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Executive Summary

- Our evidence is based on our experience of assessing the deteriorating water quality of the (Bristol) River Avon, which has given us some insight into the issues being addressed by the Committee.
- Our assessment was seriously hindered by the fact that the Environment Agency has abandoned regular chemical monitoring of our stretch of the river.
- There have been an increasing number of (consented) releases of untreated sewage into the river due to storm events from combined sewer outflows. Storm flows seem to be increasing, which may be a partial explanation of the deteriorating water quality.
- New housing developments in the catchment add to concerns that the system is unable to cope.
- Agriculture and rural land use is a major source of pollution in our area, but regulation is weak and not well enforced.
- We argue that there needs to be a greater acceptance by official bodies and water companies that releases of untreated sewage during storm flows are damaging and there needs to be an accelerated programme to reduce them.
- The sewerage system is designed to address the problems of the early 20th century and is not coping well with our changing climate, increasing population, and use of exotic chemicals.
- Technology provides a way to address some of these problems. Continuous monitoring of river water quality using an Internet of Things (IoT) approach would improve enforcement, transparency and policymaking.
- Changes to the remit of official bodies are needed to enhance an integrated approach to catchment planning. In particular, Ofwat should take more account of environmental matters rather than just the price of water. Its economic models should include these – the Dasgupta Review provides a way forward.

1. Introduction

1.1. We are: a geologist with experience in IT systems and new technology (GC); and an environmental scientist with expertise in water quality research (RS). We both live in the village of Sherston on the headwaters of the Bristol Avon. There has been a lot of local concern recently about the deteriorating quality of the river, and we have been helping the local Parish Council investigate the causes of this. We think our experiences are very relevant to the remit of the Committee, and would like to share them, and our conclusions. We write in a personal capacity.

1.2. In spite of being in a rural area, the Sherston Avon has until recently only been classified by the Environment Agency as “moderate” water quality in Water Framework Directive terminology. The reason is largely high phosphate concentrations from both agriculture and sewage treatment works. In 2019, however, the river was downgraded to “poor” due to poor biological quality. At the same time the dissolved oxygen status was downgraded from “good” to “moderate”. This fits with local perceptions that the river quality is deteriorating, with anecdotal reports of poor fishing and strangely coloured water.

2. Causes of Deteriorating Water Quality in the River Avon

2.1. We consulted the EA’s Water Quality Database (WIMS) to see if chemical water quality could explain these trends. We discovered, however, that the EA had abandoned regular chemical water quality monitoring on the river. Before 2001, water quality was measured monthly at 7 sites on the upper Avon and its tributaries. By 2013, this had been reduced to 5 sites. After 2017, there is

no regular monitoring at all. There are hints that the dissolved oxygen status was deteriorating towards the end of the period, but lack of recent data means no conclusions can be drawn.

2.2. There are a number of sewage treatment works on the river. Data shared with us by Wessex Water shows they are comfortably meeting their discharge consents during routine operation. The three largest water treatment plants, however, have combined sewer overflows (CSOs) which allow direct inputs of untreated (screened) sewage to the river during high flows. One of these, which has a groundwater ingress problem, discharged for a third of the time. There are also a few houses which discharge direct to the river, and numerous septic tanks. There are concerns because the population is growing, leading to increased loads on the works, and because high flows and thus CSO discharges appear to be becoming more frequent, probably due to climate change but also development increasing the area of hard surfaces with rapid runoff.

2.3. Agriculture has a significant effect on water quality, inputting nitrate, phosphate, sediment and agrochemicals. As far as we can see these inputs have not changed significantly. However, there have been instances of land use change due to landowners felling trees and bulldozing bushes close to the river, destroying wildlife habitat and causing erosion of banks, sometimes with support from public money. These activities appear to be very weakly regulated and there is no co-ordination between agencies, as there would be if there was truly a "catchment approach" to water quality.

2.4. The EA has continued to monitor lower down the river. Some of the data are alarming. For instance, fish from Great Somerford 10 km downstream have concentrations of PBDE (a fire retardant) between 1000 and 2500 times the toxic limit for humans in their flesh. Though this is a national problem, it illustrates that the current water treatment system is not dealing adequately with such "xenobiotic" chemicals. CSOs are relevant here: sewage treatment can remove or attenuate xenobiotics and if treatment is being bypassed due to high flows, then inputs of xenobiotics to rivers will increase.

3. **Implications**

3.1. Our experiences in this and other projects allow us to offer opinions on some of the Committee's questions below.

4. How could drainage and sewage management plans, introduced by the Environment Bill, play a role in reduced sewer discharges?

4.1. There needs to be an acceptance that storm overflows, and other occasions in which the treatment works are bypassed, are damaging and need to be reduced. The argument that they do not matter because sewage concentrations are diluted at high flows is open to question. For xenobiotics, for instance, it is the amount rather than the concentration which is important as they can accumulate in food chains. Untreated solid waste can accumulate on river banks at high flows and release faecal material and bacteria as the river falls. More data would be valuable here.

4.2. Management plans should therefore have a commitment to reducing untreated outflows over time. To eliminate them completely would be a long and expensive project, though worthwhile. Much cheaper would be to eliminate any new misconnections of clean and grey water to the foul drainage system, preferably by legislation.

4.3. The sewage system also needs a review. The system is generally designed to tackle problems of the late 19th and early 20th centuries – oxygen depletion due to excessive organic matter, toxic ammonia concentrations, suspended sediment. For instance, the trickling filter, the mainstay of the rural sewage system, was developed in the 1890s. Discharge consents also reflect this picture, focussed on BOD, ammoniacal nitrogen and suspended solids. But more modern problems such as high nutrient levels and exotic chemicals are more rarely addressed. There is also a demand for higher environmental quality, whereas consents implicitly assume that a certain level of pollution

is acceptable. If rivers in populated areas of the country are to be "fit to play in" this level needs to be examined carefully.

4.4. Our personal view is that we must be careful that the desire for wild swimming, which is always going to be problematic in the crowded parts of the country, is not prioritised over the needs of aquatic wildlife.

5. How adequate are the monitoring and reporting requirements around water company discharges? How can technology improve and assist with transparency and enforcement?

5.1. For England at least, the EA's water quality archive is an excellent resource for identifying water company discharges and their composition, though it takes some expertise to use and interpret it.

5.2. We also found that our local sewage undertaker (Wessex Water) responded promptly and helpfully to requests for data and to explain the sewerage system.

5.3. Typically the *volume* of water company discharges is measured continuously, but the *composition* is sampled monthly. Discharge permits are based on this. However, although there are rules about the conditions under which storm overflows are permitted, neither the volume nor the composition of storm overflows is usually measured. There is therefore an unmeasured input of raw sewage into the river at high flows. The assumption that these are harmless is questionable (see above).

5.4. The technology to make continuous measurements of most of the major chemicals in water already exists and has for some time. For routine sewage works discharges, continuous measurement as opposed to sampling is probably not worth the extra costs, but for sporadic outputs such as storm overflows it could be a basis for environmental permitting, and a driver for reducing these.

5.5. The EA has drastically reduced its chemical water quality sampling due to budget cuts. This seriously hindered our assessment of the problems in the Bristol Avon. Yet monitoring river water quality is just as important as compliance monitoring on outfalls. Fish and other organisms live in the river, not in sewage effluent.

5.6. Technology can be used to significantly increase the frequency and accuracy of testing while reducing the costs. Continuous monitoring of river water quality at important sites for selected chemicals would detect pollution episodes which are invisible to manual monthly sampling. It would be useful to water companies who extract the water for drinking downstream (e.g. on the Thames where it typically happens several times) for detecting problematic compounds. Advances in national infrastructure such as the 5G network would enable results to be displayed in real time to both public and regulators, improving transparency and enforcement. The data can be used to assess where the pollution is coming from (source apportionment) using techniques already developed (2) which could input into policymaking as well as enforcement. The cost of such a system is probably already comparable to monthly sampling and it is becoming cheaper.

5.7. For problematic chemicals, physical real-time analytical techniques such as medium infrared and Raman spectroscopy are being developed for field use (3). There are even methods for detecting bacteria.

5.8. A network of such connected devices analysed by artificial intelligence techniques could be used to improve understanding of our river system – an Internet of Things (IoT) approach. Such an approach has been very useful in understanding problems surrounding bee health (4), where the aim is "to be a high performance, central source of global bee health data which gives stakeholders, from policy makers and governments, to universities, smallholder farmers and beekeepers, the opportunity to find solutions to bee health declines".

6. **Should local authorities and highways agencies be given a duty to prevent pollution to watercourses without prior treatment?**
   6.1. In 2002 Highways England identified 2,500 highway outfalls posing a risk to water courses (1). Some discharges were well above the legal limits for copper, zinc, lead and polycyclic aromatic hydrocarbons (PAHs). Recent reports implicated a compound called 6PPD-quinone, used to protect tyres from ozone, as highly toxic to certain fish species and leaching from road runoff.
   6.2. Though doubtless a bigger problem in urban areas, road runoff is a problem for rural areas too. Every minor road which crosses the Avon in our area has a drain leading directly into the river. Road sediment can be seen on the river bed downstream of these. This sediment is washed gradually down the river towards Bristol, leaching chemicals on the way.
   6.3. There is however a low-tech solution which could be implemented to prevent this. In places, sediment traps have been constructed by voluntary bodies to catch this runoff. For minor roads this work is within the scope of voluntary labour, such as deployed by Rivers Trusts. Giving local authorities and highways agencies a duty to prevent pollution to watercourses would release funding to support this (and ensure the traps were emptied periodically). The EA would need to be given powers and resources to prosecute offending authorities.
7. **How effective is Ofwat's remit and regulation of water companies? Does it facilitate sufficient investment in improvements to water quality, including sustainable drainage systems and nature-based solutions such as constructed wetlands**?
   7.1. Our impression is that Ofwat's focus appears to be almost exclusively on managing the cost of water to the consumer. It is short of environmental expertise, and its economic models have led to long-term deterioration of the capital base and degrading of the natural environment.
   7.2. Environmental improvements do have to be paid for by someone, whether the water consumer, the taxpayer or the water companies' shareholders. This is a matter for political debate. However, the recommendations of the recent Dasgupta Review on the Economics of Biodiversity could be used as a basis for reframing the purpose of Ofwat so the water industry is more sustainable and better reflects the public desire for a high quality environment.
8. **Is adequate investment being made in adapting water treatment systems to future climate change?**
   8.1. Based on our experience very little. We already have increased storm flows, and more seem inevitable given climate change and more development. The Met Office provides tools for climate change planning, and these could be applied in a transparent way to give the public more confidence in the future of the system.
9. **References**

(1) Salvidge, R. Regulators ignoring 'horrific and poisonous' road runoff, say EA insiders, *ENDS Report* 3rd March 2020

(2) Bowes, M. et al. (2015) *Science of The Total Environment,* **511**, 608-620.

(3) Distributed Water Pollution Source Localization with Mobile UV-Visible Spectrometer Probes in Wireless Sensor Networks https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5855095/

(4) https://worldbeeproject.org/2020/12/08/world-hive-network/

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