An avoidable 'natural' hazard?

The UK is expecting another drought. **Robert Field** and **Albert Weale** dissect all the ways this could have been avoidable...

It's easy for UK residents to forget the intensity of the 2022 heatwave, given that they moved on from the summer heat to experience a rain-soaked autumn with downpours, floods, and rainfall. The threat of widespread drought, multiple hosepipe bans in place, and other restrictions on water use in various parts of the country that extended well into the autumn are now out of sight and out of mind. However, upcoming heatwaves and droughts are serious issues very much on the horizon. The UK's Environment Agency's latest warning in February 2023 notes that much of the UK was still likely to be in drought in the summer of 2023, with some reservoirs well below normal levels for the time of year.

The news will, however, not come as a surprise to those familiar with water planning issues in the UK, particularly as they affect supply in England. Water shortages for the 2020s and beyond have not only been predictable but have already been predicted. In 2018, the National Infrastructure Commission analysed the prospects of a severe drought in the UK, estimating the chance of such an event as being one in 200 each year over the 30 years between 2020 and 2050. One in 200 seems like a low number, but, probabilities being what they are, it implies a one in seven chance of there being at least one severe drought in that 30-year period. The summer of 2022 did not bring the sort of severe drought that the National Infrastructure Commission had in mind. But it should be just the wake-up call needed to prompt a more precautionary approach from the UK Government and the water companies towards water resources.

Of course, the issues are not unique to the UK. Indeed, the problems caused by a shortage of water are more urgent and serious in many other parts of the world. The 2021 UN Update on progress towards *Sustainable Development Goal 6*, which aims to ensure availability and sustainable management of water and sanitation for all by 2030, noted that, although water use has remained relatively stable at the global level during the previous ten years, in some regions the level of water stress increased by 14-15 per cent over two decades. Many countries are withdrawing all their renewable water resources or are relying on non-renewable resources that will eventually run dry. Globally, some two billion people lacked safely managed drinking water services in 2020.

In order to think constructively about the global situation, water use is one of the problems that we all need to think locally about public policies to ensure the protection of water supply and all that it involves. This is as true in the UK as it is elsewhere.

This begs the question, how can the problem of a water shortage be addressed? Although it is unlikely to be the whole answer, one attractive approach is to put water reuse technology in place. Water reuse, as the name implies, involves treating waste water and returning it, fully cleansed, directly for public reuse rather than discharging the treated water into rivers or the sea. We can replace part of the natural hydrological cycle with an engineered system.

Once cleansed, the water from a reuse plant can be employed in various ways. Potable reuse takes treated wastewater and turns it into consumable-quality water. This is done in Singapore, the city-state that is very much at the forefront of the deployment of such technology. In Singapore, reused water, badged NEWater, is primarily employed in industry since its purity makes it valuable for electronics manufacturing. However, NEWater is also used to supply reservoirs. Other examples of potable reuse schemes include those in Orange County, California, and Western Australia, where replenishment of groundwater is practised. In these schemes, purified water is stored in underground aquifers and naturally filtered by the rocks until needed.

In the UK, the simplest way to reuse potable water is to refill reservoirs with recovered water. There is a scheme along these lines planned by Thames Water at the Deephams sewage plant in Edmonton, north London. However, current plans show that it will not be operational until the late 2030s.

In addition to contributing to potable supply, reused water helps cut commercial and industrial abstraction in sectors such as food processing and paper manufacture. Recovered water can be reused onsite, an example being the Aquabio reuse scheme at the Bakkavor's site in Boston in Lincolnshire where 80 per cent of the water used can be safely recycled as a potable grade supply.

An important additional benefit of water reuse is its potential to improve environmental quality. A particular concern in England is the conservation of chalk streams and rivers. In global terms, such streams and rivers are rare environments, as they are a product of chalk deposits near the surface of the earth that provide the filtering conditions associated with the purity of chalk watercourses. Some 80 per cent of all the chalk streams and rivers in the world are found in the south east of England, East Anglia, and the chalk hills of Lincolnshire and Yorkshire. In other words, they are clustered in the

part of the UK that has some of the greatest demand for water. For years, abstraction licences have allowed water withdrawal both from the rivers themselves and the aquifers on which they rely, at levels that are incompatible with the maintenance of the quality of the rivers and streams.

In short, reuse promises a way of addressing the problem of water shortage by achieving greater efficiency. If water is reused, it need not be abstracted to the same level as today. Instead of taking more water from aquifers and rivers, water from reuse plants can enhance the supply and reuse of water that has already been used once, helping to reduce pollution.

The technology of reuse

The key piece of engineering technology on which water use relies are synthetic membranes of two types. The first are extremely thin polymeric filters with pores of around 0.2 microns in size, or about one hundredth the diameter of the finest human hair. Such pores can be seen using powerful microscopes, and just as infused water passes through a coffee filter, leaving the grounds behind, so fluids, like water, can pass through these membranes while other material, such as bacteria, is retained. The second type are reverse osmosis membranes, such as those used for seawater desalination, and their 'pores' are actually too small to be seen under any microscope. Membrane filtration is highly efficient, with the reverse osmosis membrane permeating water while retaining salt molecules. Both membranes work as an effective barrier for all forms of bacteria found in water, being more effective than sand or other types of traditional filters.

Many people will ask why we need to turn to water reuse rather than reduce demand. After all, the old principle of environmental protection still applies: first reduce, and only then reuse or recycle.

Clearly, there needs to be a reduction in wastage through dealing with the problem of leaks from supply pipes. But the Victorian water supply system makes this difficult. In many places, there are not even maps of the piping system. There is a government target to reduce individual demand from an average of 142 litres per day per person to 110 litres. But reducing demand relies on the difficult policy task of co-ordinating the behaviour of millions of households. Moreover, heavy commercial users, including the data centres in west London that need large quantities of water to cool their servers, are excluded from the target. Given all this, there will have to be a dual approach involving an increase in supply alongside a reduction in demand.

Some might think that water reuse would be unnecessary on an island like the UK. Surrounded by the sea, why not turn to desalination instead? There is plenty of water in the sea, all it needs is for the salt and other impurities to be removed. Moreover, reuse relies on the same membrane technology as desalination, and this has been used in Israel and the Middle East for decades to address their water shortage. With the recent opening of a second desalination plant at Sorek outside Tel Aviv, Israel will generate a supply sufficient for 85 to 90 per cent of its annual municipal and industrial water needs. If it works in Tel Aviv, why can't it work in London?

The UK's only municipal desalination plant operates at Beckton, in London. But 'operate' is not quite the right word. Planned in the early part of the 21st century and coming into operation in 2010, the original intention was to ensure the supply of water to London in times of drought. But in the summer of 2022, Thames Water did not use the plant, saying that it was out of operation for "planned maintenance." In fact, the plant has been underutilised throughout its life because it is not the right sort of technology.

More generally, reuse scores over desalination because it is cheaper in energy and economic terms, given that the near absence of salinity reduces both the capital and

running costs of the reverse osmosis units and the overall cost by at least 50 per cent. Moreover, desalination has to return highly salty water to the environment, with adverse effects on local ecology.

Despite its advantages, water reuse is currently a neglected option in water policy planning. A 2018 draft *National Policy Statement on Water Resources Infrastructure* from the Department for Environment, Food and Rural Affairs (DEFRA) failed to put it on a level footing with desalination, reservoir expansion, or transferring water from one region to another. This neglect was criticised by the Commons Environment, Food, and Rural Affairs Committee in its 2019 report on the subject. To date, no revised final version of the *National Policy Statement* has been published.

One reason for government hesitation about encouraging water reuse may be fear of public opposition. This has been an important consideration in some well-known cases, including in California, where opponents of water reuse campaigned under the slogan 'Toilet to Tap,' and in Toowoomba, Australia, where it was opposed by the Citizens Against Drinking Sewage Campaign. In this context, it is worth knowing that there is extensive research on public attitudes that goes back decades. That research generally shows a clear gradient across time and place from uses like irrigation, where opposition is low, to potable reuse, where it is higher. However, attitudes are certainly not fixed or uniform, and in the UK, there are plenty of examples of water used for drinking from the unplanned reuse implicit in the discharge of treated water into the environment upstream of water intakes. It has been said that the water abstracted from the Thames and drunk in London has already passed through seven bladders.

Perhaps if we talked about reuse more openly, the public would worry less and the government would act more quickly. In the absence of such a conversation, no one should complain that they were not warned by the summer of 2022 that severe droughts may see the return of standpipes in the street, as occurred in the UK in 1976, when by late August, London, Leeds, and many other places had less than three months of supply left. Far from discounting the possibility of a repeat and conscious of the failure of Beckton, conversations on planning for planned water reuse are overdue. CRJ

Sources

- *National Infrastructure Commission (2018):* Preparing for a drier future, *nic.org.uk*;
- *UN Water (2021):* Summary progress update 2021: SDG 6 water and sanitation for all, *www.unwater.org*;
- *UK Government (2023):* One hot, dry spell away from drought returning this summer, national drought group warns, *www.gov.uk*;
- *Water Reuse Europe (nd):* Virtual site visit: the aquabio water reuse scheme for food processing, Boston, UK, *www.water-reuse-europe.org*;
- *Financial Times (Feb 2023):* Drought and water supply in the UK, *www.ft.com*;
- *Pearce G, Field R & Weale A (2023):* Why did a desalination plant go missing in action during the drought?, *The Environment, (632), 32-33*;
- *UK Parliament Environment, Food and Rural Affairs Committee (2018):* Water supply and demand management, *parliament.uk*;
- *UK Department for Environment, Food & Rural Affairs (2022):* Draft National Policy Statement for Water Resources Infrastructure, *consult.defra.gov.uk*

Author

ROBERT FIELD *is Emeritus Professor of Engineering Science, University of Oxford and Professor in the Faculty of Engineering and Environment, Northumbria University, UK*

ALBERT WEALE *is Emeritus Professor of Political Theory and Public Policy at UCL, UK*