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Robust Reform:

Implementing robust institutional arrangements to achieve efficient water use in Australia

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  Cover photo description: Child drinking glass of water.. Photographer: Bill van Aken, Perth, WA. 1975.

Executive Summary

The focus of this report is on implementing institutional arrangements for the efficient allocation and management of water. The report builds on an earlier report entitled Robust Separation – a search for a generic framework to simplify registration and trading of interests in natural resources (Young and McColl, 2002), and expands a recent policy forum article in the Australian Economic Review (Young and McColl, 2003). We release the report to assist those involved in the present CoAG processes pursuing the National Water Initiative that Australia's Governments have collectively committed to.

Water is an input into human use including economic production and recreation activities that generate many externalities. It also provides many valuable ecosystem services only partially captured in the market. Institutional arrangements are required that are dynamically efficient and low cost, and robust enough to withstand the test of time. Robust administrative arrangements are characterised by the lack of a need for change.

The Biophysical challenge

Because Australian surface water supplies tend to be highly variable, we have invested large amounts in the development of dams and distribution systems. As a result, very few of our surface water and groundwater systems, in any way, resemble their natural state – we have re-arranged them to remove a large amount of variability. The reality is that the landscapes and rivers that now characterise much of Australia are very different to those in place a century ago.

Many of the most serious problems associated with catchment, river and aquifer management stem from a past failure to understand the hydrology of groundwater connectivity and the generally long time these groundwater systems take to respond to changes in land and water use. Most Australian rivers are inextricably connected to surrounding groundwater aquifers that supply much of their base flow.

There is much debate and misconception about the current status of Australia's water resources. Biophysical assessment – almost devoid of economic analysis – reveals an adverse report card. As a result, a process known as the "Living Murray" process has been implemented to consider the merits of enhancing environmental flows in the River Murray System with a view to improving the environmental health of this system.

The area under consideration can be described as the Southern Connected River Murray System. This consists of the River Murray in South Australia, the Darling River and its Ana Branch below the Menindee Lakes, the River Murray itself, the Murrumbidgee System and all Victorian tributaries except those in the Mallee. It does not include the Lachlan River in NSW.

Re-allocation of substantial volumes of consumptive use water to the environment is being contemplated. Volumes of 350 GL, 750 GL and to around 18% or 1,500 GL have been proposed as reference points to facilitate consideration of the options. As discussions and analysis proceeds, it is becoming clearer that the most appropriate way to proceed is to focus on deliverable outcomes rather than specified volumes. While there is a focus on the River Murray, many of the issues and concepts explored in this report are equally relevant to other river and groundwater systems. Such discussions and such processes have a major effect on investment and on community welfare.

Hydrological reality

Australia has a plethora of water licensing systems onto which mechanisms for managing externalities, rationing scarcity and trading have been bolted. Differences in approaches among States are dramatic. The case for introducing a nationally consistent water entitlement and allocation system is compelling. Consistency reduces transaction costs and opens up economic opportunity that is characterised by opportunities for permanent gain rather than the pursuit of the arbitrage opportunities associated with ongoing reform.

While there have been very few licences issued for some time, recognition of the fact that many, where only partially used, led during the 1990s to the introduction of a "cap" on diversions at 1993/94 levels of development for NSW, Victoria, and SA. This was coupled with a decision to introduce trading mechanisms to encourage economically inefficient water users to sell water entitlements and allocations to economically efficient water users.

Definition of the Cap on diversions is complex and there is considerable variation from reach to reach in the way diversions are measured and the licences that permit these diversions are defined. The Cap is a dynamic mechanism and provides for greater water usage in some years and lower use in other years. When the Cap was set in place, it represented about 75 % of the estimated natural river flows for the River Murray System in 1993/94. The introduction of a Cap on diversions was seen as a first step in establishing management systems to achieve healthy rivers and sustainable consumptive uses. The introduction of trading has also meant that governments have been able to stop issuing new entitlements without the surrender of an existing licence.

Of particular importance for any assessment of the amount of water needed to restore health to rivers, like the River Murray, is the question of how well entitlements and allocations align with the hydrological processes. The accounting systems used are not robust. They do not guarantee that when one person or one process uses more water, another uses less. Significant omissions include the influence of land-use changes that reduce recharge and run-off to the river, as well as the impact of increases in water-use efficiency on river flow. Other important omissions include the effects on river flow of salinity interception schemes, and development of inter-connected groundwater resources. As a result, allocations to some classes of irrigators and or the environment continue to decline. How much of the impact of these omissions is borne by irrigators in the form of decreased allocations and how much is borne in the form of decreased in-stream flow is unknown.

The table below provides a rough estimate of the potential consequences of these omissions for irrigators and the Southern Connected River Murray System. These estimates have been derived, using 1993/94 as a baseline, without the benefit of access to sophisticated groundwater models. We expect that more sophisticated modelling is likely to result in significant revision of these estimates. Additional hydrological considerations—in particular, the impacts of climate change, of farm dam development and of forest fires—have not been considered. (Work under contract to the Murray Darling Basin Commission is presently under way to provide more precise estimates. Nevertheless, we believe that these estimates are of the right order of magnitude.)

Estimated reduction in mean annual flow and available seasonal allocations of design omissions in the entitlement systems used to allocate water in the River Murray Basin (baseline 1993/94)

Design Omission	**Net effect**
Reduced drainage and groundwater returns to the River resulting from water use efficiency savings [a)]	- 723 GL
Reduction in water yield from catchment land-use changes like increased forestry and farm dam development [b)]	- 600 GL
Reduced groundwater flow to the River as a result of increased installation and operation of Salinity Interception Schemes [c)]	-20 GL
Reduced groundwater flow to the River from increased groundwater use [d)]	-349 GL
Estimated net reduction in mean river flow and allocations to irrigators	**-1,692 GL**

Notes a) to d) refer page 22

Under current arrangements, the effects outlined in the table above are managed via a variety of mechanisms. These include the mechanisms used to define bulk licences, the mechanisms used to assign allocations to general security licence holders in New South Wales and sales water allocations in Victoria, restrictions on surface water trading among regions and restrictions on groundwater trading.

Estimates of the volume of water access entitlements needed to secure environmental flows depend very much upon the degree of transparency associated with management of the omissions included in the above table. Three approaches are possible:

- These design omissions can be removed via the introduction of a robust entitlement and allocation system;
- Market mechanisms can be used to remove their effects; or, as is presently the case,
- Administrative mechanisms can be used to minimise their effects on the River.

Communication of the logic in purchasing, say, 1,500 GL of entitlement from irrigators and reducing allocations to a subset of them by a further 1,500 GL is, to say the least, likely to prove challenging. If, however, entitlements are aligned with the hydrological realities of water use then this difficult communication challenge and resulting adverse effects on investment could be avoided.

Finally, the introduction of both the Cap and relatively constrained trading has activated unused, dozer and sleeper licences. Removing current impediments to trading has the potential to further activate unused water entitlements, and add to the difficulties of managing within the Cap in some parts of the system. Clearly, rather than a Cap on diversions, in a robust system the Cap would be a cap on entitlements not on diversions.

The Policy challenges

Essentially, the policy challenges now faced by Australian water resource and environmental managers collapse to:

- The search for a robust set of institutional arrangements, defined in the broadest sense possible, to enable the efficient allocation and management of water resources and both *consumptive and non-consumptive* water use through time; and
- The search for an efficient and equitable transition pathway to such a set of institutional arrangements.

A Robust system

As well as being consistent with the hydrological realities of water use, a robust system would need to facilitate:

- Resolution of resource allocation between consumptive use and the environment, among consumptive users, and of issues related to distribution and use;
- Secure, economically efficient and low cost trading and administration;
- Assignment of risks making it clear where responsibility lies, under what circumstances compensation is due, and specifying the processes for obtaining redress; and
- Management of externalities associated with use—the interests of third parties, future generations and the environment—with minimum controversy.

A robust system also must pass the conventional tests of efficiency and fairness. For this to occur in a changing world, the system must not only be built on a solid conceptual foundation, but also be flexible and adaptive, transparent and equitable.

Important characteristics of a robust system include:

- Mechanisms balancing market and non-market uses as they change through time;
- Specification of water access entitlements, allocations and use conditions in a manner that is consistent with hydrological realities;
- Arrangements that enable trade between surface and groundwater systems and the development of markets for delivery or channel capacity in peak demand periods and, also, markets that allow people to trade in salinity impacts; and
- Clear pricing policies and associated arrangements that facilitate the management of externalities.

In several States, the reform processes underway are consistent with many of these characteristics. New South Wales, for example, has begun the process of separating access entitlements from use entitlements and all States have begun the process of pricing reform.

A transition pathway

Sequencing

When considering securing water entitlements for the environment and moving to a robust water entitlement, allocation and use licence system, a number of transitional issues arise. There are sequencing opportunities and traps. Implement reform in the wrong order and some reforms become impossible and the cost of the entire reform process rises significantly. The presence of existing market impediments, even given the comparative absence of externality cost obligations, means that the value of water access entitlements, allocations and use licences are less than they would otherwise be.

As a general rule, it will be less costly for governments to acquire additional water to enhance the environment before impediments to permanent water trading are removed and before a new robust water access entitlement and allocation system is put in place.

In all fully allocated systems, the further development of seasonal allocations (temporary trading) coupled with a freeze on the expansion of access entitlement (permanent trading) could be used to limit arbitrage opportunities until robust accounting systems are put in place. If arrangements are not put in place to ensure seamless alignment of the number of unit shares in the system with its hydrological capacity, ongoing problems can be expected to emerge. As an absolute minimum, water use should be defined in "net" not "gross" terms and arrangements should be put in place to ensure that the effects of land use changes like forestry development and farm dam construction are offset. The effects of activating unused groundwater and surface water access entitlements also need to be accounted for.

Securing entitlements for the environment

There are a number of relatively cost-effective options of securing water access entitlements for the environment including pro rata reductions, acquisition of water licences using market-like processes, compulsory acquisition and contracts involving investment by government in infrastructure upgrades.

The option or mix of options chosen to secure more water for the environment will mainly depend on the volumes of water needed, the proposed timelines for securing them, the expected flow of available finance, and the institutional arrangements set in place to hold them. The mix of options chosen will also depend upon decisions about management of this water. It is possible that the best arrangement will involve separation of the process of securing and holding this water from arrangements for its subsequent management in a manner that will ensure that it is subsequently deployed to achieve the most beneficial environmental outcomes. How these aspects will be dealt with will be for the relevant governments to resolve in consultation with stakeholders and the community.

If market and market-like mechanisms are used, then the financial resources necessary will need to be provided by governments. Determining how much of the cost of securing environmental water should be borne by water licence holders and how much by the rest of the community is a distributional policy issue. In recognition of the merits of securing water at current market prices, operationally any first tranche could be purchased up-front. The size and speed of program implementation should then be determined by the level of funds provided by governments and the environmental benefits being achieved, rather than by an up-front policy commitment to secure a particular volume.

There is a highly attractive opportunity to use a tender process to secure the first tranche of water required. Modelled on the current $800-1,000 million Telstra Share Buy Back Tender, all irrigators could be invited to indicate the minimum price that they would be prepared to sell different proportions of their access entitlements for. A buy-back price declared for each type of water licence and all those who tendered a price less than the buy-back price selected would then be paid the buy-back price for the volume of water they offered.

Reform program

In summary, the reform program can be undertaken as a series of sequential steps as follows:

1. Separate water use licences from water access entitlements as is happening in NSW and is foreshadowed;
2. Facilitate temporary market trading with appropriate trading rules and periodically revised exchange rates with a focus on increasing opportunities for internet trading, lowering transaction costs and reducing settlement times;
3. Temporarily freeze expansion of the permanent trade of access entitlements until the access component of each licence is converted into a shares defined in a manner that defines use in "net" not "gross" terms and accounts for the effects of all forms of land use change that reduce water yield and the interconnectedness of ground and surface water systems or, alternatively, tagging all permanent trades so that it is clear that any future changes in exchange rates, etc would be at the risk of the person who purchases the entitlement;
4. Decide on the volume of water to be secured for environmental services, the methods to be used to source it, and the approach to management of such water.
5. Put in place institutional arrangements to hold "new" environmental allocations and manage the long-term sustainable relationship between environmental flows and consumption at both the catchment and basin levels;
6. Decide on the most appropriate way to convert the access component of each licence into access entitlement shares, and remove impediments to the permanent trade in access entitlements with appropriate trading rules and periodically revised exchange rates;
7. Provide for the development of markets for salinity and other water quality impacts, for channel capacity through the issuance of shares and allocations, and for the development of secondary water market products; and finally
8. Allow conversion of all entitlements to resultant robust entitlement, allocation and trading system.

Governance

Institutional separation of access entitlements, allocations and use conditions enables management at different scales with management of interactions among them largely via market rather than administrative processes. Significantly, robust systems seek to internalise problems so that those finding an administrative flaw or omission seek to fix the problem rather than exploit it to the disadvantage of others. This is most efficiently achieved by locating responsibility and accountability for resolving problems at the scale that they occur. Where problems occur at multiple scales, nested administrative arrangements that assign responsibility and accountability to each administrative level tend to be more dynamically efficient.

Water access entitlements therefore need to be defined by catchment or supply system, allowing climate change and other similar risks to be collectively shared among the pool of shareholders interested in the long-term fate of the water supply system. Generally, the inevitable trade-offs between environmental and economic objectives are most efficiently managed at the catchment level nested within formally assigned limits set by Basin managers who need to ensure that these trade-offs do not compromise the interests of other upstream and downstream water users, and the needs of the environment.

Annual allocations can be made only after the quantity of water available for consumptive use is established. In complex systems, like those in the Murray Darling Basin, the quantity available for use will depend, among other things, upon the extent of the transmission losses. Exchange rates will have to be varied regularly by a river manager at the reach level as market and biophysical systems change.

It is also important to consider how any water access entitlements secured for the environment are managed. A preferred option is for all water secured for the environment to be placed in an independent Basin-wide trust empowered to maximise environmental outcomes. This could involve selling some environmental allocations in drought periods when the price of a seasonal allocation tends to be very high and environmental needs are less and then using the resultant money to buy back more water in wetter periods when the irrigator demand for water is less. This counter-cyclic trading opportunity could even be used to gradually increase the environmental entitlements. The result would be a more efficient social outcome – increased environmental outcomes and increased opportunities for the irrigation sector.

Use conditions and obligations to others and to the environment occur at two levels: basin-wide, associated with distant downstream impacts; and local, characterised by impacts on neighbouring businesses, the local community and local environments. Efficient management basin-wide requires assignment of outcome performance targets (both quantity and quality) that downstream local water-use managers are both responsible and accountable for delivering. In most Australian States, the logical local water-use manager is either the catchment management authority or local government authorities appropriately scaled and resourced and with boundaries aligned to coincide with catchment boundaries. These use-control arrangements need not be administered centrally.

Concluding comment

Many of the building blocks and steps identified in this report are already in place. As Australia embraces the challenge and opportunity given to it by CoAG, it will be important to identify the fundamental design characteristics of robust water entitlement, allocation and use control. These include arrangements that ensure continuous alignment between entitlements and the quantity of water available for use, full specification and assignment of risk, and separation or removal of use control from entitlement definition. If the reforms now being pursued by Australia get the fundamental design characteristics right, as a result we should have a set of robust arrangements capable of withstanding the test of time.

Choice of procedural process and sequencing, and style of communication with irrigators is critically important. As governments begin the process of securing water for the environment, irrigators will be less inclined to leave water in the river. At present, around 10 – 20% of water is neither traded nor used! Failure to address the fundamentals of system design could result in outcomes that are worse than those already expected.

Our estimates suggest that the sum of the flow losses and allocation reductions caused by existing hydrological flaws are as great as the volumes under consideration for return to the environment. If irrigators understand that, in parallel with the processes being put in place to secure additional access entitlements for the environmental, a sub-set of them will have their allocations reduced by a similar amount because of the effects of land use change, increased water-use efficiency, salinity interception and groundwater development, etc. then there is no problem. If, however, they are not aware of this, administrators may face a major communication challenge.

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Robust Reform - Implementing robust institutional arrangements to achieve efficient water use in Australia

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"A key focus of the National Water Initiative will be to implement a robust framework for water access entitlements that encourages investment and maximises the economic value created from water use, while ensuring that there is sufficient water available to maintain healthy rivers and aquifers. …Under the National Water Initiative, jurisdictions will establish a robust, transparent regulatory water accounting framework that protects the integrity of entitlements."
Council of Australian Governments, 29th August 2003.

1 Introduction

The focus of this report is on implementing institutional arrangements for the efficient allocation and management of water. The report builds on an earlier report entitled "Robust Separation – a search for a generic framework to simplify registration and trading of interests in natural resources" (Young and McColl, 2002). It expands a recent policy forum article in the Australian Economic Review (AER) (Young and McColl, 2003). This latter article briefly examined a number of conceptual challenges and uncertainties associated with the management of the Murray-Darling Basin Cap. Among other things, it proposes a sequence for their resolution in conjunction with the implementation of a robust entitlement and allocation system. Following the receipt of considerable constructive comment on the AER article, this report seeks to expand and clarify many of the points raised. Opportunity to explore some of the consequences of the recent Council of Australian Governments (CoAG) announcement of a National Water Initiative is taken.[2] We release the report to assist those involved in the present CoAG processes pursuing the water reform agenda committed to by Australia's Governments.

Water is an input into human use including economic production and recreation activities that generate many externalities, and also provides many valuable ecosystem services only partially captured in the market. The challenge, across space and through time is to find the most efficient and equitable way to deploy the nation's water resources in economic and human use and in the maintenance of environmental processes. Institutional arrangements are required that are dynamically efficient and low cost, and robust in an institutional sense. These arrangements must be able to optimally manage and deliver benefits arising from consumptive uses, in providing ecosystem services arising from non-consumptive uses, and in addressing the full suite of externalities that result from water use. When they are compromised, investment is less efficient than it otherwise would be and community welfare is less than it could be.

1 This report has benefited tremendously from the opportunity to discuss the issues identified with members of the Wentworth Group of Concerned Scientists and also our colleagues Darla Hatton MacDonald, John Radcliffe, Geoff Edwards, Alistair Watson and John Freebairn. We have also benefited from the opportunity to discuss the ideas presented with many irrigators and present them at a number of conferences and seminars. In particular, we would like to acknowledge the comprehensive comments and criticisms of early drafts made by the Board of Murrumbidgee Irrigation and Clarke Ballard both helped us to communicate the concepts presented in this report with greater clarity.

2 Copies of the CoAG communiqué committing Australia to a National Water Initiative can be downloaded from http://www.dpmc.gov.au/docs/coag290803.cfm

It is often stated that Australia is the driest inhabited continent in the world. While factually correct, from a policy perspective this statement can be misleading. Australia ranks 40th out of 180 nations in access to renewable water resources per capita (UNESCO, 2003). From an economic perspective, the Nation's water resources are abundant. Thomas and his colleagues, in a thorough assessment of the role of water in the economy, could find little to suggest that water is a constraint upon opportunities for economic growth (Australian Academy of Technological Sciences and Engineering,1999). Water shortage is not the issue, rather inadequate water resource management systems. What matters economically is the breadth of opportunities to combine capital, labour and natural resources. The challenge is to find ways to harmonise contests among environmental and economic objectives to the benefit of people living today and those yet to born.

2 Biophysical, economic and institutional challenges

2.1 Biophysical

Unlike water in many other parts of the world, Australian surface water supplies tend to be highly variable. For example, flow variability in the Darling River is 4,700:1 while flow variability in the Amazon is 1.13:1. Consequently, to endeavour to manage this extreme flow variability, Australia has invested large amounts in the development of dams and distribution systems. Storage capacity across the entire Murray Darling System is 50% higher than the average run-off of all rivers.[3] As a result, very few of our surface water and groundwater systems, in any way, resemble their natural state – we have re-arranged them to remove a large amount of variability. As Watson (2003) observes, references to what existed prior to 1788 lack an understanding of the reality of the landscapes that now characterise Australia. The Nation would benefit from a discussion to identify what we have already lost irreversibly, what is worth protecting if we act wisely and quickly, and what will require a trade off between environmental and economic objectives.

Australians incorrectly perceive rivers as narrow conduits. Many of our most serious problems in water management stem from a past failure to understand the hydrology of groundwater connectivity and the generally long time these systems take to respond to changes in land and water use. In fact, most Australian rivers are inextricably connected with a surrounding groundwater aquifer. These groundwater aquifers supply most of the base flow. In many cases, these groundwater bodies are highly saline. Recent work by the National Land and Water Resources Audit has classified groundwater systems into local, intermediate and regional (NLWRA, 2001). When perturbed, local groundwater systems typically return to a new equilibrium within 20 years and intermediate systems within 100 years, while regional aquifer systems, which dominate the Murray-Darling Basin, typically take over 500 years to express themselves fully in a river.

[3] Source: Don Blackmore, presentation to SA Parliamentary Forum on River Murray, Adelaide, February, 2003.

There is much debate and misconception about the current status of Australia's water resources. Biophysical assessment – almost devoid of economic analysis – reveals an adverse report card. Two key biophysical observations that are driving political debates include statements that:

- by 2020, unless significant action is taken, it is expected that River Murray salinity at Morgan in South Australia over 50% of the time will fail to meet World Health Organisation desirable drinking standards (MDBMC, 1999); and
- between 20 and 40% of irrigation water needs to be returned to the stem of the River Murray so that there is at least moderate probability that it can be restored as a healthy working river (Jones *et al.*, 2002).

As a result of these and many other observations, a process known as the "Living Murray" process has been implemented to consider the merits of enhancing environmental flows in the River Murray System with a view to improving the environmental health of this system. The area under consideration can be described as the Southern Connected River Murray System. This consists of the River Murray in South Australia, the Darling River and its Ana Branch below the Menindee Lakes, the River Murray itself, the Murrumbidgee System and all Victorian tributaries except those in the Mallee. It does not include the Lachlan River in NSW.

Through the Living Murray process, re-allocation of substantial volumes of consumptive use water to the environment is being contemplated and CoAG has now announced $500 million of "new" funding for this purpose. But, no decision on how much water to secure or how to go about securing water for the environment has been made. Nevertheless, volumes of 350 GL, 750 GL and to around 1,500 GL have been chosen as reference points to facilitate consideration of the options and focus analysis (MDBMC, 2002). 1,500 GL of water represents around 18% of the mean amount of water presently consumed in the Southern Connected River Murray System. More recently, it has been stressed that there is a need for an outcome-focused approach. It also needs to be recognised that these volumes relate increases in net flow against the 1993/94 CAP benchmark.

Recent statements and actions by politicians suggest they perceive the community as willing to support the use of significant public funding to address many of these biophysical problems. Indeed, the language used in the recent CoAG communiqué suggests that market-based and market-like processes will be used to reduce reduce consumptive use. Many commentators seem aware that the business case for fixing systems like the River Murray is compelling (Young *et al.,* 2002). Leave more water in the river, manage flow for both market and for non-market benefit, remove flaws in allocation systems and impediments to trading, and Gross Domestic Product will increase. Leaving more water in the River Murray and decreasing salinity impacts is a profitable investment. Many irrigation communities fear that personal welfare will decline as a result of environmental flow enhancement. The extent to which these fears become reality will depend upon implementation process and detail. A major factor influencing this outcome will be choice of the mechanisms used to secure the water needed to enhance river health and the processes followed. If these processes are perceived to be fair then much more rapid progress can be expected.

2.2 Economic and institutional

Australia has a plethora of water licensing systems onto which mechanisms for managing externalities, rationing scarcity and trading have been bolted. If trading is to become the norm, then the case for introducing a nationally consistent water entitlement and allocation system is compelling. Consistency reduces transaction costs and opens up economic opportunity. Differences in approaches among States are dramatic. Even the terminology used is inconsistent. Queensland and SA call access entitlements "allocations," Victoria and NSW only use the word "allocation" to define the quantity received in a specific year (Carmichael and Cummins, 2001).[4]

Within the Murray- Darling Basin, some New South Wales (NSW) licences allow unused periodic allocations to be carried forward to the next year, while in those parts of Victoria and South Australia (SA) relating to the River Murray, "use-it or lose-it" policies are in place. Amongst other things, this means that unfettered allocation trading among States would be problematic as this opens up the opportunity for SA and Victorian irrigators to bank allocations in NSW. Other examples of differences in approach, which resemble the "railway gauge" problem, include a foreshadowed NSW guarantee of entitlement reliability for the period of each 10 year water plan, while other States allow for uncompensated changes at any time. Licences in NSW are periodic, while in SA and Queensland they are in perpetuity. Victoria is the only State providing preferential access to so-called "sales" water.

During the 1990s, recognition by the Murray-Darling Basin Ministerial Council (MDBMC) that water resources are limited led to:

- Capping - the introduction of a "cap" on diversions at 1993/94 levels of development for NSW, Victoria, and SA; and
- Trading – the introduction of mechanisms to encourage economically inefficient water users to sell water entitlements and allocations to economically efficient water users.

2.2.1 The Cap

In 1995,the MDBMC decided that preventing any increase in diversions from the Basin was essential to arrest further decline in both river health and the security of supply to existing water users, and introduced an interim Cap defined as "the volume of water that would have been diverted under 1993/94 levels of development. In unregulated rivers, this Cap may be expressed as an end-of-valley flow regime". The Cap was subsequently confirmed permanent, effective from 1st July 1997. Any new developments were to be dependent on obtaining the required water by improving water-use efficiency or by purchasing water from existing developments.

Definition of the Cap is complex and varies on a reach by reach basis in a manner that makes discussion of overall arrangements problematic.[5] Importantly, each limit is on the volume of water that may be diverted from the river in any period, not a limit on the number or form of

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4 In this report, we define any arrangement that can be expected to deliver a stream of seasonal volumes for use as an "access entitlement" and any volume that a person may extract within a season as an "allocation."

5 Full details can be found in a 60 page MDBC document that sets out the formulas to be used to define the relationship between use and the cap for each reach.

entitlements to extract or harvest water that may be issued. Incorrectly, many people assume that arrangements for their area also apply in all other areas. This is not the case. There is considerable variation among States and between irrigation districts in the way diversions are measured and the licences that permit these diversions. In some reaches and for some but not all water supply systems, the Cap is defined in a manner that accounts for surface returns, in others it does not.

The Cap in any year is the volume of water that would have been used with the infrastructure (pumps, dams, channels, areas developed for irrigation, management rules, etc.) that existed in 1993/94, assuming similar climatic and hydrologic conditions to those experienced in a year in question. The Cap therefore is a dynamic mechanism and provides for greater water usage in some years and lower use in other years. The details of the Cap are provided as Schedule F – Cap on Diversions, to the Murray-Darling Basin Agreement. More specific reach and system details are available (MDBC, 2002).

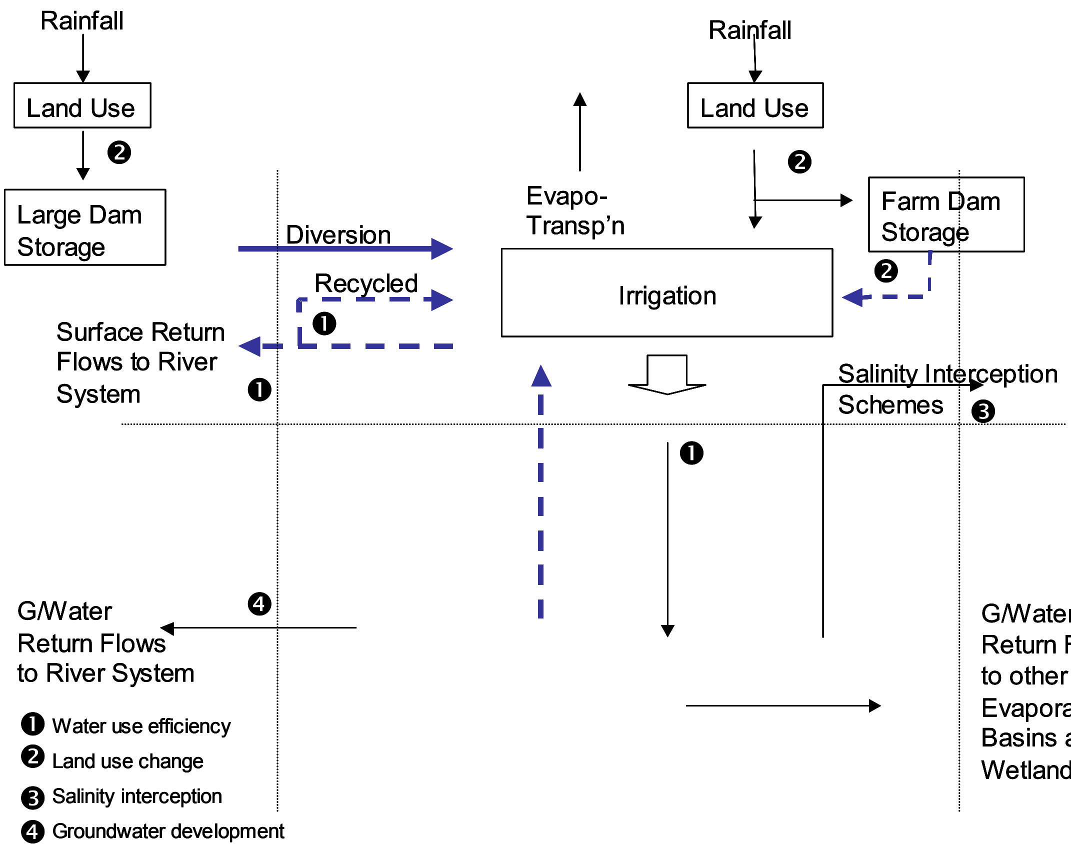
When the Cap was set in place, it represented about 75 % of the estimated natural river flows for the River Murray System in 1993/94. The introduction of a Cap on diversions was seen as a first step in establishing management systems to achieve healthy rivers and sustainable consumptive uses. The allocation process, however, is more complex than this. When determining how much sales water in Victoria and how much general security water is to be offered in each season in NSW, consideration is also given to the quantity of water in storage, hydropower supply commitments and environmental needs. In extreme circumstances, allocation to high security entitlements may be reduced. In areas where the sum of entitlements is greater than the local Cap, trading restrictions are also used to limit water use. These restrictions also mean that allocations to general security users and to those who use sales water are greater than they otherwise would be.

With robust allocation and accounting systems for both water quantity (including river flow) and quality (particularly salt) in place, the trade-offs among actions to minimise the mobilisation or movement of salt into rivers (revegetation of catchment recharge areas, salt interception schemes) and impact on river flows and river salinity (dilution effect) can be left to market mechanisms. When they are not in place, a complex array of administrative arrangements are needed.

Of particular importance for any assessment of the amount of water needed to restore health to rivers, like the River Murray, is the question of how well entitlements to divert water from the system align with the hydrological processes as land and water use changes. An overview of critical processes is provided in Figure 1 below. Changes in hydrological processes in solid blue are well accounted for in current allocation systems, changes in hydrological processes represented by a dotted blue line are accounted for in some but not all systems, and changes in hydrological processes in black are omitted from virtually all systems. This means that it is possible for a water user to change the way water is used and, hence, the volume of water left in the river without affecting their entitlement. Before going further, it is necessary to stress that many administrators and system managers are aware of these omissions and are using trading restrictions and seasonal allocation processes as a way to contain their impacts.

Significant omissions include the influence of land-use changes that reduce groundwater recharge and run-off to the river, as well as the impact of increases in water-use efficiency on river flow. Other important omissions include the effects on river flow of salinity interception schemes, and development of inter-connected groundwater resources.

Figure 1 An overview of factors that affect river flow at the local level



2.2.2 Water-use efficiency and reduced return flows to river

When water use is technically inefficient, a significant proportion of the water returns to the river for use by others and the environment via surface drainage run-off and from local inter-connected groundwater systems. Under present arrangements and at the individual level, most irrigation licences are defined as an entitlement to divert or pump a volume of water without any regard to the quantity that returns back to the river system either via a surface drain or via groundwater (see Figure 1). Such "savings" from increases in on-farm water-use efficiency have been used to expand irrigation. Importantly, increases in water-use efficiency and most water recycling reduce river flow.

It should be noted, however, that some irrigation areas in NSW and Victoria are already receiving "net" bulk entitlements after allowing for reductions in surface drainage return. This means that when one person increases water-use efficiency, water is reallocated to this person by reducing allocations to other users. In Victoria, this is achieved by reducing allocations of sales water and in NSW by decreasing allocations to general security irrigators. There are also particular circumstances, such as the Barren Box Swamp in the Murrumbidgee Irrigation Area, where surface return flows are probably not significantly affected by increased water-use efficiency as unused water does not return to the River (Thompson, 2003, pers. com.). The effects of returns via groundwater systems, however, still need to be considered. Discussions that we have held with many irrigators suggests to us that many, if not most, are not aware of the effect of increased water-use efficiency on the volume of water likely to be allocated to them in the future

The impact of increases in water-use efficiency can be significant. In the Riverland in SA, it has been estimated that an increase in water-use efficiency from 85% to 90% would reduce total groundwater inflows to the River Murray by approximately 22% (Australian Water Environments, 2003).

The contribution to return flows from leakage to groundwater by irrigation supply system channels is also significant. With supply system rehabilitation with pipes, such as in the SA Riverland, there has been around 30% saving of pumped volumes that have largely been captured by the SA Government. While this has been mostly allocated to expanded irrigation, some is being retained as increased environmental river flow. In aggregate, however, it is clear that pipe rehabilitation in the SA Riverland has decreased river flow. Other investments including the replacement of flood and spray irrigation technology with state of the art drip irrigation systems can be expected to do likewise. Indeed, the Water Allocation Plan for the River Murray Prescribed Water Course (South Australian Government, 2001) requires that all irrigation in the River Murray Irrigation Management Zone (from the Victorian Border to Mannum) achieve 85% efficiency.

Water trading can aggravate the impact of omitting the effect of increased water-use efficiency on surface returns and groundwater flow to the river. Consider, for example, the impact of a trade involving the transfer of 1,000 ML of entitlement that was being used to flood-irrigate pasture alongside the River Murray near Swan Hill. Such water is probably being applied to pasture at something like 40% water-use efficiency. This means that when 1,000 ML is pumped onto the pasture eventually 600ML would return to the River via surface drains and groundwater. Note the entitlement is defined in terms of the "gross" amount that is pumped (1,000 ML) not the net amount that is used (1,000 – 6000 = 400 ML). Under the Pilot Interstate Water Trading Trial, however, it is possible to permanently trade this 1,000 ML of entitlement through to the Barossa Valley in South Australia for use in vineyards that are outside the Basin. If this 1,000 ML was transferred under the provisions of this trial, then the full 1,000 ML would be diverted. This failure to define entitlements in net rather than gross terms results in an increase in use of 600 ML. The result is either a 600 ML decrease in flow or a 600 ML reduction in the volume of water available to other irrigators. Which of these two outcomes or some combination of both of them occurs depends upon allocation policies and trading rules. The effects of these omissions on river flow are illustrated in Figure 1 by the number ➊.

Rapid estimation of the magnitude of decreases in flow likely to be caused by increases in water-use efficiency from 1993/94 is difficult. There was little information on water-use efficiency across the Basin at the time, trading was only just beginning, rapid viticultural development had not really started, and there was still considerable scope for laser levelling. Mean water-use efficiency across the Basin during this period, however, was probably low. The foreshadowed removal of impediments to water trading, however, is likely to induce the transfer of a considerable volume of water to places where it will be used much more efficiently. Similarly, the reallocation of water from consumptive to environmental purposes, however achieved, is likely to be accompanied by considerable investment in increased water-use efficiency. The major omission in this process is the lack of any consideration of the impact of reduced groundwater flows to the river. Significantly, many of the land-use and irrigation development effects that ultimately reduce groundwater flow to the River take time to reveal themselves. This means that the people who invest in the change tend to perceive that they are not responsible for the resultant, albeit delayed, effects on flow.

2.2.3 Land-use changes and farm dam development

Water flow (yield via surface run-off and through groundwater processes) into rivers is also being reduced by upper catchment farm dam development, forestry and other forms of land-use change. For example, most volumetric systems do not account for the impact of increased forestry and other land-use changes that reduce water yield. Current estimates of the likely impact of the government-endorsed vision of trebling plantation forestry across Australia by 2020 is expected to reduce flows in the Murray-Darling Basin by around 1,300 GL (Hairsine pers. com., 2003). A detailed review of the science underpinning this issue is contained in a paper (Vertessy *et al.* 2003, forthcoming). One of the main points made is that it depends where plantations are established. As a general rule, the greater mean rainfall, the more stream flow and groundwater recharge is reduced.

Farm dams have a similar effect. Essentially, they intercept water that would otherwise reach the river and, hence, reduce flow.[6] In recognition of these effects, both New South Wales and Victoria have introduced policies that seek to contain the effects of farm dam development on water yield. Similarly, the installation of water recycling systems in a manner that captures overland flow is not yet restricted.

Interestingly, and following a serious drought in mid-1960s, South Africa introduced a regulatory system under the Forests Act 1968, effectively controlling the extension of commercial forestry by means of an Afforestation Permit System (APS). The focus was on the protection of the national water resources in determining which afforestation permits could be granted or withheld (Van der Zel,1995). Subsequently, a more general Stream Flow Reduction Activity (SFRA) Water Use Licensing System was introduced under the National Water Act (1998). An SFRA is defined as any dryland land use practice, which reduces the yield of water from that land to downstream water users. Conditions attached to an SFRA licence, amongst other things, relate to protection of the water resource and other existing and potential water users, and for practices to limit the reduction of stream flow and other detrimental impacts. The legislation and associated policies and rules allow transferability of SFRA licences between properties. For example, the impact of a proposed afforestation project in the upper zone of catchment on stream flow could be off-set by a transfer of an equivalent SFRA licence from down-stream. This facility would be particularly important in a catchment with water resources already fully-allocated and where the proposed development would otherwise most likely be refused.

Outside the Murray- Darling Basin in the South East of South Australia, there has been considerable debate as to the extent of the effects of plantation forestry on the availability of groundwater for irrigation. In this region, it now seems likely that the Government will require any future decreases in water yield to be off-set by the purchase and retirement of an equivalent irrigation entitlement so that the net impact of any increased forestry or other recharge reducing activity is neutral. The effects of these omissions on river flow are illustrated in Figure 1 by the number ❷.

2.2.4 Salinity interception schemes

A third omission is associated with salinity interception. Salinity interception schemes are not included in the Cap even though they operate by pumping groundwater to off-river evaporation

[6] A further effect, not considered in this paper is the effect of farm dams on the timing and pattern of flows while they fill.

basins, which otherwise would have flowed into the River. While these schemes reduce salt flows into the River, groundwater returns to the river are less and, as a result, river flow is less. When these schemes were first introduced, it was judged more important to prevent salt in-flow and fulfil the commitment to keep salinity at Morgan below 800 EC 95 % of the time. Nevertheless, a loss of river flow is a cost that should be included in the benefit/cost assessments of proposed schemes. The impact of schemes implemented since 1993/94 through the MDBC Salinity and Drainage Strategy and planned for implementation over the next few years has been estimated at 40 GL (Close, 2003, pers. com.). The effect of this omission on river flow is illustrated in Figure 1 by the number ❸.

2.2.5 Increased groundwater use

Across the Murray-Darling Basin, groundwater resources remain uncapped, although in many regions it is no longer possible to obtain a groundwater licence in those aquifers considered to be fully developed. There are, however, a considerable number of groundwater licences to extract water from aquifers in the Basin that are connected to the River and are still to be developed. As surface water markets develop and irrigation water becomes scarcer, those with access to reasonable quality groundwater can be expected to take the opportunity to develop this water and sell surface water entitlements to others. Increased "shandying"—the practice of mixing saline groundwater with non-saline surface water—can also be expected. As a result, groundwater flow to the River must be expected to decline. As far as we are aware, estimates of the extent of these impacts on flow have not been released by State authorities or the MDBC. Nevertheless, we understand that they are in the vicinity of somewhere between 2 and 7%**.** The effect of this omission on river flow is illustrated in Figure 1 by the number ❹. The observation that this effect on flows may be significant, however, does raise the question of whether or not flow enhancements deliberations should consider securing water from both surface and groundwater sources, not just surface water sources.

2.2.6 Estimate of hydrologic impact

To illustrate the general magnitude of the impact of these design omissions, Table 1 provides a rough estimate of the potential consequences of the omissions discussed above for the River Murray System. The table takes into account foreshadowed water trading reforms and the expectation that considerable volumes of water will be returned to the environment (using 1500 GL as an example). It should be noted that the estimates have been derived, using 1993/94 as a baseline, without the benefit of access to sophisticated groundwater models. We stress that more sophisticated modelling is likely to result in significant revision of these estimates. (Work under contract to the Murray Darling Basin Commission is presently under way to provide more precise estimates. Nevertheless, we believe that these estimates are of the right order of magnitude.)

Supported by the additional information provided above, the estimates presented in Table 1 are those presented earlier in Young and McColl (2003) after considerable consultation with groundwater experts and inspection of economic and biophysical information available to them. Publication of the estimates produced a significant debate and requests for more detail. In particular, we received a significant number of comments that a particular omission identified does not apply in the region that the commentator was interested in. Interestingly, most of these commentators observed that it was true in another part of the Basin. Having provided the opportunity to comment and having supplied more information, we remain confident that the overall estimate of the potential net change in mean flow in the River Murray System is of the right order of magnitude—especially as several people have drawn our attention to the presence of additional omissions. It is quite possible that the long run impacts of simply reducing the gross volume of water diverted could result in less—not more—water flowing in down the River. Our aim in publishing these preliminary estimates in both this paper and in Young and McColl (2003) is to stimulate discussion and research on the important issues raised and, in particular, exploration of the most appropriate way to modify existing entitlement and allocation systems so that they can be accounted for.

A second set of comments we received indicated that we should have made it clear that a number of arrangements are in place to manage these effects in order to maintain River flow. Across the Basin many different entitlement systems are in place. Conceptually, as each of the effects discussed above occur, allocations to should be reduced. One of the ways of doing this in New South Wales is to reduce allocations to those who hold a general security allocation. In Victoria, as each effect occurs sales water allocations should be reduced.

Table 1 Estimated reduction in mean annual flow and available seasonal allocations of design omissions in the entitlement systems used to allocate water in the River Murray Basin (baseline 1993/94)

Design Omission	**Net effect**
Reduced drainage and groundwater returns to the River resulting from water use efficiency savings [a)]	- 723 GL
Reduction in water yield from catchment land-use changes like increased forestry and farm dam development [b)]	- 600 GL
Reduced groundwater flow to the River as a result of increased installation and operation of Salinity Interception Schemes [c)]	-20 GL
Reduced groundwater flow to the River from increased groundwater use [d)]	-349 GL
Estimated net reduction in mean river flow and allocations to irrigators	**-1,692 GL**

a) This assumes that a mean of 8,734 GL is used for consumptive purposes in the River Murray System. Since 1993/4 there has been considerable investment that has sought to increase water-use efficiency. If 1,500 GL is withdrawn from irrigation, it can be expected that irrigators will respond by increasing water-use efficiency further. It is assumed that the collective long run effect of reduced groundwater return, reduced surface water return in those systems where licences are defined in gross not net terms and increased investment in the capture and use of run-off will be around 10% of the remaining water.

b) It has been estimated that from 2002, increased plantation forestry stimulated by financial incentives will reduce recharge across the entire Murray Darling Basin by 1,300GL (Hairsine, pers. com.; Vertessy *et al*., 2003). Assume that this reduces mean flow into the River Murray System by 600GL. The estimate is intentionally conservative. More accurately, an estimate of the impact from 1993/94 to 2002 could also be included. In our original text we did not include an estimate for farm dam development. More recent advice to us suggests this impact could be as big as that caused by forestry development in high rainfall areas.

c) At present, pumping of saline water and its subsequent evaporation as part of a salinity interception scheme is not defined as an extractive use which needs to be managed under the cap. This estimate of 20 GL is also conservative. The MDBC has since advised that 40 GL is a more appropriate estimate of the impact of existing and planned schemes (Close, pers. com.).

d) Results from MDBC studies (currently embargoed) are understood to have estimated that increasing groundwater development will erode the Cap by somewhere between 4 and 7%.

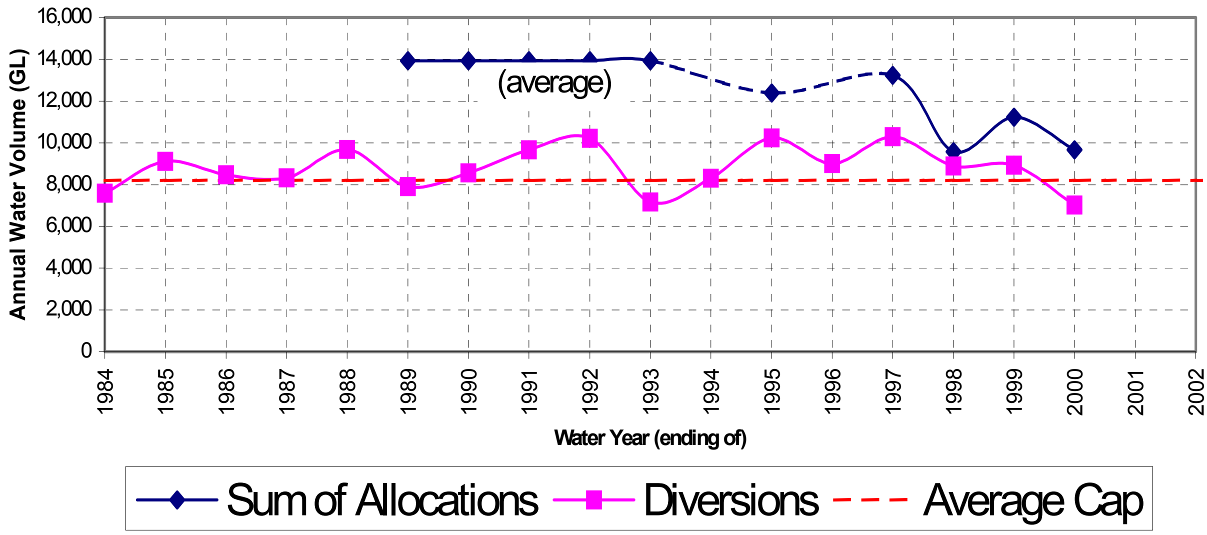
2.2.7 Climate change

Another consideration is the prospect of climate change. Although not included in Table 1, none of the arrangements in place are designed to cope with climate change. A robust entitlement and allocation system would, in advance, explicitly indicate how both reductions and increases in water availability as a result of climate change would be managed and assign responsibility for managing the risk that climate change may occur to water users. In particular, it would make it clear how the risk of climate change is assigned and which irrigators will have their allocations reduced as climate changes occur.

2.2.8 Gap between current licence entitlement and use

A related consideration is the fact that the Cap, as agreed among States, is on diversions (use) not on entitlements. Historically, licences were issued on the understanding that the water allocated would be used in most but not all years. Administrators typically issued licences so that the sum of all licence entitlements is between 10% and 20% over normal usage, and, in some groundwater systems, as much as four times normal usage (see Figure 2). Gaps between the volume of entitlements (adjusted for reliability) and the Cap are most pronounced in South Australia and New South Wales and appear to be rare in Victoria where entitlement policy has been more conservative and sales water is made available to irrigators on a regular basis but only when additional water is available. Where gaps exist, restrictions on trade and seasonal allocation policies are used to stop this water being activated. Generally, as more high security water licence entitlements are activated, seasonal allocations of sales water in Victoria and general security water in New South Wales are reduced.

Figure 2 Diversions from the Southern Connected River Murray System, the Sum of all Allocations and the Average Cap



Source: Young *et al.,* 2002.

While the gap between allocation and expected entitlements is being managed at present, its presence creates a significant problem for those who aspire to purchase entitlements from irrigators and re-assign them to the environment. There is a real risk that a naïve purchaser of environmental water could go into the market and purchase unused entitlements and have little if any impact on use. Supply managers would then have to manage this consequence by reducing allocations made to others. The policy significance of this gap between licence entitlements and the Cap is illustrated by the recently announced drought-induced reduction in allocations for irrigation water use in SA for 2003/04. In SA, many irrigators have neither been using all the water allocated nor selling it to others. SA administrators, however, have realised that many irrigators have been happy to leave water "in the River" until needed for such drought situations. In recognition of this, SA water administrators have estimated that in order to reduce water use by 20% they have to reduce allocations by 35%. This represents a ratio at the margin of 1.7:1. An associated problem is that when "left in the River", much of it has actually been left in up-stream storage dams and made available to others—including irrigators in other States—who have become used to having access to it.

The introduction of both the Cap and relatively constrained trading has activated unused, dozer and sleeper licences. Removing current impediments to trading has the potential to further activate unused water entitlements, and add to the difficulties of managing within the Cap in some parts of the system. This problem would not occur if the Cap was a cap on entitlements, rather than a Cap on diversions. In systems where this approach occurs, any unused water is left in the River.

Clearly, to be effective in the long-term, for any purchase of water entitlements for environment the presence of unused allocations in both groundwater and surface water systems must be accounted for. If no account of this is taken, then water entitlements could be purchased either from those who are not using them resulting either in no actual impact on river flow or the reduction in the volume of allocations previously available to others. A reasonable assumption is that removal of trading impediments plus increased scarcity will activate around 50% of this presently unused "cap gap". If this occurs and 1,500 GL of entitlements are secured for the environment, then we estimate that a further 373 GL of unused entitlement will be activated. If this is accompanied by an offsetting reduction in general security allocations and sales water, then there is no flow problem.[7] If, however, every megalitre of entitlement sourced for the environment is not accompanied by an equivalent reduction in the Cap, then the net result may be a 1,500 GL less 373 GL=1,127 GL.

2.2.9 Summary of omission effects

In summary, combining the estimates in Table 1 with the impact of sourcing environmental water from consumption without reducing the Cap or without reducing general security, sales water and other less secure allocations, could produce a potential net decline in mean flows of 565 GL (1692 less 1127). We would not expect this aggregate effect to occur as river managers would be forced to reduce the volume of water allocated to less secure entitlement holders. How much adjustment occurs will depend heavily upon the arrangements chosen. In drawing attention to the magnitude of these omissions, we observe that the Cap is defined in terms of diversion volumes and all the States have agreed to keep use within this limit. In responding to the issues raised in Young and McColl (2003), particularly the potential impact of the activation

7 There is, however, an equity consideration.

of unused, dozer and sleeper water, State agencies and irrigation companies have made the point that all have agreed and are committed to manage within the Cap. This is not in dispute. Our point is that the size of the changes necessary to enhance environmental flows are much greater than much of the language being used to communicate the challenge before Australia suggest.

Markets are excellent servants. Give markets an opportunity to reveal a loophole and they will. If governments decide to reduce irrigation entitlements by say 1,500 GL and fail to take action to account for the underlying effects of changes in the way water and land are used, in 20 or so years time after the impacts of all the design omissions have revealed themselves, the result may in the worst of circumstances be *less not more water* in the River Murray.

3 Two policy challenges

The discussion above draws attention to a number of significant policy issues. Essentially, the policy challenges now faced by Australian water resource and environmental managers collapse to:

- The search for a robust set of institutional arrangements, defined in the broadest sense possible, to enable the efficient allocation and management of water resources and both *consumptive and non-consumptive* water use through time; and

- The search for an efficient and equitable transition pathway to such a set of institutional arrangements.

In the following two sections, we provide detail of our vision of robust institutional arrangements and discuss important aspects of the transitional challenge in moving to such arrangements.

4 Robust institutional arrangements for water allocation and management

4.1 Robustness

Institutional robustness requires a focus on some new allocation mechanisms and assemblages of these mechanisms that differ from those considered by most policy makers at the time a system is under review and from those previously encountered. Robust systems have an architecture that can be expected to produce efficient and politically acceptable outcomes in an ever-changing world (Jen, 2003). Robust systems persist, are adaptable, and can withstand the test of time.

One of the greatest contributions to thinking about robustness comes from the inaugural Nobel Prize laureate in economics – Jan Tinbergen – in the form of the Tinbergen Principle (Tinbergen, 1950). The Tinbergen Principle[8] states that to attain a given number of independent policy targets there must be, at least, an equal number of policy instruments.

[8] The Tinbergen Principle is concerned with the possibility that there might be a robust way to efficiently manage conflicting issues in a dynamic environment. Tinbergen identified the necessary conditions for a robust solution. It is necessary to carefully examine the proposed set of instruments to determine whether or not the combination of instruments chosen will produce a solution that will stand the test of time.

Thus, if arrangements for managing water allocation and use are to be robust, the components of existing systems must be separable from one another. In unseparated systems, whenever any problem emerges, the entire system comes under review, negotiations are complex, and an opportunity is provided to reopen old agendas. The clue to the robust resolution of many of Australia's water resource problems lies more with separation than in integration.

A robust system would need to facilitate:

- Resolution of resource allocation between consumptive use and the environment, among consumptive users, and of issues related to distribution and use;
- Secure, economically efficient and low cost trading and administration;
- Assignment of risks making it clear where responsibility lies, under what circumstances compensation is due, and specifying the processes for obtaining redress; and
- Management of externalities associated with use – the interests of third parties, future generations and the environment – with minimum controversy.

A robust system also must pass the conventional tests of efficiency and fairness. For this to occur in a changing world, the system must not only be built on a solid conceptual foundations, but also be flexible and adaptive, transparent and equitable.

4.2 Balancing market and non-market uses

In the past, it has been common for legislators to grant absolute priority to the environment, transport and recreation, and only licence access to the remainder. Thus, licences were allocated for a term and Ministers empowered to reduce allocations without compensation. Performance criteria associated with this prior assignment, however, are vague. The first-best solution would be to define a set of minimum baseline river flow conditions. As suggested by Peter Cullen and others, this process could be implemented via the development of a river classification system that identifies rivers as heritage, conservation or working rivers (Jones, 2003). Once this higher-level classification system is in place, mechanisms are needed to allow river managers to make seasonal and daily trade-offs as supply conditions and both environmental and consumptive demand conditions change. In the long run, dynamically efficient water use requires either a very flexible rule-based cap or a structure that allows administrators to "trade" environmental allocations with consumptive water users. One dynamic option is to place some or even all environmental access entitlements in an independent environmental trust and then allow the trust's trustees to trade counter-cyclically, selling some allocations in a drought and purchasing allocations, presumably at a lesser cost per megalitre, in wetter years. Profits made from this counter-cyclic trading could be used either to buy more allocations or to buy additional entitlements.

4.3 Water access entitlements, allocations and use conditions

In 1994, CoAG recommended separation of water licences from land title, allowing water access entitlements and allocations to be deployed to uses generating greater economic returns. Faced with the requirement to deliver water trading or lose access to Commonwealth money, most States chose simply to bolt water-trading arrangements onto existing licence systems, with little attention to investment security, water quality and river health implications. The result has been the emergence of a host of new problems that are, amongst other things, the focus of a recent report to CoAG (NRMC, 2003).

CoAG introduced the words "property rights" into the performance requirements imposed on States in 1994. In retrospect, the use of this "economic jargon" has been interpreted by some parties as implying the creation of compensable property rights. Similarly, "clear specification of entitlements in terms of ownership, volume, reliability, transferability and, if appropriate, quality" has been misinterpreted as an instruction for States to guarantee volume and to ensure that changes necessary to effectively regulate negative externalities, accommodate changes in social values, and maintain river health will be compensable. As we have stressed elsewhere in Young and McColl (2002), the more efficient approach is to fully specify interests and risks and then transparently distribute responsibility for managing these risks among the parties involved. Some risks are most appropriately managed by private investors and some by the government. Very few are most efficiently managed by failure to fully specify them and failure to communicate the nature of them to water users.

Building upon this concept of fully specifying risk, and upon the Tinbergen Principle, the features of a robust set of water-licensing arrangements separated from land title have been identified (Young and McColl, 2002). Key characteristics of the proposed system include:

1. Formal unit shares issued in perpetuity and defined as an unequivocally guaranteed, mortgageable claim to a proportional share of any periodic water distributions;

2. Separate management of all distributions using low-cost bank-like accounting and trading protocols that define the quantity that may be traded or used in "net" not "gross" terms;

3. Independent authorisation of irrigation via use licences that reserve pollution rights to the Crown and define all duties associated with water use at a site in a manner that remains consistent with conditions expressed in statutory catchment management plans (see Figure 2); and

4. Provision for definition of the amount of water allocated for environmental purposes partly as a prior right and, where appropriate, partly as a tradeable allocation enabling an environmental manager or trustee to decide when and if a water allocation may be sold to a consumptive water user, left in the system for the benefit of recreational users, or used for the production of ecosystem benefits or to maintain estuaries.

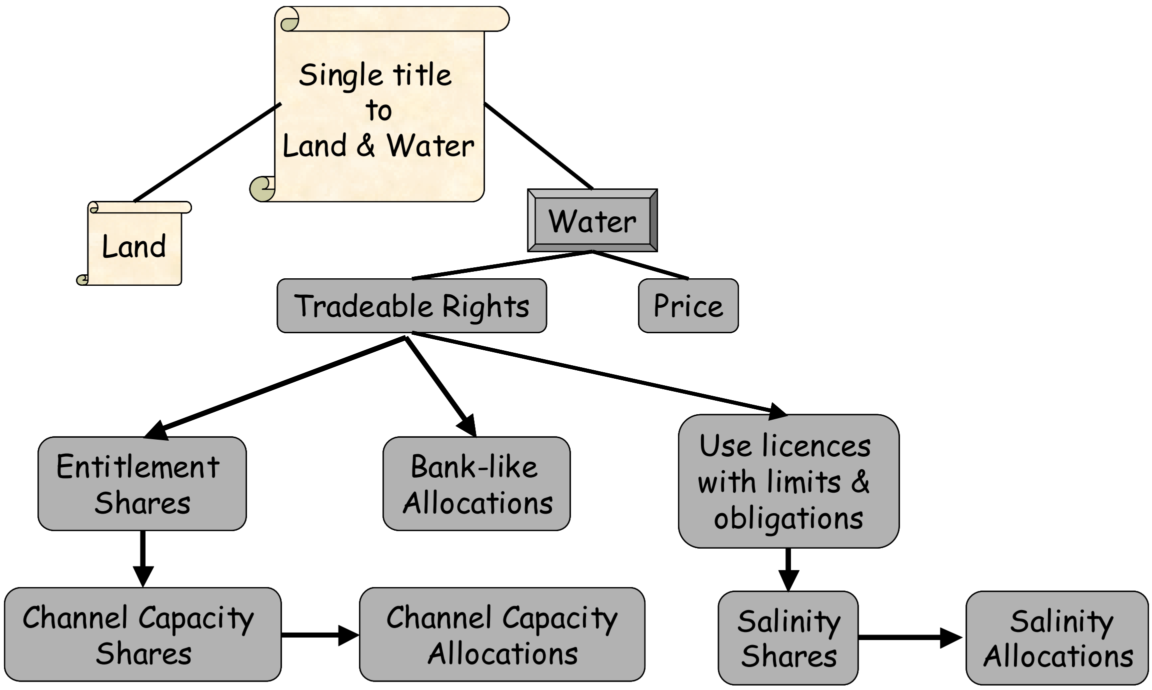
In several States, the reform processes underway are consistent with many of these characteristics. New South Wales, for example, has begun the process of separating access entitlements from use entitlements and all States have begun the process of pricing reform.

Robust design principles also require that careful attention be given to the allocation hierarchies. In many parts of Australia, entitlements and licences have been distributed both to water supply companies and trusts in the form of a bulk licence and to irrigators as an individual use licence. Robust systems recognise that only one interest can be primary. All other interests must be defined via an encumbrance on the water access entitlement or use licence. From an efficiency perspective, it does not matter whether the primary interest is held by a water supply company periodically selling water to irrigators, or by individual irrigators. Either way, each party can be expected to contract with the other party to gain access to the services they require. If irrigators are the primary holders, bulk access entitlements are unnecessary for all but supply system losses.

Other design detail includes options to enable trade between surface and groundwater and for the development of markets for channel capacity (with entitlement shares) and salinity (with use licences). Where annual and perennial land-use systems coincide, there is an option for high security and general security entitlement shares to be issued.

There is also a need to carefully consider whether or not entitlements should be defined as share of the entire system or part of the system. If entitlements are not defined as shares of the entire system then in a trading environment arbitrate opportunities emerge as people trade to take advantage of flawed exchange rates and systems reviews. One pragmatic way of dealing with this problem is to introduce tagged entitlement systems so that the exchange rate risks and reform risks cannot be passed via a trading system to others. Under such a tagged arrangement, a Murrumbidgee entitlement would always remain a Murrumbidgee entitlement even though it was being used and had been used in South Australia or Victoria for many years. The administrative costs of managing such a system could become considerable. Clearly, the fewer the tags the cheaper the system will be to administer and the easier it will be to communicate implications of any changes in exchange rates and system charges to entitlement holders. Deciding upon the optimal number of types of entitlement is a non-trivial issue that requires very careful analysis. Clearly, the optimal number of entitlements for the entire Murray-Darling System is not one. The question that CoAG is now asking Australia to decide is how many should there be and what form should they take?

Figure 2 A Robust Water Allocation and Use Management System separated from Land Title



Source: After Young and McColl (2002).

4.4 Pricing

The value of access entitlements and periodic allocations is determined by market prices, market costs, charges, levies and rates imposed by governments, and the impact of regulations. One interesting feature of nearly all water allocation systems used in Australia, is the fact that governments have sought to capture very few of the economic rents embodied in water access entitlements. If they did seek to collect all these rents by, for example, auctioning periodic allocations as they became available, many of the current policy problems would not have arisen.[9]

With regard to pricing, CoAG has recommended previously and just reaffirmed that water, as a minimum, should be supplied to consumptive users at full cost of supply, including the cost of externalities. It is assumed that CoAG meant the marginal and not average cost of supply of water for consumptive use and is not concerned about recovering the costs of previous investments from current water users. Presumably, CoAG also intended that costs of supplying water for non-consumptive uses would continue to be met from consolidated revenue as a community service obligation.

4.5 Managing Externalities

Siebert *et al.* (2000) identified three types of externalities associated with water use: supply externalities caused by dam construction and consequent changed and reduced flows etc; local use externalities associated with run-off, draw-down of neighbouring supplies; and return externalities such as caused by the return of polluted water to a river. They observe that, in many if not most cases, externalities are more efficiently managed using instruments other than the supply price. With few exceptions, water is an input into production and consumption processes. As a general rule, if specific externality outcomes relating to use can be defined and sought, then industry could be left to find the most efficient and least cost way to deliver them. In summary, the marginal cost of supply externalities will be efficiently reflected in the supply price, whereas the cost of other externalities relating to use are more efficiently signalled to water users via mechanisms encouraging them to reduce their incidence on a location by location and business by business basis.

One way of efficiently signalling the costs to others imposed by externalities is to define an environmental duty of care in a way that signals how the performance outcomes sought can be expected to change through time.[10] As recommended to the High Level Steering Group on

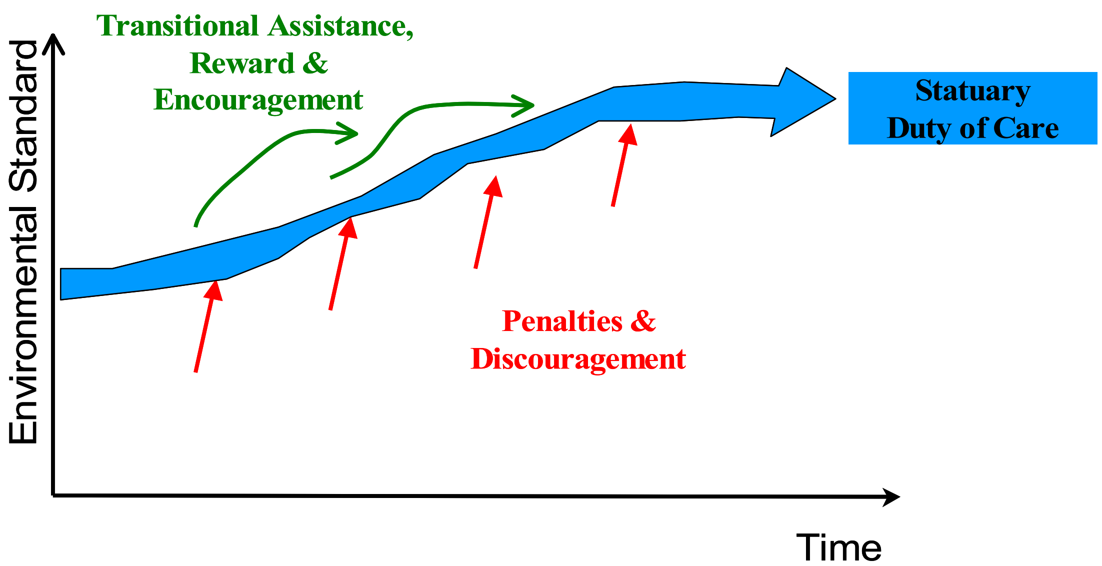
[9] From a government revenue perspective, CoAG's recommendation to separate water access entitlements from land title is raising an interesting challenge for local government. Full separation of water from land means that the rateable value for the remaining land is significantly less. Given the national commitment to separation and that the status quo for revenue collection by local government is to be maintained, either the unit rate could be increased on land used for irrigation, or local government empowered to levy water use.[9] Another approach could be for States to introduce a return-to-the-community mechanism similar to that permitted under NSW fishing legislation (Young, 1999) whereby a proportion of each water access entitlement would be resumed each year and then sold by auction or tender. If a 2% rent is to be collected, then 2% of each entitlement needs to be resumed and sold each year and the proceeds go to consolidated revenue.

[10] On the advice of the High Level Steering Group, the Duty of Care was changed to Environmental Responsibility raising the question of whether or not the many legal precedents associated with the notion of duty of care should apply without qualification to water use.

Water (Siebert *et al.*, 2000), for externalities to be costed it is necessary first for governments to define a minimum duty of care against which obligations can be measured. As a general concept, duty of care can lead to more efficient outcomes than a pure regulatory approach as duties of care are written as prescribed outcomes. Operationally, regulations can only prevent actions leading to undesirable outcomes, whereas a duty of care reverses the onus of responsibility and obliges actions to be taken to achieve desired outcomes. For example, South Australia's proposed River Murray Act will require a person to "take all reasonable measures to prevent or minimise any harm to the River Murray" (s.22). Duties of care would be defined in periodically revised catchment plans with site-specific operational detail incorporated in the individual use licence. Pollution permit trading among individuals through either offset arrangements or a full cap and trade permit system will lead to the most efficient outcomes.

In summary, it is most efficient to include the cost of supply externalities in the prices charged for the supply of water. Outcomes will be more efficient if other instruments are used to signal the cost of local use effects, and downstream externalities caused by the return of water to the environment. Under such a model, and as illustrated in Figure 2, a downstream externality could be managed via the introduction of separate pollution emission entitlement and allocation systems. In some situations, a case can be made for the provision of transition assistance to encourage development of new technology and attain speedier acceptance (see Figure 3). It is critical also that those water users failing to either offset impacts or to meet defined obligations are penalised.

Figure 3 Duty of Care, Transitional Assistance and Enforcement



Source: Young *et al.* 2003.

5 A transitional pathway

5.1 Sequencing

Australian water politicians are currently showing a preference for the removal of impediments to permanent water access entitlement trading and securing additional environmental flows for the River Murray System and other stressed river and groundwater systems. Money has been allocated to the Murray-Darling Basin and is being invested in an effort to restore flows to the Snowy River and the recently announced National Water Initiative has assigned a new $500 million to address over-allocation issues in the Murray Darling Basin. The presence of market impediments, even given the comparative absence of externality cost obligations, means that the value of water access entitlements, allocations and use licences are less than they would otherwise be. In over-allocated systems, like the River Murray, the result is a sequencing opportunity and a sequencing trap. Remove market impediments to permanent trading before a robust entitlement and allocation system is put in place, and the cost of reform increases – especially if all water is to be purchased using a voluntary offer or similar market-like schemes. However, if water is secured for the environment at the same time as market impediments are removed and entitlements are respecified, then the net market gains to entitlement holders from this process can be used to lessen the need for transitional assistance payments. Clawing back recently acquired gains from a community without compensation, irrespective of whether justifiable or not, is a politically difficult process. Especially once a precedence of using market-like processes has been set.

Failure to pursue these reform sequencing opportunities and, in particular, to implement the politically easy options without addressing the underlying flaws is likely to result in the emergence of problems that will hinder opportunities to make further progress. As a general rule, it will be less costly for governments to acquire additional water to enhance the environment before impediments to permanent water trading are removed and before a new robust water access entitlement and allocation system is put in place.

5.2 Developing water-related markets

In most parts of Australia, market and market-like arrangements for water access entitlements and use licences are in their infancy and characterised by arrangements that are designed to prevent trade from resulting in the movement of water into highly saline areas and to ensure that existing delivery expectations can be met. Private markets for access to channel capacity during peak periods and salinity impacts are virtually non-existent. Market arrangements that allow counter-cyclic trading of water environmental allocations do not exist. As a result, the removal of so-called market impediments to regional and interstate trading without the development of the new market arrangements could result in the emergence of a new set of water quality and adjustment problems. In short, the simple removal of trading restrictions without the introduction of new control mechanisms could result in the Basin trading into not out of trouble.

Within regions, the main reason for current restrictions on temporary trading with consequent high transaction costs relates to the need to check that a temporary trade will not generate increased environmental impacts, and to ensure that the traded water can be delivered. Between regions and types of licence, the necessary checks remain similar but require more time consuming coordination among agencies, regional offices and officers. A further problem, as described earlier for Murrumbidgee Irrigation, relates to the difficulty in some parts of the system of managing the activation of unused, sleeper and dozer water within the requirement of the CAP on diversions.

Nevertheless, separation of water access entitlements and use licences, as is happening in NSW, opens up opportunities to sequence implementation enabling economic progress with an understanding that further reforms will follow. It allows the management of environmental issues independently from the investment issues with water managed as an input to production. Moreover, if the intent and direction of these subsequent reforms is signalled with clarity it may be possible to minimise downside risk for investment. In particular, the so called "temporary" market – the market for periodic allocations – can be developed with little downside risk to the community of water users as exchange rates can be varied by regulation from year to year and investors understand that no long term commitment has been made. Thus, there is a strong case for developing the within-region and within-type of water licence temporary trading system as quickly as possible and so speed up opportunities for structural adjustment. For maximum short-term efficiency, the focus should be on decreasing transaction costs and reducing the time for settlement. This requires, among other things, establishment of bank-like accounts accessible over the internet, and facilitation of internet-based trading.

If use licences set a limit on the maximum amount of water that can be applied to a specific location, for example, to minimise salinity impact, then allocation trading could be left to market processes. Between-region and between-licence-system exchange rates would need to be announced periodically in a manner consistent with an expectation that they will change as reforms progress.

Such a temporary-market and use-licence focus would make it abundantly clear where exchange rate and system omission risks reside (with the person who invests on the assumption that water can be traded). The leasing of a water access entitlement for several years would be possible without any need for governments to register and control such commercial arrangements. Governments would only process transfers once exchange rates for a specific trading period had been announced. Similarly, catchment management plans could begin to put in place salinity, and other, offset arrangements to ensure that resultant environmental impacts of land-use change remain acceptable.

As discussed earlier, the risks associated with a "sequence trap" emerging lie with actions that remove impediments to so-called "permanent trading" without first removing the underlying flaws in existing water management systems. Whenever a permanent trade occurs, the market price paid reflects the value of the opportunity to exploit all existing flaws in perpetuity. Whenever a temporary trade occurs the market price paid reflects only the value of the opportunity to exploit the flaw in that year.

In all fully allocated systems, the further development of seasonal allocations (temporary trading) coupled with a freeze on the expansion of access entitlement (permanent) trading could be used to limit arbitrage opportunities until robust accounting systems are put in place. Otherwise, administrators must expect the cost of structural adjustment and transitional payments to be much higher than otherwise would be the case. There are economies of scale in reform processes. As a general principle, the more reforms undertaken at once, the lower the total transaction costs and opportunities for arbitrage.

An interesting way of facilitating permanent trade without the reassignment of risk is to tag all water entitlements by the region they are sourced from. If this is done, then the volume of allocations that attach to that entitlement at any location would always be calculated by reference to the place from which the entitlement came from and the exchange rates that operate at each allocation period. This mechanism makes it clear that the risk associated with any trade would always be assigned to the person who purchases the entitlement and not the system as a whole.

If arrangements are not put in place to ensure seamless alignment of the number of unit shares in the system with its hydrological capacity, ongoing problems can be expected to emerge. As an absolute minimum, water use should be defined in "net" not "gross" terms, arrangements should be put in place to ensure that the effects of land-use changes like forestry development and farm dam construction are offset. The effects of activating unused groundwater and surface water access entitlements also need to be accounted for.

Finally, the process of dealing with each licence is expensive as most involve third parties and complex registration procedures. As robust systems guarantee the nature of all dealings associated with an entitlement and/or a use licence, these transaction costs are significant. In many cases, and as mentioned earlier it will also be advantageous to reduce the number of types of entitlement listed. With few exceptions, there is little justification for more than two types of entitlement—a high security entitlement and a general security entitlement. With two types of entitlement, water users can mix the two options to manage allocation risk. Some regional tagging may also be justified but as more and more regional tags are introduced the cost and complexity of the resultant system must be expected to increase exponentially.

5.3 Developing markets for environmental quality

Existing market impediments largely exist due to the absence of the suite of markets needed for efficient protection, maintenance and, where appropriate, improvement of environmental values. Rather than trying to specify and develop all of these markets, governments have used administrative processes. A National Action Plan for Salinity and Water Quality is being implemented through a program of on-ground works and investments attempting to address outcomes essentially arising from the failure of administrative mechanisms to manage externalities.

Two important missing markets are those enabling the efficient management of salinity and of environmental flows. The downstream implications of these two are interdependent. Increased environmental flow produces a lower concentration of salt and less saline groundwater intrusion.

At present, markets for salinity are very imperfect and, in fact, in most areas legislation prevents individual landholders from accessing them. In the Murray–Darling Basin, for example, a salinity register exists but is only accessible to States and legislation requires that States be given a right of first refusal to purchase any salinity credits available. Private individuals therefore have little incentive to invest in salinity reduction. In particular, there is no direct management incentive for an existing irrigator, whose actions impose high salinity or other costs on downstream water users, to change practice. As a result, salinity continues to get worse. In the same way as it makes sense to cap water and allow individuals to trade allocations, so it makes economic sense to cap salinity impacts and allow individuals to trade them.

Efficiency criteria would suggest that to the extent that current salinity impact comes from existing land-use practice, these arrangements should be changed as a matter of priority. While the introduction of a transparent market for such salinity management is a major step, it could be expected to produce considerable benefits at low cost to government. Work on the development of such salinity markets is in its infancy. Consistent with the robust water entitlement and allocation principles, we suggest immediate introduction of 100% offset arrangements for all new irrigation development. This should be followed by the grandfathering of existing practice through the distribution of salinity emission units to all water users, with the reduction of these grandfathered units at a small percentage each year. A salinity manager, possibly the same entity as the river flow manager, could then decide whether or not to surrender them or sell them. The salinity manager could also accept water access entitlements or periodic allocations as offsets in lieu of salinity credits to the extent that the same environmental outcome can be achieved at less cost.

5.4 Securing environmental flows

At least in the short term, for groundwater and river systems that are not over-allocated, existing systems can be retained and run conservatively. However, if markets are allowed to operate in over-allocated and over-used systems, ultimately water access entitlements need to be reduced and/or supply reliability reduced. A number of mechanisms are available to reduce entitlements. They can be divided into two groups—those that involve an administrative change and those that operate through the water market or at least involve market-like processes.

The suite of administrative processes available include:

1. A *pro rata* reduction implemented administratively by reducing expected reliability and/or, in Victoria, by reducing the volume of water periodically offered for sale;

2. A *pro rata* reduction in the volume stated on each licence;

3. Compulsory acquisition of either a proportion of each licence or closure of specific categories of water use and/or areas of irrigation.

Market and market-like mechanisms include

4. Acquisition of water licences using, for example, open-market, voluntary-tender or compulsory-offer mechanisms;

5. Negotiated contracts involving investment by government in infrastructure upgrades (supply system and/or on-farm) in return for surrender of all or part of one or more licences.

Each option has its benefits, its costs, its equity and its political implications. In practice, a mix of approaches is probably most appropriate. *Pro rata* reduction approaches can be expected to increase market activity and incur deadweight transaction costs as those who cannot afford to give up water buy it back. In systems where two or more types of licence exist it is possible to reduce the reliability of a sub-set of licences. It is, for example, possible to just reduce cap and, as a result, reduce general security and sales water allocations.

Whatever *pro rata* approach is taken, following implementation the most economically efficient water users can be expected to purchase water access entitlements or allocations from less efficient water users and from those simply investing and trading in entitlements and allocations.

Pro rata reduction by licence volume is administratively costly as each licence has to be physically amended and registers in most states are not yet fully electronic. Legislation, however, could be put in place to enable these changes to be made whenever a licence is dealt with for another purpose and/or is replaced with a robust one. If *pro rata* reduction of each licence is combined with re-issue of a robust access entitlement and use licence, total administrative costs will be less as double handling would not be necessary.

The lowest market acquisition approach known is the compulsory offer mechanism. First introduced in the United States for sulphur trading this mechanism is perhaps the most efficient of all known mechanisms. It involves the introduction of legislation requiring all entitlement holders to make an offer to sell a proportion of the entitlement they hold for sale. While it is compulsory to make an offer for, say 2% of all entitlements held, the holder is free to set as a higher reserve price as they like. The purchasing authority, normally, a government authority then inspects all offers made and announces the buy-back price. All entitlement holders whose reserve price is less than the buy-back price then receive the buy-back price for the quantity they offered. The result is the rapid emergence of a deep and mature market characterised by lower transaction costs than any other voluntary market process can deliver (Young *et al.,* 2002). Sophisticated selection and incentive-for-cooperation approaches can be used in combination with this mechanism so that impacts on water quality and water supply costs are also considered. In some areas, for example, the most efficient outcome may involve offering an additional payment when all the licences along a supply channel are surrendered and that channel can be closed. Clearing prices would need to vary by licence type and the use that water is put to. Where serious "gross/net" flaws exist, the total costs of reducing any over-allocation problem may be lower if a higher price per unit is paid for volumes secured from the least efficient water users so that volume negative impacts on river flow are minimised.

An interesting variant of this compulsory offer process is that being used in Australia by Telstra as they seek to buy-back shares to the value of between $800 and $1,000 million via a completely voluntary process. The approach they are using is to write to every share holder and invite them to offer to sell any number of shares that they wish to by a range of prices. All shares purchased by Telstra will be at the announced buy-back price even if the amount offered was less than that price.

As the above Telstra system is a voluntary one any purchase by them could leave the seller with a capital gains liability. A significant feature of compulsory acquisition systems is that special capital gains tax provisions apply. For many entitlement holders such preferential taxation arrangements could prove attractive – especially if the water entitlements were acquired after the 19th September 1985. Compulsory acquisition powers, if granted, could also prove a particularly attractive option in areas where, as a result of environmental flow enhancement and water trading, much of a supply channel is no longer used.

Contracts involving the upgrade of supply or on-farm infrastructure in return for the surrender of water access entitlements are possible but, unless there are significant imperfections in the local water market, the outcomes sought could be more efficiently achieved by simply purchasing water access entitlements and leaving water managers to upgrade infrastructure etc and thereby realise potential from upgrading some infrastructure. Private investors and water users would then make the necessary changes in competition with all other competing investments without the need for governments to get involved. One significant income taxation imperfection that we are aware of is the differential taxation arrangements that apply to water supply companies and primary producers. At present and as we understand it, water supply companies can not gain primary producer status and, hence, can not depreciate and write-off the cost of upgrading infrastructure as quickly as primary producers. This places these companies at a competitive disadvantage.

Interestingly, the recent CoAG decision and announcement of a National Water Initiative implies, through the announcement of new funding of $500 million, that governments are willing to at least commence the process of securing additional water for allocation to environmental processes via the use of market and market-like mechanisms. Ultimately, however, it must be expected that the mix of mechanisms chosen will mainly depend on the volumes of water and the proposed timeline of securing, the expected flow of available finance, and the institutional arrangements set in place to not only to secure but also to manage environmental water to achieve the most beneficial environmental outcomes. How these aspects will be dealt with will be for the relevant governments to resolve in consultation with stakeholders and the community.

5.5 Financing delivery of a robust system and restoration of river health

The extent of the net financial impact of entitlement reduction and upgrade to a robust entitlement and allocation system will depend both on the volume secured for the environment and the extent and nature of the existing imperfections. Clearly, the aggregate package should seek to equate marginal social benefits with marginal social costs (Freebairn, 2003) using valuation techniques that account for the consequences of consumptive and non-consumptive uses.

If market and market-like mechanisms are used, then the financial resources necessary will need to be sourced. Determining how much of the cost of securing environmental water should be borne by water licence holders and how much by the rest of the community is a distributional policy issue. Significant benefits from the suggested reforms will flow to irrigators in the form of valuable, fully specified and fully tradeable water access entitlements and allocations.

A major challenge is to choose the fairest process to follow and this depends in part upon interpretation of the actual and implied rights of entitlement holders and the communities dependent upon the nature of these allocations. In recognition of the merits of securing water at current market prices, operationally any first tranche could be purchased up-front. The size and speed of program implementation should then be determined by the level of funds provided by governments and the environmental benefits being achieved, rather than by an up-front policy commitment to secure a particular volume.

5.6 Water market and access entitlement reform

As indicated above, separation of access entitlement and use systems into their components opens up opportunities to sequence implementation. In particular, it provides an opportunity to speed development of the so-called “temporary” market and freeze, at least, expansion of the permanent market for access entitlements until hydrological omissions are corrected and governments are in a position to roll-out their plan for the introduction of “a robust framework for water access entitlements that encourages investment and maximises the economic value created from water use” and “a robust, transparent regulatory water accounting framework that protects the integrity of entitlements.”

Under such a new robust system one would expect that trade in allocations would occur in “net” not “gross” terms. Once such an arrangement was in place, then unencumbered allocation (temporary) trading could be allowed across the entire system using periodically revised exchange rates. All long-term risks would remain with present licence holders. In parallel, policies should be put in place requiring all land-use changes that affect water yield and flow to be brought into the trading and allocation system. For example, any person installing a farm dam or establishing a new plantation would be required to off-set the impact on other licence holders by acquiring and surrendering an entitlement equivalent to the assessed impact of the proposed land-use change.

Decisions need to be made on the volume of water to be secured for environmental services, the methods to be used to source it, and on the most appropriate way to manage environmental flows.

The access component of each licence then needs to be converted into access entitlement shares and institutional arrangements to manage the long-term sustainable relationship between environmental flows and consumption at both the catchment and basin levels need to be put in place.

Dealing with access licences is administratively expensive as guaranteed registers need to be established and each mortgagee and each interested party needs to be contacted. In many cases, it will be advantageous as part of this process to reduce the number of types of entitlement listed. As indicated earlier, with few exceptions, there is little justification for more than two types of access licence; high security and general security. Once two levels of reliability are in place, water users can mix the two entitlements to achieve whatever degree of reliability they prefer. As access entitlement risks are most efficiently pooled at the scale that they occur, entitlement shares should be issued across connected water resources and not by state or administrative region.

Finally, markets for salinity and other water quality impacts, and for channel capacity can be developed. At present, markets for salinity are very imperfect. Salinity impact permits need to be separated from use licences. Once again, we suggest the issuance of shares and allocations (see Figure 2).

In summary, the reform program can be undertaken as a series of steps as follows:

First, separate water use licences from water access entitlements as is happening in NSW and is foreshadowed.

Second, facilitate temporary market trading with appropriate trading rules and periodically revised exchange rates with a focus on increasing opportunities for internet trading, lowering transaction costs and reducing settlement times.

Third, temporarily freeze expansion of the permanent trade of access entitlements until the access component of each licence is converted into a shares defined in a manner that defines use in “net” not “gross” terms and accounts for the effects of all forms of land use change that reduce water yield and the interconnectedness of ground and surface water systems or, alternatively, tagging all permanent trades so that it is clear that any future changes in exchange rates, etc would be at the risk of the person who purchases the entitlement.

Fourth, decide on the volume of water to be secured for environmental services, the methods to be used to source it, and the approach to management of such water.

Fifth, put in place institutional arrangements to hold “new” environmental allocations and manage the long-term sustainable relationship between environmental flows and consumption at both the catchment and basin levels.

Sixth, decide on the most appropriate way to convert the access component of each licence into access entitlement shares, and remove impediments to the permanent trade in access entitlements with appropriate trading rules and periodically revised exchange rates.

Seventh, provide for the development of markets for salinity and other water quality impacts, for channel capacity through the issuance of shares and allocations, and for the development of secondary water market products.

Finally, allow conversion of all entitlements to resultant robust entitlement, allocation and trading system.

5.7 Governance

Institutional separation of access entitlements, allocations and use conditions enables management at different scales with management of interactions among them largely via market rather than administrative processes. Significantly, robust systems seek to internalise problems so that those finding an administrative flaw seek to fix the problem rather than exploit it to the disadvantage of others. The responsibility and accountability for decisions should be located with the objective of maximising dynamic and institutional efficiency.

Water access entitlements therefore need to be defined by catchment, allowing climate change and other similar risks to be collectively shared among the pool of shareholders interested in the long-term fate of the water supply system. Generally, the inevitable trade-offs between environmental and economic objectives are most efficiently managed at the catchment level nested within formally assigned limits set by Basin managers who need to ensure that these trade-offs do not compromise the interest of other upstream and downstream water users and the needs of the environment.

Annual allocations can be made only after the quantity of water available for consumptive use is established. In complex systems, like those in the Murray Darling Basin, the quantity available for use will depend, among other things, upon the extent of the transmission losses. Exchange rates will have to be varied regularly by a river manager at the reach level as market and biophysical systems change.

It is also important to consider how any water access entitlements secured for the environment are managed. A preferred option is for all water secured for the environment to be placed in an independent Basin-wide trust empowered to maximise environmental outcomes. This could involve selling some environmental allocations in drought periods when the price of a seasonal allocation tends to be very high and environmental needs are less and then using the resultant money to buy back more water in wetter periods when the irrigator demand for water is less. Typically, the value of a water allocation to water user is greatest in a drought and least in wet years. The value of water to the environment, however, will often be the reverse. For example, applying wetting and drying cycles for particular wetlands may be in reverse. Thus, there is opportunity for a responsible environmental manager to trade environmental allocations that are to the mutual benefit of both the environment and irrigators. This counter-cyclic trading opportunity could even be used to gradually increase the environmental entitlements. The result would be a more efficient social outcome—increased environmental outcomes and increased opportunities for the irrigation sector.

It is also important to consider how any water access entitlements secured for the environment are managed. Our preferred option is for all water secured for the environment to be placed in an independent trust empowered to maximise environmental outcomes by trading water. Counter-cyclic trading could then be used to produce a more efficient social outcome. As a general rule, rivers need floods and droughts. It is possible to imagine situations where it would be beneficial for an environmental trust to sell some environmental allocation water in a drought and then buying more water back in a subsequent year.

Use conditions and obligations to others and to the environment occur at two levels: system-wide, associated with distant downstream impacts; and local, characterised by impacts on neighbouring businesses, the local community and local environments. Efficient management Basin-wide requires assignment of outcome performance targets (both quantity and quality) that downstream local water-use managers are both responsible and accountable for delivering. In most Australian States, the logical local water-use manager is either the catchment management authority or local government authorities appropriately scaled and resourced and with boundaries aligned to coincide with catchment boundaries. These use-control arrangements need not be administered centrally. Indeed, we can envisage a situation where a River Manager has to negotiate with several trusts.

In a perfect world, separated governance can occur via one of two models: a conventional delegation of powers model; or a devolved model described by the European Community as a subsidiarity model. Under the subsidiarity model, all powers held at the basin, state or national level are granted to catchment management authorities. Central authorities retain the right to call in powers and functions more efficiently managed at the central level, but if and only if, this fact can be demonstrated. Under this model, catchment management plans become statutory instruments designed to regulate use and catchment authorities have access and opportunity to trial and use the full range of market-based and other instruments available in most States only to central government.

6 Concluding comments

Australian Governments are now committed to the introduction of a suite of robust water entitlement, water trading and water accounting mechanisms. The extent of the net financial impact of entitlement reduction and upgrade to a robust entitlement, allocation and use system will depend both on the volume secured for environmental purposes and the extent and nature of the existing imperfections. Clearly, the aggregate package should seek to equate marginal social benefits with marginal social costs (Freebairn, 2003) using valuation techniques that account for the consequences of market and non-market preferences.

If market and market-like mechanisms are used to address over-allocation issues, then the financial resources necessary will need to be sourced, and, if our recommendations are accepted, placed in one or more trusts. Determining how much financial burden should be borne by water licence holders and how much by the rest of the community is a distributional issue and one that is critically dependent upon how decisions about how design omissions from present entitlement systems are managed.

With regard to the over-allocation issues, one pragmatic option is to start with acquisition via market and market-like processes and only proceed to other options as entitlements rise in value. Significant benefits from the suggested reforms, however, can be expected to flow to irrigators and other entitlement holders in the form of valuable, fully specified and fully tradeable water access entitlements and allocations recorded in a register whose integrity is unequivocally guaranteed.

As Australia embraces the challenge and opportunity given to it by CoAG, it will be important to identify the fundamental design characteristics of robust water entitlement, allocation and use control. These include arrangements that ensure continuous alignment between entitlements and the quantity of water available for use, full specification and assignment of risk, and separation or removal of use control from entitlement definition. If the reforms now being pursued by Australia get the fundamental design characteristics right, as a result we should have a set of robust arrangements capable of withstanding the test of time and make Australia the undisputed world leader in the management and allocation of water resources.

Choice of procedural process and sequencing, and style of communication with irrigators is critically important. As governments begin the process of securing water for the environment, irrigators will be less inclined to leave water in the river. At present, around 10 – 20% of water is neither traded nor used! Failure to address the fundamentals of system design could result in outcomes that are worse than those already occurring. Our estimates suggest that the sum of the flow losses caused by existing hydrological flaws are greater than the volumes likely to be secured for the River Murray in the near future. Unless these design emissions are dealt with openly and transparently, the situation could get worse not better. Markets, especially ones allowing trade in administratively defined opportunities with inadequate attention given to detail, have an uncanny ability to trade systems into, not out of, trouble.

7

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