

Water Allocation in the West: Challenges and Opportunities

By Mike Young

When considering the role of water in an economy, it is useful to reflect on the “Diamond-Water Paradox” made famous by Adam Smith: “Nothing is more useful than water: but it will purchase scarcely anything; scarcely anything can be had in exchange for it. A diamond, on the contrary, has scarcely any use-value; but a very great quantity of other goods may frequently be had in exchange for it.”

This paper explores the proposition that water management could be one of the U.S. economy’s undiscovered jewels. It searches for opportunities to increase water’s contribution to the economy without compromising environmental or social objectives.

Section I gives an overview of Australia’s successful water reforms. Section II discusses water markets and allocations. Section III identifies 10 opportunities to improve water use in the United States. Section IV considers how the United States could proceed with water reform.

I. Water Reform in Australia

In 1986, when former Prime Minister Paul Keating was Australia’s Treasurer, he famously said, “If this Government cannot get the

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adjustment, get manufacturing going again, and keep moderate wage outcomes and a sensible economic policy, then Australia is basically done for. We will end up being a third rate economy ... a banana republic.”¹

At the time, Keating was worried about the significant number of government practices holding back opportunities for economic development and national prosperity. One of the practices that came to his attention was the way in which Australian states and territories managed water. Keating was worried that the systems used to manage water were acting as a barrier to economic progress.

If he were invited to the United States today and asked to review opportunities for improving this country’s domestic economy, I am confident it would not take Keating long to suggest that it is time to look carefully at the management of water. Given the complex suite of arrangements in place, I also suspect it would not be long before he drew attention to the fact that the water right and management systems used in the United States evolved in a different era and in response to conditions that no longer exist. In the early 1990s, similar statements were being made about water management in Australia.

As prime minister, Keating went on to lead the implementation of a National Competition Policy that included a plan to transform water management throughout Australia. At the time, the Council of Australian Governments (comprising the prime minister, state premiers, territory chief ministers, and the head of local government) observed, “while progress is being made on a number of fronts to reform the water industry and to minimize unsustainable natural resource use, there currently exists within the water industry ... impediments to irrigation water being transferred from low value broad-acre agriculture to higher value uses in horticulture, crop production and dairying.”

Noting also that there was “widespread natural resource degradation which has an impact on the quality and/or quantity of the nation’s water resources,” the Council committed Australia to the “clarification of property rights, the allocation of water to the environment, the adoption of trading arrangements in water, institutional reform and public consultation and participation.”

In the case of rural water services, the Council stated that the proposed new framework was “intended to generate the financial resources to maintain supply systems should users desire this and through a

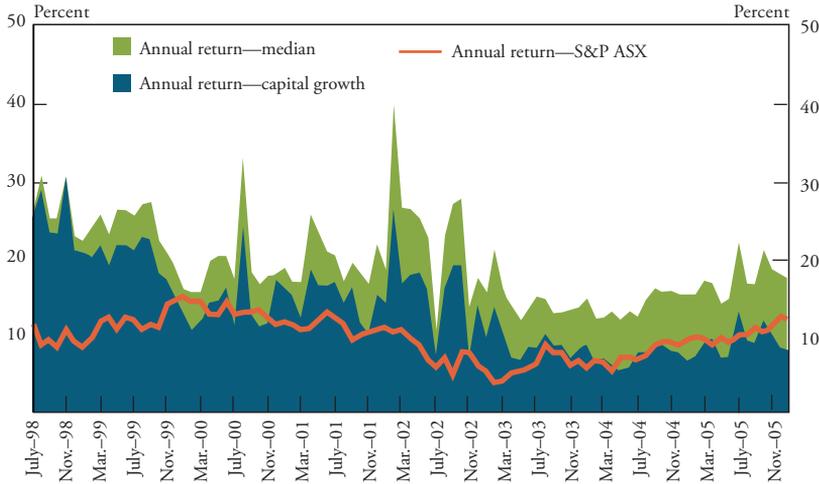
system of tradeable entitlements to allow water to flow to higher value uses subject to social, physical and environmental constraints. Where they have not already done so, States are to give priority to formally determining allocations or entitlements to water, including allocations for the environment.”

Note that the emphasis in this statement is on determining water entitlements and allocations in a manner that enables markets to emerge. As a result, there has been a dramatic improvement in the economic efficiency of water use and, through this, significant innovation. The policy insight, which has yet to be grasped in the United States, is that if a nation is interested in using water-trading arrangements to manage scarcity and produce economic benefits, it should focus on transforming the constellation of legislative arrangements that have historically been the basis for managing water.

These initiatives were followed by a countrywide agreement to a National Water Initiative and then, following a change in government and the appointment of Australia’s current prime minister, Malcolm Turnbull, as the minister for Water Resources, an agreement to prepare a new Murray-Darling Basin Plan and establish a new Murray-Darling Basin Authority. The National Water Initiative’s roots lie in a commitment to ensuring water use makes the best contribution possible to the economy, revealing to all the costs of supplying and managing water and ensuring use is kept within sustainable limits. In the detail, one can find requirements to convert all water licences to perpetual or continuing shares, to meter use, and to facilitate low-cost trade including surface water trade across state borders. The Murray-Darling Basin Plan applies these same concepts by putting in place a small, independent six-member authority responsible for ensuring that the Murray-Darling Basin’s surface and groundwater systems are managed as a single integrated system.

The agreements resulted in massive benefits for rural communities, for the economy, and for the environment. Among other things, the value of water rights in the Southern Connected River Murray System increased by well over 15 percent per year (Chart 1). In the United States, water reform is seen as a zero-sum game—in essence, a fight for a bigger share of the cake. The Australian experience would suggest, however, that it is possible to increase the contribution water makes to an economy and thereby make the cake much bigger.

Chart 1
Return from Reforming Water Rights



Notes: Chart shows return on investment from holding entitlement shares for five years, selling all allocations received during that period, and then selling the entitlement at the end of that period compared with returns achievable from holding a portfolio of Australian shares.

Source: After Bjornlund and Rossini.

Chart 1 only gives one perspective. Water reform increased gross regional domestic product during part of the last major drought by AUD 4.3 billion (2006–11) (NWC). Despite a greater than 70 percent decline in Murray-Darling Basin irrigated surface water, water trade possibilities meant that the adjusted gross value of irrigated production fell by just 10 percent (Kirby and others).

In addition to these economic benefits, water trading has resulted in positive environmental outcomes for the Murray-Darling Basin. The downstream trade of water during drought, for example, led to improved summer flow patterns and reduced system stress (Wheeler and others 2014). The development of water trading in Victoria produced a 20 EC reduction in the concentration of salt at Morgan at no cost to the government (Young, Shi, and McIntyre).² Prior attempts to achieve the same outcome using expensive drainage schemes had only been able to achieve a 6 EC reduction. Surveys have found that water trading is now widely used by irrigators as a risk-management strategy (Zuo, Nauges, and Wheeler; Nauges, Wheeler, and Zuo).

II. Understanding Water Markets and Allocations

When water resources are scarce and facilitating reallocation is beneficial, governments face two options. They must either claw back water from existing users or allow users the opportunity to trade. Taking water back from existing users is politically difficult; hence, there is rising global interest in developing opportunities to trade.

When asked to talk about water markets and allocation arrangements, I normally start by pointing out the big difference between water markets and water trading. Markets typically involve many buyers and sellers all seeking to profit from ever-changing opportunities. However, few water systems are sufficiently connected and have storage capacities large enough to make establishing a true market possible. There are, however, many benefits from opening up opportunities to trade water entitlements and allocations.

The second observation I normally make is that two types of trading occur within well-defined water entitlement and allocation systems: allocation trading and entitlement trading.

In allocation trading, allocations normally take the form of a specific volume of water that may be taken from a system within a nominated period of time. In entitlement trading, entitlements need to be defined unambiguously and, if efficient investment is the goal, are best defined as a perpetual entitlement to a share of all allocations made (Young 2014).

In Australia, these two different forms of trading are often called temporary and permanent trading. They are possible, however, only when the entitlement, allocation, and use management systems are fully unbundled and the governance, accounting, and enforcement systems that surround them are robust. When robust water allocation arrangements are missing, water users are reluctant to invest and governments are forced to revert to less efficient ways to influence water use. In Australia, the leasing of water rights is rare and fallowing agreements unheard of because it is so easy to trade allocations. In much of the United States, however, there is no metering of water use and, hence, these inefficient practices are common.

The third observation I normally make is that the Australian experience suggests that rather than focusing on the development of water markets, greater progress will be made if the focus is on establishing a

suite of institutional conditions that make it possible for water entitlements and allocations to be traded at low cost. When institutional conditions create a sense of confidence, water users will seek opportunities to trade water entitlements and allocations whenever it is possible to gain from doing so. When the costs of trade or the institutional risks are high, they will seek other ways to make money.

Fourthly, I think it is important to focus on the narratives we employ when discussing opportunities to improve the way water is allocated and used. Many debates in the United States are presented as an argument about the need to recut that cake. But when the narrative is framed as a cake-cutting exercise, stakeholders tend to spend an inordinate amount of time fighting in an attempt to make sure their share of the cake is protected. The alternative narrative focuses on finding a way to grow the cake and make everyone better off. Win-win solutions become possible. Presentations that start by searching for ways to increase the contribution water can make to the economy, to communities, and to the environment are much more likely to gain stakeholder interest. Irrigators are likely to be less fearful of change if the discussion begins by focusing on ways to improve the value of the opportunities available to them.

Fifthly, words also matter. In this paper, the term “water right” is used cautiously. Discussions about transitioning to a new system become easier when the language used is new and no term has an old meaning. Early in Australia’s water reform process, those responsible for ensuring the process worked developed a new glossary of terms.³ Discussions about rights were replaced with discussions about access to entitlements, shares, and allocations.

III. Opportunities to Improve Water Use in the United States

Water trading in a variety of forms is well-established in some parts of the United States and is expanding. Even though impressive progress is being made in some water management districts, overall progress is patchy. Reports summarizing the extent of overuse, resource depletion, and inefficient use are common. To facilitate a transition to more sustainable and efficient practices, the Western State Governors Association (2012) has recommended the increased use of water market and

trading arrangements but has not yet come up with guidelines to achieve this goal.

To catalyze interest in building upon the Australian experience, last year, the Nicholas Institute developed a blueprint for water reform in the western United States (Young 2015). This blueprint builds upon a more generalized framework for the design of robust water abstraction regimes and seeks to assist U.S. water managers in avoiding Australia's many water reform mistakes by identifying their solutions. Box 1 summarizes the results as a set of lessons. Box 2 contains an Organisation for Economic Co-operation and Development (OECD) checklist designed to enable anyone to assess the health of their water entitlement, allocation, and management regime.

The search for opportunities to improve water entitlement, allocation, and sharing systems is context-specific. As a result, it is difficult to write about in a way that will seem relevant to all. However, four concepts do seem to prevail. These are the benefits of unbundling, improving, and validating existing water rights; the benefits of establishing robust water resource plans; the benefits of transitioning toward decision-making structures characterized by trust, efficiency, and rigorous enforcement; and the merits of assigning water entitlements to the environment.

These broad concepts, however, hide many of the opportunities to reduce risk and ensure that water everywhere is put to best use. In the remainder of this paper, I wish to draw attention to 10 opportunities worthy of consideration by those interested in improving water's contribution to the U.S. economy, to community development, and to the environment. It is stressed that markets are very good at recognizing the extent of risk and the lack of certainty. As risks increase, asset values decrease.

Opportunity one: establish centralized water-right registers

An outsider might expect that when state laws are used to create and issue water rights, discovering who holds these rights and what the holders of these rights are allowed to do would be relatively easy. Throughout much of the United States, however, there is considerable uncertainty as to which people hold which rights, even in regions where the water resource has been adjudicated. This uncertainty can arise when rights are either defined by statute but not documented or defined using a paper trail that is complex and not well maintained.

Box 1

Lessons from the Australian Experience in the Development of Water Trading and Marketing Arrangements

- Lesson 1.** Unless carefully managed, the legacy of prior licensing decisions can result in markets causing overallocation problems that erode the health of rivers, aquifers, and the water-dependent ecosystems associated with them.
- Lesson 2.** Transaction and administrative costs are lower when entitlements are defined using a unit share structure and not as an entitlement to a volume of water.
- Lesson 3.** Market efficiency is improved by using separate structures to define entitlements, manage allocations, and control water use.
- Lesson 4.** Early attention to the development of accurate license registers is critical and a necessary precondition to the developing low-cost entitlement trading systems.
- Lesson 5.** Unless water market and allocation procedures allow unused water to be carried forward from year to year, trading may increase the severity of droughts.
- Lesson 6.** Early installation of meters and conversion from area-based licenses to a volumetric management system are necessary precursors to developing low-cost allocation trading systems.
- Lesson 7.** It is difficult for communities to plan for an adverse climate shift and develop water sharing plans that deal adequately with a climatic shift to a drier regime. Robust planning and water entitlement systems that facilitate autonomous adjustment are needed.
- Lesson 8.** The allocation regime for the provision of water necessary to maintain minimum flows, provide for conveyance, and cover evaporative losses needs to be more secure than that used to allocate water for environmental and other purposes.
- Lesson 9.** Unless all forms of water use are accounted for, entitlement reliability will be eroded by the expansion of unmetered uses, such as plantation forestry, farm dam development, and increases in irrigation efficiency.

- Lesson 10.** Unless connected ground and surface water systems are managed as a single integrated resource, groundwater development will reduce the amount of water available to allocate to surface water users.
- Lesson 11.** Water use and investment will be more efficient if all users are exposed to at least the full lower bound cost and preferably the upper bound cost of supplying their water. One way of achieving this outcome is transferring ownership of the supply system to these users.
- Lesson 12.** Managing environmental externalities using separate instruments is important to ensure the costs of creating externalities are reflected in production costs and to provide an incentive to avoid incurring these costs.
- Lesson 13.** Removing administrative impediments to interregional and interstate trade is difficult but necessary for the development of efficient water markets.
- Lesson 14.** Markets will be more efficient and the volume of trade will increase if entitlements are allocated to individual users rather than to irrigator-controlled water supply companies and cooperatives.
- Lesson 15.** Equity and fairness principles require disciplined governance so that all people have equal access and opportunity to profit from allocation decisions and policy announcements.
- Lesson 16.** Water markets are more effective when information about the prices being paid and offered is made available to all participants in a timely manner.
- Lesson 17.** Developing a brokering industry can avoid government involvement in the provision of water broking services.
- Lesson 18.** When introducing a new policy framework, adopting a suite of new terms is helpful so that differences between new and old concepts are easily understood.

Box 2

A Checklist for Assessing the Capacity of a Water Resource Entitlement, Allocation, and Management Regime

- Check 1.** Are there accountability mechanisms in place for the management of water allocation that are effective at a catchment or basin scale?
- Check 2.** Is there a clear legal status for all water resources (surface and ground water and alternative sources of supply)?
- Check 3.** Is the availability of water resources (surface water, groundwater, and alternative sources of supply) and possible scarcity well-understood?
- Check 4.** Is there an abstraction limit (“cap”) that reflects on-site requirements and sustainable use?
- Check 5.** Is there an effective approach to fairly and efficiently manage the risk of shortage that ensures water for essential uses?
- Check 6.** Are adequate arrangements in place for dealing with exceptional circumstances (such as drought or severe pollution events)?
- Check 7.** Is there a process for dealing with new entrants and for increasing or varying existing entitlements?
- Check 8.** Are there effective mechanisms for monitoring and enforcement with clear and legally robust sanctions?
- Check 9.** Are water infrastructures in place to store, treat, and deliver water in order for the allocation regime to function effectively?
- Check 10.** Is there policy coherence across sectors that affect water resources allocation?
- Check 11.** Is there a clear legal definition of water entitlements?
- Check 12.** Are appropriate abstraction charges in place for all users that reflect the abstraction’s effect on resource availability for other users and the environment?
- Check 13.** Are obligations related to return flows and discharges properly specified and enforced?

Check 14. Does the system allow water users to reallocate water among themselves to improve the allocative efficiency of the regime?

Source: OECD drawing upon Young (2013).

As a result, it is difficult in most states—if not all—to discover who owns what, let alone manage properly what states believe they have on record. Given this difficulty, the first opportunity to improve water management in the United States is to offer all water right holders the opportunity to convert their existing water right into a “new” water right recorded on a central register of guaranteed integrity. Building on well-established Torrens Title record-keeping principles, legislation should provide that the only way a person can own a “new” water right is by having their name recorded on the new state water register (Young and McColl).⁴

When rights are recorded on a central register of guaranteed integrity, it becomes possible to trade these rights at very low cost and minimal legal risk. As a result, the value of new system rights tends to be significantly greater than the value of the old system rights they replace. The value of these new water rights can be increased further by making it possible to register a financial interest in these rights and by guaranteeing to only allow their sale with the consent of all registered mortgagees.

Note that the process to establish such a new right requires only that the old right be validated. It does not require a full U.S.-style adjudication process. During the Australian water reform process, described above, all states established new water entitlement registers. As a result, banks became much more interested in funding investment in new water technology. On average, the validation of a New South Wales water right required only about one person-hour per water user (Young and Esau).

Moreover, the above process can be presented as a process of conversion and validation of existing rights designed to reduce legal risk and, thereby, increase opportunities to trade. Care needs to be taken to ensure conversion is not seen as an underhanded way to extinguish existing rights. The process need not be threatening and can be commenced independently of a decision to pursue a broader water reform agenda.

Opportunity two: unbundle water entitlement, allocation, and use management

During the process of reforming water management in Australia, nearly all water “licenses” were partitioned into their component parts in a manner that enabled each component to be managed separately. The result significantly reduced administrative costs and, as entitlements and allocations become fungible, increased opportunities to trade.

Unbundled water entitlement and allocation arrangements borrow administrative structures and processes used by corporations to define ownership, by banks to track deposits and withdrawals, and by the Federal Open Market Committee to increase confidence in the U.S. economy. Applied to water, these concepts suggest that water rights should be defined as shares so that it is clear that no allocation can be guaranteed; that allocations should be made via a formal announcement in the same manner as dividend announcements are made; that allocations should be made by crediting each shareholder’s water account; and that all site-specific water-use conditions should be moved to a separate permit.

The result is a structure that makes it clear that all water supply systems involve risks that have to be managed. The best that can be offered is a guarantee to a share of allocations made and, where necessary, the establishment of share classes of high and low reliability. Low-cost transactions can then be achieved by establishing banklike accounting systems and formal announcement systems similar to those used in the corporate world to announce and pay dividends. Transaction costs are kept low by making both shares and allocations as fungible as possible. In practice, this is achieved by separating location-specific use controls from the systems used to track share ownership and the volumes of water that may be taken from a water resource.

The third part of the unbundling process—a separate policy instrument to control use—requires issuing a permit that nominates the water account from which to deduct use, states how water use will be measured, and stipulates the conditions under which water may be used at a specific location.

The last of these requirements is particularly important. In many parts of the United States, if a water entitlement is not put to a beneficial use, the entitlement is at risk of curtailment. In an unbundled structure, beneficial use conditions only kick in when water is taken

from a resource. That is, there is no obligation to “use” a water entitlement or to use water in a water account. Use approvals operate like a development approval and allow the efficient management of third-party objections to a proposed change in water use. In an unbundled water entitlement and allocation system, there is no beneficial obligation to use every drop of water allocated. The result is a structure that gives each and every water account holder an economic incentive to save water.

Unbundling has one further benefit of immense importance to the improvement of water management in the United States. In an unbundled regime, third-party effects are managed through the conditions in a use approval and in water resource management plans. If a person is concerned about the likely effects of water use at a location near or upstream of them, then they may seek to stop the use approval or change an exchange rate. They cannot, however, stop allocations being made or transferred from one account to another. The result is an arrangement that, in particular, requires third parties to pay attention to the decision-making rules set out in water resource management plans.

At the same time, unbundling opens up opportunities for more efficient investment. An aspiring almond grower, for example, can secure all the development and water use approvals without having to secure a drop of water. This can be left until it is time to secure the water needed and done as fast as the almond trees grow. The result ensures much more efficient use of capital in irrigation.

Note also that in fully unbundled water entitlement and allocation systems, robust management planning processes are used to determine how much water can be allocated to shareholders. As in the corporate world, water—like dividends—is never allocated until managers are confident they can make the allocation.

Opportunity three: statutory water resource plans

In 2014, California passed legislation requiring the appointment of groundwater sustainability agencies which, once appointed, will be required to prepare plans for the “sustainable” management of the groundwater resources these agencies’ boundaries overlies. The legislation also permits these agencies to specifically regulate, limit, and suspend groundwater extractions to achieve the sustainability goals put

forth in the agencies' plans. This opens up the opportunity to improve the way opportunities to use groundwater are defined, allocated, and managed. Nevada has similar legislation that authorizes its state engineer to require the preparation of a management plan for any water resources that is in a critical state.

The first question that needs to be asked is what form should each of these plans take? If the aim is to increase the contribution water resource plans make to an economy and establish ground rules for water allocation, then these plans should be drafted in a manner that reduces the potential for legal argument. This can be achieved by making it clear that the rules in the plan are binding and may be changed only through due public process.

The robustness of these management plans can be strengthened further by drafting them in a manner that resembles a decision-making guide and deliberately leaving out detailed descriptions of the resource and the reasons why decisions have been made. By way of example, it is better to legislate a 0.9 exchange rate for the transfer of water allocations from location A to location B than to legislate that such transfers occur only in a manner that has no adverse effects on third parties. Many parts of the United States take the opposite approach; as a consequence, many attempts to transfer water end up in extremely expensive court cases, and many transfers are never contemplated.

In Australia, the risk of legal challenges is minimized further by making water resource plans statutory. That is, each local agency's water resource plan is presented to the legislature for final approval and thereby gains the same legal standing as any other approved legislation. The result is a framework that makes it possible for local boards and water masters to make allocation decisions as quickly as water supply conditions change. Confidence in the constellation of administrative arrangements used is such that an allocation trade can be completed in the Murray-Darling Basin without any legal risk in 40 minutes.⁵ In addition, as the costs of a trade are low, trading is common and routinely contemplated by all irrigators. Trading occurs in the United States, but as the costs are so high and the legal risks considerable, only large-scale farmers tend to contemplate trades. Water use would be much more efficient if all irrigators, including those with relatively small farms, were exposed to processes that reveal the marginal opportunity cost of water use.

Plans also need to avoid concepts that are scientifically contestable and be devoid of complex assessment of climatic risk. As a result of interest in the Blueprint we have developed, the Diamond Valley community in Nevada is considering basing its allocation decisions upon changes in the average depth to groundwater at four wells. If the average depth to groundwater declines, allocations per share in the following year should be reduced by between 2 percent and 6 percent. Simple rules like this are much easier to explain and much harder to contest in a court of law than decision-making approaches that rely upon complex models.

Opportunity four: replace prior appropriation with a small number of security pools

Figure 1 sets out a generic framework for developing a robust water-sharing arrangement to allow the efficient use of water. In practice, base flows and floodwaters are managed under management rules and the rest according to priority-sharing rules.

In many western U.S. water allocation systems, rights are defined using a prior appropriation arrangement that gives each water right priority according to the date on which a holder's right was issued. This means that every water right is unique in terms of its seniority and has a different value. For surface water systems, the alternative approach used in Australia is to establish several security pools and issue shares in each pool.

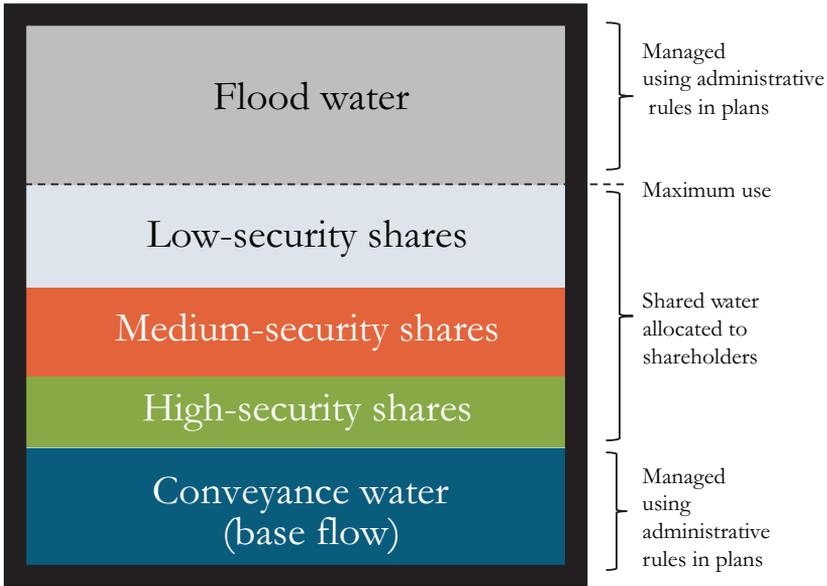
When several security pools are established, allocations are made to the high-security pool until its maximum allocation volume is reached. Allocations are then made to the general security pool and finally to the most junior, low security, pool.

When several sharing pools are in place, the resulting structure enables both the efficient management of supply risk and, because of the fungibility of shares, efficient price discovery. Moreover, because each share is identical, third parties cannot object to a sale of shares from one person to another. Note also that as supplies become scarcer, the value of high-security shares can be expected to increase.

In passing, it is worth noting that a specialist in the design of such regimes will recommend that the maximum size of each pool be defined using a moving average of all allocations made, so that if a long dry period emerges, the fact that it is getting wetter or drier is signaled to all water users.

Figure 1

Developing a Water-Sharing Arrangement that Enables Efficient Risk Management



Statutory plans and the legislation authorizing their preparation can be used to assign responsibility for managing risks in a transparent manner. Under Australia's National Water Initiative, for example, full responsibility for adapting to climatic variability and change is assigned to shareholders, while responsibility for managing changes in environmental preference are assigned to the government acting on behalf of society.

Opportunity five: giving the environment an entitlement

More by accident than good design, Australia has discovered the benefits of a sophisticated approach to the pursuit of what are often described as environmental objectives. This came about because the government decided to restore some systems to environmental health by purchasing water entitlements for the environment from willing sellers. When the federal government began purchasing water entitlements (shares) for the environment, Treasury officials were not prepared to sur-

render this new asset. As a result, the shares so purchased came to be held in trust for the environment.

Assigning water rights to the environment, rather than treating it as something to be awkwardly managed through complex administrative processes, has produced many benefits. First and foremost, the environment as a shareholder receives allocations in the same way as all other shareholders. In the past, overuse and overallocation led to significant degradation of water-dependent ecosystems. Under the new regime, the environment—just like all other shareholders—receives an allocation every time allocations are made. The trustees appointed to manage these allocations have to decide what to do with them. As a result, environmental water use has become more efficient, and a new cadre of environmental water managers has emerged. Instead of spending their time trying to influence others, these new managers are much more interested in maximizing environmental benefits per acre-foot of water made available to them.

In the past, those interested in the environment never considered the need for efficiency in the way they manage water assigned to the environment. Now, they do. Along the way, these managers discovered the benefits of countercyclical trading. Countercyclical trading involves the environmental trustees selling environmental water allocations to irrigators during a drought, then using the revenue received to purchase more shares or fund investments in environmental infrastructure.

Opportunity six: trusted governance

Transitioning from an old to a new water management regime requires consultation and administrative processes that gain community trust, especially when the prior regime was dysfunctional. When searching for ways to build trust, there is tension between the desires for a representative versus an expertise-based governance. Tensions also exist between top-down centralist approaches and bottom-up local approaches. Finally, there is a need to ensure adequate and full engagement.

From a market perspective, one other consideration needs to be put on the table. In any situation where a market operates and information about the state of the resource and likely future decisions are privileged, insider trading risks have to be managed. As a result, there is a strong case for assigning responsibility for the development, implementation, and enforcement of water resource plans to expertise-based boards and

limiting representative governance processes to the appointment of board directors. As is the case in the corporate world, if shareholders are appointed to such a board, they should not be able to trade in the same manner as any other shareholder. The Nicholas Institute Blueprint recommends that western states in the United States consider appointing small, expertise-based boards who are responsible for developing and managing a water resource on the condition that they consider the advice of appropriately constructed stakeholder reference panels. If shareholders are appointed to a board and have either a direct or indirect interest in water shares, then they should not be allowed to trade when allocation decisions are being made or policies are under review.

If robust water trading and marketing arrangements are to become the norm in the United States, then those tasked with their implementation must be trusted. When trust declines, as is the case in the corporate world, the composition of the board must change quickly. Among other things, it is critical that board decisions are supported publicly by all of its members. If a member, having been involved in a decision, wishes to express public dissatisfaction with that decision, then that member should resign. Otherwise, a board should be seen to be unanimously making decisions in the best interests of all shareholders as guided by the rules set out in the agency's water resource management plan.

Opportunity seven: nested planning hierarchies

One of the more serious mistakes Australia made as it began its water reform program was focusing on surface water systems and not bringing groundwater systems into the same process. Several U.S. states appear to be making the same mistake. The obvious solution to managing connections between water resources is bringing them together under one integrated management system.

In large systems, typically a high-level basin plan or its equivalent requires establishing a separate authority. Under these "basin plans," allocations are made to each defined ground or surface water resource and then distributed to shareholders by the decision making board or manager responsible for the day-to-day implementation of that resource.

Note that for efficient management, allocations need to be managed on a resource-by-resource basis in a "nested" manner that allows individual users to transfer water allocations between, for example, ground and surface water systems. When this is done, shareholders have an

incentive to invest in groundwater storage, carry forward unused water allocations from year to year, and generally optimize the management of stocks and flows.

Australian experience suggests that as knowledge about system interconnectivity tends to be imperfect, a considerable degree of pragmatism is required. Recognizing that it is better to be approximately right rather than comprehensively wrong, initial plans need to set limits on the amount that can be taken from each resource and develop system-wide accounting systems that can be improved. One of the more difficult decisions, which requires a considerable degree of pragmatism, is setting transmission exchange rates in unregulated streams developing effective ways to shepherd water from one river reach to another. Determining the amount of water to be set aside to prevent seawater intrusion is another consideration. Solutions to each of these problems are known, but this paper is not the place to discuss them.

With such structures in place, surface water users can be given credit for transferring surface water to a groundwater system and vice-versa by setting and periodically revising exchange rates and storage loss adjustments as knowledge improves. The result increases the value of shares in both resources and builds resilience.

Decisions about how many water resource plans to prepare are context-specific and need to be made carefully. Australia has a single plan for all the ground and surface water resources in the Murray-Darling Basin and a suite of regional plans for each ground and surface water resource. Most groundwater resources and most surface water resources are zoned. As a guiding rule, shares are issued on a zone-by-zone basis.

Opportunity eight: simplification by adopting gross rather than net water accounting regimes

When water use is inefficient, a considerable portion of the water taken from an aquifer, for example, drains back through the soil and ultimately becomes available for use by someone else or makes a contribution to the environment. Known as return flows, this biophysical reality has to be managed. Otherwise, as water use efficiency (in a technical sense) increases, the amount of water that returns to the system decreases, and there is a total increase in water consumption.

Conceptually, there are two ways to manage the return flow issue. The first option is to run a net accounting regime, as is done in much of the United States, and require changes in water-use efficiency to be ac-

counted for on a case-by-case basis. The result, however, is administratively expensive. The second option, commonly used in Australia, is to run a gross accounting system and commit to a regime that reduces allocations per share as the average efficiency of irrigation increases. Both approaches have hydrological integrity. When a gross accounting system is introduced, however, transaction costs are much lower, as there is no need to track land use and make adjustments to water accounts at the individual level.

As a general rule, the value of water entitlements will be greater under a gross water accounting regime, as transaction costs will be less. In some cases, a mixed accounting system may be appropriate, especially when there are strong connections between ground and surface water resources and some users consume 100 percent of the water they take while others return a significant volume. One of the more common examples of a water user who uses 100 percent of the water allocated to them is someone who pumps the water they use out of a basin. A flood irrigator, on the other hand, may only consume 50 percent of the water they pump from a water resource. In practice, the challenge is keeping the accounting system simple and affordable. Again, it is better to be approximately right than comprehensively wrong.

Note also that technology is changing. It is likely that in some regions and for some types of water use, it may soon be cheaper to account for net water use via satellite imagery than to rely upon data taken from flow meters and assumptions about return flow.

Opportunity nine: tagged entitlement trading

When water users seek to transfer water from one region to another, the transaction can be completed either by surrendering the entitlement in one water district and issuing a new entitlement in another district or by allowing the purchaser to “tag” an entitlement with a guarantee that any allocation made to this entitlement will be transferred automatically to another region at the current exchange rate.

In Australia, the latter approach is known as a tagged trade and has become popular as it assigns 100 percent of the exchange rate risk to the buyer and enables downstream users to reduce supply risk by holding entitlements in different parts of a river system. Tagged trading increases the value of entitlements in areas that are climatically different. Value

is increased further by developing a process that reduces transaction costs and risks to third parties. Under this arrangement, third-party effects are managed by revising exchange rates as knowledge about the nature of flows and connectivity improves. As noted earlier, however, investment confidence should be such that in the long run, there is no need to apply for a guarantee that a governance regime will not reverse a decision to allow the transfer of water between regions or set capricious conditions on such transfers.

Opportunity 10: allocating rights to individual users

In many parts of the United States, as was the case in Australia, water users are encouraged to trade water allocations and entitlements within a district. Deals to trade water between districts, however, tend to be negotiated by district managers and allowed only when it does not threaten the viability of the district as a whole. This discourages district managers from continuously improving the way they manage their system. The alternative approach, used in Australia, is to allocate water entitlements to individual irrigators and require all districts to allow both the permanent and temporary trade of water out of their districts.

If applied without considering the effect of such an arrangement on the costs of an operating district's infrastructure, this approach could discourage the efficient management of water supply and delivery arrangements. To remove this disincentive, Australian districts are allowed to charge a termination or exit fee. At present, the maximum fee is set at 10 times the annual fixed charge per water share (ACCC 2008). The result is an arrangement that forces inefficiently-managed districts to review the efficiency of their operations and search for more efficient ways to provide water to their customers.⁶

IV. Toward Improved Water Allocation and Management

The preceding set of 10 opportunities to improve institutional arrangements used to manage water in the United States is far from comprehensive. Moreover, efforts are already underway to put many of them in place. Water trading is not new to the United States. In some regions, transition to full implementation of the type of regime outlined above is relatively simple. In others, transition may be more protracted and cannot be implemented by simply tweaking one or two features.

As a well-known Australian land administrator, Sir William Payne, said in 1960, “new precedents are waiting to be born.” If a paper like this were written at the time he wrote these words, almost everyone would have thought it impossible to transition to the water management regimes now used throughout Australia. With the benefit of hindsight, it has been demonstrated that transformation is possible. I think that the time has come for the United States to consider investing in the processes that would enable it to make such a transition but to do so in a manner that does not repeat Australia’s many mistakes.

One way to start would be to enable the establishment of water right registers in a manner that enables seasonal allocations to be made and then build water accounts that record precisely the number of allocations that each user has not yet used. The latter requires metering or its satellite-based equivalent and developing robust governance arrangements. Such a transition need not come from a top-down decree at a state or national level. In most states, however, the transition will be easier if enabling legislation is put in place. As stated earlier, the arguments can be built around the economic benefits, not the need for greater control.

Arguably, transition is easier in water districts and regions in a critical condition. Transition will be easier, too, in states where the administrative leadership has the experience, understanding, and capacity to assist district leaders and water resource managers in transitioning to a new regime with minimal controversy. As set out in the Nicholas Institute Blueprint, one option is to begin with a number of pilots that demonstrate it is possible to convert from a “first-in-time, first-in-right” water management regime to a robust water-sharing regime.

Irrigators in Nevada’s Diamond Valley are already pioneering this journey. Other water resources are now searching for a similar opportunity. In particular, and as a result of the Sustainable Groundwater Management Act, several of California’s groundwater management districts have shown interest in pursuing the first-mover opportunity that will pass to those committed to finding a new way to manage their water resources so as to maximize opportunity and minimize risk.

The conversion of land and water titles from an old to a new system suggests that old and new systems can be run side by side with one another. One option is to assign responsibility for the setting up of new water entitlement registers to Land Title Offices.

At the national level, an outsider may be tempted to observe that too much attention is being given to stressed water resources. There is

a strong case for moving ahead of the game and acting before problems emerge. The return on investment from moving ahead of the game and avoiding the very high costs of having to resolve overallocation problems could be substantial.

A recent report for the governments of England and Wales suggests that all water resources should be closed when permitted use reaches 70 percent of potential (Young 2012). Upon closure, 70 percent of all the shares to be issued would be allocated to existing users and the remaining 30 percent issued to the government. It would then be up to the government of the day to decide how many of the remaining shares to issue to the environment, how many to hold in reserve, how many to give away, and how many to auction.

A role for the U.S. federal government?

Is there a case for federal involvement in water reform? The economic case for encouraging U.S. states to transition to the development of robust water-sharing arrangements is strong, especially when the cost to society of ongoing mismanagement and litigation is considered. It also needs to be recognized that reform takes time. While Australia started its water-reform journey in the 1990s, the full repair of the Murray-Darling System is not expected before 2023. Learning from the Australian experience may enable the United States to move faster, but it should also expect the process to take at least 20 years.

The first federal opportunity I can identify is to make money available to assist districts willing to pilot test and demonstrate the benefits of moving to robust water-management arrangements. Early investments could include paying for the costs of developing new water registers, new water accounting systems, and installing smart water meters that link to water accounts. Federal involvement might enable the development of systems that work efficiently across state borders.

The second federal opportunity is to search for efficient ways to pass the governance of overlapping federal and state interests in water to single, integrated management systems. Ultimately, the U.S. economy will be best served if a way can be found to rely upon robust water resource management plans and water-sharing systems to determine how much and where water is consumed. As a demonstration of good faith in areas where pilot-testing is occurring and about to occur, federal gov-

ernment agencies could, for example, show willingness to convert their rights into shares, agree to work under the conditions set out in water resource management plans, and accept decisions made by an independent expertise-based board.

A third, more sensitive, opportunity is to show willingness to enable the efficient management of environmental considerations such as endangered species. In an ideal world and in regions where a water resource management plan has been approved by a state, it should not be possible for a court to do more than order the review of a management plan. This process could be facilitated through federal government involvement in the purchase and management of water rights for the environment. In Australia, it is now expected that the Commonwealth Environmental Water Holder, acting on behalf of all, will end up holding well in excess of 20 percent of shares in the Murray-Darling Basin Plan system. Imagine what would happen if a similar structure existed in the Colorado River System and if environmental water users were free to move water among states on a daily basis.

Costs and benefits

As far as I am aware, no cost-benefit analysis of the merits of resolving many water-related environmental challenges facing the United States has been conducted. In the process of preparing the Murray-Darling Basin Plan, several such analyses were conducted; they played an important role in convincing Australia's political leadership to support this transition. The effects of the Millennium Drought, the merits of validating registers, and an understanding of the merits of building an institutional structure that enables rapid, low-cost water trading across state boundaries led to bipartisan support. As a result, Australia has much experience to share.

Assessing the merits of shifting to a new, robust water resource sharing arrangement requires models that can test policy alternatives. Wittwer (2015), for example, converts a computable general-equilibrium model for Australia into a model that can track the regional implications of severe drought in California's Central Valley under a drought scenario requiring a 40 percent cut in water availability. Under the current administrative regime, the value of farm output is reduced by 10 to 20 percent. Under unfettered Australian-style allocation trad-

ing conditions, farm output is reduced without water trading after accounting for substitution away from water. In this scenario, farm output in the Central Valley drops by only 5.4 percent. That is, transition to a regime consistent with the framework suggested in this paper might halve the effect of a drought and do so without adversely affecting groundwater supplies.

In Nevada, the state engineer has declared the Diamond Valley Groundwater resource to be in a critical state. As a result, in 10 years, he must curtail the use of all water rights issued after 1960. Most farms hold a mixture of pre-1960 “senior” and post-1960 “junior” rights, a few farms only hold “senior” pre-1960 rights, and a few only hold “junior” post-1960 rights. It is our expectation that moving to a sharing systems is likely to produce significant economic benefits and also significant social benefits to the community that, as a result of conversion, does not become embroiled in an ugly political and legal fight.

Much more analysis of the merits of improving the water entitlement, allocation, and management arrangements in the United States is needed. The benefits of moving to more robust water management regimes are likely to be substantial in terms of avoiding the adverse costs of ongoing mismanagement and also in terms of the increased economic and environmental benefits.

At the highest level, the majority of the gains will come from transitioning to a relatively simple regime devoid of the many legal and administrative arrangements that so often impede progress or make it unbearably costly. With these arrangements in place, speedy, low-cost trading will become possible; investment and innovation will significantly increase; and known environmental challenges will be resolved at much less cost than otherwise would be the case.

Endnotes

¹Speaking to John Laws on Radio 2UE, May 14, 1986.

²Electrical conductivity, or EC, is the standard measure of water quality.

³The blueprint contains a draft list for consideration by those interested in improving U.S. water policy.

⁴The Torrens Title system operates on the principle of “title by registration” (granting the high indefeasibility of a registered ownership) rather than “registration of title.” The system does away with the need for proving a chain of title (specifically, tracing title through a series of documents). The state guarantees title and is usually supported by a compensation scheme for those who lose their title due to private fraud or error in the state’s operation. For more information, see https://en.wikipedia.org/wiki/Torrens_title.

⁵Tom Rooney (Waterfind Australia) in an email to the author September 2016.

⁶In Australia, when this arrangement was introduced and as a transitional arrangement, one state was allowed to set a 10 percent limit on the permanent transfer of water shares out of a district so that there was time to reconfigure delivery infrastructure and generally improve service delivery.

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