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IMPROVING WATER ENTITLEMENT AND ALLOCATION REGIMES

7-8 November 2013

This paper is being circulated to WPBWE delegates as background information.

ACTION REQUIRED: Delegates are requested to provide comments by 30 November.

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NOTE FROM THE SECRETARIAT

This paper has been developed under Output area 2.3.2 Climate Change and Natural Resource Management of the WPBWE Work Programme for 2011-12. It contributes to Project 3.2 Water and Green Growth. It also contributes to Project 3.2. Water Resource Allocation and Economic Instruments of the WPBWE Work Programme for 2013-14.

Water allocation is a key driver of managing water for green growth. As many countries are considering reform of prevailing allocation regimes, a clear understanding of what a robust allocation regime entails is required.

The paper describes the principal elements of robust entitlement and allocation regimes. It inventories the key challenges water managers face when considering water allocation. It offers a set of tests managers and analysts can use to assess the robustness of prevailing regimes. Building on an array of experiences, it draws preliminary lessons on the management of the reform of allocation regimes.

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EXECUTIVE SUMMARY

This paper explores opportunities for countries to transition towards the use of more robust abstraction regimes. A set of robustness tests is offered. The concluding section presents these tests as a set of guidelines.

Most abstraction regimes where developed during periods of abundance. Most were designed neither for the management of water scarcity nor for the management of changing demands. Assessment of the likelihood of water scarcity issues constraining water use and economic activity in each part of a country is recommended.

Robust abstraction regimes are designed to function elegantly under the full range of conditions that may occur. Particular attention is given to their capacity to function well during periods of extreme water scarcity. Attention is also given to the contributions that water makes to economies, the environment and human wellbeing.

Robust abstraction regimes are expected to endure without the need to revise them. They encourage efficient investment in infrastructure and the efficient use of water as conditions change. Innovation is encouraged and rewarded. Use is kept within sustainable limits.

Key elements of robust entitlement and allocation regimes are characterised by:

- The use of water sharing plans to determine the proportion of water that may be abstracted, the means for distributing access to water among users, protecting the interests of third parties and maintaining environmental flows;
- Closure of catchments well before they are fully allocated;
- The use of unbundled administrative arrangements so that decisions about each element can be made quickly and without the need to consider consequences for objectives unrelated to the element under consideration;
- Definition of entitlements as shares of a resource pool, rather than an entitlement to a fixed volume of water;
- Establishment of entitlement registers that allow the names of all with an interest in an entitlement to be identified quickly and reliably;

- Accounting arrangements that adjust for changes in return flows, transfers between connected water resources so that changes in water use in one area do not perversely undermine the interests of others.

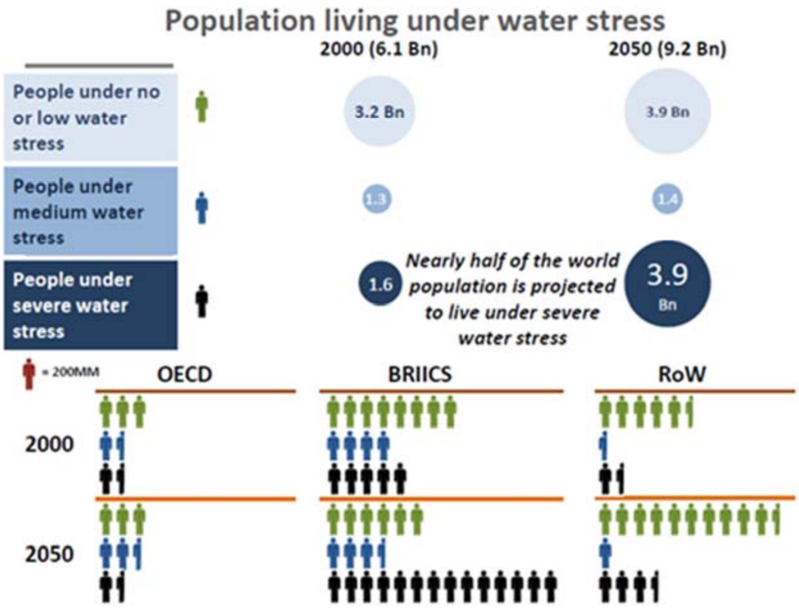
As countries begin the process of transitioning to more robust water entitlement and allocation arrangements, attention to the sequence of reforms made is recommended.

INTRODUCTION

Global recognition of the extent of water shortage challenges is relatively new.

By 2050, OECD expects global water demand to have increased by 55% and that nearly half of the world's population will be sourcing the water from a severely stressed resource (see Figure 1). Living within the constraints set by water scarcity is becoming a global challenge. Research is showing, however, that it is possible for the world to live within the limits set by water (Molden 2007). To avoid widespread water supply problems, however, the rate of improvement in water use efficiency and in the construction of new dams, desalination plants, etc. needs to be around twice as fast as has been achieved in the recent past (Young 2013). Otherwise supply will not be able to keep up with demand.

Figure 1. Proportion of people likely to be accessing water from a stressed water resource by 2050



Source: OECD (2012)

The paper's underlying premise is that, in many cases, faster and better progress will be made when countries are prepared to include the redefinition of water entitlements in the range of policy options to be considered.

With few exceptions, most abstraction regimes where developed during periods of water abundance and are not well suited for management of the challenges that water scarcity imposes on a nation. Australia, South Africa and Chile have shown that it is possible to redefine abstraction regimes. Other countries like England and Wales, France, the Netherlands and Canada have begun exploring ways to do this.

For many countries, contemplation of the benefits of abstraction regime reform could represent a significant policy shift. In many parts of the world water rights – as they are often called – often are seen as sacrosanct things that should never be changed – even when their form is known to be preventing progress. Discussions about the rights of people to have access to clean drinking water and adequate sanitation run the risk of becoming tangled with arguments about environmental needs and the distribution of any profits that might arise from investment in water use.

Abstraction reform need not be threatening, it is possible to change entitlement and allocation regimes without making any person worse off. One way of doing this is to limit changes to those that increase the value of water entitlements held. Another is to offer cash payments to people who following the reform would become worse off. When contemplating this latter action, however, it is important to begin by assessing what would have happened if the reform had not occurred.

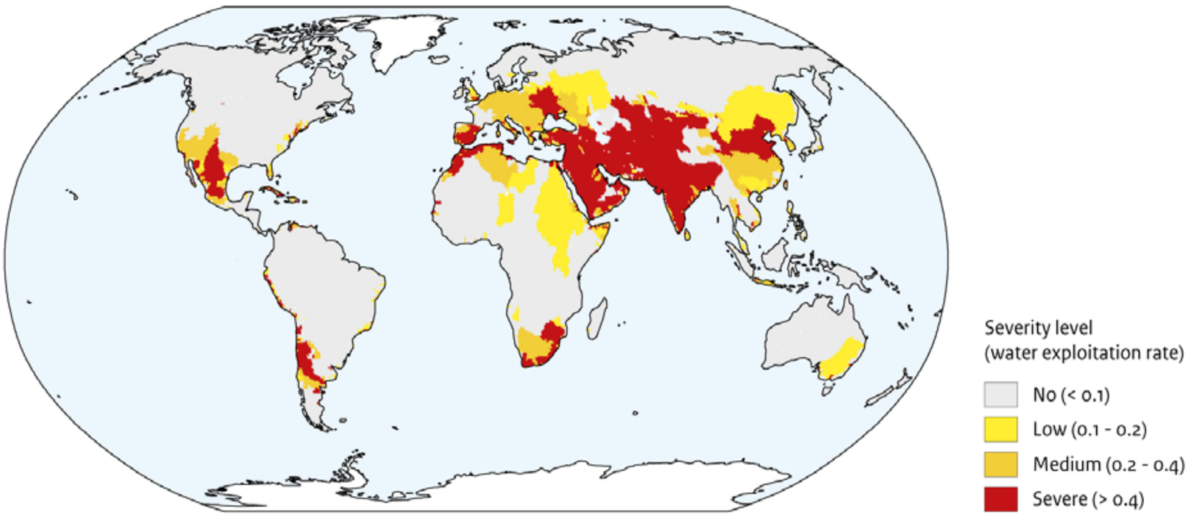
Early signalling of the need to transition from one regime to another is another characteristic of successful reform programmes. In England and Wales, for example, the process began with the release of a white paper which stated that some changes to the current licensing regime may be necessary. This process has been followed with a major investment in the development of option papers and estimation of potential benefits.

This paper builds on the experience gained by countries – especially Australia. Many mistakes have been made and many lessons learned (Young 2010a; Grafton *et al.* 2013).

Scarcity and risk

When considering water scarcity (see Figure 2, for global projections by basin), it is necessary to differentiate between economic and absolute scarcity. Economic scarcity exists when there has been underinvestment in infrastructure. Absolute scarcity exists when there is no affordable source of additional water. In the case of absolute scarcity there is no option other than to live within the limits necessary to keep use within sustainable limits. Once an absolute limit has been reached, abstraction regime design becomes critical.

Figure 2. Severity of Water Scarcity by Basin in 2050



Source: OECD (2012)

The causes of increasing absolute scarcity can be grouped into four broad categories

1. Increasing demand caused by population increases, increased living standards and the use of land to produce bio-energy instead of food and fibre;

2. Decreasing water supply as nations seek to resolve over-allocation problems, restore health to degraded water bodies;

3. Adverse climate change resulting in a reduction in the mean amount of water available for use and/or a decline in reliability;

4. Loss of opportunity to produce food as a result of the transfer of land to urban settlement and declines in soil productivity.

Catley-Carson (2009) describes the resultant mix of tensions as a cocktail to be “stirred with care.”

This paper focuses on opportunities to include abstraction regime reform in the range of measures used to resolve these tensions. The prospect that climatic conditions may change quickly has added uncertainty to the suite of challenges that water managers have to cope with.

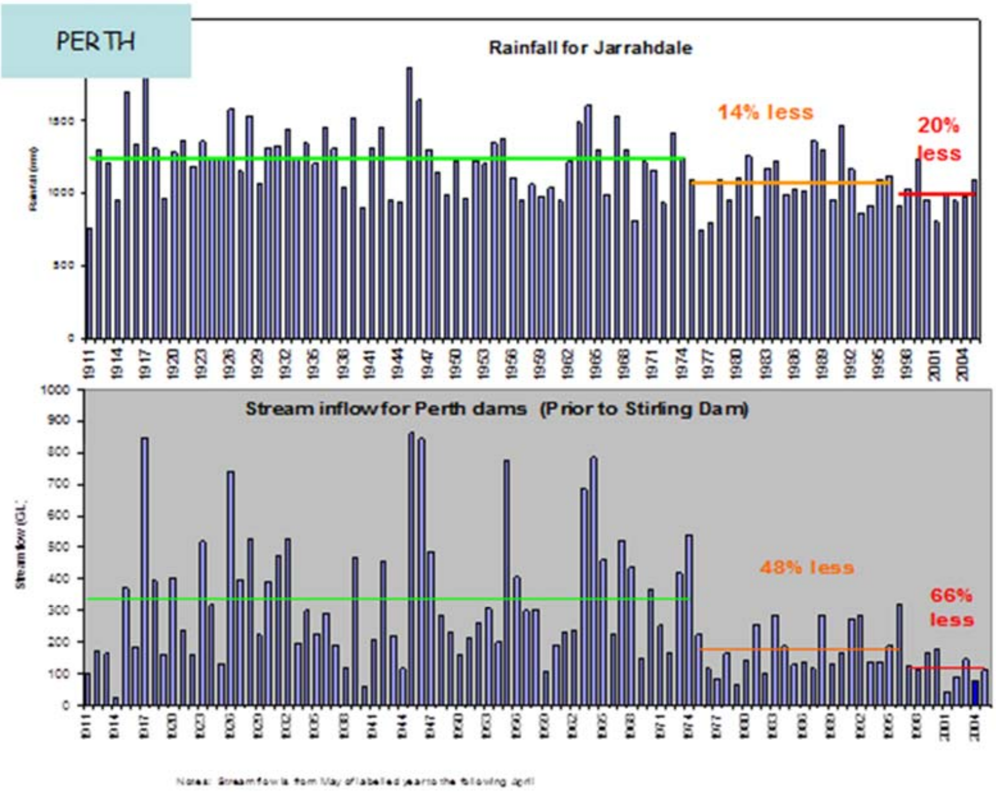
One of the most common mistakes made when considering how best to manage water allocations is to assume that the impact of climate change on water supply will be gradual. Experience is showing that sudden climatic shifts can occur. In the case of Perth, a sudden shift appears to have occurred in 1974. Since then the amount of water available for consumptive use in this region has more than halved (see Box 1).

Water abstraction regimes need to enable the efficient and equitable management of risk. Supply conditions can change quickly. It is not uncommon for a region that has been in the midst of a serious drought to find itself suddenly in the midst of a flood. In water resource planning, it is useful to differentiate between “risk”, where probabilities are known, and “uncertainty” where probabilities are unknown.

Box 1. The nature of changes in Perth’s water supplies

In 1974, the city of Perth in Western Australia appears to have experienced a sudden unexpected shift to a drier climatic pattern. Since that year, mean rainfall has been between 14% and 20% less than it was for the first two thirds of the century. As a result, inflows into Stirling Dam have more than halved.

This experience demonstrates how quickly climates can change and how relatively small reductions in mean rainfall result in a dramatic reduction in the quantity of water available for use.



Principal elements of an abstraction regime

Water scarcity brings about a suite of challenges that are quite different to those that apply when water supplies are abundant. In particular, there is a need to encourage the development and adoption of more efficient water using practices. Very few abstraction regimes, however, do this well.

The inclusion of a "beneficial use" requirement in a water allocation regime is an example of an arrangement that discourages people from improving water use efficiency. Common in Canada and the US, beneficial-use requirements guarantee ongoing access to water provided that any water allocated to an entitlement holder is "used." Under a beneficial-use regime, however, if a user improves water use efficiency and thereby generates some savings there is a risk that these savings will be taken from him/her permanently and passed onto others without compensation.

Originally, beneficial use arrangements were put in place to discourage speculation. A "use it or lose it" doctrine applied. Beneficial-use requirements, like this, make sense when water is abundant and there is a need for economic development. When water is scarce, beneficial-use requirements of the form found in some of the priority entitlement regimes in the United States and Canada have the perverse effect of discouraging people from searching for more efficient ways to use water because increases in water-use efficiency that cannot be used by the same user run the risk that the resultant savings will be re-allocated to another user.[1]

This paper

The remainder of this paper focuses on the use of abstraction regimes for the efficient and equitable management of water scarcity without compromising the effectiveness of arrangements needed to ensure full control of flood, water quality and other issues.

Rather than emphasising the need for "integrated" approaches to water management, the paper focuses on the design of abstraction regimes. A limiting factor approach is advocated.

When a limiting factor approach is taken, each element of an abstraction regime is designed to work elegantly[2] when that element is the one that limits the suite of outcomes being pursued. The resultant interplay of elements at different scales in time and space can then be relied upon to produce an efficient solution to the question of how and when to take and use water. When scarcity is the limiting factor, then this dimension of the regime takes precedent. When flood risk is the limiting factor then this dimension takes precedent. When water quality limits use then this consideration takes precedence.

The idea of focusing on the management of resources through attention to limiting factors has been most developed in agriculture. When nitrogen is the factor limiting yield then the only way to increase yield is to increase the amount of nitrogen available to the plant. Increases in other inputs like phosphate will make no difference to yield.

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1 In beneficial-use regimes, an ongoing entitlement to access water is confirmed by taking and continuing to use this water. Failure to continue to use this water results in its reallocation to holders of less senior entitlements.

2 Elegance is used as a single word that captures simultaneously the concepts of efficiency, equity and sustainability. Elegant regimes have a connotation of flawlessness that is beyond criticism.

Definitions

Around the world, many different words and terms are used to describe the components of an abstraction regime.

In this paper, the term "***abstraction regime"*** is used to describe the constellation of administrative and governance arrangements used to determine who is allowed to abstract water from a water body, how much may be taken, how much must be returned and the conditions associated with the use of this water.

The paper then goes on to use a suite of carefully defined terms to describe the principal elements of an abstraction regime.

The word "***entitlement***", for example, is used to describe the nature of a person's long-term interest in a water body. In some regimes, entitlements are issued in perpetuity and unconditional. In many countries, entitlements are conditioned. Conditions can, for example, require ongoing beneficial use and/or only be issued for say, ten, years. In Australia, typically, entitlements are defined as a right to receive a share of any water allocations made through a water sharing plan. In other parts of the world, entitlements tend to be defined as a right[3] to a nominated volume or to irrigate an area of land.

The word "***allocation***" has a specific meaning. An allocation refers to a specified quantity of water that may be taken from a water body at a point in time. In sophisticated abstraction regimes, allocations are metered and governance arrangements successfully limit the abstractions to the maximum amount that has been allocated. Unused allocations can then be made tradeable.

In this paper, the word "***system***" is used to refer to a water body and "***regime***" to an administrative arrangement.

DESIGN CONCEPTS

In a region where water is scarce, the first need is to find a way to ensure that water makes its greatest contribution to the needs of society. That is, the regime should ensure that this water goes to its highest and best use. Typically, the highest and best use is water needed for drinking and sanitation purposes followed closely by that needed to prevent irreversible damage to the environment and/or built

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3 In law, "right" has very specific meaning that often results in heated discussions among lay people. In this paper, use of this word is avoided.

infrastructure. Once these needs have been met and provided environmental and other externalities are appropriately managed, the remaining water can be used for a wide variety of activities.

In some countries, the remaining water is allocated administratively while in other countries market and market processes are being used to allocate and re-allocate water. Australia and, to varying degrees, the United States, Chile and China have embraced the use of water markets and entitlement trading to facilitate adjustment. In countries, including England, Canada, France and India, groups of farmers have negotiated arrangements that allow them to trade water with other members of the group. Other countries, like the Netherlands, use bans on less intensive forms of water use to ration water during periods of shortage.

Equity in process is critical. The use of water policies to achieve income and other distributional objectives in OECD countries needs careful consideration. Water is the heaviest item per dollar delivered to a household. As a consequence, the use of access to water as a means to protect individuals and regions from competition has high costs to society that can rarely be justified in a wealthy country. If there is a need to transfer $100 from one family to another then there are many more efficient and equitable ways to achieve this outcome than to subsidise access to water. Equity in process, however, is essential.

When it comes to the concepts critical for the design of a water abstraction regime, it is important to ensure that the regime:

- Is **robust** in the sense that it can be expected to function well in all circumstances and excel during periods of extreme water scarcity;
- Promotes **efficient resource use** as conditions change by ensuring that 1) water is put to its highest and best use; and 2) the regime stimulates efficient investment and 3) encourages innovation;
- Allocates water in ways that have **hydrological integrity** and characterised by the fact that innovation and changes in use in one area do not have the perverse effect of undermining use elsewhere. The entitlement and allocation arrangements used must be consistent with the way that rivers and aquifers function;
- Is characterised by **low transaction costs** so that individual users are encouraged to seek more efficient ways to use water and are not trapped by decisions taken at an earlier time;
- Is organised so that **risks are fully assigned** to those able to manage them most efficiently;
- Is **unbundled** to the extent necessary to enable the efficient pursuit of independent objectives.

Unbundling – the replacement of a single instrument with a suite of instruments – opens up the opportunity to achieve each of the above conditions without design compromise. Unbundled regimes are characterised by many - rather than a single - licensing instrument. In unbundled regimes, a combination of entitlements, water accounts, permits, works approvals and sharing plans are used to control water use. The first step in an unbundling process is to separate the water entitlement from land title and then, if necessary, issue a separate permit to regulate the location-specific issues associated with the abstraction, use and return of water at a specific location.

KEY CHALLENGES

In the next section, the paper focuses on options for the management of system-wide challenges in regions where water scarcity either is or is expected to constrain development. It is assumed that countries will have or are in the process of assessing all water resources with a view to determining which water resources are likely to be challenged by the emergence of water scarcity.

Issues associated with the distribution of entitlements, assignment of allocations and granting use approvals are considered in the subsequent section.

System-wide challenges

By system-wide challenges, it is meant those challenges that are most efficiently and equitably dealt with at the scale of a water resource (be it at the basin, catchment, river, stream or aquifer level). Typically, they take the form of conditions expressed in water sharing plans and other similar documents that determine how system wide decisions should be taken. Those that apply to all water resources can be contained in regional and national legislation.

A long-term abstraction limit

When using an abstraction regime to manage water scarcity, arguably the most difficult and yet most important challenge is to find a way to limit the maximum volume of water that can be abstracted from a system. If this feature is missing then, when scarcity raises its ugly head, the result will be *"over-use"* of the water resource and/or the use of restrictions on the proportion or number of entitlements that may be used. "Over-use" is the abstraction of more water from a system than can be sustained. In essence, the setting of an abstraction limit requires consideration of the amount of water that must be put aside to meet downstream, non-consumptive use and environmental needs[4].

Over-use of water resources is common around the world and, in the worst of cases, is characterised by the failure of a river to reach the sea. The list of rivers around the world that have not reached the sea

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[4] Sometimes these three different needs are collectively grouped under an environmental flows banner. In robust abstraction regimes, however, each element needs to be defined and managed separately.

for significant periods includes Australia's River Murray, the Colorado River in the United States and the Yellow River in China. Over-use is one of the main reasons why large rivers do not flow to the sea.

To prevent over-use, an abstraction limit needs to be set and a way found to keep use within that limit. Two types of abstraction limit are needed:

- A long-term limit that can be used for strategic investment purposes; and
- A short-term limit on the amount of water that can be taken at any point in time.

In robust regimes, the sum of the maximum amount of water that can be abstracted sustainably always aligns with the sum of the maximum amount that can be taken by each entitlement holder.

A long-term abstraction limit defines the maximum volume of water that can be abstracted at any point in time. Once this limit has been fully allocated, no new entitlements can be issued unless the process is accompanied by an arrangement that reduces someone else's entitlement by an equivalent amount.

When setting a long-term abstraction limit, it is important to decide whether or not include some or all entitlements in this limit. The most common approach is to set aside the amount needed for environmental, transfers to other systems, navigation, etc. as a prior right and then allocate the rest as entitlements to take water for consumptive purposes.

An alternative approach, being tested in Australia, is to assign some water to the environment as an entitlement to a share of all inflows and define this entitlement separately from the arrangements used to ensure that base flows, for example, are maintained.[5] Australia is moving towards this alternative approach because it puts environmental water on the same footing as all other water users. Under this arrangement, allocations are made in proportion to the number of entitlements held in the interests of the environment– no matter how dry or wet it is. As a result, administrators are not able to transfer environmental water to other users. In the United States, non-government groups have been buying water to ensure that the environment is looked after. One of the best known examples of this is the Oregon Water Trust. Its success has led to many other organisations setting up similar arrangements.

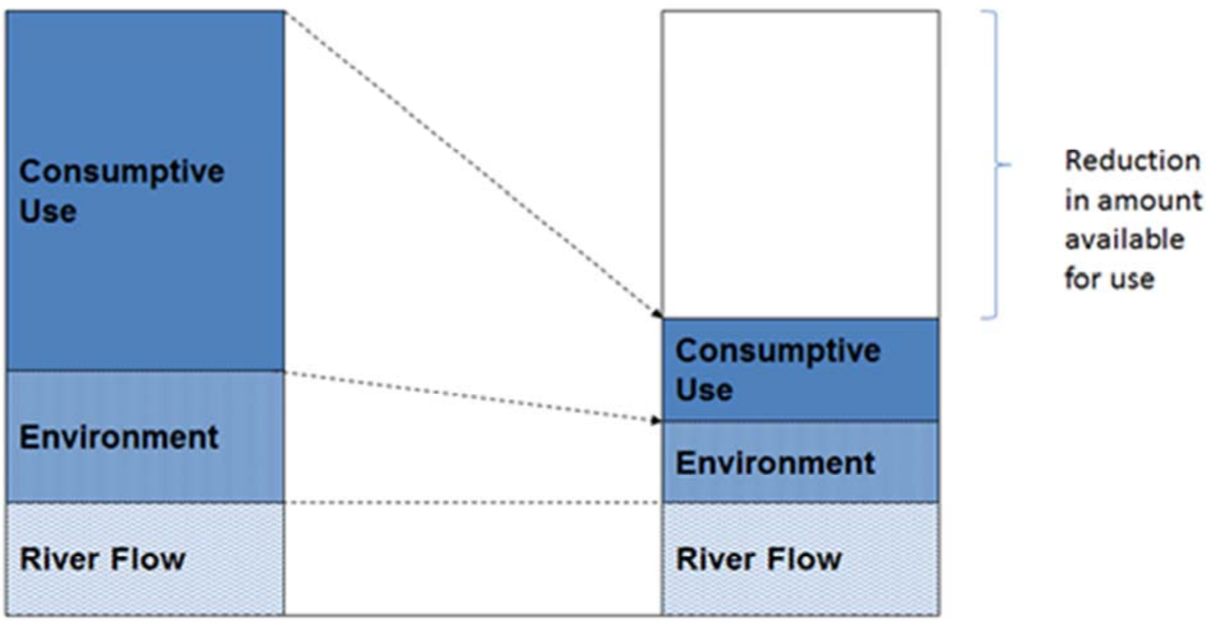
[5] In Australia's Murray Darling Basin, a Commonwealth Environmental Water Holder has been established and by 2019 is expected to hold around one third of this Basin's water entitlements. Under this new arrangement, it is not possible for the government to allocate water to consumptive users (irrigators) without making a pro-rata allocation to the Commonwealth Environmental Water Holder.

*Test 1. (**Long-term abstraction limit**) Does the regime place an enforceable long-term limit on the maximum amount of water that may be abstracted from a water resource?*

Long-term limit variation

Global experience suggests that the volume of water available is not constant and that runs of relatively wet and dry periods should be expected. Moreover, climate change research is suggesting that in many regions, transition to a drier regime should be expected. In Mediterranean climates, research is showing that a 10% reduction in mean rainfall can produce a 20-40% reduction in river flows (Chiew 2006). Typically, the impact of this is much worse than this. Before any water can be taken from a river, there needs to be sufficient base flow so that water can be extracted. This means that a relatively small reduction in mean rainfall can have a massive adverse impact on the volume of water available for use (see Figure 3).

Figure 3. Effect of a large inflow reduction on the amount of water available for consumptive use



In regions where rainfall varies and adverse climate change is predicted, it is important that the abstraction regime used enables the long-term limit on abstractions to be reduced so that all users understand that water supply involves long-term and short-term risks. Neither the average amount of water that can be supplied nor the minimum amount of water that can be supplied from a natural source can be guaranteed. Failure to make the nature of these risks clear must be expected to result in over-investment in water-dependent businesses and calls for compensation when entitlements need to be reduced in order to avoid compromising water quality and other environmental outcomes.

*Test 2. (**Long-term limit variation**) Does the regime allow the long-term limit on the maximum quantity of water that can be abstracted to be varied in response to changing biophysical conditions?*

Adjusting allocations within a season

In addition to limits on the maximum amount that can be taken over the long-term, in most regions, it is necessary to be able to vary the amount that can be taken within a season. In systems where water is usually abundant and limits are rarely needed, control can be achieved by banning some forms of water use for a period of time. Bans, however, have high costs and offer little incentive for users to save water. In urban areas, for example, the watering of lawns and washing of cars may be banned. In rural areas, some types of irrigation can be banned as happened in the Netherlands in 2003, 2011 and 2012. Bans are effective as an emergency measure but when used on a regular basis have high costs as no user is able to avoid them.

The alternative approach is to find a way to enable users to put the available water to its highest and best use at all times. Amongst other things, this requires transition to arrangements by which the amount of water taken from a resource is metered so that the volume of water taken by each user can be managed on a short-term basis. Amongst other things, this requires the development of water accounting arrangements that track use in the same manner that banks track the use of money. When water is made available for use it is credited to an account and when it is used it is debited from the account. Transfers are made by debiting one account and crediting another account.

In some systems, including most aquifers and systems with large dams, there is no need to take a water allocation as soon as it becomes available. In these systems, careful consideration needs to be given to the question of when to announce an allocation. In particular, administrators need to decide if allocations should implicitly be guaranteed before they become available for use. Irrigators, for example, like to be told how much they can take at the start of an allocation season so that they have "security." Hence, most prefer to be told how much they can have at or before the start of an irrigation season. The alternative approach, consistent with the full assignment of risk, is to make allocations only after the water to be allocated is available for distribution. This latter approach encourages users to manage risk and not to assume that water will always be allocated to them.

During Australia's recent long drought, Murray Darling Basin administrators made allocations announcements on the assumption that, at least, the sum of minimum monthly inflows would always be available. When these inflows failed to eventuate, some allocations had to be clawed back. As a result of this politically-adverse experience, today Australian water managers only make allocations when the water exists and is available for distribution. This alternative approach assigns full responsibility for managing supply risk to the user. They are then much more likely to plan for a shortage and much less likely to assume that the government will bail them out during times of severe supply shortage.

*Test 3. (**Periodic allocation mechanism**) Can the regime's short-term abstraction limit be varied in response to changes in the stock and flow of water?*

Accounting for use

Many abstraction regimes simply limit the area of land that may be irrigated and place no limit on the amount of water that may be taken by a user. The approach works well during the early stages of the development of a water resource but prevents the efficient use of water once the resource becomes fully developed. Transition from an area-based abstraction regime to one that tracks and limits the volumes of water that may be taken from day to day or by season used takes time. Once in place, however, much more water can be used on a sustainable basis. In most cases, it involves significant reform of the abstraction regime. An assessment of the volume of water being taken by each user needs to be made, meters installed, new meter reading and accounting protocols need to be set up and, in many cases, a suite of new entitlements and use approvals issued. Considerable communication with stakeholders over the benefits of converting to a volumetric allocation regime is needed. The question of who owns and who pays for the meters, etc. has to be resolved.

In an ideal world, all countries would set an abstraction limit for each water resource and stop issuing entitlements to abstract water from each resource, well before the resource was fully allocated. In the United Kingdom, for example, it has been recommended that unlimited access to a water resource should occur – via a process known as catchment closure – when 70% of resource potential has been allocated. Closure of a water resource well before it is fully allocated means that a water resource will never become over-allocated, mis-investment in water-dependent activities will not occur. It also means that governments will not have to spend huge amounts of money resolving over-use problems caused by the sale of water that previously was rarely used.

Early closure enables what Falkenmark and Molden (2008) call a "soft" landing. Typically, late closure is characterised by over-use and as a result of this investments that cannot be sustained.

The question of how best to deal with an over-allocation problem is dealt with in a later section.

*Test 4. (**Metering**) Can metering of use be introduced without the need to change the fundamental structure of the abstraction regime?*

Accounting for return flows

Because many water abstraction regimes were developed during times of abundance, it is common for many regimes to give little attention to the effects of use by one person on the use by another person. One of the most common mistakes is to fail to account for return flows. When water is abundant, users tend to abstract more water than is needed and allow the surplus to return back via drainage to the sea and in the case of urban water use following sewage treatment directly back to the sea. This water is then reallocated to others and/or used to maintain flows. When water becomes scarce, however, entitlement holders have an incentive to reduce return flows and save the water for themselves. There are two solutions to this return flow problem: either the abstraction limit has to be reduced as the technical efficiency of water use increases; or each user has to be given an entitlement only to the "net" - not the "gross" - amount of water used.

Consideration of the merits of choosing between these two equally robust approaches depends upon assessment of administrative costs and preference for innovation. The former "averaging" approach rewards first movers in the pursuit of technically more efficient users of water. The rate of adoption of more efficient irrigation technology should be faster. Those that move first, benefit from access to water that was previously being used by others. The latter approach is more equitable as changes in choice of technology made by one person have no impact on the amount of water allocated to all other users. This latter approach is much more expensive to administer as the type of technology used by each person needs to be tracked and accounted for.

In some regimes, including several parts of the United States, a hybrid approach is taken. No attempt is made to account for changes within a farm but when an entitlement is transferred to another person, the entitlement is adjusted for expected changes in the return flow.

*Test 5. (**Return flows**) Does the allocation regime include a mechanism that adjust for changes in return flows*

Managing system inter-connectivity

Limits also need to be defined so that they can be adjusted for changes in flows between water bodies. In particular, there is a need to include arrangements that adjust for changes in flows between groundwater and surface water systems. Careful consideration needs to be given to the impact of groundwater bores located next to a river. In such situations, the extraction of more water from the bore may in fact really be extraction from a river. In such a situation, the amount of water that may be taken from the river should be decreased and the amount of water taken from the aquifer increased. Otherwise, the resultant double counting can lead to over-use of the river.

In an ideal world, the plans used to set the limits for each system are nested under a broader basin plan designed to deal with system interconnectivity. Typically, these plans set long-term abstraction limits for each water body in the Basin and, where appropriate, put in place arrangements for changes in flows between each body. One option is to assign each reach in a river an entitlement to a proportion of the water in an aquifer (Young and McColl 2008b). Under such a regime, a proportion of aquifer entitlements, for example, would be assigned to a river and/or a group of people who abstract water from a river. Continuous management of a river then becomes possible.

Well-designed regimes encourage water users to seek out opportunities to take surface water, for example, and store it in an aquifer.

*Test 6. (**System connectivity**) Does the allocation regime include a mechanism that adjusts for changes in the flow of water from one system to another?*

Adjusting for uncontrolled uses

A related water accounting issue is the question of how best to account for changes in uncontrolled forms of abstraction and the interception of water which otherwise would have reached a water body and become available for use. The list of such uses can be long but in a robust allocation regime are accounted for. Some of these uses like drinking water for household and livestock watering purposes can be given a prior right and not included in the entitlement system. Other uses such as the interception of water by small farms dams and by forestry may need to be included in the entitlement and allocation regime.

South Australia is in the process of transitioning to a regime that will require any person who wishes to establish a plantation in its Lower South East to first acquire an entitlement to enough water to ensure that their plantation will not reduce the amount of water that can be taken by other entitlement holders.[6] South Africa has similar arrangements in place in some catchments. The result is much more robust water accounting arrangement. Existing users can invest in the full knowledge that expansion of forestry will not undermine the efficiency of any investments they make.

*Test 7. (**Minor abstractions and significant interception**) Does the allocation regime include a mechanism that adjusts for changes in minor abstractions and significant forms of interception?*

Preparing for scarcity

Options for limiting the total volume of water that may be abstracted in the short-term range from a requirement that the user own land abutting a river to a requirement that all abstractions be metered and that the amount abstracted always be less than that credited to a water account. Choice of the most appropriate way to set a long-term abstraction limit depends upon the value that access to water brings to an economy and the contribution it makes to the environment.

In the early stages of regime development a relatively crude abstraction regime can be used and decisions made conservatively. As scarcity increases and values rise, however, the case for introduction of volumetric allocation increases as this enables greater control and, as a result, more water to be allocated to users.

When over-allocation and/or over use already exists, there is an opportunity to use the characteristics of a more sophisticated abstraction regime to reduce the extent of an over-allocation problem. This is achieved by increasing the sophistication of a water allocation regime and thereby increasing the opportunity to take water without compromise to other objectives, including the

6 For an overview, see http://www.environment.sa.gov.au/managing-natural-resources/water-use/water-planning/water-for-commercial-forestry

environment. Opportunities to do this include the introduction of meters, making allocation announcements on a fortnightly rather than annual basis, etc.

As a general guideline, it should always be assumed that use ultimately will be metered and that the abstraction limit will be volumetric. As a general rule, the need to convert to a metered regime should be anticipated and built into any abstraction regime.

*Test 8. (**Volumetric conversion**) Is the current abstraction limit on each entitlement specified in a manner that enables its conversion to a volumetric allocation regime?*

User-scale challenges

By user-scale, it is meant those challenges that are most efficiently and equitably dealt with by specifying the arrangements that apply to an individual abstractor. Typically, these take the form of arrangements specified in entitlements, permits and licences.

A volume or a share of the abstraction limit

The first question to be asked is that of how to define an entitlement. Historically, this tends to have been done by stating the maximum volume that may be taken. The alternative approach, consistent with the full assignment of risk, is to allocate shares. Normally, conversion from one regime to the other is achieved by issuing one share for every unit of water the user was entitled to. Administratively, this may sound simple. In practice, however, it can prove difficult – especially in systems where entitlements have been defined by the date they were issued and there is no means to change them. Conversion from a seniority regime to a share regime is possible and can be achieved by issuing shares to broad priority groupings in a manner that ensures that no entitlement holder is made worse off. One of the easiest ways to do this is to make the new shares mortageable and encourage banks to offer to lend money against the value of these entitlements. Conversion from the old to the new regime can then occur on a voluntary basis as users begin to recognise the value of the new share-based entitlement.

Priority classes

The cost effective management of water supply and other risks requires a structure that enables the efficient management of that risk. Most towns and many industries, for example, need access to extremely reliable secure supplies. Even within a town, there is some room to move. During droughts, England bans the use of hoses in gardens. Many Australian cities have quite complex watering rules that ration use. Similarly, some countries give greater priority to water allocated to horticultural uses than they do to the irrigation of broad pastures. All these banning mechanisms come at significant cost to users. Much more efficient outcomes can be achieved if a suite of entitlement classes are established and users are allowed to invest in a portfolio of reliability classes and thereby manage the degree of supply risk they wish to take.

Conceptually and in order to allow the efficient management of long-term supply risks, at least two priority classes are needed: a high priority class and a low priority class. In regimes where there are two priority classes of shares, allocations are made first to the high priority class and once all these entitlement holders have received 100% of their entitlement, allocations are then made to the lower class.

In practice, most abstraction regimes already have three or four priority classes that are implicit in their current structure and, hence, it may be easier to establish more than fewer. Typically, essential urban and industrial uses are grouped into the highest class. In countries like the Netherlands, high priority is given to the water needed to maintain dikes that hold back the sea and other essential forms of infrastructure.

Provided there are at least two priority classes and shares in them are freely tradeable, then investment risks can be managed by varying the proportion of each share type held.

*Test 9. (**Priority**) Does the current abstraction regime establish a priority sharing regime that is linked to and a function of the abstraction limit set for the water resource?*

Unbundling to encourage innovation and investment

Throughout much of the world, entitlements to abstract water are typically bundled together with controls on use and other arrangements that discourage innovation. One of these arrangements is a limitation on the tenure of the licence or permit issued. In many countries, water licences are issued only for 5 or 10 years at a time.

This is done so that any arrangements included in the licence, for example, can be revised. Renewal of the licence is not guaranteed. From the perspective of a water user, however, this creates considerable uncertainty. The uncertainty they most fear is that water presently allocated to them will be re-assigned without compensation. The result is a lack of incentive to make long-term investments. The solution to this problem is to issue entitlements in perpetuity. This can be done, however, if and only if entitlements are unbundled from other elements of the abstraction regime.

Unbundling involves the replacement of a single licensing instrument with a suite of instruments each designed to deal with a specific issue and to do so at an appropriate scale. The advantages of this are considerable. Consistent with the Tinbergen Principle, separate instruments can be used to pursue essentially independent objectives:

- Water sharing plans can be used to define abstraction limits for each water body;
- Entitlement shares can be used to specify the nature of each person’s priority share in a water resource and the interests of people with a direct interest in that share;
- Allocations can be used to ensure that any water available for use is used efficiently; and
- Abstraction approvals, works approvals and land use approvals can be used to monitor take, control local impacts, adjust for return flows, etc.

The result is a constellation of arrangements that enables clear signals to be given to all water users without everything having to go through a central office. Basin planning can occur at the Basin level and using well-defined sharing arrangements catchment-scale planning can then be nested inside a Basin plan in ways that allow changes at the basin scale to flow through without the need to change the catchment plan. Share entitlements can then be defined for each water body so that allocations can be made in a manner that is consistent with these plans. If this is done then local administrators can be left to manage the local impacts of water use without the need to worry about broader catchment and Basin-wide issues. Much more efficient administration is the result.

Experience with the unbundling of abstraction licensing arrangements in Australia has shown that unbundling and the definition of entitlements as shares removes politics from the question of who should and can use water. An additional benefit, not fully appreciated at the time when this reform was implemented, is that it has enabled users to obtain permission to use water, make the necessary land use changes and source the water at a later stage. As a result of these and other reforms, the value of water entitlements has increased significantly. For most of the last decade the internal rate of return that could be made from holding a water entitlements remained above 15% per annum (Bjornlund and Rossiter 2007).

*Test 10. (**An unbundled structure**) Does the current abstraction regime enable entitlements to be managed separately from allocations and use conditions?*

Resource closure

As mentioned earlier, in robust abstraction regimes investment security is achieved by closing access to a defined water resource pool when use approaches the limit that can be sustained. Once access to a resource is closed, the only way a person may secure an interest in abstracting water from that resource is to convince someone to transfer shares to them. The decision rule is simple. If someone wants a larger share, then the only way they can do this is to convince someone to accept a smaller share.

One of the key features of this suite of administrative arrangements is the removal of any requirement for an entitlement holder to use an entitlement. Instead, the development of more efficient ways to use water is rewarded by granting all entitlement holders an unconditional opportunity to sell shares that become surplus to ongoing needs. All beneficial use requirements are repealed. Those that find more efficient ways to use water are rewarded by the opportunity to sell any savings they can make to others.

In order to keep down the transaction costs associated with entitlement trading – sometimes called permanent trading – innovation can be further encouraged by establishing a centralised share register and providing for the registration of financial interests on these registers (Young and McColl 2003a).

*Test 11. (**Investment and innovation**) Does the current abstraction regime enable entitlements to be issued in perpetuity, be mortgaged, be traded and not require use of allocations made to those who hold them?*

Low transaction costs

As indicated above, the more flexible an abstraction regime and the greater its capacity to facilitate adjustment, the greater the amount of water that can be used. Amongst other things, this requires the costs of changing the location of water use to be kept as low as possible. In order to do this, there are at least four requirements.

The first requirement is that water entitlement, allocation and trading arrangements are defined with hydrological integrity. If this is done then trades can be approved quickly as the arrangements used should not have any adverse effects on the interests of others. These arrangements can include, for example, the prior specification of the exchange rates to be used when allocations are moved up and down stream. Another is the use of registers rather than permits to record the names of all parties with an interest in any entitlement.

A second requirement is that no third party can object to and, hence, stop an allocation trade made in a manner consistent with predefined trading rules. The easiest way to achieve this is to run transparent processes to develop water sharing plans and trading rules and legislate so as to prevent people from objecting to any trade conducted in a manner that is consistent with rules that, following due process, have been approved by parliament.

A third requirement is that risks associated with a trade be fully assigned to one party. In Australia, this has been achieved via the introduction of what is known as "tagged trading." Under this arrangement, when a person acquires an entitlement it retains its original characteristics and allocations made to the entitlement at its original location. Any water allocated to that entitlement is then traded to the allocation where it is to be used at the current exchange rate – which can be varied at any stage. This tagged trading arrangement ensures that all the exchange rate risk is borne by the buyer of the entitlement.

A fourth requirement is that the charges associated with a trade are low and associated only with administrative processes that are unavoidable. Under arrangements like this and through the use of centralised registers and bank-like allocations accounts, Australian water users are now able to complete allocation trades over long distances within two days and any allocation trade within the same region instantaneously.

*Test 12. (**Low cost allocation trading**) Does the current abstraction regime prevent third party considerations from becoming a barrier to trade and, at least, enable allocation trades to be settled within a few days?*

TRANSITIONING TO A ROBUST ABSTRACTION REGIME

This paper has identified a significant number of reforms which, if made, would significantly improve the capacity of a country to deal with water scarcity. A caution is issued about the early development of trading arrangements before robust water sharing, entitlement and accounting arrangements are in place. In some systems, allocation trading may never be appropriate. In other systems, the question of whether or not to allow trading may need to be resolved at the local level. Assessment of the costs and benefits of introducing allocation trading and careful consultation is recommended.

The last question to address is that of how to transition from an existing to a robust abstraction regime.

Global experience tends to emphasise the need to engage with stakeholders at an early stage in the reform process and communicate the nature of the benefits to be pursued. While it is important to engage with key stakeholders, it is important, also, to ensure that the interests of all are considered. Otherwise, the interests of the most vocal can come to dominate discussions and result in outcomes that are judged ultimately to be unfair. If reforms are to be successful, it is critical to avoid capture by the most vocal and those with access to the most resources. In an effort to reduce the risk of capture, both Australia and the United Kingdom have invested heavily in the development of scientific capacity to understand the implications of any option under consideration.

Transition to a new abstraction regime also requires attention to the sequence of reforms that need to be made. In particular, attention needs to be given to the merits of solving over-allocation issues before entitlements begin to rise in value and new investments are made.

Australia failed to do this and, as a result, has had to solve over-allocation problems in the Murray Darling Basin through the expensive and previously unnecessary purchase of entitlements. If the sequence of reforms had been reversed then several billion dollars could have been saved (Young 2012b).

Careful consideration also needs to be given to the processes to be used to facilitate adjustment in each person's entitlement and the degree of priority to be given to each form of group of entitlement shares. Several countries have opted to use trading arrangements to assist this process. When entitlement and allocation regimes are designed with hydrological integrity, this approach can be used to facilitate rapid adjustment. The alternative approach is to periodically claw-back a proportion of each entitlement and re-allocate it. Successful examples of this latter approach are rare but remain an option worthy of consideration. One option that has been suggested is the reduction of each person's entitlement holding by, say, 2% per annum. Governments would then be free to decide how the resultant entitlement should be used.

CONCLUDING COMMENT

Demand for and the supply of water must be expected to change. In regions where this is occurring or already has occurred and water scarcity is anticipated, the case is strong for the replacement of an existing abstraction regime into one that is robust enough to facilitate ongoing adjustment and reward investment in water. Access to water is essential to human wellbeing and, if well managed, has the potential to contribute significantly to economic development.

In this paper, twelve tests of robustness are offered. While proposed as tests, they could equally be presented as guidelines.

At the system-wide level, robust entitlement regimes are characterised by the use of statutory water sharing plans that include:

- Timely closure;
- An enforceable long-term abstraction limit and a capacity to periodically vary that limit;
- A capacity to vary allocations as conditions change;
- A return-flow adjustment mechanism;
- A mechanism that adjusts for changes in minor abstractions and significant forms of interception;
- An arrangements allowing for conversion to a volumetric allocation regime in a timely non-controversial manner; and
- The metering of all significant abstractions.

At the individual user level, robust abstraction regimes are characterised by:

- A share-based entitlement regime guaranteeing that any allocation made to an allocation pool will be made only in proportion to the number of shares held;

- The definition of the number of priority allocation pools needed to facilitate efficient investment;

- An accounting arrangement enabling the tracking of use and, preferably, the transfer of allocations from one account to another; and

- An unbundled structure enabling management of land and water use without having to change entitlement and allocation arrangements.

User-specific restrictions on water use are inefficient and have extremely adverse effects on regional economies. **In regions where water scarcity either already is an acute issue or is to become one**, arrangements that allow continuous adjustment encourage efficient investment, innovation and water use.

Two approaches to the management of water scarcity are being tried around the world. The first approach involves periodic reductions in user entitlements and/or allocations. These entitlements can then be redistributed and/or re-assigned to the environment. Time can be bought via the use of subsidies and payments to users who adopt more efficient technology or agree not to use water. The second approach resolves the problem by defining a sustainable limit and then allowing users to trade entitlements and allocations. This latter approach is sustainable and self-funding as subsidies to achieve change are not needed. It is characterised by:

- Arrangements that promote investment and innovation by defining shares in perpetuity and allow these shares to be mortgaged and traded; and

- Arrangements that allow the rapid transfer of allocations from one user to another.

As noted throughout this paper, attention to the sequencing of abstraction regime reform is necessary. Some arrangements are possible if and only if other arrangements are in place. Others create expectations that cannot be sustained in a water scarce environment.

In regions where a robust water entitlement and allocation regimes are in place, ongoing use without compromise to environmental objectives should be possible.

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GLOSSARY OF TERMS

Abstraction: The capture, diversion, taking of water for any purpose including an environmental purpose.

Allocation: An amount of water that an entitlement holder has been granted permission to abstract within a specified time period in a manner that is in accordance with pre-specified conditions.

Allocation regime: The constellation of mechanisms (entitlements, licenses, permits, etc) used to determine who, when, how and how much water a person may abstract and return to a water resource pool.

Environmental flows (e-flows): Describes the quantity, quality and timing of water flows required to sustain the ecological health of a water body.

Groundwater system: A connected body of water located beneath the earth's surface in soil pore spaces and/or in the fractures of rock formations.

Over-allocated: A water body with entitlements which if fully exercised would result in a level of abstraction that is greater than that which can be sustained.

Over-used: A water body where the quantity being abstracted is greater than that which can be sustained. See water stress.

Prior appropriation: A legal arrangement where the interests of the first person in time to take a quantity of water from a water source for a beneficial (agricultural, industrial and household) use has the right to continue to use that quantity of water for the same or similar purposes. Typically, this right is transferred along with the land associated with the use of this water and/or can be sold to others able to use it for a beneficial use without change in its priority status. The next user in time obtains a similar right provided its actions do not impinge on the rights of those with a more senior right. This is also known as a seniority regime, as the interests of most senior entitlement holders are met before any water is allocated to a more junior entitlement holder.

Public trust doctrine: is a common-law principle of property law, held by states in some countries such as the United States, which establishes public rights in navigable waters and on their shores for the benefit of the public. The government is hence required to preserve them for the public's reasonable use, mainly for food, travel and commerce.

Regulated water system: A system where the flow of water in a regulated system can be controlled by the release of water from dams and/or control weirs and other similar structures.

Resource pool: A water resource that can be managed as a single entity by issuing entitlements that are similar in form. Within a pool, all allocations are defined usually in a similar manner. In some cases, the pool is described as a management zone.

Return flow: The water physically withdrawn from a system and returned back to the same or a different water body following use. Many towns abstract water for drinking, washing and flushing purposes and return the majority of this water to a water body following use. Similarly, many industries abstract water for cooling purposes and then return it back to a river after use. Irrigation is often associated with the return of a significant proportion of abstracted water back to a river or aquifer.

Riparian entitlements: Under the riparian principle, all landowners whose property adjoins a body of water have the right to make reasonable use of it. If there is not enough water to satisfy all users, allotments are generally fixed in proportion to frontage on the water source. These rights cannot be sold or transferred other than with the frontage and water cannot be transferred out of the watershed.

Surface water: All water naturally open to the atmosphere, including rivers, lakes, reservoirs, streams, impoundments, seas or estuaries. The term also refers to springs, wells or other collectors of water that are directly influenced by surface waters.

Unregulated water system: A stream or river where there is little or no opportunity to control the rate of flow. Unregulated streams and rivers typically have no dams, weirs or locks that enable the rate of flow from one reach to another to be manipulated.

Water body: A collection of connected water resource pools that can be managed as a single entity.

Water entitlement: The long-term interest or entitlement to abstract and use water from a specified resource pool as defined in the relevant water plan. In some countries, this may be referred to as “water rights”, “water users’ rights”, or “water contracts”.

Water stress: A measure of the total, annual average water demand of a river basin (or sub-basin) compared with the annual average water available (precipitation minus evapotranspiration) in that basin. Typically, there are grouped into four categories: less than 10% = no stress; 10-20% = low stress; 20-40% = medium stress; and more than 40% = severe stress.