frontier economics

love every drop anglianwater

A right to water?

Meeting the challenge of sustainable water allocation

Main report

Building a sustainable water allocation regime

Building a sustainable water allocation regime

Foreword

The Anglian Water region is on the frontline of the global climate change challenge. It serves the largest geographical area of any water company in England and Wales and is the driest and fastest growing in UK, with over a quarter of the land below sea level. The impact of climate change will be felt here first, with likely severe consequences.

With global demand for water expected to increase by 30 per cent by 2030, Anglian Water has an important role to play in shaping how to respond to the challenge of future water resourcing.

Anglian Water has a strong track record in securing and conserving water resources. Despite a 20 per cent population growth in the region since 1990, its successful demand management strategy means that it supplies the same amount of water today as it did those 20 years ago. Anglian Water is proud of that track record and looks to draw on that experience as we move forward.

We need to explore and exploit innovative solutions. Our partnership with Frontier Economics does just that.

We present this report as an important contribution to the debate on how best

to consider the decisions, processes and arrangements for how the water that sustains our environment and economy is protected and shared between different uses – what we've termed water allocation.

We recognise the importance of protecting the natural environment and safeguarding the value it brings to our society - it is part of our "natural capital". Individuals, as well as families, communities and businesses all rely on water: it is essential to our personal well-being, to our society and environment and to our economic prosperity.

The current arrangements for balancing these needs have worked well so far but in the face of serious challenges, making the arrangements for allocation of water sustainable, efficient and effective will be crucial.

Our project set out to answer:

- How can we ensure the environment gets the water it needs while securing a reliable public water supply?
- How can we ensure everyone understands the true value of water and that we have the right conditions for making good economic decisions and efficient investment?

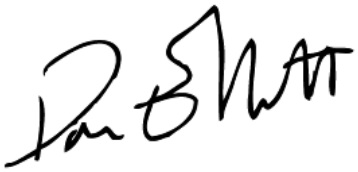
Fundamental to each of these is the essential question about 'rights' to water. We have all grown up engaging with "our" water, but we suggest this approach may have to change. We think that markets have the potential to offer new

approaches that will help answer these questions and balance the needs of all users by revealing value and enabling effective decision making.

We think that today's water allocation arrangements may need to adapt to meet the challenges and uncertainties that we face. We make specific suggestions for improvements that build on the current approach but we do not underestimate the effort that will be required to make positive changes.

For our part, Anglian Water is committed to changing fundamentally how we all engage with and use water. Our campaign for the future is called Love Every Drop and our ambition is to put water at the heart of a whole new way of living – across the UK. The work presented in this report is an important part of this ambition.

We think that the time is right for embarking on a new course and would welcome the opportunity to be part of other pilot projects to test these ideas in practice.



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1 Introduction

The water allocation regime embraces the mechanisms and processes by which available water is distributed, over time, between different users and the environment.

To be sustainable the regime must be able to meet its objectives in the face of future challenges such as climate change. This report considers the sustainability of the current regime and identifies reforms that will strengthen its ability to meet these challenges. The report is structured as follows.

- Chapter 2 discusses the challenges facing the water allocation regime.
- Chapter 3 provides details on the current water allocation regime operating in England and Wales.
- Chapter 4 proposes objectives that should be used to identify the need for reform and assess specific policy options.
- Chapter 5 assesses the need to reform and describes the framework we have used for determining specific recommendations for reform.
- Chapter 6 makes recommendations for improving the process for adapting the level of licensed abstraction in the future.
- Chapter 7 considers how best to enable water to be reallocated between users and looks at the potential scope for greater trading.
- Chapter 8 proposes reforms for facilitating the development of water and water rights' trading by removing barriers to trade.
- Chapter 9 provides a summary of the recommendations and an indicative timeline for implementation.

We have drawn on case studies of international experience and data from Anglian Water's region. However, the general conclusions and recommendations are intended to be applicable across England and Wales. Supporting information and analysis is contained in the Annexes to the report.

2 Challenges facing the water allocation regime

The current water allocation regime in England and Wales is likely to come under increasing pressure in the future. This is being driven by three factors – declining water availability, the imposition of stricter environmental standards and, to a lesser extent, increasing water demand. These factors are considered briefly in this chapter.

The combined effect of these factors is likely to be increased water scarcity. Water scarcity can be defined as an imbalance between demand for, and supply from, water resources at current prices.

2.1 Impact of climate change on water availability

Experts are predicting that there will be a decline in water available from existing supply sources as a result of climate change. The effect of this decline will be felt more keenly in specific areas of England and Wales, most notably in the east and south-east, where water resources are already considered scarce.

Climate change scenarios suggest that droughts will become more frequent as summers become drier. By 2020, between 6 per cent and 9 per cent less summer rainfall is anticipated under medium emission scenarios.[1] While water can be stored to address summer deficits, the amount that can be carried over between seasons is limited by the available storage capacity. Significant investment and planning would be required to redress this.

The Environment Agency's (EA) assessments[2] suggest that the change in rainfall and evaporation patterns could reduce total annual average river flows by up to 15 per cent. In addition, the variability of flows is expected to increase. River flows may increase in winter by 10 per cent to 15 per cent, but reduce in late summer and early autumn by over 50 per cent. For groundwater, the EA has estimated that by 2025 the overall recharge to aquifers (and river flows fed by groundwater) will have decreased.[3]

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1 UKCP09, Medium emissions 50% probability, 2020 scenario for England and Wales.

2 Environment Agency, February 2009, *Water for people and the environment - Water resources strategies for England and Wales*. Assessment based on the medium-high UKCIP02 scenario from the UK Climate Impacts Programme.

3 Environment Agency, February 2009, *Water for people and the environment - Water resources strategies for England and Wales*.

2.2 Pressure from more challenging environmental standards

More challenging environmental standards have led, and may continue to lead, to an increase in the water set aside for the environment. This will decrease the quantity available for consumptive use.

The Water Framework Directive (WFD) requires that 'good' environmental status be achieved in all water bodies by 2015. As shown in **Table 1** the EA has estimated that a considerable number of water bodies in England and Wales are at risk of failing to achieve this goal because of water abstractions.

Table 1. Water sources at risk of not meeting the WFD objectives because of abstraction pressure

	Proportion of water sources at risk
Rivers	11%
Groundwater sources	26%

Source: Department for Environment, Food and Rural Affairs, *Nation Water, the Government's water strategy for England*, February 2008, p45. Based on 2005 data from the Environment Agency.

Furthermore, the European Habitats and Birds Directive, being implemented in the UK through the 'Habitats Regulations', provides a high level of protection to a network of water-dependent special areas of conservation. Protecting the quantity and quality of water in these important water dependent habitats will continue to attract the focus of policymakers.

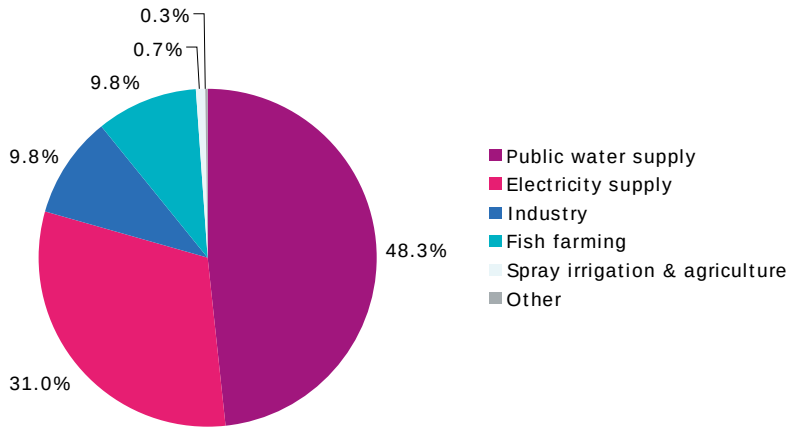
2.3 Increases in water demand

Demand for water, especially for public water supply, is likely to increase as a result of population growth, demographic change and climate change.

Current profile of use

Figure 1 below shows that public water supply, electricity generation and industry are the three largest water abstractors by volume. Agriculture and spray irrigation take up only a small share of volumes. It is relevant to note though that while public water supply and electricity generation are by far the greatest abstractors of water, a proportion of the water used in these sectors (the majority in the case of public water supply) is returned to the water environment.

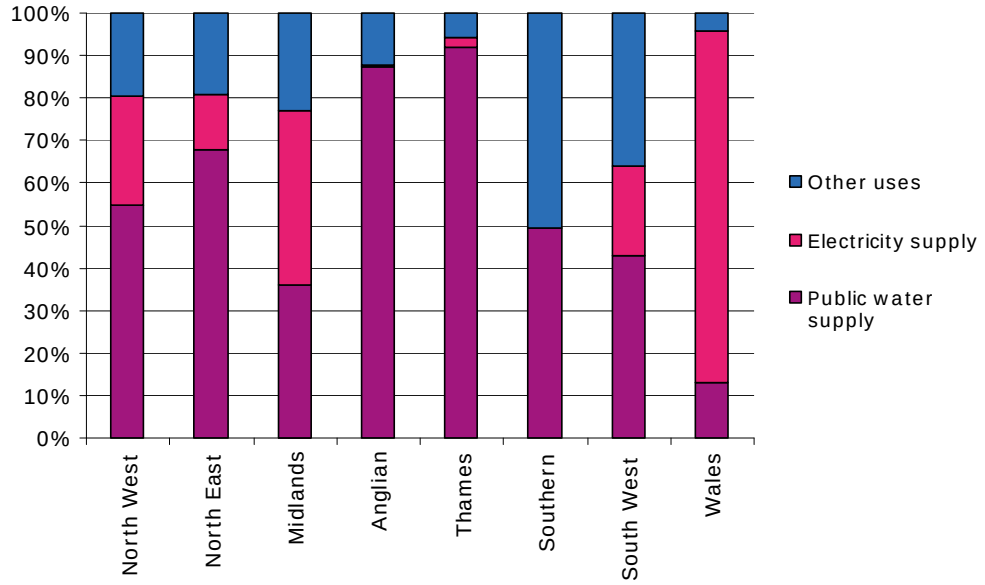
Figure 1. Percentage of abstraction volumes* in England and Wales (excluding water from tidal sources) going to different uses



Source: DEFRA, e-Digest of Environmental Statistics, Published September 2010.
*Note: Based on average estimated abstraction volumes over the period 2005–2008.

The national picture hides significant regional variation in the relative importance of different uses. This is illustrated in **Figure 2**. Abstractions by electricity generators represent a high proportion of volumes in the Midlands and Wales. The relative size of abstractions by industry and irrigators is most prominent in the south.

Figure 2. Percentage of 2008 abstraction volumes (excluding water from tidal sources) going to different types of use



Source: DEFRA, e-Digest of Environmental Statistics, Published September 2010.

Projected increases in household demand

By 2034, the total population is expected to increase by 16 per cent (from 2009 levels)[4]. This growth is likely to be predominately in the east and south of England where water scarcity is most pronounced. A change in demographics may intensify the impact of this growth. In particular, the proportion of single occupancy households (which consume 40 per cent more water per person than a dual occupancy household) is predicted to rise.[5] In addition, there may be an increase in household water demand, for garden watering, of between 2 per cent and 4 per cent as a result of climate change.[6]

This growth in demand may, in part, be offset by increased metering and improvements in water efficiency. But the general predicted trend is still for a small increase in demand.

Other uses

Among other users, power generation has by far the largest water needs. In 2008, it abstracted 14,000 ML/day, around 40 per cent of total water use in England and Wales.

Industrial demand for water is highest in the Midlands and the North West. Trends in industrial water demand are hard to predict as they are driven by the changing composition of economic activity.

Agriculture and irrigation use less than 1 per cent of water resources, with an average abstraction of just 37 ML/day from a total of 3,035 licences. However, this masks significant seasonal and regional differences.

- In East Anglia agriculture and irrigation use between 5 per cent and 8 per cent of abstracted water, and in some rivers all the licences are for agriculture.[7]

- More generally, water demand for agriculture and irrigation is concentrated in eastern England, the east Midlands and the South East.

- Most of the demand for irrigation is located in areas with low summer rainfall. In addition, agricultural water needs are highest during the driest

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4 Office of National Statistics (ONS), *Population trends Winter 2010,* ISSN 2040-1590 (source: http://www.statistics.gov.uk/populationtrends/downloads/poptrends142web.pdf).

5 Environment Agency (EA), *Water for people and the environment - Water resources strategies for England and Wale*s, February 2009.

6 Environment Agency, *Water resources in England and Wales – Current state and future pressures.* December 2008.

7 Source: http://www.defra.gov.uk/evidence/statistics/environment/inlwater/alltables.htm

part of the year, when pressure on the environment is at its greatest.[8] In summer, daily irrigation can exceed abstraction for public use.

The EA forecasts that by 2020, climate change is likely to result in increasing summer demand for irrigation water, of up to 25 per cent, in all regions. Also, irrigation requirements could shift northwards and westwards. By the 2020s, central England and eastern Wales could experience conditions similar to those currently typical of the south and east of England.[9]

Conclusion

The current water allocation regime in England and Wales will come under increasing pressure as a result of increased water scarcity. This is being driven by declining water availability, stricter environmental standards and to a lesser extent, increasing water demand. There is also likely to be greater variation in water availability.

In the short term, pressures on water resources will be more acute in the south and east of England. This is where the decline in water available from existing sources and increases in demand will be felt most keenly.

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8 Environment Agency, *Water for people and the environment - Water resources strategies for England and Wales*, February 2009.

9 Environment Agency, *Water for people and the environment - Water resources strategies for England and Wales*, February 2009.

3 The water allocation regime in England and Wales

Before considering whether there is a need to reform the existing water allocation regime, on the basis of the future challenges described in Chapter 2, it is worth highlighting the key features of existing arrangements.

The water allocation regime embraces the mechanisms and processes that allocate (and review, transfer or redistribute) available water resources between the environment and other water users. It is the water allocation regime that creates and defines water rights. More particularly, the regime covers the legislative framework and other policies and management strategies for:

- issuing rights and allocating water to users under these rights;
- meeting the water needs of the environment;
- adapting or reviewing users rights; and
- transferring or trading these rights.

The current arrangements in England and Wales are discussed further in the sections that follow. In Chapter 4 we describe a clear set of objectives for a sustainable water allocation regime. Then in Chapter 5 we assess the case for reforming these current arrangements.

3.1 Users' water rights

Water rights define the rights and obligations a party has over a water resource. Users' rights typically define the water volume that can be taken and set other conditions around abstraction (see Annexe 1 for further details). They can be defined in statute or in other legal instruments such as contracts. In England and Wales they are more commonly referred to as abstraction licences. In other countries they are termed water rights, licences, permits, allocations or entitlements.

In England and Wales a person seeking to abstract more than 20 cubic metres a day from any water resource will need a licence granted by the EA.[10] To date these licences have been issued on a first come first served basis. This means the EA has a legal duty to protect the rights of existing users and the environment

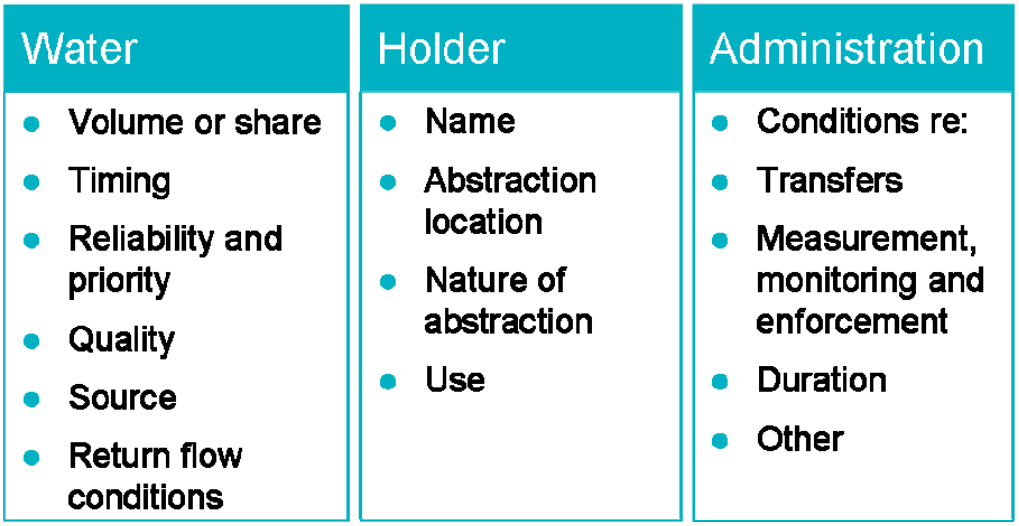
10 There are exemptions for some land drainage operations, transfers made by some authorities, the filling of vessels, e.g. for ballast water, fire fighting and to test water.

from derogation before considering the needs of new applicants.[11] The 2003 Water Act made it a legal requirement for all new licences to be time-limited.

Licences are conditional and although they specify a volume of water that can be abstracted, they do not guarantee the quality of the water or that the quantity of water will always be available. In particular, many licences contain conditions requiring the licence holder to reduce or stop abstracting water when river flows or groundwater levels fall to a critical level. Fundamentally, 'ownership' of water rights actually means ownership of 'withdrawal rights' and not ownership of the resource itself.[12] This equates to the right to take a volume of water per unit of time, from a water resource, at a particular location.

In England and Wales, and more generally, water rights are typically conditional on the nature, location and timing of abstraction and use.[13] Conditions can also include the quality and quantity of water that should be returned. The terms of the right can vary across users. However, typical attributes are illustrated in **Figure 3**.

Figure 3. Typical attributes of water rights



Source: Frontier Economics based on categorisation in WWF (2007) *Water Security Series 1, Allocating Scarce Water, A primer on water allocation, water rights and water markets.*

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11 Under the Water Resources Act 1991, a new applicant for a licence must demonstrate a reasonable need, that there will be no adverse impacts on the environment (i.e status assessments must indicate that water resources remain available) and that the licence will not derogate other users' rights.

12 Ostrom (2000), *Private and Common Property Rights*, in Bouckaert, B and De Geest, G (eds), *Encyclopedia of Law and Economics*, Volume I, Edward Elgar, Cheltenham.

13 Productivity Commission (2003), *Water rights arrangements in Australia and overseas,* Research Report, Melbourne.

3.2 Meeting the water needs of the environment

In determining whether to grant a licence the EA is obliged[14] to take account of the potential effect on river flow or groundwater levels. This involves assessing the status of the resource to determine whether water resources remain available. This process is now captured within the EA's Catchment Abstraction Management Strategies (see section 3.3). In the case of surface water this involves assessing whether the river flow would be reduced below the Minimum Acceptable Flow (MAF).[15]

Recently the water needs of the environment have been reassessed as a result of the WFD. The WFD's primary objectives are the prevention of any deterioration in ecological status, and the restoration of water bodies to 'good status' by 2015.[16] The benchmark 'high status' is defined as the biological, chemical and morphological conditions associated with no or very low human pressure. 'Good status' allows a 'slight' deviation from this. A broad range of environmental quality standards and physical habitat characteristics are used to determine whether the resource is meeting the requirements of the WFD. In relation to the environmental flow needs of a river Environmental Flow Indicators (EFIs) are used.[17]

3.3 Changing or reviewing water rights

These assessments ultimately rely on an ability to adapt or review existing water rights in order to improve environmental outcomes and to meet the requirements of the WFD. As a result processes have been developed for:

- identifying areas of 'over-abstraction'; and
- implementing sustainability reductions to bring abstractions back to sustainable levels.

These are discussed further below.

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14 The protection of in-river needs and of groundwater dependent features, rivers and wetlands is provided by Section 40 of the Water Resources Act 1991.

15 In the case of an application for abstraction from groundwater, the Agency may impose conditions in relation to flow, level or volume.

16 Where water bodies are designated artificial or heavily modified, the target is for good ecological potential. In addition to chemical status, the WFD status assessment takes into account the 'composition and abundance of aquatic flora' and 'composition, abundance and age structure of fish fauna'.

17 The first set of WFD plans used generic, national Environmental Flow Indicators (EFIs) to assess whether flow is likely to be adequate to support Good Ecological Status. The EFIs were based around comparing the per cent deviation from natural flow conditions to an 'allowable' level of change (derived from international research).

Identifying areas of over-abstraction

The sustainability of abstractions in England has been reassessed through the EA's programme of Catchment Abstraction Management Strategies (CAMS). The first stage of the CAMS process –the resource assessment – identifies the resource availability status within water bodies after considering the needs of the environment. The resource assessment also identifies parts of catchments where abstraction is causing, or has the potential to cause, environmental damage (and catchments not meeting their EFIs). Catchments are classed as being over-abstracted or over-licensed.

- A catchment is **over-licensed** if full use of the existing water rights allocated would cause unacceptable environmental damage at low flows.

- A catchment is **over-abstracted** if unacceptable damage is being caused to the environment at low flows based on current levels of use.

An over-abstracted catchment may already need action to redress issues while an over-licensed system is at risk of becoming over-abstracted if licences are more fully used in the future.

The first round of CAMS assessments have been completed. Overall, 15 per cent of catchments in England and Wales have been assessed as being over-abstracted – mainly in the south-east and east of England, although the extent of over-abstraction can vary more locally.

Figure 4 shows the EA's assessment of the amount of time that water is available for additional abstraction across catchments in England and Wales. Some areas still have water available over most of the year, although a large number of catchments remain over-licensed and over-abstracted such that water is unavailable most of the time (except at high flows).

The EA has also identified water bodies that are currently failing to meet the broader set of environmental objectives of the WFD (not necessarily associated with abstraction) through River Basin Management Plans (RBMP).[18]

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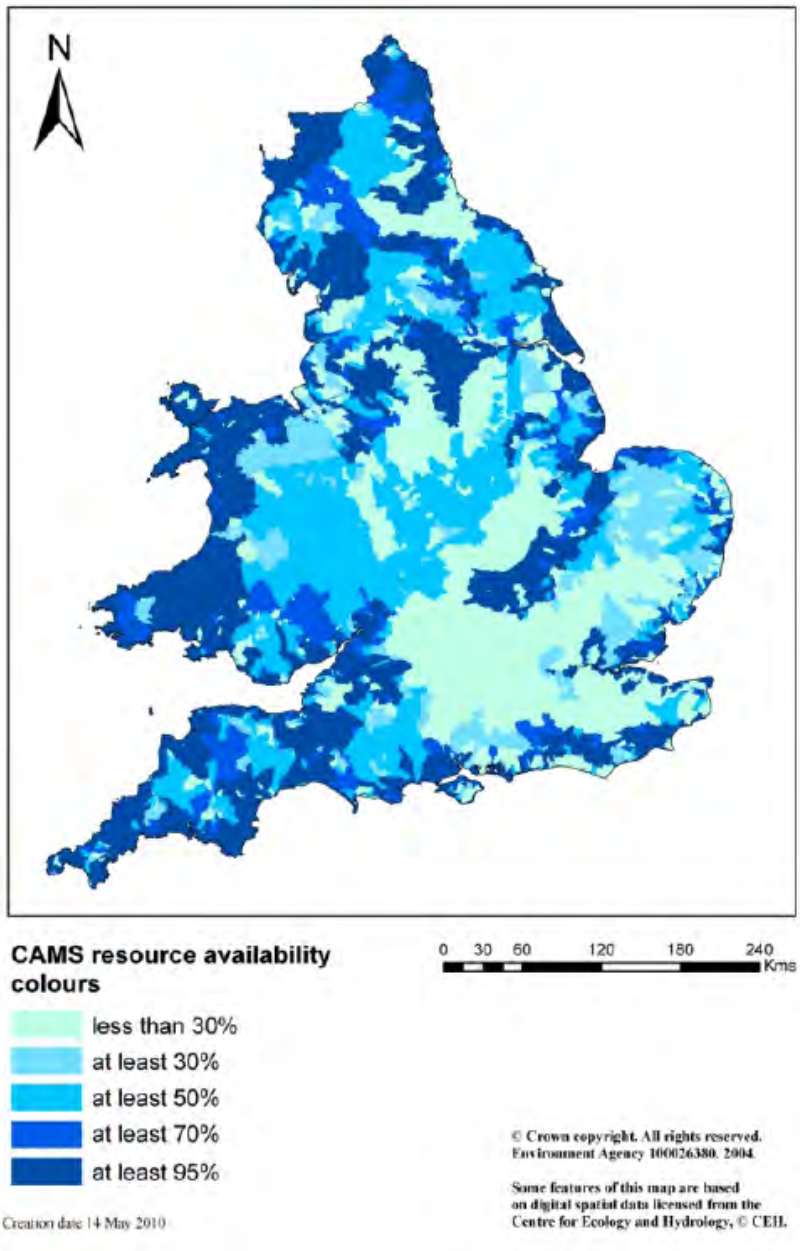
18 The River Basin Management Plans (RBMPs) published in 2009–10 identify where groundwater and surface water bodies are at risk of failing to achieve Good Ecological Status as a result of abstraction and other flow regulation pressures, and set out the Programme of Measures required to achieve Good Ecological Status in these water bodies.

Figure 4. The Environment Agency's assessment of CAMS resource availability



Source: Environment Agency, 2010.

Importance of this issue for East Anglia

East Anglia is likely to be affected by the issues around over-abstraction earlier than other parts of the country. Data for East Anglia shows approximately 66 per cent of licensed groundwater, and 69 per cent of licensed surface water, was actually abstracted. This compares to a figure of around half for England and Wales.

The extensive areas of nationally and internationally important wetland and other water-dependant habitats across East Anglia have placed increased focus on water resources management. It is clear from CAMS assessments that pressures on abstraction, and the associated uncertainty and risks for security of supply in East Anglia, are likely to continue for some time into the future. Climate change will only serve to exacerbate these uncertainties.

Implementing sustainability reductions

The EA has developed various administrative approaches for bringing abstraction back to 'sustainable levels'. These involve:

- agreeing with users, measures for reducing abstractions, in areas highlighted by the CAMS process – in some circumstances users are compensated for any reduction in their rights (this will no longer be in place from July 2012);
- making increasing use of time-limited licences (which can be reassessed at the point of renewal); and
- reducing and modifying licences at the point of trade.

CAMS licensing strategies and programmes of measures

The second stage of the CAMS process, the licensing strategy, sets out how the EA intends to manage abstraction licensing within each catchment. It identifies what resources are available, what conditions might apply to new licences and whether licences will be replaced with the same conditions. The third stage then involves identifying the nature of the abstraction pressure and suitable solutions for redressing these issues.

Implementing sustainable reductions is the focus of the EA's programme of Restoring Sustainable Abstraction (RSA) and the Government's National Environment Programme (NEP). Both of these programmes are informed by the CAMS assessment processes.

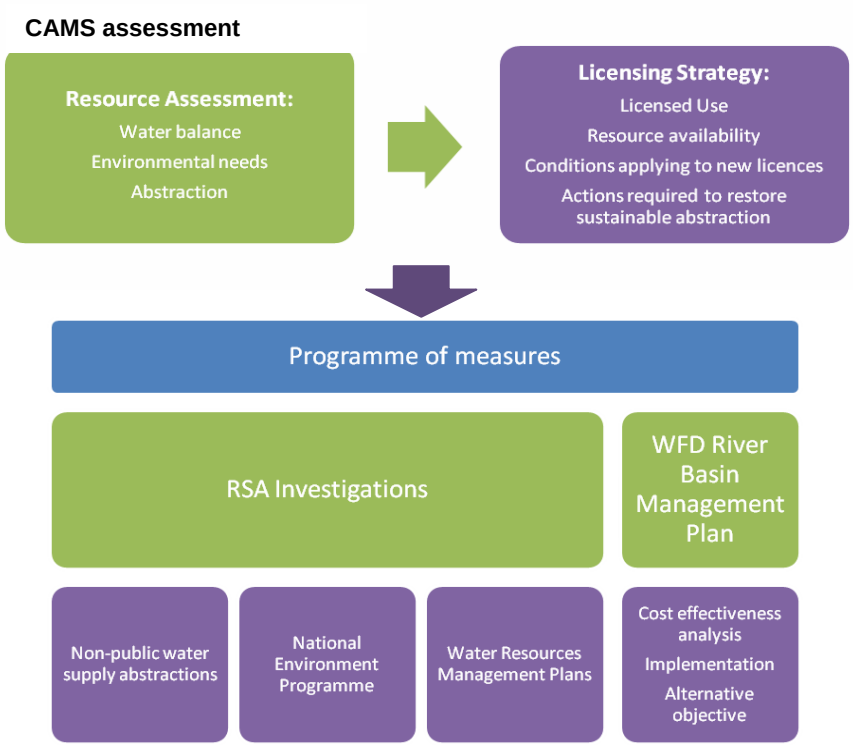
The RSA programme is intended to reflect the catchment's licence strategy of the CAMS. The CAMS/RSA process is undertaken on a rolling six yearly cycle.

To date a key driver of the RSA has been the Habitats Directive.[19] As a result of the Directive the EA has been investigating whether discharges and abstractions are having an impact on Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).[20] If any abstraction is determined as having a harmful effect on these sites the EA may affirm, modify or revoke the licence in question.[21]

For water companies it is the NEP that sets out the schemes that must be implemented to reduce abstractions. This feeds into a water company's Water Resource Management Plan (WRMP) and, in turn, to the overall level of investment funded by Ofwat. Those water bodies where the impact from a company's abstraction is greatest and confidence in the assessment is highest are addressed through the NEP.

The overall strategic approach to dealing with abstraction pressures on the water environment is summarised in **Figure 5** below.

Figure 5. The EA's current processes for addressing over-abstraction



19 Habitats Directive (92/43/EC) – Conservation (Natural Habitat, & c.) Regulations 1994.

20 There are 85 SACs and 17 SPAs in Wales, and 228 and 78 in England. The EA has also identified other conservation sites and water bodies requiring investigation. These include sites of special scientific interest (SSSI), Biodiversity Action Plan sites and sites of local importance.

21 M. Cave, 2009, Independent review of competition and innovation in water markets: final report, London: DEFRA, www.defra.gov.uk/environment/water/industry/cavereview.

Compensation arrangements

Prior to the Water Act 2003, where a licence was modified or revoked (except in some specific circumstances), compensation was provided to the licence holder. Compensation was expected to reflect the costs to the right holder of obtaining alternative supply or putting in place measures to reduce water demand.

The EA has tended to work collaboratively with abstractors to identify and agree appropriate changes to licences and the timescales over which these can be achieved.[22] An Environmental Improvement Unit Charge (EIUC) was levied on abstractors to recover the costs of these compensation payments.

Following the 2003 Water Act, as of July 2012, the EA will no longer be obliged to pay compensation for any changes to rights where it can be shown to be causing serious damage to the water environment.

To date, a large proportion of schemes identified for reducing unsustainable abstractions relate to the water industry, by virtue of the relative size of its abstractions. These have been identified within the NEP and funded through the periodic price review process, rather than through direct compensation payments. However, at least one scheme remains outside the periodic review funding mechanism and has been identified for direct compensation (by the EA).

In the future, the CAMS/RSA and the WFD RBMP planning processes will be used to identify where a licence may be unsustainable. Where this is the case, the EA will impose new conditions and time limits on the right.

Time-limiting licences

The EA has signalled that it intends to address over-abstraction in the future by time-limiting licenses and reviewing these at regular intervals. Nationally, approximately 80 per cent of water rights have been granted in perpetuity. However, since 2001 all new licences have been time-limited. The EA has also taken the opportunity to create time-limited licences where applications have been made to vary existing licences, although the EA has signalled that it has no plans to convert all existing licences.[23]

Most new time-limited licences in each CAMS area will be issued with a common end date to allow for a periodic review of abstractions. However, licences of shorter duration may be issued where the impact of abstraction remains unclear.

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22 Disputes around this amount can be referred to and determined by the Lands Tribunal.

23 Where a licence holder volunteers a change of conditions, the EA has agreed that the rights will remain permanent. However, where compensation has been paid, the licence will become time-limited.

Also, longer duration licences (up to 24 years) may be issued where applicants are able to demonstrate that shorter duration licences would have a significant impact on their business.[24]

Modifying licences at the point of trade

The EA also has the power to modify or revoke licences outside of these programmes (subject to appeal to the Secretary of State) without compensation:

- where they have not been used, or have been underused, for a four-year period;[25] and
- at the point of trade.

The extent to which the EA has made use of the first option is unclear. However, the EA has reduced licences at the point of trade (see section 6.2.2).

3.4 Current arrangements for trading water and water rights

Under existing arrangements in England and Wales it is possible to trade water in the following ways:

- by transferring water rights within and between different users;
- by leasing water rights to other users on a temporary basis; and
- through bulk water transfers between water companies.

Process for permanently trading water rights

Transferring water rights has been possible for some time and the Water Act 2003 included new provisions intended to reduce trading barriers. Under the Act it is possible to trade a water right (in part or whole) both permanently and temporarily (through a leasing arrangement). However, without interconnection assets only intra-basin[26] trading is permitted by the EA.

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24 'Taking Water Responsibly' published by the predecessor to Defra in 1999 outlined a number of tests that applicants would have to pass to secure a long duration licence. These include where the lifetime of the infrastructure associated with the proposed licence will extend over the proposed validity period; where there would be a continued need for the service/infrastructure associated with the proposed licence throughout the period of validity; where a full environmental and economic appraisal demonstrates no significant concerns arising from the abstraction; and, the infrastructure development contributes to sustainable development.

25 Prior to the Water Act 2003, that period was 7 years; it has since been reduced under section 17 of the Water Act 2003 to a period of 4 years.

26 This means trade can only take place between abstractors within the same river or groundwater area as defined by the EA.

To seek approval for and register a trade, applications are required from both the seller and buyer. For a permanent trade the transferred rights are set out in a new abstraction licence.[27] The application process for this licence is the same as for any new licence application. Pre-application discussions with the EA determine the assessments or evidence required in support of the proposed trade. Depending on the proposed arrangements and local circumstances an environmental statement (and report) or possibly an Environmental Impact Assessment may be required to support the application. This process can be complex and it assumes that applicants have an understanding of this or will have sought expert advice prior to application.

To date, the EA's approach to assessing trades has been on a case-by-case basis. While generic guidance at a national level has been provided,[28] no explicit trading rules or guidelines have been identified at either the national or basin level.

Leasing or temporarily trading water rights

Temporary or short-term leases of water rights are also possible by entering into a 'linked trade'. The buyer and sellers' licences have specific linking conditions added, which set out how the shared licence volume may be used while retaining the validity of the seller's original licence. It is understood that the trade approval process is the same as under a permanent water rights' trade.

Bulk supplies and transfers of water between companies

Trading of water already occurs between supply companies. These schemes include:

- bulk supplies – transfers of treated water from one company's supply area into another's;
- strategic transfers – (either raw or treated water) from jointly owned resource schemes; and
- inter-basin transfers – where raw water is moved from one resource zone to another via augmentation of river and canal networks.

Across England and Wales, bulk transfers between water supply companies amount to 4.4 per cent of the total water supplied by companies. This quantity has been stable over time and many of the agreements pre-date the privatisation of the water and sewerage companies in 1989.

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27 Issued under Section 59 WRA1991 as amended under section 23 of the Water Act 2003.

28 Accessing water resources. A guide to trading water rights. Environment Agency, 2007.

The text box below summarises the interconnectivity schemes operated by Anglian Water. Most of these agreements were put in place pre-privatisation, though new interconnections continue to be developed.

There are also mechanisms for facilitating trade between water companies. Ofwat, on application by a water company, can require another company to give or take a supply.[29] or it can determine terms and conditions for this supply. In addition, the EA, in consultation with Ofwat, can propose to a company that it seeks bulk supply from another company[30] where it considers that this is necessary to secure the proper use of water resources. The EA may detail the supply period and any terms and conditions it considers appropriate.[31]

Anglian Water's interconnectivity schemes

A number of interconnectivity schemes are operated by Anglian Water. Key examples are listed below.

- Grafham transfer to Veolia Water with arrangements set out in the Great Ouse Water Act 1961.
- Rutland Water transfer to Severn Trent with arrangements set out in *Heads of Terms* under the Welland and Nene (Empingham Reservoir) Act 1970.
- Ardleigh Reservoir joint venture with Veolia Water East constructed under the Ardleigh Reservoir Orders 1967 and 1969. The order originally defined the financial and management arrangements. However, these were varied by agreement in AMP4 and AMP5.
- The augmentation of River Chelmer to supply Essex and Suffolk Water Hanningfield Reservoir. Low river levels in the late 1990s led Essex and Suffolk Water to seek Anglian Water's agreement to re-divert effluent into the River Chelmer. A new treatment plant was built to enable it to be discharged into the river. Essex and Suffolk Water then applied for a variation to their abstraction licence to abstract a larger volume of water from the river. Anglian Water does not receive any payment from Essex and Suffolk.

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29 Under section 40 of the Water Industry Act.

30 As a result of amendments in the Water Act 2003.

31 The EA, in assessing any new licence application by a company, can consider whether a bulk supply agreement may be more suitable. Under section 20 of the WRA the EA must have *'…regard to any failure on the part of the applicant to make an application under section 40…pursuant to a proposal made by the Agency…'.*

4 Objectives for a sustainable regime

The current regime has generally performed well. However, the case for reform may grow as the current regime is likely to be tested by increasing water scarcity. The starting point of any assessment of the need for reform is a clear set of objectives for a sustainable regime. With this set of objectives it is possible to evaluate present arrangements, identify where reforms may be needed and, if appropriate, assess specific policy options. This chapter considers these objectives.

It is difficult to identify a unifying set of objectives for the regime from the existing objectives of the agencies involved in administering various aspects of the regime. As a result we have proposed a set of clear, overarching objectives that should guide policymakers in creating a more sustainable regime.

4.1 The absence of a unifying set of objectives

The current arrangements for water management in England and Wales reflect an institutional framework that developed in the mid-nineteenth century – and which has been primarily focused on safeguarding public health and sanitation.

Under the current institutional arrangements, a number of separate organisations are responsible for different aspects of water management. The boundaries between the respective responsibilities of each are not always clear.

- The Department for Environment, Food and Rural Affairs (Defra) is responsible for setting the overall water resource management policies and developing the legislative and statutory framework for this.[32]

- The EA is responsible for licensing abstractions, regulating abstractions and protecting the water environment. It uses a number of planning instruments to deliver its duties including Catchment Abstraction Management Strategies, Water Resources Management Plans, Drought Plans and River Basin Management Plans.[33]

- Water utility companies, as statutory water undertakings, have a duty under section 37(1) of the Water Industry Act 1991 (WIA) to '… *develop and*

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32 The functions of the Secretary of State have been undertaken by the Welsh Assembly following devolution.

33 The EA was established under the Environment Act 1995. It undertakes the consolidated functions previously undertaken by the National Rivers Authority in relation to securing 'the proper use of water resources' (Water Resources Act 1991). More recently, the Water Environment (Water Framework Directive) Regulations 2003, established new environmental objectives for all ground and surface waters and strategies and the EA is responsible for developing RBMPs to meet these.

maintain an efficient and economical system of water supply…' within their area and ensure that they are able to meet their other duties including to supply domestic demand for water.

- The Water Services Regulation Authority (Ofwat) is a non-ministerial authority responsible for regulating the price and service[34] of the England and Wales water and sewerage companies. This is achieved through the Periodic Review and its other regulatory activities.

With multiple agencies having responsibilities that relate to different aspects of the water allocation regime there is a risk that conflicting objectives may develop. However, many of the different organisations' statements, relating to the water allocation regime, identify that they have the common goal of developing a 'sustainable water allocation regime'.

- The EA's vision as outlined in its *Water Resources Strategy for England and Wales,* is that of ensuring that the '(m)anagement and use of water is environmentally, socially and economically sustainable, providing the right amount of water for people, agriculture, commerce and industry, and an improved water-related environment'.

- Ofwat has articulated its long-term vision as being 'A sustainable water cycle in which we are able to meet our needs for water and sewerage services while enabling future generations to meet their own needs'[35].

Nevertheless, to our knowledge, there is no clear statement of the objectives for a 'sustainable water allocation regime' enshrined in England and Wales's water legislation.

It is essential, before considering various reform options, to understand exactly what objectives define a successful and sustainable water allocation regime. Without clear objectives it is difficult to evaluate present arrangements, identify any necessary policy reforms and then evaluate the success of those reforms.

Government should clarify its objectives in relation to water allocation

1. Defra should develop a set of clear, overarching objectives, which relate specifically to the water allocation regime as part of its upcoming water white paper. These should be used to guide future policy development and in order to evaluate the success of any reforms in this area. Consideration should be given to the objectives proposed in this report.

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34 The Drinking Water Inspectorate regulates drinking water quality supplied by water undertakers.

35 Ofwat (2010) *Delivering sustainable water – Ofwat's strategy, Water today, water tomorrow.*

4.2 Proposed objectives for the regime

In the absence of a clear statement of objectives for the water allocation regime we have developed a set and used these to guide our reform assessment in Chapter 5.

We believe that a sustainable water allocation regime is one that efficiently allocates available supply between users and the environment, over time, in order to derive the most value for society. This is consistent with the various agencies' policy statements summarised above.

This general statement can be broken down into four high-level objectives.

- ***Protecting the environment and other in-stream uses*** by providing sufficient water to sustain the water ecosystem in the face of climate and demand pressures; and by managing any impacts resulting from abstraction and use.

- ***Ensuring affordable and reliable water supplies*** for the public and other users. This reflects the status of water as an essential service and for protecting public health.

- ***Encouraging the efficient allocation and use of water*** by ensuring water is allocated to its highest value use over time in order to ensure that the maximum benefit for society is derived from the use of the scarce water available.

- ***Encouraging dynamic efficiency or improvements in the efficiency of water use over time***. When users are appropriately incentivised to invest, innovate, increase productivity and lower costs over time, the value generated from the use of water will improve.

Performing well against these objectives will be fundamental for policy proposals to be effective.

Protecting the environment and ensuring affordable and reliable water supplies have long been the objectives of water resource management. In addition, when water becomes scarce there is also a role for policymakers in ensuring limited water resources are shared in a way that generates the most value for society. This leads to the two economic efficiency objectives.[36]

Encouraging competition is not listed as an objective for the regime. Competition and market entry may encourage economic efficiency, but these

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36 These objectives can be referred to as allocative efficiency and dynamic efficiency respectively.

should be considered as a means to an end, rather than as objectives in themselves.

These objectives are discussed in further detail below. We have also attempted to identify the key principles that underpin each objective.

Protecting the environment and other users

Water abstraction can have an effect on the environment and other in-stream uses such as fisheries, navigation and recreation. Protecting the environment is clearly an important objective for the regime and the prime objective of both Defra and the EA as the agencies responsible for regulating water resources.

Water resources are common pool resources and this raises the risk that water users can over-exploit them. Therefore, protecting the environment requires, at a minimum, that sufficient water remains in the environment to sustain the resources' ecosystem to the level society is prepared to accept. The water that society wishes to provide for the environment could be considered to be expressed, by the government, through policy instruments such as the Water Framework Directive.[37]

Providing sufficient water for the environment is important in both the short term (within the year) and the longer term (over the years with climate and demand pressures).

Furthermore, maintaining river health may also require some maintenance of the natural flow regime. Various components of the natural flow regime provide different ecological triggers, important in maintaining the integrity of a water body. Thus both intra- and inter-annual variation in flow provide the dynamics that maintain biological diversity and ecosystem function.

Protecting the environment and other users will also require that impacts (on these parties), arising from abstraction and trade, are managed. This could include both water quality and quantity impacts. These impacts are complicated by the fact that some proportion of abstracted water may return to the environment. The relative volume and quality of this return flow may differ across users.

Ensuring affordable and reliable water supplies

Ensuring that the public has access to a safe, affordable and reliable public water supply has long been a policy objective. To ensure this, water companies must remain financeable and be able to access sufficient water resources in order to

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37 We have not as part of this scope of work considered the adequacy or otherwise of this instrument in setting aside the appropriate water for the environment.

supply their customers. Efficiency in the supply and delivery of the water for the public is also important for ensuring an affordable public water supply.

This objective is principally addressed through the broader water supply regulatory regime. For example, price regulation is intended to drive efficiency in water supply operations. Also, Ofwat's statutory duties require it to ensure that the functions of each water supply company are properly carried out and that they are able to finance their functions, in particular by securing a reasonable rate of return on their capital.

However, the level and structure of customers' prices may be impacted by policy decisions relating to the water allocation regime. Changes to the regime may have an impact on the costs faced by water supply companies, the scale of investments needed to ensure reliable supplies and the degree of risk and uncertainty faced.

Therefore, policy decisions made in relation to the water allocation regime should consider the impact on the reliability and affordability of the public water supply.

Encourage the efficient allocation and use of water

Policymakers have a role in ensuring that the public's limited water resources are allocated in a way that generates the most value for society. To ensure this, water needs to be allocated to abstractors who will use water to produce goods and services that provide maximum benefits to society.

Of course the highest value use will change over time. For example, an increase in the market price of a particular agricultural product would increase the value generated from using water to produce it. As a result, meeting this objective requires consideration of how water can be reallocated over time.

When water is scarce, there could be a trade-off between this objective and the objective of ensuring affordable water supplies.

Encouraging dynamic efficiency

At any point in time efficient water use can be achieved by allocating water to its highest value use. However, over time, more efficiency may result from increasing innovation and improving the productivity of water use. This can be termed dynamic efficiency. It can be achieved by ensuring abstractors face appropriate incentives to invest or innovate to increase the productivity of their water use. This can be encouraged by setting clear, secure rights to water.

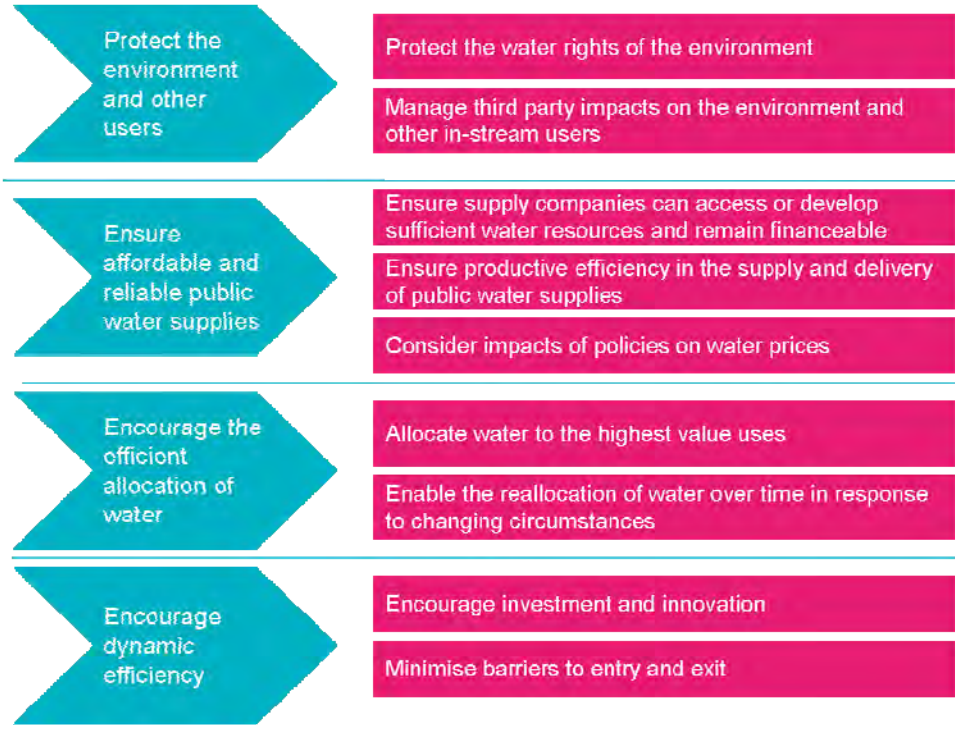
Innovation and improvements in productivity can come from competition or more generally rivalry between users. This involves more efficient water users replacing less efficient users. This suggests that there may be benefits in facilitating the entry and exit of abstractors. It is worth noting that this may potentially conflict with a structure that encourages investment by providing a low risk environment with low financing costs.

Summary of objectives

The objectives for a sustainable water allocation regime, described above, and the principles that underpin them are illustrated in **Figure 6** below.

We consider these objectives and principles to be appropriate and comprehensive and have used them in assessing the effectiveness of the various policy reforms considered in this report. We recognise there is scope for further discussion around the precise categorisation of the objectives. However, in identifying and explaining these objectives we hope to encourage debate on the importance of having a clear framework for policy in this area.

Figure 6. Objectives for a sustainable water allocation regime



Source: Frontier Economics.

5 The case for reforming the current regime

A sustainable water allocation regime is one that is able to meet the objectives, described in Chapter 4, in the face of future challenges.

This chapter assesses the case for reforming the current regime so that it will be able to meet its objectives going forward. This involves identifying issues that may emerge for the regime when faced with increased water scarcity and assessing the case for reforming the current regime to address these issues. Our assessment highlights that while the current regime has generally worked well, reforms may be needed to improve on existing processes for:

- reviewing the level licensed abstractions; and
- reallocating water between users.

This chapter also sets out a framework for assessing and developing workable recommendations for improving the regime in these areas. This framework has guided the development of specific recommendations for reform which are the subject of Chapters 6 through to 8.

5.1 Emerging issues for the regime

To date the current water allocation regime has generally performed well against some of the objectives outlined in Chapter 4. The EA's existing water resource management policies have protected the environment from damage. At the same time, Ofwat's price regulatory regime has ensured an affordable and reliable public water supply.

Despite periodic droughts the current arrangements are only beginning to be tested by water scarcity. With the availability of relatively cheap sources of supply there has been no pressing need to ensure water resources are allocated or used efficiently.

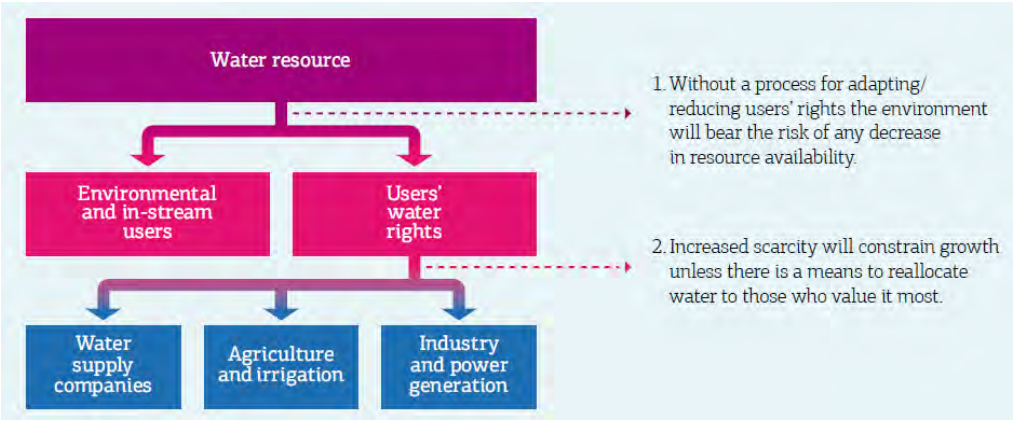
Looking ahead, sustained water scarcity, at least in some parts of the UK is a real possibility (see Chapter 2). This may be reflected both in a long-term decline in water availability and in greater volatility of supply. Both would result in the water allocation regime coming under increasing pressure. In particular, two key issues emerge.

- First, there will be growing pressure to restore more sustainable levels of abstraction by ***changing the level of licensed abstractions***. Without a process for reviewing the level of users rights the environment will bear to risk associated with the impact of climate change on water availability. Therefore, a mechanism for reducing abstraction levels is necessary to prevent unacceptable environmental damage. What is or is not acceptable is likely to be heavily influenced by changing environmental standards.

- Second, it will be increasingly necessary to **reallocate water between users** in order to maximise the value from its use. When water is scarce and increasing supply is expensive, a means of reallocating water ensures that available supplies are used most efficiently. Where existing water users are not those who generate the most value from use of the available water, then society as a whole is not getting the maximum benefit. To ensure the efficient use of water an effective mechanism is needed for reallocating it, over time, to those users who value it most.

The link between these issues and the key choices involved in allocating water between stakeholders are illustrated in **Figure 7** below.

Figure 7. Links between the emerging issues and the key choices involved in allocating water rights



Source: Frontier Economics.

Figure 8 illustrates how these issues can emerge. Over time the water 'available' declines and becomes more volatile as a result of the impact of climate change. This available water may provide benefit by either being made available for licensed abstractions or by remaining in the environment.

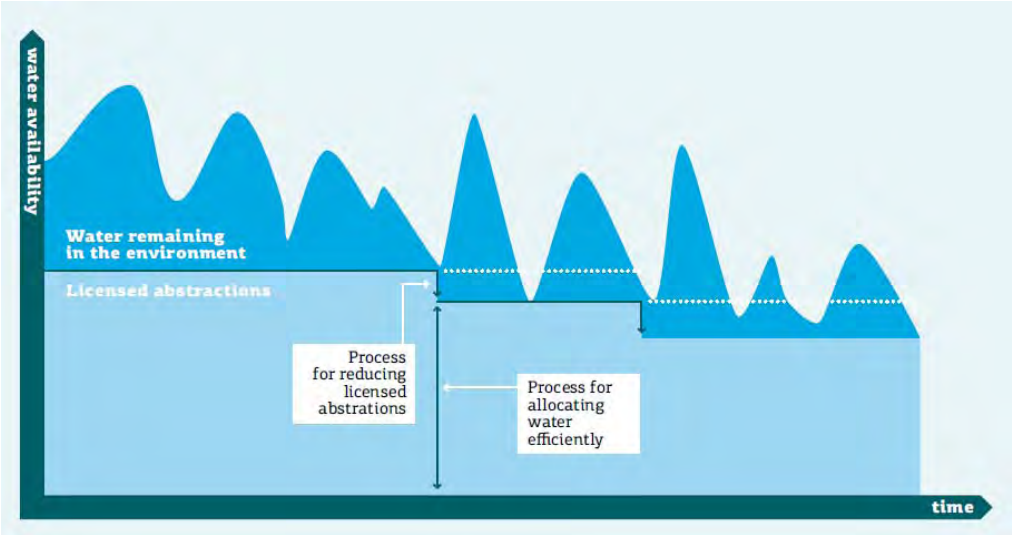
If water availability declines over time, licensed abstractions may need to be reduced in order to maintain the balance between the water available for the environment and consumptive uses. This may involve successive reductions in total licensed abstractions. Consequently less water will be available for abstraction. This makes the methods by which water is allocated between users more important in order to ensure the value from abstracting and using water is maximised.

In summary, this analysis suggests reform should be focused on three processes within the water allocation regime.

- Processes that determine the appropriate volume of water that can be taken from the environment, i.e. that define the sustainable level of abstraction;
- Processes that change abstractions to this sustainable level;
- Processes that effectively allocate water taken from the environment among competing uses.

This report does not deal in depth with the first of these processes. This is a matter that is influenced by scientific evidence on the impact of different levels of abstraction, and judgements about the level of environmental damage that society is willing to tolerate. This is complex and therefore a central role of government and the EA. However, the need for reforms to the other processes is discussed further in the following sections.

Figure 8. Emerging issues for the water allocation regime



Source: Frontier Economics.

5.2 Changing the level of licensed abstractions

It is increasingly likely that the environment's share of water resources in some catchments will be deemed insufficient, suggesting the level of water rights may need to be reviewed. There are two reasons for this.

- First, because of the introduction of more stringent environmental standards. Abstraction licences in England and Wales are allocated on a *first-come, first-served* basis. The majority of licences were issued in advance of the requirements of the WFD and so the aggregate level of these licences would

not take account these new standards. Even if this issue is addressed it could become a problem again if environmental standards change.

- Second, the risk of a **long-term reduction in water availability** resulting from climate change. Without some ability to review the level of water rights the environment will largely bear the risk of any decline in water availability. This may increasingly become a problem as a result of climate change.

Abstraction levels can be considered unsustainable if insufficient water is provided to sustain the ecosystem to the level society is prepared to accept. Where abstractions are unsustainable this can lead to low river flows, reduction in groundwater levels and consequently exacerbate the effects of any nutrient and chemical pollution.

Abstraction levels need to be reviewable if the environment is to be protected. However, policies aimed at enabling water rights to be reduced run the risk of reducing the allocative and dynamic efficiency of the regime. This suggests any reform should focus on making the processes for changing the level of rights as economically efficient as possible.

Key issues with current arrangements

The EA already has mechanisms in place of reducing the level of licence abstractions. Under these arrangements the environment is afforded protection; however, the other objectives of the regime are not adequately considered.

- Current processes do not appear to take into account different users' water valuations. As a result, water rights will not necessarily be taken from the lowest value users in any catchment. Where water does not stay with high-value users it is not being allocated most efficiently in order to generate the most value.

- Reducing the licensed volume of water rights, at the point of trade, will also mean water is not necessarily taken from the lowest value users. In addition, this creates uncertainty, which acts as a barrier to trade and therefore discourages water moving to higher value users.

- Reductions made to water supply companies' licences may not be achieved in the most cost-effective way. This may unnecessarily increase the cost of supplying water to the public.

- Any policies that enable rights to be adapted or reviewed will define the long-term reliability or certainty of the water right. Rights' holders face significant policy uncertainty relating to the extent to which their rights will

be subject to future reductions. This particularly applies to time-limited licences. This issue was noted in a report recently commissioned by Defra.[38] Certainty over the treatment of rights is important to encourage investment on the basis of the rights and, therefore, to the promotion of dynamic efficiency. This issue is discussed in further detail in section 5.2.2 below.

There would be benefit from reforms that address these issues. These benefits would increase if water scarcity becomes more severe in the future.

In addition to the issues described above, the current administrative approach may become increasingly ineffective and difficult to implement. Any future decline in water availability would lead to licences with existing restrictions (flow/level etc.) being constrained more frequently and/or future CAMS assessments identifying more licences as being a risk to the environment. An administrative arrangement may be suitable where licence reductions are rare or relate to specific sites (such that they only involved one or two licences). However, any administrative approach may become less suitable to address a larger problem of over-abstraction where many more licences could be considered to contribute to the problem.

Uncertainty around the severity of any decline in water availability will also undermine any administrative approach. Market-based approaches, which are inherently more flexible, will better adapt to changing circumstances. If an administrative system is made more flexible it will tend to lack transparency, as the administrator will find it difficult to continually justify any change in stance.

This suggests that reforms should enable a progressive transition towards a more market-based approach to adapting abstraction licence volumes, driven by the extent to which greater scarcity emerges.

Recommendations for reforms aimed at improving processes for reviewing the level of water rights are discussed in Chapter 6.

Importance of well-defined water rights

As noted above current policies for addressing unsustainable levels of abstraction mean that rights' holders face significant policy uncertainty about the extent to which their rights may be subject to future reviews.

In Australia, Chile and the western US, water rights more closely resemble private property (see Annexe 1). While they are not necessarily absolute in terms of quantity they are typically granted in perpetuity (although processes for reviewing rights may exist). Therefore, they do not appear to be subject to the same level of uncertainty as rights in England and Wales.

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38 Arkell and Piper (2010), *Assessment of regulatory barriers and constraints to effective interconnectivity of water supplies,* R&D Technical Report WT0921/TR.

At this point it is useful to consider the characteristics of water rights and highlight the importance of providing users with certainty over their water rights.

We have reviewed the literature on water rights and how this has been applied internationally. The text box summarises the key characteristics of water rights that are necessary to provide certainty for water users. A more detailed summary of the literature is provided in **Annexe 1**.

Key characteristics for water rights

In order to provide certainty for users, water rights should be:

- **clearly specified** – so that owners and potential holders of water rights understand exactly what benefits and obligations the right brings;
- **secure** – such that the right is not subject to modifications or revocation at the discretion of others without due compensation;
- **exclusive** – the direct benefits and the costs associated with the use of the rights accrue to the holder; and
- **enforceable and enforced** – it must be possible to determine when a right has been infringed and to have legal mechanisms for preventing or redressing this.

In addition, **transferability and divisibility** – the right can be traded in whole or in part to others and is defined in a consistent manner[39] – are often listed as key characteristics for water rights in order to facilitate the development of water markets.

In specifying rights for water, the challenge is applying these principles of **clarity and security** to a resource that is inherently uncertain in size. In particular, there are two uncertainties that affect available supply and which have an effect on how a water right is specified.

- First, the total volume of water available in any unit of time will vary as a result of seasonal, annual and inter-annual rainfall variations.

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39 Challen, R. (2000) *Institutions, Transaction Costs and Environmental Policy – Institutional Reform for Water Resources.*
Crase, L. and Dollery, B (2006) Water Rights: a Comparison of the Impacts of Urban and Irrigation Reforms in Australia. *The Australia Journal of Agricultural and Resource Economics.* Vol 50 pp 451-462.
Frontier Economics, (2007) *New Zealand Water Management Reform*, A report prepared for Meridian Energy Ltd, February 2007.
Scott, A (1989) Conceptual Origins of Rights Based Fishing. In Neher, A., Arnason, R., and Mollett, N. (1989) Rights Based Fishing.

- Second, the relative water needs of the environment may vary, due to changes in environmental standards.

In this context **clearly specified** (and secure) water rights are those that provide holders with certainty around the risks they face or that define the level of reliability attached to the rights.

More generally the most efficient way to allocate the risks associated with these uncertainties is to place them with those best able to manage or mitigate them.

Government has some ability to manage uncertainty associated with policy changes. In practice, this has led to compensation schemes being included in water allocation regimes, so that the risk related to any change in environmental water policy is borne by the government (see the case study of Australian arrangements below).

It is less clear who is best placed to manage the risks associated with changes in water availability. It is possible that users are best placed to manage the risk of short-term seasonal and annual variations in availability. International experience indicates that various approaches have been adopted to allocate this risk.

Nevertheless, a fundamental point is that, in advance, there is clarity about who bears these risks. This clarity appears to be missing from current policies adopted for reviewing water rights in order to address unsustainable levels of abstraction.

Case study of Australian risk sharing arrangements

Although Australian water rights are perpetual, there is some recognition that circumstances and climatic conditions may change. Rights are not time-limited. Instead, there is a periodic process for review of water rights in each catchment. The nature of this review is controlled by e*x ante* statutory rules that define the review process and the changes that can be made to water rights.

Water rights are defined as shares of the water resources available, which means that any short-term reduction in availability will be proportionately shared. However, the long-term volume of water available for abstraction may change as part of the catchment review. These changes are subject to an *ex ante* risks-sharing arrangement, which allocates the risk of any change to different parties, depending on the specific circumstance of the change.

- Any reduction arising from **long-term changes in climate or any seasonal events** such as drought are to be borne by water rights holders.
- Any reduction due to **improvements in the knowledge of sustainable abstraction limits** is to be borne by rights holders up to 2014. After 2014 this risk is borne by Governments (except for the first 3 per cent reduction).

Any reduction arising as a result of a **change in government policy** such as new environmental objectives is to be borne by Governments.[40]

For a water right to be **secure** it must not be subject to modifications or revocation at the discretion of others without due compensation. This means that any mechanism for redressing over-abstraction should describe *ex ante*:

- the circumstances when water available for abstractors can be altered in response to a change in water availability or environmental standards; and
- the circumstances where compensation will be provided.

Setting out, in advance, the terms for any future revision of rights, including the explicit details of any compensation arrangements that would apply, removes the risk of rights being arbitrarily infringed. This enables rights holders to clarify their supply risk and gives them the certainty on which they can invest and improve their efficiency of water use over time. The current policies in place for reviewing abstraction levels do not set out these conditions in any level of detail. This is particularly the case for holders of time-limited rights where the EA has identified that it intends to use the renewal process to review the right.

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40 Frontier Economics (Australia) (2007) 'New Zealand water management reform'.

5.3 Enabling water to be reallocated between users

An increase in water scarcity raises the importance of enabling water to be reallocated between users to those who value it most. In the absence of a mechanism for doing this, economic activity will be constrained by significantly raising the cost of securing supplies.

Unless existing rights' holders are those that will generate the most value from the available water, the overall benefit to society is not being optimised. The extent to which water rights currently sit with low value users is unknown. Even if this proportion was currently low, it is inevitable that users' relative water valuations will change over time. This could result from changes in technology or the value of outputs. For example, an increase in the price of an agricultural commodity would increase the value attached to the water used to produce it.

Therefore, to encourage the efficient allocation and use of water a mechanism is needed for reallocating water, over time, to those users who value it most. This will encourage inefficient or low-value users to release water and enable high-value (and potentially more efficient) users to gain access to it.

The EA in *Alternative ways to allocate water, Final report* identified that the current water resource management framework was not primarily designed, or intended to be used, as a way of allocating available water resources (other than based on a proven need at the time of application). With increased water scarcity the regime will need to do this.

Some trading and leasing of water rights already takes place, although it is relatively limited. It is based on private transfers of the right (either permanently or temporarily) between users. Typically, the interactions between parties are facilitated by the EA. Where no resources are available, the EA may identify potential rights' holders, with whom a potential entrant can negotiate.

This has led regulators to express concerns about existing processes. In particular, the EA, Ofwat and Defra have identified a number of administrative barriers to trade,[41] which could be constraining market developments. These can be summarised as follows.

- **Lack of a visible market.** Current arrangements make it difficult for users to identify potential trading partners. Also, they may be unable to estimate the value in trading as there are no visible price signals.

41 Ofwat and Environment Agency (2008), *Exploring views on the potential for more active water rights trading.*

- **High and uncertain transaction costs and approval processes**.
  - The current trade approval process is uncertain. Quoted timeframes range from 6 to 18 months from the decision to trade to completion. This prevents the development of a market in annual water trade and short-term leases.
  - The process can be complex and require expert assistance.
  - Uncertainty around whether, and by how much, the EA will reduce rights at the point of trade discourages sellers from coming forward.
  - Many potential participants do not understand the water trading process and are unwilling to commit resources to it.
  - Explicit restrictions imposed on trade outside of catchment areas and on moving abstraction points may limit the types of trades that can take place.

- **Disincentives within the regulatory regime.**[42] The regulatory regime acts as a barrier to water transfers between supply companies. This arises from the regulatory treatment of sales' revenues and purchase costs and the perceived capital bias within the regulatory regime. Ofwat also considered that trading was unfamiliar to companies and that this may act as a passive barrier.

- **General uncertainty about the future**. Uncertainty about future water availability and government policies encourages a conservative approach and users are more likely to hold on to their water rights.

Reforms that address these barriers to trade could improve market outcomes. However, the appropriate reforms to the existing processes, and the pace of any reform, should depend on the potential scale of trading markets. If the market is small because there is limited potential scope for trade then there may be little value in overhauling existing arrangements. This leads to three related questions. First, is trading the most appropriate mechanism for enabling the reallocation of water? Second, what scope is there likely to be for beneficial trade? Third, is trade being restricted by regulatory or other barriers?

These questions relating to the prospects for, and value from, trade are further explored in Chapter 7. Recommendations aimed at enabling trade are discussed in Chapter 8.

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42 Ofwat (2010) *Valuing water – how upstream markets could deliver for consumers and the environment.*

5.4 Developing workable recommendations for reform

The analysis in this chapter suggests that there is a need for reforms to improve on existing processes:

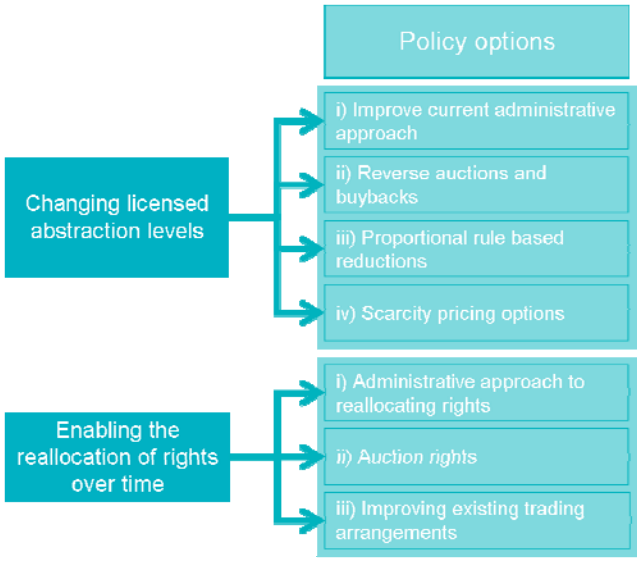
- for changing the level of licensed abstractions; and
- enabling water to be reallocated between users.

In order to take this further we have developed a framework for developing and assessing specific recommendations for reform. This involves three steps.

The first step involves identifying specific policy options. This involved looking not only at reforms that could improve on current arrangements but also at measures adopted in other countries that have faced issues of water scarcity. Annexe 2 contains the details of these case studies and a summary of the key lessons that have been extracted from these international experiences.

Figure 9 shows the key policy reform options considered in this report in relation to the processes where we have identified the need for reform.

Figure 9. Policy options relating to the processes where there is an identified need for reform



Source: Frontier Economics.

Second, evaluating policy alternatives by assessing these against a set of criteria relating to the following:

- **Objectives for the regime.** These correspond to the high-level objectives outlined above. Performing well against these criteria will be fundamental for an effective policy proposal.

- **Principles of good regulation/policy.** The policy proposals should satisfy the well-established principles of effective regulation and policymaking, namely proportionality, transparency and accountability.

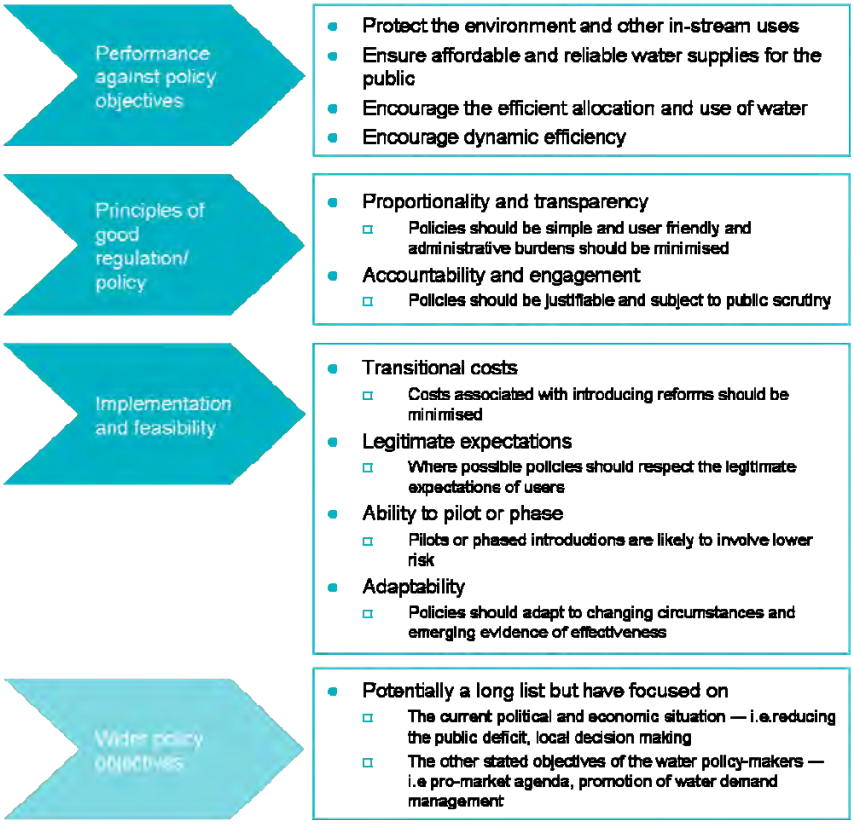
- **Implementation and feasibility of proposals.** Some of the proposals may represent a significant change from the current arrangements. It is appropriate to have a criterion that reflects the costs and risks associated with introducing new arrangements and that assesses the adaptability of reforms, particularly in the face of uncertain climate change impacts.

We have also considered the extent to which the reforms address the **wider objectives of government** and regulators.

These criteria can be seen in **Figure 10** below.

Finally, on the basis of this evaluation we have recommended workable recommendations for reform that give consideration to the uncertainty surrounding future pressures on the water allocation regime.

Figure 10. Criteria used for evaluation



Source: Frontier Economics.

6 Recommendations for improving processes for changing licensed abstractions

As outlined in the previous chapter, one of the key objectives of a sustainable water allocation regime is protecting the environment. Protecting the environment requires, at a minimum, that sufficient water remains in the environment to sustain the resources' ecosystem to the level society is prepared to accept.

Climate change and more stringent environmental requirements mean that the existing quantity of water set aside for the environment may increasingly be insufficient. As a result the EA has adopted various approaches for reducing the level of water rights in affected areas. However, as discussed in Chapter 5 the approaches used for doing this do not fully consider the other objectives of a sustainable water allocation regime.

We have looked at a variety of reform options – improvements to the current administrative approach, reverse auctions, scarcity charges and proportional rule-based reductions to all users' rights. These options all aim to improve on current policies for reviewing the level of licensed abstractions in affected areas. The effectiveness of these options varies, depending on the context in which they are used.

An overview of the reform options we have considered and our conclusions in respect of these is provided in section 6.1. Further details on our analysis and the proposed recommendations are provided in sections 6.2 to 6.4.

6.1 Options for reform

Other countries that have already experienced declines in water availability have had to address the issue of unsustainable abstraction levels. Our review of international experiences suggests there are four broad options for managing this.

- **An administrative approach** where the Government identifies specific rights to be reduced (i.e. based on an assessment of relative valuations or harm). This is the core of England and Wales' current approach and therefore adaptations to these arrangements have been considered.

- **Buy-backs and reverse auctions** where the Government buys back water from users either by entering the water market or by asking holders to tender water rights for sale (known as 'reverse auctions').[43]

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43 Policy options related to this include the Government funding water saving infrastructure in order to reduce holders' rights.

- **Proportional rules-based reductions** where reductions are made to all rights in proportion to each holder's share of the resource.

- **Scarcity charges** where the abstraction charge is set at a level that brings abstraction back to a sustainable level (rather than being set on an administrative basis).

Figure 11 below summarises our key conclusions relating to the effectiveness of these various options. Our analysis suggests that there are material disadvantages to using scarcity charges (in isolation from other mechanisms) such that they should not be used as the primary means for reducing licence abstraction levels (see section 6.4), although ring-fenced abstraction charges could have a role in funding compensation payments and the costs of reverse auctions.

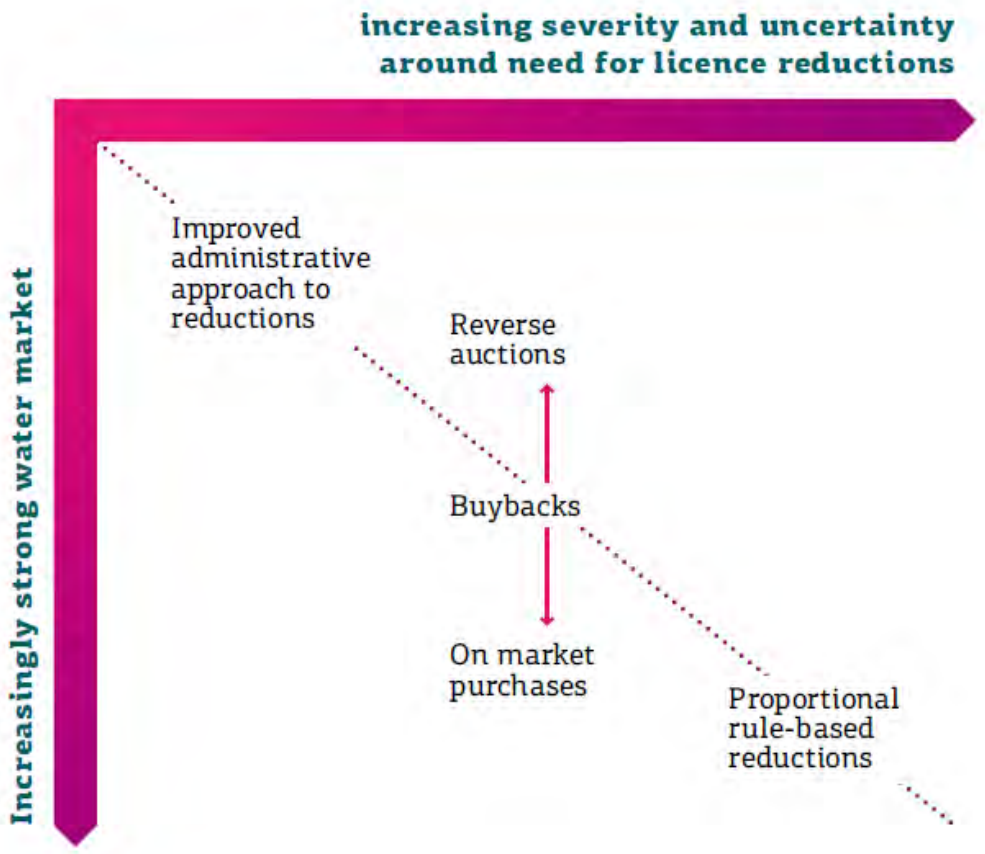
Figure 11. Policy reform options for reviewing licensed abstraction levels

	Description	Assessment against	
		Objectives	Other criteria
Administrative reductions	Particular abstractors (possibly based on an assessment of relative water valuations) are targeted and their rights reduced	Generally less efficient but extent depends on: • ability to target low value users • level of certainty users have over their rights	• Basis of current arrangements • Less proportionate if need for reductions increases as becomes costly and less timely • Lacks transparency
Buy backs/ reverse auctions	Government buys back water by entering the water market or by asking holders to tender water rights for sale (reverse auctions)	• More efficient means of reducing abstractions as incentivises low value users to sell their rights • Improves certainty of rights and puts a value on rights which will increases efficiency over time	• Less proportionate if limited need for reductions as may have higher implementation costs (but can pilot) • More adaptable, transparent & accountable • May require legislative change • Revenue implications unless funded through abstraction charge
Proportional reductions	Reductions made to all rights in proportion to each holders relative, implicit share of the resource	• Can be used as a short term measure in droughts to improve protection for the environment. • Does not take water back from lower value users. Rely on the water market to achieve an efficient allocation. • Low policy uncertainty which will increase efficiency over time	• Transparent and accountable • Highly adaptable to changing circumstance so more proportionate if reduction become more severe and/or less certain • Would require legislative change in order to be used effectively and consistently.
Charges	The abstraction charge is set at a level that brings abstraction back to a sustainable level rather than on an administrative basis	• Assuming it is estimated appropriately: • it will be more efficient than an current approach. • set a price for water and so encourage investment and improve efficiency over time	• Less proportionate if is limited need for reductions as it may have higher implementation costs. • Prone to error and not adaptable • Revenue raising but lacks transparency unless collected for funding buy backs

Source: Frontier Economics.

The analysis suggests the effectiveness of the other reform options varies depending on the context in which they are used. This includes whether there is a functional water market and the future uncertainty and severity of any sustainability reductions. The effectiveness of these alternative approaches against these dimensions is illustrated in **Figure 12** below.

Figure 12. Effectiveness of various reforms in addressing over-abstraction in different contexts



Source: Frontier Economics.

Uncertainty around the need for licence reductions, reflecting the uncertainty around the impact of climate change, leads us to propose that reforms should be incremental and should evolve as uncertainties are resolved. In particular, we consider it is possible to create a regime that is more adaptable to future needs.

- Reforms can be implemented reasonably quickly, which will improve current administrative approaches for reviewing the level of licensed abstractions (see section 6.2).

- If water scarcity becomes more severe, more flexible market-based approaches will become more appropriate, in particular government buy-

backs through reverse auctions. This approach should be piloted now, while compensation arrangements are still in place, in order to assess its effectiveness. If this approach proves effective some of the reforms to improve current administrative approaches would be unnecessary (see section 6.3).

- Proportional reductions could be appropriate if a stronger water market develops and the problem of over-abstraction becomes more severe (see section 6.4).

These conclusions are discussed in further detail in the sections that follow with specific recommendations provided.

6.2 Improving the current administrative approach

While the EA's current processes for reviewing licensed abstraction levels are designed to protect the environment, the issues identified in section 5.2.1 highlight how the current regime does not perform well against the other objectives of the water allocation regime. In particular, the current arrangement could be improved by:

- building an understanding of users' water valuations in order to keep water with high-value users;
- discontinuing policies for reducing licences at the point of trade (for the purpose of reducing licensed abstraction levels);
- improving the alignment with the regulatory regime to ensure reductions in water supply companies' licences are achieved in the most cost-effective way; and
- reducing uncertainty for rights' holders.

Reforms for addressing each of these issues are considered in more detail below.

Build an understanding of users' water valuations

To date, most sustainability reductions have been imposed under the RSA programme, and have been aimed at reducing the impact of abstraction on specific water bodies, e.g. SSSIs, SACs and SPAs. In the majority of circumstances any decision over which abstractions reduce come down to one or two users.

However, in the future it is more likely that sustainability reductions will relate to multiple users. In these circumstances a process is needed to reduce abstractions in the most allocatively efficient way. This would involve leaving water rights with the users who value them most.

Administratively reducing abstraction in this way requires an assessment of users' relative water valuations. It also requires that the assessment is applied on a catchment-wide basis (consistent with the current CAMS process) to ensure that the costs and benefits of various options can be compared.

It should be acknowledged that any assessment of users' relative water valuation will be incomplete. For example, different agricultural users' water valuations will vary depending on their location and specific product. In addition, any single user's valuation will vary over time, depending on a range of external factors such as the value of their product in an external market, climatic conditions and risk tolerances. Ultimately this limits the effectiveness and transparency of an administrative assessment such as this and is one of the key reasons for moving towards a reverse auction-based approach. That said, an improved understanding of these factors in the England and Wales context would provide helpful information for other processes. We understand that Defra may already have commissioned research along these lines.

2. Build an understanding of users' water valuations

3. To better understand the costs of alternative reduction options the Environment Agency should build up an understanding of users' relative water valuations. This should identify the opportunity costs (or lost benefits) users face when their water rights are reduced. This can then be used to inform any future assessment process, which should consider these costs when assessing alternative options. This would also aid in estimating compensation payments and provide useful evidence in any government buy-back process. Finally it could help in modelling the scope for trade between users.

We note an administrative approach will be more effective if combined with a compensation scheme, which may encourage low-value users to identify themselves (see section 6.2.3).

Remove any clawback of rights at the point of trade

There is evidence that the EA has looked to water rights' sellers in order to reduce licensed abstraction levels. On average, traded licence volumes have been reduced by 40 per cent (based on 5 years of trading data over the period July 2003 to August 2009[44]). However, this average hides significant variability in the size of the reductions applied (as shown in **Figure 13**).

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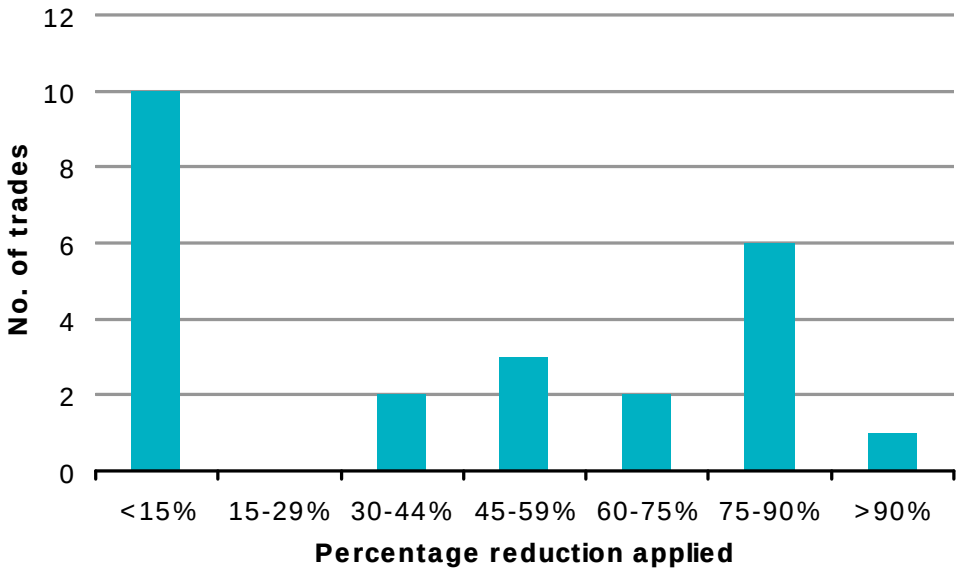
44 This figure excludes trades where data was missing and where there was a change in use associated with the trade (source: EA registered trading data provided by Dr Julien Harou).

Figure 13. Range of reductions applied to trades



Source: EA registered trading data provided by Dr Julien Harou.

It is possible that these reductions have been applied to account for specific trading externalities – where other users or the environment may otherwise be negatively impacted by the trade (see section 8.2.1). However, it is not clear that this has always been the case.

Alternatively, given the general constraints on the EA's ability to reduce licensed abstractions, making a reduction at the point of trade may be a pragmatic approach. However, reducing licences at the point of trade will have a number of negative impacts.

- First, users who put their water rights up for sale will not necessarily have the lowest water valuations and so targeting these abstractors may be inefficient and will not lead to the efficient allocation of water.

- Second, this approach acts as a direct barrier to trade. It will discourage sellers from entering the market and instead encourage hoarding. This prevents water being put to best use. The uncertainty around the potential size of any reduction will further compound this issue. This will lead to inefficiency in the water allocation regime.

- Third, reducing the rights of sellers may be ineffective as it may have limited impact on any problem of over-abstraction. Given this approach acts as a significant disincentive to trade, such that very few trades may occur, very little water can actually be clawed back in this way.

Enabling water trading may have the potential to activate sleeper rights – being rights that are held but not used. A market means sellers can realise the value of the right. On this basis trade can increase water use if the purchaser is more likely to utilise the water right than the seller. Therefore, it could be argued that clawing back rights at the point of trade is a way of limiting the impact of the trade on other users and the environment.

However, concerns that trading may increase water use in some cases do not justify approaches that artificially discourage trade. The concern regarding increased water use is ultimately caused by unsustainable abstraction levels, not by trade in itself. This concern should be addressed by a comprehensive approach to reviewing abstraction levels.

The drawbacks of clawing back water rights at the point of trade were identified in Australia. Initially, reductions were applied to trade in some areas when over-abstraction began to emerge as an issue. However, the approach was discontinued, due to the weaknesses outlined above. The water market regulator, the Australian Competition and Consumer Commission (ACCC), made the following comments.

> *The overallocation and overuse of water are best dealt with by mechanisms such as sustainable diversion limits and adjustments of the amount of water rights on issue.*[45] *The ACCC considers that restrictions on trade should not be used to adjust the overall volume of water access rights on issue or the total volume of water available for extraction by water access right holders. The burden of adjustment to address overallocation arguably should not be concentrated on people wishing to trade existing water access rights.* [46]

As an alternative the EA could consider introducing a 'first right to buy'. This would involve the EA having the option to take a buyer's place and acquire the rights put up for sale at the price laid down by the buyer in the approval application. This approach has been adopted in some areas of Spain. Although we note that while it would provide increased security for the seller it still has the weakness that it may discourage buyers from participating in the market.

4. Remove clawback at point of trade

5. The licensed volume of water rights should no longer be reduced at the point of trade, or on the basis of abstraction history in order to address over-abstraction more generally. This approach acts as a barrier to the trade of water rights. Other more systematic catchment-wide approaches should be used for reducing licensed abstractions.

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45 ACCC *Water trading rules position paper*, p 16.

46 ACCC *Water trading rules position paper*, p 47.

Improve alignment with the regulatory regime

Water supply companies hold many of the water rights and therefore could be expected to bear a significant proportion of any reductions in licensed abstractions. These reductions could impact on a company's reliability of supply unless it is adequately funded for any investments needed to meet the resulting gap between supply and demand.[47]

Assuming that funding continues to come through the regulatory regime, it is important that the process for reviewing water rights fits well with the regulatory regime. If not, there is a risk that these processes could undermine a company's assessments of its deployable output and its security of supply. An increased risk of investments being unfunded will feed through to the cost of financing investment and ultimately increase the costs facing consumers. This will also discourage interconnectivity and resource sharing. This issue was noted in a report recently commissioned by Defra.[48]

There appear to be two potential areas where inconsistencies can arise between the regulatory regime and the existing processes for reviewing licensed abstractions.

The first relates to timelines. Currently the regulatory cycle and the timelines for the existing sustainability reduction processes do not align. This can lead to unnecessary uncertainty for the companies. This issue arose during the AMP5 planning period and, according to published timelines for the next CAMS/RSA cycle, it will also be an issue in the preparation for AMP6.[49]

The second relates to the size of sustainability reductions and the treatment of anticipated future sustainability reductions. Where companies are only able to develop schemes to address the immediate reductions they may not be investing in the most cost-effective solutions in the long run. In preparing WRMPs, companies can only include schemes that have been identified and agreed with regulators through the NEP. In many regions the EA's preliminary CAMS work indicated that further, potentially more significant, changes may be needed. However, these potential reductions do not feed through to the WRMPs. In the case of Anglian Water it faced relatively modest sustainability reductions in the AMP5 regulatory period. However, earlier reports by the EA refer to sustainability reductions over ten times those funded through AMP5. Excluding

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47 This could be through either expanding storages (i.e. reservoirs, aquifer recharges) or improving demand management.

48 Arkell and Piper (2010), *Assessment of regulatory barriers and constraints to effective interconnectivity of water supplies,* R&D Technical Report WT0921/TR.

49 It should be noted that the EA and the water companies are aware of the potential issues and seeking to manage it through liaison groups.

consideration of uncertain future reductions may mean effective larger scale investment opportunities may be missed.

Of course, some uncertainty around the need for any future review of rights is inevitable. In these circumstances there may be value in waiting for these uncertainties to resolve themselves before investing. What this tension points to is the need for a more systematic approach to reviewing rights in the long term.

Improve alignment with the regulatory regime

6. The catchment-wide assessment process should take into consideration the regulatory cycle when developing the timelines for any reduction in a water supply companies' licensed abstractions.
7. A central case scenario for long-term licence reductions should be identified as part of the WRMP process. This can help assess the appropriate investments to deal with longer term reductions. Where this process suggests a different investment programme, Ofwat should give consideration to this.

Reduce uncertainty facing water rights' holders

Water rights' holders face significant uncertainty in relation to their rights due to:

- uncertainty around how future reviews of licensed abstractions will be implemented;
- the move towards time-limited licences and the uncertainty surrounding how they may be modified at the point of renewal; and
- the removal of compensation.

There is clearly the need for a mechanism that enables the level of water abstraction to be reviewed. However, this can be achieved while providing greater certainty for rights' holders.

Certainty over rights is important because it encourages investment in long-lived assets associated with the water use, and it also facilitates water trade and other forms of commercial exchange. In this section we focus on reforms that reduce the uncertainty associated with the processes described above.

Reduce uncertainty around processes for changing licensed abstractions

The current water allocation regime provides very little certainty to users over how future sustainability reductions will be implemented.

For water companies the approach to long-term water resource planning is set out by the EA in the Water Resources Planning Guide. Section 6.2.1 states that:

> *In time, we will make changes to the conditions of individual licences to ensure we adopt the sustainability reductions. We will do this in close consultation with the water companies to maintain security of public supplies.*

This statement does not provide any certainty around how any future reductions would be implemented.

Uncertainty also exists for other abstractors who have been given very little guidance around how any future reductions would be achieved through the CAMS process.

These arrangements mean water rights in England and Wales do not meet two of the key characteristics for water rights – they are neither secure nor well specified (see section 5.2.2). It is unclear whether the rights may be subject to modifications or revocation without due compensation. This leads us to the following recommendation, which would require legislative change.

Use statutory instruments to reduce uncertainty around processes for changing abstraction levels

8. The terms and conditions for varying any existing rights to address concerns around over-abstraction should be clearly specified, *ex ante*, in a statutory instrument. These terms and conditions should include:
    a. the specific circumstances and processes under which the volume can be reduced;
    b. the circumstances and processes under which other conditions may be varied;[50] and
    c. any circumstances in which compensation will be payable and the details of these arrangements – i.e. the timelines, processes and method for estimation.

Reduce uncertainty for holders of time-limited rights

The creation of time-limited licences (for new or varied licences) is part of the EA's approach to addressing unsustainable levels of abstraction. While there is a general 'presumption of renewal' for time-limited licences the EA has not set out in any detail how it will assess licences at renewal. All that has been stated is that they would normally expect to renew time-limited licences provided the abstraction:[51]

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50 For example, circumstances in which it may be reasonable to vary the rights' conditions include that it applies to all abstractors in a specific location; that there has been a change in use associated with the right; or that it is necessary as a result of new scientific evidence coming to light.

51 Environment Agency (2010), *Managing water abstraction*.

- is environmentally sustainable, as supported by the CAMS and WFD assessments;
- has a continued justification of reasonable need; and,
- represents an efficient use of water (*using the right quantity in the right place at the right time*).[52]

The EA has indicated that it will endeavour to provide the licence holder with six years notice of non-renewal, or, renewal under more restrictive terms (such as lesser quantities or further environmental constraints).

Where a time-limited licence is reissued on the same terms, the EA has stated that there will be no need to reconsider the impact upon protected rights. However, if an application includes a request to vary the licence (for example, to increase the licensed quantity), the EA will view this as essentially a new application and will reassess whether existing rights may be derogated in any way.

To provide greater certainty for the holders of time-limited licences we propose the following recommendation, which would require legislative change.

Use statutory instruments to reduce uncertainty for time-limited rights holders

9. In order to increase the security for time-limited rights' holders the automatic presumption of renewal for these rights should be specified within a statutory instrument. Instead of defining the circumstances where the EA would normally expect to renew the licence, the circumstances whereby the EA may not renew the licence should be explicitly defined.

We note that these changes would continue to allow time-limited licences to be used as part of the approach to addressing over-abstraction. Putting in place clearer rules for the renewal of licences will encourage investment and economic efficiency.

Build security by committing to compensation

Compensation can provide certainty for rights' holders by providing protection against the financial impact of policy changes that affect the rights. It can also help reveal users' valuations as they may choose to identify that they are low-value users. This could improve the efficiency of current processes for addressing over-abstraction. It could also lead to more flexible solutions.

The current compensation arrangements are funded through the Environmental Improvement Unit Charge (EIUC). This is added to the abstraction charges

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52 Environment Agency (2010), *Managing water abstraction.*

applied by the EA. The EIUC varies by region and the rate also varies between water supply companies and other abstractors.

Commit to compensation

The analysis leads us to the following recommendation, which would require legislative change.

10. Water companies should continue to be funded for any investment necessary to manage a reduction in their licensed abstractions through the regulatory process. An explicit commitment to this approach would reduce the regulatory risk faced by water supply companies.

11. A compensation scheme, for rights' holders other than water supply companies, should be reinstated post 2012 in order to limit the impact of any remaining policy uncertainty associated with future reviews of the level of licensed abstractions. This should involve clearly defining the process and how the risk of any future reductions in water availability will be shared between governments and users.

Ideally, one compensation scheme would exist, which would better enable the costs of different options for reducing rights to be compared. However, for pragmatic reasons, we are proposing separate compensation schemes for water supply companies and other users. The existing regulatory regime is well established and understood by water companies; therefore, compensating companies via this process is likely to be simpler and more transparent than overlaying an additional process for doing this. Consumers would then pay for any increase in alternative supply/demand costs associated with a reduction in a company's abstraction licence.

This would not create major distortions provided:

- Water companies do not contribute to the EIUC used to fund the compensation regime for other users, otherwise consumers would be overpaying for the cost of reducing abstraction levels.

- A compensation scheme exists for other users. Otherwise this could distort the Environment Agency's decision-making processes as they may favour taking water back from water supply companies, even if this is not warranted.

Summary of assessment

These reforms are aimed at improving the current administrative approaches used for addressing over-abstraction. Ultimately, if the problem of over-abstraction becomes more significant, an administrative approach may prove insufficient and further reforms may be required.

That said, the reforms proposed above are a necessary precursor to any further reforms in this area. The strengths and weaknesses of these reforms against the assessment criteria (identified in section 5.2.1) are described in the table below.

Table 2. Assessment of reforms to improve current administrative arrangements

Criteria	Extent to which criteria are met
Objectives for the regime	Enables the environment's water requirements to be adapted over time in response to long-term changes. Improves the extent to which water is taken back from lower value users, but will not be as allocatively efficient as other reform options. Will reduce uncertainty for rights' holders to encourage investment and improve efficiency over time, but less so than other options.
Principles of good regulation/policy	Will be a less proportionate response if the need for any reductions increases as an administrative approach will become more costly and less timely. Improves the transparency of current arrangements but in general administrative approaches can lack transparency and accountability when compared to reverse auctions and proportional reductions.
Implementation and feasibility of proposals	Does not represent a significant change from current arrangements. But some recommendations would require legislative change. Administrative approaches are not highly adaptable unless they are made less transparent.
Wider objectives of government	Reinstatement of compensation may have cost implications for government unless funded through an increased abstraction charges.

Source: Frontier Economics.

In the remainder of this chapter we evaluate the case for alternative reform options – reverse auctions, scarcity charges and proportional reductions.

6.3 Moving towards reverse auctions

As highlighted in section 5.2.1, any administrative approach may become less effective and more difficult to implement in the face of uncertainty and more severe scarcity. This suggests market-based approaches such as buy-backs and reverse auctions may ultimately be more appropriate.

Buy-backs give rights' holders greater certainty that they will receive adequate compensation for any necessary licence reductions. This may be more appropriate if the need for licence reductions becomes more significant such that investment in water use efficiency becomes paramount.[53]

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53 Australia, which has faced significant water scarcity, has increasingly been moving towards this approach.

In the absence of markets for trading water buy-backs could be undertaken through reverse auctions. Reverse auctions involve the government holding a tender process where rights' holders offer prices at which they would be willing to hand back or reduce their abstraction licences. The EA, or other government agency, would then buy back the licences offered at the lowest price in order to attain the desired environmental outcomes.

This approach improves on the EA's current approach in a number of ways:

- First, it reveals users' water valuations. Rights are bought back from the lowest value users. This improves the efficiency of water allocation.

- Second, it maintains the security of rights by ensuring users are adequately compensated for any reduction in their rights. This encourages investment and leads to improvements in the efficiency of water use over time.

- Third, it actively encourages the development of a water market by creating transactions in water rights. As a result a value will be set for water that provides appropriate signals for investment in water use efficiency.

- Fourth, it is more transparent than an approach that targets certain abstractors in order to reduce their rights. It ensures that the value and cost of providing environmental flows is known and assessed. Any reduction in rights occurs voluntarily, in a 'fair' and 'equitable' way.

- Finally, it is more adaptable and timely than administrative approaches. It would allow the EA to assess offers not only on price, but also in terms of the timing of their contribution to the environment. Also, auctions could be held as regularly as needed and so can provide flexibility when there is uncertainty around the needs of the environment.

At the same time this approach does have some drawbacks.

First, there will be an administrative cost associated with running the auctions. It is not clear, though, if these costs are likely to be higher or lower than using current administrative approaches to reduce abstractions.

Second, market power or collusion among bidders could lead to bidders selling their rights for more than they value them. The likelihood of this being a problem will depend on the number of rights' holders who could potentially take part in any auction. This could be partially addressed by holding auctions across multiple catchments (or by including multiple water companies). In these circumstances a 'reserve-price' could also be set, which represents the maximum starting bid. To estimate a reserve price or indeed assess any bid, the EA would be aided by having sound pre-auction estimates of the value of water to other

users. In any event this sort of conduct would be covered by competition law more generally.

Third, this approach would have a revenue cost for government. One option would be to fund this through an increase in abstraction charges. This would be similar to the current EIUC, which is levied to recover the costs of compensation payments. Higher charges may ultimately encourage low-value users to reduce their abstractions or release their water rights and so feed through to improvements in dynamic efficiency. At a basic level, estimating the increase in the abstraction charges necessary to fund a reverse auction in an area, would involve:

- setting a specific volumetric target for the auction (based on the assessment of the extent of over-abstraction);
- estimating the value of water to rights' holders; and
- defining the number of years over which this revenue is to be collected.

Setting an abstraction charge in this way and clearly ring-fencing any revenue raised for reverse auctions is transparent and accountable. This contrasts with other scarcity charge reforms discussed in section 6.5. Further exploration would be required in order to assess whether this should be applied at a national or regional level.

Given there is some uncertainty around the effectiveness of a reverse auction approach there may be value in piloting it in a currently over-abstracted catchment. In the piloted area the reverse auction process would aim to be an alternative to targeted reductions with the costs of purchases funded through the EIUC. As a result a pilot would be more easily implemented while a compensation scheme is in place.

At present the EIUC charges vary by region and between water supply and other users. As we argue below in relation to scarcity charges (see section 6.5) there is a case for these charges not to vary depending on location and type of user.

Our assessment of the extent to which reverse auctions would meet the assessment criteria is given in the table below.

Table 3. Assessment of reverse auctions

Criteria	Extent to which criteria are met
Objectives for the regime	Enables the environment's water requirements to be adapted over time in response to long-term changes. More efficient than current arrangements as it targets lower value users and incentivises them to give up their rights. Will reduce uncertainty for rights' holders and set a price for water, which would encourage investment and improve efficiency over time.

Principles of good regulation/policy	Will be a less proportionate response if there is limited need for future sustainability reductions as it may have higher implementation costs (but this could be piloted). Transparent and accountable.
Implementation and feasibility of proposals	Significant change from the current arrangements. But it is not clear that it would require significant legislative change. Adaptable and can be piloted.
Wider objectives of government	May have cost implications for government unless funded through an increase in the abstraction charge.

Source: Frontier Economics.

Based on the assessment above we make the following recommendations.

Pilot reverse auctions

12. Given there is some uncertainty around the effectiveness of a reverse auction approach in the England and Wales context we recommend that the government develop and pilot a reverse auction process in a currently over-abstracted catchment. This would be as an alternative to its current administrative process. A pilot would be more easily implemented while a compensation scheme is in place.
13. If the pilot scheme is effective this should be rolled out more broadly and used as an alternative to administrative reductions. This should be integrated with the existing CAMS process.

6.4 Proportional reductions

Proportional rule-based reductions involve reducing the water rights of all users in proportion to their relative share of a water resource (possibly in combination with consideration of priorities).

This option is transparent and adaptable – so it can be used as both a short-term drought response and a long-term measure for reducing over-abstraction. However, this approach makes no attempt to take water back from those who value it least.

This issue is less important where there is a stronger water market as is the case in Australia where it has been employed as a short-term measure (see case study below). In these circumstances users are able to reduce demand or mitigate the risk associated with variable supply by purchasing water from a low-value seller. With a water market it would be possible to achieve an efficient allocation of water across users through a proportional reduction. Without a market it would not.

It is possible that proportional reductions could encourage the development of the water market by increasing demand for transactions following any reduction of licensed abstractions. However, where there are other barriers to trade the resulting outcomes may not be allocatively efficient as under other approaches.

Our assessment of the extent to which proportional rule-based reductions meet the assessment criteria is given in the table below. On the basis of this assessment we conclude that this approach is not appropriate unless a strong and functional water market develops.

That said, in the longer term the appropriateness of proportional reductions could be reassessed, particularly if there is a continuing need for sustainability reductions and the water market has sufficiently developed.

Table 4. Assessment of proportional rule-based reductions

Criteria	Extent to which criteria are met
Objectives for the regime	Enables the environment's water requirements to be protected over time in response to both droughts and longer term changes in availability. Will not necessarily take back from lower value users. This approach relies on a water market in order to achieve an efficient allocation of water rights. Lead to low policy uncertainty for rights' holders, which encourages investment and improves efficiency over time.
Principles of good regulation/policy	Transparent and accountable.
Implementation and feasibility of proposals	Would require some legislative change in order to be used effectively and consistently. Highly adaptable to changing circumstance so would be a more proportionate approach if the need for reductions becomes more severe and/or less certain.
Wider objectives of government	-

Source: Frontier Economics.

Case study – the use of proportional reductions in Australia

In Australia, water rights are defined as ongoing rights to a share of the water resource, as opposed to a fixed volume.

> *A water access right should generally be viewed as a share of the resource available for consumption – which when considered over a number of years can be termed 'the consumptive pool'. The size of the available resource will vary from season to season with weather and other factors. The allocation*

[of water] to the holder of a right during a season … will vary accordingly.[54]

This approach, of specifying water rights as a share of the available resource, means that the risk of variable supply is allocated to abstractors. Efficient outcomes will be achieved if the risk is allocated to those participants with greater risk tolerance or who can most efficiently manage this risk.

Rights' holders cannot reduce the uncertainty associated with the seasonal availability and their tolerance of this risk may vary. However, they can build storage or put in place other systems to mitigate this risk. In Australia they can also easily enter the water market and purchase either water or water rights to manage this risk.

A further complication to this is that Australian water rights are actually defined in terms of two parameters – relative volume (or share) and priority. This means that risk-sensitive water users can acquire more reliable rights at higher prices, while those who are less sensitive to water shortages can acquire less reliable rights at lower prices. This approach appears to have efficiency advantages in areas where water users have heterogeneous demands and risk tolerances. It would also be more efficient where trading or transfers of water and water rights are constrained.

6.5 Scarcity charges

At present abstraction charges are set to recover the costs associated with the EA's management of water resources. Although, as explained above, this charge does include an EIUC, which is levied on a regional basis to recover the costs of compensation payments. Annual income from abstraction charges is of the order of £130 million.

A charging mechanism, such as the EIUC, may have a role to play in association with providing compensation or in funding a reverse auction process. An alternative reform option involves using abstraction charges as the main tool for managing over-abstraction. As we explain below, using scarcity charges in this way has a number of disadvantages.

Under a scarcity charging approach the EA would set higher abstraction charges in areas of water scarcity. The aim of the higher charges would be to reduce the volumes of water abstractions and to encourage low-value users to hand back their licences.[55]

This approach raises a number of issues.

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54 Chief Executive Officers' Group on Water, 2003 (Australia), Water Access Entitlements, Final Report to COAG from the CEO's Group on Water, Natural Resource Management Ministerial Council, Canberra p 5.

55 The split between these two depends on whether the higher charges are applied to the volume abstracted, to the licensed amount or to a mixture of the two.

- Estimating the appropriate level of the scarcity is a complex and uncertain exercise. Set the charge too high and this would lead to an excessive reduction in economic activity in the area. Set it too low and the environment's needs would not be fully met.

- The willingness of users to reduce volumes in response to higher charges will vary over time. For example, for power generation and agricultural users it may in part depend on the value of the output being produced and this varies season by season and year by year. This makes it even harder to predict the impact of scarcity charges on volumes.

- As a result, scarcity charges would need to be reset, potentially at frequent intervals. This undermines the rights of the water users, since they cannot predict the charges that would correspond to their entitlements. This would discourage investment and increase perceptions of risk.

- For public water supply companies the higher charges would be passed through to customers as part of the regulatory process. The main impact of the charges would come through changing long-term resource planning decisions. Depending on their elasticity of demand other users may not be able to pass on these higher charges and will face a greater impact. The EA could respond to this by applying differential charges to different users, in the same way that this is currently done for the EIUC. However, this introduces further complexity and the arbitrary targeting of certain users runs counter to the efficiency objectives of the regime.

Our assessment of the extent to which scarcity charges (in isolation from other mechanisms) would meet the assessment criteria are given in the table below. On the basis of this assessment we conclude that the use of scarcity charges is not justified.

Table 5. Assessment of scarcity charges (in isolation from other mechanisms)

Criteria	Extent to which criteria are met
Objectives for the regime	Enables the environment's water requirements to be protected and adapted over time in response to long-term changes. More efficient if lower value water users give up their water when compared to the current administrative approach. However, it could have a disproportionate impact on non-water company users. If appropriately estimated it could set an appropriate price for water and so encourage investment and interconnection and improve efficiency over time.
Principles of good regulation/policy	Will be a less proportionate response if there is limited need for future sustainability reductions as it may have higher implementation costs.

	Not transparent or accountable.
Implementation and feasibility of proposals	This approach is complex and prone to error as it relies on getting the charge right in order to reduce the volume of water abstracted and encourage the appropriate level of investment. Would involve a significant change from the current arrangements and legislative change. Not easily adapted to changing circumstance.
Wider objectives of government	High implementation cost for authorities as different charges would be needed across regions and over time.

Source: Frontier Economics.

7 Using trade to reallocate water between users

The previous chapter considered reforms aimed at improving the mechanisms for reducing licensed abstraction levels. This chapter considers the prospects for, and value from, using trade as a means to reallocate water between users. Recommendations aimed at enabling trade are evaluated in Chapter 8.

As highlighted above, any increase in water scarcity raises the importance of enabling water to be reallocated between users to those who value it most. In section 7.1 we consider a variety of options that can be used to enable the reallocation of water. From our analysis we conclude that water and water right trading is the most appropriate mechanism for doing this.

In this chapter we also consider whether there is greater scope for trading water and water rights which may imply it is currently limited by regulatory or other barriers. We do this by looking at trading outcomes to date (section 7.2), international experiences with water trade (section 7.3) and by assessing data on licence, within East Anglia in particular (section 7.4). The conclusions of our analysis are as follows.

- Trading in England and Wales is unlikely to resemble the scale of trading outcomes seen in other countries with water markets.
  - Scarcity has been shown to be the major driver of trade and so we would not necessarily expect to have seen a large water market develop to date.
  - In addition, overseas water markets have been dominated by trade between agricultural users, and these are less significant water users in England and Wales.
  - Active trading markets in England and Wales may be relatively small and discrete
- Given this uncertainty, reforms should focus on addressing administrative barriers to trade where it is relatively straightforward and low cost to do so. This will also reveal additional evidence on the scope for trading and will allow markets to develop where it is appropriate and low risk. Chapter 8 sets out our recommendations to address identified barriers to trade.

7.1 Why trade?

The existing regime for allocating water to users is *'first-come first–served'*. In the absence of scarcity both new and existing users can gain access to water to meet their demands by applying for a right. However, when supplies become scarce this may no longer be possible. This is increasingly a problem in catchments across England and Wales (as highlighted in **Figure 4** in Chapter 3) and the EA

is no longer issuing water rights (except possibly at high flows) in a large proportion of catchments.

Our assessment is that trading is the most appropriate way to reallocate water between users. In reaching this view we have considered trading against alternative mechanisms.

- An administrative option, which would involve the responsible agency taking back undervalued rights and issuing new rights to users considered to have higher valuations.

- An auction process would involve the responsible agency rescinding all or a portion of rights and then auctioning back to users. This should not be confused with the reverse auction processes discussed in Chapter 6.

Compared to trade, both of these approaches have material drawbacks. Our assessment of these alternative mechanisms is shown in **Figure 14** below. Trade is a better means for reallocating water to those who value it most.

- It enables high-value users to gain access to water and encourage low-value users to release their water.

- It is adaptable to changing circumstances. For example, trade can reallocate water in response to both long-term reductions in available supply and short-term droughts. It can also take account of any changes in users' valuations over time.

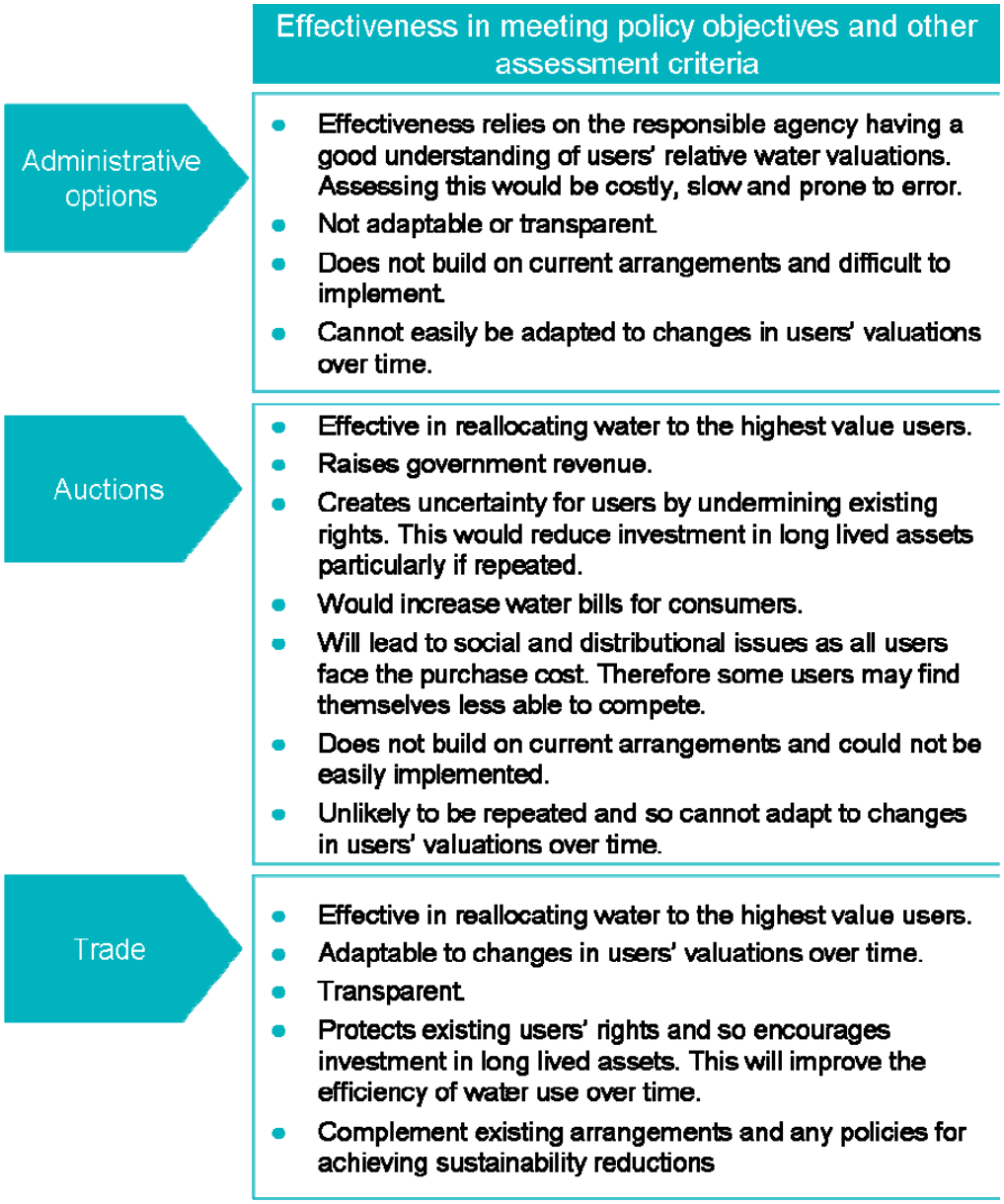
- It reveals the true value of water and so leads to the efficient allocation of available supply and efficient levels of investment.

- It protects existing users' rights and so encourages investment in long-lived assets, which in turn will improve the efficiency of water use over time.

- It complements a number of policies for achieving sustainability reductions. For example, under an administrative or proportional rule-based approach it enables users to buy alternative rights in the market if they have a high valuation.

This suggests that reform options should focus on improving the existing trading arrangements and redressing any existing barriers to trades.

Figure 14. Alternative mechanisms for reallocating water between users



Source: Frontier Economics.

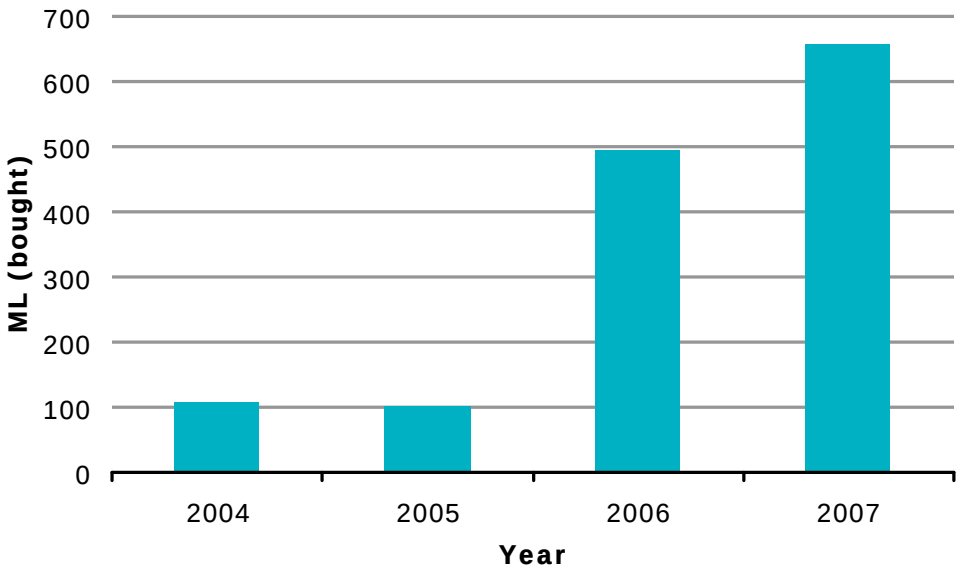
7.2 Trading of water rights to date

The EA registered 48 licence trades between 2003 and 2008, which led to 1.9GL of water rights changing hands over this period. This represents only 0.002 per

cent of the annual average abstraction in England and Wales.[56] For comparison, trading levels in Australia were around 1.4 per cent of water rights in 2007/08.[57]

Figure 15 shows that the volume of water rights traded in England and Wales has increased in recent years.

Figure 15. Annual quantities of water rights traded in ML



Source: EA data on registered trades that have occurred over the period 2004–2007.
Note: volumes are based on those issued to buyer's licences. Partial year data has been excluded.

Table 6 below shows that most water rights' trades are relatively small and occur between agricultural producers or irrigators. There are a few larger volume trades which have involved industrial users. Water supply companies are participating, but not to the same extent as other users.

Table 6. Water rights' trades by types of users involved

Donor to Recipient	Number of trades	Volume traded (ML)	Percentage by volume
Agriculture/irrigation to same	35	981	52%

56 Based on licence volumes (as listed on buyers licence) traded between July 2003 and August 2008, including two pending trades. The annual average abstraction in England and Wales is based on the average annual total water abstracted over the period 1995–2006.

57 Based on entitlement trading volumes (source: National Water Commission (2010) *The impacts of water trading in the southern Murray–Darling Basin,* Chapter 4) and estimates of the total entitlements in 2008-09 (source:http://www.nwc.gov.au/resources/documents/AWMR08-09_S3_nat_summary.pdf).

Water supply company to other/unknown	3	74	4%
Water supply company to same	2	95	5%
Other	8	731	39%

Source: EA data on registered trades that have occurred over the period July 2003 to August 2008.

Table 7 shows that the majority of water rights' trades have occurred within the Anglian region. A large proportion of trades (53 per cent involve a temporary lease of rights, although the duration of these lease agreements are unknown.

Table 7. Water rights' trades by region

	Number of trades	Volume (ML)	Percentage by Volume
Anglian	31	1,003	53%
Thames	5	429	23%
Midlands	4	296	16%
Southern	3	73	4%
South West	2	24	1%
North East	2	25	1%
Wales	1	30	2%

Source: EA data on registered trades that have occurred over the period July 2003 to August 2008.

7.3 International experiences with trade

International experience suggests that the scope for water trading varies based on the nature of abstractors, resources and climatic conditions. Some of the key factors that appear to effect the scope for trade are listed below. Annexe 1 provides detailed case studies for a range of countries that have tackled water scarcity issues.

- **The extent of water scarcity.** An explicit cap on water availability increases the importance of trade as a means to access water. In Australia, trade accelerated from the time water abstraction was capped.

- **Heterogeneity of users.** Variations in users' water valuations will drive trade. In particular, trading appears to be more prominent where there are significant agriculture users. Agricultural users' water valuations appear to be

particularly heterogeneous and can vary based on the commodity being produced, the efficiency of the user, the area and climatic conditions where they are located.

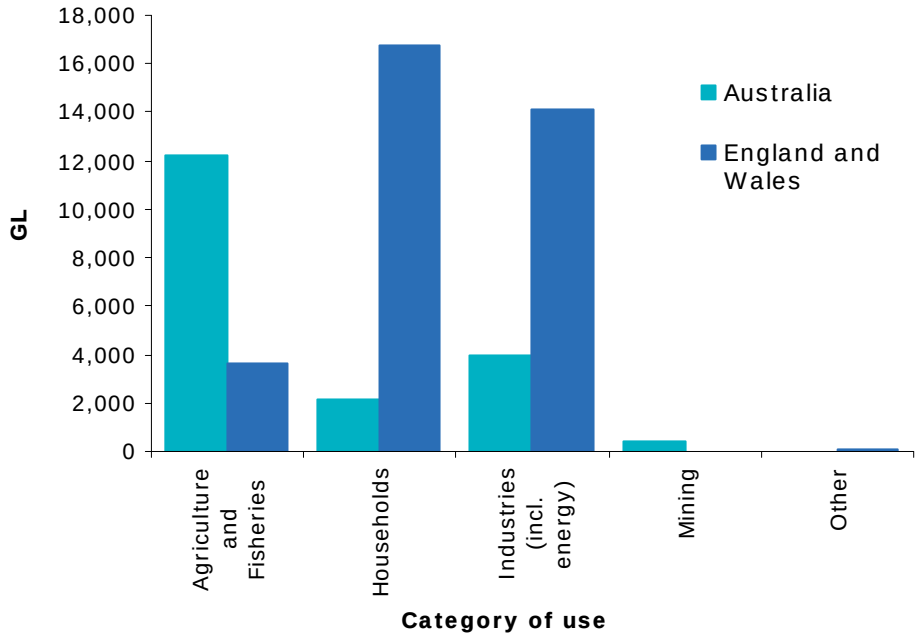
- **Extent of interconnection.** Interconnections increase the size of markets. Water trading in Australia is dominated by trade in the Murray Darling Basin. The size and extent of interconnection in this basin has created the potential for some very large water markets. This increases the potential for trade. However, note that there is a two-way relationship between markets and interconnection. Significant differences in water valuations across areas will drive investment in interconnections.

- **Government commitment to water markets** and streamlined approval and transfer processes. Countries with well-developed water markets tend to have gone through a process of legislative reform to facilitate trade. For example, Australia and Chile both acted to improve the completeness of their water rights and registries. Also, both the US and Australia have streamlined approvals for standard well-known trade types.

To date, scarcity has not been a major issue in England and Wales and so we would not necessarily expect to have seen large volumes of trade. Also, there is limited interconnection across regions. Therefore, in the short term, trading opportunities may remain limited.

One of the differences between England and Wales and the countries with large water markets – namely Australia, the US and Chile – is the importance of agricultural users. This difference between England and Wales and Australia is illustrated in **Figure 16**. The importance of this issue is further explored in section 7.4.

Figure 16. Comparison of water use in England and Wales and Australia



Source: Defra, e-Digest of Environmental Statistics, Published September 2010 & Australian National Water Commission.

International experience also shows that trade levels do increase over time. Water rights trading in Australia grew by around 600 per cent from 1999/00 to 2007/08. In 1999/00 only around 0.2 per cent of water rights on issue were traded and this level is still likely to be higher than the level of trade in early 1990s when trading began.[58]

The increase may be the result of growing water scarcity. But it is likely also to reflect improvements in the trading process. Over time participants became more aware of trading and more familiar with the processes. In addition, transaction costs of trading were reduced in other ways. This suggests that an element of the low levels of trade to date may relate to administrative and process barriers.

7.4 Scope for beneficial trades

Putting aside any transaction costs and barriers to trade, trading will be more likely to occur where:

- there is greater disparity in users marginal water valuations, such that they can derive a greater benefit from trade; and

58 ibid.

- where the costs of interconnection are lower.

Our analysis suggests there may be some scope for beneficial trades between different users, although this will be limited by the geographical size of markets. This is based on a review of existing evidence and our analysis of scope for trade in East Anglia.

- Data on different water users' valuations is limited but does suggest that there are likely to be differences that would make trading worthwhile.

- There is some scope for trade between users within the EA's resource units in East Anglia. Many areas include at least two types of water users who are likely to have different valuations. That said, trade may be constrained by the limited number of potential market participants. If interconnection costs are low the scope for trading will be significantly greater as the diversity of users and number of market participants would increase.

- Agriculture is more important in East Anglia than other regions (representing on average around 5 per cent of abstractions compared to the England and Wales average of 1 per cent[59]). However, in other regions industry is a more significant abstractor.

- There is also likely to be some scope for interregional trade between supply companies. This may be limited though by the cost of interconnection, which currently makes these options uneconomical at this stage. That said, looking further ahead, water transfers and interconnections may be necessary in order to meet future imbalances.

Users' marginal water valuations

Water's value can be equated to a users' willingness to pay for an additional unit of water. If one party's willingness to pay for water is higher than another party's, the latter will benefit from selling water (or water rights) to the former.

Users' water valuations will differ based on the specific use to which they put the water and their location. It will also vary over time.

- In the long term, users are able to adapt their operations and this will change their water valuation. For example, an agricultural producer can invest to improve their water use efficiency.

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[59] Based on irrigation and agricultures average percentage of estimated abstractions for the period 2005-2008.

- In the short run, the choices available to users are limited to immediate changes in output. An irrigator has the option to reduce water use at the expense of lower output. Short run estimates of water valuations could be significantly more volatile than longer run estimates.

Differences across users

There is little literature on different users' water valuations, outside the long run incremental cost estimates of water supply companies in their WRMPs.

In relation to other users, Moran and Dann (2008)[60] do provide some basic estimates for England and Wales. **Table 8** presents these estimates, expressed in 2009 prices. Further details are provided in Annexe 3. We are not aware of any evidence relating to power generation.

This evidence is limited, but does indicate that different types of users are likely to have different valuations.

Table 8. Summary of water valuations (2009 prices)

Commodity	Lower bound (pence/m3)	Upper bound (pence/m3)	Approach
Aquaculture (fish farming)	0.15		Average avoided costs for disposal of solid waste
Public water supply	0 (West Suffolk)	> 102 (East Suffolk and Essex)	Draft estimates of incremental cost of supply for different Water Resource Zones
Industry	0.34	17.8	Shadow price of water derived from long run cost minimisation model
Agriculture (based on potato growers only)	26.4	158.2	Net-back cost model (maximum price a farmer could pay for water for margin to remain positive)

Sources: Moran and Dann (2008), Renzetti and Dupont (2003), Ofwat (2010) based on water supply. companies draft WRMPs (2008). See Annexe 3 for further details of the approaches adopted.

These water valuations cannot be easily compared and in reality are likely to vary far more than presented. They should be considered as approximations, for a number of reasons.

- First, as there is so little research on water valuation in England and Wales these figures could not be cross-checked. Furthermore, water valuations cannot be easily transferred from other countries.

60 Moran and Dann, 'The economic value of water use: implications for implementing the Water Framework Directive in Scotland', Journal of environmental management, 2008.

- Second, different methodologies are used to determine valuations for each type of user. Also, the valuations include short-run and long-run estimates. The suitability of these methodologies has not been investigated here.

- Third, there are likely to be a wider range of valuations within certain user categories, in particular, in agriculture and irrigation. **Table A2** in Annexe 2 shows the large variations that can exist in the value added by water for various commodities in Australia. It shows that the gross margins per ML can vary from less than 1$AUD per ML for pasture, rice, dairy and cereal to 1,100$AUD for vegetables.

Further research on users' valuation of water would be beneficial in gaining a better understanding of the potential for water trading (see recommendation 2). We understand that Defra has already commissioned research along these lines.

Trade would be beneficial to users if the spread in users' valuations within any market is higher than the costs related to trading – this would include any interconnection costs. These costs are likely to be driven by the geographic spread of users in a region. Estimates of the likely scope from trade can be developed by assuming various geographic market definitions. The sections below attempt to assess this using East Anglia as a case study.

Approach to assessing scope for trading in East Anglia

The scope for trade can be considered by comparing, within an area, different users water valuations. Data on different water users' valuations is limited, so we have focused on analysing the geographic distribution of different types of users. In particular, we have considered three scenarios.

- The scope for trading between different users at the regional level using East Anglia as a case study. Markets under this scenario would involve a large number of participants. But this ignores the impact of interconnection costs and the fact that trade may be restricted because of environmental concerns from moving abstraction points.

- The scope for trading between different users within small sub-catchments based on the EA's resource units.[61] Trade under this scenario would involve limited interconnection costs, as there can be assumed to be a natural connection between abstraction points. However, there may only be a small number of participants in each market.

- The scope for trade across regions involving water supply companies.

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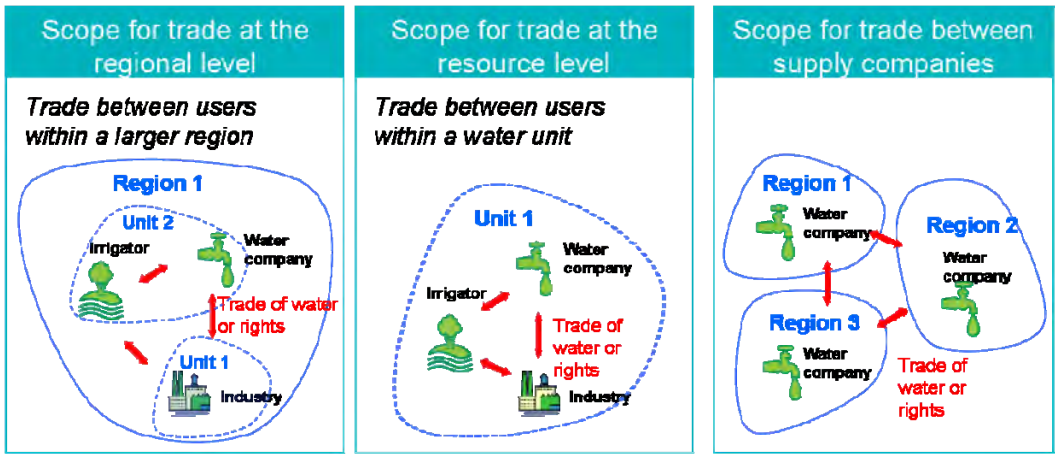
61 This geographic definition of a market is indicative only, and actual markets could be larger or smaller than those represented.

These three scenarios are illustrated in **Figure 17.**

Figure 17. Scenarios for trade

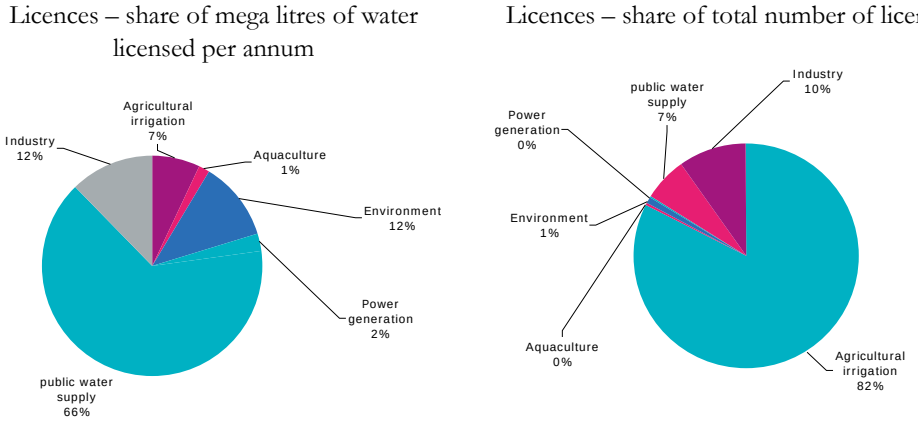


Frontier Economics

Potential scope for trade at a regional level

There are 4,895 licences in East Anglia. **Figure 18** shows the breakdown of these licences by user category. Agricultural producers and irrigators hold most of the licences in East Anglia, but only a relatively small share of the licensed volume. The majority of the licensed water volume is for public water.

Figure 18. Licences by users in East Anglia



Source: EA NALD data for East Anglia.

The broad categories of users presented in **Figure 18** hide significant diversity within these groups. For example, there are different categories of industrial and irrigation users (see Annexe 3 for further details). The evidence indicates that these different subcategories of users could have very different valuations.

Given the number of participants and the variety of different users, at the regional level, we can expect there to be material potential for trade between these users. However, developing this potential will be constrained by:

- the magnitude of any additional interconnection costs; and
- the extent to which the water rights of these users are substitutable.

To assess the significance of this second point we have analysed the nature of irrigation licences in East Anglia. The results are shown in Annexe 3. By volume almost 70 per cent are seasonal rather than annual. This heterogeneity in water rights may partly limit trading. Less uniform rights may limit the development of standardised trades resulting in higher transaction costs. In the case of a seasonal licence, users may also need storages in order to use these licences. This is not necessarily an inefficient approach to licensing water but it may constrain the development of a market for water rights.

Potential scope for trade within resource units

The most significant constraint to trade in East Anglia could be the potential cost of moving traded water from one unconnected water resource to another. Where there is a natural connection between abstraction points this is not an issue. Therefore, we have looked at the types of users within resource units where we can assume there is a natural connection.[62] East Anglia is divided into more than 170 sub-catchments, which can be further broken down into 312 resource units (which represent separate surface and groundwater resources).[63]

As discussed above the scope for trade is driven by differing valuations and this, in turn, is driven by different uses. **Figure 19** shows that different types of users seem to be spread across the region. Although this ignores potential users, it does suggest that there are:

- some areas where almost all rights' holders are irrigators. (Fenland and Lincolnshire Fens in particular); and
- some areas with very few rights holders (for example in the West and in Cambridgeshire and West Suffolk).

This means that the potential for trade is unlikely to be uniform across areas.

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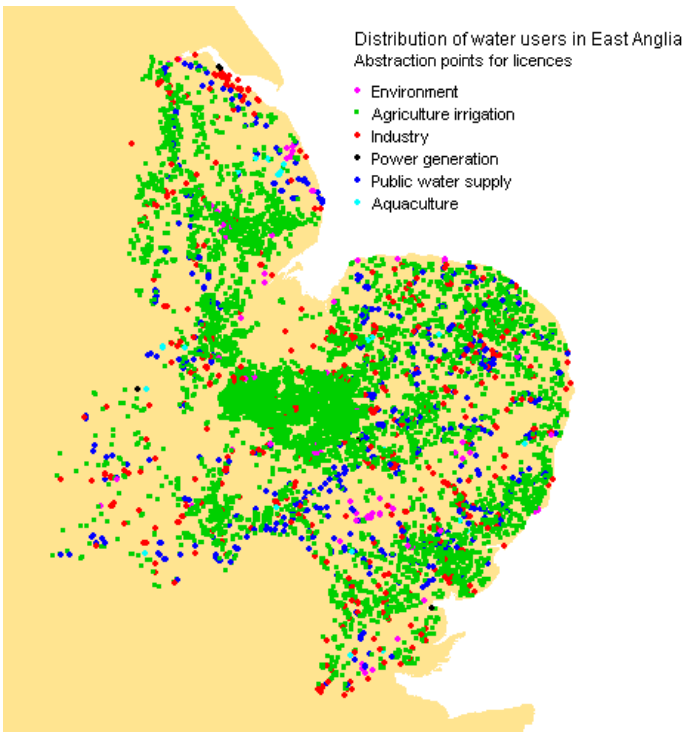
62 Although a change in the movement of water between these two points may still have an impact on the environment and so may be restricted. This means markets may be smaller than assumed.

63 This is based on EA licence data from the NALD data base and excludes recently issued water licences where the abstraction location could not be identified and excluding licence to tidal resources. Given the connections between surface water and groundwater resources within a sub-catchment are likely to be limited we have looked at the potential for trade within resource units.

Figure 19. Abstraction licences by users in East Anglia



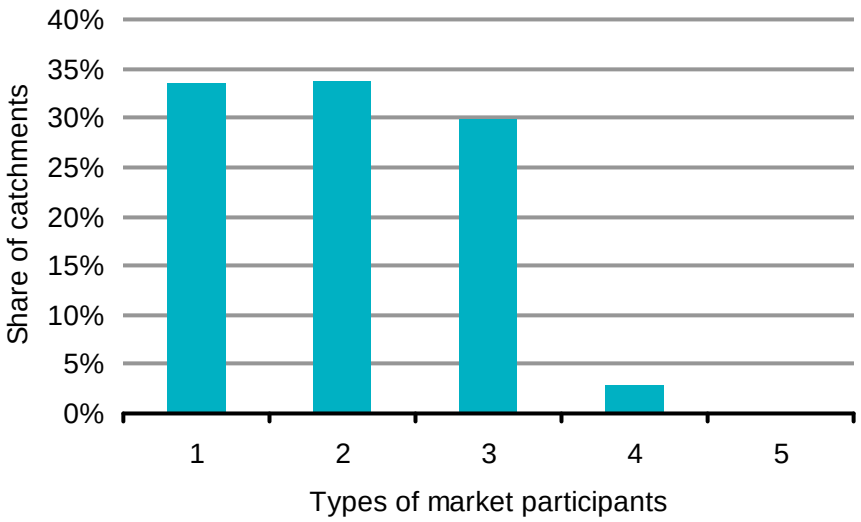
Source: Anglian Water data.

Extent of different user types in each resource unit

The scope for trade would be greater where there are a larger number of different users. Based on the EA licence categorisations there can be between one and five different users within a resource unit in East Anglia.[64] **Figure 20** shows the shares of resource units in East Anglia, which include between one and five different types of users. None of the 312 units have all five types of users. However, more than 65 per cent of sub-catchments include at least two types of water users. This suggests there is scope for at least some trade between different types of users in over half of the resource units in East Anglia. It is worth noting that these are aggregated user categories and that within each user type there may be significant variations in water valuations. In this case the scope for trade may be greater.

64 Water users in East Anglia have been divided into the following five broad categories: aquaculture, agriculture, industry, power generation, public water supply.

Figure 20. Types of market participants by catchments



Source: NALD data, excluding tidal catchments.

Annexe 3 contains further analysis of the distribution of users by sub-catchments. It shows that:

- agriculture, irrigation and industrial users have licences to abstract in more than half the region's sub-catchments;
- 43 per cent of resource units include public water supply and one of these other types of user; and
- on average, there are 18 licences per resource unit in East Anglia. Almost half the resource units have less than 10 licences, and three-quarters have less than 25 licences.

This suggests that in many of these areas the potential number of market participants (which will generally be less than the number of licences) will be relatively low. This will constrain the potential for trading opportunities.

Figure 21 illustrates the combination of the number of licences within a resource unit and the variety of users in this unit. The potential for trade will be greater in the areas with a greater number of licences and a greater variety of users. This varies significantly from area to area within the East Anglia region.

Figure 21. Distribution of licences by number of users' types within a resource unit[65]

Source: Frontier Economics analysis of EA NALD data for East Anglia.

Our analysis suggests that there is scope for intra-basin trade between users in some resource units in East Anglia. That said, in some of these resource units water trade may be constrained by:

- the fact that many licences are seasonal and so may not be suitable for all users; and
- the limited number of market participants (almost half the resource units have less than 10 licences).

It is worth noting that agriculture is more important in East Anglia than other regions (representing on average around 5 per cent of abstractions compared to

65 There are 4 resource units with more than 100 licences. These are not shown on the Figure but are represented in the averages stated.

the England and Wales average of 1 per cent[66]). However, in other regions industry is a more significant abstractor such that East Anglia has on average a similar percentage of users, other than power and water supply, to the England and Wales average.

Likelihood of greater interconnectivity within East Anglia

What is missing from this analysis is an understanding of the extent to which these various resource units are interconnected and whether the cost of any interconnection is low, relative to users' water valuations. Assessing this in any detail would require hydro-economic modelling.

The fact that Anglian Water holds a licence in only 44 per cent of resource units suggests that there is some interconnection already (given that Anglian Water will be supplying customers in virtually all of these resource units). This indicates that trade could occur between resource units at low cost and that the market may be larger than those considered here.

Scope for interregional trade

In a recent study,[67] Ofwat evaluated the productive efficiency gains from interconnecting regions based on differences in the incremental costs of developing new supplies. This estimate is based on quantifying how bulk new transfers between some adjacent companies could reduce the cost of new supplies across England and Wales. It arrived at a net present value (NPV) of £959 million.

This analysis may underestimate interconnection costs, which are based on data from companies draft WRMPs. Certainly, an assessment of the scope for water transfers between companies in East Anglia suggests that there is a limit on the number of economic transfer options. At the same time, Ofwat's estimate of efficiency benefits may also be an underestimate as the modelling:

- only considers options involving adjoining regions (which were chosen based on a review of WRMPs); it is possible that further benefits may stem from multi-company (chain) connections; and
- omits any further gains resulting from increased interconnection leading to water being able to move to higher value uses more generally, through increased prospects for water rights' trading between a larger set of users.

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66 Based on irrigation and agricultures average percentage of estimated abstractions for the period 2005–2008.

67 Ofwat (2010), *'Potential benefits of upstream markets in the water sector in England and Wales'*.

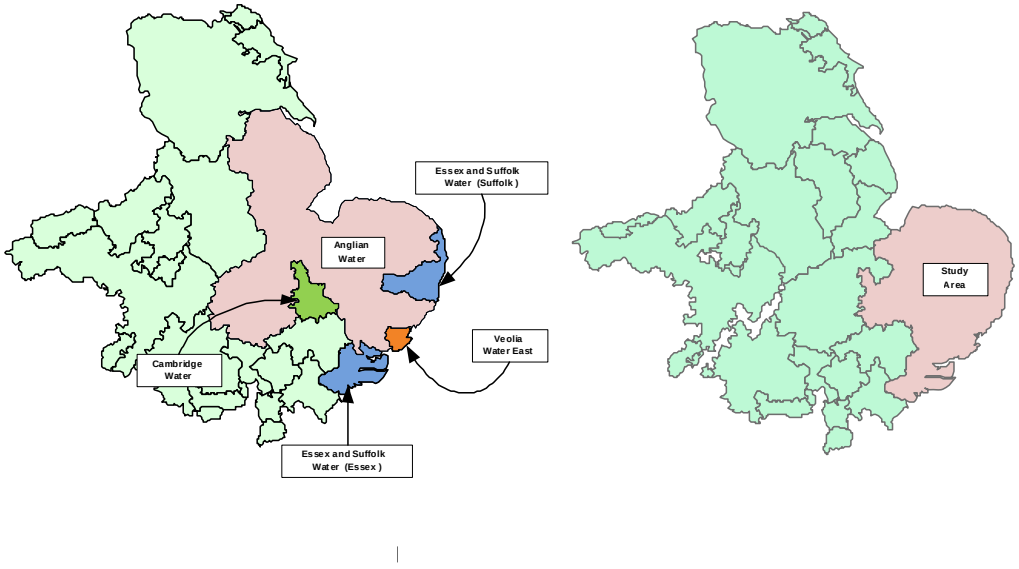
It is possible to estimate the benefits from trade more accurately; however, this requires significant modelling.

Assessment of scope for increased transfers between water supply companies in East Anglia

In order to assess whether there is greater scope for water transfers between companies, Anglian Water, Cambridge Water and Northumbrian Water have completed a joint planning exercise. This tested whether trading or sharing of water resources in East Anglia would lead to more customer and environmental benefits. We summarise the findings here.

The exercise focused on an area of East Anglia that is characterised by low water surpluses and is likely to be vulnerable to water scarcity in the future – as a result of low rainfall, predicted demand growth and future EA sustainability reductions. This suggests that investment to maintain the supply-demand balance will be needed in the short, medium and long term. **Figure 22** shows the area in question.

Figure 22. Area of focus for the trading exercise



Source: Anglian Water.

In this exercise, the latest WRMPs were used to generate a baseline scenario for investment in each region. This was based on each company's final planning solution (outlined in the 2009 WRMPs[68]). These reflected the lowest average incremental cost (AIC) options needed to maintain the supply–demand balance.

68 Options developed in the WRMPs beyond 2015 assuming that the agreed investment plans for AMP5 (2010–2015) have been committed and implemented.

The study then extended the options developed in the WRMPs to include additional options identified for transferring water between companies. This was termed the 'unconstrained options' scenario. In effect, it considered the region as a whole and ignored restrictions associated with current planning and supply boundaries.

Expenditure under the feasible unconstrained options was then assessed against the baseline option. The results from this exercise show that there is likely to be limited value from water transfers between companies in this area. More specifically, sharing or trading opportunities in the short to medium term were limited to two schemes:

- a transfer from Essex and Suffolk Water into Norwich in 2025/30; and
- a transfer from Cambridge Water into Bury St Edmunds, also in 2025/30.

The combined capacity of these schemes is 6.3 ML/d. This equates to around 0.5 per cent of the 1,180 ML/d of water that will be available for use in the study area in 2034/35.

The limit on the number of economic transfer options reflected the limited surpluses in the study area and the high cost of transferring the small amounts available over long distances. That said, looking further ahead, the study suggested that beyond 2035 meeting water demand in the Anglian region will require bringing water from further afield. This means there should be more opportunities to develop shared resource or transfer options in the future. This would require cross-companies collaboration and joint working with the EA.

Finally, the study concluded that because major strategic resource planning schemes have long-term lead times, significant advance planning and investment (in storage and interconnection infrastructure) may be required well in advance.

Building modelling capacity

Ofwat's report considered trades and their benefits as being driven by differences in marginal cost. Considering the demand for water across different sectors and regions would complete the picture by estimating benefits arising due to differences in marginal valuations.

Regulators may soon be able to begin this work. Defra recently began a project entitled 'Modelling Abstractors' Supply and Demand for Water into Production'. The project, aims to *'enhance the evidence relating to the demand for and the costs of water for non-water industry abstractors'*. The two major outputs of this study are marginal cost curves and demand curves for water abstractions for different industries.

With appropriate marginal cost curves and demand curves the net economic value generated from a water allocation decision can be determined for a user or aggregation of users. This can be used to:

- evaluate the economic impact of different allocation or infrastructure schemes to help with planning and policy decisions; or
- model likely market outcomes by maximising net benefits.[69]

These optimisation models can provide an upper estimate of the potential benefits of trade. What they cannot do is represent the imperfect information and transaction costs inherent to real markets. That said, such models have been applied in many locations around the world.[70] In particular, they can be used to more accurately represent how the market will interact with licensing and drought rules.

While they can be used to model efficiency gains from trade this will always be somewhat incomplete and therefore should be viewed in this context. First, there may be potential gains from dynamic efficiency improvements. Such economic gains are difficult to quantify within these models. Second, future hydrological conditions will likely influence the development of a market.

Putting these limitations aside further research would be required before models can be developed that can be used to inform policy development or evaluation. Therefore, there would appear to be some value in the relevant agencies beginning to build up their hydro-economic modelling capacity now. This may help in assessing the likely scope for trade. However, it may ultimately be better used to assess the economic impact of strategic infrastructure schemes and the specifics impacts of other water resource management decisions. It may also have a role to play complementing the pilot exercises outlined in Chapter 6 relating to reverse auctions.

Build modelling capacity

14. Options for modelling the scope for trade as an input into the reform process should be considered, taking account of upcoming work on users' supply and demand curves.

Trade in water vs. water rights

It is difficult to anticipate whether trade in water or trade in rights would bring the highest benefits. In general terms, temporary water trading provides operational flexibility in the short run, as it helps users respond to changing seasonal conditions. Buying water rights allows users to secure longer run access

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69 Such hydro-economic optimisation models represent hydrological inflows, engineered storage and conveyance infrastructure in a single model where allocation maximises net benefits throughout the network of supply and demand nodes at each time step.

70 Harou et al., *Hydro-economic models: Concepts, design, applications, and future prospects*, Journal of Hydrology, 2009.

to water. In this way the water right acts as a tool that facilitates a decision to enter or expand operation or exit.

Australian water trading experience shows that over time, market participants have used both water trading and water rights trading to adapt to changes in the environment and longer term industry changes. Irrigators in Australia have adapted to new trading environment and interviews from a sample of irrigators showed they derived various benefits from these additional sources of flexibility (see case study below).

In a water market context, price uncertainty is added to the existing supply uncertainty. Different trade types will distribute the burden of these uncertainties to different players. A key driver of trade is the desire to manage the uncertainty. For example, buyers in a spot market must internalise two sources of uncertainty: the availability of water on the spot market and its price. This may cause a municipal water supplier who must meet inelastic demand without a fallback supply option to abstain from relying on spot markets.

In permanent trades the roles are shifted with the burden placed on the seller to correctly value the long-term value of a water right. Water rights' owners may abstain for fear of selling water below its unknown future value linked to unknown future supply and demand conditions.

Option markets or short-term leases reduce the risk externality as both parties share in internalising the uncertainties; this has been found to increase participation in markets.

Case study of trading outcomes in the Murray Darling Basin

A study of water trading in Australia's Murray Darling Basin (MDB) showed an inverse relationship between the level of seasonal water trade and the water available within the season.[71] It concluded that the benefits from water trading are higher in times of scarcity. This finding is consistent with interviews of irrigators conducted by the Australian Bureau of Agricultural and Resource Economics. It examined irrigators' responses to water shortages in 2007/08. They concluded that irrigators use water trade as a means of maximising the value from limited water supplies. The main buyers of water during the 2007/08 droughts were horticulturalists while the main sellers were dairy producers, who benefited from being more flexible in their water consumption in the short term.

The same study then assessed the benefits to the irrigation industry from trading water rights. Over the period 1998/99 to 2007/08, severe droughts regularly occurred, which affected the price of water and feed for milk producers. Sales in water rights increased over the period, as a means to manage drought-induced debt, as some dairy producers shifted to other activities with higher water flexibility. Horticulturists were the principal

71 'The impacts of water trading in the Southern Murray Darling basin – an economic social and environmental assessment' – Australian government, national water commission, 2010.

buyers of these water rights in the early 2000s. Trade in water rights seems to have enabled new industry developments in horticulture to emerge.

8 Addressing barriers to trade

Chapter 7 highlights that, while to date there has been limited trades of water or water rights, there is potential for increased trading. This potential will be enhanced as scarcity becomes more acute.

In part, existing barriers to trade may be constraining the development of the market. Given the uncertainty around the scope for greater trade we propose that barriers to trade should be addressed when it can be done in a low-risk and low-cost way. This represents a proportionate and measured approach to the development of the market.

Therefore, the following reforms could facilitate the development of the water market and encourage the efficient allocation of water. These reforms build on some of the work previously conducted by Ofwat, the EA and Defra.

- **Increasing the visibility of the market.** Current arrangements make it difficult for users to identify potential trading partners. Reforms should include developing a platform for publishing buy and sell offers, publishing traded prices and building on existing process for companies to work with each other and the EA (see section 8.1).

- **Reducing transaction costs.** A more streamlined approval process would reduce the EA's ongoing costs for approving trades and reduce users' transaction costs by reducing the time and uncertainty associated with the process. Doing this without impacting on the effectiveness of the EA's process requires the development of explicit trading rules. It would be appropriate to test the effectiveness of developing more specific rules through a pilot exercise in suitable areas (see section 8.2).

- **Reducing disincentives to trade through the regulatory regime.** The regulatory treatment of any trading revenues and expenses directly discourages trade. This should be addressed in order to reduce barriers to trade (see section 8.3).

- **Reducing future policy uncertainty.** The uncertainty about government policies to address future water availability may mean users are more likely to hold on to their water rights. This highlights the importance of the recommendation discussed in Chapter 6 (also see section 8.4).

These reforms are low cost and pose limited risk of unintended consequences. This is because they are based on allowing trade to develop where it is efficient. We also consider whether water trading could play a role in meeting the environments water needs but conclude that there are constraints to this (see section 8.5).

8.1 Increasing the visibility of the market

As discussed in section 5.3, users have identified that they face difficulties in finding potential trading partners, and in estimating the benefit they may get from an exchange given there are no visible price signals.

To estimate the benefit from trade, potential participants need to understand:

- if, and where, there may be water rights available for trade;
- the nature of, and condition associated with the rights; and
- the likely selling/buying price.

Some trades appear to have been facilitated by the EA identifying potential sellers to potential buyers. Online message boards have also been used by prospective buyers and sellers to indicate their interest to the wider potential market.

In Australia, some authorities set up brokerage services to help facilitate the growth of the water market. This was successful, but concerns did arise around these authorities having conflicting interests given their roles as the approval agency and a broker.[72]

It is not clear if there are any barriers to private agents setting up exchange platforms or brokerage services. However, it may be that the start-up costs currently outweigh the benefits, given the size of the market. Therefore, there may be a case for policymakers to develop a web-based platform for publishing buy and sell offers. This would help users to identify potential trading partners and therefore facilitate the development of a market.[73]

In the same way facilitating interactions between water supply companies may enable transfer and trading opportunities to be more easily identified. Companies should be encouraged to build on existing processes for working with each other and the EA to identify any transfer opportunities. Other regions could learn from the experiences of the w*ater resources in the south-east* working group.

The WRMP process means companies can overlook beneficial interconnection schemes,[74] particularly if companies are not sharing information on the nature of their surpluses or deficits and the costs of supplies. The prospects for companies

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72 For example, one Victorian water authority with a responsibility for approving water trades also operates Watermove, a water exchange (source: ACCC (2009) *Water trading rules, position paper, p109*).

73 It's worth noting that this will not be effective if potential sellers fear the EA will reduce their right if they identify themselves.

74 In developing their WRMPs, companies do consult with neighbouring companies to confirm their future bulk supply arrangements and some companies' options assessments have included appraisal of a broad range of interconnectivity options. However, they are not explicitly required to consult on the nature of their supply demand balance.

to identify new transfer opportunities may be enhanced by having data on supply costs estimated in a consistent way. This was identified in Defra's recent report.

In order to improve the visibility of the market the EA could be given additional powers to obtain traded price information. Publishing traded prices would assist users to identify the benefit they may get from entering into a trade. While markets are small this may require traded prices to be identified at a regional level so that buyers and sellers can not be identified.

Increase market visibility

The following recommendations are aimed at increasing market visibility.

15. Options should be explored by the Environment Agency for developing an online platform for publishing buy and sell offers. We do not recommend a brokerage service.
16. Approaches for achieving greater consistency in the data and costs estimates used in preparing Water Resource Management Plans should be explored. This would aid companies in identifying transfer opportunities through existing approaches for working with each other and the Environment Agency.
17. Options should be explored for publishing pricing information where a transfer occurs. This may need to be at a regional level so as trades can be kept adequately anonymous.

8.2 Reducing transaction costs by streamlining the approval process

The current trade approval process imposes significant transaction costs on users. The cost of participating in the market may deter some trades from taking place. Transaction costs will be affected by the:

- timeliness of the process;
- the costs involved in understanding the approval process;
- the costs involved in complying with the approval process; and
- any uncertainty around the outcome of the process.

The current trade approval process is slow by international standards. Quoted timeframes for the application process in England and Wales range from 6 to 18 months. The standard applied in Australia's Murray Darling Basin is that 90 per cent of water rights trades should be approved within 20 business days.[75] A slow

75 http://www.nationalwatermarket.gov.au/about/trade-processing.html

approval process effectively prevents temporary leases or water trades from taking place.

The EA approves trade on a case-by-case assessment, often by applying a process that is based on the application process for a new licence (see text box below). This will inevitably affect the timeliness of the process. In Australia authorities have developed streamlined approval processes, which rely on trading rules, set out in advance, which identify how different types of trade would be treated. Where specific forms of trades are known to have an impact, on other users and the environment, the conditions or parameters that would be applied to these trades were also identified in advance (see section 8.2.1). This has resulted in a different approval process for temporary and permanent trades.

Requirements that must be met when applying for a new licence

An applicant for a new licence needs to demonstrate:

- Reasonable need – including that all reasonable steps have been taken to secure the efficient and proper use of water.
- No adverse environmental impact – through an environmental report and in some cases an accompanying Environmental Impact Assessment (which must assess all potentially affected water bodies within a radius determined in agreement with the EA).
- No derogation of other users licensed rights.

Identifying upfront how different forms of trade will be treated and providing these details to potential traders will:

- reduce the EA's ongoing costs associated with approving trades;
- reduce transaction costs for users by making the process faster; and
- reduce users' uncertainty around the approval process by enabling the likelihood of approval to be assessed in advance of trade.

A further way to reduce transaction costs is by unbundling the various components of the right. The text box below outlines how this has been applied in Australia. This step of unbundling all rights in order to streamline trade is unlikely to be of net benefit in England and Wales at this stage given that trading volumes may not be significant. In the same way, highly detailed trading rules that describe how every possible trade may be treated are also unlikely to be of net benefit.

Unbundling water rights – experience in Australia

The transaction costs related to the exchange of water rights can be reduced by

unbundling these rights. In some irrigation areas in the Murray Darling Basin irrigators' water rights have been separated out into three components:

- A water share – the long-term interest (or share) in the water available to be taken from a water system.
- A delivery share – the entitlement to have water delivered to land in the irrigation district. When a delivery system is congested it also provides a share of the available water flow.
- A water use licence – grants the holder permission to use or abstract water in a certain way (this could include an annual use limit or conditions on what water is used for so that it does not impact on groundwater infiltration or runoff water quality). These licences are attached to a piece of land.

Unbundling a water right can enhance the efficiency of the market by reducing transaction costs and the complexities associated with the trade approval process while still providing a high degree of protection. The negative environmental impacts from water trade typically relate to the trade inducing a change in use or abstraction location. In some cases these conditions may not change as a result of water trade.[76] And where they do this can be assessed separately to the trade (for example these changes could be pre-approved). With all conditions relating to use and abstraction contained in a separate licence, water rights' trades need only be subject to a minimal approval process. This was the aim of these policy reforms.

These arrangements can also have advantages for abstractors that extend beyond lower transaction costs.

- First, users can sell rights to a share of water without giving up the right to use or abstract water in the future as these rights are contained in a separate licence.
- Second, they can adopt different water sourcing options, such as leasing.
- Third, it enables users to make decisions about their water rights' holdings and their delivery needs independently. This is important where there are delivery constraints that make these delivery rights valuable.

Not all Australian jurisdictions have gone this far, as the administrative process involved is costly. For unbundling to be of value users must value the flexibility described above and the improvements in market outcomes must justify the costs.

Transaction costs can also be high as a result of the complexity of the process. The current process is the same as that for a new licence application. It is not clear that this is necessary for all trades, specifically where there is no change in use or the abstraction point. The EA has indicated that no real regulatory

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76 For example, an abstractor may wish to increase their security of supply or fill a storage without changing their abstraction conditions or the primary use of that water.

intervention will be required where an abstraction stays the same after the trade.[77] However, this has not yet been stated as an explicit policy.

Market processes could also be improved if users are better able to judge the outcome in advance of an application to trade. Uncertainty about the outcome discourages users from participating in the market (e.g. the possibility of a reduction in right at the point of trade). Clear and explicit trading rules can help in this regard.

Streamline the approval process

The current trade approval process should be reformed. A streamlined approval process would reduce the EA's ongoing costs associated with approving trade and reduce transaction costs for users.

18. The complexity of the approval process should vary depending on the nature of the transaction. For example, a simplified process should be introduced if there is no change of use or the abstraction point. The process should be clear and explicit.

19. Generic *ex ante* trading rules should be developed, which identify upfront types of trades that could negatively impact on other users and the environment, and the terms and conditions that would be applied to these trades in order to protect third parties while reducing uncertainty for buyers and sellers.

Trading rules

As discussed above, *ex ante* trading rules can reduce uncertainty for market participants. These rules can be important in addressing the externalities that can arise from water trading. Externalities arise where transacting parties do not face all the costs and benefits associated with their decisions. For example, the water rights of other users and the environment may be affected by trading.

Addressing these issues will necessarily result in constraints being imposed on trade. In approving trade the EA needs to be satisfied that an application:

- will not lead to environmental damage;
- will reflect any existing licence conditions; and
- be consistent with the local CAMS and WFD RBMP.

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77 For example, a bulk supply agreement between water companies or an agricultural trade where a farmer allows the water on his irrigation licence to be used on a neighbouring farm.

International experience suggests that the environment and other users can be affected when trade results in a change in use or conveyance patterns. This can lead to changes to return flows, in-stream flows and localised aquifer drawdown.

Explicit trading rules, often developed for an individual catchment, can be used to prevent and redress these impacts. These could include rules that specify:

- what categories of rights can be traded;
- trading zones within which trade is unconstrained and outside of which further restrictions may apply; and,
- exchange rates or tariffs that are applied to certain trades.

Types of externalities and the rules that can be used to redress them are discussed in further detail below.

Managing return flows

Many potential rights' holders will return part or all of their water right to the environment. Typically, the overall allocation of water resources is based on some presumption of water being returned, based on past consumptive trends. Trade can result in a change in use, which in turn may change the amount of water returned to the environment. For example, if water is traded from a water supply company to an irrigator, less water will be returned to the water course. The impact of this change needs to be managed to avoid affecting other users' rights.

Trading rules can be developed *ex ante* for managing any change in use of a traded water right. Water rights specify a purpose on the licence and this can be linked to an assumption with regard to return flows. Where the trade does not result in an increase in net abstraction, no intervention is required. Where it does, exchange rates can be applied to the licensed volume to account for any increase or decrease in return flow arising from the change in use. Generic exchange rates could be specified for certain types of trades. Otherwise the key parameters that would be used in estimating the exchange rate could be identified in advance. In either case specifying these rules in advance will reduce the uncertainty faced by users.

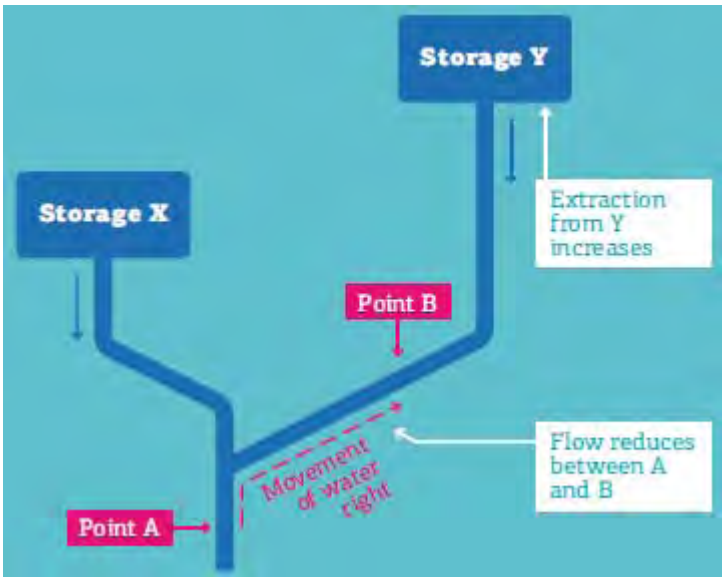
Reliability of supply and change in in-stream flows

The EA restricts trade which results in the abstraction (and/or return) point moving outside the same river catchment or groundwater area. Issues may arise for both the environment and other users if the water abstraction point changes, particularly if the water is being drawn from an alternate resource. By way of example, **Figure 23** shows that if a water right is traded upstream from point A to point B this may:

- impact on the environment by reducing the in-stream flow between points A and B; and
- impact on other users by reducing the reliability of all water rights in the river fed by storage Y as relatively more water is being drawn from storage Y than before.

The rules governing Australia's water markets typically specify trading zones that define who can trade with each other and/or those trades that will be subject to specific conditions or modifications to account for any broader impacts on other users or the environment. For example, upstream trades could be subject to an exchange-rate adjustment, which reduces the volume of the water right to account for the negative impact on in-stream flows. This is instead of a more restrictive approach of preventing these trades altogether.

Figure 23. Possible impacts of a change in abstraction point



Source: Frontier Economics.

Localised aquifer drawdown

A change in abstraction point resulting from trade within a groundwater unit can also be a problem as it can increase localised extraction rates and result in localised drawdown of the aquifer. This means adjacent abstractors lose pressure and may need to increase their pumping requirements.

Trading zones within a groundwater unit can be defined which highlight where this may be an issue. Any trade into this zone could then be assessed on a case-by-case basis.

Developing trading rules in practice – a piloted approach

The appropriate set of trading rules will depend on the specific circumstances in England and Wales (and potentially regional circumstances). The experience from other countries is instructive, but care should be taken when applying the lessons from one country to another.

We consider that the best way to develop how best to implement trading rules in this country is through pilot exercises applied in particular areas. The pilots could be used to test the effectiveness and administrative costs of both trading rules and a streamlined approval process. This process would help identify where either generic parameters or approaches can be adopted or where more regionally specific approaches may be needed. A possible template for the pilot exercise is set out in the box below.

Streamline the approval process

20. A pilot exercise should be introduced to test the effectiveness and suitability of a streamlined approval process and more specific *ex ante* trading rules for an individual catchment. This would enable the costs incurred to be compared to any benefits in terms of increase trading volumes.

Template for pilot exercise

The design of the pilot would require detailed further work. An initial review has identified the following issues.

Suitable areas for pilot. The pilot area(s) should ideally have the following characteristics:

- Water scarcity – an area where new licences are generally not available;
- Number and variety of users – the area should have a significant number of users and users of different types;
- Limited environmental exposure – the risks to the environment during the course of the pilot should be moderate;
- Scale – the area should be large enough (in hydrological terms) to allow rules for moving abstraction points to be trialled and tested.

Trading rules. During the pilot exercise trading rules should include:

- A set of preapproved trades. This would describe a complete set of trades (temporary or permanent) that can occur without further investigation.
- A set of exchange rates. For a subset of the preapproved trades rules would be specified that vary the terms of the licence to reflect change of use (i.e. return flow) or change of location (third party and environmental impacts). The terms of the variation will be specified in advance.

- For other trades, a case-by-case investigation would be needed prior to approval.

Approval process. A streamlined approval process would allow trades to occur in a timely way.

- For preapproved trades the timing should be short and reflect the time needed to update registers, etc.
- For other trades, that require more investigation, a fixed timeline should be applied (e.g. two months).

Communications. Users in the area should be well aware of the terms of the pilot. Regular reports should be provided on the number of trades and the details of trades that required more investigation.

Duration. The pilot should be long enough to allow the effectiveness of the rules to be fully tested. It should also recognise that the incentives to trade will be stronger when water scarcity is more acute.

8.3 Removing regulatory disincentives to trade

Ofwat has identified that disincentives within the regulatory regime act as a barrier to water transfers between supply companies. These same issues also represent a barrier to trades involving a water supply company and any other type of user.

By addressing these issues companies will be incentivised to trade. As a first step this is preferable to developing additional mechanisms outside the regulatory regime to incentivise trade.

Revising the treatment of trading revenues and expenses

Regulated water supply companies lack incentives to trade under the regulatory regime. A company selling water will keep any net revenue benefits from trade for five years before these are passed on to customers. For a company buying water the disincentive lies in the fact that the purchase cost of water is treated as opex. Under this arrangement the company may find it harder to achieve the efficiency targets set by the regulator.

If the regulatory regime is restricting trading opportunities, allocative efficiency gains will be forgone. This is illustrated in the text box below. Ofwat have recognised this and noted that *'In principle, by removing or loosening the price cap on a certain proportion of each water company's water we should create an incentive for water trading.'*[78]

78 Ofwat (2010), *Technical paper on upstream markets. [●check reference]*

Reduce regulatory disincentives to trade

21. Barriers to trade within the existing regulatory regime should be addressed. This includes the regulatory treatment of any sales revenues and purchase costs. The structure of regulatory incentives should be flexed in order to generate revenue benefits for both the buyer and seller in order to encourage trades.

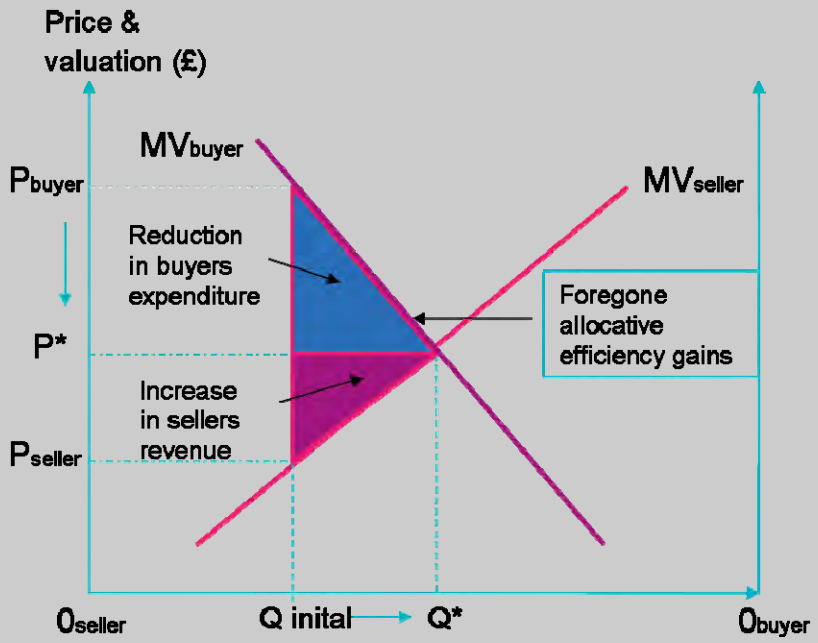
In reviewing these regulatory incentives Ofwat will need to determine a suitable methodology for the treatment of any gains from trade. Over time, it may also consider whether the structure of regulated charges needs to evolve to ensure that consumers face the appropriate price signals relating to water resource availability. Finally, it could give consideration to whether other regulatory mechanisms are needed relating to the development of new infrastructure arising in response to trading pressures.

Potential efficiency gains from trade

To illustrate the potential gains from allowing water (or water rights) trade, the figure below shows the marginal value of water in two companies' regions. The two MV lines represent the marginal value of water to the buyer and the seller. Each slope downward with respect to different origin. Prior to trade, the total supply of water is assumed to be divided between the companies such that the buyer has Obuyer to Qinitial MLs of water and the seller has Oseller to Qinitial MLs.

Under the initial distribution, and prior to trade, the marginal value of water in the buyers region (Pbuyer) is higher that the sellers (Pseller). Under this scenario there would be gains from water moving from the relatively low-value user (the seller) to the higher value user (the buyer), as this would result in an increase in allocative efficiency. The gains from trade would continue with water moving from the seller to the buyer until they both place the same value on the water. This occurs at point P*, Q* which represents the optimal allocation of this water. At this point society is getting the most value from this water.

Where trade is prevented because of an explicit restriction, or because either the buyer or seller is unable to benefit from trade, allocative efficiency gains will be forgone. This is represented by the shaded area in the diagram below.



Incentivising trade through other mechanisms

It has also been suggested that additional mechanisms are required to incentivise trade. This includes reforms that involve mandating trade or using a pricing mechanism to incentivise trade. Such mechanisms do not appear to be justified at this stage. Given these reforms are not addressing the barriers to trade they risk leading to unintended consequences including the inefficient allocation of water.

The case for these mechanisms should be considered only after reviewing the impact of addressing the existing barriers to trade.

Requirement to trade

Ofwat's technical paper on upstream markets suggests that water companies could be required to trade a proportion of their water resources.

This reform is aimed at encouraging entry, by making it easier for upstream entrants to obtain water. It is suggested that this will generate competition upstream and therefore lead to greater efficiency in the future. The potential advantage of this approach is that it could encourage entry and market transactions. However, the drawback is that entry and transactions would not necessarily be efficient. For example, an efficient water supply company could, as a result of the requirement, be forced to sell its water right to a new entrant, which later simply sells it back.

It has been argued that this reform could be designed to encourage trading from areas with relatively plentiful water supply to areas where water is relatively scarce. This could be achieved by keeping the sale requirement on water companies in water scarce areas relatively small.

It is not clear why companies, working within a regulatory regime where they are appropriately incentivised, could not be left to judge where trading would be most efficient. Therefore, reforms should first remove the barriers to efficient trade and then assess whether this has worked before moving on to more significant reforms with the potential for unintended consequences.

Setting abstraction charges to encourage trade

Ofwat also discuss using scarcity-based abstraction charges as a way of incentivising water transfers from water plentiful areas to water scarce areas. While this may be an outcome of scarcity charges, we would argue that incentivising trade should not be the object of these scarcity charges. Setting the abstraction charge in order to incentivise transfers between companies could easily result in inefficient outcomes. This is because policymakers would need to be able to pre-judge the efficient level of transfers in order to set and then assess whether the charge was achieving this.

As before, reforms should seek first to remove the barriers to efficient trade before attempting to incentivise trade through reforms that may lead to unintended consequences.

Clarify the role for high level strategic planning

The WRMPs of many water supply companies, including Anglian Water, signal the need to develop major new resources at or after the end of the forecast

period in order to meet the public's growing demand. It is likely that this may involve the construction of strategic storage and interconnection assets.

Such major assets potentially enable substantial benefits both in terms of security of water resources for public supply, to support economic growth and to secure the future of our water environment.

They may also enable markets to expand by introducing greater storage capacity and increasing interconnections in the system. While differences in water valuations across areas can drive investment in storage and interconnection, the relationship is not one way. The presence of interconnection and storage assets can also increase the scope for trading by increasing the size of markets. Storage assets can facilitate greater intra-basin transfers while interconnection assets can facilitate increased inter-basin transfers.

Therefore, while market forces can clearly play a substantial role in the development of this strategic infrastructure there is a question as to whether the market alone will be enough to facilitate such investment. Such strategic assets can raise many complex social, environmental, political and economic issues, which create heightened uncertainty around whether any investment will be recoverable. This is because they typically involve the use of, and interaction with, natural water resources that are managed by government agencies. This has been true internationally, where experience shows the construction of large interconnection or storage assets and any large transfers of water away from other sectors have required a degree of strategic planning and government involvement (see Annexe 1).

In the past the existence of a secure and stable regulatory regime has been essential to encourage such investments. Therefore, it seems likely that some degree of cross-company and government collaboration will be necessary. At present it is questionable as to whether there is sufficient clarity in relation to the roles of government and other parties in planning these investments.

Clarify the role for high level strategic planning

22. Consideration should be given to developing and introducing collaborative planning arrangements that facilitate greater investment in strategic large-scale interconnection and storage assets. These assets will be required at some stage to meet the public's water supply needs and may facilitate greater inter- and intra-basin transfers. The need for improved strategic planning approaches will become more apparent once the impact of removing the administrative barriers to trade has been observed.

8.4 Uncertainty around the future

High levels of uncertainty about future water availability and government policies mean users are more likely to hold on to their water rights. It also makes users less likely to buy additional rights as they are not sure exactly what they are buying.

The reforms outlined in Chapter 6 are aimed at clarifying the measures for changing the level of licensed abstractions in the future. Part of reducing the current level of uncertainty is around being clear on the processes and explicit on the processes that will apply in the future.

8.5 Using trade to meet the environment's water needs

Meeting the environment's water needs requires more than just setting aside a minimum quantity of water. Healthy rivers rely on variations in the volume, timing, duration and magnitude of flow events down their watercourses. Changes in this regime as a result of abstraction can damage the ecosystem. This is because various components of the natural flow regime provide different ecological triggers, important in maintaining the river's integrity. Both intra- and inter-annual variation in flow provide the dynamics that maintain biological diversity and ecosystem function.

Some countries have enabled environmental managers to trade in an ongoing dynamic way in order to better meet the objective of providing water for the environment. For example, environmental managers can enter the existing water market and buy and sell water in order to make flows mimic natural conditions or to boost water available for the environment at critical times.

The advantages of using the market to dynamically provide environmental water include the following:

- allowing adaptive management over time to account for any uncertainty;
- ensuring that the water market is complete, resulting in the most efficient outcome and providing appropriate signals for investment; and
- ensuring that the value and cost of providing environmental flows is known and assessed.

Constraints to using this approach

However, at this stage there are a number of practical barriers that would limit the environment's ability to trade water in this way.

- First, there is no functional short-term water market in which the EA could participate.

- Second, the EA would need to hold tradable water rights.

We consider that it is likely to be premature for such an approach to be adopted by the EA.

Putting aside the practical barriers, a potential downside of the environment entering the water market is the potential for conflicts of interest to arise. Any institution that operated in the market, on behalf of the environment, would require strong oversight. Also, governance and accountability arrangements would need to be clearly defined. This would include ensuring that this organisation was separate from the organisation that oversees the market.

9 Summary of recommendations

9.1 Recommendations aimed at improving processes for changing licensed abstractions

The table below summarises our recommendations for improving future processes for reviewing licence abstractions such that they better meet the objectives of a sustainable water allocation regime.

Protecting the environment is at the core of these recommendations, which promote the continued existence of a process for changing the level of licensed abstractions.

Table 9. Recommendations for improving the processes for reducing licence abstractions

	Recommendations	Benefits	Target objective
	1. Develop objectives for the water allocation regime	Objectives can be used to assess the need for reforms and to evaluate the success of reforms	NA
	2. Build up understanding of users relative water valuations	Improves ability to target low-value users in making any sustainability reductions. Also informs any compensation payments	Encourages the efficient allocation and use of water by ensuring it remains with high-value users
	3. Remove ability of EA to claw back licence at point of trade	Uncertainty around the trading process may suppress trade. Removing this barrier may create favourable conditions for market development and increase licence trade	Encourages the efficient allocation of water.
Improve alignment with the regulatory regime	**4. Align process for reviewing licences with the price review funding cycle**	Reduces regulatory risk and funding uncertainty. Will also lead to improved coordination between the regulatory and catchment-wide assessment process	Ensures affordable and reliable water supplies
	5. Include central estimate of future sustainability reductions in WRMP. Ofwat to give consideration to this	Reduces the risk of inefficient supply/demand investment	

Reduce uncertainty for rights holders	**6. Terms and conditions for varying licences should be specified upfront in a statutory instrument**	Users become more aware of how they will be affected by any future reductions which will encourage investment	i) Improves the efficiency of water use over time (dynamic efficiency) by improving the certainty of rights. ii) Encourages the efficient allocation of water by encouraging trade
	7. Specify presumption of renewal for time-limited licences in a statutory instrument	Users become more certain of renewal, which will encourage investment particularly with long payback periods	
	8. Give explicit commitment that funding to mitigate the impact of sustainability reductions will be made available through the regulatory process	Reduces regulatory risk	
	9. Extend current compensation arrangements beyond 2012.	Increase security of water rights and therefore encourage investment and market activity	
Pilot reverse auctions	**10. Pilot a reverse auction in a currently over-abstracted catchment**	Helps assess whether or not reverse auctions are a more cost-effective means of reducing over-abstraction. In particular, may help identify barriers to implementation and enable feasibility to be assessed	
	11. If successful, use reverse auctions as an alternative to current administrative arrangements for managing over-abstraction	If cost-effective this process will better meet the objectives of the regime and be a more flexible policy for managing over-abstraction than current processes. It will also increase security of water rights, encourage investment and market activity	

9.2 Recommendations for enabling trade

The table below summarises our recommendations for removing barriers to trade in order to facilitate the reallocation of water and water rights between users.

Table 10. Recommendations targeted at facilitating the reallocation of water between users through trade

	Recommendations	Benefits	Target objective
Build modelling capacity	**12. Options for modelling the scope for trade should be considered**	This will help to quantify the potential scale of water and water rights' markets and therefore the economic benefits they may bring and the risks and issues they may present to assess benefits in pursuing higher cost options for facilitating greater trade	NA

Increase market visibility	**13. Develop online platform for buying and selling of water and water rights**	Improves the visibility of the market for water and water rights to strengthen market activity	i) Encourages the efficient allocation of water by removing barriers to trade ii) Improves the efficiency of water use over time (dynamic efficiency) iii) Protects the environment by continuing to maintain a strong approval process
	14. Explore approaches for achieving greater consistency in the data and cost estimates used in preparing the WRMPs		
	15. Publish pricing information where a trade occurs		
Streamline the approval process	**16. Vary the complexity of the approval process depending on the nature of the transaction**	Reduces the complexity and uncertainty of current trade approval processes to strengthen market activity	
	17. Develop generic *ex ante* trading rules, which identify types of trade that could have negative impacts and the specific terms and conditions that would be applied to these trades		
	18. Pilot simplified process and specific *ex ante* trading rules	Helps assess whether or not the development of *ex ante* rules is a cost-effective way of increasing market activity by reducing the uncertainty around the trade approval process. If cost-effective, this process will better meet the objectives of the regime	
Reduce regulatory disincentives	**19. Address regulatory disincentives to trade associated with treatment of sales revenue and purchase costs**	Removing the regulatory disincentives for companies to trade should increase the transfers between water companies, which in turn reduces the need for additional resource development and reduces the impacts on customer bills	
Greater strategic planning	**20. Consider introducing approaches that facilitate greater strategic planning**	Facilitates investment in strategic large scale interconnection and storage assets	

9.3 Implementing the recommendations

Figure 24 below proposes an implementation path for the recommendations in this report. It shows the dependencies between recommendations and gives some indication of appropriate timelines for the intervention proposed.

It identifies a number of priority matters that should be addressed in the short term. In particular, the issues listed below should be considered in Defra's upcoming white paper:

- development of a clear set of objectives for the water allocation regime;

- removal of any clawback of licences at the point of trade as a mechanism for reducing licensed abstractions;
- commitment to a path of reform related to improving the certainty of rights; and
- commitment to a path of reform related to improving trading mechanisms.

In the medium term we consider there are a number of recommendations relevant agencies should be looking to implement.

First, the relevant agencies should deliver on the commitments highlighted above to improve the certainty of rights by:

- developing the necessary statutory instruments that give rights' holders greater certainty;
- piloting a reverse auction process while compensation arrangements are still in place; and
- based on the outcomes of the pilot, deciding whether to extend compensation or adopt a reverse auction approach to reducing licensed abstractions in the future.

Second, agencies should deliver on the commitments highlighted above to improve trading outcomes by:

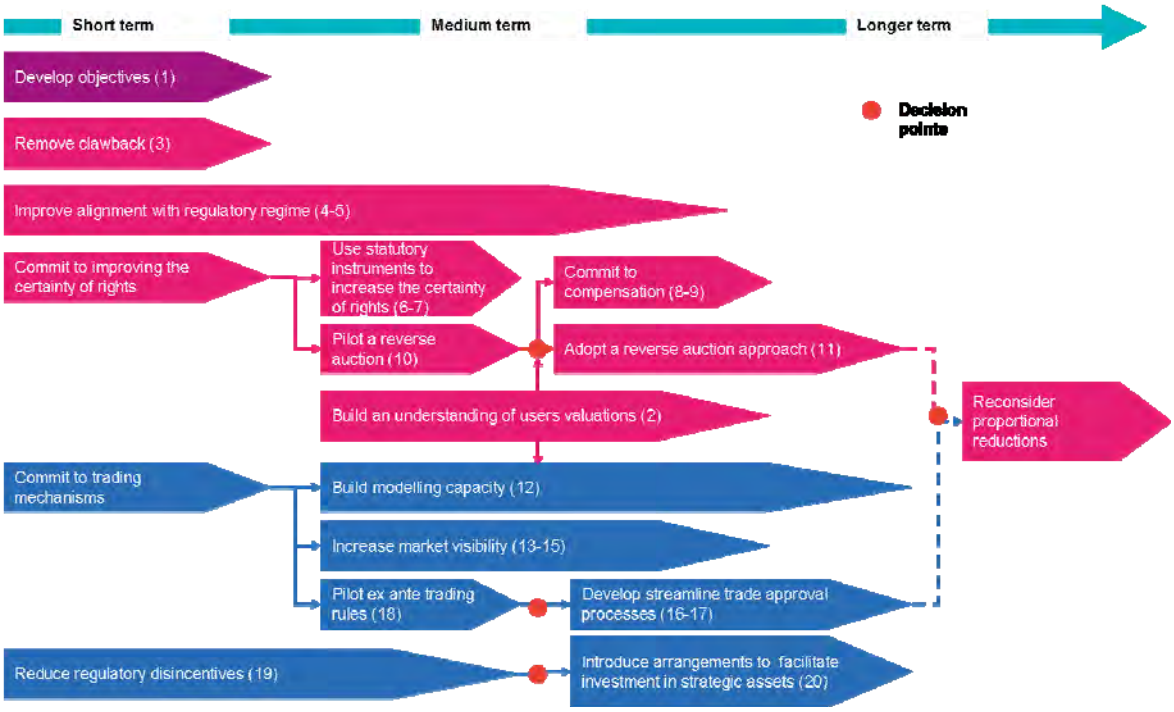
- building modelling capacity;
- implementing reforms aimed at increasing the visibility of the market;
- piloting the development of specific *ex ante* trading rules; and
- based on the outcomes of the pilot, determining and then implementing streamline trade approval processes.

Finally, agencies should look to implement the recommendations associated with:

- improving the alignment of any licence reduction process with the regulatory regime;
- reducing regulatory disincentives to trade; and
- assessing whether any new mechanisms are needed to facilitate greater investment in strategic large-scale assets.

In the longer term an assessment should be made as to whether the need for continuing sustainability reductions has increased, and the water market has sufficiently developed, such that a proportional rule-based reduction approach should be introduced.

Figure 24 Timetable of reforms



Source: Frontier Economics.

Annexe 1: International water allocation regimes and experiences with trade

Selected case studies

Four water allocations regimes outside Europe were studied – namely those of Australia, the western US, Chile and South Africa.[79] These jurisdictions were chosen because they face water scarcity and they have in place regimes for water trading. In particular, Australia and certain regions in the US have well-developed water markets where the outcomes have been well documented.

The European context has also been explored. This has involved reviewing the relevant requirements of the Water Framework Directive (WFD) and the water allocation regimes in Spain and France.

Key lessons

Defining the environment's rights to water

In the case studies we examined, two primary approaches for meeting the environment's water needs were evident. The first involves prescribing flow requirements, which mimic natural flow conditions. The second involves allocating water to remain in, or for the exclusive use of, the environment. In some jurisdictions a combination of these approaches are used.

Internationally it is not uncommon for the environment's water rights to be defined before determining the amount available for consumptive users. This is the process adopted in the western US, South Africa and Australia.

In some instances the environment has been provided with tradable rights. This is the case is some areas of Australia and the US and it means that environmental agencies can participate in the market. In Australia this has led to perceived conflicts of interest. This is because, unlike the US, the same agency can be responsible for trading and administering users' water rights.

Defining users' water rights

The countries with well-developed water markets tend to have perpetual rights, namely the western US, Chile and Australia. Time-limited rights are used in South Africa and Spain.[80]

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79 In the case of the western US we focused on states where water trading is more common place.

80 Rights in Spain have long durations of around 30 years.

In Australia, governments saw well-defined, secure property rights as a precondition to water trading. They also put in place clearly specified processes, terms and conditions for reviewing the volume of water and other conditions associated with these rights. These arrangements are specified in legislation as is the compensation that would apply following any modification to rights. These experiences are relevant to England and Wales and are discussed in Chapter 6.

Approaches to reviewing the level of water rights issued

International experience highlights a range of mechanisms that can be used to manage over-abstraction where it has emerged as an issue. These are explored as options in Chapter 6.

- **Proportional reductions** – Typically, countries have, in legislation, some mechanism for reducing abstractions during droughts. Over-abstraction can be managed by increasing the use of these emergency drought measures or by putting in place other legislative arrangements for reducing all rights in proportion to their relative volume. Australia (and to a certain extent Chile) have in place a more formal process for this where rights are explicitly defined as share of the available supply. This means the volumes associated with water rights can be reduced both within and across seasons.

- **Reductions at the point of trade** – In some regions in Australia, early on in the development of the market, traded volumes were reduced in order to address over-abstraction concerns. This approach was ultimately abandoned due to its negative impact on incentives for trade. As a variation on this approach, Spain has a 'first rights of refusal'. This gives approval authorities the option of purchasing any rights put up for sale at the price listed in the approval application.

- **Funding infrastructure improvements** – Australia initially attempted to redress over-abstraction by directly funding improvements in infrastructure in order to reduce water losses. The water rights of abstractors that received funding were then reduced in line with the predicted water savings. This equates to a form of conditional compensation.

- **Government buy-backs** – More recently Australian governments have begun purchasing water rights through the market and through reverse actions. This practice is also common in the US.

Factors affecting the scope for trading

Administrative approaches to allocating water rights are the norm, but in recent decades there has been a shift towards enabling rights to be reallocated through trading mechanisms. This appears to be motivated by water scarcity.

International experience suggests that the scope for trading in water and water rights will depend on the nature of abstractors, resources and climate conditions. Some key factors that seem to affect the scope for trade (outside any administrative barriers) include:

- **The extent of water scarcity** – An explicit cap on water availability increases the importance of trade as a means to access water. In Australia, trade accelerated from the time water abstractions were capped. Since that time trade has also been driven by a persistent drought and government policies to address over-abstraction. In the western US, trade was also kick-started as users responded to drought.

- **Heterogeneity of users** – Trading appears to be more prevalent where agricultural usage of water is significant. Trades in the western US, Australia and Chile most frequently involve agricultural users. This may be because agricultural users' water valuations are more heterogeneous as they can vary, based on the commodity being produced, the efficiency of the user and the location of the user. It is also reasonable to suppose that valuations will change over time. Other things being equal, the greater the variation in valuations placed on rights to water and the more frequently such valuations change, the greater the potential economic benefit of trade. The development of trading among users in these regions seems to bear this out.

- **Extent of interconnection** – Interconnections increase the scope for trading by increasing the size of potential markets, making trade possible among greater numbers of users and at greater volumes. Water trading in Australia is dominated by trade in the Murray Darling Basin (MDB). Of Australia's total water resources diverted for consumptive uses, around two-thirds or 18,000GL are in the MDB.[81] The size and extent of interconnection in this basin has created the potential for some very large water markets. This increases the likelihood of users with heterogeneous demands being in a position to trade. This is also true in the western US where large rivers flow through several states (such as the Colorado River) and where there is also significant interconnection infrastructure.

  In the western US, the infrastructure pre-dated growth in trading volumes. However, it does not seem to be the case that the infrastructure is a necessary precursor to the growth in trade. In contrast, in the MDB, significant differences in water valuations across areas have driven some investment in interconnections.

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81 PWC (2006), '*National Water Initiative Water trading study'*, produced on behalf of the Department of the Prime Minister and Cabinet, Chapter 2, p 13.

- **Government commitment to water markets, secure water rights and streamlined approval processes** –Countries with well-developed water markets have tended to go through a process of reform to the water allocation regime to facilitate trade. Political and government commitment to this process appears to have been an important factor in driving forward change, in many cases over many years. In both the US and Australia the authorities have explicitly tackled aspects of the water allocation regime in order to encourage the development of and participation in markets. For example, Australia has taken significant action to improve the completeness of its water rights and registries. Both the US and Australia have made efforts (and continue to make efforts) to streamline approvals for standard well-known trade types. Some government-sponsored exchanges were set up in Australia until private providers emerged to provide equivalent services. Improvements in the market infrastructure have tended to evolve over time. In both the US and Australia it is accepted that rights holders will profit from the sale of water and water rights and that this is necessary in order to release water from lower value users.

Temporary vs. permanent trade

In both the western US and Australia temporary water trades or water rights leases are the dominant form of trade. In the US, temporary trade moves over 20 times the volume of permanent trades. In Australia's MDB the differential is around 5 times. This trend is likely to have been driven by two factors:

- First, the significant variations in water available both within and between years. This can lead to the economic value of water varying over time. This creates risks for users who may turn to temporary water trading as a more flexible means for addressing this. This may be of greater importance where agricultural users are dominant in the market. This is because they can sometimes choose more easily to reduce demand such as by temporarily producing less (in the case of those growing annual crops).

- Second, the approval and transfer processes for temporary trades tend to be less complex. In both the western US and Australia, leases and temporary trades generally involve lower transaction costs and are subject to fewer legal and administrative constraints than permanent sales.

Trading platforms

The mechanisms or platforms involved in trading water vary according to the type of water right being transferred.

Australian water markets can have a large number of well-informed participants. This has led to the development of spot markets and online exchanges[82] for temporary water trades. Water rights' trades typically occur through brokers or bilateral contracts.

In the US, similar trading mechanisms are used. For example, California water banks facilitate water trades mostly through option contracts or spot markets. Trade within irrigation districts is also well developed with members able to trade freely often via internet platforms. Trades involving parties outside the district require a greater level of approval. Permanent water rights' transfers, dry year options and short-term leases are typically negotiated on a bilateral basis.

Trade between different types of users

In Australia, Chile, Spain and to a lesser extent in the western US, most water trade occurs between agricultural users.

However, trade between water suppliers and agricultural users is also common. In the US the most common trades involve public water suppliers buying rights from agricultural users. Similarly, leases between agricultural users and public water suppliers (in both directions) are becoming increasingly common. This is because there are fewer restrictions on trade when compared to permanent trades. For example, dry year option contracts are often used by public water suppliers, which give them the ability to exercise an option to purchase water in dry years. Often, option sellers are agricultural producers who can fallow land in the event that a water option is exercised.

In Australia, trades between public water suppliers and agricultural users or, 'rural to urban trades' as they are termed, have grown substantially in the last five years. This has been driven by a need to improve urban water security. Trade has enabled public water suppliers to benefit from different availability pattern across catchments and helped suppliers secure supply until new investment comes online. It has been most common for water suppliers to purchase water rights from agricultural users, although suppliers also temporarily sell surplus water back to agriculture when they have a surplus.[83]

In both countries such trades have frequently involved the construction of additional interconnection assets. For these assets and in circumstances where

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82 For example, offers to buy or sell water can be submitted to the Watermove weekly pooled exchange for a range of trading zones. Watermove conducts an exchange each week, which matches buyers and sellers through a double bid auction system and determines a pool price for each trading zone where trade has occurred. Successful sellers in the exchange receive a price equal to or higher than their offer price. Successful buyers in the exchange pay a price less than or equal to their offer price.

83 Frontier Economics (Australia) *'Rural–urban water trade in Australia – a report prepared for the Department of the environment, water, heritage and the arts (DEWHA)'*, November 2009.

there have been very large trades away from the agricultural sector, government involvement has been required to assist with managing broader community perceptions around the social and environmental impacts of these trades.

Externalities and broader social impacts of water trade

International experience highlights the issues or externalities[84] that can emerge for the environment and other users as a result of water trade.

The Chilean experience shows that clear rules and a transparent information system are vital. When trading began in Chile the environment's rights were unclear and there were very few trading rules. This resulted in a number of issues.

- Initially, water rights could be transferred, without modification, across hydrological boundaries. This undermined the limits placed on water use in some areas and led to a variety of adverse environmental impacts.

- Trade between different types of users was uncontrolled and changed return flow conditions resulting in increases in waste discharge and increases in underlying levels of abstraction.

- Information asymmetries and prohibitive transaction costs excluded some groups from engaging in trade.[85]

In Australia trading has not had the same negative impacts. This is probably the result of a more stringent approval process being developed. A recent study of the impacts of trade in Australia's southern MDB suggests there have very few observable negative environmental impacts from trade.[86] Water trading generally moved water downstream, leading to increases in in-stream flows. Also hydrological assessments have shown no discernable impact on key ecological assets. In its early stages water trading did drive a change in water use, which increased salinity in some areas. This was addressed through new policy instruments including site use licences and in some areas, salinity trading markets.

Water trade has been linked to adverse impacts that arise from water becoming more valuable (as a result of increasing scarcity). For example:

- In Australia return flows reduced over time as irrigators and other users improved the efficiency of their water use. As water rights were specified as

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84 Externalities arise where transacting parties do not face all the costs and benefits associated with their decisions, such as a decision to trade.

85 ` World Wildlife Fund (2007), *'WWF Water Security Series 1 Allocating Scarce Water, A primer on water allocation, water rights and water markets'*.

86 National Water Commission (2010,) *'The impacts of water trading in the southern Murray–Darling Basin An economic, social and environmental assessment'*.

water abstraction limits, which took limited account of net water usage or return flows, this decreased the quantity of water re-entering the environment. Ultimately, this meant less water was available for other users and worsened problems of over-abstraction.

- By enabling the value of water to be realised water markets led to greater activation of existing water rights when compared to historic patterns of use. In Australia, unused licences were termed 'sleeper licenses'. In the early stages of trading there were concerns that the market would lead to many currently unused rights being sold and activated, worsening problems of over-abstraction. This may have occurred, but it is difficult to separate out the impact of the introduction of trading from the impact of a worsening drought period. This was addressed through methods for managing over-abstraction more generally. In contrast, in Chile, concerns were focused on the reverse problem: that rights would be bought up and not used, i.e. hoarding. It is not clear why this was a concern, but to manage this a 'use it or lose it' rule was introduced, which meant rights could be taken back if they were not used.

- In Australia, many agricultural users increased the volume and number of farm dams they had on their properties in order to reduce their water abstractions. In the western US, agricultural users have increased their use of unregulated groundwater for the same reason. In both cases this may ultimately lead to a decline in the quantity of water entering the environment, which can worsen problems of over-abstraction.

Water trading is a means to facilitate the reallocation of water. As a result it can facilitate changes in regional production and result in industry structural adjustment. This emerged as a public concern in both Australia and the US where many permanent trades were sometimes blocked, due to the feared negative impacts of water-dependent industries declining in specific regions (for example, loss of regional employment).

The remainder of this Annexe provides our review of water allocation and trading arrangements in place in the countries selected as case studies, namely Australia (focusing on the Murray Darling Basin), the western US, Chile, South Africa, Europe (more generally through the Water Framework Directive), Spain and France. Each case study considers:

- the processes used for allocating water to the environment;
- the mechanisms for reducing users' rights;
- the nature of users' water rights;
- the rules for, and outcomes from, water and water rights trading; and

- the processes for managing third-party and environmental impacts of trade.

Australia

Water resources management at a glance

Australia is a dry continent, with highly variable rainfall. Agriculture is one of its major industries and water policies have been a major source of political debate.

In the 1970s and 1980s, concerns began to arise about water scarcity. Cost-effective, viable options for increasing supply were diminishing and demand for water was growing – driven by Australia's increasing population and economic growth. There was also a realisation of the environmental damage associated with water abstraction and use.

This resulted in a general shift of policy away from development of new water resources towards the use of trade to improve the allocation of the scarce water available.

In the last 20 years there have been major changes to the water allocation regime. The first major reform was the Council of Australian Governments (COAG) Water Reform Framework (1994). This committed Australia's state governments[87] to various reforms including the introduction of clearer water rights for abstractors and the environment.

In 1997, use was capped in Australia's largest river basin: the Murray Darling Basin (MDB) (see **Figure A25**). This accounts for around half of Australia's water use and supports around 70 per cent of its irrigated agricultural production.[88] Of the total water resources diverted for consumptive uses, around two-thirds or 18,000GL are in the MDB.[89] The MDB is also notable because of the level of interconnection within the Basin. It connects two large rivers, a number of multi-year storages and numerous conveyance and transfer networks.

While there was some water trading taking place in the MDB before the cap, water markets grew substantially following its introduction. The MDB is still the

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87 In Australia, legislative control of water rests with State and Territory Governments, which are responsible for granting parties' rights to access water for various purposes.

88 The Murray Darling Basin system is notable for its size, importance to Australia's economy and the fact that it encompasses several jurisdictions. The Basin accounts for almost half of Australia's total water use (52% in 2004–05) and the majority of agricultural water use (66% in 2004–05). Agriculture accounts for the vast majority of water consumed in the Murray–Darling Basin (83% in 2004-05) (source: ABS (Australian Bureau of Statistics) 2008, *Water and the Murray-Darling Basin – A statistical profile*, 2000-01 to 2005-06, Cat. 4610.0.55.007).

89 PWC (2006), '*National Water Initiative Water trading study',* produced on behalf of the Department of the Prime Minister and Cabinet, Chapter 2, p 13.

major focus of trading activity in Australia. However, water trading does occur in all states and territories.

Figure A25. Australia's Murray Darling Basin

Source: Murray Darling Basin Commission.

More recently focus has shifted to improving the operation of markets. In 2004, the National Water Initiative (NWI) was signed by governments. These extended the reforms of the 1994 COAG agreement. The key reforms of the NWI included:

- providing certainty and security of title for water rights by defining these as perpetual access rights to a share of the water resources available for consumption;
- developing a planning framework that clearly assigned the risk of future reductions in water availability between governments and users;
- returning over-allocated resources to environmentally sustainable levels of abstraction;
- developing clearer more efficient administrative arrangements to facilitate trade in connected systems, including the progressive removal of barriers to trade; and
- developing national standards for water accounting, reporting and metering.

Given legislative control of water rests with Australia's States and Territory Governments, the water allocation regime varies between states. In 2007, in

order to address some inconsistencies the NWI was formalised and extended by the *Commonwealth Water Act (2007)*.

Allocating water to the environment

In 1997, water diversions from the MDB were capped because of concerns about the health of the environment. This was repeated across the country with abstractions from the majority of Australia's basins now capped. This cap is being updated through the MDB Plan,[90] which is currently being finalised. It will set new limits on the quantities of surface water and groundwater that can be taken from the Basin's water resources. These 'sustainable diversions limits' (SDLs[91]) will replace the current cap on abstractions.

Sustainable, in this context, is defined as the level at which water within a resource can be taken without 'compromising key environmental assets, key ecosystem functions, key environmental outcomes or the productive base of the water resource'[92]. This requires judgements to be made as to which ecosystem functions are 'key' and at what level of water take they will be 'compromised'.

Mechanisms for reviewing the level of water rights issued

The initial cap on abstractions in the MDB was based on existing use levels rather than the specific needs of the environment. This meant that many catchments were 'over-abstracted' in that licensed abstraction volumes exceeded sustainable levels of abstraction.

The way water rights were defined meant that water abstraction could be reduced proportionally, based on abstractors' relative licence volumes and the supply available in any one year in order to reduce abstractions. However, with water availability continuing to decline, the reliability of all water rights was being substantially reduced. To prevent undermining the long-term reliability of rights, governments began to explore different ways of reducing abstractions.

In some instances water licences that were put up for trade were reduced. For example, water rights' trades within South Australia's North Adelaide Plains groundwater system were subject to a 20 per cent reduction factor upon trade. This approach was criticised by regulators and is now prohibited under the MDB water trading rules, which state that water right trades should not be conditional on a reduction in the trade volume or restricted in any other way solely in order to address over-abstraction.[93]

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90 A legislative instrument under the Commonwealth Water Act (2007).

91 SDLs can vary, in terms of water volume, in different years depending on storage levels, expected inflows, groundwater levels and estimates of recharge, interception activities and other factors.

92 http://www.mdba.gov.au/basin_plan/concept-statement/key-elements

93 Australian Competition and Consumer Commission, *'Water trading rules, final advice',* March 2010.

More generally governments opted to address any underlying over-abstraction by:

- funding infrastructure that increased water use efficiency; and
- carrying out reverse auctions and government buy-backs.

Government-funded projects have ranged from on-farm water savings projects to large infrastructure projects. Realised water savings from these investments were then transferred from the users' water right to the environment. These investment programmes are often tendered, with abstractors nominating a price for a volume of water they would be willing to transfer based on estimates of achievable water savings. At the time there was significant public concern about water scarcity leading to the decline of rural communities. Therefore, this approach was originally favoured as it was seen as providing support to these communities. However, it did not enable the rationalisation of infrastructure or closure of unsustainable irrigation supply schemes.

As a result, governments have more recently opted to buy back water rights. In areas where the existing water market is relatively thin, reverse auctions have been favoured. This involves willing sellers putting up offers that nominate a volume and price at which they would be willing to transfer some or all of their water right. Offers are then compared and those offering best value accepted.

There are also examples of the government purchasing directly from the market. Again, these are not compulsory and purchases are made from willing sellers. For example, the NSW Riverbank programme committed $105 million over five years to 2011 for the purchase of water rights. The Commonwealth Government's Water for the Future plan provides $3.1 billion (over 10 years) for buy-backs.

Governments' willingness to buy back water rights rather than erode their reliability comes from the long held view (espoused in the 1994 COAG agreement) that secure water rights are critical for encouraging investment and therefore dynamic efficiency and also to ensure the efficient operation of the water market. Water rights' purchases are also used as a form of structural adjustment package that enables subsistence farmers to exit the industry and start up elsewhere.

Users' water rights

In Australia, water rights are defined in statute. They are now perpetual, exclusive, tradeable, enforceable and must be recorded in a publicly accessible water register.

Since the 1994 COAG agreement, Australia has been progressively moving towards more secure rights for water abstractors. This was driven by water users and their financiers becoming increasingly concerned about the risk of water rights being continually re-specified as a result of changing government policies.

This uncertainty was thought likely to have adverse impacts on investment. As a result the key reforms of the NWI (2004) included providing certainty and security of title by:

- defining water rights as perpetual access rights to a share of the water resources available for consumption; and
- clearly assigning the risk of future reductions in water availability between governments and users.

Water rights (or water access entitlements as they are termed) are typically defined as a share of a consumptive pool of a specified water resource. This means they specify a right to a set volume and some indication of the likelihood of receiving that volume in any one year. Fixed volumetric entitlements are still provided on streams that are unregulated by an upstream storage.[94]

Where rights are defined as a share of the available resource different volumes are allocated to rights depending on the total amount of water available. Each season (and within a season) a water allocation or seasonal assignment is made to rights that specify the volume of water made available, for the period. This can change within a year as more information becomes available. This determination of available supply is made by the responsible statutory authority or government department in each state in accordance with a specified water plan.[95]

Figure A26 illustrates how supply availability, or the seasonal assignment made to a water right, may vary over the season. This is for general security licence holders within a dry season in one district.

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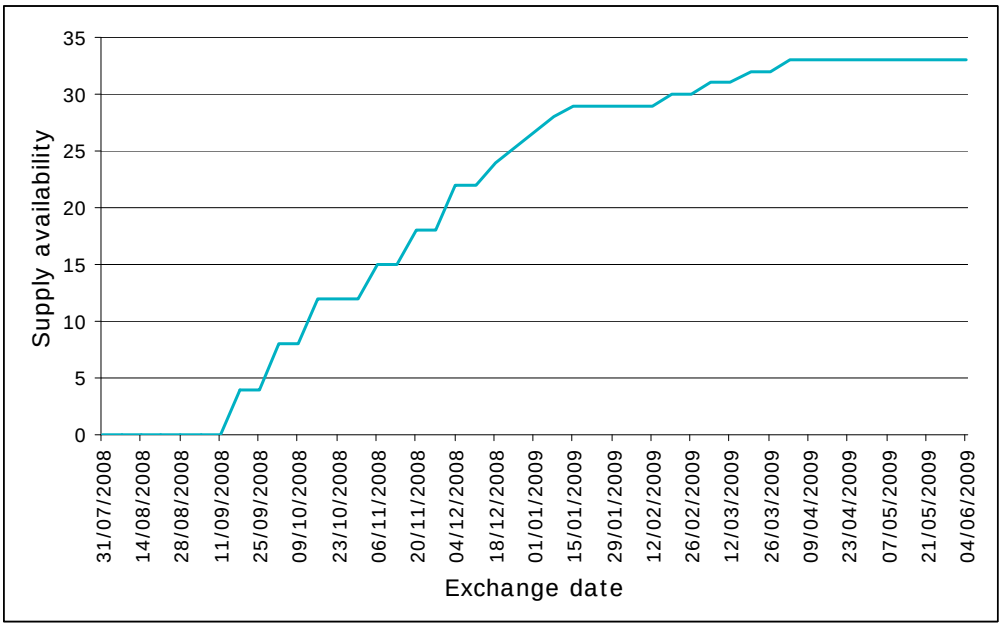
94 PwC (2006), '*National Water Initiative Water trading study',* produced on behalf of the Department of the Prime Minister and Cabinet, Chapter 2, p 13.

95 This is undertaken by the storage operator in the case of regulated rivers (the exception is NSW, where this is undertaken by the water resources agency); and the water resources agency in the case of unregulated rivers (except in Victoria where this is the responsibility of the rural water supply authorities).

Figure A26. Supply availability in the Greater Goulburn Zone, in Victoria



Source: Watermove.

Although Australian water rights are perpetual, there is some recognition that circumstances and climatic conditions may change. There is a periodic process for review of water rights in each catchment. The nature of this review is controlled by *ex ante* statutory rules.

While the volume of water available for abstraction may change as part of this review, with rights defined as shares users know that any reduction in availability will be proportionately shared. There are also *ex ante* risk-sharing arrangements that allocate the risk of any change in water availability to different parties, depending on the specific circumstance of the change.[96]

- Any reduction (or decrease in the reliability of a water right) arising from **long-term changes in climate or any seasonal events** such as drought are to be borne by water rights' holders.

- Any reduction arising as a result of **improvements in the knowledge of sustainable abstraction limit** is to be borne by water rights' holders up to 2014. After 2014 this risk is to be shared between rights' holders (who bear the first 3 per cent of any change) and Governments for anything above this.

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96 Specified in the National Water Initiative Intergovernmental Agreement.

- Any reduction arising as a result of a **change in government policy** such as new environmental objectives is to be borne by Governments.

As a result of defining in advance the process for review, water rights as a share of resources, and the risk-sharing arrangements that will apply, rights' holders have a high degree of certainty in regards to their rights.

Priorities given to certain rights

In the MDB water rights exist with differing levels of reliability. Arrangements vary between states, reflecting underlying differences in the reliability of water resources and the needs of users, but rights are generally categorised as either:

- high reliability – the full volume of entitlements expected to be available every year, except during severe droughts (95–100 per cent reliability). These are common in Victoria and South Australia;[97]
- general reliability – subject to allocations announced annually with reliability varying between states and specific systems. In New South Wales these have a reliability of 70 per cent while in Victoria this varies between 30 per cent and 68 per cent;[98] and

Public water supplies typically hold a high priority right.

Unbundled water rights

In some irrigation areas in Victoria, irrigators' water rights have been separated out into the three components as a way of improving trading outcomes.

- A water share (the right itself) – the long-term interest (share) in the water available to be taken from a water system. A seasonal allocation of water is then made against this share depending on availability.
- A delivery share – which provides an entitlement to have water delivered to land in an irrigation district. When a delivery system is congested it provides a share of the available water flow.
- A water use licence – grants permission to use or abstract water in a certain way (this could include an annual use limit or conditions on crop changes so that it does not impact on groundwater infiltration or runoff water quality). These licences are associated with a piece of land.

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97 ACCC (2006), '*A regime for the calculation and implementation of exit, access and termination fees charged by irrigation water delivery businesses in the southern Murray–Darling Basin*', p 33.

98 Ibid.

Uncoupling the tradable water share and allocation from the licence to use and abstract water from a particular location was intended to reduce transaction costs by:

- making rights more homogenous and therefore more easily traded; and
- reducing the complexities associated with the trade approval process. The potential for externalities to arise from trade mostly relates to a change in the use or location of an abstraction point. In some cases this may not change as a result of trade[99] or this could be assessed separately to any water trade. With all conditions relating to use and abstraction contained in a separate licence, trades are only subjected to minimal approval processes.

Managing return flows

Australian water rights are not fully specified in relation to return flows and some issues have arisen in relation to this issue. Water rights are typically specified as limits on water abstraction without consideration being given to water usage. This meant that as irrigators improved their on-farm efficiency they increased their net usage and decreased the quantity of water re-entering the environment.

Water not used by crops or lost through evapotranspiration will ultimately return to surface or groundwater systems through subsurface drainage and become available for other downstream water users. Therefore, improvements in on-farm water efficiency, often funded by government, led to return flows reducing. This ultimately impacted on the availability of water for all users and the environment.

Water and water rights' trading

Trade is the primary mechanism for reallocating water resources among competing users and uses. Water and water rights' trading has been possible in Australia for many decades. Before the mid-1990s there was only limited water trading. However, in the mid- to late 1990s, following the capping of use in the MDB, water trading grew rapidly. This growth was also driven by a lengthy drought and reforms that made water rights more secure and explicit.

Agricultural users hold the vast majority of Australia's water rights. Prior to the 1994 COAG reforms, most of these users held licences that tied their water right to land. When water rights were unbundled from rights to land, abstractors had these new rights grandfathered to them.

Water trading is the primary mechanism for enabling new abstractors to gain access to water or water rights. In the MDB this has been effective in enabling

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99 For example, an abstractor may wish to increase their security of supply or fill a storage without changing their abstraction conditions or the primary use of that water.

the development of new horticultural enterprises. New managed investment schemes and other greenfield horticultural developments have been the main buyers of entitlements, although this has slowed recently.[100]

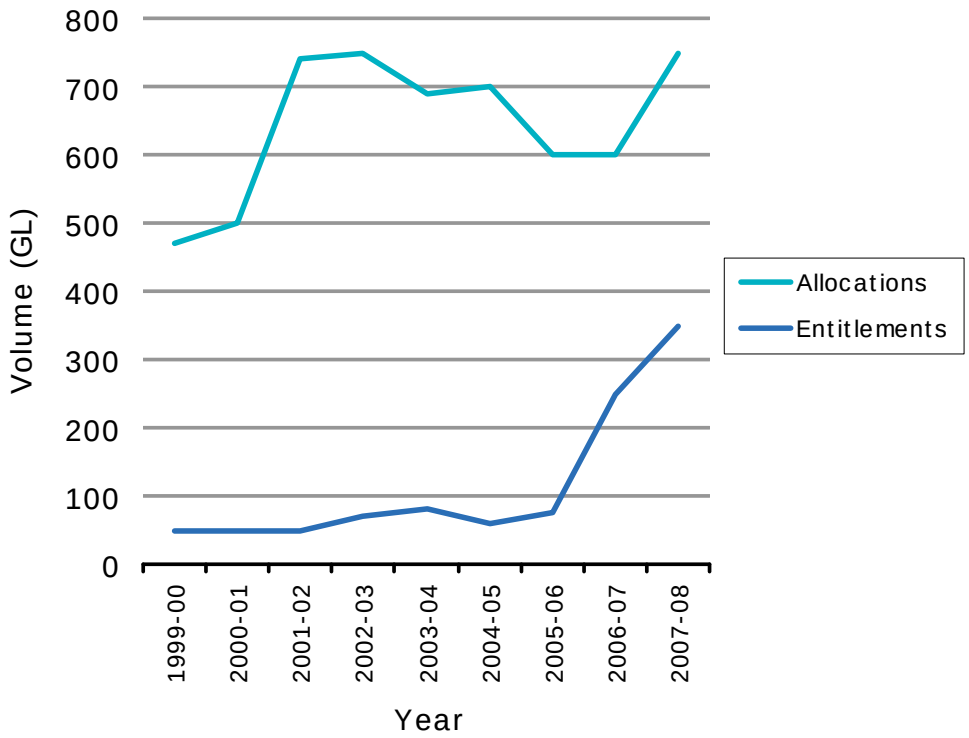
Types of trade

In Australia markets exist for both:

- the water right or the 'entitlement'; and
- the water or the allocation associated with the entitlement.

Trade in water rights are referred to as permanent trades while trades in water are referred to as temporary trades. It is also possible to lease water rights. Users have exhibited a preference for temporary trade (see **Figure A27**). This appears to be due to the tax treatment, policy uncertainty, administrative complexity and the higher transaction costs associated with permanent trade.

Figure A27. Volume of allocations and entitlements traded



Source: NWC (2010) National Water Commission (2010) 'The impacts of water trading in the southern Murray–Darling Basin An economic, social and environmental assessment'.

100 National Water Commission (2010), '*The impacts of water trading in the southern Murray–Darling Basin An economic, social and environmental assessment'*, p vi.

The largest volume of water trade occurs in the MDB and in 2008/09 this market was valued at over $2.8 billion AUD.[101] In 2008/09 between 7 per cent and 35 per cent of the rights issued in various sub-catchments of the MDB were temporarily traded in.[102]

The key features of Australian water markets are described below.

- The majority of trade occurs in interconnected, regulated systems where there are major storages. In particular water trading in Australia is dominated by trade in the southern interconnected reaches of the MDB. Of the total water resources diverted for consumptive uses, around two-thirds or 18,000GL are in the MDB.[103] However, water trading does occur in all states and territories in Australia.

- Markets remain thin in some areas, which may reflect low demand for water and/or the availability of 'free' unallocated water from the government.

- The majority of trade occurs between agricultural users. In 2003/04 there were 40,400 irrigating agricultural establishments, of which 15 per cent were involved in buying water and 10.9 per cent were involved in selling water.[104] There appears to have been very little speculative activity in the market by third parties who do not have a primary use for the water (such as banks or traders).

- Most trade occurs within regions or sub-catchments rather than between them. Interregional trading (still within the larger catchment of the MDB) accounted for a small proportion of total trade until 2004/05, when its importance started to increase probably as a result of streamlined approval and transfer processes.

Market outcomes

Prices for water rights (high reliability entitlements) in the MDB are close to 10 times the price of water.[105] The market price for water has been shown to vary

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101 Market turnover estimate based on gross value of allocation and entitlement trades (source http://www.nwc.gov.au/resources/documents/AWMR08-09_S3_nat_summary.pdf).

102 National Water Commission '*National summary of trading activity*' (source: http://www.nwc.gov.au/resources/documents/AWMR08-09_S3_nat_summary.pdf).

103 PWC (2006), '*National Water Initiative Water trading study'*, produced on behalf of the Department of the Prime Minister and Cabinet, Chapter 2, p 13.

104 ACCC (2006) 'Submission to the Productivity Commission paper *Rural Water Use and the Environment: The Role of Market Mechanisms'*.

105 In 2008/09 water prices (for allocations) hovered around $350 AUD per ML. Prices for water rights (high reliability entitlements) in the MDB over the same time period varied between $2000 and $3000 AUD per ML.

significantly over the season in response to availability, while the market price for a right tends to link to the longer run trend in water prices. Prices for both vary over time in response to information about future water supply and changes in commodity prices (given irrigators are the major participants).

Trading between different types of users

While trade primarily occurs between irrigators, public water suppliers do participate. Trades have occurred between water suppliers and between suppliers and irrigators (termed 'rural to urban trades').

Urban water suppliers are generally purchasers of water and water rights as opposed to sellers. Even so, some suppliers have sold water to rural users in recent years. Where suppliers sold water this typically coincided with a purchase of rights, which provided increased security of supply and led to suppliers having a water surplus in some years which could be sold temporarily.[106] Trades have ranged from one-offs that required a high degree of government involvement to ongoing purchases on the market. Generally, suppliers have been positive about the benefits of trade with rural users. Trade has enabled water suppliers to acquire a mix of water products (such as rights with different priorities) and to improve their security of supply in the face of declining water availability. However, there have been some negative perceptions and political sensitivities, which appear to have limited trading by public water suppliers.[107] In particular, communities in rural regions have expressed concerns at having their rights bought up to supply urban areas.

Some urban water suppliers in Victoria have facilitated pilot projects to allow individual water users connected to their network to directly purchase allocations on the market. However, the volumes of this type of trade have been relatively small.[108]

The environment's participation in the market

It is becoming more common to see environmental agencies participating in the temporary market in order to enable water flows to mimic natural conditions and boost water available for the environment at critical times.

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106 Frontier Economics Australia (2009), *Rural–urban water trade in Australia'*, A report prepared for the Department of the Environment, Water, Heritage and the Arts (DEWHA), November 2009, p 10.

107 Ibid.

108 Ibid.

Initially this was limited by legislative restrictions.[109] However, various government authorities now hold transferable water rights obtained as part of Government buy-backs and are in a position to buy and sell these.

The *Water Act* formalised this approach when it created the *Commonwealth Environmental Water Holder* who will be the holder of its newly purchased rights for the environment.[110] This separate agency was created to address market participants' concerns about environmental authorities having conflicting interests where they are also responsible for other water resource planning and trading activities. It was felt that these multiple interests could conflict and that this would undermine the credibility and transparency of the water market. An example that highlights the circumstances where this could occur is SunWater. SunWater is a water authority owned by the Queensland Government. It is responsible for approving water trades, operating water infrastructure and making seasonal determinations of the available water supply. It also trades water that it holds on behalf of the environment.[111]

While stopping short of requiring functional or structural separation of these various state authorities, the MDB trading rules require that approval authorities disclose any direct interest they have in a trade to all parties, before they approve or reject it. These approval authorities are also required to provide reasons for rejecting a trade, and to report on their own trading activity.[112]

Successes and challenges

Water trading is largely viewed as a success, by governments and market participants. Recent studies have indicated that water trading has led to the following benefits:

- Improvements in water use efficiency – With the market price accounting for scarcity and greater certainty over rights there has been more investment in interconnections and in improving existing infrastructure to reduce water losses.

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109 Siebert, Young et al. (2000), '*Market-based opportunities to improve environmental flow: A scoping paper*', report to Environment Australia, Policy and Economic Research Unit, CSIRO Land and Water, Adelaide.

110 These rights will retain their original characteristics. Given Australian rights represent a share of available resources, this mean that if there is a reduction in water availability or a change in the reliability of water rights, the rights of the Environmental Water Holder will be treated the same as all other rights holders. The Australian Government has also indicated that it will continue to pay charges related to holding and using the rights.

111 ACCC, *Water trading rules Position paper*, September 2009.

112 ACCC, *Water trading rules Final advice*, March 2010.

- Reduction in the economic impact of drought –Agricultural users have been better able to manage seasonal supply variations and drought risks. This has proved invaluable for allocating scarce resources given the supply demand imbalance and has been shown to be adaptable and flexible in the face of changing conditions. It has been estimated that these arrangements reduced the economic impact of the recent drought, the worst in Australia's history, by $220m in 2008/09 alone.

- Improvements in the dynamic efficiency of industries – Trade has facilitated the restructuring of the irrigation industry and enabled new, more productive developments to augment supply.

- Contributions to urban security of supply – Trade has enabled suppliers to diversify their water sources.

Generally, trade has been restricted in areas where there are constraints to delivering this water, or where there has been concern with respect to a trades' impact on the environment. As a result trade has not had any major negative impacts on the environment. Where environmental concerns have arisen these have largely been associated with the impact of drought and climate change driving up the value of water, rather than being seen as a negative consequence of trade per se. For example:

  - previously unused water was activated by the presence of the market in some areas (this included increases in farm dam diversions and groundwater use); and

  - return flows reduced as a result of improvements made in water use efficiency. This impacted on the quantity of water re-entering the environment.

Trade did lead to some societal impacts associated with trade facilitating the restructure of the irrigation industry. Irrigation areas that were inefficient or were generating low economic value from water use became water selling regions. This led to the loss of productive enterprises in these regions and is seen as having contributed to economic decline.

Applicability to the UK

Some important aspects of the water resource situation in Australia, which drove the move towards a greater degree of trading and associated policy change, may not be as applicable to the England and Wales context.

- The extent of water scarcity – A cap on abstractions and a period of historically low rainfall, has meant that restrictions and rationing began to impose a significant constraint on economic growth. This dramatically

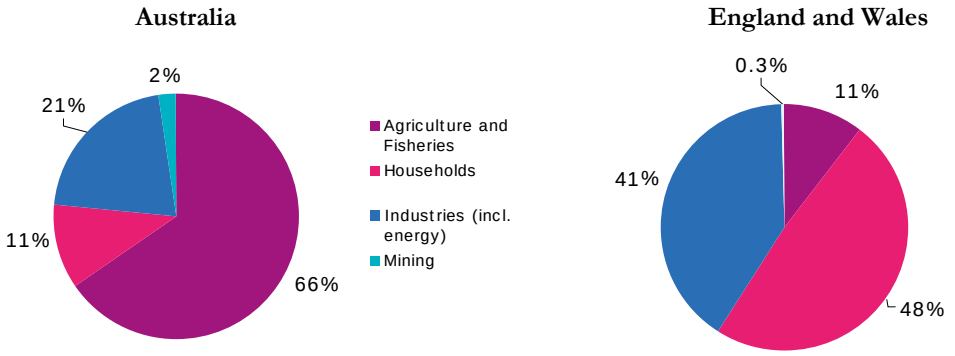
increased the importance of using trade as a means to free up water, a valuable input, from low-value uses.

- Heterogeneity of users – Agricultural water users are in the majority in Australia (see **Figure A28**). Agricultural users' water valuations depend primarily on the value of the commodity being produced and as a result the prospect for many users to place disparate and varying values on water over time is high.

- The extent of hydrological interconnection in the major basin (the MDB) – Water trading in Australia is dominated by trade in the MDB. The size and extent of interconnection in this basin has created the potential for a very large water trading market involving users with heterogeneous demands. Interconnection also means there are often a large number of participants in each market. This reduces the potential for issues around market dominance to develop.

- The variability of rainfall and supply – This variability also contributes to significant variation in the economic value of water, and as a result temporary water trading became a major focus of reforms.

Figure A28. Water use by purpose for Australia and England and Wales



Source: Australian water consumption figures for 2004/05 from the National Water Commission website; DEFRA, e-Digest of Environmental Statistics, Published September 2010 (based on average estimated abstraction volumes over the period 2005-2008).

Reforms that facilitated trade

Over time various reforms were introduced in Australia to improve the effectiveness and efficiency of water markets. These reforms included:

- the removal of various administrative barriers to trade associated with the trade approval process;

- reductions in transaction costs through streamlining trading processes and improving coordination between the states;

- the development of rules relating to the conduct of market participants;
- the provision of market information and trading platforms to make market information more accessible;
- redefinition of water rights and water registries to further facilitate trade; and
- various rules for managing environmental impacts of trade.

As a result of these reforms trade approval process have been rationalised. The MDB state approval authorities have standards for trade processing times for both entitlement and water allocation trades. In most circumstances 90 per cent of all water allocation trades must be approved within 10 business days and 90 per cent of entitlement trades within 20 business days.[113]

Streamlined approval processes have also spurred on development of the now commonplace online water exchanges where water can, in some circumstances, be traded in real time.

There is a generally held view that the extent to which water trading has developed has partially reflected the effectiveness of the existing trading frameworks in each jurisdiction:

> *To the extent the market is not functioning as effectively as it might, this is more to do with frictions caused by certain rules and administrative requirements related to the processing and approval of trade, including at the interstate level but also within states*[114]

More recently reforms have focused on removing various trading barriers and restrictions, in place within legislative instruments and the operational charters of irrigation districts, which prevent the movement of water out of irrigation districts. These rules were put in place because of concerns around the long-term impacts on communities from water moving away from their district.

Managing third-party and environmental impacts of trade

The MDB Plan includes within it water trading rules. The trading rules deal with a range of matters including:

- the removal of unnecessary barriers to trading water rights;
- the terms and processes for trading water rights;
- the manner in which trades of water are conducted; and
- the provision of information to enable trading to take place.[115]

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113 http://www.nationalwatermarket.gov.au/about/trade-processing.html

114 PricewaterhouseCoopers (2006) *National Water Initiative Water Trading Study,* for the Department of the Prime Minister and Cabinet, June 2006.

In many catchments there are also more highly specific rules that apply. These rules are outcomes of the catchment-based water management and planning processes.

It is not uncommon to have certain types of trades identified up front as either being restricted, subject to more stringent approval processes or subject to exchange rates or levies, which are applied to trades to take account any negative impacts on the environment (refer to section 8.3 for a description of these mechanisms. Often trading zones are defined where particular rules or restrictions apply. In some cases more complex approval processes exist.

Types of trades that may be subject to explicit trading rules and either restricted or subject to tariffs include trades:

- between streams that are not clearly connected unless associated with new connection infrastructure;
- where water moves upstream, outside of certain trading zones, to account for a reduction in in-stream flows; and
- where there are delivery capacity constraints in the system (in some cases where water moves downstream and could exacerbate congestion at in points along the river).

Often trading rules exist that are intended to manage impacts on the environment or other users arising from the way in which water is put to use. For example in areas of shallow and highly saline groundwater, excess irrigation water can filter into the groundwater, pushing it into rivers and thereby increasing their salinity. This problem is of particular concern in the downstream areas of the MDB. The State of Victoria has created additional rules to deal with these salinity impacted areas, defining High and Low Impact Zones (HIZ and LIZ). Trade into HIZs is prohibited while trade into LIZs is permitted but each trade attracts a levy at a varying rate per ML to offset the associated salinity impacts and cover the cost of public salt interception schemes. This issue is increasingly being handled through the application of conditions on a separate use licence. Salinity trading schemes can then be adopted and these have been trialled in some areas.

Western United States

Water resources management at a glance

In the US each state has autonomy in the way it manages water and therefore significant differences between states exist. This case study focuses on the arrangements in place within the western states of California and Colorado.

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115 http://www.mdba.gov.au/basin_plan/concept-statement/key-elements

Public water supply is typically provided by government organisations (federal, state or county). However, private entities are involved. For example, irrigation associations or 'districts' play a prominent role due to their large and well-protected historical water rights. The Kern Water Bank, a formerly government-run groundwater water storage facility in Central California, was transferred to private ownership and now sells water to municipalities in dry years. The fact that responsibilities for water and the environment are divided between different levels of government make the allocation regime complex and diverse.

Water supply systems in the Western US are generally more interconnected than in England and Wales. Large rivers, such as the Colorado River, flow through several states. There is also significant conveyance infrastructure such as the California Aqueduct built in the 1960s, which connects various catchments. These natural and built transfer systems have helped facilitate subsequent trading activity. Because natural supply variability is significant, large storage dams were also built to store water during wetter years for drier periods. The use of multiyear carry-over storage is not as significant in England and Wales.

Differences in demand characteristics also exist. Significant supplies are used in agriculture, for example up to 80 per cent of total abstractions in California. Average domestic per capita demand in western states is between approximately 4 and 10 times typical UK consumption levels. This mostly relates to higher demand for outdoor use.

Allocating water to the environment

Ecological 'in-stream' flows are guaranteed by federal laws[116] that protect certain wildlife species. In California and Colorado a specific allocation of water is made to protect the environment. In some cases these are issued as tradeable rights. In these circumstances any unused portion of the allocation can be temporarily traded. And in some US jurisdictions there are agencies dedicated to managing these rights. For example, the Colorado Water Conservation Board is responsible for enforcing Colorado's in-stream flow and lake level rights.[117]

User's water rights

Water law in the Western US is mostly based on the 'prior appropriation' doctrine where beneficial historical uses of water have been accorded strong perpetual 'rights'. The degree to which these are 'use' rights (e.g. California) rather than owned property rights (Colorado) vary by state. In either case water rights do not depend on land ownership or even source proximity.

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116 These include the 'Endangered Species Act' (ESA) and the 'Federal Wild and Scenic Rivers Act'.

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

Federal and state governments have varying levels of power over these rights. Within each state that power depends on when the rights were issued. For example, California cannot regulate surface water transfers for water rights issued before 1914. Although water rights are issued on the condition of beneficial use and subject to forfeiture, it is not common that existing rights be withdrawn.

Prior appropriation implies 'first in time, first in right', meaning date of first use establishes seniority of water rights. Senior rights can be exercised in virtually all hydrological conditions. As seniority decreases, rights are increasingly vulnerable to not being exercisable in dry periods.

Groundwater is managed under legislation, which is distinct from that applicable to surface water. These laws also vary by state. In certain states, such as California, groundwater is allocated by correlative rights, i.e. correlated to a share of the pooled resource, with the share typically proportional to the area of land above ground. California groundwater use is not regulated or measured by public authorities, so in cases of resource conflict, courts adjudicate a concrete division of aquifer use through an often protracted and expensive process.

There is no mechanism for the jurisdictional governments to favour certain water uses over others. Because water rights are transferable property rights, as long as their future use is considered beneficial, they can be transferred through market transactions. Government agencies could purchase these rights if they wished to favour certain uses, such as environmental uses.

Mechanisms for reviewing the level of water rights issued

The water right seniority system prevents further water rights from being granted and may also limit junior right holders from exercising their rights in times of scarcity.

Under the Endangered Species Act (ESA) water rights may be modified if they are deemed to be destroying an endangered species. Nevertheless, more generally, buy-backs are used to redress any over-abstraction. This is reflected in the number of purchases for the environment in **Figure A30** below (see the green line). Colorado and California both have government-agency-run programmes to purchase environmental water from markets. For example, in 2001/02 US$90 million was spent to purchase water rights to restore riverine health and protect fish populations in the San Francisco Bay–Delta. Environmental interest groups have also purchased and donated water rights.[118]

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

Water trading arrangements

There are a number of geographical water markets in the western states. Sometimes these locations are interconnected (e.g. the Colorado River system), but not necessarily. Trades can be long-term permanent transfers with water right exchanges requiring arduous regulatory approval. Local authorities can attempt to block these to prevent water permanently leaving the area on the basis that this will be detrimental to future growth in the region.

Dry-year options (contingent contracts) and short-term leases between 1 and 5 years allow more flexibility and are increasingly popular. In 'option' agreements, a buyer (e.g. a municipality) purchases the ability to exercise an option to purchase water in dry years. The option premium represents the value of the flexibility gained by the buyer from postponing its decision about whether to buy water.[119] Often option sellers are agricultural producers who can fallow land in the event that a water option is exercised. Short-term leases of the right itself also typically involve farmers who may chose to fallow land or use an alternate source (e.g. groundwater).

The basis and mechanisms for trade vary by region and by the type of water right involved in the transaction. For example, California water banks operate mostly with option contracts or spot markets. Spot markets are particularly active in dry years when extra supplies are immediately needed. Price can be volatile, reflecting varying spatial and temporal conditions. Short-term leases can be traded bilaterally or within spot markets.

In irrigation districts, where all farmers have a contract to some proportion of the district's aggregated rights efficient and well-developed exchanges have been created. An example is California's Westland's Water District where members can trade freely on the internet. Trades involving parties outside the District require District-level approval.

Water rights sales or longer term leases are typically brokered or arranged through bilateral negotiations.

Recent trading trends

Figure A29 shows that the number of short-term trades has been increasing in recent years. In general the volume of water traded through leases is around 20 times that of water rights sales.[120]

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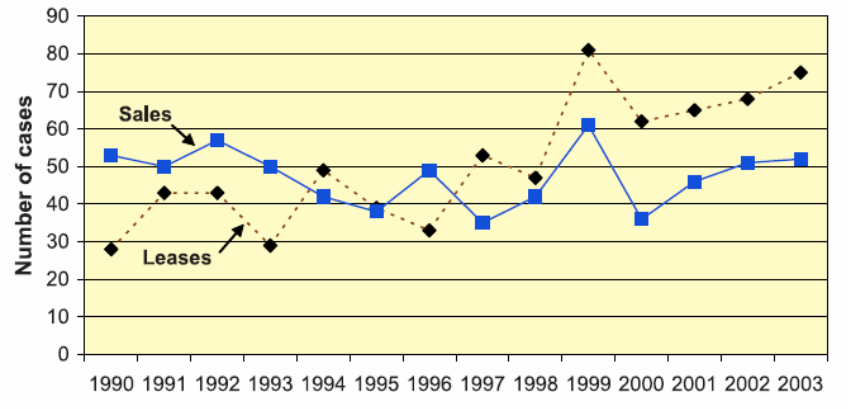
119 Hansen, K., Howitt, R. and Williams, J.C., 2006, Implementing Options Markets in California To Manage Water Supply Uncertainty, American Agricultural Economics Association Annual Meeting, Long Beach, California.

120 Brown, T.C., 2006, *Trends in water market activity and price in the western United States,* Water Resources Research, 42(9). Based on over 2000 trades across the western states from 1990 to 2003.

Figure A29. Trend in use of leases vs. permanent trades



Source: Brown, T.C., 2006, *Trends in water market activity and price in the western United States,* Water Resources Research, 42(9).

The most common trades involve municipalities buying from agricultural users. Often the water right is purchased with land when farmland is transferred to municipal use. Otherwise, leases between agricultural users and public water suppliers (going both ways) are increasingly common. This could be because permanent trades are subject to greater scrutiny and often have higher transaction costs. Where public water suppliers buy permanent rights, they do in some cases lease water back to agricultural users in normal and wet years.

Environmental trading

Trades increasingly involving the environment (see **Figure A30**). Federal agencies in both California and Colorado have acted as flexible purchasers of water rights for real-time environmental management. This was the case of the Environmental Water Account active in California from 2001 to 2008, which provided fishery agencies with between 200 and 400 GL of water per year.[121] The programme was discontinued for lack of funds and general poor or unproven performance at improving fish species survival.

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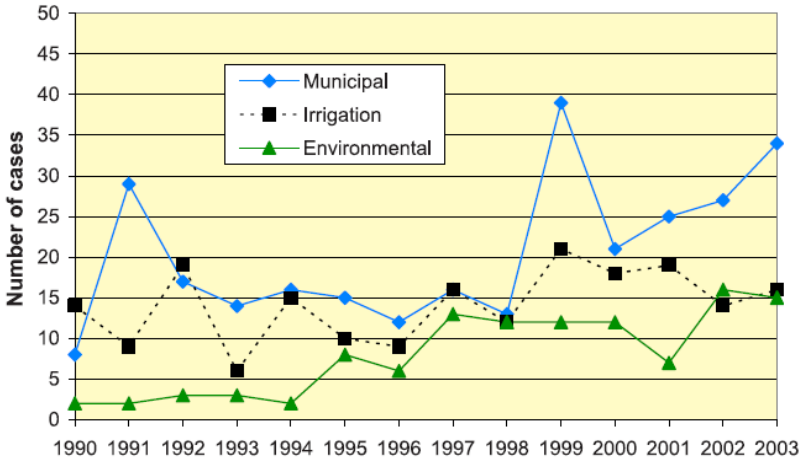
121 Brown, L.R., Kimmerer, W. and Brown, R., 2009, *Managing Water to Protect Fish: A Review of California's Environmental Water Account*, 2001-2005, Environmental Management, 43(2): 357–368

Figure A30. Trend in use of trading for municipal, irrigation and environmental purposes



Source: Brown, T.C., 2006, *Trends in water market activity and price in the western United States*, Water Resources Research, 42(9).

Market outcomes

Price distributions for individual states and water uses are wide. Variance in price across states reflects relative scarcity, availability of publicly managed water, and state and local institutional differences. Prices may be influenced by a large number of factors including:

- number of buyers and sellers in the market;
- existence of available storage and delivery infrastructure;
- transaction costs, institutional arrangements;
- amount of water transferred; and
- the use to which the water is put.

Managing third-party and environmental impacts of trade

The prior appropriation doctrine (or system of right seniority) contains provisions that protect the interests of other legal users by a 'no injury' rule. This safeguards other users rights as compensation is payable if a more senior water right is derogated.

Additionally, state water codes may impose other restrictions, particularly on permanent trades. For example, for post-1914 trades where California has jurisdiction, it prevents trades from using government-funded infrastructure if they have 'unreasonable' effects on ecological and other in-stream uses. Local

municipal (county) ordinances can also be used to prevent trades that are seen as posing undue burden on the water's place of origin.

In California it is recognised that the multiple agencies that may have jurisdiction over a particular trade serve as an impediment to the extension of California's water market as regulatory uncertainty increases costs and causes delays.

The California State Water Resources Control Board recently recommended the streamlining of approval for standard well-known transfer types that have been used before or known not to cause externalities. A pre-approval approach has also been recommended to decrease uncertainty in the trade approval process.

Leases or short-term trades involve less of a risk of irreversible third-party effects and so these are subject to less stringent regulations.

South Africa

Water resources management at a glance

In 1994, in the context of the post-apartheid reallocation of wealth and resources, South Africa implemented a comprehensive programme of institutional reforms to its water industry. These resulted in the 2004 National Water Act (NWA) and a National Water Resources Strategy (NWRS). Together with the 1996 national constitution these documents are the key sources of water policy in South Africa today.[122]

While the country as a whole has a water surplus,[123] deficits exist in more than half its water management areas. Agricultural and irrigation use represents more than 60 per cent of the total water use, urban requirements constitute about 23 per cent and the remaining 15 per cent is shared by the other four sectors, namely mining and industry, power generation and afforestation.[124] There is significant variation in demand across areas. For example, the share of irrigation varies from 9.5 per cent in the Upper Vaal areas to 93.5 per cent in the Lower Orange areas.[125]

Surface water is the dominant source of supply in South Africa. Supply is highly variable, with large differences within and across years and between regions. Four of its major water systems[126] are shared with its immediate neighbours.[127]

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122 Frontier Economics, *New Zealand Water Management Reform*, February 2007.

123 According to the most recent estimates of the Department of Water Affairs and Forestry (DWAF), South Africa is not going to run out of water by 2025.

124 National Water Resource Strategy, 2004, South Africa.

125 G.R. Backeberg, 2004, *Water Institutional Reform in South Africa,* Water Research Commission, Pretoria, South Africa.

126 The Orange, the Limpopo, Incomati and Usutu/Pongola.

Therefore, international obligations are a key aspect of South African water policy.

Allocating water to the environment

The South African NWRS sets aside about 20 per cent[128] of the total river flow as ecological reserve. This must remain in the river to ensure the quantity and quality of water meets basic human needs and protect aquatic ecosystems. The reserve has priority over other uses.

In addition to the ecological reserve, South Africa has environmental flow requirements in place which comprise base flows, flow events (i.e. flooding events), the timing of flows, minimum and maximum flows at certain check points along a river and water quality rules concerning the physical, chemical and biological characteristics of the water.[129]

Users' water rights

The NWA transformed the system of water rights from a system based on riparian rights[130] to a system of administrative, time-limited and conditional authorisations to use water. Water licences in South Africa are now understood to be all time-limited, with a maximum duration of 40 years.[131]

Any water abstraction in excess of a basic entitlement must be licensed by the Department of Water Affairs and Forestry (DWAF). New applicants may be required to provide an assessment of the likely impact of the proposed licence on water quality and quantity.

A license is specific to a particular user, property and use. It must be reviewed every five years and conditions may be attached to water rights in order to protect the environment[132].

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127 Botswana, Lesotho, Mozambique, Namibia, Swaziland and Zimbabwe.

128 The percentage varies across regions.

129 National Water Resource Strategy, 2004, South Africa, http://www.dwaf.gov.za/Documents/Policies/NWRS/Default.htm

130 Under a system of riparian rights landowners whose property adjoins a body of water have the right to make reasonable use of it.

131 National Water Resource Strategy, 2004, South Africa, http://www.dwaf.gov.za/Documents/Policies/NWRS/Default.htm

132 See section 29 of the National Water Act.

Priorities given to different uses

The NWA states that water should be allocated to ensure that the greatest social and economic benefits are achieved. On this basis the NWA classifies different priorities of access:

- The first priority is the reserve needed to meet the basic human needs[133] and the ecological reserve.
- The second priority is to meet international obligations through bi-lateral and multi-lateral arrangements.
- The third priority is to provide water for specific social needs, such as poverty eradication.
- The fourth priority is to provide water for strategic purposes such as electricity and the transfer of water between basins.
- The final priority is given to meeting general, social and economic needs.

During droughts, the responsible authorities have the right to apply curtailments in supply. Where restrictions are necessary the priorities above will be relevant. In general, water for irrigation is restricted first. However, recognising the negative impacts of such restrictions, the Department aims to provide notice to agriculture as early as possible.[134]

Mechanisms for reviewing the level of water rights issued

In certain parts of the country new rights are no longer granted because water resources are already fully utilised. Furthermore, additional environmental water can be obtained by reducing the volume attached to existing water rights.[135]

The NWA makes explicit provision for catchment plans to be revised under a statutory planning cycle which occurs every five years. This must be undertaken in consultation with users. Other than licence duration, any condition, including adjustments to licensed volumes, may be amended on review, if such amendments are necessary to maintain the integrity of the water resource, achieve a balance between available water and water requirements, or accommodate changes in water use priorities.

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133 For this purpose, a quantity of 25 litres per person per day has currently been adopted.

134 National Water Resource Strategy, 2004, South Africa, http://www.dwaf.gov.za/Documents/Policies/NWRS/Default.htm

135 G.R. Backeberg, 2004, *Water Institutional Reform in South Africa,* Water Research Commission, Pretoria, South Africa.

The ministry can through this process reduce, cancel or limit water rights without necessarily giving compensation. However, licence conditions for all similar uses from the same water resource must be amended in an equitable manner.

Water rights are also subject to conditions of efficient and sensible use and the responsible authority may suspend or withdraw the entitlement if the user fails to comply with them.

Trading of water or water rights

The NWRS notes that trade in water licences may be used to improve equality of access to water or to increase efficiency of water use by moving water use from lower-value to higher-value uses.[136] The NWA allows for some temporary and permanent transfers of water rights. However this is subject to the following:

- Only water use licenses for the purpose of irrigation are transferable.
- Temporary water trades must be used for the same purpose, and only for irrigation.
- Permanent water trades occur by the process of the seller surrendering their licence and the prospective buyer applying to the DWAF for a new licence.

The government of South Africa has attempted to maximise the trading opportunities between users by constructing a series of canals and aqueducts that interconnect its river systems.[137]

Currently, trade between different types of water user is considered on a case-by-case basis. The government has been criticised for the amount of red-tape potential water traders must go through to get a trade approved and it has been noted that few trades have been approved.[138]

Managing third-party and environmental impacts of trade

It is understood that regulations will soon be introduced, specifying the conditions under which trade will be permitted.

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136 G.R. Backeberg, 2004, *Water institutional reforms in South Africa,,* Water Research Commission, Pretoria, South Africa.

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

138 Frontier Economics, *New Zealand Water Management Reform*, February 2007.

Regulations are also in place to protect the long-term interests of deprived groups, preventing, for instance, subsistence farmers from selling their water rights for short-term gain.[139]

Chile

Water resources management at a glance

Before 1981, ownership of Chilean water resources was vested in the state with concessions granted for water use. Post 1981, the Water Code liberalised the water allocation regime and created fully tradable water rights which were granted in perpetuity.[140] These rights had similar constitutional guarantees to that provided for other forms of private property.

Water supply is highly variable in Chile. Rainfall patterns are heavily influenced by the El Niño and La Niña effects.[141] Seasonal disparity is significant with rainfall during the winter months three times higher than other times of the year. With this variation, and some very arid regions in the north, the efficient allocation and use of water are essential.

Despite a diversified economy, water use in Chile is dominated by irrigation, which represents 85 per cent of consumptive water use. Industrial use represents 7 per cent of abstractions and mining and potable water supply each account for a little more than 4 per cent of total water use.

Allocating water to the environment

In Chile the environment is protected outside the system of rights. Minimum flows are set aside by an administering body but the environment does not necessarily have a prior right to the water. The water left in the environment is not constituted as an explicit water right.

Users water rights

The 1981 Water Code established rights to water that were separated from land, fully tradable, perpetual and unlinked to the type of use. Existing rights were

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139 G.R. Backeberg, 2004, *Water institutional reforms in South Africa*,, Water Research Commission, Pretoria, South Africa.

140 As well as being pushed for by the new market-minded government, this approach can be traced back to the Spanish (Roman origin) law inherited by Chile during its colonisation. Roman law did not consider continental water as common resource but rather as either public or private and emphasised the protection of individual rights such as private property. (Source: Southgate, D. and Figueroa B, E 2006, *Reforming water policies in Latin America: some lessons from Chile and Ecuador*, in K. Okonski (ed.), *The Water revolution: practical solutions to water scarcity*, International Policy Network, London.)

141 For example, in 1998, rainfall in Chile in May totalled 65 mm, while in 1992 it was 115 mm.

largely grandfathered. Rights for new uses are largely granted on a 'first come, first served' basis.[142] Formal rights do not cover all water taken from the environment. A significant proportion of water rights are still not formalised. These rights are established under previous legislation or relate to customary use.[143]

While ownership of water remains with the state, formal water rights, once granted, are fully protected under the Constitution and cannot be expropriated without due compensation.[144] Water rights can also be mortgaged. They legally define a holder's rights to water:[145]

- to a specific surface or groundwater resource;
- as a flow of defined volume per unit of time;
- as either consumptive or non-consumptive rights;
- as either a permanent or eventual right – eventual rights can be used only if there are sufficient flows to supply all the permanent rights, and then only according to their order of precedence; and
- as continuous, discontinuous or alternate, depending on the times at which they may be used.

Holders of formal consumptive use rights are entitled to withdraw a specific volume per time period. In rural areas the government has the authority to determine the volume of water available and to assign this to water users' accounts during low flows.[146] Therefore, in practice these rights are a share of stream flows given the variability in water availability.[147] Water rights holders can

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142 If there is more than one request for the same resources (over a period of 30 days) the flow is allocated by auction in which, in addition to the requesting parties, government agencies can participate (source: E. Brown and Pena, H., 2003, Systemic study of water management regime, Chile, Global Water Partnership).

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

144 Southgate, D. and Figueroa B. E. 2006, *Reforming water policies in Latin America: some lessons from Chile and Ecuador*, in K. Okonski (ed.), *The Water revolution: practical solutions to water scarcity*, International Policy Network, London.

145 E. Brown and Pena, H., 2003, Systemic study of water management regime, Chile, Global Water Partnership.

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

147 Rosegrant et al., 1996 sourced in Hodgson, S., 2006, Modern water rights: theory and practice, FAO Legislative Study No. 92, Rome: Food and Agriculture Organisation (FAO).

freely change how they use their rights without notifying the relevant authority or asking administrative approval.[148]

Holders of non-consumptive rights, the majority of whom are hydropower generators, are entitled to legal recognition of their diversions from rivers, provided that equal volumes are returned to the same channel.

The 1981 Water Code definition of non-consumptive use rights did not specify the timing of use. This eventually led to conflicts between irrigators and generators.[149] Generators scheduled reservoir releases during the cool winter months, when demand for electricity is high, while irrigators favoured releases in the dry summer months. This conflict was resolved in court, but rights still do not have timing of use specifications.

Non-consumptive rights grant the owner the use of the water as long as it is returned to its source, and does not interfere with consumptive use rights. As water is a basic factor in their productive process, hydroelectric plants cannot afford to expose themselves to the risk of future supply shortages, or of having to buy at high prices. Thus, without any corrective framework, they are induced to store non-consumptive water rights. To counteract this tendency, in January 2006 an additional legislative tool was added to the system: all non-consumptive rights that were not being used were made subject to a fee.[150]

New water rights have limitations attached relating to the quantity of water that may be extracted from natural sources, with the requirement that users must show proper regard for the particular status of the rights involved.[151]

Priorities of different rights

The water code does not establish any legal priorities among different kinds of water use.[152] The only order of priority is given by the distinction between permanent and eventual water rights. Permanent water rights are fulfilled prior to eventual water rights, which are granted for water flows that exceed those

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

149 Hearne, R. and Donoso, G., 2005. Water institutional reforms in Chile. Water Policy 7: 53–69.

150 An example of water hoarding behaviour is provided by ENDESA, a Spanish firm that has invested heavily in the Chilean energy sector, and which, before 2006, acquired more than four-fifths of all such rights. After the 2006 legislative addition, ENDESA had to pay more than US$2.6 million in fees.

151 G. Donoso, 2006, Water markets: case study of Chile's 1981 Water Code, *Cien. Inv. Agr. 33(2): 157–171.*

152 C. Bauer, 2005, *In the image of the market: the Chilean model of water resources management*, International Journal of Water, Vol. 3, No. 2, 2005.

required by holders of permanent rights. Permanent water rights have a probability of being met in full 85 out of 100 years.[153]

Mechanisms for reviewing the level of water rights issued

In general, the government has no power to reduce, cancel or limit water rights unless it buys these back. In Chile, water required for the environment is obtained primarily by investment in water infrastructure.[154] There are no explicit provisions for the licensed volumes to be revised under a statutory planning cycle.

Authorities are able to determine the volume of water available and assign an amount to water users' accounts during low flows. However, this mechanism seems only to have been used to manage short run seasonal scarcity. During times of extraordinary drought, zones of shortage can be declared. In these zones water rights can be curtailed for periods of up to six months in equal proportion. The relevant authority must consult with water users before proceeding with any proposed restriction.[155]

Water and water rights' trading

The only means for reallocating water rights is the market. Sales are allowed between different types of users. Most water trades are temporary annual water trades between neighbouring irrigators in the same region. There have also been a small number of permanent trades of water rights.[156]

Water trades most regularly occur in water scarce regions and in high demand catchments like the Limarí Valley where there is an emerging agricultural sector. Chile, although a relatively arid country, has abundant water in some catchments and trading is less prevalent in these. The absence of adequate distribution infrastructure restricts activity in many areas.[157]

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

154 Productivity Commission 2003, *Water Rights Arrangements in Australia and Overseas*, Commission Research Paper, Productivity Commission, Melbourne, p 137.

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

156 Bauer 1997 (source: Productivity Commission 2003, *Water Rights Arrangements in Australia and Overseas*, Commission Research Paper, Productivity Commission, Melbourne, p 136).

157 E. Brown and Pena, H., 2003, Systemic study of water management regime, Chile, Global Water Partnership.

Water trading is perceived to have led to a more efficient allocation of water as the market is being driven by demand from sectors that value water relatively highly in areas with growing economies.[158]

Water resources management takes place in an institutional context that has been shaped by water markets.[159] Chile's pro-market water laws and the strength and security of its water rights have undoubtedly facilitated trade. Trading also appears to have been facilitated by low transaction costs.[160]

That said, some issues have emerged with the Chilean trading regime. The main hindrance to the water market has been the incomplete registration of water rights.[161] Currently, many rights are not recorded in any registry. This makes it difficult for those interested in trading to find a counterpart or confirm the nature of their rights. The lack of easily accessible and transparent information (or incomplete information) on rights' holdings has been one the biggest obstacles to the development of water markets.

Furthermore, not all rights' holders are able to trade. The 1981 legislation failed to convert some limited concessions for water into tradable water rights.[162]

Managing impacts of trade

A legal and institutional framework that makes trading simple may have affected the government's ability to protect the environment.

Water rights in Chile are not defined on the basis of net water use. Water rights are also not linked to particular uses with rights only categorised as consumptive or non-consumptive. Therefore, changes in water use as a result of trade may:

- change the quantity of water returning to the environment which may worsen any problems of over-abstraction; and
- change the quality of water returning to the environment. This may be worsened by the fact that water quality standards relating to effluent discharge have not yet been adopted. In addition, Chile's environmental

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158 G. Donoso, 2006, Water markets: case study of Chile's 1981 Water Code, *Cien. Inv. Agr. 33(2): 157–171.*

159 C. Bauer, 2005, *In the image of the market: the Chilean model of water resources management*, International Journal of Water, Vol. 3, No. 2, 2005.

160 G. Donoso, 2006, *Water markets: case study of Chile's 1981 Water Code*, Cien. Inv. Agr. 33(2): 157–171.

161 Hodgson, S., 2006, *Modern water rights: theory and practice,* FAO Legislative Study No. 92, Rome: Food and Agriculture Organisation (FAO).

162 Southgate, D. and Figueroa B., E., 2006, Reforming water policies in Latin America: some lessons from Chile and Ecuador, in K. Okonski (ed.), *The Water revolution: practical solution to water scarcity*, International Policy Network, London.

policy lacks standards for background groundwater or in-stream water quality and water quantity.[163]

The European context — The WFD

The 2000 Water Framework Directive (WFD) established the basis for water resource management policy in the European Union (EU).[164] Its overall aims are to maintain a sustainable balance between the water needs of the environment and of human activities and to guarantee sufficient quantity of good quality water across Europe, with the goal of achieving 'good status' across the region by 2015. Implementing the WFD is the responsibility of each member state.

The Directive focuses water management on individual river basins. For each basin, member states are required to produce a River Basin Management Plan (RBMP). This describes the basin's characteristics, economic uses and measures adopted to ensure it meets the required standards. Currently most member states have developed RBMPs. However, there are still a few countries where consultations are awaiting adoption or have not been started.[165]

Allocating water to the environment

The Directive states, in paragraph 41, that 'overall principles should be laid down for control on abstraction and impoundment in order to ensure the environmental sustainability of the affected water systems'.[166] This has been implemented in diverse ways across Europe. The vast majority of states have chosen to set up an environmental reserve whose quantity is protected from use.

Water rights and trade

The Directive does not specify how member states should define their water rights, allocate these rights, or whether they should adopt trading as a means of redistributing water. In fact there is a great variety between member states regarding water rights' specifications and in the adoption of water trading mechanisms.

The Directive requires that member states ensure that 'water-pricing policies provide adequate incentives for the sustainable and efficient use of water resources by 2010'. Also, it requires that users be disaggregated into at least

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163 Hearne, R. and G. Donoso, 2005, *Water institutional reforms in Chile*, Water Policy 7: 53–69.

165 Such as Spain, Portugal and Greece.
http://ec.europa.eu/environment/water/participation/map_mc/map.htm

166 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2000L0060:20090625:EN:PDF

agriculture, industry and household sectors and that these sectors contribute to the recovery of costs in an 'appropriate' way.

Spain

Water resources management at a glance

Spain is the most arid country in Europe. It also has significant seasonal and territorial variation in water availability. Water deficits are much more frequent in the southern and south-eastern areas of Spain, where rainfall is scarce and highly variable year-to-year. This is aggravated by high evaporation.[167]

The agricultural sector is the most important user of water in the country, representing nearly 79 per cent of the total consumption. Irrigation water demand in Spain has been slowly increasing in the past decades and is expected to continue growing. As for the remaining supply, 15 per cent goes to drinking water needs and 6 per cent goes to industry.

Because of the large water imbalances across the Spanish territory there is a significant degree of interconnection.[168] Spain's water policy is also strongly influenced by the international management arrangements for four rivers which run from Spain into Portugal. In 1998, a specific water management process was developed for these basins.[169]

Spain has not implemented all the requirements of the WFD.[170]

In 2007, the approval of the reform of the Autonomous Statutes of Catalonia, Andalusia, Aragon and Valencia consolidated the power of the regional governments on water affairs, decentralising most responsibilities away from the central state.

Allocating water to the environment

The 1985 Water Law (WL) established a resource allocation reserve for current and future demands, as well as for conservation of the environment. Amendments in 1999 introduced ecological flows to meet the needs of the environment which has priority over all other uses except for public water supply.[171]

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167 Tagus- Segura; Segura-Ju´ car; Ebro-Northern Spain; Ebro-inner basins in Catalonia.

168 A. Fanlo Loras, 2005, *Water resources management in Spain,* in Sustainable management and rational use of water resources. http://www.isgi.cnr.it/stat/pubblicazioni/sustainable/148.pdf

169 M. Rodrigo, 2009, The water framework directive implementation in the Iberian context.

170 http://ec.europa.eu/environment/water/water-framework/index_en.html

171 Costeja, M., N. Font, A. Rigol and J. Subirats, 2002, The evolution of the national water regime in Spain, EUWRENESS, www.euawareness.nl

Users' water rights

Most large-scale users of surface waters are required to obtain a government concession that provides the right to abstract or divert water. A typical concession or water right entitles its holder to make use of a given volume or flow at a specific location for specific purposes. They are typically issued for 30 years, but they can have a maximum duration of 75 years.

Each basin has a Basin Hydrological Plan, which includes priority rules that detail the allocation criteria under scarcity. These are guided by general rules in the WL, which define urban users as the first priority, irrigators second and industries third.

Mechanisms for reviewing the level of water rights issued

In Spain the government has bought back water rights in order to tackle over-abstraction. For example, in the Guadiana region, permanent groundwater rights were purchased. Agricultural users were paid between 6,000 to 10,000 euros per hectare of irrigated land. The government then redistributed fewer rights than it had purchased, allocating the difference to wetlands and to increase aquifer levels. Those that gained access to new rights were granted 30-year concessions.[172]

Rights' holders seeking approval for a trade must declare the exchange price in their approval application. At this point the responsible agency can exercise the option to take the buyer's place and acquire the rights at the price laid down in the application.[173]

Water and water rights' trade

Right-holders are permitted to trade water. Trade involves users seeking approval, for exchange, from the Basin Authority (*Organismos de Cuenca*). An exchange agreement can be for one or more periods. The Basin Authority has 30 days to respond and unless major technical, environmental or third-party difficulties are encountered this will be approved. A transferable water right retains its initial priority level irrespective of the buyer's priority level.[174]

Spain also has smaller scale interregional water trading schemes. For example, the Irrigation Subscribers Association of the Riudecanyes Reservoir allows temporary water and permanent water rights' trade among its members.

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172 Garrido A. and M. R. Llamas, 2007, Water management in Spain: an example of changing paradigms, Paper presented at the Engelberg Academy Conference on Water in Switzerland.

173 A. Garrido, 2003, Water market design and evidence from experimental economics.

174 A. Garrido, 2003, Water market design and evidence from experimental economics.

Basin Authorities can set up water banks or trading centres.[175] These water banks can purchase and sell water not-for-profit, although, experience so far has been limited to the Jucar, Segura and Guadiana basins. One commentator has argued that this approach is a much more efficient means to promote trade, particularly as it may avoid third-party effects.[176]

Water banks are also used to increase environmental flow on a temporary basis. For example, in 2005, an Offer of Public Purchase (*Oferta publica de adquisición de derechos, OPA*) was issued in the Juan Basin. Agricultural users were given the option to lease out their right for one year in return for compensation. The purchased water was used to increase flows.

France

Water resources management at a glance

France has more water resources than many other European countries, although scarcity can occur locally or in certain seasons. Agriculture accounts for the majority of water consumption in France.

Water policy is set at the national level but licensing and administration is shared between the state's local representatives and municipalities.

France has a complex water resources planning system based on General Water Plans covering one or more basins and Detailed Water Plans covering one or more sub-basins (or aquifers).[177]

Allocating water to the environment

Some recent changes have occurred to the water resources planning system in order to implement the WFD. In particular, Basin Committees were entrusted with implementing the environmental objectives of 'good status' into management plans and programs of measures.[178] In general, France sets statutory minimum flow requirements for rivers, needed to guarantee environmental needs, from which no derogation is permitted.[179]

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175 Garrido A. and M. R. Llamas, 2007, Water management in Spain: an example of changing paradigms, Paper presented at the Engelberg Academy Conference on Water in Switzerland.

176 Garrido A. and M. R. Llamas, 2007, Water management in Spain: an example of changing paradigms, Paper presented at the Engelberg Academy Conference on Water in Switzerland.

177 S. Hodgson, 2006, Modern water rights: theory and practice, FAO legislative studies No. 92, Rome: Food and Agricultural Organisation (FAO).

178 Organization of water management, 2007, French water policy and its overall organisation.

179 Organization of water management, 2007, French water policy and its overall organisation.

Users' water rights

Water is part of the common national heritage.[180] The state's local representatives (*Préfet)* are responsible for issuing abstraction permits, which are required above a certain threshold (80 cubic metres per hour). The *préfet* can also take measures to limit water use in periods of shortage.

Water abstractions incur a system of charges. These vary, depending on the source and volume of water abstracted and the area in which the water is used.

The decision to grant an authorisation for abstraction (water right) is made by the *préfet* after assessing the potential impacts of the project and consulting with the population concerned. In issuing the water right the *préfet* must define an abstraction quantity per unit of time, take into account other users, ensure it complies with the provisions of the relevant plans and set other conditions relating to measurement and water abstraction points.[181]

In France a water right is granted for a defined duration. It can be withdrawn or modified should there be a risk to public health (drinking water), safety (floods) or aquatic environments. The prefect's decree must take into account these risks.

According to French law the supply of drinking water to the population has priority over all other uses. Other uses are considered after the quantity necessary to meet this demand is set aside.[182]

Mechanisms for reviewing the level of water rights issued

The *préfet* can take measures for limiting or stopping water uses to deal with accidents, floods, droughts or water scarcity. Such decisions are made after dialogue with the users.[183] In a longer term sense the responsible agencies are also understood to levy taxes on abstraction designed to promote water saving. These are, in part, based on the scarcity of the resources in each zone (abstraction from a balanced or unbalanced zone) in order to help avoid over abstraction.[184]

Reallocating water between users

In France there does not appear to be any formal trading of water rights. Some reallocation can occur through new entrants placing bids for water rights when current contracts expire. Also, the *préfet* can make the decision not to renew a water right in specific circumstances.

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180 B. Barraque' and C. Le Bris., 2007, Water sector regulation in France.

181 Organization of water management, 2007, French water policy and its overall organisation.

182 Organization of water management, 2007, French water policy and its overall organisation.

183 Organization of water management, 2007, French water policy and its overall organisation.

184 Hodgson, S., 2006, Modern water rights: theory and practice, FAO Legislative Study No. 92, Rome: Food and Agriculture Organisation (FAO).

Annexe 2: Theory of water rights

What are water rights?

Water rights define the rights and obligations a party has over a water resource. They can be defined in statute or in other legal instruments such as contracts. They can be referred to as water abstraction rights, licences, permits, allocations or entitlements.

All water rights will be partially defined by the water allocation regime. For example, any short-term emergency drought provisions will define the priority of the right. And other policies, such as the processes in place for redressing over-abstraction, will define the long-term reliability or certainty of water rights.

In England and Wales (and most commonly) 'ownership' of water rights means ownership of 'withdrawal rights' not ownership of the resource itself.[185] In other words, ownership confers the right to take a volume of water, from a water resource, for a particular period of time, at a particular location. As a result water rights can be conditional on the nature, location and timing of abstraction and use.[186] This definition differs from the legal concept of property.

Optimal definition of water rights

Theory does not define an optimal set of characteristics for property rights, and certain characteristics will be more important than others, depending on the property in question.

The literature on water rights and how this has been applied internationally suggests that water rights should be:[187]

- clearly specified – so that owners and potential holders of water rights understand exactly what benefits and obligations the right brings;

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185 Ostrom (2000), *Private and Common Property Rights*, in Bouckaert, B and De Geest, G (eds), *Encyclopedia of Law and Economics*, Volume I, Edward Elgar, Cheltenham.

186 See for example, PC (Productivity Commission) Research Report, Melbourne, Australia (2003,) *Water rights arrangements in Australia and overseas*.

187 See for example, ACIL Tasman (2003), '*Water trading in Australia current and prospective products'* prepared for the water reform working group; PC (Productivity Commission) Research Report, Melbourne, Australia (2003) *Water rights arrangements in Australia and overseas***.** Tietenberg, 1988; Saliba and Bush, 1987 suggest that property rights should satisfy the conditions of specificity, exclusivity, transferability, comprehensiveness, and enforceability (Lee, T.R. and Jouravlev, A.S. (1998) Prices, Property and Markets in Water Allocation).

- secure – such that the right is not subject to modifications or revocation at the discretion of others (this does not rule out the right being subject to attenuation under clearly defined terms);
- exclusive – the direct benefits and the costs associated with the use of the rights accrue to the holder;
- enforceable and enforced – it must be possible to determine when a right has been infringed and to have legal mechanisms for preventing or redressing this; and
- transferable and divisible – the right can be traded in whole or in part to others and is defined in a consistent manner.

These principles could be argued to commonly apply to all property rights. In specifying rights for water, the challenge is applying these principles to a common resource that inherently varies in size, based on climatic influences.

Clear specification and security

From an economic perspective, clearly specified property rights are a precondition for efficient investment, use and trade. A clearly specified water right ensures owners are fully aware of the benefits and obligations brought by the right. Thus, clearly specifying water rights generally involves specifying a right to take a particular quantity of water per unit of time at a particular location, for a defined level of reliability. The specification can also include the quality and quantity of water that should be returned.

Similarly, security is important. A secure right would not be subject to unspecified modifications or revocation at the discretion of others without due compensation. Linked to this is the concept of security of tenure. To make investments for which costs are recovered over a long period of time, users must have confidence that they will have access to any available water over the long term.

It is important to note that it is security of the right not the water, which is important. In order to allow for some adaptive management it may be necessary to attenuate rights both within and across years. With this in mind it is still possible to specify a water right that is clearly defined and secure, even if the supply from the water resource to which it relates is uncertain. In this context rights' holders must have certainty around the risks they face. This requires clearly defined and understood rules, processes and principles for any future attenuation.

With a water resource, there are two inherent uncertainties that affect available supply:

- First, the total volume of water available in any unit of time will vary as a result of seasonal and annual rainfall variations.

- Second, improvements in knowledge may result in the water needs of the environment changing.

In general the most efficient way to allocate the risks associated with uncertainties is to place them with those best able to manage or mitigate them.

The allocation of risks can come through the way the right is specified. For example, a water right can be specified as a share of the resource available for consumption, this means that the risk of variable supply is allocated to abstractors. Otherwise, under a system of fixed volumetric allocations the environment and other in-stream users bear this risk.

Many water allocation regimes enable some reduction in water rights even when they are specified as fixed volumes (for example under emergency drought legislation). In these circumstances (or more generally where rights are specified as shares) they may be prioritised or reduced proportionately.

Under a priority rule, water rights are defined in terms of two parameters – size and priority. Priorities may be determined in terms of time of use, type of use (for example, public water supply versus irrigation) or location. Under a priority system, risk-sensitive water users could be given more reliable rights. By contrast, a proportional system would allocate the same risk to each right.

A priority rights' system may have efficiency advantages in areas where water users have heterogeneous demand functions and risk tolerances. It would also be more efficient where trading or transfers of water and water rights are constrained. A proportional system is advantageous where demand or risk tolerance of users is more uniform or trading is possible such that risk adverse users can acquire more water or rights.[188]

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188 Lee, T.R. and Jouravlev, A.S. (1998), *Prices, Property and Markets in Water Allocation, Serie Medio Ambiente y Desarrollo n6,* Economic Commission for Latin America and the Caribbean, United Nations. – referring to:

Howe, Charles W., Dennis R. Schurmeier and William Douglas Shaw, Jr. (1986), 'Innovations in water management: lessons from the Colorado-Big Thompson Project and Northern Colorado Water Conservancy District', *Scarce water and institutional change,* Kenneth D. Frederick (Editor), Resources for the Future, Inc., Washington, D.C.

Exclusivity and enforceability

All the rights, obligations and responsibilities related to a water right should be protected by monitoring and enforcement arrangements. Rights holders should be given "certainty of title", i.e. the recognition and protection of their rights.

Exclusivity means water users face the full costs and benefits of their water abstraction decisions. It also ensures that the holder of a water right can use and invest in water-related infrastructure without the prospect of these investments being undermined by the actions of other parties. Each potential step in using the right, from abstraction to return, could impact other right owners or third parties. Therefore, exclusivity ensures that all parties are protected from any derogation of the water resource. For rights to be enforceable there needs to be a means for detecting and then preventing, or seeking damages, from parties that infringe these rights.[189] Where a right is not enforceable it cannot be protected from encroachment by others and so can become valueless.

Divisibility and transferability

The value of a resource will be maximised if rights to it can be subdivided and traded in part or whole. This is principally because of the need to adapt the allocation of water rights over time in order to generate the most value from its use. If public authorities had the information necessary to make trade-offs between uses (which would require information about the value of water in all alternative uses, and the demand and supply conditions for every user) administrative policies could result in an efficient resource allocation. Given that public authorities cannot acquire such information at a reasonable cost, non-tradable water rights systems are unlikely to achieve economic efficiency, and can result in a rigid allocation of water rights which is unresponsive to changing values.[190]

However, with markets comes the prospect for market failures, which can lead to transactions taking place that may otherwise be inefficient from society's perspective. These include:

- externalities – users not facing all the costs and benefits associated with their decisions; and
- information asymmetry – one party having more or better information than the other, creating an imbalance of power in transactions.

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189 Fisher (2000), quoted in PC (Productivity Commission) Research Report, Melbourne, Australia (2003) *Water rights arrangements in Australia and overseas.*

190 Howe, Charles W. (1996), 'Sharing water fairly', *Our Planet*, No. 3. (1997), 'Protecting public values under tradable water permit systems: efficiency and equity considerations', *Seminar on Economic Instruments for Integrated Water Resources Management: Privatization, Water Markets and Tradable Water Rights. Proceeding*, Inter-American Development Bank, Washington, D.C.

In the case of water rights, Lee and Jouravlev (1998) highlight that third parties, in particular the environment, could be exposed to externalities arising from water or water rights' trades. A clear specification of rights and obligations is necessary to prevent this. Similarly, a clearly specified right helps prevent the risk of information asymmetry as parties are better able to identify what it is they are purchasing.[191]

Trade-offs and choices

Water rights that possess the five attributes described above create the conditions for an efficient water allocation regime by providing abstractors with the security necessary to encourage investment; protecting third parties and, in particular, the environment; and facilitating the efficient allocation of water.

Failing to achieve these conditions would have negative consequences on these objectives.

- Clearly specified secure rights are necessary to protect the environment and to encourage investment and trade.[192]

- Exclusivity and enforceability are necessary conditions for providing investors with security and lead to efficient levels of investment. Also, if rights are not exclusive maintaining a certain level of water for the environment is difficult.

- Finally, water rights with limited divisibility and transferability would hamper trade, with further consequences for investment. The promotion of efficient investment requires a framework that permits the benefits of competing water uses and the costs of getting the water to these uses, to be compared in a meaningful way.

That said, trade-offs exist between the criteria for well-defined water rights. These need to be considered by policymakers.

The main trade-offs exist between the clear specification of rights and other attributes most notably tradability. Lee and Jouravlev (1998) stress the necessity of secure, well-specified water rights.[193] However, they simultaneously warn that

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191 Limiting the risk of information asymmetries also requires specific institutional features. For example, an adequate and accessible register of titles and record of transfers. This reduces transaction costs by facilitating the enforcement of property rights and by enabling market participants to be sure of the nature of any water right they wish to purchase.

192 Shabman, Leonard and William E. Cox (1986), 'Costs of water management institutions: the case of southeastern Virginia', *Scarce water and institutional change*, Kenneth D. Frederick (Editor), Resources for the Future, Inc., Washington, D.C.

193 Attributes would include quantity diverted, timing and places of diversion, use and return of water.

the definition of the right should not be excessively detailed, given that markets operate more efficiently when the commodity being traded is homogeneous. Indeed, the more detailed the definition of the property right in water, the greater the heterogeneity. Heterogeneity could create higher transaction costs for potential buyers and sellers, and lead to a lower number of market participants for each product.[194]

Trade-offs also exist between other attributes. Improving the tradeability of rights without adequate controls might jeopardise exclusivity. For example, a water rights' trade could result in a change in the abstraction location. This may lead to an increase in abstraction in a location that may reduce the reliability of other users' rights in the immediate vicinity.

Because of these trade-offs, there is no one best definition for water rights. In practice, the approach that best meets the objectives of the water allocation regime will depend upon the specific characteristics of users and the water supply. The following table summarises the main trade-offs. The table also illustrates potential solutions for offsetting any impacts of favouring one attribute over another.

Table A11. Illustration of trade-offs between attributes

Attribute	Decision	Impact on other attributes	Potential solution
Specificity	Highly specified rights	*On tradability*: an increase in the heterogeneity of rights can deter trade	Develop a system of exchange rates to allow conversion between different types of rights Unbundle the rights into tradeable and non-tradeable components. This creates more homogeneity across the tradeable components of the right
Tradeability	Enabling greater trade of rights	*On exclusivity*: can impact on third parties by the potential for a change of use or abstraction location	Define clear rules for trade, increase the specificity of rights, or unbundle rights
Exclusivity	A detailed approval process which protects the environment and other users	*On tradeability*: can restrict trade and limit the size of the market	Set out the rules clearly to ensure market participants understand these

Source: Frontier Economics.

194 Howe, Charles W., Dennis R. Schurmeier and William Douglas Shaw, Jr. — (1986), *Innovative approaches to water allocation: the potential for water markets,* ***Water Resources Research***, April, No. 4.

Conclusion

The literature defines a number of attributes essential for water rights. These attributes are a clear specification of rights, security, exclusivity, enforceability, divisibility and transferability. These conditions all have to be at least partially met for the system to reach its objectives.

However, the theory also recognises that trade-offs exist between these attributes. In particular, the way rights are specified has major impacts on other conditions. The decision to fully meet one of these criteria would largely reduce the likelihood of meeting others.

Consequently, what the theory provides is a framework for the definition of water rights. The objectives of the water allocation regime and the country's specificities, will then inform the decision to favour one attribute over another. Heaney et al. (2005) suggest that the appropriate balance is likely to differ between countries as the benefits (of improved outcomes from trading) and costs (of formulating, implementing and administering the necessary institutional arrangements) will differ.[195]

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195 Heaney A., Dwyer G., Beare S., Peterson D. and Pechey, L. (2005), *Third party effects of water trading and potential policy responses*, conference paper presented to the American Agricultural Economics Association, Providence, Rhode Island, 25–27 July 2005.

Annexe 3: Scope for water trading

The report identifies that trading will be more likely to occur where:

- there is greater disparity in users' marginal water valuations, such that they can derive a greater benefit from trade; and
- where the costs of interconnection are lower.

However, it also highlights that the scope for beneficial trades between different users will be limited by the geographical size and composition of markets. In particular, the report identifies that, among other things, the scope for trading will be affected by:

- differing valuations between users;
- the homogeneity of water rights; and
- the nature of users in a region.

This Annexe provides data, mostly relating to the east of England, to support the analysis contained in Chapter 7 of the report. Please refer to this chapter for further details around how this data has been used to support our analysis.

Users' water valuations

There are few reliable sources of information about the values placed on water by different type of use (or users) in England and Wales. This section briefly presents results of selected academic literature on this issue. We have drawn primarily on work by Moran and Dann (2008),[196] which summarises results from previous research and provides additional analyses.

Public water supply

Households valuations

In East Anglia, water supply to households represents a third of total licences. In common with other parts of England and Wales households pay for water based on an annual tariff that reflects the average regional cost of supply. It is therefore hard to observe the public's response to variations in price.

Consequently, the literature tends to use estimated demand functions to measure the marginal value of water for individual consumers. Moran and Dann (2008) reference an elasticity of demand for water for Swedish households of -0.2. On

196 Moran and Dann, 'The economic value of water use: implications for implementing the Water Framework Directive in Scotland', Journal of environmental management, 2008.

this basis, they estimate that the households' willingness to pay for water in Britain varies from 0.102 pence/m³ (in Northumbria) to 0.244 pence/m³ (in the South West).

However, these figures look unlikely and their usefulness in deriving households' water values are limited. First, because these are average figures for relatively large regions and second because they are based on consumers facing average not marginal costs.

Water company estimates of incremental costs of supply may therefore provide more useful estimates.

Incremental costs of public water supply companies

In preparing Water Resource Management Plans (WRMPs), water companies predict future supplies and demands in each water resource zone and, in case of supply shortfall, set out the options to restore balance between supply and demand. All else being equal, schemes with the lowest Average Incremental Social Cost (AISC) will be selected. The AISC measures the incremental cost of each option in pence per cubic metre (pence/m³), including the whole-life economic cost (capital and operating costs), and social and environmental costs (e.g. cost of carbon emissions). AISC of the marginal scheme in each water resource region might therefore be used as a proxy for the value placed on water by household users. This approach has the advantages of greater geographic specificity (water resource zones are generally smaller than companies operating regions) and the fact that the costs are incremental. Nevertheless, they should be used with caution because they are cost-based, and the outcome of an essentially administrative process.

In its 2010 study of the potential benefits of upstream markets Ofwat summarises the AISCs of the least cost options envisaged by supply companies in their draft WRMPs (2008).[197] Across England and Wales the next incremental AISCs vary from 20 pence/m³ to more than 100 pence/m³. Importantly, AISCs have not been computed in regions where water is expected to remain in surplus or in regions where no more exploitation is possible. **Figure A31** presents approximate estimates of the next incremental AISCs by region.

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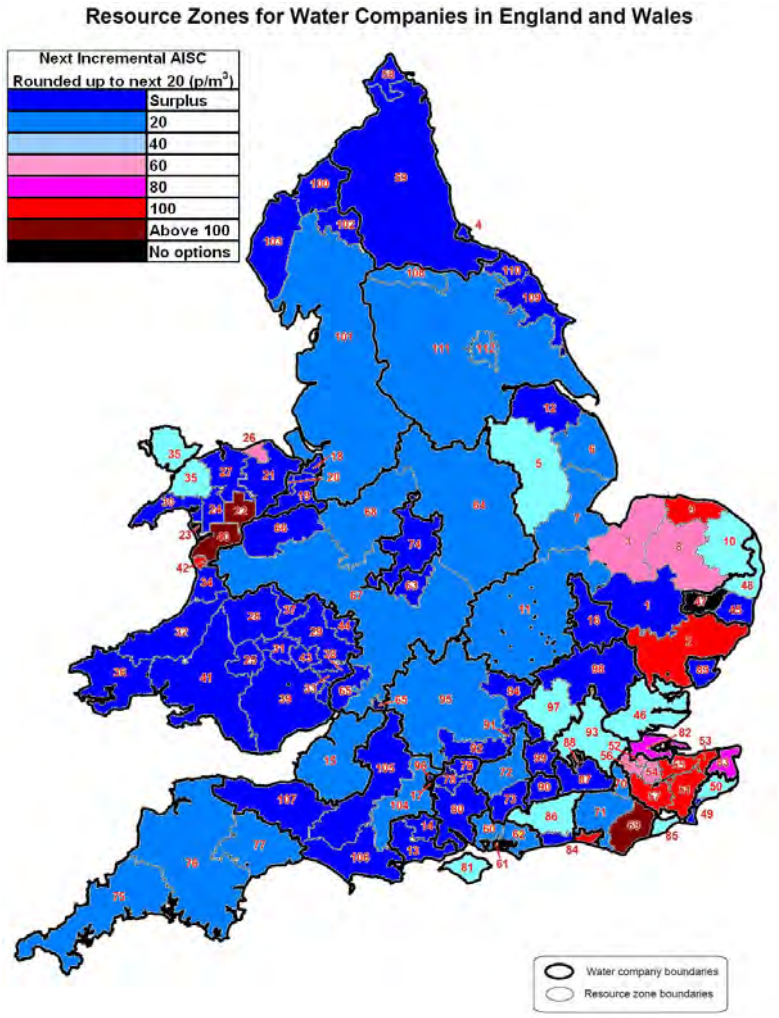
197 Ofwat 2010 – *A study on potential benefits of upstream markets in the water sector in England and Wales.*

Figure A31. Incremental cost of water by region in England and Wales (p/m3)



Source: Ofwat 2010 – A study on potential benefits of upstream markets in the water sector in England and Wales (Ofwat calculations based on draft WMRPs).

East Anglia is one of the regions with the largest variation in AISC, as it includes areas with water surplus (Cambridgeshire and West Suffolk) as well as areas with some of the highest incremental costs (East Suffolk and Essex and North Norfolk Coast).

Agriculture

The most common method used to estimate the value of water for agricultural and irrigation purposes is the net-back model, where all farming costs, except water, are subtracted from the benefits made from selling the output produced. The resulting margin represents the maximum price that irrigators would be willing to pay to irrigate their land.

Bate and Dubourg (1997[198]) define a net-back method to assess the willingness to pay of irrigators for water in East Anglia. Moran and Dann (2008) follow Bate and Dubourg's methodology to analyse the willingness to pay of potato farmers in Scotland. They estimate these irrigators' maximum willingness to pay as being between 23 pence/m³ and 138 pence/m³.

However, and as highlighted by Moran and Dann, this analysis is only considered indicative, as it does not account for subsidies or variations in demand within or across seasons as a result of rainfall variation or changes in market prices.

In addition potatoes are unlikely to be representative of water valuations for other crops. Water valuations are likely to differ greatly depending on the commodity produced. This is because the intensity of water use differs across crops and because the added value may vary independently of the intensity of water use. As an illustration, Table A12 presents the added value per ML consumed for various agricultural commodities in Australia.

Table A12. Gross margins from a range of irrigation products in Australia

Commodity	Mean gross margin ($AUS'000/ML)
Pasture(Livestock)	0.075
Rice	0.125
Dairy	0.32
Cereal	0.135
Annual Row Crops (i.e. cotton, soyabean	0.225
Vine and tree fruit	450
Vegetables	1100

Source: Moran et al. (2009). [199]

These estimates should not be taken as water valuations. However, with such large variations in the total value added from commodities when expressed in ML of water used, it seems likely that the value attached to the underlying water input might vary.

[199] Net-back analysis of water irrigation demand in East Anglia (Roger N. Bate and W. Richard Dubourg, Centre for Social and Economic Research on the Global Environment, University College London and University of East Anglia, 1997.

[200] Moran, Barrett and Cote, 'A statistical analytical method to assess the potential for worked water sharing between mines' (Centre for Water in the Minerals Industry, The Sustainable Minerals Institute, The University of Queensland, Brisbane Australia.

We are not aware of similar studies in the UK but it would seem reasonable to suppose that substantial variation in implied water valuations between crop types would exist in the UK.

Industry

Renzetti and Dupont (2003)[200] assess the value of water to Canadian industries using a marginal value approach. This involves solving a cost minimisation problem, which then allows them to derive the shadow price of water. This is the willingness to pay for one unit of water based on the resulting impact on the value of production from this unit change in input. The figure below summarises the results from Renzetti and Dupont, translated in pounds by Moran and Dann (2008).

Figure A32. Industrial value of water use (per m^3)

Manufacturing industry	1991 values ($can)	2004 values ($can)	2004 values (£UK)
Refined petroleum and coal products	0.288	0.362	0.157
Primary metal	0.107	0.134	0.058
Chemical and chemical products	0.072	0.09	0.039
Fabricated metal products	0.048	0.06	0.026
Beverage	0.038	0.048	0.021
Plastic products	0.032	0.04	0.017
Paper and allied products	0.031	0.039	0.017
Transport equipment	0.025	0.031	0.014
Non-metallic mineral products	0.023	0.029	0.013
Wood	0.02	0.025	0.011
Food	0.027	0.021	0.009
Rubber products	0.006	0.008	0.003
Textile products	0.005	0.006	0.003

Source: Moran and Dann (2008).

Moran and Dann (2008) recognise that it is slightly inaccurate to simply translate Canadian 1991 $ into GB 2004 £, for two reasons:

- technology has evolved in the intervening period; and
- even with similar technologies, the related costs may differ substantially between the two countries.

[201] Renzetti, S., Dupont, D.P., 2003, The value of water in manufacturing, CSERGE Working Paper ECM 03-03, University of East Anglia.

However, this gives an indication of the range of water valuation for the industry. As with agricultural crops, valuations vary greatly across different types of industrial usage.

Power generation

No estimate was available of the long run marginal cost of water for power generation for England and Wales.

Different power generation technologies consume different quantities of water to produce 1MWh of electricity. So valuations may be likely to differ between power generation technologies.

Aquaculture

Moran and Dann use an avoided costs method to determine the long run value of water for aquaculture. Some fish farms use filtration techniques to avoid disposing of solid waste in water. Using an estimate by Slatski (2004)[201] for the cost of a technology filtering water abstracted, Moran and Dann assess the cost for solid removal abstracted aquaculture at 0.126 pence/m^3.

Summary of valuations

Table A13 summarises the valuations of water by user and methodology, expressed in 2009 prices.

Table A13. Summary of water valuation (2009 prices)

	Lower bound (pence/m^3)	Upper bound (pence/m^3)	Approach	Source
Aquaculture	0.15		Average avoided costs for disposal of solid waste	Moran and Dann (2008)
Public water supply (based on households' valuations)	0.11	0.28	Demand response function	Moran and Dann (2008)
Public water supply (based on incremental costs of water supply companies)	0.00	more than 102	Incremental cost of supply	Ofwat (2010) based on water supply companies draft WRMPs (2008)
Industry	0.34	17.76	Shadow price of water derived from Long run cost minimisation model	Moran and Dann (2008) based on Renzetti and Dupont (2003)
Agricultural irrigation (based on potato growers)	26.36	158.15	Net-back cost model (maximum price an irrigator could pay for water for margin to remain positive)	Moran and Dann (2008)

Sources: Moran and Dann (2008), Renzetti and Dupont (2003), Ofwat (2010) based on water supply companies draft

[202] Slaski, R., 2004, Federation of Scottish Aquaculture Producers, pers.comm, Valuation of water use draft report—input from aquaculture, e-mail, 18 June 2004.

WRMPs (2008). See Annexe 3 for further details of the approaches adopted.

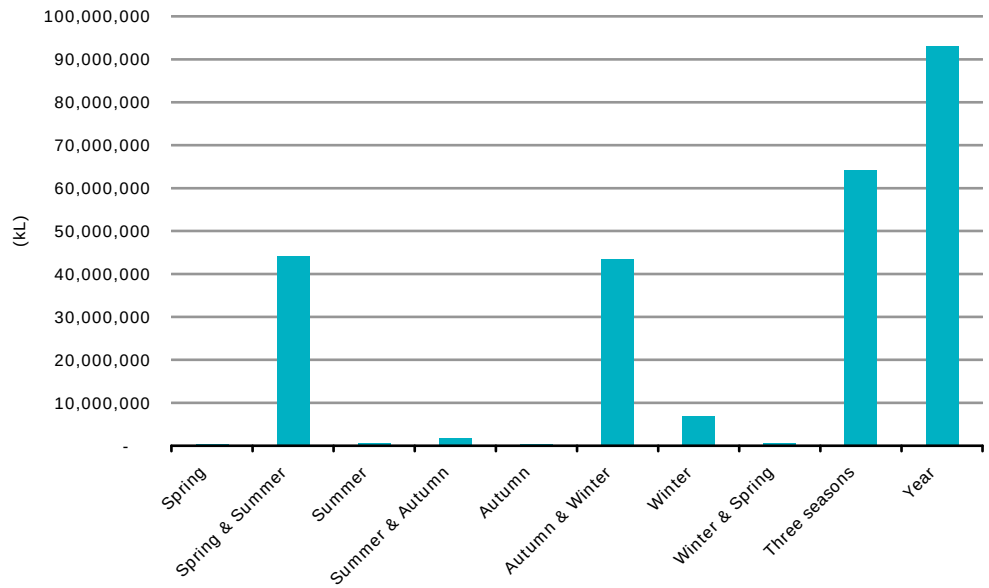
With limited data, caution should be exercised in drawing conclusions from this data. Nevertheless, this evidence suggests that there may well be a substantial range of valuations by type of use and this would seem to support the prospects for beneficial trade between users in different sectors or between those that use water differently in the same sector.

Clearly, whether difference in valuations lead to actual trade, depends crucially on the locations of the users relative to one another and to the catchments concerned. It also relies on there being rights in a form that is attractive to buyers. We now turn to these issues.

Homogeneity of water rights

Water rights are not all homogenous. They can contain different conditions relating to the daily and annual amount that can be abstracted. In particular, many irrigation licences in East Anglia are seasonal. **Figure A33** shows the seasonality of different irrigations licences in East Anglia. By volume almost 70 per cent are seasonal rather than annual.

Figure A33. Seasonality of irrigation licences (kL licensed)



Source: EA NALD data for East Anglia.

This lack of homogeneity in water rights may partly restrict trading of rights. Less uniform rights limit the development of standardised trades, resulting in a higher

transaction cost. In the case of a seasonal licence users may also need storages in order to use these licences.

Nature of users in East Anglia

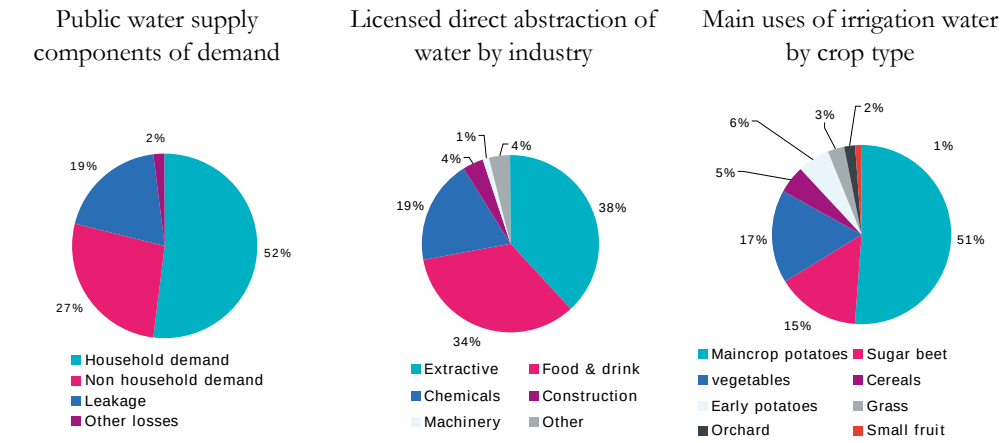
As noted above, whether difference in valuations lead to actual trade depends on the locations of the users relative to one another. In this section we look at data about the users of water in East Anglia. In particular we look to what extent there are different types of user and whether users of different types are present in the same catchments. By doing so we aim to understand more about the scope for trade. In general we presume that the scope for trade will be greater:

- the more distinct types of user there are within each catchment; and
- the more users there are within each catchment.

Broad categories of water use

Figure A34 shows the largest uses of water, within each category, in East Anglia. The broad categories of users hide significant diversity within these user groups. For example, there are different categories of industrial and irrigation users. The evidence above indicates that these different subcategories of users could have very different valuations.

Figure A34. Variety of water uses within each category, in East Anglia



Source: Environment Agency, *Water resources for the future, a strategy for Anglian region*, March 2001. Public water supply and irrigation water are expressed as shares of the licence volume, the industry is expressed in shares of licences.

Users by sub-catchments in East Anglia

Table A14 shows the number of resource units where different types of users are represented. Agriculture, irrigation and industrial users have licences to abstract in more than half the region's sub-catchments. It is worth noting that 43 per cent of resource units include public water supply and one of these other types of user.

Table A14. Number of catchments in which each type of user is represented

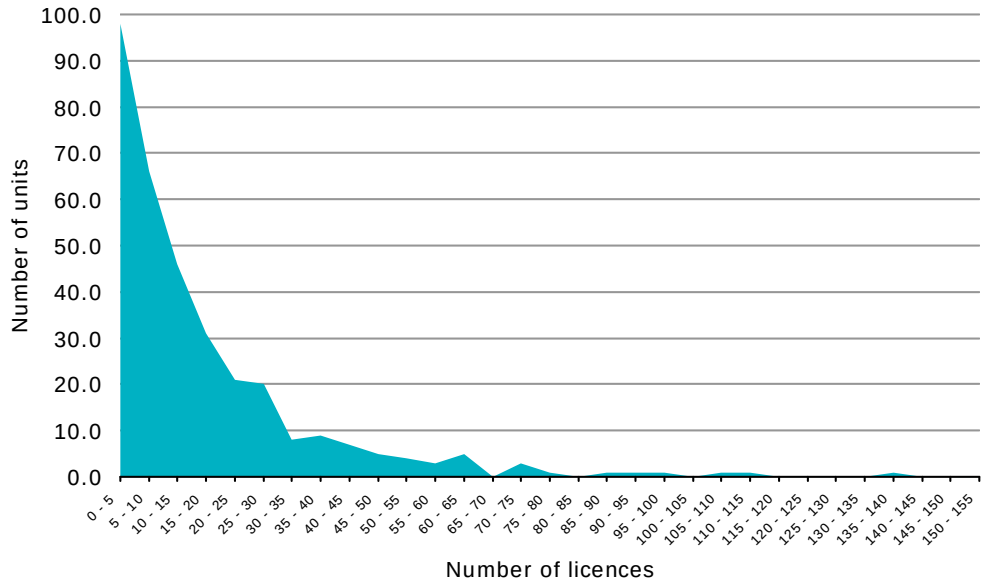
	Aquaculture	Public water supply	Power generation	Industry	Agriculture and irrigation
Number of sub-catchments	18	138	3	177	293
Share of sub-catchments	6%	44%	1%	57%	94%

Source: Anglian Water data, excluding tidal catchments.

Number of market participants

Within resource units, the main constraint to trade could be the limited number of market participants. The number of market participants can be approximated by the number of licences in each area. On average, there are 18 licences per resource unit in East Anglia. **Figure A35** shows the distribution of resource units by number of licences. Almost half the resource units have less than 10 licences, and three-quarters have less than 25 licences.

Figure A35. Distribution of resource units by number of licences[202]



Source: Frontier Economics analysis of EA NALD data for East Anglia.

This Annexe provides selected data used to support the analysis of the scope for trade presented in Chapter 7 of the report. Please refer to this chapter for further details around how this data has been used to support our analysis..

202 Note that one resource unit counts 276 licences. It does not appear on this chart for clarity purposes.

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