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Reform of Freshwater Abstraction

In some parts of the UK, high levels of water abstraction are reducing the quantity and quality of surface water (rivers, lakes) and groundwater (water accumulated in spaces in soil and rocks). This POSTnote sets out the challenge of balancing competing requirements for freshwater, and summarises proposed reforms to the abstraction system in England and Wales and their implications.

Overview

- Freshwater resources in the UK will be affected by climate change and rising demand due to population growth.
- The existing water abstraction (withdrawal) system is too inflexible to both protect freshwater environments and to meet future business and public water supply needs.
- Proposed reforms to the abstraction system include measures to better link abstraction to water availability and to introduce quicker and easier trading of abstraction permits.
- A 'twin-track' approach of managing both water supply and demand may help to achieve water supply resilience.
- Water resource decision-making could benefit from increased stakeholder collaboration and better integration with land management.

Background

Water is abstracted (withdrawn) from either freshwater (surface water and groundwater) or tidal water for a range of uses. While water issues exist in many parts of the UK, this POSTnote focuses on proposed abstraction reforms in England and Wales. In these countries, the majority of freshwater is used for public water supply and electricity generation. The balance between surface water and groundwater abstraction varies by region. For instance, the geology of parts of South and East England means that groundwater provides over 70% of drinking water supply.[1] Total freshwater abstraction has declined by 15% since 2000, mainly because of a decline in water usage for electricity generation.[2] However, demand is expected to rise by 9% over the next 30 years.[3]

This is largely because of forecast population growth of 6.6-16 million in England and Wales.[4] Much of this growth will be concentrated in areas already classified as 'water stressed', such as the Thames catchment. In addition, even currently water-rich areas such as the west of the UK are likely to experience supply-demand deficits by 2050 because of climate change.[3] An increasing number of catchments (areas of land drained by river systems) will be unable to meet abstraction demand without further climate change adaptation beyond that already set out by the UK's water companies.[3] This POSTnote sets out the challenges for managing freshwater abstraction, planned licensing system reforms, and other measures to balance the competing needs for water and the environment.

Constraints on Freshwater Resources

A large proportion of abstracted water is returned after use. For example, public water supply returns up to 90% of treated flow,[1] although rarely to the same place it is taken from. Some activities, such as spray irrigation, consume almost all their abstracted water. Climatic changes may lead to dwindling supply from some freshwater resources over the coming decades, because of both a reduction in summer rainfall and increased evaporation from surface water.[3] Without an adequate quantity and quality of water, the ecology of freshwater bodies may deteriorate.

Effects of Climate Change and Drought

Many parts of the England and Wales are likely to experience a significantly drier climate over the coming decades. In the East of England, the risk of 'severe' drought could treble, from a 1 in 200 annual chance to a 1 in 70 annual chance.[4] By the end of the century, serious droughts like that of 1975/6, when standpipes were installed in parts of the country to ration water, could have a 1 in 10 annual chance of occurring.[5] Hotter and drier conditions are likely to lead to greater demand for water from household users (for

gardening and showering) and agriculture (for irrigation and livestock), but usage may have to be restricted in times of drought. Water companies currently rely on Drought Orders and Permits for prioritised access, but there is some uncertainty about how this system can cope in future.[4] Water UK estimates that imposing the most severe water restrictions, including largely untested Emergency Drought Orders, would cost the UK economy £1.3 billion per day.[4]

Overall, the Environment Agency (EA) is projecting an average drop in river flows of 15% by 2050, but predicting future changes in flow is complex. This is because of uncertain rainfall patterns and difficulties in distinguishing long-term trends from year-to-year variability.[6] There will also be increased seasonal and geographical variability. Average winter flows may increase in the coming century,[7] but spring and summer flows could decrease by 50-80%.[1] Groundwater recharge (i.e. water moving downwards from the surface) could also suffer, with up to 40% reduction in recharge in southern England by 2080 under 'high' climate change (a worst case scenario approximating to a 3.5ºC increase).[8,9] Lower flows and recharge rates lead to reduced dilution of pollutants, which can adversely affect ecosystems and water supply quality (POSTnote 478).[1,10]

Current Abstraction Licensing System

The EA and Natural Resources Wales (NRW) regulate water abstraction in England and Wales respectively. In both countries, most abstractions are licensed within the same system, first introduced in 1963 (Box 1). Over 21,000 licences now exist,[11] of which 79% are licences of right, meaning they are issued in perpetuity. These exist alongside time-limited licences, which are valid for a set period with regular environmental impact reviews. More than a third of issued licences, primarily held by agricultural and industrial users, remain unused (termed 'paper water'). The EA suggest there could be widespread environmental deterioration if all allocated rights were used to their full extent. The current system was developed at a time when there were fewer concerns about the environmental effects of abstractions, and over-allocation of water licences has become problematic. Defra have stated the abstraction system is dated and inefficient, and environmental protection is expensive and time-consuming to deliver.

Sustaining Freshwater Ecology

Freshwater bodies provide benefits to humans, known as ecosystem services (POSTnote 281), which include fish production, recreation, and water provision and purification.[15] The EA sets out its approach to balancing abstraction demands against the need to maintain desired ecology, particularly of surface water, through its Catchment Abstraction Management Strategies (CAMS). Currently, 6% of freshwater bodies in the UK fail to meet environmental standards because of over-abstraction.[16] The EA estimate the target amount of water needed to sustain freshwater ecology by modelling Environmental Flow Indicators (EFIs; Box 2). At a particular threshold, below which ecological damage could occur, the EA imposes 'hands off flow' controls (HoF; Box 2) on abstraction licences.

Box 1. Abstraction Legislation

The abstraction licensing system in England and Wales was formally introduced in the Water Resources Act 1963, and became regulated by the Environment Agency (EA) under the Water Resources Act 1991 (POSTnote 419). The Water Act 2003 introduced a number of amendments to the Water Resources Act 1991 to comply with the European Union's Water Framework Directive (WFD). This includes a requirement for all water bodies to achieve Good Ecological Status (i.e. conditions close to their natural state) by 2027. [12] Consequently, the Restoring Sustainable Abstraction (RSA) programme has sought to investigate the causes of environmental damage and to reduce unsustainable abstraction.[13] Licence holders can be compensated if their licences are modified or removed under RSA. However, the WFD may not be applicable following the UK's anticipated exit of the European Union.[14]

Planned Reforms to Abstraction Licensing

Defra and the Welsh Government consulted on reforms to the abstraction regime from 2013-2016.[16,17,18] Following from the consultations, phased implementation by the EA and NRW is expected in the early 2020s. The focus is on linking abstraction volumes more closely to water availability. The Adaptation Sub-Committee of the Committee on Climate Change (ASC) has warned that the reforms should be undertaken before new infrastructure is built that relies on current levels of abstraction.[19]

Managing Catchments as a Whole

The new licensing regime proposed by Defra and the Welsh Government will be introduced in two stages.[20] Firstly, abstractors previously exempt from licensing will be integrated into the current system (Box 3). Secondly, all abstraction licences will be reissued as 'permits' based on past peak water usage over at least 10 years (including in dry years).[16] This time period is designed to ensure that climate variability is taken into account when setting future allocation levels. Different allocation methods may be needed to account for groundwater, since it responds to weather changes more slowly than surface water. However, reallocating permits based on past water usage could lock in, and perhaps reward, previous inefficient water use.

To avoid undesirable effects on power generation, industry, agriculture and water companies, the abstraction system will be managed collaboratively by abstractors and regulators, according to rules adapted to the specific needs of each catchment. The most water-scarce catchments (less than a third of the total) will be designated as 'enhanced catchments', with specific rules for environmental controls and trading of permits (see page 3).[21] Groundwater sources can involve multiple catchments, so may be more difficult to

Box 2. Modelling and Control of Surface Water Flows

- **Environment Flow Indicators** (EFIs) are used by the EA and Natural Resources Wales (NRW) as a precautionary estimate of the likely amount of water needed to sustain the ecology of a river. EFIs vary across rivers[12] and do not provide direct measures of local ecosystem 'health'.[22] Environmental flows tend to be set on the basis of expert consensus supplemented by local knowledge or studies for specific river reaches.[23]
- **Hands off flow** (HoF) is a minimum flow condition below which abstraction must cease. This is set as at a particular threshold (such as the flow level that is exceeded 95% of the time) where serious ecological damage could occur. However, the science behind setting HoFs is often uncertain.[24]

Box 3. Ending Abstraction Exemptions
Approximately 5,000 'New Authorisations' are planned by Defra to end certain exemptions, which had allowed abstractors to legally take an unlimited supply of water.[11] These include trickle irrigation farms, quarries, mines and ports. Ending abstraction exemptions will help to maintain future water supplies. However, indirect effects of ending exemptions could include increased food imports and impacts on jobs and production, if agriculture and mining operations move overseas because of uncertain future water supply.[11]

manage on a catchment basis.

Improved Sharing of Water

Most permits will continue to specify absolute annual and daily constraints on abstractions, but in enhanced catchments, a water share 'accounting' framework will be introduced.[17] This will provide abstractors with a proportion ('share') of the total available water in each catchment. Short-term allocations based on these shares should allow a range of trades to occur, including flexible 'put and take' water transfers; for instance, from reservoirs and re-use schemes. Defra's impact assessment suggests that net economic benefits of introducing the water share accounting framework in England and Wales could be £100-£650 million over 25 years.[16] Defra and the Welsh Government have proposed a scaled approach to permit charges, with higher prices for reliable water access and lower prices for less reliable access. As in the current system, charges for permits will be based on the cost of issuing them.[24]

Flow-Based Controls

Under the new abstraction system, all permits will have conditions that set flow-based controls to protect the environment. One option may be 'smart licensing', where the amount of water that may be abstracted gradually reduces as river levels drop. Smart licensing requires flow data in near real-time, so may be expensive and complex to introduce.[25] However, if properly implemented it could achieve environmental flow targets more frequently than conventional seasonal abstraction limits.[25] Defra's proposed system will have 'hands off flows' (HoF; Box 2), which change in response to actual conditions instead of being fixed. Important decisions will need to be taken over which permits take priority in times of low flow.[26]

Removal of Time Limits

To simplify the abstraction system, all permits will be reissued without time limits, but will be subject to ongoing review. This differs from the current system, where time-limited licences are periodically re-assessed for environmental damage. Compensation would not be paid for losses due to changes to abstraction conditions on permits. The EA and NRW will publish data on risk indicators of abstractions, and give notice of permit changes at least 3 years in advance (except in the case of serious environmental damage, where no notice will be needed). Some commentators worry that perceived uncertainty from unpredictable permit reviews may deter long-term investment in water management.

Further Measures to Manage Abstraction

A range of further measures are being implemented or considered by Defra to manage levels of abstraction. These include introducing more efficient permit trading, enhancing the ability of water companies to cope with disruption and working with stakeholders to maximise water use efficiency.

Trading of Water Permits

Defra plans to introduce quicker and easier trading of permits in enhanced catchments to allow abstractors to exchange water allocations through a range of pre-approved trades.[20] Trading setups are likely to vary by catchment, but will be based on an electronic system that allows water prices to be agreed between the buyer and seller directly. It is anticipated there will be minimal 'spot trading' (i.e. transactions settled on the spot), with most trading part of long-term agreements to provide water in times of need.

In theory, trading reduces adverse environmental and economic effects in times of water stress.[26] Some studies also suggest that trading may encourage efficiency and promote innovation.[27,28] Australia is often held as an example of how the introduction of tradeable licences has led to efficient new usages of water (Box 4). However, the extent to which this can be attributed to trading is disputed, as at the same time there has been a major investment programme to improve irrigation efficiency.[29] The Australian experience may not be entirely applicable to the UK, but it suggests that strong regulation and clear communication of information, risk and permit reliability will be essential for establishing a functioning water permit market.

Trading of permits could enable more effective resource distribution, especially through 'put and take' arrangements. For example, in Kent, trickle irrigation farmers are considering trade arrangements with water companies. Water reuse schemes may supply cheaper, untreated water to fruit growers locally, while other growers could benefit from companies trading reservoir water. Other areas with irrigated farming, such as East Anglia, may benefit from similar schemes. However, challenges could include:

- Large abstractors dominating the market, raising costs and decreasing accessibility for smaller users and negating the benefits of trading.
- 'Water brokering' (third-party negotiation) emerging if third parties without a direct need for water are allowed to hold shares in catchments.
- Hoarding of tradeable volumes if there is uncertainty about water access during droughts. Trading may lead to

Box 4. Water Markets: The Australian Example
Some studies suggest that water markets have driven innovation in Australia,[26] but other commentators claim their effect has been marginal. Australian water rights are defined as a share of available water within a cap-and-trade system. Public water supply is effectively separate from water markets.[30] There are important differences between the UK and Australian water systems:

- Rivers in Australia tend be large and therefore lend themselves well to being dammed, with 84,000 gigalitres (Gl, billion litres) of storage capacity in reservoirs (1,600 Gl in England and Wales).[30] Flows in Australia can therefore be regulated and water allocated over longer timescales than in the UK.
- Water services in Australia are publicly owned, relying on state corporations or local authorities instead of private companies.
- There is a low proportion of agricultural abstractions in the UK (< 2%) compared to Australia (65%).[31,32]

Box 5. Reducing Demand and Enhancing Supply

Overall, the Government aims to reduce water consumption from 150 litres per person per day, to 130 litres per person per day by 2030.[33] This could be achieved through flexible and scalable demand reduction strategies. These include installing 'smart' water meters (POSTnote 471), retrofitting water efficiency products and improving building standards.[34] Innovative technology can be used to tackle leakages, which account for over 10% of public demand for water in many areas.[3] However, cultural and behavioural barriers remain to demand management.[35,36] The Adaptation Sub-Committee of the Committee on Climate Change (ASC) recommends that implementing water prices that reflect scarcity could reduce demand.[37] However, 'scarcity pricing' does not always result in reduced water usage.[26] 'Tiered (or rising block) pricing', where prices differ for essential and non-essential uses, may provide incentives to conserve water,[38] but may not address the issue of low water users cross-subsidising (typically more affluent) high water users.[35]

Supply enhancement includes water transfers between river catchments (such as from the River Severn to the Thames), new reservoirs and extended dams, desalination plants, recharging of groundwater aquifers with treated water, and effluent reuse for public water supply (POSTnote 419). Large-scale transfers and infrastructure construction can affect the environment (such as transfers spreading invasive species, and reservoirs de-naturalising flows), and present technical, commercial and financial challenges. In some cases, costs and risks can be spread across sectors, such as reservoirs or large-scale transfers serving both agriculture and public water supply. While large-scale supply interventions can be expensive to implement and require long lead times, the cost of inaction may be far higher. According to Water UK, the additional cost (not bill impact) of making water supply more resilient to severe droughts would equate to £4 per year per household.[4] The value that consumers place on avoiding severe restrictions during droughts is ten times more than this.[4]

increased water usage, which, if initial allocation rights exceed environmental thresholds, could lead to deterioration. However, evaluating effects of trading on the environment is difficult (POSTnote 542).

- Abstraction of a volume of water upstream represents a larger proportion of flow than it does downstream.[24] Therefore, over-allocation of water may arise if a trade results in abstraction taking place further upstream.
- Reduced prices from efficiency gains may stimulate consumption, thereby leading to increased abstraction.[39]

Increasing Resilience of Water Companies

Ofwat, the water regulator in England and Wales, has a duty of 'resilience' (the ability to cope with, and recover from, disruption[40]) under the Water Act 2014, and expects water companies to build resilience into their business plans. The Water Resource Management Plans (WRMPs) of water companies show how they intend to fulfil their statutory duty to supply water over a 25-year period. A 'twin track' approach will likely be needed to improve water security in England and Wales, with strategies that both enhance supply and reduce demand for water (Box 5). However, the current system for drought planning by water companies in England may be encouraging a narrower focus on supply-side measures over demand management.[41]

Modelling Risk and Resilience

To date, WRMP guidance has required companies to plan for the worst historic droughts. The latest focus on resilience encourages companies to use innovative modelling to improve evidence around future risks. Water companies can stress-test policy options, or assess them against multiple success criteria over hundreds of scenarios using approaches such as Robust Decision Making.[42,43] For example, Water Resources in the South East,[44] a regional grouping of six water companies, models future water demand to inform each company's WRMP. The UK Government Office for Science have emphasised the need for public investment in monitoring and modelling to improve resilience of the water supply sector.[1] One option would be for an overarching national framework for the water sector that explicitly defines 'resilience' and ensures consistency in companies' strategies.[45]

Stakeholder Collaboration on Water Efficiency

The UK Climate Change Risk Assessment 2017 evidence report suggests water-scarce areas may need to maximise water efficiency by moving to more collective arrangements.[6] 'Adaptive co-management', where water users devise flexible rules together, could promote more collaborative water management.[46] Collaborative arrangements range from farm-based water-sharing schemes, to river catchment management partnerships bringing together key stakeholders. Over 100 catchment partnerships (composed of 1,500 organisations) exist in the UK,[47] which could be used as a basis from which to develop a catchment-based approach. The Water Resources East planning forum brings together Anglian Water, farmers and other sectors to better understand risks and improve long-term planning.[48] However, commentators have suggested a centralised planning authority or 'Catchment Boards' may be needed alongside such collaborative schemes to ensure efficient and integrated catchment management.[49,50] This would likely require a 'catchment system operator' with a duty to consider legislative frameworks and to carry out day-to-day coordination (similar to the Electricity National Grid).

Interactions with Land Management

Certain land management practices can decrease the soil's capacity for infiltration, which reduces water retention for groundwater and increases drought vulnerability. These issues could be addressed by rewarding land users that conserve water (POSTnote 484) and practice good soil management (POSTnote 502), and by investing in natural water storage (POSTnote 396).[51,52] The Green Alliance, a think tank, has proposed a Natural Infrastructure Scheme[53] to create formalised markets for farmers to sell such services. Exit from the Common Agricultural Policy (CAP) could present an opportunity to introduce new incentives[54] for land managers to improve water efficiency in the UK. For example, with expected climatic shifts to wetter winters and drier summers, measures could incentivise surplus winter rainfall to be stored for the summer when deficits occur.

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