental impact assessments.
- Under section 7 of the *Endangered Species Act 1973*, consult with the US Fish and Wildlife Service if the proposed action jeopardises an endangered species or its critical habitat.

Under Section 10 of the *Endangered Species Act 1973*, any person wishing to purchase or appropriate a water right that can potentially have an adverse effect on an endangered or threatened species, must apply to the US Fish and Wildlife Service for an 'Incidental Taking Permit'. The applicant is required to prepare a 'habitat conservation plan'.

In response to these applications, the US Fish and Wildlife Service:

- can make recommendations on the environmental impact assessment to prevent the loss or damage of wildlife resources;
- must provide a biological opinion and an incidental take statement, which indicates the service's assessment of environmental harm and preferred method of addressing these concerns; and
- approve the issue of an 'incidental taking' permit on the grounds that the approved 'habitat conservation plan' is in accordance with the Service's terms and conditions.

Source: Clean Water Act 1972; National Environmental Policy Act 1969; Fish and Wildlife Coordination Act 1965; Endangered Species Act 1973; F&WS (US) et al (1998).

⁵ In California, the Public Trust Doctrine also applies. Under the Public Trust Doctrine, certain resources are held to be the property of all citizens and subject to continuing supervision by the State. The SWRCB must balance the potential value of a proposed or existing water diversion with the impact it may have upon the public trust.

In the US, the additional level of federal approval may have a significant impact on the administration of applications and may increase administrative costs.

7.2 Functions

Across the jurisdictions studied, administrators undertake the following functions:

- assess and approve applications for new surface and groundwater rights;
- approve modifications (including renewals) to existing surface and groundwater rights; and
- approve transfers of surface and groundwater rights.⁶

Administration processes and related procedures to fulfil these functions are generally established by a combination of legislation, regulation, case law, codes, guidelines and standards. Regulations, and in some instances guidelines, are used to specify administrative procedure. For example, the water codes of California, Colorado and Chile describe in detail what the processes must entail.

In the jurisdictions studied, there are two distinct approaches to the assessment and determination of approvals:

- In California, Colorado and Chile, the administrator is responsible for adjudicating over whether existing water rights (and in California, the Public Interest) would be injured by the application. Applications and appeals are settled by an independent authority or a court.
- In the other jurisdictions studied, an administrator has the legislative authority to approve an application in accordance with the provisions outlined in legislation, regulation and guidelines that it determines (such as those established in conjunction with resource plans, see chapter 6).

In Colorado, applications are heard before a water referee or water judge of a water court, where existing water rights holders are responsible for defending their rights from injury. In California and Chile, similar proceedings are undertaken before a statutory authority — the SWRCB and the DGA respectively.

In NSW, Queensland, South Australia, the ACT, and South Africa, guidelines and rules are determined as part of a resource planning process (see chapter 6). In

⁶ Other applications not expressly considered here are those for building or modifying works for extracting, transporting and storing water. In many jurisdictions, such applications are necessary for the establishment of a water right.

Victoria, RWAs have the authority to make by-laws which govern the administration of water rights.

New rights

In most of the jurisdictions studied, the main determinant of whether a new right will be granted is whether the administrator is satisfied that sufficient water is available. In the majority of the Australian jurisdictions studied, as well as those studied overseas, most water resources are either fully or close to fully allocated (appropriated) by consumptive users (see tables 7A.3 and 7A.4).

Indeed, there is an embargo on issuing new water rights in many jurisdictions, to protect the environment and the interests of existing right-holders. For example, in NSW, all Murray–Darling Basin and North Coast surface water systems and several groundwater systems are currently embargoed. Similarly, in Victoria, no new water rights are being issued in the northern catchments.

In California and Colorado, constitutional and legislative provisions guarantee the right of applicants to apply for water rights if these do not injure existing water rights. For example, under the Constitution of Colorado:

The water of every natural stream, not heretofore appropriated ... is dedicated to the use of the people of the state, subject to appropriation as hereinafter provided (Colorado Constitution Article XVI, section 5).

This has been interpreted to mean that individuals cannot be denied from applying for a water right.⁷ Similar provisions exist in Chile, where applicants cannot be denied an application for a water right, except if the proposed application injures a third party (Water Code 1981 (Chile), Art. 141).

These provisions, coupled with the possibility that applicants in California and Colorado can appropriate the return flows of upstream users, can and has resulted in an over-appropriation of water (see chapter 5).

⁷ *Colorado River Water Conservation Dist. v. Vidler Tunnel Water Co.*, 197 Colo. 413, 594 P.2d 566 (1979).

Modifying rights

The modification of a water right may be initiated by the existing right-holder or by the administrator. For example, in Victoria, the Minister for Water may amend a bulk entitlement order and therefore all other water rights to which it applies.⁸

Modifications to existing water rights involve changes to the type, terms or conditions of a water right, including:

- changes in the duration of a right;
- changes to the specified use;
- alterations to the point of extraction or the return of water;
- alterations to the specified volume (including the amalgamation of multiple rights held by a single holder into a single right) or the rate of extraction; and
- conversion from a high security right to a low security right, or a bulk right to an individual right (see tables 7A.5 and 7A.6).

In the Australian jurisdictions studied, the guidelines permitting modification of water rights vary according to local resource plans or by-laws. In California, Colorado and Chile, modifications to water rights are generally permitted provided that there is no injury to existing right-holders.

Transferring rights

Transfers of water rights include any exchange, transfer, sale or lease of all or part of an existing water right. A sale involves the permanent transfer of a water right from one right-holder to another. A temporary transfer occurs when the water right-holder leases their water right for one or more years. In most jurisdictions, temporary transfers is usually limited to sales of that season's assignment of water.

The transfer of a water right typically involves changing the record of ownership in the registry. In most jurisdictions, the transfer also involves changing the specifications of the right (such as location of use) and in some cases the conditions associated with the water right.

In most Australian jurisdictions studied and in South Africa and Mexico, there are legislative and regulatory provisions that describe the circumstances when water users can transfer a water right (see tables 7A.7 and 7A.8). For example, there are

⁸ Under the *Water Act 1989* (Victoria), the Minister may make such an amendment on receiving an application from the right-holder or another authority with the support of another Minister. For example, the Minister for Environment (the other authority) can apply to amend a RWA's bulk entitlement order with the support of the Premier or Treasurer (another Minister).

statutory provisions in Queensland, South Australia and the ACT, for water rights to be transferred provided that the transfer is in accordance with the relevant resource plan. In Queensland, in the absence of a resource operations plan, water rights may be traded subject to the approval of the Chief Executive of the Department of Natural Resources and Mines.

Water rights may also be freely transferred in California, Colorado and Chile as they are deemed to be the property of the individual (see chapter 3). However, applications have to be made to the administrator to change the location and use conditions (if any) of the water right. In these jurisdictions, other right-holders can object to a proposed transfer of water if the concurrent change in use, point of diversion or return flow conditions cause an injury.

Trade restrictions are commonly employed in all the jurisdictions studied to protect against concerns of stranded assets and possible community decline (see box 7.2).

Box 7.2 Trade restrictions

A common response to the introduction of trading has been to embargo or limit the sale of water rights from an irrigation district or between rural and urban water users. For example:

- In NSW, where water rights are held by irrigation companies and districts, members are generally not permitted to sell any or all of their right or share outside the company's area.
- In Victoria, there is a 2 per cent limit on the volume of water that can be permanently traded out of an irrigation district in any year.
- In Queensland, permanent water trading is currently under embargo until water trading rules are finalised.
- In South Australia, where water rights are held by irrigation trusts and districts, rules prohibit members from exporting some or all water rights out of districts.
- In California and Colorado, where water rights are held by water districts, irrigation districts and irrigation companies, members are generally not permitted to sell water rights, company shares or water supply contracts outside the district or company's area.
- In Chile, water user associations place restrictions on water right trades out of the association's area.

In addition, it is illegal for water rights to be transferred from Colorado, unless these transfers are credited towards Colorado's inter-jurisdictional commitments to downstream States.

Sources: Easter et al. (1999); Annexes B to F and H to L.

In NSW, Victoria and South Australia, the volumetric and reliability component of water rights are defined in terms of the catchment in which the right is located. Responsibility for distributing water changes as water rights are transferred (see chapter 8). Supply reliability exchange rates are applied to water rights whenever they are traded between supply catchments with different hydrological characteristics (DNRE 2001).

In Colorado, California and Chile, the right remains under the control of the administrator where it was first issued. The water right is served by that catchment and retains the reliability of the catchment regardless of how far down the river it is traded. This approach requires water rights to be defined and tagged in terms of their source.

7.3 Comparisons

In this section, the arrangements for each of the main administrative processes are compared.

Applications

The processes for lodging applications for new rights, modifying rights and transferring rights should be clearly defined, ensure consistency, and provide adequate information for their assessment.

The use of standard application forms promotes consistency across applications and provides an avenue for administrators to identify clearly the information required for assessment. In general, the jurisdictions studied use standard application forms that are easily accessed from licensing offices and more recently over the Internet (see tables 7A.9 and 7A.10). Instructions for applicants are generally attached to the application forms or are readily available from administrators.

Chile is the exception, where standard application forms are not used in applications for new water rights or transfers of rights. Instead, a set of guidelines that specify what an application must entail is used to assist applicants.

Across all jurisdictions, the minimum information sought in an application includes the:

- personal details of the applicant or applicants;
- name and location of the water source from which water will be or is taken; and

-
- volume of water (or time and rate of extraction) requested to be extracted or transferred.

In some jurisdictions, the applicant is required to provide supporting information that describes the impact of the water's extraction on the environment. In NSW, applications for a new or renewed access licence require the preparation of an environmental impact assessment to determine whether harm will result from the water right. In California, applicants for a new water right are required to provide a range of information — including information on the environmental setting and fish and wildlife of the area — which aids in the environmental review of the application by the SWRCB. In Chile, applicants must undertake environmental impact assessments when applying to extract groundwater, or to extract surface water in national parks, wildlife reserves and certain wetlands.

Most jurisdictions require approval for the construction and operation of water related infrastructure and for the use of water. In jurisdictions where the water right confers a right to construct and operate works and to use water, the water right administrator is responsible for approving the extraction, storage and use of water. In jurisdictions where this is not the case, a separate body is responsible for administering such approvals. For example:

- In NSW, Queensland and the ACT, water users are required to separately apply for a works permit and approval to use the water.
- In Chile, a water right confers a right to apply for a works approval and to use water for any purpose. A separate approval may be required to construct the necessary works to extract water.
- In Victoria, a water right does not confer a right to extract water but does confer a right to its use. A separate approval is required to construct the necessary works to extract water.
- In South Australia, California, Colorado, Mexico and South Africa, a water right confers a right to extract and to use water. In California and Colorado, separate applications may be required under US federal law to gain approval for the construction of works.

Applicants seeking approval to construct or operate infrastructure or to use water — whether as part of a water right application or not — are frequently required to prepare either an environmental impact assessment or a farm management plan. For example in:

- Queensland, applicants are required to prepare a Land and Water Management Plan before a water right (water and interim water allocation, and a water licence if allowed by a resource operations plan) can be used for irrigation purposes.

-
- South Australia, irrigators extracting water from the River Murray Prescribed Watercourse are required to prepare an irrigation and drainage management plan before any new irrigation development can commence.

There are no requirements to prepare environmental impact assessments or farm management plans for the use of water in California, Colorado or Chile.

Generally, farm management plans are used as a basis of ensuring that best practice will be employed in irrigation and drainage management, water use efficiency, and managing environmental impacts such as soil salinisation, waterlogging, nutrient pollution, rising groundwater tables and water quality.

A detailed assessment of the role of environmental impact assessments, farm management plans, works and use approvals are outside the scope of this study.

Consultation

Most administration processes allow for some form of public consultation after applications have been received. Consultation generally takes the form of a public announcement of the application, giving third parties the opportunity to make submissions about the application (see tables 7A.11 and table 7A.12).

Allowing the public to comment on an application assists administrators in identifying any third-party (including environmental third-party) effects associated with its approval. In addition, consultation improves the transparency of administrative decisions and may also facilitate a greater degree of acceptance of decisions within local communities.

In most of the Australian jurisdictions and some of the overseas jurisdictions studied, extensive public consultation is undertaken during the resource planning process. Administration procedures, related rules and guidelines used in assessing subsequent applications are usually established under these processes (see chapter 6). As a result, in these jurisdictions, water right applications do not necessarily require public notification and may not call for submissions. For example, in NSW, where a water sharing plan is in place, transfers do not require consultation. However, any changes to the conditions on an associated work or use approval will need to be advertised and objections resolved.

In Victoria, applications relating to bulk entitlement orders must be given public notice. However, there is no requirement for applications for a new water right or licence or modification to these rights to be advertised. Applications for transfers are required to be advertised in some areas, depending on the by-laws of the relevant RWA.

In the other Australian jurisdictions studied, applications are given public notice as required. For example, in Queensland, where a water allocation is managed under a Resource Operations Plans, an application for a new water allocation or modification to or transfer of an existing one, will only be given public notice if it is required under the plan.

In some of the overseas jurisdictions studied, public hearings are triggered if an application is contested. For example, in Colorado all applications made to the water court and the OSE require public notification and public hearings must follow if a statement of opposition to an application is lodged.

Applications for a new right in California, Chile and South Africa must be given public notice and the general public is given the opportunity to comment on the application. In California and Chile, applicants are given the opportunity to address submissions. If protests cannot be resolved, then a public hearing is held.

Inviting submissions for each individual application may be administratively costly and may impose a burden on some right-holders — both in resources and time. However, this approach increases transparency and provides a forum to limit injury to third parties.

Assessment

Administrators assess the suitability of an application on the basis of information provided by applicants and interested parties (including other government agencies). In assessing applications, the administrator is usually required to have regard to a range of hydrological, distribution, environmental or community matters (see box 7.3). The degree to which these matters are addressed by administrators varies across jurisdictions.

How administrators assess these factors is determined by the requirements of legislation, regulation, and standards and guidelines (see tables 7A.13 and 7A.14). It is also determined by whether the jurisdiction's Constitution and water legislation offers protection to water right-holders against injury to water rights.

In the Australian jurisdictions studied, applications for new rights, modification to existing rights and the transfer of water rights are generally assessed against a range of administrative criteria. The criteria assist the administrator to determine whether harm is caused to other water right-holders, water uses, the environment or the community more widely. The effect of using such criteria is to streamline administrative processes and to minimise the time and costs associated with assessing applications.

Box 7.3 Application assessment matters

Administrators consider a range of matters when assessing applications for new rights, the modification of rights or the transfer of rights. Some examples of the matters considered in the jurisdictions studied include:

Source issues

- Is water available to obtain a water right or will the application injure existing water users?

Distribution issues^a

- Is there a physical connection to get the water to the new point of diversion? Is there enough delivery capacity in the river and channels, or will the trade create congestion?
- Can water be transferred between catchments or supply systems? How is this managed? What rate, if any, should be applied to conveyancy losses?
- Is there an embargo on the transfer of water rights between irrigation schemes or areas to prevent the stranding of assets?

Environmental issues

- Are there any environmental problems that might arise from the diversion or change in the point of diversion?
- Will the use of the water right at its new location have adverse environmental consequences, such as salinity, drainage or dredge and fill impacts?
- For new developments, have statutory planning and other approvals been obtained?

Community issues

- Will the transfer of a water right have implications for regional economic growth and development?
- Will the transfer of water rights injure community, indigenous, traditional, cultural or other social values?

^a Distribution issues tend to be considered in those jurisdictions where the approving body also owns water distribution infrastructure.

Source: DNRE (2001); NRC (1992).

Such criteria were generally developed by the administering body from over-arching legislation, regulation, guidelines and resource plans (see chapter 6). For example, NSW Water Management Plans and implementation programs, which stipulate the rules for transferring rights, were prepared by the Department of

Infrastructure, Planning and Natural Resources in consultation with water users.⁹ The trading rules generally identify the areas between which trades can take place and the exchange rates that must be applied to any trades.

Similarly, the Queensland Department of Natural Resources and Mines, in consultation with water users, developed the environmental criteria of the Water Resource Plan and the Resource Operations Plan for the Fitzroy Basin. When approving water right applications, the environmental criteria that must be considered by an administering agency include the:

- extent of inundation of stream bed habitats;
- extent of artificial rapid variations of in-stream water levels;
- impact of in-stream infrastructure on water quality;
- localised impact on stream flows associated with large scale storage developments; and
- extent of water losses.

In many jurisdictions, ‘zoning’ is often used to assist the administrator to determine the relevance of a source, distribution, environmental and community issue. Rather than assess each application separately, agricultural and riparian land, rivers and streams are often divided into areas of common features to streamline administration processes and minimise the costs associated with undertaking detailed assessment of each application.

In Victoria, zoning is used to assist in the assessment of applications for the transfer of water rights. For example, the land adjoining the River Murray between Nyah and the South Australian border has been classified into four low impact zones (LIZs) and a high impact zone (HIZ). Water cannot be traded into a HIZ from a LIZ. These zones are used to ensure water trading does not increase salinity levels of the river. Water can be freely traded into a LIZ area.¹⁰

Whereas the administering body of the Australian jurisdictions has some authority to determine what constitutes harm to water users, the environment and other persons, this is less the case in California, Colorado and Chile. In these jurisdictions, water rights are the property of individuals and these rights are

⁹ A set of ministerial trading principles that must also be followed are yet to be finalised.

¹⁰ Where water is traded into a LIZ area, water buyers are required to pay an up-front charge based on the volume of the water right transferred. The levy is intended to discourage water being traded to the more susceptible areas and to finance future investments in salt interception schemes (SRWA 2002).

protected against injury (see chapter 3). What constitutes injury is defined in their respective Constitutions, legislation and, with the exception of Chile, case law.

In California, Colorado and Chile, the administrator is responsible for testing the suitability of an application. But unlike in the Australian jurisdictions studied, the administering body (the SWRCB (California); the district water court, OSE (Colorado); and the DGA (Chile)) is only responsible for adjudicating applications during a public hearing process.

Generally, for an application for a new water right to be successful in these jurisdictions, the administering body must find that there is sufficient water available and the application will not ‘unreasonably impair’ or ‘injure’ the rights of existing water users. In California, the SWRCB must also find that the appropriation is in the Public Interest. This allows a potentially wide range of third-party effects to be considered beyond those defined by water rights (see box 7.4).

As mentioned earlier, in California and Colorado, downstream water users can appropriate the return flows of upstream water right-holders (see chapter 5). This creates a legal obligation for upstream water right-holders to negotiate with downstream right-holders. Applications to change the use or to transfer water rights have resulted in lengthy and costly approval processes.

In addition, in California and Colorado, the definition of harm as it applies to the environment and community tends not to be as comprehensively defined or applied as in the Australian jurisdictions studied:

- Generally, under the Public Trust Doctrine approach, there is a lack of precise standards to judge how water should be allocated and used by competing users (NRC 1992). Public welfare is not statutorily defined in California, but a definition of Public Interest is evolving in case law (Saliba and Bush 1987).
- Water quality is protected by the federal US *Clean Water Act 1972* (US) and administered by both California and Colorado. However, the effects of agricultural non-point pollution are not considered under this regulatory framework (NRC 1992).
- Other federal environmental laws that require environmental impact statements to be prepared in support of applications — such as the *National Environmental Policy Act 1969* (US) and the *Endangered Species Act 1973* (US) — do not generally allow for the assessment of the net benefits of the project (NRC 1992).

Box 7.4 Assessment of applications for new rights — California

Before issuing a water right permit, the State Water Resources Control Board (SWRCB) takes into account the following:

- all prior rights and the availability of water in the source;
- the flows needed to preserve in-stream uses, such as navigation, recreation and fish and wildlife habitat (Public Trust Doctrine);
- the relative benefit derived from all beneficial uses of the water concerned and the reuse and reclamation of the water sought to be appropriated;
- any water control plans; and
- the State's goal of providing a decent home and suitable living environment for every Californian.

Under the *Environmental Quality Act 1970* (California), the SWRCB must consider the environmental effects of any proposed appropriation. Large projects that could endanger or degrade natural habitat may require an environmental impact assessment (EIA). An EIA contains a description of the project, a discussion of the project's environmental impacts and mitigation measures, any public comments received on the proposed project and the SWRCB's response to those comments.

For a permit to be issued, the SWRCB must find that unappropriated water is available to supply the applicant and that the appropriation is in the Public Interest. The Board may impose any conditions that in its judgement will best develop, conserve and utilise water resources for the Public Interest.

When construction of the project is complete, the terms of the permit have been met and the largest volume of water has been put to beneficial use, the Board confirms the terms and conditions and issues a licence to the applicant. The licence is the final confirmation of the water right and remains effective as long as its conditions are fulfilled and beneficial use continues.

Source: Annexes G and H; SWRCB (2002).

Where the approach to water rights administration is dictated by guidelines and rules, as is the case in the Australian jurisdictions, there may be less scope for discretion in decision making. In such cases, the integrity of administration is dependent to a large extent on the soundness of the guidelines and rules established through resource planning or administrative law.

Decision notification

Once a decision on an application is made, it is communicated to the applicant and other interested parties. The procedures for notifying an administrative decision in

the Australian and overseas jurisdictions studied, are outlined in tables 7A.15 and 7A.16 respectively.

The administrative processes employed should ensure transparency of decision making. A transparent process ensures that all interested parties and not just the applicant are informed of the decision and that the reasons for the decision are clearly enunciated.

In all of the jurisdictions studied, applicants are informed of the decision. In some jurisdictions those who formally objected to the application are also informed of the decision. For example, anyone who makes a submission in Queensland on the application for a new, modification to or transfer of a water allocation or licence also receives an information notice. In some jurisdictions, decisions are announced publicly through publication and placement on the Internet.

Hearing appeals

After the decision has been announced, those affected usually have an opportunity to object, appeal or seek arbitration against the decision of the approving agency. An appeals or arbitration mechanism allows for administrative decisions to be reviewed and is vital for ensuring that the correct or preferable decision has been reached. The grounds for appeal available to applicants are outlined in tables 7A.17 and 7A.18.

Some form of appeals mechanism is available in each of the jurisdictions studied. Some of the jurisdictions allow both applicants and third parties to appeal administrative decisions and others only allow applicants to appeal.

Generally, for an appeals mechanism to be fully effective and equitable, all parties affected by the decision should have the opportunity to appeal. It is particularly important that third parties have an opportunity to appeal administrative decisions if no opportunity exists for third parties to object to applications before a decision is reached.

In NSW, Victoria and South Australia, both applicants and third parties may appeal a decision made by the administrator.¹¹ However, in Mexico, rights of appeal are only available to the applicant. In California, Colorado, South Africa and Chile, decisions (or rulings in the case of Colorado) may be appealed by the applicant and

¹¹ In South Australia, if the Water Allocation Plan specifies that a public notice of an application must be given to the transfer of a licence or the water allocation of a licence, then applicants and third parties may appeal a decision made by the Department of Water, Land and Biodiversity Conservation.

third parties. In Queensland, applicants and third parties who made a submission to the original application and received an ‘information notice’, can appeal a decision.

Registration

For transparency and certainty of ownership, it is important that administration processes ensure all registries and other administrative records are updated automatically to reflect the decisions and outcomes of appeals.

All jurisdictions maintain records of water rights issued (see tables 7A.19 and 7.A20). As mentioned earlier, some jurisdictions even maintain separate titles of water rights in natural resource or land title registries. The nature of different registration systems used and the implications for certainty of ownership and trading are discussed in chapter 5.

7.4 In summary

The administration of water rights — the issuing of new rights, modification of existing rights and the approval of transfers — plays an important role in ensuring that water is allocated efficiently and that the integrity of the system of rights is maintained over time.

The organisations involved in administering water rights in the jurisdictions studied typically undertake similar functions and processes. In each jurisdiction, processes are in place for the lodgement of applications, consultation of potentially affected parties, the assessment of applications, notification of decisions, appeal of decisions and the registration of rights.

In most of the Australian jurisdictions and Mexico, a single agency is generally responsible for consulting with the public, assessing the application, and deciding or adjudicating on applications. In Victoria and South Africa, administration is decentralised to local rural water authorities or regional catchment management authorities.

In Colorado, California and Chile, a number of organisations are involved in the administration process. In the United States, for example, a separate federal government approval process can be required prior to a formal application for a water right. In Chile, local courts have jurisdiction over the legal title to traditional water rights and operate in parallel to the procedures of the DGA.

The involvement of multiple organisations in the administration process in some jurisdictions may impose additional administrative costs on those wishing to apply for, modify or transfer a water right.

In administering water rights, Australian agencies are largely guided by the rules and guidelines established as part of the resource planning process. In Colorado, California and Chile, applications are generally assessed to determine whether water is available and whether existing right-holders would be injured. However, existing water right-holders are also expected to defend their rights from injury in these jurisdictions.

The approach undertaken by the Australian jurisdictions potentially provides consistency in decision making and should also ensure accountability. The rules and guidelines used by administrators are publicly available, making the basis for assessment of applications transparent. Applicants and third parties are able to assess whether the decisions made by administrators are consistent with the rules and guidelines for a particular catchment.

That said, outcomes will only be administratively efficient if the rules and regulations used in assessment are followed and applied consistently by administrators and the planning process used to develop them is sound and well informed.

Attachment 7A

Table 7A.1 **Responsibilities for administrative procedures — Australian jurisdictions, 2003**

<i>Jurisdiction</i>	<i>Consultation</i>	<i>Assessment</i>	<i>Decision</i>	<i>Appeal</i>	<i>Registration</i>
NSW	Minister for Natural Resources ^a	Minister for Natural Resources ^a	Minister for Natural Resources ^a	Land and Environment Court	Land and Property Information NSW
Victoria	RWA, Minister for Water ^b	RWA, Minister for Water ^b	RWA, Minister for Water ^b	Victorian Civil and Administrative Tribunal	RWA, Department of Sustainability and Environment ^c
Queensland	Department of Natural Resources and Mines	Department of Natural Resources and Mines, ROL holder ^d	Department of Natural Resources and Mines, ROL holder ^d	Land Court	Queensland Resource Registry ^e
South Australia	Dept of Water, Land and Biodiversity Conservation	Dept of Water, Land and Biodiversity Conservation	Dept of Water, Land and Biodiversity Conservation	Environment, Resources and Development Court	Dept of Water, Land and Biodiversity Conservation
ACT	Minister for the Environment ^f	Minister for the Environment ^f	Minister for the Environment ^f	Administrative Appeals Tribunal	Environment Protection Authority

^a The Minister may delegate powers and functions to the Department of Infrastructure, Planning and Natural Resources. ^b The Minister is responsible for the administration of bulk entitlement orders. All other rights are administered by the rural water authorities. ^c The Department of Sustainability and Environment is responsible for maintaining the register of bulk entitlement orders. Registers for other rights are administered by the rural water authorities. ^d Resource operations licence holder is responsible for administering temporary transfers in line with the resource operations licence. ^e Water allocations must be recorded on the Water Allocations Register which is a module of the Queensland Resource Registry. ^f The Minister may delegate powers and functions to the Environment Protection Authority.

Sources: Annexes B to F.

Table 7A.2 Responsibilities for administration procedures — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Consultation</i>	<i>Assessment</i>	<i>Decision</i>	<i>Appeal</i>	<i>Registration</i>
California	State Water Resources Control Board	State Water Resources Control Board	State Water Resources Control Board	Court	State Water Resources Control Board
Colorado	Water and Groundwater Courts ^a , Office of the State Engineer ^b	Water and Groundwater Courts ^a , Office of the State Engineer ^b	Water and Groundwater Courts ^a , Office of the State Engineer ^b	Supreme Court (surface water), water courts (groundwater) ^c	Water and Groundwater Courts ^a , Office of the State Engineer ^b
Chile	Directorate General of Water (DGA)	DGA Local Civil Courts	DGA Local Civil Courts	Appellate Courts	Real Estate Titles Office, Public Water Cadastre (DGA)
Mexico	National Water Commission (CNA)	CNA	CNA	Court	CNA
South Africa	Catchment Management Agencies (CMA), Department of Water Affairs and Forestry (DWAF)	CMA, DWAF	CMA, DWAF	Water Tribunal	CMA, DWAF

^a Water and Groundwater Courts are the administrator of all transferable rights. ^b The Office of the State Engineer administers certain groundwater on behalf of the Groundwater Commission. ^c Appeals on groundwater well permits are made to the Office of the State Engineer, then either the Ground Water Commission, District Court or water court depending on the circumstances.

Sources: Annexes H to L.

Table 7A.3 Provisions for issuing new rights — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
NSW	The <i>Water Management Act 2000</i> has provisions for the issue of new <i>access licences</i> but only where a management plan has determined that the water source is not fully committed. Where an embargo has been placed on the issuance of new licences, no applications for new licences may be received. Such embargoes do not prevent the application to transfer an existing licence or part thereof.
Victoria	The <i>Water Act 1989</i> allows for the granting of new <i>bulk entitlement orders, take and use licences</i> and <i>water rights</i> .
Queensland	The process for allocating new water allocations is described in the Resource Operations Plan (ROP) relevant to an area. If permitted under the ROP new water allocations may be granted. For example, tender processes are described in the draft Fitzroy and Burnett Basin ROPs. If the Water Resource Plan or ROP states a process for allocating water licences, the licences are issued in accordance with the process outlined in the plan. For example, in Fitzroy they have outlined specific parties that may apply for new licences. The issuing of new rights cannot undermine the security of existing rights.
South Australia	The <i>Water Resources Act 1997</i> allows for new licences to be granted in accordance with the relevant water allocation plan.
ACT	The <i>Water Resource Act 1998</i> allows for water allocations to be granted if permitted by the relevant Water Resource Management Plan. The Act also makes provisions for holders of water allocations to be granted a licence to take water.

Sources: Annexes B to F.

Table 7A.4 Provisions for issuing new rights — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
California	Permits may be issued for appropriate uses from surface stream and subterranean stream for use on land that is not riparian, provided existing rights are not injured.
Colorado	Provisions are made for the granting of new water rights and well permits provided existing rights are not injured.
Chile	Provisions are made for the granting of new licences and for the regularisation of existing water use.
Mexico	The water code provides for the issue of new concessions taking into account availability of water, existing right-holders, and any existing restricted areas or reserves.
South Africa	The <i>National Water Act 1998</i> allows for the granting of new general authorisations to use water, new licences and compulsory licences.

Sources: Annexes H to L.

Table 7A.5 Provisions for modifying an existing water right — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
NSW	The Minister may vary a major or local water infrastructure service provider's water right at 5-yearly intervals or on application by the infrastructure service provider where there is rapid growth in population. Other licence types may not be modified (except through transfers) except via the making of a new plan. If the water available to a licensed water user is reduced as a result of modification during a plan's term, the user is entitled to compensation. Holders are not entitled to compensation if rights are varied as a result of the making of a new plan.
Victoria	<i>Bulk entitlement orders</i> may be amended by the Minister. The Minister may amend a water right on receiving an application from the right-holder or another authority with the support of another Minister. ^a Provisions are made for the Minister to amend <i>take and use licences</i> . However, there are no provisions for the right-holder to apply for a modification to the right.
Queensland	A water allocation may be amended as part of the review of the relevant Water Resource Plan. Water allocations may also be modified in accordance with rules outlined in the resource operations licence. Water licences may be amended on the application of the licensee or in accordance with a Water Resource Plan. Provisions are also available for the executive to amend water licences.
South Australia	Provisions are made for a person or authority to apply to vary a water licence. That is to increase an allocation, change the names attached to the licence, change the conditions of the licence, or to add additional property.
ACT	Provisions are made for a person or authority to apply to vary a water licence or allocation, or to increase or decrease an allocated volume, change the names attached to the licence and change the conditions of the licence.

^a For example, the Minister for Environment (the other authority) can apply to amend a RWAs bulk entitlement order with the support of the Premier or Treasurer (another Minister).

Sources: Annexes B to F.

Table 7A.6 Provisions for modifying an existing water right — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
California	Provisions are made for modifications to the purpose, place of use or point of diversion of water rights provided rights to other users are not injured.
Colorado	Provisions are made for the modification of water rights and well permits provided existing rights are not injured.
Chile	Information not obtained.
Mexico	Information not obtained.
South Africa	Licensees can request that amendments be made to their licence. A licence may only be amended if the amendment will not have a significant detrimental impact on the water resource or the interests of any other person unless that person has consented.

Sources: Annexes H to L.

Table 7A.7 Provisions for transferring existing water rights — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
NSW	Provisions are made in the <i>Water Management Act 2000</i> and individual Water Management Plans for access licences to be transferred.
Victoria	Provisions are made in the <i>Water Act 1989</i> for bulk entitlement orders, water rights and take and use licences to be transferred.
Queensland	Provisions are made in the <i>Water Act 2000</i> for all water allocations to be transferred. Water licences can only be transferred or the non-land holding entity transfers the licence to another entity in accordance with Water Regulation 2002. Interim water licences can be transferred subject to Water Regulation 2002.
South Australia	Provisions are made in the <i>Water Resources Act 1997</i> for water licences (including its water allocation) to be transferred.
ACT	Water allocations may be transferred. Once a transfer of a water allocation has been approved any related licence to take water may also be transferred.

Sources: Annexes B to F.

Table 7A.8 Provisions for transferring existing water rights — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
California	Appropriative licences may be transferred.
Colorado	Water rights may be transferred.
Chile	Water rights constitute private property and are freely transferable.
Mexico	Where the terms of the water right (concession) are not altered, the transfer is made via a notice of registration in the Public Registry of Water Rights. Where the rights of third parties may be affected or the hydrological or ecological conditions of the relevant basin or aquifer may be affected, the National Water Commission must authorise the transfer.
South Africa	Water use licences for irrigation may be permanently or temporarily transferred. Transfers are permitted where both the original and transferred water use are from the same water source.

Sources: Annexes H to L.

Table 7A.9 Application procedures — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
NSW	<p>Applicant completes a standard application form for new access licences and transfers.^a</p> <p>A separate works approval permit (which requires information on the point and method of diversion and gives approval to the maximum pumping rate), and use approval permit (which requires a description of the land for which water will be applied and the proposed use of the water) are required before water can be physically extracted from the water source. An access licence is required to be 'associated' with an approved work before water available under the licence may be physically taken. An access licence without an associated work approval may only trade water.</p>
Victoria	<p>Standard application forms are available for the issue of new water rights and the transfer of water rights.^b Application fees apply for all applications.</p> <p>As part of the water right, information provided on the point of diversion (in the case of groundwater), the method of diversion, the location of the land for which water is to be applied and the use for which the water will be applied.</p>
Queensland	<p>Applications for new water and interim water allocations and water licences, and for transfers of water allocations and licences must be made using a standardised and approved form.</p> <p>Separate works approval permit (which requires information on the point and method of diversion and gives approval to the maximum pumping rate). Preparation and compliance to a land and water management plan may be required by a resource operations plan.</p>
South Australia	<p>Applicant completes standard application form for each of the approvals. Application fees apply.</p> <p>As part of the water right, the methods of diversion and storage (in terms of capacity), the location of the land for which water is to be applied, the use for which the water will be applied, and irrigation and drainage management plans where required by a Water Allocation Plan.</p>
ACT	<p>Applicant must write to the Minister for the Environment requesting an allocation. Application fees apply. Following the grant of an allocation, the applicant completes a standard application form for a licence to take water. Application fees apply.</p> <p>A separate permit is required to take water from a water source through either a water control structure permit or a bore construction permit. A standard application form exists for both permits and application fees apply. These permits require information on the point of diversion or abstraction. Bore drillers also require an ACT driller's licence, which has a standard form and application fee.</p>

^a However, where an embargo is in place, no application may be lodged. Application fees apply. ^b No new rights can be issued in the Northern catchments. In the Southern district, the applicant completes a standard application form for a new licence.

Sources: Annexes B to F.

Table 7A.10 Application procedures — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
California	<p>An application for a new or transfer of appropriative right is filed with the State Water Resources Control Board (SWRCB) on standard application forms available from SWRCB offices. Instructions for applicants are readily available with application forms.</p> <p>Applicants must indicate the proposed point of diversion, volume required and the proposed use. Applicants are also required to indicate whether the necessary federal and state permits have been obtained and provide a range of environmental information.</p>
Colorado	<p>Applications for new and modifications to surface (or tributary ground) water rights are made with the water clerk using a standard application form. Applications for new and modifications to groundwater rights are made with the Office of the State Engineer using a standard application form.</p> <p>Applicants must indicate the proposed point of diversion and the proposed use for which the water will be applied.</p>
Chile	<p>Applications for new and transfers of surface and groundwater rights are made to the Directorate General of Water. No standard application form is employed, but guidelines are available as to the information to be provided. Applicants are asked to indicate the volume of water required and the point and method of extraction. No information is sought on the proposed water use, but information is sought on whether the right is consumptive or non-consumptive, continuous or discontinuous and alternate.</p>
Mexico	<p>Applications for new and transfers of surface and groundwater rights are made to the National Water Commission using standard application forms.^a</p> <p>Applications contain information on the locality to which the application refers, the site from which national water is to be extracted, the volume of consumption required, the initial use, the point of discharge, the project works required and the period for which the concession is sort.</p>
South Africa	<p>Applications for water use licences are made with the relevant Catchment Management Agency or the Department of Water Affairs and Forestry using a standard application form. Applications must be accompanied by the processing fee.</p> <p>The applicant may also be required to provide additional information, an assessment by a competent person of the likely effect of the proposed licence on water resource quality and an independent review of the assessment of the impact on water resource quality.</p>

^a Separate discharge licences are required as part of the application process.

Sources: Annexes H to L.

Table 7A.11 Consultation procedures — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
NSW	Public consultation is governed by the presence of an approved water sharing plan. If a plan is in place, access licence transfers, which must be in compliance with provisions of the plan, do not require consultation. However, the changes to conditions on an associated work or use approval require advertisement and objection resolution.
Victoria	Public consultation is a part of the development of bulk entitlement orders, and Stream Flow and Groundwater Management Plans. Applications for a new Bulk Entitlement Order and transfers of Bulk Entitlement Orders must be published in the Government Gazette and in a newspaper circulating in the area concerned. Applications for transfers of licences and water rights are advertised in a local newspaper. There are no requirements for applications for new or modifications to existing rights to be advertised. ^a
Queensland	An application for a new, modification to or transfer of a water allocation will be given public notice if the process is outlined in the relevant Resource Operations Plan (ROP). If a modification or transfer of a water allocation is not covered by rules specified in the ROP then public notice of the application is given and submissions invited. Applications for a water licence are given public notice unless decided by the chief executive. However, if the Water Resource Plan or ROP outline a process for the allocation of water licences then the application will only be given public notice if required by these plans. If public notice is given submissions may be made.
South Australia	Public consultation is a part of the formulation of water allocation plans. If specified in a WAP, notice of an application for the transfer of a licence or the water allocation of a licence must be given by the DWLBC to those persons specified in a water allocation plan, to those persons (if any) prescribed by regulation and to the public generally. There is no requirement for the DWLBC to give public notice of an application for a new water right.
ACT	Public consultation is a part of the development of the Water Resource Management Plan. No further consultation is required.

^a When considering to apportion or sell new water rights, rural water authorities must have regard to any existing water rights within the district and must consult the Victorian Farmers Federation and any other bodies the Authority considers appropriate.

Sources: Annexes B to F.

Table 7A.12 Consultation procedures — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
California	For new rights, a notice of the application is given by the State Water Resources Control Board and posted or published by the applicant depending on the size of the project. The public is permitted to comment on the application. If protests are received that cannot otherwise be adjusted then a hearing is held. A hearing may also be held to consider an unprotested application.
Colorado	The water court and Office of the State Engineer must each publicly announce the application by letter, that is advertise applications. Public hearings follow lodgement of statements of opposition to an application.
Chile	All applications are published within 30 days in the Official Newspaper of the Republic. Applicants must also publish their application in a newspaper or periodical in the respective province, or in the region's capital if a newspaper is not published. Statements of opposition may be lodged against the application within 30 days of the date of the publication of the application. The statements of opposition are transferred to the respective applicant, who has 15 days to address the concerns of third parties.
Mexico	Information not obtained.
South Africa	Before issuing a general authorisation the authority must publish a notice in the gazette which sets out the proposed general authorisation and invite written comments to be submitted on the proposed general authorisation. In the case of applications for water use licences, the relevant authority may require the applicant to give suitable notice in newspapers and other media and may direct the applicant to take steps to bring the application to the attention of relevant organs of the state, interested persons and the general public.

Sources: Annexes H to L.

Table 7A.13 Assessment procedures — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
NSW	<p>The Minister assesses applications for new licences in accordance with the <i>Water Management Act 2000</i> and the rules contained in the relevant Water Management Plan (WMP). Where the Minister has imposed an embargo, no new access licence applications may be lodged.</p> <p>Transfers involving the change of associated work (that is where the water is to be extracted) must conform with the <i>Water Management Act 2000</i> and the transfer rules set out in the relevant WMP and are subject to the approval of the Department of Infrastructure, Planning and Natural Resources in accordance with the WMP.</p>
Victoria	<p>Rural water authorities assess applications for new rights and modifications to existing rights in accordance with relevant regulation — Bulk Entitlement Orders, Stream Flow Management Plans, Groundwater Management Plans and local by-laws.</p> <p>Rural water authorities assess applications for transfers in accordance with transfer rules outlined in regulations, by-laws and local guidelines. In particular, water regulations (permanent transfer of water rights).</p>
Queensland	<p>The <i>Water Act 2000</i> outlines criteria to be considered when assessing applications.</p> <p>Processes and guidelines for the issue of new rights, modification and transfers may also be outlined in the resource operations plan and resource operations licence. If this is the case, applications are assessed in accordance with the relevant plan or licence.</p> <p>Generally transfers are assessed according to allowable transfer zones developed as part of the resource operations plan.</p>
South Australia	<p>The Department of Water, Land and Biodiversity Conservation is responsible for assessing applications for a new licence, modification and a transfer in accordance with the relevant water allocation plan, Public Interest and any relevant regulation.</p> <p>Transfers within a private irrigation district are administered by the Trust in accordance with its guidelines.</p>
ACT	<p>Under the <i>Water Resources Act 1998</i>, the Environment Protection Authority must consider the availability of water, existing and likely future demand for water in the area, environmental flow guidelines for the waterway or aquifer in question; any agreement entered into by or on behalf of the Territory with the Commonwealth, a State or another Territory concerning the sharing of water; and any other matters the Minister or the Authority, as the case may be, considers relevant. Other matters include future matters.</p>

Sources: Annexes B to F.

Table 7A.14 Assessment procedures — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
California	<p>Application for permits are assessed in accordance with all relevant legislation to the specific application. All applications are assessed for possible environmental impacts as required by the <i>Environmental Quality Act 1970</i> (California). The board considers if there is unappropriated water to supply the applicant, that no existing rights are injured and that the permit is in the Public Interest.</p> <p>Separate US federal environmental applications may be required, for example, for the construction of water works necessary, to qualify for a water right.</p> <p>A permit is issued authorising the diversion and use of water. Following an assessment of whether beneficial use of the water has been made, a licence may be issued.</p>
Colorado	<p>Water courts, Ground Water Commission and Office of the State Engineer adjudicate as to whether water is available and whether the application will 'materially injure' or 'unreasonably impair' existing rights. Parties to the application may present arguments for or against the application.</p> <p>Separate US federal environmental applications may be required, for example, for the construction of waterworks necessary to qualify for a water right.</p> <p>A 'conditional' right is issued. To qualify for an 'absolute' right, the applicant must demonstrate that the water has been put to beneficial use.</p>
Chile	<p>The Directorate General of Water (DGA) grants requests for new rights whenever water is physically and legally available. The agency has no discretion to deny such requests if there is water available, nor decide whom among competing applicants will receive water. If there is not enough water to satisfy simultaneous applications, the DGA must hold a public auction and sell the new rights to the highest bidder. Once constituted, rights are governed by private or civil law.</p>
Mexico	<p>The National Water Commission (CNA) assesses applications in accordance with the <i>National Water Law 1972</i> and takes into account the availability of water as determined by the National Water Program and associated regional plans and the Public Registry of Water Rights.</p> <p>Under the <i>General Law of Ecological Balance and Environmental Protection 1988</i> the CNA must also be guided by four criteria:</p> <ul style="list-style-type: none"> • It is the responsibility of the State and society to protect aquatic ecosystems and the balance of natural elements participating in the water cycle. • The sustainable exploitation of natural resources involving aquatic ecosystems shall be carried out in a manner that does not affect their ecological balance. • To maintain the integrity and balance of natural elements involved in the water cycle, it shall be necessary to consider the protection of soil and wooded and forest areas and maintain basic levels of water currents, and the recharge capacity of aquifer layers. • The preservation and sustainable exploitation of water and aquatic ecosystems falls within the responsibility of users, as well as individuals carrying out works or activities affecting such resources.
South Africa	Information not obtained.

Sources: Annexes H to L.

Table 7A.15 Decision procedure — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description of procedure</i>
NSW	The applicant is given notice of the decision. Where a transfer involves a change in the location of extraction and objections have been lodged, objectors are also given notice of the decision.
Victoria	Once an application for a bulk entitlement order is approved, an order must be published in the Government Gazette. If after receiving preliminary approval an application is refused, notice of the refusal must be published in a newspaper circulating generally in the area concerned.
Queensland	The applicant and any person who makes a submission on the application for a new, modification to or transfer of either a water allocation or licence will be given an information notice regarding the decision within 30 business days of the decision having been made.
South Australia	The applicant is given notice of the decision.
ACT	The Minister must publish notice of decisions granting a water allocation within 14 days of the grant being made.

Sources: Annexes B to F.

Table 7A.16 Decision procedure — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description of procedure</i>
California	Decisions, including reasons, are published on the Internet.
Colorado	Decisions are made by the water judge based on rulings made by the referee and any protests received to that ruling. Court decrees include reasons for the decision.
Chile	Administrative decisions made by the Directorate General of Water are placed on the Public File of Administrative Decisions and Water Quality Standards which is part of the Public Water Cadastre.
Mexico	The National Water Commission must respond within a maximum of 90 working days of receiving the required information.
South Africa	The relevant authority must promptly notify the applicant and anyone who objected to the application and at the request of the applicant or anyone who objected to the application give written reasons for its decision.

Sources: Annexes H to L.

Table 7A.17 Grounds for appeal — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description of procedure</i>
NSW	The applicant may appeal to the Land and Environment Court any decision to refuse an application or to impose a condition. Also any person who lodges an objection to the application and has that objection overruled may appeal to the Land and Environmental Court. Appeals must be made within 28 days of the decision having been made.
Victoria	A person whose interests are affected by a decision made by an authority under the <i>Water Act 1989</i> may apply to the Victorian Civil and Administrative Tribunal for review of that decision. Applications for review must be made within 28 days of the decision being made or the statement of reasons being provided.
Queensland	Any person who receives an 'information notice' can appeal an original decision which must then undergo an internal review. Applications for internal review must be made within 30 days of receiving an information notice. Submissions by the applicant must be considered and a decision made within 20 days. If an any person that received an information notice remains dissatisfied with the reviewed decision can appeal the review decision with the Land Court within 30 days.
South Australia	A person has the right to appeal to the Environment, Resources and Development Court if an application for a licence has been refused, against conditions imposed on an approved licence, if a transfer has been refused or granted subject to a variation to the licence or if a licence has been varied. The appeal must be lodged within 6 weeks of the decision.
ACT	Applicants can appeal to the Administrative Appeals Tribunal any decision to refuse an application for a new licence, to impose a condition or to refuse the transfer of a licence.

Sources: Annexes B to F.

Table 7A.18 Grounds for appeal — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description of procedure</i>
California	Administrative decisions may be appealed in the State's courts.
Colorado	Parties have an opportunity to protest the initial ruling made by the referee before the judge confirms it. Once the water judge has confirmed a ruling, appeals may be made to the Colorado Supreme Court.
Chile	Interested parties can make objections to Courts of Appeal within 30 days of notification of the decision.
Mexico	Applicants can appeal to the Courts.
South Africa	Applicants and anyone having made a written objection to an application can appeal decisions to the Water Tribunal. Decisions of the Water Tribunal can be appealed to the High Court on questions of law.

Sources: Annexes H to L.

Table 7A.19 Registration procedures — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description of procedure</i>
NSW	Licences applied for, granted, renewed, transferred, surrendered, suspended or cancelled, and any legal or equitable interest held in a licence, are entered into the register. A separate register exists for the recording of works and use approvals.
Victoria	New bulk entitlement orders, modifications to and transfers of bulk entitlement orders must be recorded in the registry updated by the Department of Sustainability and Environment. New water rights, modifications to and transfers of water rights must be entered into the water rights register of the irrigation district. Records of licences are also kept by rural water authorities.
Queensland	New water allocations, modifications to and transfers of water allocations must be entered into the Water Allocations Register which is a module of the Queensland Resource Registry. Details of water licences are placed on a register held by the Department of Natural Resources and Mines on the Water Entitlements Registration Database.
South Australia	New water licences, variations and transfers of licences (including water allocations) must be entered into the Register held by the Department of Water, Land and Biodiversity Conservation.
ACT	New licences, water allocations and permits granted, and the transfer of rights are entered into the register.

Sources: Annexes B to F.

Table 7A.20 Registration procedures — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description of procedure</i>
California	Record of licences held by State Water Resources Control Board. Records volume of water, source, use, location and period of time. Updated for new appropriative rights, modifications and transfers.
Colorado	In the case of groundwater, new rights, modifications to and transfers of rights are entered into the register maintained by the Office of the State Engineer. The register records the owner, the volume or rate of water to be extracted, the point of diversion, the beneficial use to which the water will be applied, description of the land, and a priority date.
Chile	Water rights under the Water Code (1981) are registered with the Conservatory of Real Estate. The Directorate General of Water also maintains the Public Water Cadastre, which provides a public register of all water rights, applications and extractions.
Mexico	New rights, modifications and transfers of rights are entered into the Public Registry of Water Rights which is maintained by the National Water Commission. Administrative and judicial decisions which affect, modify or cancel existing rights are also entered into the register.
South Africa	Information not obtained.

Sources: Annexes H to L.

8 Distribution management

Distribution management involves determining how much water is available and who is to receive it (water accounting), and coordinating the collection, storage and transportation of water to its various uses and users (water distribution).

Distribution management is undertaken by a range of organisations — collectively referred to in this chapter as distributors. These organisations include a variety of government (federal, state and municipal) and private operators of storage facilities, irrigation schemes and water reticulation infrastructure. Many government agencies are also involved in the water accounting aspect of distribution management.

Water accounting involves keeping an inventory of the volume of water available for supply at any point in time and the volume of water that has been assigned and distributed to uses and users. It also involves the re-assignment of water in times of severe water shortage.

Water distribution involves the collection and transportation of water to a variety of uses and users. In undertaking this aspect of distribution management, distributors coordinate the supply of water to the environment and non-consumptive and consumptive uses in order to avoid problems of congestion in channels, flooding and delays in water delivery.

Water distributors play an integral role in ensuring the efficient allocation of water. Their practices can affect the volume of water that is available for consumptive and non-consumptive uses. Further, the environmental health of rivers, streams and groundwater reserves is dependent on distributors' compliance with environmental flow requirements.

8.1 Distributors and their reporting requirements

The organisations involved in distribution management in the jurisdictions studied include water resource agencies (defined to include government departments), bulk water utilities, irrigation companies and cooperatives, and water user associations (see tables 8A.1 to 8A.3).

Reporting requirements

The efficiency of a water rights system depends on the distributor accurately accounting for water use and efficiently distributing it. Consequently, it is important that distributors maintain records and report their activities.

In most of the jurisdictions studied, distributors are required to provide a detailed annual water report, which covers water stored and distributed, water lost to evaporation and seepage, and the number of water trades. For example:

- The River Murray system¹ storage operator, River Murray Water, publishes an annual Water Audit Monitoring Report, as part of its requirement under Schedule F of the *Murray–Darling Basin Agreement 1992* (MDBC 2002).
- In Victoria, the resource manager publishes an annual water report that includes summaries on the availability of water, the water accounts held by the MDBC, distribution losses, and a summary of water trading (GMW 2002).²
- The US Bureau of Reclamation (BoR (US)) is required to publish annually an operating plan for each of its major storage and distribution projects. Comprehensive time-series data are published for water in storage, environmental flow releases, diversions, evaporation and precipitation, flood control benefits, and water made available for hydroelectric power generation (see for example BoR (US) 2002a and 2002b).
- In Queensland, each licensed storage operator (resource operations licence holder) must provide an annual water report for the previous water year. The report includes a monthly summary of the water in storage and water releases and the implementation of flow management strategies, announced procedures and outcomes and water allocation movements (trades) (NR&M 2002a).

These reports provide detailed and comprehensive assessments of the availability of water resources. However, they typically do not include sufficient information to assess thoroughly the performance of the water distributor or its compliance with operational requirements.

The most comprehensive of these reports are the annual operating plans of the BoR (US) projects, which describe in detail the role of storage operators in supplying

¹ The River Murray system is that part of the River Murray and Lower Darling River whose distribution management is described in the *Murray–Darling Basin Agreement* (1992).

² In Victoria, under s. 43A of the *Water Act 1989*, the Minister may appoint a resource manager. For the River Murray system, the resource manager is Goulburn–Murray Water — a rural water authority. In accordance with the terms of appointment, the resource manager is required to allocate water for each of the nine River Murray bulk entitlement orders, manage the distribution of water in accordance with these orders, and monitor compliance with the orders.

water for consumptive and environmental purposes, and power generation and flood control services (BoR (US) 2002a and 2002b).

In some of the jurisdictions studied, there are legislative requirements for water account managers to maintain a public registry of their activities. For example:

- In NSW, the NSW Ministerial Corporation is required to keep at its head office a public register containing information on irrigation company operations, including the operating licence, audit reports, applicable water sharing or management plans, and any recommendations of the Minister (Water Management Act 2000, s. 138).
- In Chile, the Directorate General of Water (DGA) is required under the *Water Code 1981* to establish in the Public Water Cadastre. Information contained in the registry include summaries of the main legal and administrative features of water user associations, water communities, drainage communities, canal associations, monitoring committees, groundwater communities and other societies.

In NSW and Queensland, the effectiveness of water distribution is assessed in the course of regular reviews of the Water Management Plans and Implementation Programs (NSW), and Water Resource Plans and Resource Operations Plans (Queensland) (see chapter 6). Plans are to be reviewed every 10 years with a mid-term audit. These reviews and audits examine the performance of the distributor against the water distribution rules described in the plan.

From time-to-time, independent reviews or audits of water accounting and water distribution practices are also undertaken. For example, in December 1996, the Murray–Darling Basin Ministerial Council agreed that the way in which the largest storages of the River Murray, the Hume and Dartmouth dams, were operated should be reviewed (HDORRP 1998).

8.2 Water accounting

Water accounting involves maintaining a record of the volume of water available and distributed to uses and users at any point in time. The purposes of maintaining accounts are to:

- assist the distributor to keep track of water use and to estimate demand so that their infrastructure can be managed efficiently, and so that they are able to meet any environmental flow requirements;
- allow consumptive users to keep track of their use and the water remaining available for use, and enable distributors to bill users for their use; and

-
- facilitate monitoring and enforcing compliance with water use regulations.

Water accounting procedures are generally specified in inter-jurisdictional agreements, legislation, regulations and resource plans in the jurisdictions studied. The procedures are also influenced by the specification of the water rights, and in the case of California and Colorado, the legislative protection offered to water right-holders against injury. Water accounting procedures can also be influenced by government policy — as in the case of the rules governing the Murray–Darling Basin Commission’s (MDBC’s) ‘Pilot Interstate Water Trading Project’.

For the efficient allocation of water, accounts need to accurately reflect the ownership of water rights, as described in water right registries, and the hydrological characteristics of the water sources. In particular, accounts need to reflect changes to the ownership of water rights, the exercise of unregistered water rights, rainfall and run-off patterns, and patterns of evaporation and seepage, distribution, water use and return flows. Failure to account adequately for these issues can be detrimental to right-holders and the environment.

In all jurisdictions studied, processes were employed to:

- determine the volume of water available for distribution and to assign it for that season to uses and users; and
- record the volume of water in a user’s account, after adjusting for inflows, carry overs, borrowings, storage losses and deliveries.

In most jurisdictions, processes were also employed to update the registries of water rights and water accounts for:

- changes to supply reliability when water rights were transferred between jurisdictions or catchments;
- conveyancy (transit) losses when water rights were transferred along a channel over long distances; and
- restrictions placed on water rights during periods of serious water shortage.

Various organisations can be involved in maintaining water accounts. These include:

- inter-jurisdictional storage operators, such as the MDBC, the Lower Colorado River Basin Commission, and the International Boundary and Water Commission, that are responsible for keeping accounts of water shared between jurisdictions;
- jurisdictional administrators, that are responsible for keeping accounts of water distributed within a jurisdiction; and

-
- water supply organisations, such as water districts, and water user associations, such as irrigation companies and irrigation districts, are responsible for keeping accounts for water distributed to their members or water right-holders.

Registries of water rights are typically maintained by the organisation responsible for administering water rights or an independent titling office (see chapters 5 and 7).

In some instances, an organisation is responsible for simultaneously maintaining both the water right registry and a water account. For example, the irrigation districts of rural water authorities in Victoria maintain registries of water rights in their area as well as accounts of water received and used by irrigators.

Similarly, the water commissioner attached to a water district in Colorado is responsible for tabulating a list of water rights as well as ensuring that water is accounted and distributed consistently with the Doctrine of Prior Appropriation.

Where there is no formal regulation of groundwater, accounts of water use are not maintained unless required following court adjudication, such as in California.

Determining water availability and assignment of water

The way in which the volume of water for distribution is determined and how that volume is assigned to uses and users is described in tables 8A.4 to 8A.6 for each of the jurisdictions.

In all jurisdictions, the task of determining the availability of water and assigning it each season is undertaken by:

- The storage operator in the case of regulated rivers. The exception is NSW, where this is undertaken by the water resources agency on behalf of the responsible Minister.
- The water resources agency in the case of unregulated rivers. The exceptions are Victoria and Chile, where this is the responsibility of the rural water authorities and water user associations respectively.

Where there are arrangements for resource sharing at an inter-jurisdictional level, the volume of water available to each jurisdiction is determined first.

In the Murray–Darling Basin, the Water Liaison Committee of the MDBC is responsible for estimating the volume of water available to each of the signatory states. Each jurisdiction’s water resources agency or storage operator is then responsible for determining the volume of water available to water right-holders.

Similarly, the 17 major users in the Lower Basin of the Colorado River notify the BoR (US) of the volume of water that they want in the next calendar year. The BoR (US) either accepts or rejects these requests, based upon their forecasts of water availability. If a petition is rejected, the BoR (US) sets an alternative extraction limit for the user that conforms with requirements. Each user is then responsible for determining the volume available for individual water right-holders.

After inter-jurisdictional assignments have been determined, or when no inter-jurisdictional arrangements exist, distributors within the jurisdictions studied determine the volume of water available to individual water users and right-holders.

Typically, the volume of water available at the beginning of an irrigation season along a regulated river depends on the following:

- useable water carried-over from the previous year;
- volume of inflows received by the start of and during the water year;
- environmental water requirements;
- volume of water diverted by riparian or unlicensed users;
- water saved or banked for use in the next season;
- water losses in storage;
- water losses in transporting water; and
- other relevant matters, such as cropping requirements.³

The extent to which any of these factors influence the volume of water available for distribution depends, in part, on the intended purpose of the storage. For example, dams that are principally intended for flood control might allocate more storage capacity to collecting and managing flood water than a dam intended to provide water to consumptive users.

Storage operators and local distributors make regular announcements of water determinations and assignments. The announcements provide water users with timely information on the volume of the assigned water and sometimes forecasts of the volume that will be available at the beginning of the next season.

In all jurisdictions studied, right-holders drawing water from regulated rivers are advised of the volume of water and rates of extraction attached to their right that they can expect to receive (see chapters 5 and 6).

³ See NSW Minister for Land and Water Conservation (2003) for an example of some of the factors taken into account.

The announcements are generally directed at the holders of low priority or low security rights. In NSW, Victoria, Queensland and Chile respectively, these include general security, sales water, medium security and eventual water rights. In the vast majority of years, the holders of high security rights in NSW, Victoria, Queensland and South Australia and permanent water rights in Chile⁴ can expect to receive the nominal volume of water attached to their right. Announcements in NSW and Victoria are made on a monthly basis (GMW undated).

In California and Colorado, where water users possess appropriative rights, a reference date is announced by the storage operator. Right-holders with an appropriation date earlier than or equal to the announced reference date can expect to receive their water. Where water users possess water supply contracts instead of water rights, water users are advised of the proportion of the nominal volume of water attached to their contract that they can expect to receive.

Similar processes are employed along unregulated rivers in all of the jurisdictions studied. Within most of the Australian jurisdictions, the water resources agency determines the volume of water available for extraction and the rate of extraction (or daily flow limits) for unregulated rivers.

The State Water Resources Control Board (SWRCB) and the Office of the State Engineer (OSE), in California and Colorado respectively, declare the priority order of supply to right-holders for unregulated rivers. In Chile, water user associations are responsible for determining the level of extraction of each water user.

Agencies responsible for assigning water in unregulated rivers generally do not make regular announcements for water rights that are likely to be met in most seasons. These include high security and riparian rights in most jurisdictions. For example, riparian access to water is generally unaffected by the availability of water — hence no announcements are necessary.

In most circumstances, groundwater extractions do not vary from year to year. In some cases, groundwater extractions may be adjusted to sustainable levels, but this occurs infrequently.

In Colorado, generally, the volume of groundwater that can be extracted is permanently set by the district water court (in the case of tributary groundwater) and OSE (in the case of non-tributary and designated groundwater).

In contrast, groundwater extraction in California is largely unregulated. As mentioned, Californian courts often adjudicate to define the rights of groundwater

⁴ Permanent water rights are those that can be met in full 85 (or more) years in any 100 years.

users when the consequences of over-pumping are severe and to set specific extraction rates on individual users. As reported, watermasters are often appointed by the courts to ensure that pumping conforms to court limits.

In most jurisdictions studied, consultation is normally undertaken during the development of the distributor's operational rules. Consultation with water users is important for the efficient distribution of water, and to ensure that the interests of stakeholders are considered by distributors.

Ongoing consultation occurs in situations where water users are represented on the management board of the storage operator, irrigation district or water user association. For example, in Colorado, weekly conference meetings are held by the Managing Entities of the Green Mountain Reservoir to coordinate releases to the Grand Valley Power Plant and other non-consumptive users (BoR (US) 2002a).⁵

Managing water accounts

The water assigned to each right-holder is recorded in their water account. The volume in the account is then adjusted throughout the irrigation season or water year as water is drawn down, carried over or borrowed.

The type of water accounting method can influence the efficient allocation of water. The method depends on how water is shared, and how records are maintained over time. Two broad water sharing arrangements were observed among the jurisdictions studied:

- Priority-based sharing — each water right has a priority to access water in storage and inflows up to a defined volume.
- Capacity sharing — each water right is defined as a share of the storage facility and its inflow. Water rights are not differentiated on the basis of priority (see box 8.1).

Under a priority-based system, the storage operator manages the year-to-year variability of water supply by assigning water first to high priority water rights (see chapter 5). The storage manager is also responsible for managing storage losses and carry-overs in accordance with the priorities of the water rights.

Under capacity sharing, each water user receives a share of the capacity of the storage and is responsible for managing individually the year-to-year variability of

⁵ The Managing Entities comprise the Grand Valley Water Users Association, the Orchard Mesa Irrigation District, the Grand Valley Irrigation Company, the Divisional Engineer, the Colorado Water Conservation Board, and the US Fish and Wildlife Service.

water supply. Water users are permitted to store water indefinitely and usually bear the effects of evaporation and other losses in proportion to their capacity shares (ESCAP (UN) 2000).

In addition to these sharing arrangements, there are two distinct methods for accounting for water assigned and distributed to users:

- annual or period accounting, with or without provisions for carry-overs and forward-draws; and
- continuous accounting (see box 8.1).

Annual and period accounting is usually associated with the priority-based water sharing arrangements. Continuous accounting is associated with both priority-based and capacity sharing methods.

The most common methods of water accounting among the jurisdictions studied, was priority-based sharing and annual accounting with carry-over and forward-draws — although carry-overs were not available to water right-holders in Victoria (see tables 8A.7 to 8A.9).

Priority-based sharing and annual accounting with carry-over is used in Colorado, such as the Northern Colorado Water Conservancy District (NCWCD), the Fryingpan–Arkansas Project and the Arkansas River Banking Program (see BoR (US) 2002a and 2002b).

Priority-based sharing and continuous accounting is used in a small number of regulated rivers in NSW (MDBC 2002).⁶ Continuous accounting is increasingly being adopted throughout NSW (State Water, pers. comm., 1 August 2003).

In NSW and South Australia, water users in unregulated rivers are allowed to extract more than their allocated water in a particular year. However, their total extractions over three or five-years cannot exceed their allowable allocation over that period.

Capacity-sharing and continuous accounting tend to be used in cases where water rights are all of the same priority. For example, NSW and Victoria each have equal shares in the Hume Reservoir of the River Murray system. Similarly, two water authorities drawing water from Lake Eppalock in the Campaspe Basin in Victoria also use capacity sharing.

⁶ Information on water accounting was not available for Chile, Mexico or South Africa.

Box 8.1 Accounting for water in storage — regulated rivers

Priority-based sharing

Right-holders are given a priority to access a volume or share of the resource in storage and its inflows. Higher priority right-holders are provided with the first call on water and the needs of lower priority water users are only met after other priorities have been satisfied. Depending on the accounting method, right-holders may carry over water.

Evaporation and other losses in storage are accounted separately.

Capacity sharing

Right-holders are allocated a share of the storage capacity and a proportion of the inflows to the storage, based on their water right. The right-holder is able to draw continuously on their share when flows are available. There is a theoretical maximum volume that each right-holder may reserve in storage.

Right-holders' accounts are reduced by the evaporation and any other losses from the storage as a whole, in proportion to the rights held. When a right-holder's storage capacity reaches its theoretical maximum, water notionally spills into all the other accounts that have not filled.

Annual or period accounting

At the start of the accounting period, water from the previous year's or season's common pool and inflows to the water storage are determined and then assigned to each water right-holder's account. An announcement is made at the beginning of the irrigation season as to how much is available to water right-holders.

At the end of the year or irrigation season, remaining water in the accounts is re-allocated to the common pool for the next accounting period.

Annual or period accounting with carry-overs and forward-draws

Right-holders are permitted to carry over some of their water from one period to the next or, in some cases, to forward-draw part of next year's allocation. Limits are imposed by the storage operator on the total volume of water that can be carried over or brought forward to protect other right-holders. Carry-over volumes are also adjusted to account for evaporation and seepage.

Continuous accounting

A right-holder's account is continuously updated during the year or season, including any additional inflows and draw downs. A limit is placed on the proportion of the volume of water that a right-holder can store and access in any year. Limits are also imposed on the volume of water that can be kept in storage.

Source: ESCAP (UN) (2000).

The advantage of priority-based systems is that they allow for differing priorities of water rights. However, this requires risk to be managed by the storage operator according to defined rules that may not necessarily reflect each water right-holder's preferences. In addition, priority-based sharing creates incentives for water users to over-use or trade water because water cannot be carried-over indefinitely. This creates third-party effects on other water users (ESCAP (UN) 2000).

The advantage of capacity sharing is that water right-holders have the freedom to manage their own water supplies. Capacity sharing also allows water to be stored indefinitely, thereby minimising the problem of pooling (ESCAP (UN) 2000).

Accounting for water right transfers

Water rights can be transferred between supply systems provided these are hydrologically connected. When transfers take place, both water right registries and water accounts need to be updated to reflect changes in ownership.

In the US jurisdictions studied and in Chile, water rights are specific to a single supply system. Under this approach, water accounting is a comparatively simple exercise. The resource manager debits the seller's account and credits the buyer's account irrespective of the new user's location. Similarly, the manager of the water right registry also makes changes to the ownership of water rights.

In addition to adjustments to ownership, changes are sometimes made for possible changes to the hydrological or legal characteristics of the water right.

In the Australian jurisdictions studied, water rights are not specific to a particular supply system. As they are transferred, water rights must be supplied at the level of reliability of the supply system into which they are traded. Adjustments to the water right will need to be made in order to ensure that the right is supplied at the new reliability. This would minimise the impact on other water users in the new supply system.

These adjustments are undertaken through the use of supply reliability exchange rates (see chapter 7). These are applied by the administering agency to the volumetric component of the water right (DNRE 2001).

The determination of supply reliability exchange rates is complex and lacks transparency (DNRE 2001; Young et al. 2000). Exchange rates are especially complex where inter-state trades are involved because of different dam management practices as well as different hydrological characteristics.

In principle, exchange rates need to be calculated for every supply system and water right. In the case of inter-state trade, they must also take into account the different types of water rights. The MDBC has recognised that the complexity of exchange rates associated with lower security water rights is an important issue that has yet to be resolved (MDBC undated(e)).

Accounting for conveyancy losses

Conveyancy (evaporation and seepage) losses occur when water is transported down rivers and irrigation channels. Losses that occur when water is ordered but allowed to flow downstream rather than being used are also regarded as conveyancy losses. When transfers take place, both water right registries and water accounts have to be adjusted to reflect changes in hydrological characteristics.

The treatment of conveyancy losses affects the efficient allocation of water and overall economic efficiency:

- When the right to the water lost is not defined, there is a disincentive to invest in new or improved infrastructure (such as irrigation channels) because there may be a lack of clarity as to which parties will acquire the water.
- When water losses are not accurately accounted to a users' water right, inefficient (geographic) patterns of irrigation agriculture may result. There will be reduced incentives for water users to locate closer to the water storage where conveyancy losses would be minimised (Chakravorty and Roummaset 1991; Hafi, Klijn and Toyne 1999).

In the Australian jurisdictions studied, conveyancy losses are borne either by a storage operator or an irrigation district, but not by individual water users.⁷ Conveyancy losses are borne by a jurisdiction (in the case of inter-jurisdictional rivers), a storage operator (in the case of other rivers) or an irrigation district (in the case of irrigation channels) (see tables 8A.10 to 8A.12).

In California and Colorado, the volumetric component of a water right is recalculated whenever it is traded. This adjustment takes into account the effects of conveyancy losses. The storage operator then proceeds to release the same volume of water as before, and the new water user receives the adjusted volume after accounting for net increases or decreases due to conveyancy losses — to do otherwise would injure the water rights of other users (Colorado Revised Statutes, ss. 37-82-105 and 37-92-105).

⁷ Information on the treatment of conveyancy losses in Chile, Mexico and South Africa was not available.

The manager of the pilot water banking scheme on the Arkansas River in Colorado, for example, must release the same ‘gross’ volume of water (referred to as ‘consumable water’) to the new water user. This volume comprises the volume of the user’s water right and a specified volume for seepage, evaporation and other losses for the zone inhabited by the user.

In contrast, in the Australian jurisdictions studied, storage operators set aside a pool of water, which is released to offset any conveyancy losses. This pooling arrangement means that right-holders will receive their volume of water, regardless of the conveyancy losses associated with its transport — that is, the volume of water assigned to a right is at the point of extraction. Where conveyancy losses are high, the storage operator must release a correspondingly high volume of water from the conveyancy loss pool.

Generally, inter-state and intra-state water right trades in Australia do not result in an adjustment for conveyancy losses, because the few trades that occur do not have an appreciable impact upon the pool of water set aside for conveyancy losses (DNRE 2001). This incorrectly implies that each additional water right trade experiences negligible conveyancy losses. As a result, water from NSW and Victoria is traded without penalty into South Australia, despite the high evaporation rates of water in the long and slow moving Murray and Darling rivers.

Arrangements for water shortages

In all jurisdictions studied, water rights are often held by storage operators and infrastructure owners on behalf of their customers or members. In these cases, bulk water right-holders can restrict the volume of water that can be consumed by their members or customers when the water allocated to them is insufficient to meet demand.

In most of the jurisdictions studied, legal authority is also conferred on the Minister, water resources agency or storage operator to declare emergency provisions and restrict water rights (see tables 8A.13 to 8A.15). For example, in Queensland, if the Minister declares a water shortage (under section 22 of the Queensland *Water Act 2000*), the water supplier has the authority to restrict the volume, timing or use of water if:

- there is an urgent need;
- the water available has fallen to a level where unrestricted use would not be in the public interest; and

-
- the water service provider has a reasonable and comprehensive demand management strategy and the restrictions are consistent with that strategy (Queensland Water Act 2000, s. 388).

Colorado and South Africa are the only jurisdictions where there is no statutory authority to restrict water rights.

Declarations of water shortages

Legislation in South Australia and California gives some direction on the factors to be taken into account before declaring a water shortage. For example, in South Australia, the Minister must take into consideration the effects on the environment, current and future demand and the potential impact on aquifers (South Australia Water Resources Act 1997, ss. 16 and 37).

The approach in California is prescriptive, stipulating that restrictions can only be imposed when the ‘ordinary demand’ would result in insufficient water being available for human consumption, sanitation and fire protection (California Water Code s. 350).

What constitutes a water shortage and when water rights are to be restricted is not defined in legislation in NSW, Victoria, Queensland or Chile. For example, under NSW legislation, the Minister has only to be satisfied that there is a severe water shortage (NSW Water Management Act 2000, s. 59).

Consultation during water shortages

Consultation during periods of scarcity provides an avenue for those potentially disadvantaged by any contingency arrangements to bring their concerns to the attention of the decision maker.

Among the Australian jurisdictions studied, the relevant authority is not required generally under water legislation to consult with water users when declaring a water shortage.⁸ The exceptions are when: there is a prospect of curtailing the right of an in-stream water licence in Victoria; and if the Minister wishes to reduce the water rights in unequal proportion in South Australia (Victoria Water Act 1989, s. 33; South Australia Water Resources 1997, s. 37).

In both California and Chile, the relevant authority must consult with water users before proceeding with any proposed restriction. For example, in California, the

⁸ In order to comply with natural justice requirements in statutory and common law, authorities may consult with affected parties prior to imposing restrictions.

governing body of the storage operator must hold a public hearing to provide all water users with an opportunity to express their views (California Water Code s. 350). In Chile, each monitoring committee is required to consult with its members before proceeding with restrictions (Chile Water Code 1981, Article 274).

In all of the jurisdictions where water rights can be restricted by a Minister or the President (in the case of Chile), the restriction constitutes an order, decree or subordinate legislation that must be published either in a government gazette or the appropriate local newspaper.

Forms of restriction during water shortages

In some of the jurisdictions studied, legislation provides guidance on how water rights are to be restricted, including the uses to which water can be put. In Victoria, South Australia and Chile, water rights are to be reduced in equal proportion across rights or uses. In NSW and California, water right priorities change (Water Management Act 2000 s. 59; Water Code s. 354). For example, during periods of water shortage in NSW, domestic water use and basic landholder rights are given first priority to water, and water for environmental purposes is given second priority (NSW Water Management Act 2000, s. 60).

Compensation is provided in Chile for restrictions in some circumstances. A right-holder may seek compensation from the government if they are required to reduce their consumption by a proportion greater than the overall water shortage (Chile Water Code 1981, Article 314).

In addition to the above measures, jurisdictions allow water to be re-allocated through markets. For example, in Colorado, local governments have entered into long-term options contracts with irrigators to purchase water in the event of an extreme drought (Noonan 1993).

Water banking

Water banking refers to the practice of depositing a water right for a fixed term and allowing the water right to be traded by the bank in the intervening period. Water banking has been employed in California (such as the drought banks of 1991, 1992 and 1994) and in Colorado (see box 8.2).⁹

⁹ They have also been employed in jurisdictions outside the scope of this report, including Idaho and Texas. Bank-like programs have also been introduced in Kansas and Washington State.

Box 8.2 Arkansas River Pilot Water Bank

On 5 June 2001, the General Assembly of Colorado passed legislation authorising the trialing of a water bank in the Arkansas River. The pilot is intended to:

‘...simplify and improve the approval of water leases, loans and exchanges, including transactions, and increase the availability of water-related information. It is also the purpose of this pilot water bank to assist farmers and ranchers by developing a mechanism to realize the value of their water rights assets without forcing the permanent severance of those water rights from the land’ (Sections 37-80.5-102 Colorado Revised Statutes).

The depositor informs the water bank of the applicable duration of the deposit, the minimum acceptable price for the water, and the volume of water to be leased, loaned, optioned or exchanged.

Once an agreement is settled, the water is available for other persons to accept. Once approved, the water bank lists the availability of water on its Internet site and in its field offices. The listing contains the volume of water available, the stored location, the source of water, the minimum price and the historic use of the water.

Applications for the lease or option for water must gain the approval of the water bank and the Office of the State Engineer. The Office of the State Engineer may include terms and conditions on the time, place or type of use that the available water can be put to, to prevent injury to vested water rights, including dry-up provisions where available.

The water bank charges fees to cover the administrative costs of operating the bank.

Source: Annex I.

In a water banking program, special accounts are created and managed by the bank operator. A water right is deposited into the account for one or more years, for carrying over, lending (renting), exchanging or optioning to other water users for one or more years — depending on the contractual agreement between the bank operator and the depositor.

Water banking can also refer to a range of other depositing practices intended to provide water users with greater flexibility to manage their water supplies, including artificial groundwater recharging. Groundwater recharge projects have been in operation in California and Colorado (MacDonnell et al. 1994), and both South Australia and the ACT provide for groundwater recharging.¹⁰

In California, water banks have proven effective in re-allocating water between users during periods of drought. They were introduced because water rights could not be practicably restricted and re-allocating water through normal water markets

¹⁰ Groundwater recharging has received extensive legislative treatment in Arizona, Nevada, Oregon and Utah in the United States.

was costly and time-consuming. Since the mid-1990s, water banks have been used increasingly to facilitate water transfers more generally.

Water banking programs are intended to simplify many of the administrative procedures of the Doctrine of Prior Appropriation (see MacDonnell et al. 1994). As mentioned earlier, high transaction costs are incurred when downstream users have a legal title to the return flows of upstream users and downstream users' water rights have to be protected from injury before a transfer can be made (see chapters 5 and 7).

Water banks overcome these transaction costs by allowing water rights to be traded outside the normal administrative processes. The bank operator ensures that all deposited water provides for evaporation and seepage losses, downstream water users' rights, and groundwater intrusion. That said, trading using water banks may still be subject to administrative provisions imposed by governments, such as environmental protection requirements (see chapter 7).

8.3 Water distribution

Water distribution involves transporting water along natural and artificial channels to consumptive and non-consumptive uses. In distributing water, distributors may also be responsible for allocating water to the environment or controlling water flows to meet environmental needs.

A key challenge for water distributors is to coordinate the distribution of water to minimise congestion and flooding, and to maximise the net benefits to water users. Water users generally prefer to receive their water at certain times of the day, month or year, and these preferences often conflict.

Managing environmental flows

Key environmental third-party effects are those that result from:

- changes to the timing, frequency and quality of natural flows from the activities of storages, locks and weirs; and
- extracting water from the water body by consumptive water users (see chapter 2).

These third-party effects can be addressed by providing environmental flows. These flows are usually determined through a resource plan or acquisition program (see

chapter 6). The environment's requirements are satisfied by specifying minimum and maximum flow rates at specific locations along rivers over time.

Among the jurisdictions studied, the environment's requirements can be met by:

- conferring environmental water allocations, which are expressed as volumes or shares of the resource, to an agency responsible for managing environmental flows, which may or may not be a distributor; and
- requiring distributors to follow a set of rules when releasing water to ensure that the environmental requirements are satisfied. These rules act as constraints on the volume and timing of water distributions.

In some of the jurisdictions studied, both instruments are used. The instrument used in each of the jurisdictions studied is set out in tables 3.11 and 3.12 in chapter 3.

Environmental allocations are employed in all of the jurisdictions studied except Queensland, where water is not made exclusively available for specific environmental purposes.

Most environmental allocations are specified as volumes. However, they can also be specified as a share of the available water, such as in South Australia. In most jurisdictions studied, they are made for specific purposes, such as flooding wetlands.

Environmental flow requirements are provided in each of the Australian jurisdictions studied. They usually specify the maximum and minimum flows that must be observed in a watercourse. For example, an environmental flow requirement may specify that during the summer months the flow of a river at a designated gauge must not be less than 10 per cent of its natural flow observed for at least 95 out of 100 years.

Normally, environmental flow requirements permit water rights to be restricted to ensure that minimum environmental flow requirements are met. For example, in NSW, Victoria and Queensland, daily pumping rates are set at the beginning of the water year in unregulated rivers to protect the environment (for example, see DLWC undated, ss. 49 and 53).

However, environmental flow requirements can in some instances restrict water right-holders from exercising their right even when water is available to them. For example, in a wet year a storage manager may be required to ensure that a river floods. To ensure that flooding takes place, the storage manager may limit the extraction by consumptive water right-holders.

These aspects of environmental flow requirements are not employed in California, Colorado and Chile, where consumptive water rights cannot be restricted if water is available to water right-holders.¹¹

Environmental flow requirements can provide water for environmental purposes without necessarily employing water that has been allocated for the specific and exclusive use of the environment. This is achieved by restricting when downstream users can take their water, and could require them to invest in on-farm storage. However, such rules can at times be complex and lack transparency (Australian Conservation Foundation, pers. comm. 18 July 2003). They are also potentially less flexible than if environmental flows were managed by a dedicated environmental manager.

Where environmental allocations are made, the purchase of transferable environmental water rights can be an efficient means of re-allocating water between consumptive and non-consumptive uses. Water is obtained at the lowest cost because water users placing the lowest value on water are the most likely to transfer water to the environment (Siebert et al. 2000).

Managing distributions for consumptive use

Water is distributed from storages on regulated rivers for consumptive purposes such as irrigation, household consumption, stock and domestic, industrial and commercial purposes. In distributing water, the storage operators and water resource agencies are responsible for ensuring that the water is distributed in accordance with water rights, environmental allocations and flow requirements, and other operational requirements of the storage.

Ordering water

In the jurisdictions studied, users have requested the delivery of their water by: ¹²

- ordering in advance — where the water user places a request with the storage operator in advance of the time needed for its use;
- availability on demand — where the water is made available at the water user's convenience; and

¹¹ Environmental flow requirements are used in California in some wild and scenic rivers.

¹² Information on the methods of ordering water was not available for Chile, Mexico and South Africa.

-
- rostering — where water is made available to the user on a pre-determined date, usually notified at the start of the irrigation season (ANCID 2002).

The choice of method is often determined by the nature of the supply network. ‘Order in advance’ is typically employed when water is supplied by gravity supply systems (for example, open irrigation channels) and where there is a delay in the delivery of water (ANCID 2002). In contrast, ‘on demand’ is available for pressurised reticulation systems in urban areas and in pumped irrigation systems.

The ordering method used also reflects how water rights are prioritised. In most jurisdictions, ‘order in advance’ tends to be the most common method of ordering. For example, in Australia and in certain BoR (US) projects (where water users have water supply contracts rather than water rights), water users all have the same priority of access to the water, so ordering in advance is the preferred method of queuing deliveries.

In California and Colorado, where water rights are defined under the Doctrine of Prior Appropriation, a ‘prioritised roster’ is used. An announcement is made at the beginning of the irrigation season, which establishes a roster of supply according to the priorities of each user. When there is insufficient water to fulfil a higher priority right under the roster, the storage operator curtails supply to lower priority right-holders.

Managing congestion

At certain times of the year, the demand for water may result in congestion of water courses and irrigation channels because of physical constraints or environmental flow requirements. This congestion can result in delays in water deliveries and flooding of private and public lands.

Along the River Murray in Australia, for example, the demand for water in the lower reaches of NSW, Victoria and South Australia during the peak of the irrigation season can exceed 30 GL per day (MDBC undated(a)). The maximum capacity at the Barmah Choke in the River Murray (at the western end of the Barmah–Millewa forest in NSW and Victoria) is 8.5 GL per day.

Congestion of the Barmah Choke during the summer months could lead to harmful flooding of the Barmah–Millewa forest (MDBC undated(b)). Congestion can also lead to flooding of private land along the Mitta Mitta River in Victoria.

The coordination of water releases for consumptive and non-consumptive uses and for environmental purposes requires ongoing management of the water resources and distribution system. Good management practices are also likely to be cost

effective. Indeed, better management of congestion in the longer term may be more cost-effective than investing in additional water delivery infrastructure (DNRE 2001).

The following methods were observed in managing congestion:

- Queuing — water users who place their order ahead of others receive it first.
- Rostering — releasing water according to a pre-determined list of priorities.
- Rationing — water users are limited in the water that they can receive to a pro-rata share of each water right.
- Preventative — water users are prevented from trading water rights into areas that could contribute to future congestion.
- Capacity sharing — users are allocated, in addition to their water right, a permit based on the volumetric capacity of the delivery system. Users can only request water at any point in time up to the volume specified in the permit. Water users may sell or buy permits from other users.

Queuing and rationing arrangements are common among Australian water districts that require water users to place their water orders in advance of the expected time of use. Rostering is used in several irrigation districts in Australia (ANCID 2002). Capacity sharing has not been widely implemented in any of the jurisdictions studied.

Queuing and rationing are also used by some irrigation districts in California and Colorado (such as the NCWCD), where water users have claim to water supply contracts or company shares. Generally though, water rights in California and Colorado are rostered in accordance with each right-holder's priority (Getches 1997).

In NSW and Victoria, water right trading has been restricted to prevent congestion in natural channels and irrigation areas. For example, under the NSW water management plan for the River Murray, transfers of water rights downstream past the Barmah Choke are not permitted. Temporary trades from upstream of the choke to South Australia are permitted, because this can be served by Lake Victoria which is downstream of the Barmah Choke (DLWC 2002). Similarly, rural water authorities in Victoria are required to check whether a proposed water right trade will congest an irrigation district's infrastructure network (NRE 2001).

Each of these methods has implications for the efficient allocation of water. In Australia, rationing on the basis of the volume of water right ownership has resulted in water users acquiring more water rights in order to gain access to irrigation infrastructure. This is not necessarily an efficient use of water.

In California and Colorado, under the Doctrine of Prior Appropriation, the priority of the water right also determines the priority of access to water during periods of congestion. Higher (earlier-dated) priority rights are less likely to be congested than lower priority rights because they get first call on the channel capacity. Consequently, users with high valued uses for water have an incentive to acquire high priority water rights because of the access to channel capacity these rights provide.

Restrictions on water right trades may prevent congestion. However, restrictions do not ensure that the existing use of the channel capacity is necessarily yielding an efficient allocation of water. Higher valued activities may be denied access to the network infrastructure because of the presence of incumbent lower valued uses.

Capacity sharing allows the network to be managed separately to water rights (Marsden 2002). Capacity sharing enables water users to obtain access to the infrastructure capacity in accordance with their willingness to pay, and therefore allows water to be allocated to its highest valued use.

It is not clear to what extent capacity sharing has been adopted in the studied jurisdictions. An alternative approach would be to encourage discriminatory pricing to ration delivery capacity (DNRE 2001).

Managing distributions for non-consumptive water uses

In the Australian and US jurisdictions studied, the distribution of water is managed so that it can be used for non-consumptive purposes prior to it being used by consumptive users.¹³ Consequently, distributors and water users aim to coordinate the release of water so that it maximises the benefits to both consumptive and non-consumptive users.

There are two approaches used for coordinating flows for consumptive and non-consumptive uses among the jurisdictions studied:

- storage operators consult with prospective water users and estimate the net benefits associated with different release strategies; and
- water users negotiate and agree on a mutually beneficial release of water.

In most of the Australian and US jurisdictions studied, storage operators consult with water users and negotiate the release of water for consumptive and non-consumptive purposes. For example, the MDBC, through its storage operator River Murray Water, has canvassed with prospective users a number of options to

¹³ Information was not available for Chile, Mexico or South Africa.

release water. The MDBC has provided water users with its estimates of the costs and benefits of each option (HDDORP 1998). Similarly, the Green Mountain Reservoir's operating criteria were developed by the BoR (US) in consultation with its Managing Entities (BoR (US) 2002a).

In California and Colorado, water users arrive at mutually beneficial releases of water for consumptive and non-consumptive uses. For example, in the Green Mountain Reservoir in Colorado, water is lent by the Orchard Mesa Irrigation District to the US federal Grand Valley Power Plant, which later returns it in sufficient time and volume for irrigation users (BoR (US) 2002a).

Facilitating negotiation

To facilitate negotiation between consumptive and non-consumptive users over the timing of flows, it is important that the right to the timing of the flow be clearly specified and assigned — as it is under the Doctrine of Prior Appropriation — and that the costs of negotiation do not outweigh the benefits that could be derived.

The right to the timing of the water flow can be conferred on either consumptive or non-consumptive right-holders. If the right is conferred on consumptive users, non-consumptive users must make use of water when it becomes available for downstream use or negotiate for water to be released at different times.

Where a negotiated settlement cannot be reached, non-consumptive water users have acquired consumptive water rights (DNRE 2001). Although this may provide them with water, this may not represent an efficient allocation of water.

There are numerous examples from Chile of the difficulties of negotiating settlements between upstream hydroelectric power companies and downstream irrigators — where there have been disagreements over the interpretation of the relative rights to the timing of the flow (Lee and Jouravlev 1998; Dourojeanni and Jouravlev 1999).

Monitoring committees in Chile normally provide a low-cost forum for water users to negotiate conflicts over the timing of flows, but these have proven unable to resolve differences between consumptive and non-consumptive users. These conflicts have instead been taken up with the Chilean courts. However the costs of organising many small irrigators and the nature of decision making of Chilean courts has meant that decisions have been unevenly applied, and the dispute settlement procedures have been costly and drawn out (Bauer 1998; Lee and Jouravlev 1998; Dourojeanni and Jouravlev 1999).

In the absence of either a negotiated or consulted release of flows, water use can be inefficient. For example, upstream hydroelectric power companies might be left with little discretion as to when to generate electricity if they have to rely on the water released for irrigation (DNRE 2001).

8.4 In summary

In most of the jurisdictions studied, storage managers and water resource agencies are responsible for coordinating the distribution of water to meet the needs of water users. These distributions generally follow a process of consultation with users. In the Australian jurisdictions studied, provisions for the management of congestion, and the timing of environmental, consumptive and non-consumptive use flows are developed as part of a resource plan.

In the Australian jurisdictions studied, environmental flows can be managed by restricting water rights in terms of the volume of water or times at which water can be extracted. In California, Colorado and Chile, consumptive water users' rights cannot be restricted if water is available for them.

In all of the jurisdictions studied, except Queensland, allocations of water are provided exclusively and specifically for environmental purposes. In Queensland, there has to be sufficient water allocated for non-consumptive purposes to allow environmental flow requirements to be met with relatively minor adjustment to the volume and timing of right-holder extractions.

The annual accounting methods used in most of the jurisdictions studied, where unused water is pooled at the end of an accounting period, create incentives to over-use water.

In the Australian jurisdictions studied, the transfer accounting methods are complex in inter-state trade if water rights of different reliabilities are involved. This may act to reduce the potential for efficient inter-state trade of water rights until satisfactory exchange rates are developed.

The pooling of conveyancy losses in the Australian jurisdictions studied provides little incentive for efficient location. The volume of water received by right-holders located furthest from a water source does not necessarily reflect the losses incurred in delivering their water.

Only in South Australia and California is there legislative guidance on the triggers for emergency water restriction and public consultation required. Only Colorado and South Africa do not restrict water rights in periods of water shortage.

Restrictions placed on water rights during severe water shortages may not be effective and efficient. Apart from California and Chile, the processes followed in imposing restrictions do not necessarily result in users with the lowest valued use reducing their water consumption first. Moreover, these processes often involve extensive community consultation.

In California and Colorado, consumptive and non-consumptive users can arrive at mutually beneficial arrangements for the timing of water flows. This in part reflects a legal framework that confers on water users a right to the timing of the flow of water as well as the volume. The framework also confers on water users a right to the capacity of the delivery system, the principal mechanism for managing congestion.

The effectiveness and efficiency of water distribution is influenced by the rigour of external review and auditing of the practices of water distributors. In all of the jurisdictions studied, except NSW and Queensland, water distributors publish data annually on the volume of water available, its evaporation and seepage, the volume of water distributed, the timing of its distribution, and the level of water trading.

That said, the level of reporting is insufficient to review the performance of water distributors from year-to-year. However, in NSW and Queensland, there are five-yearly reviews of the extent to which operational requirements imposed on water distributors are met.

Attachment 8A

Table 8A.1 **Water distribution agencies — Australian jurisdictions, 2003**

<i>Jurisdiction</i>	<i>Water accounts</i>	<i>Water distribution</i>
NSW	Ministerial Corporation, State Water, SCA, ^a SWC ^b and other metropolitan suppliers.	Urban water suppliers, irrigation companies, districts and trusts, private diverters.
Victoria	Resource manager, ^c RWAs, ^d UWAs. ^e	RWAs, ^d UWAs, ^e private diverters.
Queensland	NR&M, ^f ROL ^g holders (SunWater, water boards, local governments).	SunWater, SEQWater, private diverters, water authorities, local governments.
South Australia	Minister for Environment and Conservation, SA Water,	SA Water, government irrigation districts, private irrigation trusts, private diverters.
ACT	ACTEW ^h , EPA. ⁱ	ACTEW, ^h private diverters.

^a Sydney Catchment Authority, ^b Sydney Water Corporation, ^c On behalf of the Minister for Water, ^d Rural water authority), ^e Urban water authority, ^f Department of Natural Resources and Mines, ^g Resource Operations Licence, ^h ACT Electricity and Water. ⁱ Environment Protection Authority.

Sources: Annexes B to F.

Table 8A.2 **Water distribution agencies — overseas jurisdictions, 2003**

<i>Jurisdiction</i>	<i>Water accounts</i>	<i>Water distribution</i>
California	Department of Water Resources, US Bureau of Reclamation, Water districts, ^a Investor-owned water utilities, court appointed watermasters.	Department of Water Resources, irrigation districts, investor-owned water utilities, other districts. ^b
Colorado	US Bureau of Reclamation, water districts ^c , water utilities, municipal authorities, groundwater management districts, water commissioners.	Water districts, ^c municipal authorities, private bulk water customers, irrigation companies and districts, private diverters.
Chile	Directorate General of Water, monitoring committees.	Water communities, canal associations
Mexico	National Water Commission.	Irrigation districts, civil associations.
South Africa	Water boards, local government.	Water boards, local government, water user association, irrigation boards.

^a Municipal, county and water districts ^b Public utility districts and community service districts. ^c Water conservancy and conservation districts.

Sources: Annexes H to L.

Table 8A.3 Water distribution agencies — Murray–Darling and Colorado River Basins, 2003

<i>Basin</i>	<i>Water accounts</i>	<i>Water distribution</i>
Murray–Darling Basin (River Murray system) ^a	River Murray Water (Hume, Dartmouth, Lake Victoria and Menindee Lakes). ^b	Under state jurisdiction.
Colorado River Basin	Upper Colorado River Commission, Secretary of the Interior, US Bureau of Reclamation, International Boundary and Waters Commission.	Under state jurisdiction.

^a River Murray system includes the River Murray downstream of Doctors Point and the section of the Darling River downstream of Menindee Lakes. ^b The River Murray system storages of the Hume and Dartmouth dams, Lake Victoria and the Menindee Lakes are owned by jurisdictions. River Murray Water is responsible for the management of the system's storages.

Sources: Annexes A and G.

Table 8A.4 Water determination and assignment practices — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
NSW	Minister has the authority to allocate water to accounts via 'available water determinations' and transfer water between users' accounts (account transfers) when so applied for by users. In accordance with provisions of the relevant water sharing plan, the plan may also determine account limits and maximum annual use limits.
Victoria	Rural and urban water authorities have the authority to determine water and assign it to water users' accounts (or set extraction limits in the case of unregulated rivers or groundwater) in accordance with provisions contained in the relevant bulk entitlement order (regulated rivers), stream flow management plan (unregulated river) or groundwater management plan (groundwater).
Queensland	Storage operators have the authority to determine and assign water from regulated rivers to water users' accounts in accordance with the provisions of their resource operations licences. The Department of Natural Resources and Mines has the authority to determine extraction limits for unregulated rivers and groundwater in accordance with the relevant resource operations plan.
South Australia	River Murray Water, in accordance with provisions of the <i>Murray–Darling Basin Agreement 1992</i> determines the aggregate resource available to the State. River and groundwater diverters are limited by the provisions of their water allocation plans. SA Water has the authority to determine the volume of water for extraction for metropolitan and non-metropolitan towns.
ACT	The Environment Protection Authority can determine the total volume of water to be allocated each year, in accordance with the provisions of the water resource management plan to ensure that environmental flows are maintained.

Sources: Annexes B to F.

Table 8A.5 Water determination and assignment practices — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
California	The storage operator has the authority under its administrative arrangements to determine and assign water to water users' accounts. Groundwater is generally unregulated, except that courts may adjudicate in setting extraction rates. Courts may appoint watermasters to mediate extraction.
Colorado	The storage operator has the authority to determine and assign water to water users' accounts in accordance with company by-laws and state and federal guidelines. The State Engineer (including on behalf of the Groundwater Commission) has the authority to determine the volume of groundwater available for extraction in accordance with promulgated regulations.
Mexico	National Water Commission has the authority under <i>National Water Law 1992</i> to determine the volume of surface water and to assign it to water users' accounts. Groundwater is generally unregulated.
Chile	In urban areas, corporatised urban water suppliers have the authority to determine the volume of water available for distribution to urban customers. In rural areas, monitoring committees have the authority under the <i>Water Code 1981</i> to determine the volume of water and to assign it to water users' accounts.
South Africa	Storage operators may determine the volume of water in regulated rivers and to assign it to water users' accounts.

Sources: Annexes H to L.

Table 8A.6 Water determination and assignment practices — Murray–Darling and Colorado River Basins, 2003

<i>Basin</i>	<i>Description</i>
Murray–Darling Basin (River Murray system) ^a	River Murray Water (system operator of the River Murray system) has the authority to determine and assign water in accordance with the terms of the <i>Murray–Darling Basin Agreement 1992</i> .
Colorado River Basin	The US Bureau of Reclamation (storage operator of the Colorado River) has the authority to determine and assign the volume of water to be diverted by each of the signatory jurisdictions, in accordance with the Law of the River. The determination and assignment of water to individual water users is the responsibility of each State in the Upper Colorado River Basin. The US Bureau of Reclamation, in terms of water use contracts with the Secretary of the Interior, makes determination and assignment of water to individual water users in the lower Colorado River Basin. State input and review of contracts is invited.

^a River Murray system includes the River Murray downstream of Doctors Point and the section of the Darling River downstream of the Menindee Lakes.

Sources: Annexes A and G.

Table 8A.7 Storage accounting practices in rural storages — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
NSW	Water is accounted annually or continually in regulated river storages, depending on the provisions of the water sharing plan. Carry-over and forward-draw provisions are available for general security entitlements only. Account limits may not exceed the storage capacity.
Victoria	Water is accounted annually in regulated river storages. Urban and rural water authorities are required to normally plan to carry water for two years on some systems to provide security of supply but individual water users may not elect to carry over water.
Queensland	Typically water is accounted annually although it varies across resource operations plans. High and medium security water right-holders can also borrow next year's water. In some plans, allowances are also made for the limited carry-over into the next water year.
South Australia	Provisions for extractions by SA Water to follow a five-year average to comply with its right. Carry over and recharging of groundwater depend on provisions of water allocation plan.
ACT	ACTEW, responsible for urban water supply, may carry-over. Holders of water allocations are allowed to borrow up to twice their allocated volume in any 12 month period, but must not exceed three times their allocation over three years.

Sources: Annexes B to F.

Table 8A.8 Storage accounting practices in rural storages — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
California	Water is accounted annually in regulated river storages. Carry-over provisions subject to the storage. Urban storages can carry-over water.
Colorado	Water is accounted annually in regulated river storages. Carry-over provisions subject to the storage. Urban storages can carry-over water.
Chile	Information not obtained.
Mexico	Information not obtained. Processes for the annual determination of water availability are reviewed at least every six years.
South Africa	Information not obtained.

Sources: Annexes H to L.

Table 8A.9 Storage accounting practices in rural storages — Murray–Darling and Colorado River Basins, 2003

<i>Basin</i>	<i>Description</i>
Murray–Darling Basin (River Murray system) ^a	State water accounts are adjusted continually throughout the year and there are provisions for NSW, Victoria and South Australia to carry-over water subject to the provisions of the <i>Murray–Darling Basin Agreement 1992</i> .
Colorado River Basin	Annual accounting with provisions, although the States of the Upper Basin must not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75 million acre-feet for any ten consecutive years.

^a River Murray system includes the River Murray downstream of Doctors Point and the section of the Darling River downstream of the Menindee Lakes.

Sources: Annexes A and G.

Table 8A.10 Conveyancy losses — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
NSW	Specifications vary across water sharing plans. Frequently, storage losses are assigned to the storage operator and removed from the available water before it is allocated to users. Off-stream conveyancy losses are defined in a water right and assigned to the primary right-holder — such as the irrigation company. Exchange rates may be applied in recognition of losses in inter-state and intra-state transfers.
Victoria	Storage losses are assigned under the bulk entitlement. Conveyancy losses within irrigation districts are assigned to the rural water authority.
Queensland	The resource operations licence holder is granted a water allocation to account for conveyancy losses. A volume for transmission and operational losses may also be factored into the calculation of the announced assignments to water users.
South Australia	Storage and conveyancy losses of water along the River Murray are provided for under the <i>Murray–Darling Basin Agreement 1992</i> and are provided by the Murray–Darling Basin Commission.
ACT	There are no policies to address conveyancy losses.

Sources: Annexes B to F.

Table 8A.11 Conveyancy losses — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
California	Information not obtained.
Colorado	Evaporation and seepage losses attributed to individual water rights, although practice varies across rivers and districts.
Chile	Information not obtained.
Mexico	Information not obtained. These losses are not considered by the <i>National Water Law 1992</i> .
South Africa	Information not obtained.

Sources: Annexes H to L.

Table 8A.12 Conveyancy losses — Murray–Darling and Colorado River Basins, 2003

<i>Basin</i>	<i>Description</i>
Murray–Darling Basin (River Murray system) ^a	Conveyancy losses and storage spillages are attributed to each signatory jurisdiction. Inter-state transfers are deemed to have a small impact on the pool of conveyancy losses and consequently no adjustments are made to water rights for the effect of losses incurred in inter-state transfers.
Colorado River Basin	The US Bureau of Reclamation is required to provide detailed and accurate records of diversions, return flows, storage, and the consumptive use of water diverted from the mainstream of the Colorado River.

^a River Murray system includes the River Murray downstream of Doctors Point and the section of the Darling River downstream of the Menindee Lakes.

Sources: Annexes A and G.

Table 8A.13 Provisions for addressing severe water shortages — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
NSW	The Minister may declare a severe water shortage and suspend existing water allocation rules. The conditions for declaring a water shortage are not specified in Act. During such a declaration an alternate set of priority of access right must be adhered: 1) domestic and basic rights; 2) the environment; 3) utility commercial rights and high security irrigation; and 4) others.
Victoria	The Minister may declare a water shortage and suspend, reduce, increase or otherwise alter any or all rights if the volume or quality of water is or will not be available to satisfy rights.
Queensland	The Minister may reduce the volume available to any person for up to 21 days. This restriction can be extended for no longer than 12 months by regulation. The chief executive may restrict the taking of water by stock and domestic users, and licence and permit holders until the notice is revoked.
South Australia	The Minister has authority to declare a water shortage and prohibit, restrict or reduce water allocations. It is preferable that the Minister reduce water allocations in equal proportion.
ACT	Both allocations and licences can be reduced in response to changes to water quality and volume for environmental reasons, or if the Minister is satisfied that demand cannot be met or there is a risk that future demand cannot be met from existing supplies. The Environmental Flow Guidelines do allow for consideration of drought conditions and evaluation of both environmental flows and water supply.

Sources: Annexes B to F.

Table 8A.14 Provisions for addressing severe water shortages — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
California	The governing body, subject to a public hearing, may set new priorities that apply to water rights. First, the domestic use needs of riparian users. Second, domestic purposes to appropriative users. Third, irrigation uses of riparian users. Fourth, irrigation uses of appropriative rights.
Colorado	There are no legislative provisions for curtailing water rights during a shortage.
Chile	Monitoring committees are responsible for managing water shortages, in accordance with water rights, in their respective basins. During times of extraordinary drought, the President of the Republic, on advice from the Directorate General of Water, has the authority to suspend the activities of the monitoring committees and to declare zones of shortage and curtail water rights for periods of up to six months.
Mexico	The Federal Executive Branch, through the National Water Commission, has the authority to regulate the extraction and use of national waters, and establish restricted areas or reserves in unusual water shortages or droughts.
South Africa	There are no explicit legislative provisions in the <i>National Water Act 1998</i> to address water shortages.

Sources: Annexes H to L.

Table 8A.15 Provisions for addressing severe water shortages — Murray–Darling and Colorado River Basins, 2003

<i>Basin</i>	<i>Description</i>
Murray–Darling Basin (River Murray system) ^a	When the total storage capacity of the River Murray reaches a critical level, the Murray–Darling Basin Commission may announce emergency provisions. NSW, Victoria and South Australia are each allocated one-third of the available water in the River Murray storages.
Colorado River Basin	Water shortage provisions in the US Supreme Court judgement <i>Arizona v. California 1964</i> come into effect when the available mainstream water in any year does not allow 7.5 million acre-feet to be provided. ^b

^a River Murray system includes the River Murray downstream of Doctors Point and the section of the Darling River downstream of the Menindee Lakes. ^b See Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs Pursuant to the Colorado River Basin Project Act of September 30, 1968 (PL 90-537).

Sources: Annexes A and G.

9 Pricing

Trades of water rights have the potential to allocate water to society's highest valued uses. Opportunities to trade can, however, be foreclosed or distorted by factors described earlier in this report, including:

- restrictions on the sale of water rights from jurisdictions and from irrigation areas (see chapter 7);
- high transaction costs associated with administering water rights (see chapter 7); and
- inefficient practices in managing supply reliability and congestion in distribution systems (see chapter 8).

In addition, inefficient pricing of water infrastructure services may affect outcomes in water markets. For example, if infrastructure charges were set below their efficient level, this would increase the prices at which water rights were traded, and could lead to inefficient use of some water.

Trade in water rights may also not lead to efficient outcomes from the perspective of society as a whole if the attributable costs of water rights management or of environmental third-party effects are not reflected in prices. However, even in these unfavourable circumstances, there may be good economic reasons to permit trade in water rights, including, for example, when third-party effects are small or infra-marginal.

Consistent with the objective of encouraging efficiency in water markets, governments in the jurisdictions studied have considered:

- how to regulate the prices charged for water delivery infrastructure in order, for example, to provide useful signals about investment decisions;
- how to recover the costs associated with allocating, administering, monitoring and enforcing water rights; and
- whether and how to recover the costs associated with third-party effects.

These issues are considered in this chapter.

9.1 Pricing infrastructure services

The provision of water infrastructure services incurs costs associated with water storage and delivery infrastructure, including headworks (storage facilities) and irrigation and urban reticulation (diversion and supply).¹ This infrastructure is typically comprised of large capital works, whose costs cannot normally be attributed to particular users. Further, the capital works have little value in alternative uses — the opportunity cost of the assets, once constructed, is low.

Setting prices to recover short-run marginal cost of using sunk capital is efficient. However, during periods when the infrastructure service provider operates below full capacity — and in which there are increasing returns to scale — prices set at marginal cost will be less than average cost, and the producer will make a loss.

Sophisticated pricing regimes, which differentiate prices between customers, can in theory enable costs to be recovered without discouraging efficient consumption. Such pricing regimes can, however, be difficult to implement.

Pricing at short run marginal cost can result in substantial price fluctuations as capacity utilisation changes over time. Infrastructure prices at average costs will be more stable, and may be seen by governments as being more conducive to producing useful price signals relevant to investment in water infrastructure service provision.

Price regulation

Many of the jurisdictions studied regulate the prices charged by public and private infrastructure service providers, who might otherwise be able to exploit their monopoly positions (IPART 1996; QCA 2000). Regulation is undertaken either by government departments or by independent regulators, sometimes involving price controls and sometimes price monitoring. In the case of rural water service providers, in particular, however, there have been concerns that prices are too low, rather than too high.

Of the jurisdictions studied, prices were controlled in NSW, Victoria, Queensland (for SunWater), South Australia (for metropolitan and non-metropolitan town customers), the ACT, California and Colorado (for privately-owned suppliers), Chile (for urban water suppliers only), Mexico and South Africa. Price controls were also undertaken at the municipal level in Colorado by the Board of County Commissioners (see tables 9A.1 and 9A.2).

¹ The following discussion does not consider sewerage and drainage infrastructure networks.

Prices set by water infrastructure service providers can be monitored by a government department or independent pricing regulator, with an implicit or explicit threat of possible control. The Queensland Competition Authority, for example, is authorised to monitor whether government-owned urban, regional and rural supply authorities are monopolies and should be subject to price controls.

Price regulation is generally not employed where service providers supply water only to their stock-holders, such as in NSW (for private irrigation companies), South Australia (for private irrigation trusts), California and Colorado (for water districts and irrigation companies), and Chile (for water user associations).

The scope of cost items covered by price regulation was observed to be similar across the jurisdictions studied. Broadly, prices have been set to include charges for the delivery of water and natural resource management costs (IPART 1996; QCA 2000; IPARC 1999; Fernández and Medina 2000; Schur undated).

Only in two of the jurisdictions studied did the price regulating body also control the price of the water itself. In the ACT, the Independent Competition and Regulatory Commission is responsible for setting an abstraction charge for urban and rural users. In Colorado, the Board of County Commissioners for Denver Water is responsible for setting drought surcharges for Denver Water.

In South Africa and Chile, considerable emphasis seems to be placed on achieving a range of social objectives in setting prices. For example, in South Africa, it is government policy to ensure that:

- water is provided at no charge for ‘basic human needs’ (set at 25 litres per day per person); and
- water is supplied to previously ‘disadvantaged farmers’ through price concessions (Schur undated).

Independent price regulation has the potential to increase the transparency of price determinations (IPART 1996). Another advantage is the impartiality of the decision when governments own the businesses being regulated or have a policy interest in the decisions. However, price regulation is complicated by many factors, including difficulties in estimating costs. These difficulties suggest the risk that regulators could set prices too low by not having full regard for the water infrastructure service provider’s unavoidable costs or necessity to invest for future demand (PC 2001b).

Recovery of current and capital costs

Operating within an environment of regulated prices, most Australian urban infrastructure service providers earned positive rates of return or were on price

paths to recover the capital costs of service delivery² (NCC 2001a to 2001f; WSAA 2001).³ Similarly, many US urban infrastructure service providers earned positive rates of return (Wahl 1997). In Chile, urban infrastructure service providers set prices to recover at least their current costs⁴ (Fernández and Medina 2000). In contrast, urban water users in Mexico did not pay for their current or capital costs (Aguilar undated).

Rural water authorities in Victoria (except Goulburn–Murray Water) and private irrigation trusts in South Australia recovered their current costs in 2000–2001 (ANCID 2002). Rural infrastructure service providers in NSW and Queensland were on price paths or were expected to recover their current costs in the near future (NCC 2001a). In contrast, their counterparts in California and Colorado generally did not recover their current costs (Wahl 1997; OECD 1999).

Typically, rural infrastructure service providers did not fully recover the capital costs of service delivery in any of the jurisdictions studied (NCC 2001a to 2001f; ANCID 2002; Wahl 1997; OECD 1999; Fernández and Medina 2000; Aguilar undated). For example:

- water users within South Australian irrigation districts did not contribute towards the costs of maintaining River Murray headworks — despite accounting for about 80 per cent of all water use in the state;
- many of the irrigation districts in Australia received generous capital grants, which had the effect of reducing the scope of the relevant asset base on which capital costs were calculated (OECD 1999); and
- many new irrigation projects in Chile received subsidies of up to 75 per cent of the construction and maintenance costs of the infrastructure (Fernández and Medina 2000).

Most Australian rural infrastructure service providers adopted, or were adopting, renewal accounting to maintain their infrastructure at current operational levels (ANCID 2002).⁵

² Capital costs are defined as the costs associated with the consumption of capital (depreciation) and the opportunity cost (weighted average cost) of capital.

³ Differences were also observed in the valuation methods. In NSW and the ACT, independent pricing regulators value fixed assets using the optimal deprival method (IPART 2000a and 2000b; IPARC 1999).

⁴ Current costs are defined as the costs of operating and maintaining of infrastructure. In some jurisdictions, maintenance includes the collection of an annuity levy for the long-term replacement and refurbishment of the asset.

⁵ Under renewal accounting, the water infrastructure service provider collects a charge from water users to cover the average annualised costs of asset replacement and refurbishment at existing

Pricing policy reforms

As mentioned earlier, most governments of the jurisdictions studied have sought to reform the pricing of water-related services, and in particular, infrastructure services. Pricing reforms among the Australian jurisdictions have been guided by the Council of Australian Governments' Water Reform Framework pricing guidelines (see box 9.1).

Box 9.1 CoAG pricing guidelines

1. Prices will be set by the nominated jurisdictional regulators (or equivalent) who, in examining full cost recovery as an input to price determinations, should have regard to the principles set out below.
2. The deprival value methodology should be used for asset valuation unless a specific circumstance justifies another method.
3. An annuity approach should be used to determine the medium to long-term cash requirements for asset replacement/refurbishment where it is desired that the service delivery capacity be maintained.
4. To avoid monopoly rents, a water business should not recover more than the operational, maintenance and administrative costs, externalities, taxes or TERs [tax equivalent regime], provision for the cost of asset consumption and cost of capital, the latter being calculated using a WACC [weighted average cost of capital].
5. To be viable, a water business should recover, at the least, the operational, maintenance and administrative costs, externalities, taxes or TERs (not including income tax), the interest cost on debt, dividends (if any), and make provision for future asset refurbishment/replacement (as noted in (3) above). Dividends should be set at a level that reflects commercial realities and simulates a competitive market outcome.
6. In applying (4) and (5) above, economic regulators (or equivalent agencies) should determine the level of revenue for a water business based on efficient resource pricing and business costs. Specific circumstances may justify transition arrangements to that level.
7. In determining prices, transparency is required in the treatment of community service obligations, contributed assets, the opening value of assets, externalities including resource management costs, and tax equivalent regimes.

Source: ARMCANZ 1995.

In the United States, there has long been a recognition that the charges for irrigation infrastructure, particularly that provided by the US Bureau of Reclamation (BoR

service levels. Such fees are typically less than the costs of depreciation and the opportunity cost of the capital.

(US)), were too low, leading to inefficiencies in water use. In BoR (US) projects, irrigators received interest-free finance. Irrigators were later able to shift part or all of their repayment obligations to other ratepayers, on the basis that they benefit from owning land in the project area (OECD 1999).

There have been attempts to increase charges for infrastructure services in the United States. For example, the introduction of tiered rates and surcharges under the US federal *Central Valley Project Improvement Act 1992* increased charges to water users in the Californian Central Valley Project (Wahl 1997).

Generally, it has been difficult to increase charges because of:

- the binding long-term contracts between the US Bureau of Reclamation, water districts and irrigators; and
- resistance from irrigators, because an increase in prices would penalise those who purchased land at prices in which access to subsidised water had already been capitalised (OECD 1999).

Instead, pricing reform in the United States has been concentrated on encouraging water trading. Water banks have been established to increase the extent of trading and improve signals about the opportunity cost of water in short supply (OECD 1999; see chapter 8).

In Chile, publicly-owned urban infrastructure service providers have been corporatised, in order to reduce their reliance on government support (except through funding for the provision of community service obligations). Rural infrastructure service providers are owned and managed by a variety of water user associations. However, there remains a national program of subsidising the construction and maintenance costs of new irrigation investments (Fernández and Medina 2000).

In Mexico, the cost of water administration and of operation and maintenance of irrigation schemes was traditionally paid jointly by government and water users. In the early 1980s, farm contributions to these costs represented less than 20 per cent, the remainder being paid through public funds — resulting in the deferral of maintenance activities (Aguilar undated).

It is the policy of the Mexican National Water Commission to recover eventually the costs of operating and maintaining their rural water assets (Aguilar undated). The *National Water Law 1992* (Mexico) and other water-related laws such as the *Federal Water Levy Law* were aimed at addressing the under funding of economic infrastructure (Aguilar undated). Mexican pricing reforms have centred on:

-
- devolution of the management responsibility for operations and maintenance to irrigation districts;
 - increasing water levies to manage and develop water resources, including managing the scarcity of water, and to allow irrigation districts to recover the costs of their operation and maintenance activities; and
 - introducing waste water discharge levies to restore and improve water quality (Aguilar undated).

In South Africa, the Department of Water Affairs and Forestry has a long term objective to recover the costs of operating and maintaining its rural water assets. The *National Water Act 1998* includes the objectives of efficiently pricing water and achieving cost recovery of water rights management and infrastructure service provision. The pricing objectives also have regard to the principles of equity, environmental sustainability and water quality (Schur undated).

Price structures

Multi-part water infrastructure service charges, with (fixed) access and (variable) consumption-based components, are common in Australia (see table 9A.3). However, there are exceptions:

- In most irrigation districts in the Goulburn–Murray area of Victoria, charges have been based on the volume of water obtainable under the right, and did not vary with the level of consumption. Revenue shortfalls were defrayed with consumption-based charges from allocating ‘sales water’.
- A number of groundwater (‘stock and domestic’) schemes in NSW, Victoria, Queensland and South Australia, where charges are based on the ‘area-of-land serviced’.
- The Lower Murray Swamps area of South Australia, where charges have been collected on the basis of the area of land serviced, instead of consumption.

In the United States, there has been a diversity of pricing structures, possibly reflecting the independence of local infrastructure service providers in setting charges. Urban prices have been set with and without fixed charges, and with and without consumption-based charges (OECD 1999).

Urban and agricultural water districts in California and Colorado obtained revenues from tax assessments (or betterment levies) based on ‘the value of the property or the number of acres of land owned’ (Wahl 1997). These have been used to recover capital costs. It has been argued that non-water using beneficiaries needed to contribute because:

Such assessments on land were based on the rationale that all property owners within a district enjoyed a benefit from the availability of water — reflected in the increased value of their land — even if they did not use the resource (Wahl 1997, p. 144).

Tax assessments have, however, encouraged cost-shifting by water users. A study by McCann and Zilberman (2000) found that cost recovery from water users was greater among those water districts in California whose board members were elected by a simple popular vote of members than by those elected by a vote based upon the size of the land holding.

In Mexico, urban infrastructure service providers tended to employ both access and consumption-based charges (OECD 1999). In contrast, a variety of different pricing structures are used by infrastructure service providers for irrigation schemes. These include consumption-based charges, area-of-land serviced charges, and combined consumption and area-of-land serviced charges. In many areas, these charges are adjusted according to the season and the crop (Tsur and Dinar 1995; Dinar 2000).

A two-part tariff structure allows all or some of the directly attributable cost of supplying infrastructure services to be included in the variable charge, while also collecting an access fee to recoup all or part of the capital costs incurred (IC 1992).

Overall, water infrastructure prices in the form of multi-part consumption-based charges — as agreed by the CoAG and extensively introduced in Australia — are potentially efficient, provided that charges are set to recover at least attributable costs.

Competitive neutrality

Competitive neutrality policies aim to promote efficient competition between public and private businesses by ensuring that government businesses do not enjoy competitive advantages over their private sector competitors by virtue of their public ownership. Competitive neutrality principles may require infrastructure service providers to:

- pay (or include an allowance for) government taxes and charges;
- pay commercial rates of interest on borrowings;
- generate commercially acceptable profits; and
- comply with the same regulations that apply to private businesses (CCNCO 2000).

In Australia, many water authorities supplying major urban and rural centres are subject to state and federal competitive neutrality policies. For example:

-
- Metropolitan and most non-metropolitan urban infrastructure service providers in Australia are subject to state and territory tax equivalent regimes. Most also make regular dividend payments to the shareholding government (NCC 2001a to 2001f; WSAA 2001).
 - Government-owned rural infrastructure service providers, such as those in Victoria, are subject to state and territory tax equivalent regimes.

Generally, publicly-owned infrastructure service providers in the United States are required to make payments to municipal general funds in lieu of taxes, such as those paid by private utility companies (Mann 1993).

Community service obligations

Governments impose community service obligations (CSOs) on some infrastructure service providers, requiring the provision of services to groups of customers at low prices (PC 2002). In these cases, CSO payments by the government to service providers can enable the service provider to continue to operate on an otherwise commercial footing, while ensuring that the cost of the service is fully disclosed.

Across the Australian jurisdictions studied, CSO payments are received by metropolitan urban infrastructure service providers. These included payments for categories of water users that include, for example, charities, schools, pensioners and persons with special needs (NCC 2001a to 2001f). In Chile, municipal governments provide CSO payments to urban infrastructure service providers (up to 80 per cent of the invoice up to 20 cubic metres per year) to assist the poor (Fernández and Medina 2000).

Governments provided payments to water infrastructure providers in rural areas to assist classes of water users. For example, in:

- NSW and Queensland — rural infrastructure service prices were below current costs but were on price paths to increase cost recovery (NCC 2001b and 2001d)
- Victoria — maintaining picnic facilities, toilet blocks, boat ramps and marker buoys for skiing and boating (NCC 2001c).
- South Australia — non-metropolitan urban prices were set equal to metropolitan urban prices under the state's uniform pricing policy (NCC 2001e);
- California and Colorado — different pricing schedules were listed according to the class (household, industrial or agriculture) of the customer (OECD 1999);
- Mexico — rural infrastructure service charges were adjusted to account for equity, land quality differences and the water user's ability to pay (OECD 1999); and

-
- South Africa — legislation allows prices to be varied according to the needs of water users (National Water Act 1998).

CSOs influence the efficiency of water markets because they affect the prices paid by different user groups — such as urban and rural water users. In addition, if infrastructure service providers do not receive payments from governments to fund their CSOs, the prices they charge to other customers who are not receiving subsidies under CSOs, may also be affected.

9.2 Pricing conveyancy losses

Evaporative and seepage losses occur while water is in storage and while it is conveyed to water users. Conveyancy losses comprise the loss of water in transit from the source to the water user (see chapter 8).

The attributable costs of storage and conveyancy losses should be included in the delivered price of water, if economic efficiency is the objective. Otherwise, there will be diminished incentives for water to be delivered to and used where it would be most valuable.

In most of the jurisdictions studied, there is no charge for water losses. Consequently, the price of water for infrastructure service provision is set in accordance with the volume of water delivered to the point of extraction. In Australia, these prices are the same for all water users, including those further downstream. Losses are costed, but are then averaged across all water right-holders. Similarly, for many BoR (US) projects, infrastructure service costs are also based on deliveries to the point of extraction, and are not differentiated by location.

Prices which take account of conveyancy losses can reduce the costs of water systems by:

- in the short term, reducing water losses, by strengthening incentives for water to be used closer to the water storage;
- in the long term, reducing required storage capacity, since upstream users need less storage capacity than downstream users to supply them with the same volume of water.

9.3 Pricing water rights management

There are costs involved in allocating, administering, monitoring and enforcing water rights. Some of these costs may not be attributable to particular users.

However, it may be feasible to charge individual users for the costs associated with issuing new water rights and approving water trades. The extent to which such costs are recovered can affect the pattern of water trading.

In most of the jurisdictions studied, there is a policy of pricing to recover at least some of the costs associated with water rights management. At the very least, fees are collected to recover some or all of the costs of processing water right applications. For example:

- fees to transfer water in the temporary (annual) market are set at a fixed amount plus a per megalitre variable amount in NSW (IPART 1996, 2000a and 2000b);
- fees to process applications for new and changes to water rights and well permits are set in legislation in Colorado;
- although there are no costs to water users for the Directorate General of Water's processing of water right applications, a fee is charged if a site inspection is required in Chile; and
- fees are collected to cover the costs of monitoring and administering groundwater rights in certain ground water aquifers in Australia and overseas.

NSW is the only Australian jurisdiction, among those studied, where an independent pricing regulator separately identified water rights management costs in its pricing determinations (IPART 1996; IPARC 1999; QCA 2000).

The overall cost of water rights management to right-holders might be higher in California, Colorado and Chile because court-based or similar proceedings feature in their administration of water rights (see chapters 5 and 7). In the western United States these costs have been estimated to be up to 20 per cent of the value of the water right (Nieuwoudt 2000).

9.4 Pricing environmental third-party effects

Environmental third-party effects may occur when water is collected and stored (storage effects), extracted from a watercourse or body (extraction effects), and used and returned to the watercourse or body (return effects) (see chapter 2).

In each of the jurisdictions, the most common approach to regulating environmental third-party effects has been to control the volume of water stored, extracted or returned. For example, in most Australian jurisdictions, resource plans are used to allocate water between consumptive and non-consumptive uses, with the intention of ensuring that the marginal cost to the environment does not exceed the marginal economic and social benefits of using water (see chapter 6).

Similarly, most jurisdictions have sought to control the third-party effects through government approval processes for the construction of water works (works approvals) and the use of water (use approvals) (see chapter 7). Other approaches to address return effects, such as the licensing of pollution discharges, though not addressed in this study, were available to a number of jurisdictions. Other measures to control for environmental third-party effects, such as environmental taxes, are possible.

Although CoAG has advocated that water prices should cover the costs associated with externalities, this has not yet happened in Australia. Nor does it appear to have been implemented in the overseas jurisdictions studied.

Pricing for environmental costs is complex. Environmental costs may be non-linear, reaching thresholds where irreversible environmental damage occurs. The NSW Independent Pricing and Regulatory Tribunal noted that it was doubtful that all environmental costs could be known with certainty, and that greater knowledge was needed in the development of management options (IPART 1996).

There would also be administrative and transaction costs if environmental damages were to be priced. Some of the relevant factors to be considered in structuring the price are the:

- volume of water extracted;
- sensitivity of the location of the water being extracted;
- timing of the water being extracted; and
- effects of transfers of water rights.

Instead, water infrastructure providers are often required to undertake a range of activities to restore or prevent environmental damage. These environmental management costs were often collected through water infrastructure service provision charges (see tables 9A.4 and 9A.5). For example:

- In NSW, Victoria and Queensland, water infrastructure operators have been obliged under legislation or their licensing requirements to undertake certain environmental management activities. The costs of these activities were recovered from users through water infrastructure service charges.
- In northern Victoria, separate charges are collected on new irrigation projects to finance the capital and current costs of operating salinity interception schemes along the River Murray.
- In the ACT, environmental charges are collected by ACTEW on the volume of water consumed for catchment activities of Environment ACT. Each of these charges is separately identified in customers' water delivery charges.

In contrast, Catchment Water Management Boards in South Australia collected environmental charges on landholders to finance catchment management operations. The costs of natural resource management activities were typically passed on in the infrastructure service costs or land rates.

In South Africa, the Department of Water Affairs and Forestry employed environmental taxes to address a range of point and non-point source water-related pollution (Schur undated; National Water Act 1998 (South Africa)).

9.5 In summary

For trade in water rights to allocate water to society's highest valued uses, the prices charged for water infrastructure services and water rights arrangements should cover the opportunity cost of the resources used in these activities. Environmental impacts of water extraction and use also need to be taken into account.

Prices charged for water infrastructure services are regulated in almost all of the jurisdictions, because competitive pressures on water infrastructure service providers are too weak to ensure cost efficiency and to deter excessive profits.

Across all of the jurisdictions studied, urban infrastructure service providers recovered more of their costs than did rural water infrastructure service providers. Among the Australian jurisdictions, California, Colorado and Mexico, urban infrastructure service providers recovered most or all of their current costs and earned positive rates of return on their assets. However, rural infrastructure service providers recovered (some of) their current costs, and almost none of their capital costs.

The Australian jurisdictions studied have adopted consumption-based pricing to recover infrastructure service costs — consistently in the case of urban infrastructure service providers, but less so among rural providers. Among some of the overseas jurisdictions, a variety of less efficient pricing structures have been adopted, including taxation assessments and area-of-land serviced charges.

There is a policy of recovering at least some of the water rights management costs in all of the jurisdictions studied. In most jurisdictions, fees are collected to recover some or all of the costs of processing water right applications (see chapter 7). However, it is not clear to what extent the costs of allocating, administering, monitoring and enforcing water rights are fully recovered. Of the Australian jurisdiction studied, only in NSW does the independent pricing regulator separately identify the administration fees in its pricing determinations.

Most jurisdictions address environmental third-party effects through resource plans or acquisition programs (see chapter 6). In most jurisdictions, providers of infrastructure services are required to meet minimum standards in natural resource management — defined in licence obligations. The costs of meeting these obligations are passed on to water users in the form of higher delivery charges. Apart from these charges, there is no active policy to address environmental third-party effects through environmental taxes.

Finally, the current practice in most jurisdictions studied is for infrastructure service providers to price the water at the point of extraction. As a result, upstream water users subsidise downstream water users for any conveyancy losses from evaporation and seepage. This reduces the incentive for users to trade water upstream closer to the water storage facility, where water losses would be reduced, or to invest in infrastructure that might reduce conveyancy losses.

Attachment 9A

Table 9A.1 Price regulation — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
NSW	The Independent Pricing and Regulatory Tribunal is an independent statutory authority that sets maximum prices for bulk water sold by State Water to non-metropolitan and rural customers and for government-owned water monopolies and the major urban water authorities (Sydney Water Corporation, Hunter Water Corporation, Sydney Catchment Authority), as well as the water supply services of local councils (for example, Gosford City Council, Wyong City Council).
Victoria	Non-metropolitan urban water authorities set prices in accordance with a 3-year Pricing Framework set in 2001 by the Victorian Government. Rural water authority prices are set in consultation with water service committees in accordance with Government objectives and CoAG requirements. The Essential Services Commission, an independent statutory authority, is expected to set prices for all urban and rural water authorities from 2005.
Queensland	The Queensland Competition Authority is authorised to monitor whether government-owned urban, regional and rural supply authorities are monopolies and subject to price controls. The Department of Natural Resources and Mines is responsible for setting price paths for SunWater.
South Australia	The Minister for Government Enterprises sets metropolitan and non-metropolitan town water, sewerage and drainage prices on advice from SA Water. Irrigation water users are not subject to independent prices oversight.
ACT	The Independent Competition and Regulatory Commission is an independent statutory body that sets prices of the sole water utility, the government-owned water infrastructure service provider to urban and rural water users.

Sources: Annexes B to F.

Table 9A.2 Price regulation — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description</i>
California	The California Public Utilities Commission provides independent prices setting of privately-owned utilities that supply water to users other than mutual members or stock holders.
Colorado	The Colorado Public Utilities Commission provides independent prices setting of privately-owned utilities that supply water to users other than mutual members or stock holders. The board of County Commissioners sets prices for water conservation districts and municipal water authorities. Prices of water conservancy districts are not subject to price control or monitoring. In all other areas, water prices are unregulated.
Chile	The Superintendency of Sanitary Services, a statutory authority, is responsible for setting water prices for utilities supplying households. Rural water user associations are not subject to price control or monitoring.
Mexico	The Federal Executive Branch through the Secretariat of Finance recommends the fee to be paid for water rights for the exploitation and use of National waters.
South Africa	Prices are set by the Department of Water Affairs and Forestry in accordance with the provisions of the <i>National Water Act 1998</i> .

Sources: Annexes H to L.

Table 9A.3 Structure of water infrastructure service charges — Australian jurisdictions, 2002

<i>Jurisdiction</i>	<i>Description</i>
NSW	
Urban	Access and consumption-based charges.
Rural	Access ^a and consumption-based charges. ^b One irrigation district has area-of-land serviced based charge. ^c Other levies collected. ^d
Victoria	
Urban	Access and consumption-based charges.
Rural	Access charges ^e and consumption-based charges. ^f No area-based charges or other forms of pricing. ^g
Queensland	
Urban	Access and consumption-based charges.
Rural	Access ^h and consumption-based charges. No area-of-land serviced charges. ⁱ
South Australia	
Urban	Access and consumption-based charges.
Rural	Access and consumption-based ^j charges. No area-of-land serviced charges. ^j
ACT	
Urban	Access and consumption-based charges. ^k
Rural	Access and consumption-based charges. ^k

^a Except Coleambally and Murrumbidgee stock and domestic. ^b Except Murray Irrigation, Murrumbidgee, West Corrgan and Narromine stock and domestic. ^c Murrumbidgee stock and domestic. ^d Coleambally, Murrumbidgee irrigation and Coleambally stock and domestic. ^e Generally based on the volume of the water right. Goulburn–Murray Water will formally introduce a separate access charge for infrastructure-related costs from 2003–04. ^f Except Goulburn–Murray Water which collected a consumption-based charge on the basis of sales water allocated in a season. Also, except Torrumbarry, Swan Hill Pumped, Bacchus Marsh, Macalister, Werribee stock and domestic. ^g Except River Diverters, Sunraysia, and Wimmera–Mallee stock and domestic. ^h Except South Burdekin irrigation stock and domestic. ⁱ Except South Burdekin stock and domestic. ^j Except Lower Murray. ^k Abstraction charge.

Sources: ANCID (2002); Annexes B to F.

Table 9A.4 Environmental management charges and restoration levies — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Charges</i>
NSW	Natural resource management costs. ^a
Victoria	Natural resource management costs. ^a Salinity levy on inter-state transfer of water rights. ^b
Queensland	Natural resource management costs. ^a
South Australia	Catchment management charge on land or water. ^c Proposed salinity levy on inter-state transfer of water rights. ^b
ACT	Abstraction charge includes natural resource management costs. ^d

^a Costs to infrastructure operators of maintaining water bodies and catchments, as part of their licence obligations, recovered through infrastructure service costs. ^b Salinity levy on the permanent transfer of water rights intended for new irrigation projects to finance future salt interception schemes. ^c Charge may be imposed on landholders on the basis of rateable land, water rights or water consumption. ^d Imposed to manage water demand in part only.

Sources: NCC (2001a, 2001b, 2001c, 2001d and 2001e).

Table 9A.5 Environmental management charges and restoration levies — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Charges</i>
California	Natural resource management costs. ^a
Colorado	Natural resource management costs. ^a
Chile	Not obtained.
Mexico	Not obtained.
South Africa	Not obtained.

^a Costs to infrastructure operators of maintaining water bodies and catchments, as part of their licence obligations, recovered through infrastructure service costs.

Sources: Annexes H to L.

10 Monitoring and enforcement

Monitoring and enforcement arrangements are employed in each of the jurisdictions studied to maintain the integrity of water rights and environmental allocations. These arrangements are discussed and compared in this chapter.

Monitoring (or periodic evaluation) is also undertaken to assess the effectiveness of water acquisition programs and resource plans. This aspect of monitoring is examined in chapter 6.

Effective monitoring protects water rights from encroachment. Where monitoring and enforcement are ineffective, the value of the right can be diminished. Effective monitoring and enforcement of water rights also ensures that both those with and without rights comply with relevant water legislation and licence or permit conditions.

Monitoring and enforcement should also be efficient. The costs of the resources committed to identifying a breach and undertaking enforcement action should not exceed the benefits of doing so.

10.1 Enforcement agencies

The roles and responsibilities of the Australian and overseas enforcement agencies are set out in tables 10A.1, 10A.2 and 10A.3. They can be broadly categorised as follows, although some enforcement agencies may not undertake all of these responsibilities:

- *consultation* — to educate and inform water right-holders of their responsibilities and the likely consequences of breaching conditions of their right;
- *monitoring* — to determine the volume of water extracted and the quality of return flows, to ensure that right-holders comply with the conditions attached to their water rights and to ensure that water allocated for environmental purposes is made available;

-
- *investigation* — to discover breaches of water legislation and licence or permit conditions such as meter tampering, water theft and excessive overuse of allocation; and
 - *enforcement* — to impose sanctions for offences.

Most enforcement agencies in the Australian and overseas jurisdictions studied are government-owned and accountable to a single higher authority such as a Minister (the Australian jurisdictions studied, South Africa and Chile), or Secretariat (Mexico) or a Governor (California and Colorado), in meeting their obligations (see tables 10A.4 and 10A.5).

In most of the Australian and overseas jurisdictions studied, only one agency is involved in monitoring and enforcing water rights and environmental allocations. In the US, there are some notable differences:

- In California, the monitoring and enforcement of surface water rights (including in-stream rights), groundwater rights and the provision of water for specific environmental programs is undertaken by a number of independent agencies.
- In Colorado, the monitoring of surface and groundwater rights is undertaken by the Office of the State Engineer (OSE), whereas the monitoring of in-stream flow water rights is undertaken by the Colorado Water Conservation Board (CWCB) (both are separate divisions within the Department of Natural Resources).

As noted in chapter 4, enforcement is for the most part undertaken by agencies with multiple responsibilities.¹ This can create conflicts of interest. For example, if enforcement agencies are responsible for water distribution and enforcing their own water right, the enforcement effort might be compromised and appropriate sanctions not applied.

With the exception of Victoria, South Africa and Chile, the enforcement agencies in the Australian and overseas jurisdictions studied do not have a water distribution role.² The Victorian rural water authorities (RWAs) monitor and enforce rights held by individuals and have the power to impose sanctions. They are also responsible for delivering water to individual right-holders.³

¹ Water organisations can be responsible for policy development, water allocation, administration of the water right, distribution of the water and monitoring and enforcement.

² It is proposed that the Department of Water Affairs and Forestry in South Africa will progressively withdraw from direct involvement in water distribution (Thompson et al. 2001).

³ Individual right-holders include private diverters and irrigators.

In addition, Victorian water authorities (including RWAs) are granted a bulk water entitlement that is enforceable at law. However, in most river basins there is no independent agency monitoring the authorities' compliance with their obligations under that entitlement.⁴ This situation is not ideal. As noted by the Parliament of Victoria's Environment and Natural Resources Committee Inquiry into the Allocation of Water Resources for Agricultural and Environmental Purposes:

Water authorities are required to report on the extent to which they have met obligations specified on bulk entitlement orders and these can reveal shortfalls in meeting these obligations. Shortfalls do occur, but no prosecutions had resulted by July 2001 (ENRC 2001, s. 6.58).

Accountability and reporting requirements

Monitoring and enforcement obligations should be clearly defined in legislation or regulation, to provide the enforcement agency with certainty about their role and to make them accountable for procedural fairness and outcomes.

The legislation that underpins enforcement arrangements generally requires agencies to report 'upwards' to a Minister or Governor and ultimately to Parliament or the Legislature (in the ACT, California and Colorado). Reporting requirements may also be formalised by an agreed memorandum of understanding with the agency.

In the Australian jurisdictions studied and South Africa, agencies are required to prepare annual reports on their financial and operational performance. Similarly, in California, the State Water Resources Control Board (SWRCB) is required under the California Water Code to publish biannual program reports relating to the activities of the Board. However, in most of the Australian and overseas jurisdictions studied, there are no specific statutory requirements to publicly report compliance outcomes. This is optional and outcomes are rarely reported (see tables 10A.4 and 10A.5).

In some jurisdictions studied, accountability arrangements may be tiered. Right-holders may be required to report to an enforcement agency, and the enforcement agency to a Minister and Parliament. For example, an irrigation code of practice has been developed for some areas of South Australia through a mandated community planning process. A person that holds a water licence has agreed under the code to

⁴ There are 26 river basins in Victoria which have a bulk entitlement. Two independent agencies (a Catchment Management Authority and the Department of Sustainability and Environment (DSE)) have been appointed and another agency is expected to be appointed, to monitor the water authorities' compliance in three of these river basins (DSE, Victoria, pers. comm., 12 May 2003).

submit details of their water use, among other things, to the enforcement agency annually. This report is not a public document.

In Victoria, water authorities are required to report on the extent to which they have met obligations specified on Bulk Entitlement Orders to the Minister for Water. Compliance outcomes are reported in all water authorities' annual reports. However, there is no statutory requirement for RWAs to report on the compliance outcomes of individual right-holders.

Although less common, accountability may also be 'lateral' from one agency to another. Separate agencies may be responsible for monitoring the volume extracted and water quality. One agency may be required to report to the other on volume extracted or water quality outcomes through some formal agreement.

In South Australia, there is currently no consolidated reporting of monitoring results to identify whether a right-holder has complied with both volume and quality conditions specified on their licence to extract and return water to an aquifer. The Environmental Protection Authority in South Australia (EPA) is responsible for monitoring the quality of water and the Department of Water, Land and Biodiversity Conservation (DWLBC) is responsible for monitoring the volume extracted or discharged into the aquifer.

To address this issue, the EPA (South Australia) is developing a code of practice for the management of aquifer storage and recovery schemes in consultation with the DWLBC and the Department of Human Services.⁵ It is proposed that one agency will be responsible for the scheme and for consolidating monitoring results (EPA, South Australia, pers. comm., 26 May 2003).

An enforcement agency is made more accountable for their actions if compliance outcomes are independently audited and reported. Similarly, an agency can only be held accountable if they are adequately resourced to perform their functions.

Transparency

The accountability of enforcement agencies will be strengthened by public reporting of the outcomes of their enforcement effort. Further, agencies can be held more accountable if the compliance policy and strategies of the enforcement agency and its administrative procedures are publicly available and understood.

⁵ Aquifer storage and recovery means the process of drainage or discharge of water directly or indirectly to a well for the purpose of recharging the aquifer or of recharging the aquifer for subsequent extraction.

Enforcement record

Information on how enforcement policies and strategies have been exercised, and the sanctions that have been imposed for breaches, helps to ensure transparency and to allow for public scrutiny.

Sanctions available to the enforcement agency are specified in legislation in all jurisdictions studied. They range from warnings (written), imposition of fines, to legal action through tribunals and courts.

A record of monitoring and enforcement effort is not publicly available in most Australian and overseas jurisdictions (see tables 10A.6 and 10A.7). This reduces transparency and limits the ability of the public to scrutinise the enforcement process and form judgements about its appropriateness.

South Australia and California are the only jurisdictions studied that report some details of their enforcement actions. In South Australia, the DWLBC discloses in its annual report the number of incident reports logged for investigation, cautioned suspects, and prosecuted breaches.

In California, enforcement action is currently reported by the Californian Environmental Protection Agency (EPA) on behalf of the SWRCB. This includes both violations relating to discharge permits and water licences. However, the SWRCB is in the process of developing a procedure to post all enforcement action taken on their Internet site (SWRCB, California, pers. comm., 17 October 2002).

The Californian EPA discloses enforcement action in far greater detail than the DWLBC in South Australia. For example, the EPA reports on the number of permits and licences inspected, percentage of violations that require voluntary corrective action by the right-holder, the number of licences revoked and the number of unauthorised diverters that are subject to an administrative civil liability penalty (EPA (California) 2001).

In addition, the Californian watermaster is required by a Los Angeles County Superior Court Judgement to report annually to the Court and the parties to the judgement on its activities.⁶ Included in this report are details on the number of parties that over-extracted and the number that were in violation (DWR 2002). There are no details provided on what action has been taken by the watermaster against those who are in violation of their groundwater right.

⁶ The Los Angeles County Superior Court Judgement for the Central Basin limits the volume of groundwater each party can extract annually from the Basin. Parties include municipalities, individuals, private companies and water districts (DWR 2002).

Compliance strategies

With the exception of Colorado and California, the enforcement agencies of most Australian and overseas jurisdictions studied do not publish a statement of their compliance strategy. This makes it difficult to compare the mechanisms used to enforce compliance for their robustness, effectiveness and efficiency.

In Colorado, water commissioners, acting on behalf of the State Engineer, are responsible for day-to-day enforcement of water use. A publication entitled 'Water Commissioner Manual' is intended for use in the field as a guide to the effective administration of Colorado water rights. Although this is primarily an internal document, it can be purchased by the public.

Similarly, California has developed a compliance strategy for its water right program. The SWRCB intends to describe this strategy on their Internet site (SWRCB, California, pers. comm., 17 October 2002).⁷

Other jurisdictions plan to develop a compliance strategy. For example:

- The NSW Department of Infrastructure, Planning and Natural Resources (DIPNR) is developing a generic compliance strategy for all resources, including water (DIPNR, NSW, pers. comm., 22 October 2002).
- The Queensland Department of Natural Resources and Mines (NR&M) has developed a draft compliance strategy for the Department as a whole, and one specifically for Land, Water and Vegetation. As well as dealing with monitoring and enforcement, the strategies include pro-active approaches such as education and awareness raising strategies. These documents are expected to be finalised and made publicly available in the second half of 2003 (NR&M, Queensland, pers. comm., 5 June 2003).
- The South African Department of Water Affairs and Forestry (DWAF) is planning to develop a comprehensive compliance management strategy. However, implementation will not occur until a significant number of licences have been issued under the *National Water Act 1998* (DWAF 2002).

Similar information could not be found for Chile and Mexico.

⁷ California has also developed and made publicly available a compliance strategy for its water quality enforcement program, an environmental compliance strategy for the CALFED Bay-Delta Program, and a strategy for investigating water right complaints.

Industry consultation

To some extent, right-holders are informed of their compliance obligations through the water rights application process. For example, the water rights application package in California includes the enforcement sections of the Water Code. In the Australian jurisdictions studied, the water licence generally includes a statement of the right-holder's compliance obligations.

Compliance obligations need to be supported by direct consultation with right-holders when changes to enforcement policy and strategies are introduced.

Consultation with right-holders may involve information sessions or educational campaigns to disseminate information on enforcement procedures and can also be used to reinforce what constitutes a breach of the water right. Direct consultation does not set legally binding rules on behaviour but encourages compliance through education and persuasion.

In most of the jurisdictions studied, there is limited face-to-face consultation (see tables 10A.8 and 10A.9). The Internet and newsletters are more commonly used to disseminate information.

In Queensland and South Australia, the promotion of public awareness of water resources and the use and management of those resources is required by legislation.⁸

As part of Queensland's water reform process and as general operational practice, NR&M conducts information sessions with water users. Specific information sessions and mailouts are also being proposed in relation to the issuance of infringement notices.⁹

Similarly, the DWLBC in South Australia consults with the community to ensure that changes to legislation that impact on water resource compliance issues are understood by right-holders. The DWLBC also presents information sessions to catchment water management boards, committees and other community groups.

In NSW, the DIPNR is proposing to develop an education strategy to complement their proposed compliance strategy (DIPNR, NSW, pers. comm., 22 October 2002).

⁸ Refer chapter 2, section 2 (vii) of the Queensland *Water Act 2000* and part 2, section 2 (vii) of the South Australian *Water Resources Act 1997*.

⁹ The issue of an infringement notice is a new amendment to the *Water Act 2000*.

10.2 Monitoring procedures

Monitoring programs may include continuous or periodic review of water extraction, water quality and environmental flows. They provide a means of assessing compliance with regulations governing water use and ensure environmental flow requirements are being met.

The nature and extent of monitoring will depend on an assessment of the risks of non-compliance. For example, where water theft is low, monitoring can be scaled down accordingly, with less resources used. Alternatively, where monitoring indicates that ecological values are at risk, increased resourcing may be required, to enable immediate remedial action, thereby minimising risk of permanent degradation of ecological values.

Monitoring water rights

In all of the Australian and overseas jurisdictions studied, there is no direct monitoring and enforcement of stock and domestic rights (unless administratively granted through a licence or permit), or of indigenous rights.

Monitoring is not costless and may not be warranted if the volume of water used is considered insignificant and the rights have no third-party effects. However, as the demand for water increases in the future, pressures to monitor the volume used may increase.

In South Australia, Queensland, California and to a lesser extent Colorado, the procedures used to monitor metered surface and groundwater rights are similar. Enforcement agencies in these jurisdictions generally rely on self-monitoring and reporting by right-holders. In South Australia and California, enforcement agencies conduct periodic random audits to determine compliance with water right conditions.¹⁰

In South Australia, most water allocation plans require licensees using a prescribed water resource for irrigation, to prepare an irrigation report which among other things, must include the volume of water used in a water use year. This report must be submitted annually to the DWLBC or Minister for Environment and Conservation.

¹⁰ In California, the SWRCB generally targets five watersheds per year. The largest water right-holders in the watershed are chosen and all the water rights held by the party are inspected (SWRCB, California, pers. comm., 17 October 2002).

Similarly, all persons or designated agencies holding a surface water right in California are required to file a statement of diversion and use each year with the SWRCB. If a person fails to file a statement, the Board may, at the expense of the right-holder, investigate and determine the facts as required by the California Water Code.

In addition, all groundwater users who have an adjudicated right are required to report their extractions each month to the Californian Watermaster. The Watermaster computes the volume pumped thus far in the current fiscal year and the volume that can be legally pumped during the remainder of the fiscal year.¹¹ Each month the Watermaster forwards a copy of the monthly water extraction report to all users. To ensure that meter readings are accurate, the Watermaster's field staff schedule tests to determine the accuracy of the meter on every active well at least once every two years.

In Colorado, the OSE has sufficient staff to undertake field monitoring of surface water diversions. However, self-monitoring and reporting of groundwater use does occur in some areas because the OSE do not have the staff to check diversions in these areas. The OSE relies on power data from electrical suppliers on individual metered wells with a power coefficient to convert monthly power consumption to water used in that month.

In Victoria and NSW, regular meter readings are undertaken by the enforcement agencies to ensure compliance with water right and licence conditions. In NSW, the DIPNR also conducts periodic random audits.

In Australia, not all licensed water use is metered. For example, in South Australia and Queensland area based licences are not metered.¹² To ensure compliance, the DWLBC in South Australia conducts aerial surveys to determine if the area under crop complies with licence conditions. In Queensland, water advisory councils operate in most areas and provide a degree of self regulation. NR&M will monitor to ensure compliance in response to a complaint, through general surveillance or in response to information obtained by the Department.

South Australia is the only Australian jurisdiction where right-holders are required to undertake ongoing monitoring of both the volume and quality of water extracted or discharged into aquifers for the purpose of aquifer storage and recovery. An annual report on monitoring outcomes must be prepared at the end of each water-use year by each right-holder and submitted to the DWLBC.

¹¹ Fiscal year is defined as 1 July of one year to 30 June of the following year.

¹² Queensland and South Australia are in the process of converting area based licences to volumetric licences which will be metered.

The right to harvest overland flows varies between and within jurisdictions studied (see chapters 3 and 5). It is common to limit the volume of water that can be captured or restrict the size of the storage facility that can be built through the issue of licences and permits.¹³ Some right-holders may also be required to install meters or measuring devices on storage facilities, and report annually to an enforcement agency on the volume of water diverted from the storage facility.¹⁴

Monitoring environmental allocations

In the Australian jurisdictions studied, the allocation of water for environmental purposes is commonly based on environmental flow requirements, rather than expressing water for environmental purposes as a share of available water or as a fixed volume of water.

In the Australian jurisdictions studied, it is difficult for the public to determine whether mandated environmental flow requirements have been met, because there is limited reporting of monitoring outcomes. The extent to which resource plans provide for the monitoring of environmental flows in the Australian jurisdictions studied is described in box 10.1.

There is also evidence to suggest that allocations for consumptive use take priority over minimum flow requirements in times of water shortages. For example, in Victoria, the policy for meeting bulk water entitlements stipulates that urban and rural demands must be met even at the expense of the environment. However, in some rural areas, there is evidence that during very dry periods, RWAs have difficulty in meeting minimum flow requirements (SRW 2002).

In some Australian jurisdictions studied, fixed volumes of water have been allocated for specific environmental purposes including the Barmah–Millewa Forest (NSW and Victoria), the Murray Wetlands (Victoria) and the Lower Murray Swamps (South Australia). These environmental allocations have been

¹³ In Victoria, a licence is required for all water harvesting activities, except for stock and domestic purposes. In NSW, a licence is only required if captured flows are greater than 10 per cent of average rainfall run-off. In South Australia, a permit is required to construct or modify on-farm dams in some prescribed or designated areas.

¹⁴ In Queensland, the NR&M is proposing that meters and measuring devices be adopted to monitor use of overland flow. In South Australia, measuring devices are used to monitor water diversions from on-farm dams in those areas where permits are required.

administratively granted as a bulk entitlement (in Victoria), an environmental water allowance (in NSW) and a licensed allocation (in South Australia).¹⁵

The extent to which fixed volumes of water for environmental purposes are monitored are described in boxes 10.2 and 10.3.

Box 10.1 Monitoring of environmental allocations in the Australian jurisdictions studied

In *NSW*, there is no statutory requirement for Water Management Plans (or Minister's Plans) to provide for the regular monitoring of environmental flows. However, there is a statutory requirement to undertake a review every five years into the term of each Plan to determine if allocations for the environment are being met. The Minister can change the water allocation rules if the Minister is satisfied that it is in the public interest to do so.

In *Victoria*, there are no statutory requirements for Bulk Entitlement Orders, Stream Flow and Groundwater Management Plans to provide for the regular monitoring of environmental flows. However, environmental flows are usually monitored. Constraints may be imposed on consumptive rights to reflect environmental needs.

In *Queensland*, the Water Resource and Resource Operations Plans outline monitoring requirements to ensure environmental flow requirements are being met.

In *South Australia*, the *Water Resources Act 1997* requires Water Allocation Plans to provide for the regular monitoring of the resource's capacity to meet the demands for water. This includes the monitoring of environmental flows to determine if allocations for the environment are being met. The Minister may reduce consumptive rights if it is found that the resource is over-allocated or more water is required for the environment.

In the *ACT*, there are no statutory requirements to audit or review allocations for the environment under the *Water Resources Act 1998* or within the Environmental Flow Guidelines or Water Resource Management Plans. However, monitoring of environmental flows is undertaken on a monthly basis and reported in the Environment Protection Authority's annual report. The Minister has the power to reduce consumptive rights to reflect environmental needs.

Sources: Annexes B to F.

¹⁵ Victorian legislation provides for licences to be issued for in-stream uses and also provides for bulk entitlements to be issued for environmental use. Similarly, in South Australia, licences can be issued with an allocation to be used solely for environmental purposes.

Box 10.2 Monitoring of environmental allocations for the Barmah–Millewa Forest

In 1993, the Murray–Darling Basin Ministerial Council (MDBMC) approved an annual Environmental Water Allocation (EWA) of 100 GL to the Barmah–Millewa Forest, to be provided equally by NSW and Victoria. First use of the EWA did not occur until October 1998.^a

Under the Barmah–Millewa Forests Water Management Strategy, an annual operating plan for the forest must be prepared by the state managing agencies.^b The Barmah–Millewa Forum is responsible for coordinating the plan to ensure consistency with the strategy and state water management plans.^c The plan is also supported by a set of operating rules and triggers which indicate when the EWA can be used.^d

Funding is provided by the Murray–Darling Basin Commission for a number of monitoring programs within the forest. However, there is no statutory requirement for contracted agencies to report annually on monitoring outcomes. Nor is there a statutory requirement to report on the volume of water received by the forest from the release of the EWA. It would appear that some monitoring results are available, but they are not readily accessible to the public. There is also evidence to suggest that prior to October 2001 there had been no monitoring in the forest.

^a The operating rules for managing the Barmah–Millewa Forest requires on average three medium sized long-duration floods every ten years and that there should be no more than five years between these events. This requirement allows each state's annual share of the EWA to be carried over if not used, up to a maximum of 700 GL. ^b The plan outlines the yearly works program, including proposed water operations, research and monitoring, and forest works to be undertaken. ^c The Forum is a formal community and agency partnership established under the Murray–Darling Basin Agreement, to oversee implementation of the Strategy. It has no powers and is an advisory body only. ^d The rules have been approved by the MDBMC and have received broad consensus from the Victorian Murray Water Entitlement Committee and the NSW Murray Lower Darling Community Reference Committee. The rules and triggers cover a three year period and allow for year-to-year flexibility in the operation of the system. The triggers establish the frequency, duration and seasonality of flooding to sustain the forest ecosystem.

Sources: BMF (2002); MDBMC (2001); MDBC (Canberra, pers. comm., 27 May 2003).

Box 10.3 **Monitoring of environmental allocations for the Murray Wetlands and Lower Murray Swamps**

In Victoria, the Division of Parks, Flora and Fauna within the Department of Sustainability and Environment holds the bulk water entitlement for its share of water dedicated to the Barmah–Millewa Forest (50 GL per annum) and the Murray Wetlands (27.6 GL per annum).^a

An annual works program for the Murray wetlands is published each year by the Environmental Water Allocation Committee. The Committee makes recommendations for the distribution of the Murray Wetlands allocation and reviews, among other things, the previous year's use.

The annual works program includes a requirement to develop a simple monitoring program to assist with evaluating environmental flows to a number of wetlands. However, there does not seem to be a consistent or coordinated approach taken to monitoring environmental flows in all water bodies in the Murray wetlands. In those areas where monitoring is undertaken, monitoring results are not publicly reported.

There is also evidence to suggest that there has been limited monitoring of the volume of water received by the Lower Murray Swamps in South Australia.

^a The Murray Wetlands allocation is a defined water right and cannot be carried over in storage. After all ecological requirements have been met, it is possible to temporarily trade the unused portion of the EWA. Funds generated are used to cover the cost of service delivery and for onground works. The Murray Wetlands include the River Murray, Barmah Forest, Gunbower Forest, Kerang Lakes, Hattah Lakes, Cardross Lakes and Lindsay–Walpolla Island system.

Sources: DSE (Victoria, pers.comm., 14 March 2003) and RMCWMB (2001).

In contrast to the Australian jurisdictions, there are organisations dedicated solely to managing environmental allocations in California and Colorado (see chapter 6). For example:

- The California Bay–Delta Authority (CBDA) is responsible for implementing the CALFED Bay–Delta Program (see chapter 6); and
- The Secretary of the Interior (SoI) has delegated responsibility for implementing the provisions of the *Central Valley Project Improvement Act 1992* (CVPIA) to the US Bureau of Reclamation (BoR (US)) and the US Fish and Wildlife Service (see chapter 6).

California has specific state and federal environmental legislation. The objectives of the environmental legislation are made operational through the CALFED Bay–Delta Program and the CVPIA. State legislation and the program set out the requirements to achieve the US Federal Government's objectives. For example, the SoI is required to manage 987 GL of water annually and establish an appropriate accounting method for measuring the release of this water. Water accounting data are available on the SoI's Internet site.

The SoI is also required to provide an annual report to the US Congress no later than 30 September of each calendar year. This report must describe all significant action taken by the SoI pursuant to the CVPIA and progress toward achievement of the intent, purposes and provisions of the CVPIA.

Similarly, the CBDA is required to submit a report to the Governor of California, the SoI, the Californian legislature and the US Congress that describes the status of implementation of all elements of the CALFED Bay–Delta Program. If at the conclusion of each annual review, the Governor or SoI determine that the program’s schedule or objectives have not been adhered to, the Governor and the SoI, in consultation with the CBDA, prepare a revised schedule. The revised schedule ensures that the program’s elements are consistent with the intent of the Californian Bay–Delta Program and applicable regulatory requirements.

In Colorado, the CWCB holds over 1300 environmental in-stream flow (ISF) rights for the benefit of all of the people in the State of Colorado.¹⁶ The monitoring of ISF rights is undertaken in a number of different ways.

- The OSE and the United States Geological Survey (USGS) have hundreds of gauges throughout the state that the CWCB can rely on to monitor whether or not its ISF rights are being met. Many of the gauges have satellite telemetry and, as a result, the flow volumes are available on a day-to-day basis via the USGS and the OSE Internet sites. Consequently, the information is available to the public.
- Where the OSE and USGS gauges are not located on stream segments that the CWCB is attempting to protect, the CWCB’s gauges are used to monitor flows. Alternatively, the CWCB will do field flow measurements if it is alerted that flows look low on a particular stream.

Information on how environmental flows are monitored in Chile, Mexico and South Africa was not available.

Monitoring of inter-jurisdictional arrangements

In 1995, a cap (the Murray–Darling Basin Cap, or ‘the Cap’) was included as a schedule to the Murray–Darling Basin Agreement (1992) to limit diversions and to protect and enhance the riverine environment.

The jurisdictions covered by the Murray–Darling Basin Agreement (NSW, Victoria, Queensland, South Australia and the ACT) are required to monitor and report

¹⁶ An ISF right is a specific volume of water that can be allocated for environmental purposes.

annually to the MDBC on compliance of actual diversions against the Cap's target diversions.¹⁷ The monitoring of these diversions can also be used to indirectly determine whether environmental allocations have been met.

The Independent Audit Group (IAG) appointed by the MDBC is responsible for conducting an annual audit of each state's performance in implementing the Murray–Darling Basin Cap (see box 10.4).

If the results of monitoring reveal that a state's diversions have exceed its Cap, the MDBC has no power to take enforcement action against the non-complying state. The MDBC, as an advisory body, has no power to withhold water. The power to take action rests with the respective state.

If the Cap has been exceeded, the MDBC is required by the *Murray–Darling Basin Agreement* (Schedule F) to declare that the state has exceeded the Cap and report the matter to the next meeting of the MDBMC. The non-complying state is required to report to the MDBMC on the action taken, or proposed to be taken by it, to ensure that cumulative diversions recorded by the MDBC are brought back into balance with the Cap.¹⁸

The Colorado River Basin, which covers seven States (Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming) and parts of Mexico, is governed by a body of law commonly referred to as the Law of the River. Under the Law of the River, the upper and lower basin states have the right to develop and use 7.5 million acre-feet (9250 GL) annually.¹⁹ A further 1.5 million acre-feet (1850 GL) of the Colorado River's annual flow is committed to Mexico.

¹⁷ In 2001–02, a Cap on diversions had not been established for Queensland and the ACT. The Cap on diversions only covers the water resources of each state within the Murray–Darling Basin.

¹⁸ In 2001–02, NSW was the only state to have exceeded their long-term Cap diversion.

¹⁹ The upper basin states include Colorado, New Mexico, Utah and Wyoming. The lower basin states include Arizona, California and Nevada.

Box 10.4 Monitoring and enforcing the Cap on diversions under the Murray–Darling Basin Agreement (1992)

Each state which is party to the *Murray–Darling Basin Agreement* (Schedule F) is required for each water year and in relation to each river valley specified in Schedule 2 within its territory, monitor and report to the Murray–Darling Basin Commission (MDBC) on:

- (a) diversions made;
- (b) water entitlements, announced allocations of water and declarations which permit the use of unregulated flows of water; and
- (c) trading of water entitlements within, to and from the territory of that State in that water year.

In addition, each state which is party to the *Murray–Darling Basin Agreement* (Schedule F) is required for each water year and in relation to each designated river valley within its territory, monitor and report to the MDBC on:

- (a) compliance with each relevant annual diversion target calculated under this Schedule [F] for that water year; and
- (b) such actions which the State proposes to take to ensure that it does not exceed the annual diversion targets calculated under this Schedule [F] for every ensuing water year.

The MDBC is required to produce a water audit report. This report includes information about each state's compliance with the annual diversion target. This target is calculated for each designated river valley in the territory of that state and for the whole of the state in that water-use year. The MDBC may publish any such report, or a summary thereof, in such a manner as it may determine.

The Independent Audit Group (IAG) is required by the MDBC to conduct an annual audit on each state's compliance with the Cap and report annually to the MDBC. This report is publicly available. The IAG may also be required to conduct a special audit of a designated river valley to determine if the Cap diversion in that valley has been exceeded.

Sources: MDBC (2000).

Under the *Colorado River Basin Project Act 1968*, an annual operating plan (AOP) for the Colorado River Basin must be prepared. The AOP includes forecasts of the availability of Colorado River water in the coming calendar year and sets out how the basin's reservoirs will be operated to supply each Lower Basin State and Mexico with its apportionment under the Law of the River.²⁰ The *Upper Colorado River Basin Compact 1948* sets out the distribution of water among the upper basin states.

²⁰ Apportionment refers to the distribution of available water.

The AOP must conform to a number of legislative requirements, including those established in environmental legislation, such as the *Endangered Species Act 1969*, that govern dam releases for the preservation of aquatic resources.

Three organisations have the power to monitor and enforce the Law of the River (see box 10.5).

- The Upper Colorado River Commission (UCRC) oversees the use of the overall apportionment given to each of the upper basin states. However, each upper basin state acts as the watermaster, that is, they assign rights to the water apportioned to them, and administer the delivery of water pursuant to those rights.
- The SoI performs more of the functions of a watermaster in the lower basin states.²¹ The SoI also has responsibility for coordinating the reporting of annual consumptive uses and losses of water from the Colorado River system, for each state every five years.
- The International Boundary and Water Commission (IBWC) was established, among other things, to monitor and ensure compliance with the *US–Mexico Water Treaty 1944*.

Unlike the MDBC, the UCRC has the power under Article IV of the *Upper Colorado River Basin Compact 1948* to curtail the use of water by the upper basin states to maintain flows to the lower basin states and Mexico. In the event of curtailment, if any state, has in the ten years immediately preceding the water year in which curtailment is necessary, consumed more than their apportionment, the non-complying state must supply a volume of water equal to its overdraft.

Since the enactment of the *Colorado River Compact 1922*, there has not been any need for enforcement action because the upper basin states have not used their full allocation (UCRC, Utah, pers. comm., 7 March 2003).

If and when payback policies are enacted, the SoI will have the power to request contractors and individual diverters to payback the volume of water that they have taken in excess of their right.

²¹ Under the *Boulder Canyon Project Act 1928*, no one in the Lower Basin is allowed to use Colorado River water without a contract with the SoI.

Box 10.5 Monitoring and enforcing the use of Colorado River water under the 'Law of the River'

The Upper Colorado River Commission

The Upper Colorado River Commission (UCRC) is required under Article VIII of the *Upper Colorado River Basin Compact 1948* to:

- monitor and report on stream flows, storage, diversions and use of the waters of the Colorado River and its tributaries;
- monitor the volume of water delivered to the upper basin states each year;
- report on incidences of serious drought or accidents that may prevent the US Federal Government from fulfilling its obligations to Mexico; and
- provide an annual report to the Governors of the signatory states and the President of the United States, on financial and operational activities of the UCRC for the preceding water year. This report is publicly available.

The Secretary of the Interior

As the watermaster for the lower basin states, the Secretary of the Interior monitors the consumptive use of water by contractors (distributors of water) to ensure annual diversion limits are not exceeded.

Although there are no specific penalties imposed if one of the lower basin states uses more water than its apportionment at this time, the Bureau of Reclamation is investigating an inadvertent overrun and payback policy for contractors and individual diverters.

Under such a policy, a contractor who inadvertently diverts, pumps or receives water in excess of their allocation for that year would be required to have a payback plan. Similarly, if individual diverters exceed their annual allocation they would be required to reduce their diversions below their annual allocation in a subsequent year, or over a limited number of subsequent years. The volume to be paid back is equal to the volume by which they had previously exceeded their allocation (US Bureau of Reclamation, Nevada, pers. comm., 21 March 2003).

The Sol is required by Article V of the Decree of the Supreme Court of the United States in *Arizona v. California* Dated March 9, 1964 to provide detailed and accurate records of diversions, return flows and consumptive use of water diverted from the mainstream of the Colorado River. The data must be stated separately for each diverter, each point of diversion and for each of the States of Arizona, California and Nevada. The Sol is also required to provide details on volume of water delivered to Mexico under the *US–Mexico Water Treaty 1944*.

These records are published annually in the Decree Accounting Report.

(continued next page)

Box 10.5 (continued)

The Secretary of the Interior (cont.)

In addition, the Sol is directed by s. 601 of the *Colorado River Basin Project Act 1968*, Public Law 90-537 to:

Publish a report on annual consumptive uses and losses of water from the Colorado River system after each successive 5-year period, beginning with the 5-year period starting 1 October 1970. The report is required to include a breakdown of the beneficial consumptive use of water by major types of use, by major tributary streams, and, where possible, by individual states. The report is to be prepared in consultation with the States of the Lower Basin individually and with the UCRC and must be transmitted to the President, the Congress and to the Governors of each state signatory to the *Colorado River Compact 1922*.

The International Boundary and Water Commission

The US and Mexico, through the International Boundary and Water Commission (IBWC), jointly administer the terms of the *US–Mexico Water Treaty 1944*. The IBWC is required to monitor and ensure compliance with the Treaty allotment and schedules.

Each country's Section of the IBWC is required to construct, operate and maintain all necessary gauging stations and other measuring devices for the purposes of keeping a complete record of the waters delivered to Mexico and of the flows of the Colorado River downstream of the Imperial Dam in the United States.

For this purpose, there are six gauging stations operated by the IBWC on the Colorado River. The US Section of the IBWC operates and maintains five other stations for Treaty purposes. The Operations and Maintenance Division of the Operations Department of the US Section of the IBWC collects the hydrological data from the river gauging stations on the US side. The results are fed through to the Water Accounting Division of the Operations Department.

The field data collected are jointly compiled and reviewed by the IBWC. Records of the flows of the Colorado River reaching Mexican points of diversion are published annually in IBWC bulletins entitled, 'Colorado River and other Western Boundary Streams', in English and Spanish. Copies are available from the United States Section of IBWC in El Paso, Texas.

The US has always met its water delivery obligations under the Treaty. The Treaty does not specify what recourse there would be if the US failed to deliver the water apportioned to the Republic of Mexico.

Sources: IBWC (pers. comm., 15 March 2003).

10.3 Enforcement procedures

In the Australian and overseas jurisdictions studied, powers to take immediate action on discovering breaches are set out in legislation. Activities that constitute a breach, the sanctions that can be applied, and appeal mechanisms are also specified.

Enforcement agency procedures are not prescribed in the legislation of the jurisdictions studied. Matters such as how frequently they should monitor for compliance are left to the discretion of the agencies to determine.

The methods used to enforce a water right should be effective and efficient, otherwise the community will not receive value for the money spent on the activity. An effective enforcement strategy also ensures that right-holders comply with conditions of the right.

For the enforcement agency to be accountable for fulfilling its role, it has to be adequately resourced. An enforcement agency will also be more effective if it has the appropriate skills to interact with, and communicate the importance of regulatory compliance to, the right-holder.

The type of enforcement strategy employed can be assessed against certain characteristics. These include the flexibility to adopt a graduated response to non-compliance, a consistent approach to enforcement, effective sanctions, cost effective strategies and an effective appeals mechanism.

Flexibility

Flexibility is a desirable characteristic because it provides scope to alter an enforcement agency's approach as circumstances arise.

Some enforcement agencies in the jurisdictions studied have the flexibility to adopt a graduated response to the seriousness of the offence (see tables 10A.6 and 10A.7).

Enforcement agencies in NSW and the ACT tend to issue a warning in writing to those who may have unintentionally or intentionally breached the Act, regulations or licence conditions. If the breach is not remedied, stronger sanctions such as financial penalties can be applied. In NSW, the DIPNR has the flexibility to issue on-the-spot fines without referring the matter to the court.

The ability to scale the enforcement action to the seriousness of the offence is particularly appropriate in circumstances where farming may be subsistence-based and financial penalties can cause severe hardship. For example, in Mexico, the

National Water Commission assesses penalties with regard to the type and severity of the offence but also considers the offender's financial circumstances.

In South Africa, the DWAF's enforcement procedures are focussed on cooperation rather than deterrent based strategies. DWAF prefers water users to comply with conditions of use which have been determined and mutually agreed to by users and DWAF. Under these circumstances, it is considered that it will only be necessary to resort to enforcement by deterrent based strategies in exceptional cases.

Consistency

A consistent approach to enforcement can be difficult to achieve when an enforcement agency has the flexibility to adopt a graduated response to non-compliance.

Consistently applied enforcement procedures ensure that they do not discriminate between different right-holders in terms of penalties imposed or inspection procedures applied. Differential treatment may also weaken a right-holder's resolve to cooperate with an enforcement agency, if they believe they are being treated unfairly.

As already noted, in most of the jurisdictions studied, there are no published compliance strategies or records of enforcement action. This makes it difficult to determine if a consistent enforcement approach is applied to all right-holders.

Effective sanction mechanisms

It is important that sanctions provide an effective disincentive to non-compliance to protect the value of the water right. If water is taken without a licence or in excess of an allocation, there is less water available for other right-holders and the value of their right will be reduced.

Sanctions, such as fines or the threat of criminal prosecution, can act as a deterrent by imposing an expected cost upon a right-holder before a breach of a water right condition has occurred or been detected.

Most of the Australian and overseas jurisdictions studied have the ability to impose a penalty or revoke a licence. In some jurisdictions, for example, Victoria, South Africa and Colorado, imprisonment is also an option.

In California and Colorado, there appears to be greater reliance on the courts to adjudicate disputes and breaches of water right conditions (see tables 10A.6 and 10A.7).

An alternative to financial sanctions is for the identity of the person who has breached a condition of the right to be reported in local newspapers. Where right-holders are concerned about a loss of reputation, adverse publicity can often be as effective a deterrent as traditional sanctions. In the Goulburn–Murray region of Victoria, local newspapers in some cases report the identity of those prosecuted (Goulburn–Murray Water, Victoria, pers. comm., 16 May 2003).

The effectiveness of sanctions to act as a deterrent in most jurisdictions is unknown because there is limited reporting of compliance outcomes.

Cost effectiveness

The enforcement of water rights can be costly and resource intensive. A cost effective enforcement strategy requires that the benefits of achieving compliance outweigh the cost of enforcement. To this end, the enforcement strategy should accommodate sufficient flexibility to avoid penalties for minor violations if the cost involved in detection and prosecution outweighs the benefits that compliance may have brought.

Designing a cost effective enforcement strategy involves trade-offs. An approach where all offences are referred to a court may have a substantial deterrent effect but be very costly to apply. A graduated approach, including warnings or an on-the-spot fine for minor offences and reserving court action for major offences may have a lower deterrent effect but be less costly to apply.

Although limited data are available on how sanctions are being exercised, some of the jurisdictions studied have the option of issuing a written warning to encourage compliance prior to imposing a fine or taking action to prosecute through the courts (see tables 10A.6 and 10A.7).

In other jurisdictions, such as California, over-extraction of groundwater is allowable within a set tolerance level, on the premise that the over-extraction will be off-set against annual allocation during the following financial year. In the Goulburn–Murray region of Victoria, a right-holder must arrange for overuse of an annual allocation by one Megalitre or more, to be covered by an appropriate temporary transfer during that season (GMW 2001).

In Victoria, South Australia and Queensland, all offences must be heard and determined by a court.²² This limits the enforcement agency's ability to issue on-the-spot fines for minor offences and can be resource intensive, time consuming and reduce cost effectiveness. Although this approach may be more costly, it is likely to result in greater consistency and possibly reduce the number of appeals.

Data on the specific costs of enforcement are generally not reported in the Australian and overseas jurisdictions studied, because enforcement activity is subsumed within an agency which has multiple responsibilities. However, it appears that the resources allocated to this activity are relatively small. For example, the SWRCB has six people who conduct compliance inspections and follow up activities for the State of California. Similarly, four people ensure compliance with water right conditions in South Australia.

Adequate resourcing is essential to efficiently manage the risk of water theft that can undermine the value of the right. Water theft has the potential to increase the costs to those who have to purchase water if it is already in short supply. Higher prices for water could increase the risk of further theft if monitoring and enforcement is not increased.

Effective appeals mechanism

An effective appeals mechanism allows a right-holder to challenge the decisions of an enforcement agency and determine if enforcement action is fair and appropriate through courts or tribunals. The fact that there is an avenue for appeal imposes a discipline on the enforcement agency to adhere to procedures that are set out in legislation. This ensures that an enforcement agency can be held accountable for its actions.

In most of the jurisdictions studied, legislation allows a right-holder to appeal the decisions of an enforcement agency if imposed sanctions are considered harsh or unreasonable. Appeals may be heard by a court or tribunal (see tables 10A.10 and 10A.11).

²² Under recent amendments to the Queensland *Water Act 2000*, an infringement notice may be issued for taking water in excess of the authorised allocation (s. 812A) (NR&M, Queensland, pers. comm., 5 June 2003). Previously, the only option available to NR&M was to prosecute those who breached their water right conditions.

10.4 In summary

Monitoring and enforcement of rights protects right-holders' interests. However, monitoring is not costless. Strategies have to be devised to maximise the net benefits of detection and deterrence. Generally, monitoring and enforcement should only proceed to the extent that the benefits of these activities exceeds their costs.

South Australia, Queensland and California rely on right-holders to self-monitor surface and groundwater diversions, and report on water use to their respective enforcement agencies (where metering devices are installed). Periodic random audits may be undertaken by the enforcement agency to protect rights from encroachment from water theft by right-holders and others.

Random audits are undertaken by agencies in California, NSW and South Australia. In the absence of a metering device, some enforcement agencies in Australia conduct aerial surveys to determine if the area under crop complies with licences based on area irrigated.

In Colorado, the enforcement agency employs water commissioners to undertake onground monitoring of surface and groundwater diversions. However, self-reporting of groundwater use occurs in some areas of Colorado.

The monitoring of inter-jurisdictional arrangements in the Murray–Darling Basin and in the Colorado River Basin are quite different. In the Murray–Darling Basin, each state is required to monitor and report annually to the MDBC on compliance of actual diversions against target diversions. This is supported by an annual audit conducted by the IAG, the results of which are reported annually by the MDBC.

In the Colorado River Basin, there are three organisations responsible for monitoring Colorado River diversions:

- The SoI, through the Bureau of Reclamation, is the principal agency responsible for monitoring the river flow and the appropriation, consumption and use of water in the Colorado River Basin. The SoI is also responsible for reporting on the volume of water delivered to Mexico and consumptive use in each of the upper and lower basin states. The SoI also acts as the watermaster for the lower basin states (all water users in Arizona, California and New Mexico are required to have a contract with the SoI to use Colorado River Water).
- In the upper basin states, the UCRC oversees the use and monitors the apportionment given to each state, but it does not act as a watermaster. The states act as watermasters and are responsible for administering water rights.
- The IBWC monitors the volume of water delivered to Mexico.

The enforcement of inter-jurisdictional arrangements in Murray–Darling Basin and the Colorado River Basin are also different. In the Murray–Darling Basin, the MDBC does not have the power to withhold water from a state that does not adhere to the Cap. The non-complying state decides on what action it will take to bring their diversions into balance with target diversions.

In the Colorado River Basin, the UCRC has the power to withhold water from a non-complying state (although this power has never been enforced). In the lower basin states, the SoI is investigating a payback policy that will be imposed on water users should they take water in excess of their water right.

Enforcement is undertaken by agencies which have multiple responsibilities including policy development, administration of water rights and water distribution. A conflict of interest can arise if an agency distributes water and monitors compliance with a bulk entitlement, a resource plan or acquisition program (see chapter 4). In particular, enforcement effort may be compromised and appropriate sanctions may not be applied.

Enforcement agencies in the Australian and overseas jurisdictions studied are not publicly accountable for their activities, because it is not transparent how they undertake their responsibilities. Compliance outcomes are rarely reported, limiting the ability of the public to scrutinise enforcement processes and outcomes.

The absence of reporting makes it difficult to determine the extent to which monitoring and enforcement is effective and efficient in the Australian and overseas jurisdictions studied because:

- there is no evidence to confirm if a consistent enforcement approach is applied to all right-holders;
- limited reporting of compliance outcomes prevents an assessment of whether enforcement effort and sanctions are acting as a deterrent; and
- the cost of enforcement is not reported.

Except in Victoria and South Australia, enforcement agencies have access to a range of sanctions and have the flexibility to tailor the sanction to the seriousness of the offence. This is in accordance with good practice.

In California and Colorado, it appears that there is greater reliance on the courts to adjudicate disputes and breaches of water right conditions. This approach has the potential to be expensive, time consuming and resource intensive.

Right-holders in all jurisdictions have the right to appeal decisions handed down by the enforcement agency. This allows right-holders and the public to assess whether enforcement is fair and sanctions are appropriate.

Where water is committed for environmental purposes, monitoring provides a basis for ensuring whether minimum flow requirements or specific volumetric allocations are met. In most of the Australian jurisdictions studied, there is limited reporting of monitoring results. Consequently, the public cannot readily determine whether environmental flow requirements or specific environmental allocations have been met and that the environment is being protected.

There is evidence to suggest that in some of the Australian jurisdictions studied, the commitment of water for environmental purposes would appear to be discretionary during times of water shortages.

In contrast to the Australian jurisdictions, there are agencies in California and Colorado dedicated solely to manage water allocated for environmental purposes. In these jurisdictions, environmental allocations are usually held as private water rights in perpetuity and cannot be removed or modified. These rights are protected by statutory ‘no injury’ provisions which provide a greater incentive to enforce the right against encroachment. Further, the organisations dedicated to managing environmental allocations are accountable and transparent as they are required by law to report regularly on the volume of water delivered for environmental purposes.

Attachment 10A

Table 10A.1 Roles and responsibilities — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Organisation</i>	<i>Responsibilities</i>
NSW	Department of Infrastructure, Planning and Natural Resources	Monitor, investigate and impose sanctions to ensure compliance with the <i>Water Management Act 2000</i> , statutory Water Sharing Plans and licence conditions.
Victoria	Resource manager ^a	Monitor, investigate and impose sanctions to ensure water authorities (including rural, regional and urban), and Department of Sustainability and Environment comply with their bulk water entitlements.
	Rural water authorities	Monitor, investigate and impose sanctions to ensure individuals comply with their water rights or licences.
Queensland	Department of Natural Resources and Mines ^b	Monitor and impose sanctions to ensure right-holders comply with the <i>Water Act 2000</i> and water allocation or licence conditions.
South Australia	Department of Water, Land and Biodiversity Conservation	Monitor, investigate and impose sanctions to ensure compliance with <i>Water Resources Act 1997</i> and licence conditions.
ACT	Environment Protection Authority	Monitor, investigate and impose sanctions to ensure compliance with <i>Water Resources Act 1998</i> .

^a A resource manager is a person appointed by the Minister for Water under s. 43A of the *Water Act 1989* to enforce bulk water entitlements. The resource manager is not necessarily an independent entity. ^b In regulated systems, resource operations licence holders distribute water to water allocation holders, and monitor their diversions in order to ensure that they comply with their supply contracts.

Sources: Annexes B to F.

Table 10A.2 Roles and responsibilities — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Organisation</i>	<i>Responsibilities</i>
California	State Water Resources Control Board	Enforce the terms and conditions of existing permits and licences to appropriate surface water, prevent the unlawful diversion of water, ensure water is put to reasonable and beneficial use, and protect the public's right to use the state's water for in-stream purposes such as recreation, navigation, fish and wildlife.
	Watermaster, Department of Water Resources ^a	Monitor and enforce groundwater rights that have been determined by adjudications.
	California Bay–Delta Authority	Monitor and assess the progress of the CALFED Bay–Delta Program.
	Secretary of the Interior (US Bureau of Reclamation and US Fish and Wildlife Service)	Monitor and assess the implementation of the <i>Central Valley Project Improvement Act 1992</i> .
Colorado	Office of State Engineer (Division of Water Resources, Department of Natural Resources)	Monitor and enforce well permits and water rights, diversions and extractions, and dam construction and safety.
	Colorado Water Conservation Board (Department of Natural Resources)	Monitor flow conditions to ensure appropriated flows are being met and administered within the state's prior appropriation system.
Chile	Directorate General of Water	Information not obtained.
	Water User Associations ^b	Information not obtained.
Mexico	National Water Commission	Monitor water abstractions and enforce compliance with <i>National Water Law 1992</i> .
South Africa	Department of Water Affairs and Forestry	Enforce conditions of use attached to permitted water uses specified in general authorisations and licences.

^a In California, most groundwater use is unregulated. However, groundwater users can ask the court to adjudicate to define groundwater rights to protect the water supply from deterioration. Through adjudications, the courts can assign specific water rights to users and can compel the cooperation of pumpers who might otherwise refuse to limit their pumping. Watermasters are assigned to ensure that pumping conforms to the limits defined by adjudication (WEF (California) 1998). ^b In Chile, the water user associations are owned and operated by their members. Members may include irrigators, mining companies and water supply companies.

Sources: Annexes H to L.

Table 10A.3 Roles and responsibilities — Murray–Darling and Colorado River Basins, 2003

<i>Inter-jurisdictional area</i>	<i>Organisation</i>	<i>Responsibilities</i>
Murray–Darling Basin	Murray–Darling Basin Commission	Record each state's annual diversion from the Basin. Appoint an independent audit group to audit performance of each state in implementing the long-term diversion Cap. Publish an annual water audit monitoring report on each state's compliance with Cap target diversions.
Colorado River Basin	Upper Colorado River Commission	Monitor the volume of water delivered to upper basin states.
	Secretary of the Interior (Bureau of Reclamation)	Determine the volume of water available for consumptive use in the lower Colorado River Basin and monitor diversions, return flows, consumptive use from Colorado River for each Lower Basin State. Act as watermaster for the lower basin states. Report on volume of water delivered to Mexico and consumptive use in each of the upper and lower basin states.
	International Boundary and Water Commission	Monitor the volume of water delivered to Mexico to ensure compliance with <i>the US–Mexico Water Treaty of 1944</i> .

Sources: Annexes A and G.

Table 10A.4 Accountability and reporting requirements — Australian jurisdictions, 2003

<i>Organisation, by jurisdiction</i>	<i>Accountabilities</i>	<i>Reporting requirements</i>
NSW		
Department of Infrastructure, Planning and Natural Resources	Minister for Natural Resources	No overt statutory requirement to publicly report breaches of the Act or licence conditions. However, the reporting requirements of a Water Sharing Plan would require such a report. The form this report would take is yet to be determined. No requirement in Water Sharing Plans for a licensee to report on compliance. Requirement may arise with publication of the compliance strategy.
Victoria		
Resource managers	Minister for Water	The resource manager is required by the Bulk Entitlement Order to prepare basin water accounts to show water authorities' compliance with their bulk entitlements.
Rural water authorities (RWAs)		RWAs are required by the Bulk Entitlement Order to report annually to the Minister on compliance with the bulk entitlement and publish any breach in their Annual Report unless otherwise agreed by the Minister. There is no statutory requirement for RWAs to publicly report breaches of individual right-holders.
Queensland		
Department of Natural Resources and Mines (NR&M)	Minister for Natural Resources	No statutory requirement to publicly report breaches of the Act or licence conditions. NR&M is developing a case management system to record all information about compliance issues including notification, awareness of an issue and action taken. Statistical summaries and reports are expected to be publicly available by the end of 2003.
South Australia		
Department of Water, Land and Biodiversity Conservation (DWLBC)	Minister for Environment and Conservation	The DWLBC is required to prepare an annual report but there is no statutory requirement to publicly report breaches of the Act or licence conditions. However, the DWLBC does report the number of incidents logged during each financial year. A number of Water Allocation Plans require each licensee to prepare an irrigation annual report for the Minister. This report allows for the assessment of compliance with licence conditions but is not publicly available.
ACT		
Environment Protection Authority	Minister for the Environment	No statutory requirement to publicly report breaches of the Act or licence conditions.

Sources: Annexes B to F.

Table 10A.5 Accountability and reporting requirements — overseas jurisdictions, 2003

<i>Organisation, by jurisdiction</i>	<i>Accountabilities</i>	<i>Reporting requirements</i>
California		
State Water Resources Control Board	Governor of California	No statutory requirement to publicly report breaches of water right conditions.
Department of Water Resources	Court	Statutory requirement to publicly report breaches of water right conditions.
Colorado		
Department of Natural Resources	Governor of Colorado	No statutory requirements to publicly report breaches of water right conditions.
Chile		
Directorate General of Water	Minister of Public Works	Information not obtained.
Mexico		
National Water Commission	Secretariat of Environment and Natural Resources	The Secretariat is required to report annually to the President of Mexico. However, it is unclear if breaches of <i>National Water Law 1992</i> and concession conditions are publicly reported.
South Africa		
Department of Water Affairs and Forestry (DWAF)	Minister of Water Affairs and Forestry	No statutory requirement to publicly report breaches of authorisations and licences. DWAF is required by legislation to prepare an annual report on its operations. The Minister has discretion on the content of the report but it does not include the reporting of compliance outcomes.

Sources: Annexes H to L.

Table 10A.6 Enforcement procedures — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Available sanctions</i>	<i>Enforcement record</i>
NSW	<p>The Department of Infrastructure, Planning and Natural Resources may:</p> <ul style="list-style-type: none"> • Issue an on-the-spot fine. • Refer the matter to the court. The court may impose a penalty for a minor offence ranging from 20 to 200 penalty units. For a major offence a corporation can be liable for up to 2500 penalty units, and up to 1200 penalty units for each day the offence continues. An individual can be liable for 1200 penalty units, and up to 600 penalty units for each day the offence continues.^a <p>The Minister may :</p> <ul style="list-style-type: none"> • Suspend or cancel an access licence if the holder has failed to comply with the licence conditions. 	None at the moment but this could change when compliance strategy is developed.
Victoria	<p>If a licensed right-holder fails to comply with the conditions of their right, or a water right-holder takes water without the consent of a rural water authority (RWA), a RWA may:</p> <ul style="list-style-type: none"> • Refer the matter to the court. The court may impose a penalty of 20 penalty units or 3 months imprisonment for a first offence. For a subsequent offence, the court may impose 40 penalty units or 6 months imprisonment.^b <p>The Minister or RWA (exercising power delegated by the Minister) may:</p> <ul style="list-style-type: none"> • Revoke a licence if the holder has failed to comply with any condition of the licence. <p>There are no provisions in the <i>Water Act 1989</i> for sanctions to be imposed on authorities, other than power companies, for non-compliance with a Bulk Entitlement Order (s. 47A).</p>	None

(Continued next page)

Table 10A.6 (continued)

<i>Jurisdiction</i>	<i>Available sanctions</i>	<i>Enforcement record</i>
Queensland	<p>The Department of Natural Resources and Mines may:</p> <ul style="list-style-type: none"> • Refer the matter to the court. The court may issue a penalty notice. Maximum penalty is 1665 penalty units if the holder has not complied with the conditions of the licence (s. 812).^c • Forfeit a water allocation (s. 138) or cancel a water licence (s. 227). • Issue an infringement notice, which includes a demit point against a licence and a fine based on the volume of water taken in excess of that authorised (s. 812A). 	None
South Australia	<p>The Department of Water, Land and Biodiversity Conservation may:</p> <ul style="list-style-type: none"> • Refer the matter to the court. The court may issue a penalty notice. The penalty for most offences is \$5000 for individuals and \$10 000 for a body corporate. <p>The Minister may:</p> <ul style="list-style-type: none"> • Cancel a licence if the holder contravenes or fails to comply with its conditions or takes water in excess of the specified allocation. 	<p>The DWLBC reports the number of incidents logged in their annual report to the Minister. No details are provided on percentage of breaches, number of licences cancelled or number of penalty notices issue.</p>
ACT	<p>The Environment Protection Authority may:</p> <ul style="list-style-type: none"> • Issue a notice or written warning for a minor offence such as failing to take a monthly meter reading. • Refer the matter to the court. The court may issue a penalty notice for a major offence such as taking water without a licence or breaching a licence condition. The penalty is 50 penalty units for an individual and 250 penalty units for a body corporate.^d • Cancel a licence to take water if grounds exist on which the authority may refuse to grant a licence. 	None

^a Under the *NSW Crimes (Sentencing Procedure) Act 1999*, s. 17, one penalty unit equals \$110. ^b Under the *Victorian Sentencing Act 1991*, s. 110, one penalty unit equals \$100. ^c Under the *Queensland Penalties and Sentences Act 1992*, s. 5, one penalty unit equals \$75. ^d Under the *Water Resources Act 1989*, one penalty unit for an individual equals \$100 and one penalty unit for a body corporate equals \$500.

Sources: Annexes B to F.

Table 10A.7 Enforcement procedures — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Available sanctions</i>	<i>Enforcement record</i>
California	<p>The State Water Resources Control Board may:</p> <ul style="list-style-type: none"> • Notify licensee of the breach. • Encourage compliance by requiring change petitions or additional water right filings. • Issue an Administrative Liability Complaint for up to US\$500 per day. • Issue a cease and desist order, which may result in a penalty of up to US\$1000 per day if a licensee fails to observe a final cease and desist order. • Revoke a licence if it finds the licensee has failed to observe any of the terms and conditions of the licence. In particular, the use-it or lose-it conditions. <p>The Watermaster may:</p> <ul style="list-style-type: none"> • Impose a fine of not less than US\$25 but no more than US\$250, or seek imprisonment in the county jail for not less than 10 days but not more than 6 months, or impose a fine and imprisonment, if it finds that a person has tampered with the headgate, waterbox or measuring device or takes water denied her/him by the Watermaster. • Arrest any person violating water right conditions and make a complaint before a magistrate. 	<p>Planning to post all enforcement actions on the Internet. Monitoring results are public record, but an individual needs to request those results or come into the SWRCB to view them.</p> <p>Required to report on activities but limited information on enforcement action.</p>
Colorado	<p>The Office of State Engineer (OSE) may:</p> <ul style="list-style-type: none"> • Order or direct, for example, the release from storage of water illegally stored, discontinue out-of-priority diversions, and require valves of flowing wells to be capped. • Seek restraining orders or injunctions through the water courts. • Issue a penalty notice. Right-holders can be fined up to US\$500 for each day the offence continues. • Take action through the water courts which may result in imprisonment (imprisonment for all intents and purposes never happens). <p>The Colorado Water Conservation Board (CWCB) protects existing in-stream flows water rights by:</p> <ul style="list-style-type: none"> • Filing Statements of Opposition with the water courts if there is potential for injury from new water right applicants. • Review water court decrees that include protective terms and conditions for in-stream flow rights and determine if those water users are in compliance with their decrees. • Contact the OSE to request that in-stream rights be administered within the priority system. The OSE is the agency responsible for enforcing the CWCB's decrees and can take any action outlined above to bring the offender into compliance. 	<p>None</p> <p>A summary of actions taken to protect in-stream flow water rights is provided on the Internet.</p>

(Continued next page)

Table 10A.7 (continued)

<i>Jurisdiction</i>	<i>Available sanctions</i>	<i>Enforcement record</i>
Chile	Information not obtained	Information not obtained
Mexico	<p>The National Water Commission may:</p> <ul style="list-style-type: none"> • Suspend a concession, if holder fails to comply with the terms of the concession. • Impose a fine having regard to the geographic area where the offence occurred, the type and severity of the offence and whether it was a repeat offence. The fine can range from 50 to 10 000 times the minimum daily wage. • Order the partial or total, temporary or permanent closure of wells, works or intakes. 	Unclear
South Africa	<p>The Department of Water Affairs and Forestry may:</p> <ul style="list-style-type: none"> • Issue a notice of contravention. A right-holder has at least 2 days to rectify the contravention. • Suspend or withdraw the right to use water. • Prosecute, which may result in a fine or imprisonment. 	None

Sources: Annexes H to L.

Table 10A.8 Industry consultation — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description of consultation policy</i>
NSW	Proposed that compliance strategy will provide for a community education program so that water users and the community understand their responsibilities and rights.
Victoria	Rural water authorities usually disseminate information through newsletters and media releases and are required to closely consult with their customers through water service committees.
Queensland	The Department of Natural Resources and Mines (NR&M) conducts information sessions with water users in various water supply schemes around Queensland. NR&M also produces brochures, factsheets and bulletins on various issues as they become relevant.
South Australia	The Department of Water, Land and Biodiversity Conservation (DWLBC) consults with licensed water users if changes to legislation are likely to impact on compliance issues. The DWLBC also presents information sessions on enforcement policy and procedures to catchment water management boards, water resources planning committees and community groups.
ACT	The Environment Protection Authority consults with ACTEW on a regular basis. Information relating to the implementation of the <i>Water Resources Act 1998</i> is disseminated in fact sheets and by the Internet.

Sources: Annexes B to F.

Table 10A.9 Industry consultation — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Description of consultation policy</i>
California	The State Water Resources Control Board does not consult directly with right-holders on enforcement policy and procedures. This information is disseminated in the water rights application package.
Colorado	Water commissioners spend considerable time educating new right-holders mostly by telephone. A quarterly newsletter is disseminated to all right-holders and the 'Guide to Colorado Well Permits, Water Rights and Water Administration' is used as an educational tool.
Chile	Information not obtained.
Mexico	Unclear
South Africa	A compliance strategy is being developed. Unclear if it will include a requirement to undertake community education programs.

Sources: Annexes H to L.

Table 10A.10 Review, appeal and arbitration — Australian jurisdictions, 2003

<i>Jurisdiction</i>	<i>Rights to review, appeal or arbitration</i>	<i>Constraints on the ability to appeal</i>
NSW	Licensees may appeal to the Land and Environment Court against a decision by the Minister to suspend or cancel an access licence because the licence holder has failed to comply with the conditions to which the licence is subject.	Emergencies. Failure to participate in mediation or neutral evaluation proceedings. An appeal may not be made more than 28 days after the date on which the decision was made.
Victoria	Under s. 64 of the <i>Water Act 1989</i> a person may apply to the Victorian Civil and Administrative Tribunal for a review of a decision by the Minister to revoke a licence for failure to comply with any condition to which the licence is subject.	None
Queensland	Under s. 877 of the <i>Water Act 2000</i> a right-holder may appeal the forfeiture of a water allocation or the cancellation of a water licence. In the first instance, the appeal must be internally reviewed. Thereafter it can be referred to the Land Court.	A right-holder can only appeal a decision if that person has been issued with an information or compliance notice by the Department of Natural Resources and Mines.
South Australia	Licensees may appeal to the Environment, Resources and Development Court against a decision to cancel, vary or suspend a licence because a breach of a condition was harsh or unreasonable.	A licensee cannot appeal against a decision by the Minister to reduce water allocations to prevent further reduction in water quality or damage to an ecosystem.
ACT	Licensees may appeal to the Administrative Appeals Tribunal for a review of a decision made by the Environment Protection Authority to cancel a licence.	None

Sources: Annexes B to F.

Table 10A.11 Review, appeal and arbitration — overseas jurisdictions, 2003

<i>Jurisdiction</i>	<i>Rights to review, appeal or arbitration</i>	<i>Constraints on the ability to appeal</i>
California	If a party does not agree with a decision of the State Water Resources Control Board, they may file a lawsuit against the SWRCB. Aggrieved parties may continue to appeal the decision of a court to an appellate court.	Information not obtained.
Colorado	Any party (including third parties affected by the right-holders alleged behaviour) adversely affected or aggrieved by any decision or act of the State Engineer, may appeal to the district court or water court depending on the issue. An appeal of a water court decision goes directly to the Colorado Supreme Court.	The Supreme Court may not necessarily accept an appeal if it appears to be an issue of fact and not law.
Chile	Information not obtained.	Information not obtained.
Mexico	A concession holder is given the opportunity to be heard at an administrative hearing if a concession is revoked or terminated because of failure to comply with the terms of the concession.	The concession holder must appeal within 15 days after the date of notification of the sanction.
South Africa	A person entitled to use water or the licensee may appeal to the Water Tribunal against a decision to suspend or withdraw a right to use water. If a person or licensee is not satisfied with the Tribunal's decision, they may, on a question of law, appeal against the decision to the High Court.	Information not obtained.

Sources: Annexes H to L.

A Participants

The Commission had contact with a number of organisations and individuals during the course of the study (listed below).

Following the release of the draft report the Commission invited comments on its factual content, scope and the presentation of information.

As part of its consultation process, a workshop was held on Thursday 24 July 2003, to provide a forum for discussion of the study, the presentation of results and their interpretation.

- ACT Environment Protection Authority
- Australian Bureau of Agriculture and Resource Economics
- Australian Conservation Foundation
- Agriculture, Fisheries and Forestry Australia
- Bureau of Reclamation, Lower Colorado River Basin (United States)
- Bureau of Reclamation, Upper Colorado River Commission (United States)
- Central Irrigation Trust (South Australia)
- Colorado River Water Conservation District (Colorado)
- Comisión Nacional del Agua (Mexico)
- Commonwealth Department of Transport and Regional Services
- Commonwealth Department of the Environment and Heritage
- Cotton Australia
- CSIRO Land and Water
- Department of Prime Minister and Cabinet

-
- Department of Infrastructure, Planning and Natural Resources (NSW)
 - Department of Sustainability and Environment (Victoria)
 - Department of Natural Resources & Mines (Queensland)
 - Department of Water Affairs and Forestry (South Africa)
 - Department of Water, Land and Biodiversity Conservation (South Australia)
 - Dirección General de Aguas (Chile)
 - Division of Water Resources (Office of the State Engineer, Colorado)
 - Economic Commission for Latin America and the Caribbean (United Nations)
 - Fitzroy Barrage Irrigators (Queensland)
 - Fitzroy Food and Fibre (Queensland)
 - Goulburn–Broken Catchment Management Authority (Victoria)
 - Goulburn–Murray Water (Victoria)
 - International Boundary and Water Commission (United States and Mexico)
 - Mallee Catchment Management Authority (Victoria)
 - Melbourne Water
 - Murray–Darling Basin Commission
 - Murray Irrigation Ltd
 - National Competition Council
 - National Farmers’ Federation
 - NSW Environmental Protection Authority
 - NSW Farmers’ Association
 - NSW Irrigators’ Council
 - Queensland Farmers’ Federation
 - River Murray Catchment Water Management Board (South Australia)

-
- State Water Resources Control Board (California)
 - Sunraysia Rural Water Authority (Victoria)
 - SunWater (Queensland)
 - University of Melbourne, The
 - Victorian Department of Premier and Cabinet
 - Victorian Department of Treasury and Finance
 - Victorian Farmers' Federation
 - Colorado Water Conservation Board
 - Water Services Association of Australia

Glossary

Acquisition program	Programs primarily concerned with setting target volumes for the purchase of water rights for environmental purposes.
Acre-foot	A measure of the amount of water required to cover one acre of land under one foot of water. Approximately equal to 1.23 Megalitres.
Adaptive management	The process of continually reviewing the allocation of water between consumptive and non-consumptive purposes as conditions change over time, such as the understanding of environmental needs evolves and/or the community values of environmental protection change.
Allocation	The act of providing a water right to a water user or a use, or the act of modifying the volumetric entitlement of a water right. Allocations can be undertaken administratively (by planning body) or through the purchase in a market for water rights.
Appropriation	The act of diverting water from a natural surface stream or body and applying it to a use recognised in statute as beneficial. Under the Doctrine of Prior Appropriation, it is the first step towards establishing a legal right towards water.
Appropriative rights	Water rights acquired under the Doctrine of Prior Appropriation.
Appurtenant right	The right to take water which results from the ownership of land or other property which has a legal title to water.
Aquifer	A layer beneath the surface of the ground which stores and allows water to move through it, and from which water can be extracted.
Artesian	A confined aquifer wherein the internal pressure allows for water to flow to the surface.

Assignment	<p>The act of determining at the beginning of each water year or season the volume of water available to a water user.</p> <p>Assignments are determined in accordance with water right and other legislative and regulatory provisions. Sometimes referred to as the seasonal allocation, water allocations, water determinations and seasonal assignments.</p>
Beneficial use	<p>The use of water for socially desirable purposes such as meeting human needs (health and sanitation), economic production, and for the needs of aquatic flora and fauna.</p>
Blue-green algae	<p>Organism that reproduces at very high rates, releasing toxins that can cause illness, irritation and death.</p>
Murray–Darling Basin Cap	<p>The water cap established by the Murray–Darling Basin Commission to regulate the volume of water diverted from the Murray River for economic development.</p>
Carry-over	<p>In the context of water rights, the option available to irrigators to deposit water in storage for their future use at a later date.</p>
Catchment	<p>A discrete geographic area of land, comprising one or more hydrometric sub-catchments, whose boundaries are defined primarily from natural features (such as ridges) that allow surface water to drain and flow to a river, stream, lake, wetland or estuary.</p>
Catchment management	<p>Land and water natural resource management using water catchment systems as the unit of management. Typically, it involves the creation of partnerships between different levels of government and non-government organisations.</p>
Certainty of ownership	<p>Legal recognition and protection of water rights.</p>
Consumptive use	<p>The application of water to a use which typically diverts water from its natural flow and permanently withdraws at least some of the water from the water source.</p>
Consumptive rights	<p>A water right for which the right-holder is not required to return to the water body the entire amount of water diverted.</p>

Conveyancy losses	Water evaporation from surface water sources and man-made water transportation facilities, such as irrigation channels.
Detached from land title and use restrictions	In the context of water rights, is separate and free of any requirements to hold land or any restrictions on how they may be exercised.
Diversion	1. Extraction, abstraction. 2. Changing the natural flow or part of the natural flow of a water source.
Divisibility and transferability	In the context of water rights, legal recognition that can be sub-divided and is freely traded to other parties.
Doctrine of Prior Appropriation	Doctrine of water rights in the western States of the United States in which the rights obtained at the earliest date have a superior right — ‘first-in-time-in use first-in-time-in-right’. The right is perfected when water, diverted from a natural water course is applied to a defined beneficial use, and that such use does not injure other water rights.
Drainage district	Reticulation network used to drain water from irrigation districts. Drainage districts may be separate legal entities (such as companies, trusts, statutory authorities, quasi-municipal authorities, or wholly owned subsidiaries) or owned and managed by irrigation districts.
Draw-down	In the context of water accounting, the reduction in a water user’s account resulting from the release or distribution of water.
Dryland salinity	Caused when percolating surface water raises the water table which brings natural salts in the soil to the surface. The replacement of deep rooted native plants, perennial trees, shrubs and grasses with annual crops and pastures (that do not use as much water) is a major cause for the increase in the volume of percolating surface water.
Duration	In the context of water rights, the specified period that users possess the title.
Ecologically sustainable development	Using, conserving and enhancing the community’s resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the

	future, can be increased.
El Niño	A disruption of the ocean-atmosphere system in the tropical Pacific that causes changes in rainfall patterns.
Environmental allocations	Water allocated for the specific and exclusive use of the environment. They may be defined in volumetric terms or as a share of the available resource. Allocations may possess their own legal title and be transferable.
Environmental flow requirements	<p>The minimum, maximum and other flow targets that are to be maintained in the operation of a water body to limit environmental degradation, for certain locations, and times of the year and periods.</p> <p>Often used in conjunction with setting limits on the amount of water that can be distributed or extracted from the water body.</p>
Environmental flow rules	Conditions imposed on environmental allocations regarding the minimum, maximum and other flow targets that are to be maintained for the allocation.
Environmental flows	Water released for the specific and exclusive use of the environment, or water allocated for other purposes (such as for irrigation) but which also protects the environment.
Environmental objectives	Policy objectives for the maintenance of riverine or ecosystem health, or the preservation or conservation of threatened and endangered species. Usually specified in policy documents or a water allocation plan.
Environmental water rights	Environmental allocations that possess a separate legal title and are transferable.
Exclusivity	A water right exhibits the characteristic of exclusivity, if at the margin, the benefits and costs of possessing the title to a right is specified.
Extraction	The withdrawal of water from surface and ground water sources.
Extraction limits	Ceilings and floors on the amount of water that can be taken by extractive users in regulated, unregulated rivers and in

	ground water — either specified at the original issue of a water right or through the seasonal assignment of water.
Extractive uses	Uses of water that requires its removal from the source.
Farm water plans	Plans that specify the activities that will be adopted by the land-owner in applying water. Typically used to control for the effects of salinity, nutrient discharge, siltation and erosion.
Forward-draw	In the context of water rights, the option available to irrigators to borrow from the water source or use more water than they are currently permitted.
Gigalitres	Equal to 1000 megalitres.
Groundwater	Water occurring under the ground in aquifers.
Groundwater rights	The legally or formally defined right to extract ground water.
Harvest right	The legally or formally defined right to store water, whether obtained from overland flows, ground water or other surface water.
Hydrogeology	The study of ground water and its interaction with geological features.
Hydrology	The physical or hydraulic properties of water in the landscape, such as the flows of ground water, floods, rivers or the changes in dam levels according to inputs and outputs.
Indigenous rights	A right to extract water, whether surface or ground water, for the specific and exclusive use by indigenous communities such as Australian Aboriginal and Torres Strait Islanders and Native American Indians.
Inflows	In the context of water accounting, the volume of water that flows into the storage.
Infrastructure service provider	An organisation responsible for operating fixed infrastructure for the collection, storage, transportation and reticulation of water.
In-stream rights	Legally or formally defined right to in-stream

	(non-consumptive) use of water for hydropower, aesthetic and recreational uses, environmental flows and so on.
In-stream use	Water is left <i>in situ</i> and the volume of water is largely unaffected by use. Examples of in-stream uses include fishing, recreational purposes and the protection of the environment.
Integrated (or total) catchment management	The management of land, water and other natural resources as a coordinated system for an entire water catchment. It involves incorporating community determined economic, social and environmental values.
Irrigation district	Reticulation network supplying water to irrigators managed by companies, trusts, statutory authorities and quasi-municipal authorities.
Irrigation salinity	Caused when irrigation water percolates through the soil and raises the water table, thereby bringing natural salts either to the surface of the soil or into neighbouring surface water bodies.
La Niña	A disruption of the ocean-atmosphere system in the tropical Pacific that causes changes in rainfall patterns. Changes in the rainfall patterns are the reverse of the El Niño.
Megalitre	Equal to 1000 cubic metres or one million litres.
Natural resource management	In the context of water, the management of water in a way that sustainably manages the resource and its associated uses.
Nephelometric Turbidity Units	Nephelometric Turbidity Units are comparative measures of turbidity. The greater the turbidity, the greater is the Nephelometric Turbidity Unit.
Non-point source pollution	Pollution originating from many diffuse sources, such as that caused by rainfall or snowmelt moving over and through the ground, picking up and carrying away natural and human-made pollutants and finally depositing them into water sources.
Non-transferable environmental allocations	Environmental allocations defined in statute that are a claim to a volumetric or share of the resource and are not transferable.

Nutrients	Chemical elements essential to plant and animal nutrition. Nitrogen and phosphorus are the two most common and the major components of fertilisers. In low concentrations they benefit plant and animal growth but in high concentrations they become pollutants.
Open access resource	A resource that is not owned by anyone where competition can arise between users to consume or control the available resource.
Over-allocation	Refers to situations where the volume of water taken from a source has reached a level that significant environmental damage occurs and future supplies to users are jeopardised.
Overland flows	Rainwater that has fallen to the ground but not yet reached a defined surface watercourse, body or ground water source.
Percolating ground water	Water moving slowly through the soil, not in any underground stream or lake.
Point source pollution	Pollution originating from a particular and identifiable source.
Precautionary principle	The principle of taking action to minimise potentially serious risks waiting until further information becomes available.
Predictability of quantity and enforceability	Users have a reasonable expectation of the volume of water that they can extract from a source, and monitoring and enforcement arrangements are established to protect the right from encroachment
Public Trust	Doctrine in the western United States requiring the application of community values during applications for water rights or transfers of water rights.
Recharge rate	The rate at which water enters an aquifer or artesian basin.
Regulated river or stream	River or stream with flow controlled through the use of weirs, locks and dams. Also known as supplemented river or stream.
Reliability	1. A probability attached to the volumetric entitlement of some water rights that describes the number of years in every

	100 that the volumetric entitlement will be met in full. 2. The variability of available water supply of supply systems (catchments).
Resource plan	Legislation or regulation that describe the allocation of water between uses (including the environment) and how water is to be subsequently re-allocated. Plans might also include conditions on water users to meet a range of environmental and other objectives of water use.
Return flow	Water returned to its original source after its extraction and use. Where they still occur, return flows are from irrigation uses which re-enter the stream via surface run-off or ground water recharge.
Right-holders	Water right-holders
Riparian right	The right to take water which results from the ownership or occupation, or legal access, to land adjacent to a river or body of water.
Security	See ‘reliability’.
Sub-surface flow	Water that moves through the bed of a river or stream.
Supply reliability exchanges rates	Exchange rates applied to the volumetric component of a water right to adjust for differences in supply reliability of water in different locations.
Surface water	Water that occurs or flows on the surface, including streams, rivers, estuaries, lakes, and overland flooding.
Surplus water	Water that is surplus to the needs of fulfilling all current and future water right commitments.
Third-party effect	A third-party effect (or externality) arises whenever the production or use of a good or service affects parties other than those involved in the transaction and these effects are not fully reflected in the prices paid or received by the first two parties.
Transferable right	A formally established or legal right to water that can be freely transferred.

Turbidity	Turbidity is a measure of water clarity and an indicator of the presence of suspended material, such as silt and clay, in water sources.
Universality	In the context of water rights, the situation where all the available water resources (as far as practicable) are covered by a system of water rights.
Unregulated river or stream	River or stream whose flow is not controlled through the use of weirs, locks and dams.
Usufructuary right	A right to the use of water (Latin: <i>usus</i>) and to the fruits of the water's use (<i>fructus</i>). With very few exceptions, water rights are usufructuary rights.
Water accounting	The method of recording and accounting for water assigned to water users by storage operators.
Water sharing	The act of determining the amount of water to be shared between competing users and uses, through the use of planning, administrative and market based arrangements.
Water banks	An institutional arrangement for depositing and lending water.
Water cycle	The continuous sequence of water evaporating into the earth's atmosphere where it condenses and returns to the earth as rainfall.
Water distribution	The process of distributing water to water right-holders, according to agreed rules or priorities.
Water resources agency	In the context of this study, the government body responsible for water resources policy development. Depending on the jurisdiction, it may be responsible for planning (regulating the allocation of water), administration, and monitoring and enforcement.
Water right	A formally established or legal authority to take water from a water body and to retain the benefits of its use. Rights may be attenuated in a number of ways and are referred to in different jurisdictions as licences, concessions, permits, access entitlements or allocations.

References

- ABARE (Australian Bureau of Agricultural and Resource Economics) 1996 *Environmental Water Flows*, Outlook 96, ABARE, Canberra.
- ABS (Australian Bureau of Statistics) 2000, *Water Account for Australia: 1993-94 to 1996-97*, Cat. No. 4610.0, Australian Bureau of Statistics, Canberra.
- 2001, *Australia's Environment: Issues and Trends*, Cat. No. 4613.0, Australian Bureau of Statistics, Canberra.
- Aguilar, E. undated, *Pricing of Irrigation Water of Mexico*, mimeo, The World Bank <http://lnweb18.worldbank.org/ESSD/essdext.nsf/18DocByUnid/AAA8334042E08A8E85256BEA00732BB6?Opendocument>.
- ANAO (Australian National Audit Office) 1996, *Better Practice Principles for Performance Information*, Commonwealth of Australia, Canberra Australia.
- ANCID (Australian National Committee on Irrigation and Drainage) 2002, *Australian Irrigation Water Provider: Benchmarking Report for 2000/2001*, April.
- ARMCANZ (Agricultural and Resource Management Council of Australia and New Zealand) 1995, *Guidelines for the Application of Section 3 of the Strategic Framework and Related Recommendations in Section 12 of the Expert Group*, ARMCANZ Meeting Hobart, 27 February 1998, communiqué.
- Ashley, J and Smith, Z. 2001, Western Groundwater Wars, *Forum for Applied Research and Public Policy*, University of Tennessee, vol 16, no. 1, Spring 2001, pp. 33 - 39.
- Basson M. S. 1997, *Overview of Water Resources Availability and Utilisation in South Africa*, Department of Water Affairs and Forestry (South Africa), Pretoria.
- Bauer, C. J. 1997, 'Bringing Water Markets Down to Earth: The Political Economy of Water Rights in Chile, 1976–95', *World Development*, 25(5):639–656.
- 1998, 'Slippery property rights: Multiple water users and the neoliberal model in Chile, 1981 to 1995', *Natural Resources Journal*, 38(102):118-122.
- Bellamy et al. (Bellamy, J., Ross, H., Ewing, S., Meppem, T.) 2002, *Integrated Catchment Management: Learning from the Australian Experience for the Murray-Darling Basin*, CSIRO, Canberra.

-
- Black, H. C. 1968, *Black's Law Dictionary*, Revised Fourth Edition, West Publishing Co. St Paul Minn.
- BMF (Barmah–Millewa Forum) 2002, *Annual Report 2001-2002*, Water Management in the Barmah–Millewa Forest.
- Boardman et al. (Boardman, A., Greenberg, D Vining, A and Weimer, D.) 1996, *Cost–Benefit Analysis Concepts and Practice*, Prentice-Hall, New Jersey.
- BoM (Bureau of Meteorology) 2003, *Australia — Climate of our Continent*, <http://www.bom.gov.au/lam/climate/levelthree/ausclim/zone.htm> (accessed 12 May 2003).
- BoR (US) (Bureau of Reclamation) 2002a, *Annual Operating Plan: Colorado–Big Thompson Project, Water Year 2001*, <http://www.usbr.gov/gp/aop/cbt/0102/toc.htm>.
- 2002b, *Annual Operating Plan: Fryingpan–Arkansas Project, Summary of Actual Operations, Water Year 2001*, <http://www.usbr.gov/gp/aop/fa/01/toc.htm>.
- Boughton, W. (ed) undated *A Century of Water Resources Development in Australia: 1900–1999*, The Institution of Engineers, Australia.
- CALFED (CALFED Bay–Delta Program) 2000, *Strategic Plan for Ecosystem Restoration*, Ecosystem Restoration Program, July.
- CBC (California Biodiversity Council) 2003, *California Biodiversity Council: Welcome*, State of California, <http://ceres.ca.gov/biodiversity> (accessed 13 February 2003).
- California State Lands Commission 1993, *California's Rivers*, A Public Trust Report, California State Lands Commission, Sacramento.
- Caponera, D. 1992, *Principles of Water Law and Administration: National and International*, Balkema Publishers, Rotterdam, Netherlands.
- CCNCO (Commonwealth Competitive Neutrality Complaints Office) 2000, *Competitive Neutrality: A Guide to its Application to Commonwealth Government Businesses*, mimeo, June.
- CES (Cooperative Extension Service) 1998, *Salinity Issues in Colorado*, Agronomy News, Colorado State University, www.colostate.edu/Depts/SoilCrop/extension/Newsletters/1998/June98.pdf (accessed 29 August 2002).
- Chakravorty, V. and J. Roumasset 1991, 'Efficient Spatial Allocation of Irrigation Water', *American Journal of Agricultural Economics*, 73:165-173.
- CNA (National Water Commission) 2001, *Programa Nacional Hidráulico 2001–2006*, Mexico, <http://www.cna.gob.mx/portal/switch.asp?param=4016> (accessed 21 August 2002).

-
- CoAG (Council of Australian Governments) 1994, *Water Resource Policy*, Commonwealth of Australia, February.
- CSIRO (Commonwealth Scientific and Industrial Research Organisation) 2001, *Salinity FAQ*, <http://www.clw.csiro.au/issues/salinity/faq.html> (accessed 1 August 2002).
- DEAT (Department of Environmental Affairs and Tourism) 1999, *National State of the Environment Report: Freshwater Systems and Resources*, South Africa, <http://www.ngo.grida.no/soesa/nsoer/issues/water/state4.htm#box3.2> (accessed 28 August 2002).
- Department of the Premier and Cabinet (Queensland) 2002, *2001-02 Annual Report Guidelines for Queensland Government Agencies*, www.premiers.qld.gov.au/policies/annualreports.pdf (accessed 19 March 2003).
- DGA (Directorate General of Water), 1999, *National Water Resources Policy*, Directorate General of Water, Santiago, Chile, December.
- Different World 2002, *Mexico*, <http://www.differentworld.com/mexico/common/pages/climate.htm> (accessed 5 July 2002).
- Dinar, A. (ed) 2000, *The Political Economy of Water Pricing Reforms*, World Bank, Oxford University Press, New York.
- DLA (Department of Local Affairs) 2002, *Historical Census Population by County*, Colorado, <http://dola.colorado.gov/demog/history/countyHist1.cfm> (accessed 20 August 2002).
- DLWC (Department of Land and Water Conservation) 2002, *Water Allocation Plan for the Regulated Sections of the Murray and Lower Darling River Valleys: 2002–03*, Department of Land and Water Conservation, Murray Region.
- undated, *Draft Water Sharing Plan for the Kangaroo River Water Source*, Part B, prepared by the Shoalhaven/Illawarra Water Management Committee.
- DNRE (Department of Natural Resources and the Environment) 1999, *Entitlements to the Murray: Outcomes of Work to Define How Victoria's River Murray Water is to be Shared*, Victorian Department of Natural Resources and the Environment, Melbourne.
- 2001, *The Value of Water: A Guide to Water Trading in Victoria*, Victorian Department of Natural Resources and Environment, December.
- 2002, *Healthy Rivers, Healthy Communities and Regional Growth — Victorian River Health Strategy*, Victorian Department of Natural Resources and Environment, August

-
- Dourojeanni, A. and Jouravlev, A. 1999, *El Código de Aguas de Chile: Entre la Ideología y la Realidad*, Recursos Naturales e Infraestructura, Serie 3, CEPAL, Naciones Unidas, Santiago, Octubre.
- DSD (Department of Social Development) 2000, *State of South Africa Population Report, 2000*, South Africa, <http://population.pwv.gov.za/state.htm> (accessed 22 August 2002).
- DWAF (Department of Water Resources and Forestry) 2002, *Proposed First Edition National Water Resource Strategy*, Department of Water Resources and Forestry, Pretoria, South Africa.
- DWLBC (Department of Water, Land and Biodiversity Conservation) 2003, *Consultation Draft Natural Resource Management Bill 2003: Explanatory Document and request for comments*, Government of South Australia, Adelaide.
- DWR (Department of Water Resources) 1998, *California Water Plan*, Bulletin 160–98, California <http://www.waterplan.water.ca.gov/b160/previous/b160updates.html> (accessed 25 March 2002).
- 2002, *Watermaster Service in the Central Basin Los Angeles County 1 July 2001-30 June 2002*, October 2002.
- Easter et al. (Easter, K. W., M. W. Rosegrant and A. Dinar) 1999, 'Formal and Informal Markets for Water: Institutions, Performance and Constraints', *The World Bank Research Observer*, 14(1):99-116.
- ENRC (Environment and Natural Resources Committee) 2001, *Inquiry into the Allocation of Water Resources — Report*, Parliament of Victoria, November.
- EPA (California) (Environmental Protection Agency) 2001, *Enforcement Progress Report 1999-2001*, Office of the Secretary, Deputy Secretary for Law Enforcement and Counsel, California, <http://www.calepa.ca.gov/Enforcement/documents/ProgReport.pdf> (accessed January 2003).
- EPA (NSW) (Environmental Protection Authority) 2000, *State of the Environment Report*, http://www.epa.nsw.gov.au/soe/95/8_2.htm#0_8_2_1_3_0_0 (accessed 2 September 2002).
- ESCAP (UN) (Economic and Social Commission for Asia and the Pacific United Nations) 2000, *Principles and Practices of Water Allocation among Water-Use Sectors*, Water Resources Series, No. 80, United Nations, New York.
- ESDSC (Ecologically Sustainable Development Steering Committee) 1992, *National Strategy for Ecologically Sustainable Development*, endorsed by the Council of Australian Governments December, 1992.

-
- FAO (Food and Agriculture Organisation) 2000, *Extent and Causes of Salt-Affected Soils in Participating Countries*, United Nations <http://www.fao.org/ag/agl/agll/spush/topic2.htm#mexico> (accessed 29 August 2002).
- Fernández, E B and Medina, J E S, 2000, *Informe Nacional Sobre la Gestión del Agua en Chile*, January, www.dga.cl accessed 26 August 2002.
- Fisher, D. E. 2000, *Water Law* LBC Information Services, Sydney.
- Getches, D. 1997, *Water Law in a Nutshell*, Third Edition, West Publishing Co., St. Paul, Minnesota.
- GMW (Goulburn–Murray Water) 2001, *Over-Use of Annual Entitlement*, http://www.g-mwater.com.au/downloads/Over_Use_of_Entitlement1.pdf (accessed January 2003).
- 2002, *Murray Basin Water Accounts and Resource Manager's Report, 1999–2000*, Prepared for the Department of Natural Resources and Environment, Goulburn–Murray Water (as Murray Resource Manager), April.
- undated, *News and System Reports*, unpublished, www.g-mw.com.au, (accessed 17 March 2003).
- Goss, K., J. Powell and B. Newman 2000, *Murray-Darling Basin: The Salinity Audit and Implementation Strategy*, Outlook 2000, ABARE, Canberra.
- Hafi, A., N. Klijn, and C. Toyne 1999, 'Efficient Water Use in the Presence of Conveyancy Losses', *Australian Commodities*, 6(4):688-694.
- HDDORP (Hume and Dartmouth Dams Operations Review Reference Panel) 1998, *Hume and Dartmouth Dams Operations Review: Options Paper*, Murray–Darling Basin Commission, November.
- 1999, *Hume and Dartmouth Dams Operations Review: Final Report and Recommendations*, Murray–Darling Basin Commission, May.
- HLSGW (High Level Steering Group on Water) 2000, *Draft Guidelines for Managing Externalities: Restoring the Balance, Exposure Draft*, Prepared by the Policy and Economic Research Unit, CSIRO Land and Water, Adelaide.
- IC (Industry Commission) 1992, *Water Resources and Waste Water Disposal*, Report no. 26, AGPS, Canberra.
- IPARC (Independent Pricing and Regulatory Commission) 1999, *ACTEW's Electricity, Water and Sewerage Charges for 1999/2000 to 2003/04: Price Direction*, Independent Pricing and Regulatory Commission, Canberra, May.
- IPART (Independent Pricing and Regulatory Tribunal) 1996, *Bulk Water Prices: An Interim Report*, Independent Pricing and Regulatory Tribunal of NSW, October.

-
- 2000a, *Sydney Catchment Authority: Prices of Water Supply Services*, Determination No. 10, Independent Pricing and Regulatory Tribunal of NSW, September.
- 2000b, *Sydney Water Corporation: Prices of Water Supply, Sewerage and Drainage Services*, Determination No. 8, Independent Pricing and Regulatory Tribunal of NSW, September.
- Langford, J. 1999 *Participation of the Private Sector in Irrigation*, IRC Delegation Paper, The Australian Academy of Technological Sciences and Engineering, ATSE Delegation to South Africa, 1-2 November 1999.
- LAO (Legislative Analyst's Office) 1996, *Calfacts 1996*, California <http://www.lao.ca.gov/cf96toc.html> (accessed 20 August 2002).
- Lee, T. and A. Jouravlev 1998, *Prices, Property and Markets in Water Allocation*, United Nations, Santiago, Chile.
- MacDonnell et al. (MacDonnell, L. J., C. H. Howe, K. A. Miller, T. A. Rice and S. F. Bates) 1994, *Water Banks in the West*, Natural Resources Law Center, University of Colorado School of Law.
- Mann, P. 1993, *Water Utility Regulation: Rates and Cost Recovery*, Policy Study, No 155, Reason Public Policy Institute, March.
- Marsden, J. 2002, 'Water entitlements and property rights: An economic perspective', in Land and Water Australia (ed), *Property: Rights and Responsibilities, Current Australian Thinking*, Land and Water Australia, Canberra.
- McCann, R. J. and D. Zilberman 2000, 'Governance Rules and Management Decisions in California's Agricultural Water Districts', in Dinar, A (ed), *The Political Economy of Water Pricing Reforms*, World Bank, Oxford University Press, New York.
- MDA (Murray Darling Association) 2001, *South Australia's Majestic Murray: A User's Guide*, Murray Darling Association Inc., Adelaide.
- MDBC (Murray–Darling Basin Commission) 2000, *Murray–Darling Basin Agreement (Schedule F — Cap on Diversions)*, August, Canberra.
- 2002, *Water Audit Monitoring Report 2000–01: Report of the Murray–Darling Basin Commission on the Cap on Diversions*, Murray–Darling Basin Commission, Canberra.
- undated(a), *Backgrounder 3: Lake Hume: Overview of Operation*, http://www.mdbc.gov.au/river_murray/river_murray_system/hume/ops_review/overview_hume.htm (accessed 17 March 2003).

-
- undated(b), *Backgrounder 6: The Barmah Choke*, http://www.mdbc.gov.au/river_murray/river_murray_system/barmah/barmah_choke.htm (accessed 17 March 2003).
- undated(c), *Environmental Flows and Water Quality for the River Murray*, http://www.mdbc.gov.au/naturalresources/policies_strategies/projectscreens/flowproject.htm (accessed 2 September 2002).
- undated(d), *The Impacts of Water Regulation and Storage on the Basin's Rivers*, http://www.mdbc.gov.au/education/encyclopedia/Water_Regulation/Water_Regulation_Impact.htm (accessed 26 August 2002).
- undated(e), *The Pilot Inter-State Water Trading Project*, http://www.mdbc.gov.au/naturalresources/policies_strategies/projectscreens/pilot_watertrade.htm (accessed 4 February 2003).
- undated(f), *Water and Land Salinity*, http://www.mdbc.gov.au/education/encyclopedia/water_and_land_salinity.htm (accessed 1 August 2002).
- MDBMC (Murray–Darling Basin Ministerial Council) 1999, *The Salinity Audit of the Murray–Darling Basin*, http://www.mdbc.gov.au/naturalresources/policies_strategies/Salt_audit/salinity.htm (accessed 28 August 2002).
- 2001, *Operating Rules for Managing the Barmah-Millewa Forest Environmental Water Allocation*, s. 5.3, 30 March 2001.
- NCC (National Competition Council) 2001a, *Assessment of Governments' Progress in Implementing National Competition Policy and Related Reforms*, National Competition Council, June.
- 2001b, *Assessment of Governments' Progress in Implementing National Competition Policy and Related Reforms: Water Reforms: New South Wales*, National Competition Council, June.
- 2001c, *Assessment of Governments' Progress in Implementing National Competition Policy and Related Reforms: Water Reforms: Victoria*, National Competition Council, June.
- 2001d, *Assessment of Governments' Progress in Implementing National Competition Policy and Related Reforms: Water Reforms: Queensland*, National Competition Council, June.
- 2001e, *Assessment of Governments' Progress in Implementing National Competition Policy and Related Reforms: Water Reforms: South Australia*, National Competition Council, June.
- 2001f, *Assessment of Governments' Progress in Implementing National Competition Policy and Related Reforms: Water Reforms: ACT*, National Competition Council, June.

-
- NHT (National Heritage Trust) 2001a, *Australian Water Resources Assessment 2000*, http://audit.ea.gov.au/ANRA/water/docs/national/Water_Contents.html (accessed 19 July 2002).
- 2001b, *National Land and Water Resources Audit*, http://audit.ea.gov.au/ANRA/water/water_frame.cfm?region_type=AUS®ion_code=AUS&info=resources (accessed 28 June 2002).
- 2001c, *Surface and Groundwater Management, Availability, Allocation and Efficiency of Use State of New South Wales Water Resources Overview*, http://audit.ea.gov.au/ANRA/water/docs/state_overview/NSW_ovpage.html (accessed 25 March 2003).
- Nieuwoudt, W L 2000, 'Water Market Institutions in Colorado with Possible Lessons for South Africa', *Water SA*, 26(1):27–34.
- Noonan, P. 1993, *Findings on Selected Water Resource Policy Issues in the United States of America: Report on Study Tour in September–October 1993*, Queensland Department of Primary Industries.
- NRC (National Research Council Water Science and Technology Board, Committee on Western Water Management) 1992, *Water Transfers in the West: Efficiency, Equity and the Environment*, National Academy Press, Washington DC.
- NR&M (Department of Natural Resources and Mines) 2002a, *Burnett Basin Draft Resource Operations Plan*, Water Planning Group, Department of Natural Resources and Mines, December.
- 2002b *Water Resource (Border Rivers) Plan 2002*, consultation paper, Department of Natural Resources and Mines, Brisbane.
- NSW Minister for Land and Water Conservation 2003, *Water Sharing Plan for the Murray and Lower Darling Regulated Rivers Water Sources 2003 Order*, Department for Land and Water Conservation.
- OECD (Organisation for Economic Cooperation and Development) 1999, *The Price of Water: Trends in OECD Countries*, Organisation for Economic Cooperation and Development, Paris.
- 2002, *Distributed Public Governance, Agencies, Authorities and Other Government Bodies*, Organisation for Economic Cooperation and Development, Paris.
- 2003, *OECD Environmental Data: Compendium 2002, Inland Waters*, Organisation for Economic Cooperation and Development, Paris.
- ORR (Office of Regulation Review) 1998, *A Guide to Regulation*, Second Edition, AGPS, Canberra.

-
- 2002, *Regulation and its Review 2001-02*, Annual Report Series, Productivity Commission, AGPS, Canberra.
- PC (Productivity Commission) 2000, *Arrangements for Setting Drinking Water Standards*, International Benchmarking, AusInfo, Canberra.
- 2001a, *Harnessing Private Sector Conservation of Biodiversity*, Commission Research Paper, Ausinfo, Canberra.
- 2001b, *Review of the Prices Surveillance Act 1983*, Report no. 14, AusInfo, Canberra.
- 2002, *Financial Performance of Government Trading Enterprises, 1996-97 to 2000-01*, Performance Monitoring, AusInfo, Canberra.
- 2003, *Industries, Land Use and Water Quality in the Great Barrier Reef Catchment*, Research Report, Canberra.
- Pigram J. 1986, *Issues in the Management of Australia's Water Resources*, Longman Cheshire, Melbourne.
- Pomanto, J. and D. Wolcott 2001, *Assault on Salinity*, Aqueduct Magazine Cubed, Metropolitan Water District of Southern California, <http://www.mwdh2o.com/aqueduct/july2001/salinity.htm> (accessed 27 August 2002).
- QCA (Queensland Competition Authority) 2000, *Statement of Regulatory Pricing Principles for the Water Sector*, December.
- RMCWMB (River Murray Catchment Water Management Board) 2001, *Draft River Murray Catchment Water Management Plan*, South Australia, August 2001.
- Saliba, B. and D. Bush 1987, *Water Markets in Theory and Practice: Market Transfers, Water Values and Public Policy*, Studies in Water Policy and Management, No. 12, Westview Press, Boulder and London.
- SCEH (Standing Committee on Environment and Heritage) 2000, *Co-ordinating Catchment Management*, Report of the Inquiry into Catchment Management, House of Representatives, The Parliament of the Commonwealth of Australia, Canberra, December.
- Schur, M. undated, *Pricing of Irrigation Water in South Africa*, mimeo, The World Bank <http://lnweb18.worldbank.org/ESSD/essdext.nsf/18DocByUnid/AAA8334042E08A8E85256BEA00732BB6?Opendocument> (accessed 24 February 2003).
- Siebert et al. (Siebert, E., D. Young and M. Young) 2000, *Market-Based Opportunities to Improve Environmental Flows*, Scoping Report to Environment Australia, CSIRO Land and Water, Adelaide.

-
- SnowyHydro Limited 2002, *Water — A Journey Westward*, <http://www.snowyhydro.com.au/corporate/water.cfm> (accessed 2 September 2002).
- SRW (Southern Rural Water) 2002, *Annual Report 2001–2002*, September.
- SRWA (Sunraysia Rural Water Authority) 2002, *Refinement of the River Salinity Zoning System: Information for Irrigators*, unpublished, <http://www.srwa.org.au> (accessed 3 February 2003).
- SWRCB (State Water Resources Control Board) 2002, *The Water Rights Process* http://www.waterrights.ca.gov/html/wr_process.htm (accessed 4 February 2003).
- Tan, Poh-Ling. 2002, Legal Issues Relating to Water Use, *Property: Rights and Responsibilities Current Australian Thinking*, Land and Water Australia, Canberra.
- Thompson et al. (Thompson, H. Stimie, C. M. Richters, E. Perret, S.) 2001, *Policies, Legislation and Organizations Related to Water in South Africa, with Special Reference to the Olifants River Basin*, Working paper 18 (South Africa Working Paper No. 7) Colombo, Sri Lanka: International Water Management Institute.
- Tsur, J. and A. Dinar, 1995, *Efficiency and Equity Considerations in Pricing and Allocating Irrigation Water*, No. 1460, Rural Development Department, The World Bank, May.
- Tyndall Centre 2001, *Recent Climate in Individual Countries*, http://www.cru.uea.ac.uk/~timm/climate/cty_new/countries.htm (accessed 5 July 2002).
- UMN (Union Mundial para la Naturaleza) 2000, *Desertificación y Degradación Ecosistemas no Boscosos: Chile*, Chile, <http://www.sur.iucn.org/programa/desertificacion/paralela/Chile.PDF> (accessed 30 August 2002).
- University of Washington undated, *The Water Cycle*, http://www-k12.atmos.washington.edu/k12/pilot/water_cycle/grabber2.html (accessed 27 June 2002).
- USGS (United States Geological Survey) 1999, *National Water-Use Data Files*, <http://water.usgs.gov/watuse/> (accessed 20 August 2002).
- Vanderzee, M and Turner, G 2002, *The Snowy Flows Again: Intergovernmental Co-operation on Water Reform*, Presented at the 4th Water Law and Policy Conference, Sydney, 24 – 25 October 2002.
- Wahl, R. W. 1997, 'United States', in Dinar, A and Subramanian, A, (ed), *Water Pricing Experiences: An International Perspective*, World Bank Technical Paper, No. 386, The World Bank, Washington DC.
- Water Transfer Workgroup 2002, *Water Transfer Issues in California*, Final report to the California State Water Resources Control Board. June 2002

-
- WEF (Water Education Foundation) 1998 *Layperson's Guide to Groundwater*, Water Education Foundation, Sacramento, California.
- 2000a, *Layperson's Guide to California Water*, Water Education Foundation, Sacramento.
- 2000b, *Layperson's Guide to Water Rights Law*, Water Education Foundation, Sacramento.
- 2001, *Layperson's Guide to the Colorado River*, Water Education Foundation, Sacramento.
- Western Regional Climate Center (undated) *Average Pan Evaporation Date by State*, <http://www.wrcc.dri.edu/CLIMATEDATA.html>, accessed 5 July 2002.
- WSAA (Water Services Association of Australia) 2001, *WSAA Facts 2001: The Australian Urban Water Industry*, WSAA, Melbourne.
- Young et al. (Young, M. D., H. MacDonald, R. Stinger and H. Bjornlund) 2000, *Inter-State Water Trading: A Two-Year Review*, Draft Final Report Prepared for MDBC, CSIRO Land and Water, December.
- Young, M. and J. McColl 2002, *Robust Separation: A Search for a Generic Framework to Simplify Registration and Trading of Interests in Natural Resources*, CSIRO, Canberra.