Water Allocation in the West: Challenges and opportunities

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Introduction

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* (Smith 1776).

This paper explores the proposition that water management could be one of the US economy's undiscovered jewels.

In 1986, when former Prime Minister Paul Keating was Australia's Treasurer, he famously said:

> *If this Government cannot get the 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 worrying about the significant number of government practices that were 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.

If he were invited to the US today and asked to review opportunities for improving this country's domestic economic competitiveness, I am confident that it would not take Keating long to suggest that it is time to look carefully at the management of water. Puzzled by the complex suite of arrangements in place, I suspect that it would not be long before he drew attention to the fact that the water right and management systems used in the US 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 totally transform the management of water 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:

> *… [W]hile 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.*

[1] Speaking to John Laws on Radio 2GB, May 14, 1986.

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:

> … *[I]ntended 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 and has since led to dramatic improvements in the economic efficiency of water use and, through this, significant innovation. The policy insight, which has yet to be grasped in the US, 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 where followed by a country-wide agreement to the National Water Initiative and then, following a change in government and the appointment of Australia's current Prime Minister as the Minister for Water Resources, an agreement to prepare a new Murray-Darling Basin Plan and new Murray-Darling Basin Authority.

The result produced 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% per annum in the ensuing ten years (Figure 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. Australian experience would suggest, however, that it is possible to increase the contribution that water makes to an economy and thereby make the cake much bigger.

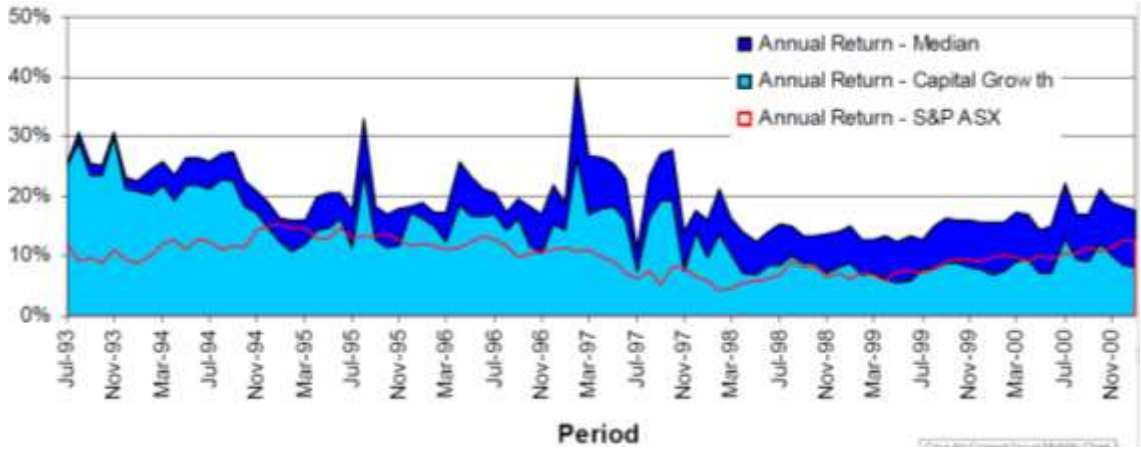

Figure 1 Return on investment from holding entitlement shares for five years, selling all allocations received during that period and then selling the entitlement at the end of that period compared with returns achievable from holding a portfolio Australian shares
Source: After Bjornlund and Rossini (2007)

Figure 1, however, only gives one perspective. Water reform increased gross regional domestic product during part of the last major drought by AUD$4.3 billion (2006-2011) (NWC, 2012). Between 2000-01 and 2007-08, despite a greater than 70% decline in MDB irrigated surface-water, water trade possibilities meant that the adjusted gross value of irrigated production fell by just 10% (Kirby et al., 2014). In addition to these benefits, water trading has resulted in positive MDB environmental outcomes. The downstream trade of water during drought, for example, led to improved summer flow patterns and reduced system stress (Wheeler et al., 2014). The development of water trading in Victoria produced a 20 EC salinity reduction at Morgan (the standard measuring location for lower River Murray water quality) at no cost to the government (Young et al. 2006). 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 et al., 2014, Nauges et al., 2015).

Understanding water markets and allocations

The focus on this paper is on the role of markets and allocation arrangements in water management. When water resources are scarce and there are benefits in facilitating its reallocation, governments face two options. They must either claw back water from existing users or they must allow users the opportunity to trade. The claw back of water from existing users is difficult and, hence, there is rising global interest in the development of opportunities to trade.

When asked to talk about water markets and allocation arrangements, I normally start by pointing out that there is a 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 the establishment of a true market possible. There are, however, many benefits from opening up opportunities to trade water entitlements and allocations.

The second observation that I normally make is that in well-defined water entitlement and allocation systems, you will find two “markets”:

- **A market for allocations** – normally in the form of a specific volume of water that may be taken from a system within a nominated period of time; and
- **A market for entitlements** — which receive periodic allocations into perpetuity based on a percentage share of the water system.

In Australia, these two different forms of trading are often called temporary and permanent trading. These different forms of trading, however, are possible only when the entitlement, allocation, and use management systems are fully unbundled. When robust water allocation arrangements are missing, water users and investors will revert to less efficient ways to achieve a similar outcome. Examples include the leasing of water rights, agreements to fallow land, and other less efficient arrangements.

The third observation I 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 the establishment of a suite of institutional conditions that makes it possible for water entitlements and allocations to be traded at low cost. These efficient water markets, as many people like to call them, will emerge naturally. When the institutional conditions create a sense of confidence, water users will seek opportunities to trade water when it is possible to gain from doing so. When the costs of trade are high and/or the institutional risks are high, they will seek other ways to make money.

Finally, I think it is important to focus on the narratives we choose to employ when discussing opportunities to improve the way water is allocated and used. Many debates in the US are presented as an argument about the need to recut that cake. But when we frame the narrative as such, everyone spends the majority of their time simply fighting to make sure their share of the cake is protected! The alternative narrative is one that focuses on finding a way to grow the cake and make everyone better off.

Presentations that start by searching for ways to increase the contribution that 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.

Words also matter. In this paper, the term "water right" is used cautiously. When talking about transitioning to a new system, discussions become easier when the language used is "new" and no term has an "old" meaning. Early on in Australia's water reform process, those responsible for ensuring that the process worked developed a new glossary of terms. Discussions about rights were replaced with discussion about access to entitlements, shares, allocations, etc.

Opportunities to improve water use in the US

Water trading in a variety of forms is well-established in some parts of the US and is expanding. However, even though impressive progress is being made in some water management districts, overall progress is patchy. Reports summarizing the extent of over-use, resource depletion, inefficient use, etc. are common. In an attempt to facilitate a transition to more sustainable and more efficient practices, Western State Governors (2012) have recommended the increased use of water market and trading arrangements but, as of now, have not come up with guidelines as to how to achieve this goal.

In an attempt to catalyze interest in advancing a pathway that builds upon the Australian experience, the Nicholas Institute developed a blueprint last year for water reform in the western US (Young 2015). This Blueprint builds upon a more generalized framework for the design of robust water abstraction regimes (Young 2015) and seeks to assist US water managers in avoiding the many water reform mistakes Australia made. The good news is that the depth of commitment was such that solutions to each of these mistakes were found. Box 1 summarizes the result as a set of lessons. Appendix One contains a checklist designed to enable anyone to assess the health of their water entitlement, allocation, and management regime. {Examination of the lessons in Box 1 and the checklist tends to be quite revealing. It is very common for a system to fail nearly every test.}

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:

1) The benefits of unbundling, improving and validating existing “water-rights”
2) The benefits of establishing robust water resource plans
3) The benefits of transitioning towards decision making structures characterized by trust, efficiency and rigorous enforcement
4) The merits of assigning water entitlements to the environment.

These broad concepts, however, hide many of the opportunities to reduce risk and increase opportunities to ensure that water everywhere is put to its highest and best uses. In the next part of this paper, I wish to draw attention to ten opportunities worthy of consideration by those interested in improving the contribution that water makes to the US economy, to community development and to the environment. It is stressed that markets are very good at recognizing the extent of risk, the lack of certainty, etc. When problems are there, values are low.

Box 1

Lessons from 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 over-allocation problems to emerge in a manner that erodes 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 the use of water.*

Lesson 4: *Early attention to the development of accurate license registers is critical and a necessary precondition to the development of 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 a necessary precursor to the development of 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 need 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 un-metered uses, such as plantation forestry, farm dam development, increases in irrigation efficiency, etc.*

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 that can be allocated 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 water to them. One way of achieving this outcome is to transfer ownership of the supply system to these users.*

Lesson 12: *Manage environmental externalities using separate instruments so that the costs of creating externalities are reflected in production costs and there is an incentive to find ways to avoid incurring these costs.*

Lesson 13: *Removal of administrative impediments to inter-regional trade and inter-state trade is difficult but necessary for the development of efficient water markets.*

Lesson 14: *Markets will be more efficient and the volume of trade greater 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: *Develop a brokering industry and avoid government involvement in the provision of water broking services.*

Lesson 18: *When introducing a new policy framework, adopt a suite of new terms so that differences between "new" and "old" concepts are easily understood.*

Source: Adapted from Young (2010) and Young and Esau (2016)

Opportunity One – Establish centralized water-right registers

To an outsider, one would expect that if state laws were used to create and issue water rights, it would be relatively easy to discover who holds these rights and what the holders of these rights are allowed to do. Throughout much of the US, however, there is considerable uncertainty as to which people hold which rights – even in regions where the resource has been adjudicated. One of the core reasons for this is that rights are either:

1) Defined by statute but not documented; or
2) Defined using a paper trail that is complex and not well maintained.

As a result, it is difficult in most states — if not all — to discover who owns what, let alone manage properly what they believe they have on record. Given this situation, the first opportunity to improve water management in the US is to offer all water right holders the opportunity to convert their existing, "old" water right into a "new" water right that is recorded on a central register of guaranteed integrity. Building on well-established Torrens Title record keeping principles,[2] 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 2002).

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 tend 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 guarantee to only allow their sale with the consent of all registered mortgagees.

Note that the process required to establish such a new right only requires that the old right be validated. It does not require a full US-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 2013).

With regard to the development of an appropriate narrative, 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 that conversion it is not seen as an underhand way of extinguishing 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" – as they were called – were partitioned into their component parts in a manner that enabled each component to

[2] "The 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 (i.e. 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

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 from the generic systems used to define ownership in a corporation and manage money — namely:

1) Water rights are defined as shares;
2) Management plans require all allocations to be made in proportion to the number of shares held; and
3) All site-specific use conditions are moved to a separate permit.

In an unbundled water sharing regime, each water share is linked to a water account with exactly the same names as those on the share. Allocations made to each share are created by crediting them to that account. In some regions, this simple framework can be extended to include the issue of shares in storage capacity, delivery capacity, etc.

The third part of the unbundling process is to issue "use approvals" that authorize the taking of water from a specific location. Typically, a use approval:

1) Requires that all use be metered;
2) Nominates the water account from which use is to be deducted; and
3) Establishes 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 US, a water entitlement must be used and, if it 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 more efficient management of third party objections to a proposed change in water use.

Note also that each and every water account holder has an economic incentive to save water. Note also that one of the early mistakes made in Australia was a failure to allow people to carry-forward unused allocations with adjustment for losses from one season to another. When introduced, there was a significant increase in the value of water allocations and changes in the way that water was used.

Unbundling has one further benefit of immense importance to the improvement of opportunities to use water in the US. In an unbundled regime, third party impacts are managed via the conditions in a use approval and in water resource management plans. If a person is concerned about the likely impacts of water use at a location near or upstream of them, then they may seek to stop the approval. 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 the much more efficient use of capital in irrigation.

Opportunity Three – Statutory water resource plans

In 2014, California legislated to require the appointment of groundwater sustainability agencies who, once appointed, will be required to prepare plans for the "sustainable" management of the ground water resources these agencies' boundaries overlie. The legislation also permits these agencies to specifically regulate, limit, and suspend groundwater extractions in order to achieve the sustainability goals put forth in the agencies' plans. This opens up the opportunity to improve the way opportunities to use ground water are defined, allocated and managed. Nevada has similar legislation that authorizes its State Engineer to require the preparation of a management plans for water resources that are 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 that water resource plans make to an economy and establish the ground rules for water allocation, then the first requirement is that they are drafted in a manner that reduces the opportunity for legal argument. This can be achieved by making it clear that the rules in the plan are binding and may be changed only via due public process. The robustness of these plans can be strengthened further by writing in a manner that resembles a decision-making guide that deliberately leaves out detailed descriptions of the state of knowledge about the resource and the reasons why particularly decisions are made.

In Australia, legal risks of challenge are minimized by making water resource plans statutory. That is, a local agency's water resource plan is presented to the legislature for final approval and full legal standing. The result is a framework that makes it possible for local boards, water masters, etc. 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 remaining legal risk in 40 minutes.

Plans also need to avoid concepts that are scientifically contestable and be devoid of complex assessment of climatic risk, etc. As a result of interest in the Blueprint we have developed, rather than building complex computer models, etc. 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 must be reduced by between 3% and 6%. 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 2 sets out a generic framework for the development of a robust water sharing arrangement designed 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 US 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 sharing pools are put in place, the resultant 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, there is no opportunity for third parties to 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 should 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 then to all water users.

Statutory plans and the legislation used to authorize their preparation can be used, also, 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.

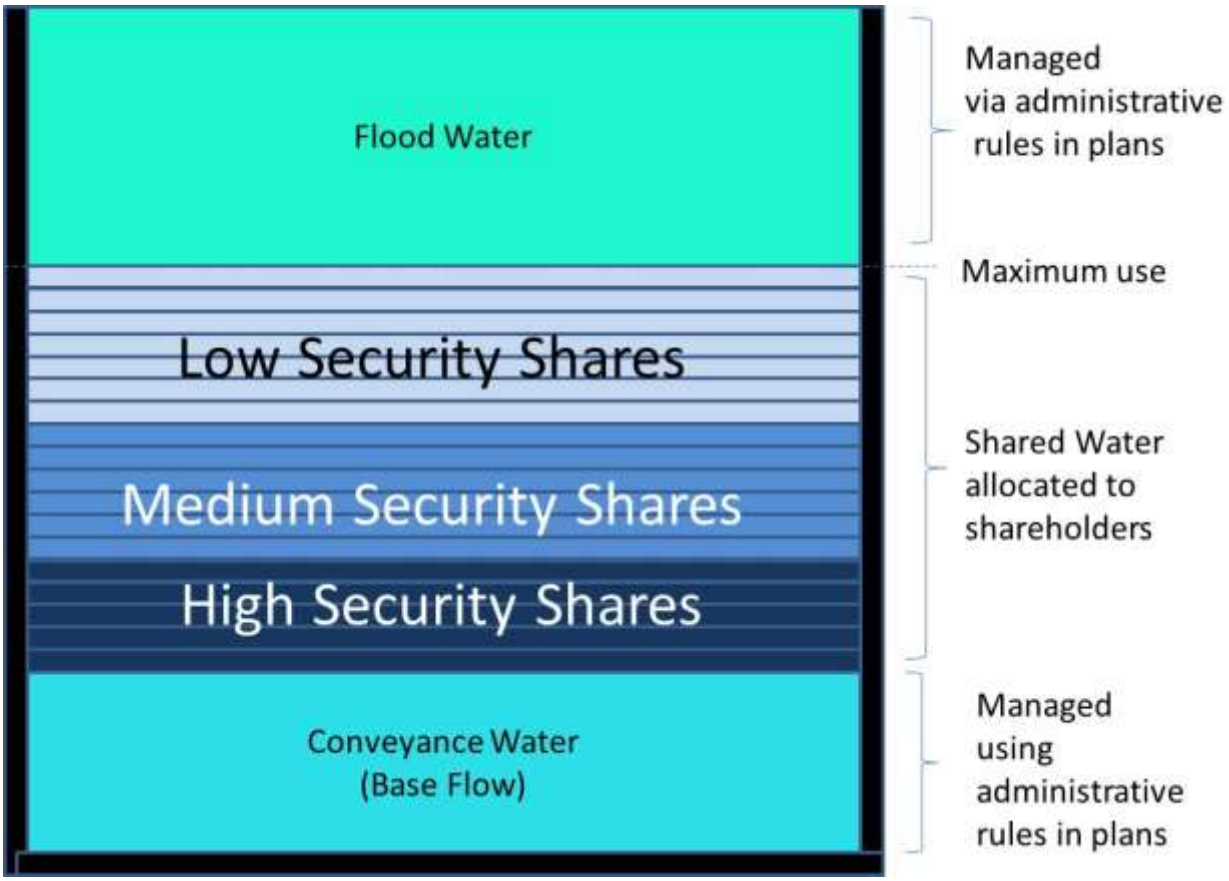

Figure 2 A robust schema for the development of a water sharing arrangement that enables efficient risk management

Opportunity Five – Giving the environment an entitlement

More by accident than good design, Australia has discovered the benefits of developing a sophisticated approach to the delivery 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 from willing sellers. When the Federal Government began purchasing water shares for the environment, Treasury officials were not prepared to surrender this new asset. As a result, the shares so purchased came to be held in trust for the environment.

In practice, the purchase of water shares for the environment 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, over-use and over-allocation was tolerated and degradation was the result. Under the new regime, every time allocations are made, the environment – just like all other shareholders – receives an allocation. The Trustees who have been appointed to manage these allocations then have to decide what to do with these allocations. As a result, environmental water use has become more efficient and a new cadre of environmental water managers has emerged. Differing from those who previously spent much of 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 to be efficient. Now, they do. Along the way, these managers have discovered the benefits of counter-cyclic trading. Counter-cyclic trading involves the government's sale of environmental water allocations to irrigators during a drought, and then using the revenue received to purchase more shares and/or fund investments in environmental infrastructure, etc.

Opportunity Six – Trusted governance

Transitioning from an old to a new water management regime requires the use of 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.

When considering all these considerations, there is a strong case for assigning responsibility for the development, implementation, and enforcement of water resource plans to expertise-based boards and using representative governance processes to appoint a board directors. Among other things and, as is the case in the corporate world, if a shareholder is appointed to such a board, these people should not be able to trade in the same manner as any other shareholder. As a result, the Nicholas Institute Blueprint recommends appointment of small, expertise-based boards responsible for the development and management of a water resource on the condition that they be required to consider the advice of

appropriately constructed stakeholder reference panels. If a shareholder is appointed to a board and has either a direct or indirect interest in water shares, then they should not be allowed to trade when allocation decisions are being made and/or policies are under review.

If robust water trading and marketing arrangements are to become the norm in the US, then — more than anything else — those entrusted to implement the water sharing systems used must be trusted. When trust is declining, then, as is the case in the corporate world, there must be a quick revision in the composition of the board. Amongst other things, it is critical that decisions taken by a board are supported publicly by all of its members. If a member, having been involved in the making of a decision, wishes to express public dis-satisfaction with that decision, then they should resign. Otherwise, a board should be seen to be unanimously making decisions that are 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 made as Australia began its water reform program was to focus on surface water systems and not bring groundwater systems into the same process. Several US states appear to be making the same mistake.

The obvious solution to the management of connections between water resources is to bring them together under one integrated water resource plan. In large systems, these arrangements are best dealt with in a high-level Basin Plan or equivalent. 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, if efficient management is the goal, then allocations need to be managed on a resource-by-resource basis in a "nested" manner that allows individual users to transfer water between, for example, ground and surface water systems. When this is done, shareholders have an incentive to invest in groundwater storage, the carry-forward of unused water allocations from year to year. and generally optimize the management of stocks and flows.

Australian experience suggests that, as knowledge about system inter-connectivity 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 the setting of transmission exchange rates in unregulated streams and the development of effective ways to shepherd water from one river reach to another. Determination of the amount of water to be set aside so as to prevent seawater intrusion is another such 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. The result increases the value of shares in both resources and builds resilience.

Decisions about how many water resource plans to prepare need to be taken carefully and are context specific. Australia has a single plan for all the ground and surface water resources in the Murray-Darling Basin and then a suite of regional plans for each ground and surface water resource. Most groundwater resources and most surface water resources are zoned.

Opportunity Eight – Simplification by adopting "gross" rather than "net" water accounting regimes

A related issue is the question of how to account for return flows. 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, the robust management of this biophysical reality is a challenge. Otherwise, as water use efficiency (in a technical sense) increases, the amount of water that returns decreases with the consequence that increases in water efficiency result in 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 US, and require changes in water use efficiency to be accounted 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% of the water they take while others return much less. One of the more common examples of a water user who uses 100% 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% of the water they pump from a water resource.

Opportunity Nine – Tagged entitlement trading

Another opportunity to improve the value of shares is to develop efficient ways to transfer an interest in one part of a resource to another without permanently diminishing the interests of shareholders not involved in the transaction. In theory, the most efficient way to manage permanent trades between two connected water resources is to only allow the trade of water allocations and not the trade of shares from one resource to another. Sometimes, however, water users in one region would like a guarantee that water will always be available to them in another. When water users need such a guarantee, such as when a permanent trade across a state border is being contemplated there is a choice between either:

1) Surrendering shares in one water district and issuing new shares in another district; or
2) Allowing the purchaser to hold "tag" the shares they purchase in a manner that guarantees that as soon as an allocation is made to these shares, they are transferred to a nominated water account in the other water district.

When Australia started reforming its water entitlement and allocation there was strong interest in the former surrender and re-issue approach. With experience, however, there has been a strong shift to the latter tagged-trading arrangement as this does not require the development of efficient ways to revise the rules that determine who receives the water that is to be allocated into the connected water resource. In some parts of the US, tagged trading already exists.

In all systems, whether small or large, tagged trading protects third parties by allowing the continuous revision of 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 decide to reverse a decision to allow permanent trades between regions and/or set capricious conditions on such transfers.

Opportunity Ten – Allocating rights to individual users

In many parts of the US, as was the case in Australia, water users are encouraged to trade water within a district. Deals to trade water between districts, however, tend to be negotiated by district managers and allowed only when in the interest of both parties. This discourages many irrigators from seeking opportunities to save relatively small amounts of water in order to sell them to someone else. Sometimes, the highest and best use of such water lies outside a local region but it is simply too hard for a water user to find a way to access this opportunity. The alternative approach, used in Australia, is to require all districts to allow both the permanent and temporary trade of water out of their districts.

If applied without consideration of the impact of such an arrangement on the costs of an operating district's infrastructure, this could discourage the efficient management of water supply and delivery arrangements. To remove this dis-incentive to the efficient management of water supply infrastructure, Australian districts are allowed to charge a termination or exit fee. At present, the maximum fee is set at ten 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.[3]

Note that in an unbundled water entitlement and allocation regime and coupled with metering and the full assignment of rights to individuals, fallowing programs would become redundant. Every irrigator would have an incentive to sell water savings drop by drop. Instead of contracting to fallow, each irrigator would be free to transfer as many allocations as they like and those interested in accessing water would be able to purchase as much water as they need. One of the main features of this suite of institutional arrangements is an arrangement that allows continuous adjustment as conditions change. If, for example, an unexpected rain shower results in an irrigator requiring one less irrigation than planned, these saving can be sold.

Towards an improved water allocation and management

It should be emphasized that many of the ten opportunities identified in this paper and others identified in our Blueprint are to varying degrees already in place in some states and some districts. Water trading is not new to the US and, in some regions, transition to full implementation of the type of regime outlined above is relatively simple. In others, transition may be more protracted.

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. I think that the time has come for the US to consider investing in the processes that would

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[3] In Australia, when this arrangement was introduced and as a transitional arrangement, one state was allowed to set a 10% 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.

enable it to make such a transition. When one monitors the US water media, there is considerable interest in finding a way to move to the Australian style water entitlement and management systems. More than anything else, this transition requires the establishment of:

1) Water right registers in a manner that enables seasonal allocations to be made; and then
2) Water accounts that record precisely the number of allocations that each user has not yet used.

The latter requires a commitment to require metering and the development of robust governance arrangements. Such a transition need not come from a top-down decree at a State or National level. In most states, however, transition will be easier if enabling legislation is put in place. As stated earlier, the arguments can be cast in a narrative built around recognition of the economic benefits and not the need for greater control.

Arguably, transition is easier in water districts and regions that are in a critical condition. Transition will be easier too in states where the administrative leadership has experience, understanding, and capacity to assist district leaders and water resource managers to transition 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, in particular, demonstrate how 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 are showing 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.

At the National level, an outsider may be tempted to observe that too much attention is being given to stressed water resources. There is, however, a strong case for moving ahead of the game and selecting a few unstressed resources to operate in a precautionary manner, preventing future problems from ever occurring. The return on investment from moving ahead of the game and avoiding the very high costs of having to resolve over-allocation problems, etc. could be substantial.

In a recent report for the governments of England and Wales (Young 2012), it has been suggested that all water resources should be closed when permitted use reaches 70% of potential. Upon closure, 70% of all the shares to be issued would be allocated to existing users and the remaining 30% 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 US Federal Government?

Is there a case for Federal involvement in water reform? The economic case for encouraging US states to transition to the development of robust water sharing arrangements is strong – especially when the cost to society of ongoing mismanagement and legal litigation is considered. It also needs to be recognized that reform takes time. While Australia started its water-reform journey in the 1990's, the full repair of the Murray-Darling System is not expected before 2023. Learning from the Australian experience may enable the US 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 end up working efficiently across state borders.

The second Federal opportunity is to search for efficient ways to pass responsibility for the governance of overlapping Federal and State interests in water to single integrated management systems. Ultimately, the US will be best served if a way can be found to rely upon 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 is about to occur, Federal Government agencies could, for example, show willingness to convert their rights into shares and agree to work under the conditions set out in water resource management plans.

A third, more sensitive, opportunity is to show willingness to enable the efficient management of endangered species and other environmental considerations. 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% of shares in the Murray Darling system.

Costs and benefits

As far as I am aware, no cost benefit analysis of the merits of resolving the many water-related environmental challenges facing the US has been conducted. In the process of preparing the now agreed Murray-Darling Basin Plan, several attempts were made to do this and they played an important role in convincing Australia's political leadership to support this transition. As a result of the impact of the Millennium Drought, the merits of validating registers and an understanding of the merits of building the institutional structure that enable rapid, low cost water trading across state boundaries support was bi-partisan. As a result, Australia has much experience to share.

Assessment of the merits of shifting to a new robust water resource sharing arrangement requires the development of models that test policy alternatives. Using a CGE model, Wittwer (2015) has converted TERM-H20 into a model that can track the regional implications of severe drought in California's Central Valley under a drought scenario requiring a 40% cut in water availability. Under the current administrative regime, the value of farm output is reduced by between 10 and 20 percent. (***??***Under unfettered Australian style allocation trading 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 impact of a drought and do so without adversely impacting on groundwater supplies.

In Nevada, the State Engineer has declared the Diamond Valley Groundwater resource to be in a critical state and, as a result, in ten year's time he must curtail the use of all water rights issued after 1960. Most farms hold a mixture of pre- 1960 "senior" and "junior" post-1960 rights, a few 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 benefits to the community that 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 used in the US 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; a significant increase in investment and innovation can be predicted; and known environmental challenges resolved at much less cost than otherwise would be the case.

References

AUSTRALIAN COMPETITION AND CONSUMER COUNCIL (ACCC) (2008) Water charge (Termination fees) rules. Final advice, December 2008. Available at https://www.accc.gov.au/system/files/Water%20charge%20%28termination%20fees%29%20final%20advice.pdf

HARRISON, Z & Others (2016) Benefits, costs and distributional impacts of a groundwater trading program in the Diamond Valley, Nevada. Report Prepared for The Rockefeller Foundation by the Nicholas Institute for Environmental Policy Solutions, Duke University.

KIRBY, M., BARK, R., CONNOR, J., QURESHI, M. E. & KEYWORTH, S. (2014) Sustainable irrigation: How did irrigated agriculture in Australia's Murray–Darling Basin adapt in the Millennium Drought? Agricultural Water Management, 145, 154-162.

NATIONAL WATER COMMISSION (NWC) (2012) Impacts of water trading in the southern Murray-Darling Basin between 2006-07 and 2010-11. Canberra: National Water Commission.

NAUGES, C., WHEELER, S. A. & ZUO, A. (2016) Elicitation of irrigators' risk preferences from observed behaviour. Australian Journal of Agricultural and Resource Economics.

ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT (OECD) (2015) Water Resources Allocation: Sharing Risks and Opportunities, OECD Studies on Water, OECD Publishing, Paris.

SMITH, Adam (1776) Of the Origin and Use of Money. An Inquiry into the Nature and Causes of the Wealth of Nations. Available at http://www.econlib.org/library/Smith/smWN.html

WESTERN GOVERNOR'S ASSOCIATION (2012) Water transfers in the West. Available at http://www.westgov.org/index.php?option=com_content&view=article&id=231&Itemid=84

WHEELER, S., LOCH, A., ZUO, A. & BJORNLUND, H. 2014a. Reviewing the Adoption and Impact of Water Markets in the Murray-Darling Basin, Australia. Journal of Hydrology, 518, 28-41.

WHEELER, S., ZUO, A. & BJORNLUND, H. 2014b. Australian irrigator's recognition of the need for more environmental water flows and their intentions to donate water allocations. Journal of Environmental Planning and Management, 57, 104-122.

WITTWER, G. (2015) From Almond Shaming to Water Trading: CGE Insights into Managing California's Drought. Centre of Policy Studies Working Paper No. G-258. Available at https://ideas.repec.org/p/cop/wpaper/g-258.html

YOUNG & McCOLL, J. (2003) Robust separation.

YOUNG, M & ESAU, C. (2013) Detailed case study of the costs and benefits of abstraction reform in a catchment in Australia with relevant conditions to England and Wales. Department of Environment, Food and Regional Affairs R&D Technical Report WT1504/TR. Available at file:///C:/Users/MikeY/Downloads/11089_GwydirReport130328m(3)%20(4).pdf

YOUNG, M. (2013) Improving Water Entitlement and Allocation, Background paper for the OECD project on water resources allocation (unpublished).

YOUNG, M. (2014) Designing water abstraction regimes for an ever-changing and ever-varying future. Agricultural Water Management, 145, 32-38.

YOUNG, M. (2015) Unbundling water rights: A blueprint for development of robust water allocation systems in the Western United States. Durham, NC: Nicholas Institute for Environmental Policy Solutions, Duke University.

YOUNG, M.D. (2010) Environmental effectiveness and economic efficiency of water use in agriculture: The experience of and lessons from the Australian water reform program, consultant report prepared for the OECD, Paris, France.

YOUNG, M.D. (2012) A framework for the allocation and management of water in England and Wales. University College London Environment Institute and The University of Adelaide. Available at http://www.lifestudy.ac.uk/research/domains/environment/research/past-research-reports/water-use

YOUNG, M.D., SHI, T. & MCINTYRE, W. (2006) Informing Reform: Scoping the affects, effects and effectiveness of high level water policy reforms on irrigation investment and practice in four irrigation areas. CRC for Irrigation Futures Technical Report No. 02/06.

ZUO, A., NAUGES, C. & WHEELER, S. A. (2014) Farmers' exposure to risk and their temporary water trading. European Review of Agricultural Economics, 42, 1-24.

Appendix One A check list to assist in 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 *in situ* requirements and sustainable use?

Check 5. Is there an effective approach to enable efficient and fair management of 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 impact of the abstraction 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 (2015) drawing upon Young (2013)