



DO IT
FOR YOUR
PLANET

2017

FLUSHED AWAY

HOW SEWAGE IS STILL POLLUTING THE RIVERS OF ENGLAND AND WALES

NATURE NEEDS YOU.

Much of our current environmental protection comes from the EU. As we leave the EU #NatureNeedsYou to help make sure we maintain and even improve on this protection for our environment.

This report was written by Hannah Blackburn, Rose O'Neill and Charles Rangeley-Wilson, with contributions from Catherine Moncrieff and Jacob Tompkins on behalf of WWF. We would like to thank Daniele Di Fiore and Simon Gordon-Walker of Artesia Consulting and Guy Linley-Adams for their help developing and conducting the research for this report. We would also like to thank the many people who shared ideas, evidence and analysis: Paul Jennings, Charlotte Hitchmough, Toby Hull, Bella Davies, Jonah Tosney, Brian Smith, Mark Lloyd, Ali Morse, Roger Harrison, Zoe Draisey, Alice Moore and Dave Tickner.

In particular we would like to thank all of the water and sewerage companies of England and Wales, the Environment Agency and Natural Resources Wales for providing information, and the 21st Century Drainage Programme.

This is a WWF report and does not necessarily represent the views of each of the contributors.

WWF-UK, 2017. For more information please visit wwf.org.uk. If you would like any further information or have any feedback regarding this report please contact cmoncrieff@wwf.org.uk or zdraisey@wwf.org.uk.

FOREWORD

On their timeless journey from spring to sea, Britain's bountiful rivers have forever provided the lifeblood of our nation – vital to our economy as well as our wildlife and our own wellbeing.

These fabulous waterways fascinate us at all ages – whether we're skimming stones and floating sticks or drawn to them for quiet contemplation and the promise of a fleeting glimpse of a kingfisher. They offer refuge as well as a source of food to countless natural wonders.



Tanya Steele,
Chief Executive, WWF-UK

Yet for all their beauty and value, our rivers are in decline. I find it truly alarming to hear that just 20% of rivers in England and Wales are now classed as being in a healthy state. They face severe pressures from pollution and over-abstraction, which affect not only our wonderful wildlife but also the people who depend on rivers for their livelihoods or use them for recreation. Such impacts are creating one of the most urgent environmental crises facing the UK today.

Current protection for rivers in England and Wales comes from the Water Framework Directive, a piece of EU legislation that requires the UK government to ensure our waterbodies reach 'good ecological status' by 2027. But the government isn't remotely on course to achieving this target. Agriculture has a major impact on our rivers and WWF is doing a lot of work to address this. But alongside farming, one of the most pressing problems is that crude sewage mixed with rainwater is regularly pumped into our rivers because outdated treatment facilities can't cope with more intense rainfall and the ever-increasing volume of waste that is being flushed away.

There has been progress and recently water companies have started working together to tackle sewerage problems but we want to see more action more quickly and that is the focus of this report. We are willing to work with the water sector to encourage greater progress, but whilst we recognise the steps they have taken we believe there needs to be culture change within water companies and the wider public to understand that the problem can't simply be flushed away.

**ONLY 20%
RIVERS IN
ENGLAND AND
WALES ARE
HEALTHY**

The current situation is unacceptable, as you'll read in these pages. For instance, sewage is being discharged directly into rivers across England and Wales from nearly 18,000 sewer overflows. These overflows are meant to discharge only during extreme rainfall, but the information available suggests that many are discharging far more frequently. Although there is an ambitious programme to improve monitoring of overflows, at present neither the environmental regulators nor water companies know the volume of untreated sewage being discharged into the environment.

The positive news is that right now the UK government has an opportunity to make a commitment to the environment as we prepare to leave the EU. It's not just the Water Framework Directive: most of our environmental legislation comes from the EU, and the government must deliver its commitment to transpose all of it to UK domestic law.

But with the *2016 State of Nature Report* report showing 56% of species in the UK in decline, now is the perfect chance for the government to go further – to strengthen our laws and commit to a long-term plan that ensures our precious wildlife and wild places are restored to a healthy state.

Pushing for such commitments is the basis for our Nature Needs You campaign. We're calling on the UK government to grasp this opportunity and show it is a world leader in standing up for the environment – including our cherished rivers.

The findings in this report demonstrate the urgent need to transform the way we treat our freshwater environment. I hope you'll support our call for a commitment to ensure our rivers are restored to 'good ecological status' by 2027.

Tanya Steele
Chief Executive

SUMMARY

Four out of five rivers (80%) in England and Wales fail to achieve ‘good ecological status’. The situation is poor and getting worse, and yet the EU Water Framework Directive - which the UK has signed up to - mandates that all waterbodies should achieve ‘good’ status by 2027 (except where costs outweigh the benefits). According to the Environment Agency that would equate to 75% of rivers in England. Clearly there is a long way to go.

The pressures vary across the country but the water industry along with agriculture are the main sectors responsible for failing river health. Although the water industry has recently made great strides in cleaning up pollution from beaches, sewage remains one of the main pollutants in English and Welsh rivers. To find out why sewage is still a problem in our rivers, WWF launched a nine-month investigation into the entire sewerage system, how it works, its capacity, infrastructure and governance.

We found that:

- **55% of all rivers in England and Wales failing to reach the required good ecological status are polluted by wastewater.** There is a degree of uncertainty and complexity in the data, but activities linked to sewage contribute to a large majority of failures due to wastewater. Pollution from wastewater is one of the top three management reasons for failing to meet good ecological status - the other two are pollution from rural areas and physical modification.
- **Factors contributing to sewage pollution incidents include shortcomings in monitoring, management and risk assessments, operational practice and staff culture.** Despite the work of the 21st Century Drainage Programme to increase monitoring and improve processes, there is still a need for the water sector to give more focus to wastewater management.
- **There are 17,684 licensed sewer overflows across England and Wales:** places where water companies are allowed to discharge untreated sewage directly into the environment. Of these, 89% discharge to rivers. In addition there are 750 such places covered only by temporary licences with only very basic conditions. Data that was made available from one water company suggests that 14% of overflows are spilling untreated sewage into rivers more than once a week, and half are spilling more than once a month. Some are spilling hundreds of times a year. Given that the EU Urban Waste Water Treatment Directive requires that storm water overflows are only allowed in ‘unusually heavy rainfall’, it is likely that many are in breach.
- **Most of the present-day sewerage infrastructure was installed over half a century ago.** Investment is not keeping pace with deterioration – at the current rate of renewal it will take 800 years to renew and replace ageing assets, yet their lifespan is less than a tenth of that. We welcome the work of the 21st Century Drainage Programme which seeks to identify and address the major risks for drainage in the future - but there is opportunity to up the pace of progress and ensure all water companies are actively involved.
- **The combined pressures of urbanisation, population growth and climate change are placing a heavy burden on a system already running at or over full capacity.** Projected population figures alone suggest a 44% increase in England and Wales from 1961-2039. Without significant investment in sewerage infrastructure our rivers will suffer from increased pollution.
- **A significant number of households in England and Wales (over 1 million) are not connected to mains sewerage.** The majority of these will be connected to a septic tank instead. However, there is no requirement to register the type of sewage treatment installed and there are only 15,466 known septic tanks. If not properly maintained, these can be highly polluting. Septic tank owners are meant to comply with General Binding Rules – statutory requirements set by the UK government – meaning they could be fined by the environmental regulators if they do not properly maintain them. But these rules are not enforced or even monitored. Even where regulators know septic tanks are a problem, and a water company is open to connect properties to mains sewerage, there are no powers to force households to connect to the mains, and perverse incentives exist to stop them doing so.
- **It seems companies are relying on sewer overflows to compensate for under-capacity.** This is based on evidence we have been able to gather on the frequency and duration of discharges from sewer overflows. Under-capacity increases the frequency and duration of sewer discharges, as do higher incidences of heavy rainfall and sewer blockages.
- **The public want rivers safe to swim in and think regulators and companies should do more to tackle pollution.** Public awareness of these issues is low – half were not aware that raw sewage could even be released into rivers and 35% have flushed/put down the drain something that they shouldn’t in the past month. Once informed, 80% think that it is never acceptable to release raw sewage into rivers, and 87% think the public must be told when this happens.
- **Sewage pollution is a hidden problem: very little information is in the public domain, and public awareness is low.** Although there is an ambitious programme to increase monitoring of overflows, currently there is little data available publicly, and data on environment impact is difficult to analyse and interpret.

In the 1980s the UK was known as the ‘dirty man of Europe’: our rivers and beaches were heavily polluted and this pollution placed a heavy burden on wildlife, on human health and on businesses. Recently, important European legislation has driven investment in sewage treatment and the control of pollution: the UK now has wonderful, clean beaches and wildlife has returned to many of our rivers.

But we’ve taken our eye off the ball. More people, more rain, more development and insufficient investment mean that, although

we’re not at risk from a cholera epidemic as in the Victorian era, things are not as good as is often claimed. Right across the country untreated sewage is still flowing into our rivers.

Our research has revealed a sewerage system on the edge; one that is ill-equipped to protect people and nature as we face the tough challenges ahead. We must not shy away from these challenges or leave them for our children and grandchildren to deal with. Now is the time to act so we can be proud of the legacy we leave.

WWF recommends urgent action:

We ask the government to ensure that every aspect of the EU Water Framework Directive and the Urban Waste Water Treatment Directive are fully transposed into law in England and Wales when we leave the EU. In addition, we ask that the government mandates water companies to develop long-term strategic wastewater management plans to improve river health; and ensure that the environmental regulators review all existing permits relating to sewage treatment and discharge. We ask Ofwat and water companies to contribute to good ecological status of rivers through the 2020-2025 business plans, and that Ofwat recognise it as a common performance commitment.

1. The Water Framework Directive and Urban Waste Water Treatment Directive must be transposed in full into law in England and Wales and sanctions established to enforce implementation after we leave the European Union. The 2027 deadline to achieve good ecological status in all our waterbodies must be met.
2. The UK government and the Welsh government must mandate water companies to develop long-term strategic wastewater management plans to ensure the sewerage system is sufficient to address pollution. They must also regulate to reduce the amount of surface water entering the sewers by enacting Schedule 3 of the Flood and Water Management Act (2010). This would make Sustainable Urban Drainage Systems (SuDS) in new developments a legal requirement and remove the automatic right to connect to the public sewer network. We recognise that Wales has made progress in this area by launching a consultation to make SuDS mandatory for all larger developments.
3. The Environment Agency and Natural Resources Wales must review all permits for sewage treatment works and sewer overflows to ensure that consents sufficiently protect the environment. As a minimum, they must require real-time monitoring and reporting on every overflow. They must enforce General Binding Rules on septic tanks and report annually on compliance. Both the Environment Agency and Natural Resources Wales must be properly resourced to do this. We recognise

there has been an increase in monitoring, and that permits are being reviewed. But we also understand that many water companies are still only providing the statutory minimum data and we would like to see a culture of openness and participation from all water companies.

4. Ofwat must recognise contributing to good ecological status as the critical environment outcome companies must report upon, and introduce this as a common performance commitment for the next price review in 2019 (a five yearly review of water company investments).
5. Water and sewerage companies and Ofwat must ensure that final business plans for 2020-2025:
 - Contribute to ensuring good ecological status is achieved by 2027 where it is technically feasible and not disproportionately costly to do so.
 - Demonstrate that investments are underpinned by long-term strategic wastewater management plans.
 - Include performance commitments on pollution prevention (including enhanced monitoring and performance on both pollution incidents and sewer overflows).
 - Include action to stop surface water getting into sewers – a combination of sustainable drainage systems (SuDS), household behaviour change initiatives and catchment management.
 - Deliver a major programme to upscale innovation and address sewage pollution at treatment works by investing in green infrastructure and new technology, and by maximising sewage as a resource for energy, nutrients and water.
6. Companies should develop ways to communicate to the public about sewage pollution and prevention and make information about sewer overflows and pollution publicly available. This could include developing a ‘Safer Rivers Service’ to inform the public about inland sewer overflows and promoting incentives to reduce surface water inundation and encourage installation of SuDS and green infrastructure.
7. We urge households to play a part by:
 - Keeping sewers flowing and our rivers and beaches clear of sanitary litter by flushing only poo, pee and toilet paper down the toilet.
 - Saving water by using water wisely in the home and requesting a water meter (where appropriate) and water efficiency visit from your water supplier.
 - Checking your drains are not misconnected if you’re having any building work done.
 - Avoiding too much paving in gardens and using permeable materials for any hard surfaces to ensure as much rainfall as possible soaks into the ground.
 - Installing a water butt and disconnecting drain pipes from the sewer (e.g. into a soak-away instead) – ask your water company for advice and incentives.

PERMITTED TO POLLUTE?

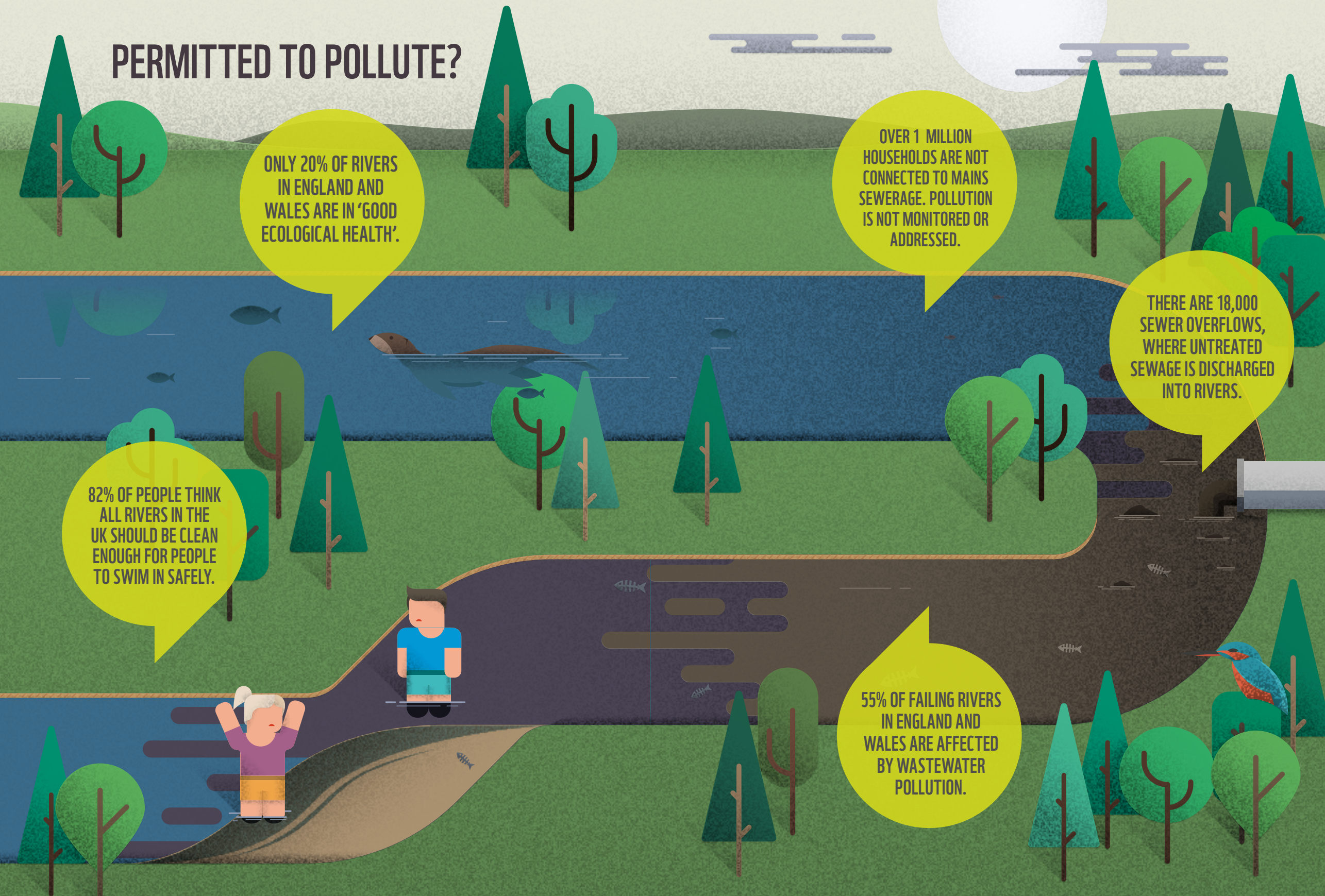
ONLY 20% OF RIVERS IN ENGLAND AND WALES ARE IN 'GOOD ECOLOGICAL HEALTH'.

OVER 1 MILLION HOUSEHOLDS ARE NOT CONNECTED TO MAINS SEWERAGE. POLLUTION IS NOT MONITORED OR ADDRESSED.

THERE ARE 18,000 SEWER OVERFLOWS, WHERE UNTREATED SEWAGE IS DISCHARGED INTO RIVERS.

82% OF PEOPLE THINK ALL RIVERS IN THE UK SHOULD BE CLEAN ENOUGH FOR PEOPLE TO SWIM IN SAFELY.

55% OF FAILING RIVERS IN ENGLAND AND WALES ARE AFFECTED BY WASTEWATER POLLUTION.



CONTENTS

INTRODUCTION	14
SECTION 1: HOW THE SEWERAGE SYSTEM WORKS	17
1.1 History of the sewerage system	17
1.2 Different types of system and treatment	19
1.2.1 Sewage treatment works	19
1.2.2 Sewer overflows	22
1.2.3 Septic tanks	23
1.3 Impacts of sewage pollution on people and wildlife	25
1.4 Pollution incidents	28
1.5 Future challenges	30
SECTION 2: WWF INVESTIGATION INTO THE STATE OF OUR SEWERAGE SYSTEM	33
2.1 The health of our rivers and reasons for failure	34
2.2 Sewage treatment works – permitted to pollute?	38
2.3 Sewerage system capacity – on the edge?	39
2.4 Sewer overflows – from emergency ‘storm’ releases to everyday occurrence?	44
2.5 Sound investment requires reliable data and real engagement	48
2.6 Septic tanks	48
2.7 Public awareness is low but concern is high	52
SECTION 3: CONCLUSION AND RECOMMENDATIONS	56
GLOSSARY	62
REFERENCES	66

INTRODUCTION

England and Wales have some of the most beautiful and inspiring waterways in the world: iconic, stately rivers like the Thames; wild, untamed rivers like the Eden or Dee; the clear-watered chalk streams of the south and east; the tumbling, tea-stained becks of the north; loughs and lakes, marshland and fen. It would be hard to imagine more variety packed into such a comparatively small land mass.

Water is a life-force of nature and our history is shaped by rivers: they have been sacred and revered, they have been borders and battlegrounds, the birthplaces of cities and industry. They give us precious moments and lasting memories: of summer walks and waterside picnics, of swimming, boating, fishing. Rivers are cathartic and healing; they help us unwind and they connect us to the natural world.

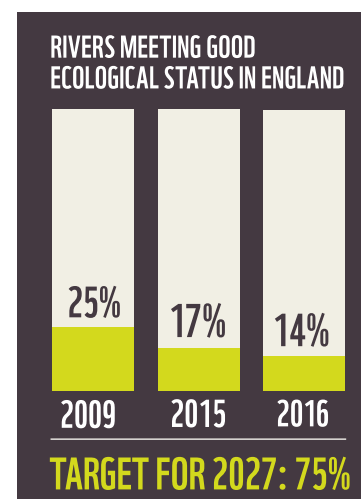
Not so long ago many of our rivers were so polluted that little survived in them. They ran thick with sewage and the chemical pollution of heavy industry. To swim in them was to risk death. To live beside them was to risk cholera or dysentery. The innovation of Bazalgette’s 19th century urban sewerage systems might have saved the lives of tens of thousands of Londoners, but 100 years later in the 1950s the River Thames was still biologically dead.

Twenty years later, in the 1970s, we were still pumping untreated sewage into rivers and the sea; unwittingly, children played on beaches polluted by untreated sewage, while our rivers remained a deadly cocktail of sewage and toxic chemicals. In Liverpool, people joked that you couldn’t drown in the Mersey, because you’d die of poisoning first¹.

Driven by a desire to lose our reputation in the 1970s-80s as the ‘dirty man of Europe’, Britain has since greatly improved the health of its waterways. Transformational laws stemming from Europe, such as the Bathing Waters Directive and Urban Waste Water Treatment Directive (UWWTD), and the associated threat of large fines, have compelled a clean-up of our coastal waters and improvements to sewage treatment works. As a result, 70% of England’s marine bathing waters received an ‘excellent’ rating in 2016².

By the late 1990s, the UK had established itself as a driving force in Europe-wide efforts to clean up our waterways. When the ground-breaking EU Water Framework Directive (WFD) was passed in 2000 it was known as the ‘British Directive’. The Water Framework Directive has driven a huge investment in research leading to a much better understanding of the health of our rivers and the pressures they are under.

As a result we now know that the clean-up job has only just begun. Four out of every five rivers in England and Wales are failing their ecological health targets³. The Directive’s target – which the UK not only signed up to, but conceived – was that all our rivers should meet good ecological status⁴ by the year 2027 where this is technically feasible and not disproportionately costly. The Environment Agency has calculated that this equates to 75% of the nation’s waterways and will, in addition, deliver £8.4bn benefit⁴. But there is a long way to go and the current direction of travel is one of decline rather than improvement. In 2009, 27% of surface waters (rivers, lakes, estuaries and coastal waters) in England and Wales were classed as being in good or better ecological status⁵. By 2015, this was down to 21%⁶. If we want our rivers truly to be the healthiest they have been since the Industrial Revolution, significant new efforts are needed.



The rivers of England and Wales are under threat from a number of pressures, including pollution from farms and man-made changes to rivers for historical land drainage, flood protection and industrial purposes. In addition, despite improvements in wastewater treatment, sewage is still one of the biggest problems. Although it’s perhaps more of a hidden problem now than in 1858 when parliament closed because the Thames smelt so bad.

The Water Framework Directive has driven massive improvements in monitoring, and all the data collected by the Environment Agency and Natural Resources Wales is now publicly available. WWF has spent the last nine months analysing this data and gathering new information so we can reveal the true state of our sewerage system.

This report reveals the results of the WWF investigation and aims to set out the scale of the problem of sewage pollution and the impact it has on people and nature. First, we present the results of our investigation to ascertain how the current system works, including different types of treatment processes. We then present the findings of our investigations into the state of the sewerage system in terms of its health and the impact on people and nature. We conclude the report with our recommendations for government, water companies and communities to tackle the issues and ensure that we have a strategic, smart and sustainable sewerage system that’s truly fit for purpose.

¹Ecological status is determined by the quality of the biological community, the hydrological characteristics and the chemical characteristics. Ecological status is recorded as high, good, moderate, poor or bad. ‘High’ represents ‘largely undisturbed conditions. Other classes show increasing deviation from undisturbed or reference conditions. Ecological status is determined by the worst scoring component (one-out-all-out approach), so it can mask improvements in some components.

Source (25%): Environment Agency. 2011. Briefing – 2010 WFD Classification Results.

Source (17%): Environment Agency, 2015. Update to the river basin management plans in England National Evidence and Data Report.

Source (14%): WWF 2017. The percentage of rivers at ‘good ecological status’ in 2016, provided by email on request by the Environment Agency.

Source (75%): Environment Agency. 2014. A consultation on the draft update to the river basin management plan Part 3: Economic analysis.

SECTION 1: HOW THE SEWERAGE SYSTEM WORKS

1.1 HISTORY OF THE SEWERAGE SYSTEM

Our sewerage system had its origins in an innovative feat of engineering that saved lives. Once upon a time – and not that long ago – we had little in the way of sewage systems or treatment and people didn't really understand the links between health and clean water. It was all chamber-pots and 'night soil', and either a hole in the ground or the local river would take it all away.

All this was pretty disgusting, but as urban populations grew during the late 18th and 19th centuries our lack of organised sanitation became a major health hazard. By the mid-19th century thousands of people died of cholera in London every year. Living conditions, especially for the poor, were awful: dozens sharing a single outhouse, open drains running along streets and through houses, latrines lined up along the rivers from which people also drank. The streets and rivers of Victorian Britain not only stank, they were lethal.

But if the situation was terrible, the solution was expensive.

At the time almost everyone thought that cholera was spread through the 'miasma' of the smell (a doctor, John Snow, had proposed the truth – that it was waterborne – but few agreed with him⁷). It took a particularly hot and smelly year – 1858 – to offend the noses of government to such a degree that Parliament was suspended – they all thought they might get ill. This became known as the "Great Stink" and an Act was passed enabling the funds to be raised to solve the problem.

The civil engineer Joseph Bazalgette devised a system of sewers – 82 miles of mains sewer and 1,100 miles of street sewer – to intercept the raw sewage that washed through London's streets, to brick in the 'miasma' and deposit the troublesome stuff directly into the River Thames beyond the city.

Bazalgette's sewers greatly reduced the cholera – not because he had bricked in the smell but because he had separated sewage from drinking water. But the raw sewage did no favours to the Thames estuary and you wouldn't have wanted to go swimming there. In 1900 a sewage treatment works was added to the system, but in 1957 the Thames was still deemed 'biologically dead'⁸.

**WE STILL MANAGE
SEWAGE IN MORE
OR LESS THE SAME
WAY AS WE DID IN
THE 1800S**

Though much has improved since then, the real point of this historical overview is to show that we still treat sewage in more or less the same way as we did in the 1800s. So long as we can't smell it, we imagine all is well.

Our sewerage system is now an immense and largely hidden infrastructure that is vital to public and environmental health. It has evolved since the time of Bazalgette but, in part because we inherited such amazing Victorian engineering, we have taken it for granted and not kept pace with the investment needed. We are now saddled with a fundamental sewage treatment problem – combined systems – that will only get worse with population growth, urbanisation and climate change.

When the water sector was privatised in 1989, 10 water and sewerage companies took over ownership and maintenance of the sewerage system in England and Wales. For the purposes of this report all references to water companies from here on in imply water and sewerage companies. Company planning, investment decisions and operations are overseen by the economic regulator Ofwat, and the two environmental regulators: the Environment Agency in England and Natural Resources Wales in Wales.

By and large, Ofwat's focus has been on improving efficiency, ultimately to keep customer bills low. Ofwat estimates that the sector is over a third more efficient since privatisation as a result of economic regulation⁹. But investment is not keeping pace with the deterioration of assets. While much of the infrastructure is built with a lifespan of 60-80 years, Defra's 2011 Water White Paper showed that at recent rates of replacement, it would be 800 years before the public sewers in England and Wales were replaced or rehabilitated¹⁰. This suggests that short-term economic 'efficiencies' are passing the real cost on to following generations and our environment. The drive towards efficiency over the past 25 years has led to a 'wait until it's broken before fixing it' culture and left us with ageing infrastructure.

In 2014, the Water Act added a new primary duty for Ofwat to secure the long-term resilience of water companies' water supply and wastewater systems. The new duty should add balance and a long-term perspective to ensure that the sector is able to cope with, and recover from, climate variability and change while maintaining services for people, and protecting the natural environment.

The role of the environmental regulators is to issue and enforce environmental permits that specify the conditions under which a discharge is allowed. There are conditions, for example, on the level of treatment required before effluent can be released to rivers or seas. These permits should be reviewed every five years, as part of the 'National Environment Programme' the environmental regulators agree with the companies and Ofwat under the price review. A breach of permit conditions can result in enforcement action and court sanctions.

565,070KM OF SEWERS AND 6,354 SEWAGE WORKS CARRY AWAY AND TREAT 16 BILLION LITRES OF SEWAGE EVERY DAY

AT RECENT RATES OF REPLACEMENT, IT WOULD BE 800 YEARS BEFORE THE PUBLIC SEWERS IN ENGLAND AND WALES WERE REPLACED

The 21st Century Drainage Programme, led by industry body Water UK

Water companies, government and regulators are working on a joint project to understand the capacity of the drainage and sewage system and where new investment will give the greatest benefits. It aims to develop solutions to the major challenges facing the drainage and sewerage system. To date, this has included public campaigns to tackle sewer misuse, a work stream to investigate sewer capacity, and initiating the development of a framework for Drainage and Wastewater Management Plans. It's a welcome initiative - the coming together of the industry and others to look at this issue is valuable – but action is urgently needed and the scale of the environmental issues needs to be fully recognised and addressed.

1.2. DIFFERENT TYPES OF SYSTEM AND TREATMENT

Today, 565,070km of public sewers and 6,354 sewage treatment works carry away and treat 16 billion litres of sewage flushed every day by homes and businesses across England and Wales¹¹.

1.2.1 SEWAGE TREATMENT WORKS

There are four main levels of sewage treatment. It is important to note that not all of the sewage treatment works across England and Wales operate the same levels of treatment.

In the **preliminary** or **pretreatment** phase solid items, leaves and things that shouldn't be flushed like sanitary towels are screened off, dried and taken away to landfill.

Then in the **primary** phase the screened sewage is passed through tanks where suspended solids settle and oils and fats rise to the surface. The liquid from between the settled layer and the surface sludge is drained off and passes onto the next stage, while the sludge and oils are skimmed off for further treatment, recycling or disposal.

The **secondary** phase uses micro-organisms and bacteria to break down suspended and dissolved organic matter. The resulting effluent is generally considered safe enough to release into rivers. In 1991, the Urban Waste Water Treatment Directive introduced new minimum standards for sewage collection, treatment and discharge from towns of 2,000 people or more, specifying at least secondary treatment.

Tertiary treatment is reserved for more sensitive discharge points and involves an additional phase to remove nitrogen and phosphorous (known as phosphorous or nutrient stripping), and sometimes a disinfection phase using UV, chlorination or ozone treatment, to remove bacteria and viruses. Sewage treatment works that discharge into rivers and estuaries protected by the EU Habitats Directive typically use this higher level of treatment to meet stricter phosphorous constraints.

Under normal circumstances, once it has been treated, wastewater is then released to the environment, either out to sea (through long sea outfalls or coastal discharges) or into rivers.

While not the norm, water companies are piloting new technologies to treat sewage to reduce the amount of phosphorus discharged to the environment. For example, Wessex Water is testing the effect of adding iron to sewage¹²; Thames Water is trialling the use of reed beds¹³; and Severn Trent Water is trialling new filtration technologies and biological treatments¹⁴. Wessex Water, with the Environment Agency, is also piloting a new approach, issuing a catchment-wide permit to set a constraint for total phosphorous discharge into the Bristol Avon (the traditional approach sets discharge constraints for each individual works). This new system will allow Wessex Water the flexibility to target their investment at the most polluting sewage works and could be a more effective and economic way to deliver a net reduction in phosphorus¹⁵.

Circular economy: from wastewater to resource

Sewage contains heat, rare metals and phosphates. These things are polluting our waterways but are actually sought-after commodities. Water companies are realising the potential business case to recover these resources, particularly in relation to their larger sewage treatment works. For example, Thames Water has developed a phosphate recycling plant that produces fertiliser from sewage¹⁶ and in 2015/16 generated 15% of its energy requirements using biogas from sewage sludge¹⁷. A number of French cities, such as Paris, use waste heat from sewers to heat public buildings¹⁸. The Marselisborg Wastewater Treatment Plant in Denmark now generates more than 150% of the energy needed to run the plant from biogas created from the sewage, which means that the surplus can be used to pump drinking water to 200,000 people and the excess sold to the local grid¹⁹. Ofwat is encouraging a market in sewage sludge and hopefully this will lead to a greater appreciation of the value of wastewater.

THE EU URBAN WASTE WATER TREATMENT DIRECTIVE SETS MINIMUM STANDARDS ON SEWAGE, WITH TOWNS OF 2,000 PEOPLE OR MORE REQUIRING AT LEAST SECONDARY TREATMENT

SEWAGE WORKS IN CATCHMENTS PROTECTED BY THE EU HABITATS DIRECTIVE MUST MEET STRICTER PHOSPHOROUS TARGETS



© SOUTHERN WATER

Some of the country's largest sewage works, like Southern Water's Peacehaven facility (pictured), treat sewage to the highest standards and offer significant potential to recover energy, recycle nutrients and reuse water.

1.2.2 SEWER OVERFLOWS

There are three main types of sewer:

- **Foul sewers** take kitchen and bathroom waste from homes and businesses straight to a sewage treatment works, where it is treated and discharged to the environment.
- **Surface water sewers** take rainwater from roofs, roads and other surfaces to an appropriate discharge point in a local river or other watercourse. Up to 300,000 homes in the UK are estimated to have a ‘misconnection’ with foul water from toilets or pipes discharging into the surface water sewer²⁰. The most common misconnection is a washing machine²¹ which results in water rich in polluting phosphorus from detergents running straight into the local waterway.
- **Combined sewers** collect both foul and surface water and take it to a sewage treatment works, where it is treated and discharged to the environment.

The vast majority of England and Wales’ sewer network is a combined system²² – the same as Bazalgette’s. The combined system mixes rainwater with sewage and in times of high flows the sewage treatment works simply can’t cope with the volume. When this happens untreated sewage^{**} is released straight into rivers, just as it was in Victorian London, through a **sewer overflow**. These are specific places – on the sewer, at a sewage pumping station, or at a sewage treatment works – designed as a safety valve, releasing sewage to prevent it backing up and flooding streets and homes. In theory, releases from these overflow sites should only be triggered when an exceptionally large volume of surface water – for example in a storm or a sudden, intense summer downpour – suddenly overwhelms the capacity of the treatment works or the sewer.

No one knows how often and for how long these sewer overflows discharge untreated sewage into rivers and seas. In 2013, Defra wrote to Ofwat and water company chief executives requiring the installation of sewer overflow monitoring for the “vast majority” by 2020²³. A lot of work is now under way to make this happen, but at present over two-thirds of overflows in England remain unmonitored.

MOST OF THE SEWER NETWORK IS A COMBINED SYSTEM THAT MIXES RAINWATER WITH SEWAGE

IN WET WEATHER, COMBINED SYSTEMS INCREASINGLY CANNOT COPE WITH THE VOLUME, RESULTING IN UNTREATED SEWAGE GOING STRAIGHT INTO RIVERS THROUGH A SEWER OVERFLOW

1.2.3 SEPTIC TANKS

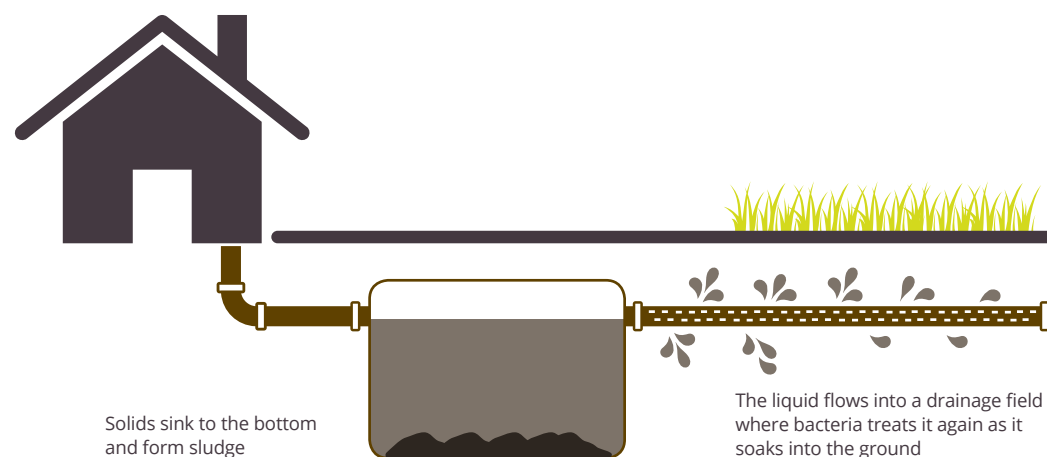
Not everyone in England and Wales is connected to mains sewerage. In many rural areas, sewage is processed with septic tanks attached to individual homes, or for a small cluster of properties such as a farm, sewage is taken to package treatment works.

Septic tanks are underground chambers which collect sewage from buildings that aren’t connected to mains sewerage. As such they are much more common in rural areas.

The term ‘septic’ refers to the anaerobic bacterial processes which break down the sewage. Wastewater enters the first chamber in the tank and, as in the primary part of a sewage treatment works, the solids settle and the fats and oils rise as scum to the surface. The clarified fluid then flows into a secondary chamber where more settlement and separation takes place. Anaerobic decay reduces the volume of solids, but even so they build up and must be periodically removed. An outlet pipe is arranged in such a way that only clear fluid can escape the tank, where it spills into what is known as a drain field or seepage field.

The important point is that septic tanks require regular maintenance to function properly. Without it, they can be damaging to the environment. Owners of septic tanks must comply with ‘General Binding Rules’ – legal requirements to ensure that a septic tank should be properly maintained and not cause pollution²⁴.

Septic tanks – how do they work?



These systems are not capable of removing phosphates and should not discharge directly into a river.

^{**}Untreated sewage here refers to crude sewage mixed with rainwater that has passed through a grill to try and remove items such as sanitary towels and wet wipes which have been flushed down loos. It has not undergone primary, secondary or tertiary treatment

Phosphorus from agriculture and land management

Sewage is a major source of phosphorus pollution but phosphorus from agriculture – found in nutrients spread on fields and in slurry – is an equally big issue impacting river health. Almost a third (31%) of all pressures preventing England's waters reaching good ecological status can be attributed to the agricultural sector²⁵. Our rivers will never be healthy if we only deal with the sewage issue alone. This is why in 2015 WWF and the Angling Trust took a judicial review to force the government to take action to address agricultural pollution. The resultant court order means that the government has to consider and, where necessary, use regulatory tools to ensure pollution is addressed in our most precious rivers and coastal waters. In addition WWF is working with Coca-Cola and the Rivers Trust to support farmers, through advice and incentives, to reduce pollution in areas where sugar beet is grown. This partnership has also supported the establishment of a new Catchment Based Approach Water Stewardship Service to help businesses from across the agricultural supply chain invest in catchment solutions to deliver a healthier water environment.

1.3 IMPACTS OF SEWAGE POLLUTION ON PEOPLE AND WILDLIFE

Sewage pollution happens when, for one reason or another, any of the treatment processes stops working properly or because the rules around them are not sufficient in the first place – as in the case of sewer overflows, which are a major source of pollution.

There are two timescales in which sewage pollution occurs:

- One-off 'incident' pollution is caused by some failure in the sewerage system, such as blocked pipes or a lack of maintenance, or sometimes by an extreme event like groundwater flooding or a heavy storm.
- Continuous 'chronic' pollution is caused by a basic inadequacy in the treatment system. Examples include a small sewage treatment works that does not treat sewage to a very high standard, or a large number of poorly maintained septic tanks having a cumulative impact.

Straddling both categories, and a primary concern in this report, is a form of sewage pollution that is supposed to be very infrequent, but has become chronic because of a lack of investment in our sewage infrastructure – sewer overflows.

So, what is sewage pollution and why is it a problem?

Sewage contains high quantities of phosphate, a very effective fertiliser. In rivers, excessive concentrations of phosphate cause algae to grow rapidly. This extracts dissolved oxygen from the water, which suffocates the other forms of river life, from the smallest insects to the biggest fish.

The impact ripples up and out too: kingfishers, otters, dippers – all wildlife that depends on life under the water suffers when a river is polluted.

In addition to phosphates, ammonia and nitrogen, other 'modern' chemicals are now found in sewage: caffeine, ibuprofen and synthetic oestrogen, to name a few. The effect of these chemicals is not routinely monitored and the full impacts are unknown; conventional sewage treatment is not effective at removing them. However, a growing body of evidence suggests they are harmful to wildlife. There's evidence to show that just under half of UK rivers could contain ibuprofen at levels that pose an unacceptable risk to fish²⁶. One study on starlings showed a debilitating impact on appetite when the birds were exposed to an anti-depressant which is also found in sewage²⁷. Increasing levels of synthetic oestrogen in water, because of contraception medication passing into sewage, can trigger a condition known as intersex in freshwater fish, which has caused population decline in some species²⁸.

Sewage pollution can threaten people's health. No-one has died of cholera in the UK for over 100 years, but untreated sewage contains all sorts of other bacteria, pathogens and parasites. Anyone whose hobby or profession brings them into contact with potentially infected water – surfers, rowers, anglers and wild swimmers for example – is at risk. Those who do come into contact with polluted water will most likely suffer a mild to bad case of gastroenteritis: *E. coli*, salmonella, listeria, campylobacter, adenovirus, norovirus and cryptosporidium will all cause illness, which can be serious. Diseases such as leptospirosis, septicaemia and hepatitis A are all linked to sewage pollution and can be very serious indeed, sometimes fatal.

Some forms of pollution – when a sewer blocks and overflows into houses, for example – affect people nowhere near a river. In the year to March 2017, 5,690 properties and 33,481 areas of private land or gardens were flooded with sewage²⁹. The causes of such flooding are similar to those of sewer overflows: rainwater or groundwater overwhelming sewerage capacity, blockages (fat, sanitary towels and wipes, broken pipes or tree roots can all block sewer pipes) or a lack of maintenance (a blocked sewer overflow grating or a failed pump).

The impact of sewage pollution on the shellfish industry

In 2015 the shellfish industry landed product valued at £264 million³⁰. But it is an industry vulnerable to sewage pollution. For example, in August 2013, Newham sewage treatment works discharged 730,000 litres of untreated sewage into the Fal estuary near Truro, a highly protected site, after an inlet was blocked by a piece of grating. The spill occurred near mussel and oyster beds and the shellfisheries had to temporarily close because of the risk to human health. The incident was preventable if the grating had been removed or the site inspected more frequently. South West Water was fined £200,000³¹. More recently the European Court of Justice ruled that Welsh Water's sewer overflows on the South Wales coast near Llanelli broke UK and EU clean water laws, with implications for the shellfishery.

“Minister, it's now been 12 years since the cocklers of the Bury inlet have reported significant die-offs of shellfish and we still don't know the cause of these deaths. We do know, however, of its economic impact: an export industry has been devastated and local cocklers are now struggling to make even a basic living. Six years ago, courts found against Welsh Water and now they found again against the UK government. Would the government look again at this and consider helping this devastated local industry?”

Lee Waters, Welsh Assembly Member, Llanelli³²



1.4 POLLUTION INCIDENTS

A ‘pollution incident’ is an individual event that has caused environmental harm. These are categorised according to the extent of harm, with ‘serious’ pollution incidents causing significant fish deaths and risk to public health.

Although the overall environmental performance of water companies is improving, in 2016 the number of pollution incidents reported by the 9 water and sewerage companies operating in England rose for the first time in five years. There was also an increase in the most serious pollution incidents which were all associated with sewage³³. In addition, the improvements seen in category 3 pollution incidents over recent years seems to be levelling off. Environment Agency data (Table 1) shows the number of sewage pollution incidents per 10,000km of sewer for each water company in 2016.

A pollution incident, failure to comply with the law, or a breach of permit conditions will need to be investigated to determine cause, at which point a formal enforcement action may be needed. The Environment Agency and Natural Resources Wales have a range of options at their disposal. These include warnings, prosecutions, fines and the revocation of environmental permits, depending on whether the purpose is to stop the action, restore the environment, bring into compliance or punish the polluter.

The Environment Agency has found that key factors in sewage pollution incidents include shortcomings in monitoring, management and risk assessments, operational practice and staff culture³⁵. This suggests that many such incidents could be prevented.

In 2014, revised sentencing guidelines dictated that “the fine must reflect the seriousness of the offence and the court [is] to take into account the financial circumstances of the offender.³⁶” This was pivotal in increasing the size of fine companies have recently received related to sewage pollution (Figure 1); in March 2017, Thames Water was fined a record-breaking £20 million for sewage pollution that occurred over 2012-2014³⁷.

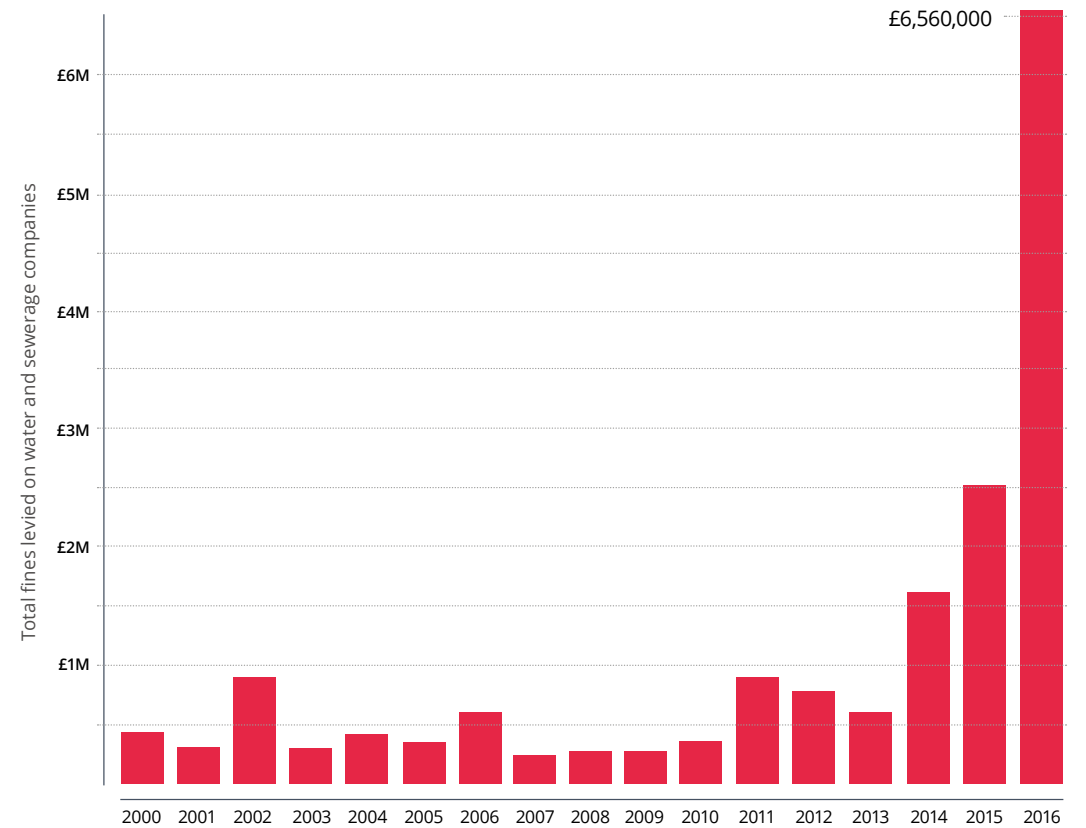
Table 1: Sewage pollution incidents (per 10,000km of sewers) in 2016

Anglian Water	32
Thames Water	33
United Utilities	22
Severn Trent Water	30
Wessex Water	22
Welsh Water	30
Yorkshire Water	46
Southern Water	35
Northumbrian Water	38
South West Water	115

Source: Discover Water³⁴

The change in sentencing has been a key step forward in ensuring that it is no longer cheaper for a company to pollute than invest to prevent pollution. As a result companies are being more proactive. For example, Thames Water analysed previous pollution incidents and detected a pattern that showed energy use at a treatment works surging directly before key pollution incidents, so by monitoring energy use it is possible to predict when an incident is likely to occur. Its new Wastewater Operational Centre monitors near-live data and advanced weather radar which allows Thames Water to detect potential problems and respond. This has resulted in a significant reduction in pollution incidents from their peak in 2013³⁸.

Figure 1: Water company fines for pollution incidents, 2000-2016



Source: Environment Agency Prosecutions January 2000-March 2017³⁹.

Sewage pollution on the River Trent

In September 2016, sewage pollution resulted in more than 15,000 dead fish on the River Trent in the West Midlands⁴⁰. This was as a result of pollution from Strongford sewage treatment works which serves Stoke-on-Trent, a large city on the river’s headwaters.

1.5 FUTURE CHALLENGES

Wales's population is projected to reach 3.3 million by 2039 (an increase of 6.1%)⁴¹ while England's is expected to reach 63.3 million (16.6% increase)⁴² in the same period. The 2017 Housing White Paper concluded that we need from 225,000 to 275,000 more homes per year⁴³. Under current legislation, developers have an automatic right to connect new properties to the mains sewer. Water companies are not a statutory consultee on planning decisions, which means that new homes could be built in areas without sufficient sewerage capacity.

The UK Water Industry acknowledges that investment has struggled to keep pace with rapid development; and that this will be exacerbated by current rates of deterioration and population growth.⁴⁴

In addition, climate change models suggest that intense rainfall and flash-floods are likely to become much more common in future, with heavy rainfall events potentially becoming 30% more extreme over the next decade⁴⁵.

Increasing urbanisation, changing absorbent landscapes into impermeable developed spaces, will also result in more pressure on the sewerage system as the rain runs off hard surfaces into sewers, instead of soaking into the earth. In 2015, one in four front gardens were estimated to be completely paved over, three times as many as in 2005, with plant cover decreased by as much as 15%⁴⁶.

In combination, these pressures will place heavy demands on the system. Unless we do something now, the burden of sewage pollution will only increase.



There are still some places on the River Kennet where water crowfoot is so abundant it can be cut (pictured). But Action for the River Kennet have shown large stretches are so dominated by algae there is no sign of the beautiful water weed which acts as the 'hedgerow' of the river, a haven for wildlife. Sewage overflows, common in the catchment when groundwater levels rise, are a significant part of the problem.



SECTION 2: WWF INVESTIGATION INTO THE STATE OF OUR SEWERAGE SYSTEM

We have conducted a prolonged investigation into our sewerage system and the real impact wastewater and sewage pollution is having on our precious rivers. This section reveals our findings along with a discussion about what these mean for the state of our sewerage system.

To do this we used several different techniques:

1. We sent an Environmental Information Request (under the Environmental Information Regulations, 2004) to all 10 water and sewerage companies.
2. We obtained Environment Agency information on pollution incidents, sewage treatment works, and sewer overflows.
3. We commissioned Artesia Consulting to conduct new analysis of large datasets collated by the Environment Agency and Natural Resources Wales. To analyse the results by individual company area Artesia digitised the water company boundaries (as Water UK, the Environment Agency and Ofwat were all unable to provide a GIS layer). The full Artesia report *Rivers on the Edge – an assessment of the impact of sewage pollution* is available at wwf.org.uk/flushedaway and contains full details of the methods and data sources used.
4. We commissioned social research company Populus to explore public attitudes towards sewage and wastewater pollution, including 20 in-depth interviews and an online survey of 2000 people stratified to represent the population of England and Wales. The full report is available at wwf.org.uk/flushedaway
5. We met with stakeholders from water companies, the Environment Agency and conservation groups and conducted a number of field trips to key sites.
6. We carried out a 'mystery shopper' exercise on all water companies to find out how easy it would be for customers to take action to help tackle the issue.

2.1 THE HEALTH OF OUR RIVERS AND REASONS FOR FAILURE

The Artesia analysis of Environment Agency and Natural Resources Wales' Water Framework Directive data showed that, as of 2015⁴⁷:

- Most rivers (80%) across England and Wales fail to meet the required good ecological status.
- Assessing the impact of pollution from sewage is not straightforward. There is limited data available and a degree of uncertainty; many of the key pressures on rivers occur in combination, and it can be unclear which pressure is responsible for the impacts seen and to what degree. However, the analysis on the data available suggests:
 - Pollution from wastewater⁴⁸ is one of the top three management issues for water bodies in England and Wales failing to meet good ecological status, the others being pollution from rural areas and physical modification.
 - In over half (55%) of all the English and Welsh rivers failing to meet good ecological status, wastewater pollution is a contributing factor for failure.
- All of the 10 water and sewerage companies are responsible for causing sewage pollution that is resulting in waterbodies not achieving good ecological status; however, there is wide variation in performance between the companies. Table 2 shows the proportion of river waterbodies in each water company area affected by wastewater pollution.
- Of the different types of wastewater pollution:
 - 'continuous sewage discharge' (the outflow from sewage treatment works) affects 45% of failing rivers,
 - 'intermittent sewage discharge' (sewer overflows) affects 14%,
 - 'unsewered domestic sewage' (i.e. septic tanks) affects 8%⁴⁹.
- However, monitoring procedures are far more effective in assessing continuous discharges than at capturing intermittent activities, meaning that the impact of sewer overflows and septic tanks is likely to be underrepresented in the data.

Name	% of total rivers
Thames Water	72%
Southern Water	64%
Anglian Water	63%
Severn Trent Water	61%
Wessex Water	53%
Yorkshire Water	48%
South West Water	45%
United Utilities	31%
Northumbrian Water	19%
Welsh Water	17%

Table 2: Proportion of rivers in company area polluted by wastewater

Note a margin of error resulting from only being able to obtain images with water company boundaries, rather than an accurate GIS layer.

Source: Artesia Consulting, 2017. *Rivers on the Edge – an assessment of the impact of sewage pollution*

⁴⁸This includes industrial and urban wastewater but a large majority of the activities contributing to failure are linked to sewage.

⁴⁹The percentages do not add up to 55% due to more than one type of sewage pollution occurring concurrently in certain rivers.

Figure 2: The rivers polluted by wastewater in England and Wales

The map shows all the rivers where water company wastewater pollution is classed as a 'reason for not achieving good' status by the Environment Agency and Natural Resources Wales.



Source: Artesia Consulting, 2017. *Rivers on the Edge – an assessment of the impact of sewage pollution*. Attribution Statement: Shapefiles obtained from © Environment Agency and Natural Resources Wales. Copyright and/or database right 2016. All rights reserved. Contains Ordnance Survey data © Crown copyright and database right 2013

Treating sewage with plants and ponds on the River Mun

At the top of the Mun, a chalk stream in Norfolk, is a small sewage treatment works serving 800 people. Because of the works' small size, Anglian Water was not required to treat sewage beyond minimal standards. Just downstream, nutrients from the sewage works were causing algal blooms on a small lake – so dense that during the summer it was almost impossible to push a boat along the surface. Algae reduces oxygen levels in the water, killing fish and almost all other life in the lake. In 2014, Norfolk Rivers Trust worked with the landowner to come up with an innovative, low-carbon solution to tackle the issue – a treatment wetland designed with three large and shallow pools, with 18,000 native wetland plants, specially chosen to effectively 'strip' the phosphate from the water. Two years since installation, levels of phosphate entering the river have reduced by up to 90%⁵⁴. Not only this, but the wetland is thriving with spotted orchid, bogbean and flag iris supporting species such as mayfly, sedge warblers and otters, and increasing the number of species of birds and dragonflies seen around the site. While it may take years for the overall levels of algae to reduce in the lake, the initial results show that this low-cost, low-maintenance and sustainable solution has real promise in tackling one of the key problems facing Norfolk's aquatic landscapes. Anglian Water is now working with Norfolk Rivers Trust to explore the potential for similar treatment wetlands at other sewage works.



2.2 SEWAGE TREATMENT WORKS - PERMITTED TO POLLUTE?

The Water Framework Directive requires controls on sewage pollution that are sufficient to ensure that rivers meet good ecological status. The Artesia analysis showed that continuous discharges from sewage treatment works are affecting nearly half of the rivers failing to meet good ecological status.

To understand why, we asked all the water companies to provide information on the total volume of sewage discharged to the environment, broken down by treatment type. Very little information was forthcoming. However, according to the Environment Agency, nearly all sewage treatment works have at least secondary treatment. In addition, compliance with environmental permits at sewage treatment works is over 98.5%.

So, despite the fact that water companies seem to be almost fully compliant with their regulatory permits, discharges from sewage treatment works are still polluting rivers. Clearly the existing permit system is not fit for purpose.

Environmental regulators are in the process of reviewing permits, but urgent, concerted action is needed.

2.3 SEWERAGE SYSTEM CAPACITY - ON THE EDGE?

We asked all companies how often they assessed the maximum capacity of their sewage treatment works. Answers varied significantly – from every five years, to when there are changes on site, to monthly, to some not providing an answer.

As part of the 21st Century Drainage Programme there is workstream developing an approach to mapping drainage and sewerage capacity. This is a welcome initiative but long overdue: we feel companies and regulators do not know enough about the capacity of sewerage treatment infrastructure.

But we do know that:

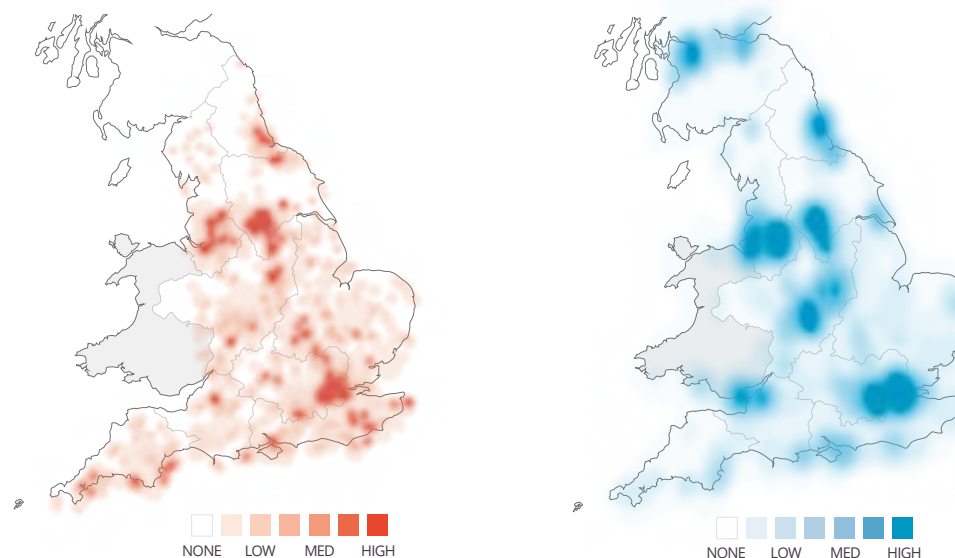
- Areas with higher sewage loads correspond with areas with higher numbers of pollution events. Artesia used Environment Agency data to produce heat maps to compare the volume of sewage that the largest sewage treatment works handle with the number of pollution incidents (Figure 4). The mirroring suggests that the more sewage sent down the line, the more likely it is to overspill and end up in a river or other watercourse.

- Much of the public sewer network across the UK is at least 50 years old⁴⁸. It was designed and installed for times with smaller populations and when far less of the country was paved over, meaning rainwater was able to soak away instead of entering the sewer. The industry code of practice suggests loadings for sewage treatment systems of 150 litres sewage per person per day⁴⁹. Given the lack of capacity data, we used population data to estimate the loads on the system (Figure 5). This suggests that in 2015, the sewage system was coping with an extra 2 billion litres per day, compared to 1961 – an extra 26%. From 1961-2039 the sewage load will have increased by 44%, an extra 3 billion litres per day. These estimates are crude in the absence of actual water company data, but give an illustration of the impact population growth alone is having on sewage treatment capacity.

Figure 4: Left, heat map showing frequency of pollution incidents in England. Right, heat map showing loads on large urban sewage treatment works in England

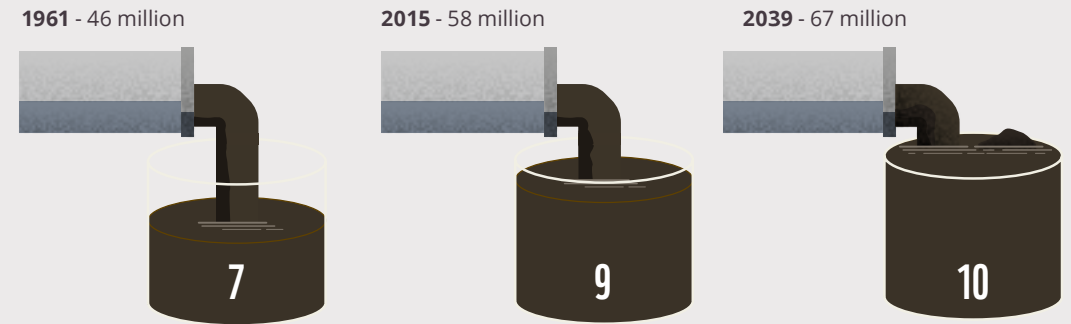
Frequency of pollution incidents (2000-2015) due to sewage

Load from urban wastewater treatment works entering the environment (data only available for works serving >2000 people)



Source: Artesia Consulting, 2017. *Rivers on the Edge – an assessment of the impact of sewage pollution*. Attribution Statement: Shapefiles obtained from © Environment Agency and Natural Resources Wales. Copyright and/or database right 2016. All rights reserved. Contains Ordnance Survey data © Crown copyright and database right 2013

Figure 5: Sewage load estimates based on a growing population for England and Wales

Population:

Total sewage load (billion litres / day)

The information we have been able to gather about capacity and sewer over flows (next section) indicates that companies are relying on over flows to compensate for under-capacity.

Our sewerage system is on the edge. Significant investment and a long term, strategic approach is needed to make it fit for the future pressures of increased population, development and climate change.

While the regulators have produced a good practice Drainage Strategy Framework⁵⁰ to encourage a more strategic approach, it is voluntary and does not go far enough. Something similar to the statutory Water Resource Management Plans, which is approved by the regulators and the Secretary of State, is urgently needed for wastewater. This will ensure that companies plan for future demand scenarios and build in contingency capacity ('headroom'). Water companies should also assess alternative options to managing wastewater, including catchment-based management and incentives to change customer behavior, to ensure they are investing strategically. The work of the 21st Century Drainage Programme to develop a framework for Drainage and Wastewater Management Plans is a welcome step in the right direction.



© PAUL JENNINGS

Lack of sewage treatment capacity on the River Chess

The River Chess in Buckinghamshire is a chalk stream and an Area of Outstanding Natural Beauty. Since 2003, the River Chess Association has been concerned that untreated sewage is polluting the river. In 2014, raw sewage mixed with groundwater continuously spilled from the Chesham sewage treatment works over a four-month period – an estimated 600,000⁵¹ tonnes in total, equivalent to the amount of oil that spilled into the Gulf of Mexico in the 2010 Deepwater Horizon disaster. Fish were killed and there was a drastic reduction in invertebrates. No action was brought against Thames Water.

Despite Thames Water making an additional storm tank available to increase capacity, raw sewage was still discharging into the Chess⁵² in 2016. The Chess flows through an area earmarked for 1,000 new homes⁵³, which will put even more pressure on sewage works which already exceed capacity. Thames have started an extensive upgrade project to improve capacity and level of treatment. This is very welcome but it needed to be initiated sooner.

Allen Beechey doing his monthly fly monitoring at a site just below the Chesham sewage treatment works outlet while it was discharging untreated sewage. This discharge started in early February 2014 and continued until early June 2014.

2.4 SEWER OVERFLOWS – FROM EMERGENCY ‘STORM’ RELEASES TO EVERYDAY OCCURRENCE?

Our research revealed that:

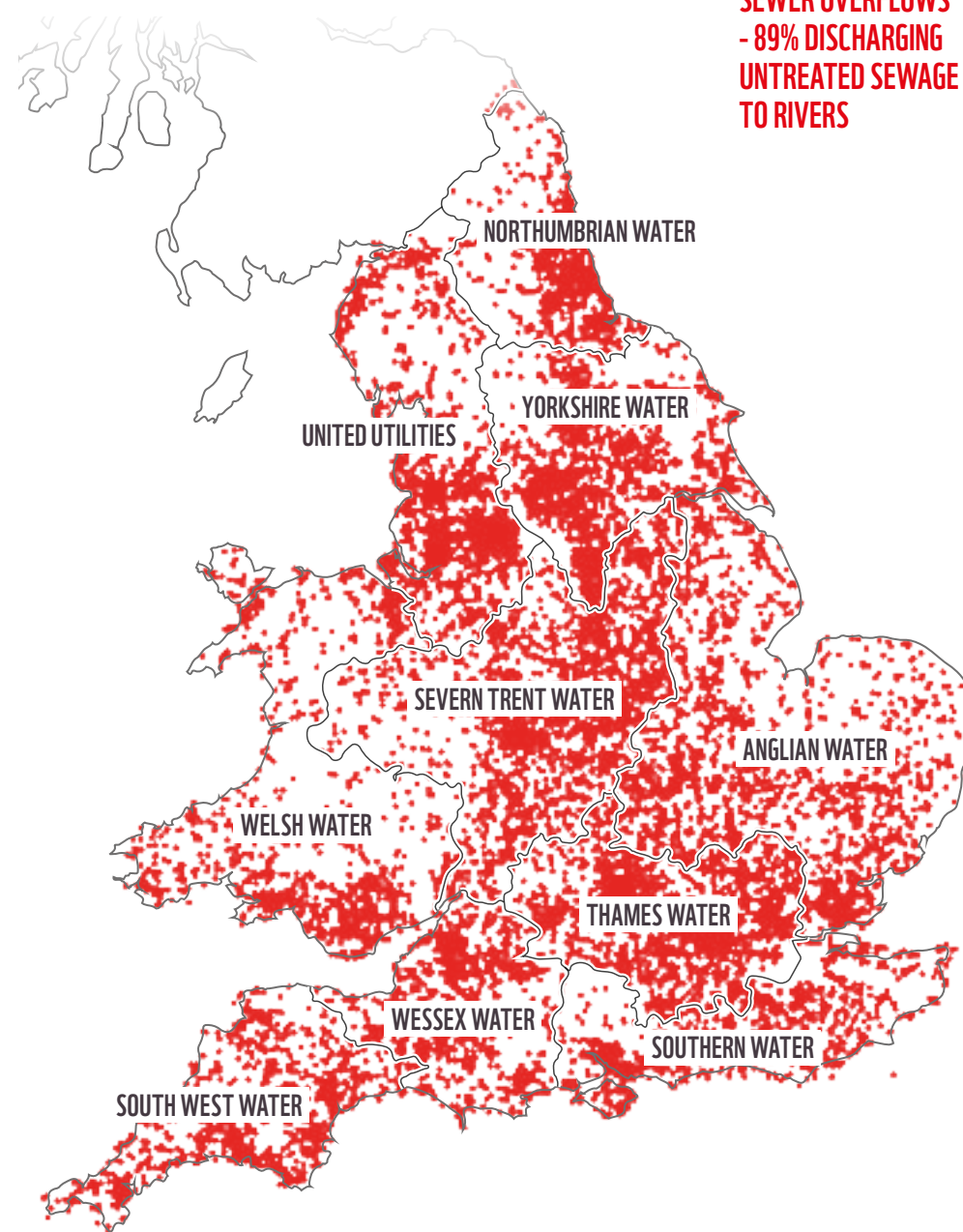
- There are 17,684 permitted sewer overflows across England and Wales – places where the environmental regulators have consented untreated sewage to spill into the environment (Figure 6)⁵⁵.
- 89% of these discharge into rivers, with the remainder discharging into estuaries or seas⁵⁶.
- In addition, there are approximately 750 sewer overflows in England that were given ‘temporary deemed consents’ when the industry was privatised in 1989, which still have not been given full environmental permits (and even when such permits are issued they are unlikely to be monitored)⁵⁷. These ‘temporary deemed consents’ have very basic conditions, meaning that they can spill as much untreated sewage as they like as long as they like. We suspect that many of the permitted sewer overflows also have similar basic conditions but we have not been able to obtain data about the conditions attached to every overflow.
- There is a heavy reliance on self-reporting and it is largely up to individual companies to decide how they will effectively monitor overflows, and review future performance. We hope that companies will use self-reporting as an opportunity to improve their performance and to share as much information as possible with regulators, their customers and communities. We would also like to see water companies admitting to incidents rather than cases being taken to court.
- Sewer overflows affect 14% of rivers failing to meet good ecological status. It is likely that this is a significant underestimate because the monitoring method is largely based on routine sampling which can be insufficient to detect intermittent pollution incidents, such as sewer overflows during wet weather – the conditions when sewer overflows are likely to occur.

Whilst there is an ambitious programme to increase monitoring, at present a significant proportion of sewer overflows remain unmonitored (Table 3) and there is little information readily available about the duration and frequency of discharges. The Environment Agency was able to provide some sample data related to new monitoring conditions on environmental permits that they have begun rolling out. This data showed annual spill counts in 2016 for two unnamed companies – one with mostly coastal discharges and one with only inland discharges⁵⁸ (Table 4).

Table 3: Proportion of sewer overflows monitored (Data from October 2016)

Companies	Current	By 2020
Anglian Water	37%	80%
Northumbrian Water	Not provided	100%
Severn Trent Water	18%	80%
South West Water	14%	81%
Southern Water	50%	98%
Thames Water	Not provided	
United Utilities	Not provided	
Welsh Water	20%	100%
Wessex Water	Not provided	75%
Yorkshire Water	Not provided	100%

Figure 6: Locations of sewer overflows across England and Wales in 2015



Source: Welsh data from Environment Agency, 2017. Use of Event Duration Monitoring (EDM) Data from Storm Overflow Monitoring. Presentation to WWF 29 March 2017. English data from Artesia Consulting, 2017. Rivers on the Edge – an assessment of the impact of sewage pollution. Attribution Statement: Shapefiles obtained from © Environment Agency and Natural Resources Wales. Copyright and/or database right 2016. All rights reserved. Contains Ordnance Survey data © Crown copyright and database right 2013.

Table 4: Sewer overflow spill frequency for two water companies

	More than once a week	More than once a month	More than once a year	Never
Company 1: overflows to rivers	14%	50%	88%	8%
Company 2: overflows to coasts	8%	33%	69%	25%

Source: Environment Agency Event Duration Monitoring data.

This data suggests that overflows to rivers are spilling more frequently than those to coastal waters, potentially reflecting the significant investment companies have made to clean up bathing waters. The sample data also shows that some overflows are spilling very frequently (up to 230 times per year).

The length of time an overflow spills for is also important. Little national data is available. But Welsh Water provides information on the sewer overflows they monitor on their website, which is a very welcome step. We looked at data for 247 overflows in South West Wales⁵⁹. On average, each overflow spilled for a total duration of 217 hours over a one year period. Some (13%) didn't spill at all, while a similar proportion (9%) spilled for at least 730 hours over a one year period – equivalent to flowing constantly for a whole month.

Sewer overflows are a necessary part of the system, providing relief for exceptional circumstances such as extreme rainfall or when there is a blocked sewer. However, the data shows they are discharging far more often than they should be. This suggests the UK is in breach of legal requirements under the EU Urban Waste Water Treatment Directive to restrict sewer overflows to times of 'unusually heavy rainfall'. The UK has already been deemed in breach of this Directive by the European Court of Justice (in relation to the Thames in 2012⁶⁰ and the South Wales coast in 2017⁶¹) and was prosecuted in May 2017 for failure to comply with the Urban Waste Water Treatment Directive at a number of sites across the country.⁶² It is likely that as more data is collected, more breaches will be identified.

The inadequacy of sewer overflows has been recognised for many years⁶³. While there are signs of progress, this year there are likely to be many occasions when untreated sewage spills into our rivers. Future pressures (as discussed in section 1.5) will make spills even more frequent. Consents relating to every single sewer overflow should be changed to ensure:

1. The precautionary principle – so the environment does not have to be damaged before action is taken. Regulators must deem all sewer overflows high risk unless evidence has shown otherwise.
2. A clear link between river flow and volume of discharge, so that when river flows are low, much tighter constraints are in place.
3. Controls on duration of spills, as well as the frequency.



© CHARLES RANGELEY-WILSON

Sewage treatment works discharging into the headwaters of the River Wensum, a Special Area of Conservation and Site of Special Scientific Research

2.5 SOUND INVESTMENT REQUIRES RELIABLE DATA AND REAL ENGAGEMENT

The Environment Agency and Natural Resources Wales draw up a National Environment Programme (NEP) at the 5-yearly review of water company plans. This is a list of environmental improvement schemes that ensure water companies meet European and national targets related to water. Companies incorporate these requirements into their proposed business plans, which inform Ofwat’s decision on prices. Each water company’s NEP contains hundreds of environmental actions, but the fact that there remain environmental impacts from sewage after repeated NEPs shows that there are gaps in the programme.

The NEP, and Ofwat’s decision on planning and investment, require a detailed understanding of environmental pressures and what is happening across water company networks and sites. This enables regulators to draw up appropriate schemes for the NEP, and water companies to plan for investment, target critical points and request appropriate funding from Ofwat.

2.6 SEPTIC TANKS

To understand the proportion of households not connected to the main sewer network, we asked the water companies what percentage of their bill payers do not pay a sewerage charge (Table 5). In England and Wales, 95% of properties are connected to a wastewater treatment works⁶⁴. Given there are 23.4 million households⁶⁵, this suggests that 1.17 million households use non-mains sewerage.

Natural England research found that many septic tank systems do not function properly –being either incorrectly sited (too close to a river), improperly maintained or too small for the household – and that this can have a significant local impact e.g. up to 700% increase in downstream concentrations of phosphorous⁶⁶.

As described, there has been significant progress recently on monitoring and data collection relating to wastewater, and there is more to be done. But equally important is what happens to this data.

Water companies must analyse and use it to make strategic, long-term planning decisions about wastewater management. Companies should also make data – as well as information on how it is used – freely available, so the public can make informed decisions on what they are willing to pay for. This type of approach will ensure meaningful public engagement and encourage collaboration with NGOs and community groups. Some companies are open and share their data online and we would like to see others follow suit.

Meanwhile, we urge Ofwat to question companies more about their wastewater plans and make sure they are fit for purpose. We would also like to see greater involvement of community groups and NGOs in drawing up the NEP.

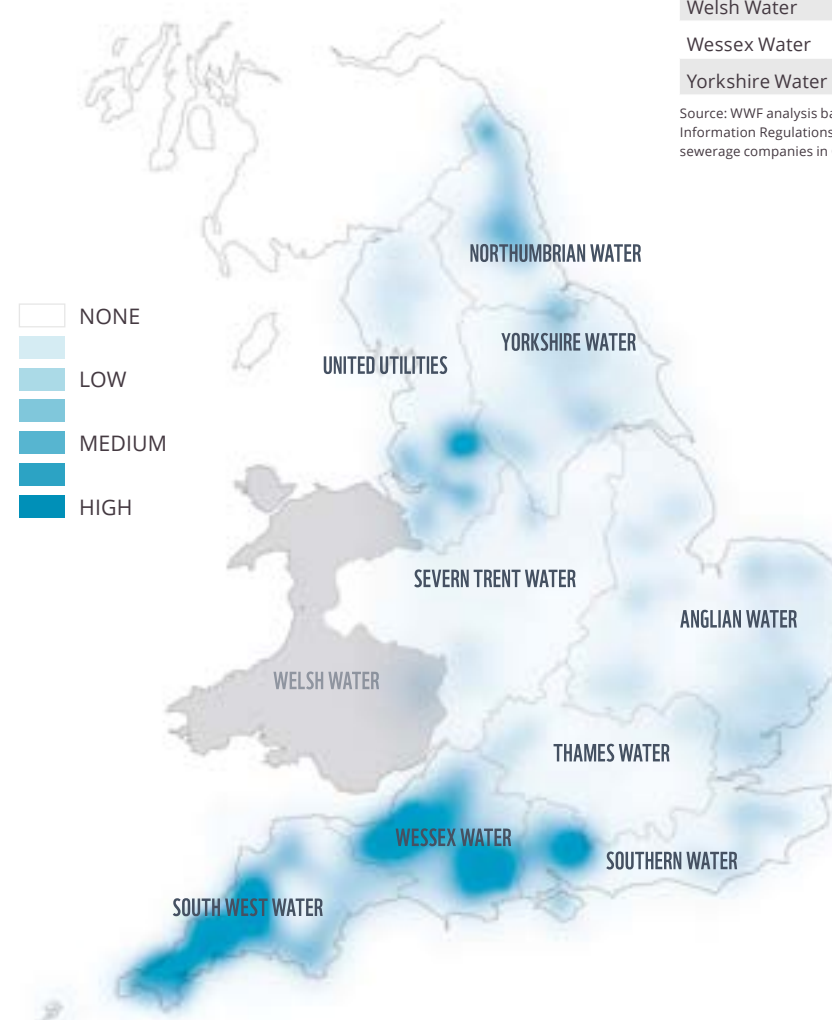
Environment Agency data on reasons for not achieving good ecological status in waterbodies shows that, on average, sewage discharges from such properties only affect 8% of failing rivers. However, given their distribution across the country, they can have major impacts in certain catchments. The headline figure is also likely to be a significant underestimate of impact – due to the nature of monitoring and the fact that so little is known about the whereabouts of non-mains discharges.

Table 5: % of households not connected to mains sewerage

Companies	% of households that do not pay a sewerage charge
Anglian Water	9%
Northumbrian Water	2%
Severn Trent Water	8%
South West Water	11%
Southern Water	5%
Thames Water	Did not disclose
United Utilities	Did not disclose
Welsh Water	6%
Wessex Water	5%
Yorkshire Water	Did not disclose

Source: WWF analysis based on responses to Environmental Information Regulations Request made to all 10 water and sewerage companies in October 2016

Figure 7: The concentration of 15,466 known septic tank permits across England (data was not available for Wales), showing that there are real pressure spots in the south-west and parts of Hampshire and the north.



Source: Artesia Consulting, 2017. *Rivers on the Edge – an assessment of the impact of sewage pollution*. Attribution Statement: Shapefiles obtained from © Environment Agency and Natural Resources Wales. Copyright and/or database right 2016. All rights reserved. Contains Ordnance Survey data © Crown copyright and database right 2013

The River Itchen – a paradise polluted

The River Itchen is one of the world's most iconic chalk streams and is protected by our toughest nature law – it's designated a Special Area of Conservation under the European Habitats Directive. Yet the spring-fed river is polluted. Every summer the crystal-clear water takes on a green tinge as algae blooms. Populations of freshwater shrimp have plummeted. Sewage, along with agricultural fertiliser, is a key source of the phosphorous that is polluting the river. Southern Water's sewage treatment works at Alresford does not have tertiary treatment including phosphorous stripping and its works at Morestead is being considered by the European Court of Justice as part of a legal action against the UK for failing to comply with water directives. Yet there is another significant but hidden source – septic tanks. An investigation by Hampshire and Isle of Wight Wildlife Trust found that there were over 1,200 private sewerage systems just in the most sensitive headwaters of the Itchen, and Natural England research indicated 5,700 across the whole catchment. Through the Test & Itchen Catchment Partnership, the Wildlife Trust has since launched a communications campaign to raise awareness and advise septic tank owners on how to properly use and maintain their tanks in order to reduce pollution: for example, by not overloading tanks, emptying them frequently, avoiding household chemicals which kill the bacteria vital to break down waste, and choosing phosphate-free detergents and dishwasher tablets.

Our discussions with stakeholders highlighted some real challenges relating to addressing the impact that septic tanks have on our environment:

- There is no formal register of septic tank owners – so we don't know with accuracy how many or where they are or the condition that they are in.
- Adherence to the General Binding Rules – legal requirements to prevent pollution and ensure proper maintenance – is neither monitored nor enforced.
- There are several common household chemicals that can harm the bacteria that are responsible for the breakdown of sewage waste in a septic tank. Labelling on these chemicals needs to be sufficient to ensure that households are aware that these chemicals are not suitable for use with a septic tank.
- While many of the companies we spoke to would consider connecting households to mains drainage (and even waiving the connection fee), the onus is on individual communities to request this.
- The environmental regulators seem to have no powers to mandate households to connect to mains drainage even where the cumulative impact of septic tanks is causing environmental damage.
- Households have little incentive to request a switch to mains drainage. Perverse incentives are also at play, including a sewerage bill of around £300 per year and the fear that connecting to mains sewerage will give a green light to new housing development.

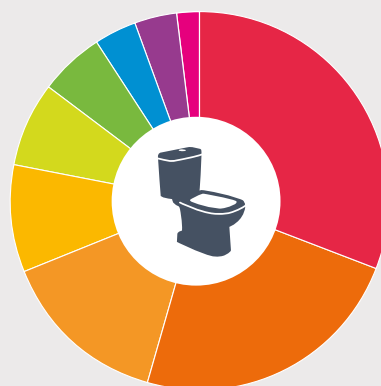
**OVER 1 MILLION HOUSEHOLDS
RELY ON SEPTIC TANKS AND
OTHER NON-MAINS SEWERAGE –
BUT RULES TO STOP POLLUTION
ARE NOT ENFORCED**

2.7 PUBLIC AWARENESS IS LOW BUT CONCERN IS HIGH

Awareness about water issues, and sewage pollution of rivers in particular, is very low. Research by Populus⁶⁷ found that the public cares about rivers and has a low tolerance towards pollution, but members of the public don't understand what the current situation is and if rivers are protected 'enough':

- 82% think all rivers should be clean enough so that it is safe for people to swim.
- 50% were not aware that raw sewage could be released into rivers – “*sewage goes to get cleaned ... I'd imagine.*”
- 80% agree that it is never acceptable to release raw sewage into rivers, 10% agree that it is sometimes acceptable and 5% think it's always acceptable – “*It's disgusting really. It must kill the fish and stuff like that. It should be illegal I think.*”
- 87% think the public should be informed when raw sewage is released into rivers.
- People are very unsure about regulations – just 29% were confident that regulations were sufficient to protect the environment.
- Despite deeming sewage overflows unacceptable, people were unsure whether they should pay more to prevent them (46% willing to pay more, 21% unwilling, 33% neither or don't know). This is perhaps underpinned by an expectation that the water company should not be causing pollution as part of business as usual - so why should people pay more now to stop it?
- The public want someone else to take action and protect the UK's rivers: government, water companies, environmental agencies.
- Many mistakenly believe items that can block the sewers and cause pollution can be flushed (Figure 8).

Figure 8: 35% of the public have put down the drain something they shouldn't in the **past month**



- 'Flushable' wipes - 17%
- Tampons - 13%
- Wet-wipes - 8%
- Cooking fat - 5%
- Dental floss - 4%
- Chewing gum - 3%
- Contact lenses - 2%
- Sanitary towels - 2%
- Paint - 1%

OUR EXPERIENCE OF ACCESSING ENVIRONMENTAL DATA HAS BEEN CHALLENGING AND HAS DEMONSTRATED THAT A SHIFT IS NEEDED TO ENSURE THAT COMPANIES ARE FULLY ACCOUNTABLE TO CUSTOMERS AND STAKEHOLDERS

We also conducted a 'mystery shopper' exercise to find out what advice and information company call centres could provide about reducing surface water inputs into the sewer. Staff from eight of the ten companies seemed familiar with the issue and were able to provide broadly accurate information about company policy on surface water drainage rebates. Staff from three companies were able to provide information on the total rebate available to customers if they disconnect surface and rain water from the sewer (e.g. by installing a soak-away). On asking if any support or advice was available about how to reduce surface water inputs, staff were only able to suggest looking at the website. The exercise suggested that company call centre staff are infrequently asked about these issues – suggesting staff and customer awareness is low⁶⁸.

Public awareness is low perhaps because so little information on sewage pollution relating to rivers is publicly available. In 2015, the non-profit organisation Fish Legal won a historic victory which was the culmination of a six-year legal campaign for greater transparency within the water and sewerage industry⁶⁹. The courts ruled that water companies in England and Wales are 'public authorities' for the purposes of the Environmental Information Regulations (2004) and are under a legal duty to disclose environmental information they hold to the public. In response to our request under these regulations some companies were quick to respond, helpful and welcomed a conversation. Others provided very little information because “they did not consider it to be an environmental request”, thought it “manifestly unreasonable” or advised that the process would be much quicker if we would agree to submit the questions outside of the regulations.

Our experience of accessing environmental data has been challenging and has demonstrated that a shift is needed to ensure that companies are fully accountable to customers and stakeholders. Initiatives such as the Discover Water dashboard and the Safer Seas Service (run by Surfers Against Sewage using company information on sewer overflows to bathing waters) are very welcome.

Given that zero sewage pollution is practically and economically impossible, having a dialogue with the public about what is and isn't acceptable and enabling public engagement and behaviour change is a crucial part of the solution. To enable this, companies must get better at communicating the extent of sewage pollution and make more information openly available, for example as the Environment Agency does through Catchment Data Explorer: www.environment.data.gov.uk/catchment-planning

USING GREEN INFRASTRUCTURE TO REDUCE SEWER OVERFLOWS AND FLOOD RISK



Green infrastructure can encourage water to soak into the ground and slow its flow through a catchment, thereby reducing surface water flooding and the risk of rainwater overwhelming the sewerage system. Green infrastructure could include planting trees, river restoration and other sustainable drainage systems (SuDS) such as ponds, grass swales, wetlands, soak-aways, green roofs, water butts and permeable paving. Well designed, they can reduce water use, encourage wildlife and make communities greener, more attractive places to live.

There is a growing evidence base showing the success of green infrastructure and impact of SuDS^{70,71}. However, a review of water company business plans in 2014 showed that there was limited uptake across the board⁷². One exception is Welsh Water's 'Rainscape' project, which will invest £80 million by 2020 in a range of SuDS projects to prevent and slow down surface water entering the sewer network, in part driven by the need to reduce sewer overflows⁷³. For example, in the River Neddern catchment, playing fields are used as natural flood storage during heavy rains. The water soaks into the ground or is slowly discharged to the sewer network at a fraction of the cost of the traditional solution (a pumping station to move water faster through the sewer).

London Wildlife Trust have created rain gardens in Herne Hill traffic islands to encourage more rainwater to soak into the ground and reduce the risk of surface water flooding and sewer overflows.

Green infrastructure can also generate returns for investors. For example, in 2017, Goldman Sachs and the District of Columbia Water and Sewer Authority, USA, launched a \$25 million investment bond that funds the installation of green infrastructure to reduce sewer overflows. It has a similar rate of return to traditional infrastructure and, if sewer overflows are reduced by more than 41%, then the water authority will make a bonus payment to investors⁷⁴.

The evidence suggests that the main obstacles to uptake of green infrastructure and SuDS are not technical, nor financial – they are political and institutional: weak planning policy; low capacity, knowledge and resource in water companies and local authorities; insufficient legislation⁷⁵.

For example, following the Pitt Review set up to learn lessons from the devastating 2007 floods, the Floods and Water Management Act (2010) included a new legal requirement for SuDS in new developments⁷⁶. Seven years on, this has not been enacted in England and a committee of MPs has since criticised the government saying communities are being unnecessarily exposed to flood risk as a result⁷⁷. There is better progress in Wales, with the Welsh government launching a consultation in 2017 to enact the legislation and make SuDS compulsory for all larger new developments. The consultation suggests Wales would save nearly £1 billion in construction costs and that the wider benefits would be worth more than £20 million per year⁷⁸.

SECTION 3: CONCLUSION AND RECOMMENDATIONS

We are not about to get another Great Stink, a smell bad enough to rouse government, because today the problems are more hidden. But just as that event inspired, or terrified, the government of 1858 into action, we need a comparable step-change in our approach; otherwise our sewage systems will reach breaking point.

We need a more strategic system

We must learn the lessons of the past – and invest in our wastewater system for the future. Water companies must produce long-term (50 year) strategic wastewater plans that ensure the sewage system is sufficient to prevent pollution and cope with today's downpours, future climate variability and change, increasing urbanisation and population growth. And crucially, these plans must show that the system can cope without polluting the environment or causing flooding. These plans are vital to ensure investment, proper maintenance and innovative new catchment solutions.

Everyone has a part to play in such new strategic wastewater plans:

- The UK government and the Welsh government must make these plans a legal requirement, require companies to update them every five years, and formally approve them.
- Water companies must develop, consult and implement these plans.
- The environmental regulators must review and approve the plans to ensure they are sufficient to prevent pollution.
- Ofwat must ensure that no business plan is signed off without evidence it is justified as part of the strategic wastewater plan.
- Stakeholders, catchment groups, NGOs and local authorities must actively engage and respond to draft plans.

LONG-TERM PLANNING IS VITAL TO TACKLING POLLUTION BY ENSURING INVESTMENT, PROPER MAINTENANCE AND CATCHMENT SOLUTIONS

We need a smarter system

At the moment, we react to problems when they occur. And, with sewer overflows and septic tanks, we often don't even know what problems are occurring and how often. We need to move to a system that is based on principles of foresight, prevention and transparency – a smarter, more integrated system. Enhanced monitoring and open data are essential to tackle problems and enable collaboration between companies, catchment groups, local authorities and environmental regulators to manage risk and deliver solutions.

We need a sustainable system

There is no one solution to these issues and it would be prohibitively expensive solely to build our way out of the problem. We need much greater action on managing demand – starting in the home with what's flushed down the loo or flows down the drainpipe. We need catchment solutions to unleash the power of plants and ponds to encourage rainwater to soak into the ground, recharge our water supplies and prevent inundation of the sewage system.

There is also no one party that can fix this alone. Water companies clearly have a key role to play, but we also need greater action through regulation - it should not be legally acceptable to pollute our rivers or frequently discharge untreated sewage. Our recommendations below describe actions for a range of actors, including the public.

Steps in the right direction

Over the past 5 years, in response to pressure from governments and NGOs, the water industry has made great efforts to improve its understanding of sewer overflows and sewerage system capacity. Just under a third of CSOs in England are now monitored and there are plans to increase this number dramatically by 2020. The water industry has established the 21st Century Drainage Programme and this is developing a Storm Overflow Assessment Framework to help prioritise investment and tools to map sewerage capacity. There has also been increased efforts to address sewer blockages, including engaging with the public on what should and shouldn't be flushed and poured down drains.

In addition, companies and the Environment Agency are working to help wastewater planning catch up with water resources planning.

This report commends all of this work but wants to see it go further and faster, and ensure all water companies are actively involved. We also want to see more real engagement on these initiatives with local communities, the public and NGOs.

We ask the government to ensure that every aspect of the EU Water Framework Directive and the Urban Waste Water Treatment Directive are fully transposed into law in England and Wales when we leave the EU. In addition, we ask that the government mandates water companies to develop long-term strategic wastewater management plans to improve river health; and ensure that the environmental regulators review all existing permits relating to sewage treatment and discharge. We ask Ofwat and water companies to contribute to good ecological status of rivers through the 2020-2025 business plans, and that Ofwat recognise it as a common performance commitment.

RECOMMENDATIONS

1. The Water Framework Directive and Urban Waste Water Treatment Directive must be transposed in full into law in England and Wales and sanctions established to enforce implementation after we leave the European Union. The 2027 deadline to achieve good ecological status in all our waterbodies must be met.
2. The UK government and the Welsh government must mandate water companies to develop long-term strategic wastewater management plans to ensure the sewerage system is sufficient to address pollution. They must also regulate to reduce the amount of surface water entering the sewers by enacting Schedule 3 of the Flood and Water Management Act (2010). This would make Sustainable Urban Drainage Systems (SuDS) in new developments a legal requirement and remove the automatic right to connect to the public sewer network. We recognise that Wales has made progress in this area by launching a consultation to make SuDS mandatory for all larger developments.
3. The Environment Agency and Natural Resources Wales must review all permits for sewage treatment works and sewer overflows to ensure that consents sufficiently protect the environment. As a minimum, they must require real-time monitoring and reporting on every overflow. They must enforce General Binding Rules on septic tanks and report annually on compliance. Both the Environment Agency and Natural Resources Wales must be properly resourced to do this. We recognise there has been an increase in monitoring, and that permits are being reviewed. But we also understand that many water companies are still only providing the statutory minimum data and we would like to see a culture of openness and participation from all water companies.
4. Ofwat must recognise contributing to good ecological status as the critical environment outcome companies must report upon, and introduce this as a common performance commitment for the next price review in 2019 (a five yearly review of water company investments).
5. Water and sewerage companies and Ofwat must ensure that final business plans for 2020-2025:
 - Contribute to ensuring good ecological status is achieved by 2027 where it is technically feasible and not disproportionately costly to do so.
 - Demonstrate that investments are underpinned by long-term strategic wastewater management plans.
 - Include performance commitments on pollution prevention (including enhanced monitoring and performance on both pollution incidents and sewer overflows).
 - Include action to stop surface water getting into sewers – a combination of sustainable drainage systems (SuDS), household behaviour change initiatives and catchment management.
 - Deliver a major programme to upscale innovation and address sewage pollution at treatment works by investing in green infrastructure and new technology, and by maximising sewage as a resource for energy, nutrients and water.
6. Companies should develop ways to communicate to the public about sewage pollution and prevention and make information about sewer overflows and pollution publicly available. This could include developing a ‘Safer Rivers Service’ to inform the public about inland sewer overflows and promoting incentives to reduce surface water inundation and encourage installation of SuDS and green infrastructure.
7. We urge households to play a part by:
 - Keeping sewers flowing and our rivers and beaches clear of sanitary litter by flushing only poo, pee and toilet paper down the toilet.
 - Saving water by using water wisely in the home and requesting a water meter (where appropriate) and water efficiency visit from your water supplier.
 - Checking your drains are not misconnected if you’re having any building work done.
 - Avoiding too much paving in gardens and using permeable materials for any hard surfaces to ensure as much rainfall as possible soaks into the ground.
 - Installing a water butt and disconnecting drain pipes from the sewer (e.g. into a soak-away instead) – ask your water company for advice and incentives.



GLOSSARY

Bathing Waters Directive

An EU directive to protect and improve bathing water quality, with the aim of protecting human health and facilitating recreational use of natural waters. Available at: eur-lex.europa.eu

Bazalgette

Sir Joseph William Bazalgette was an engineer who created the sewer network for central London which was instrumental in relieving the city from cholera epidemics.

Catchment

The area of land that feeds rainwater into a river or its tributaries.

Environment Agency

A non-departmental public body established to protect and enhance the environment in England.

Ecological status

A classification under the Water Framework Directive which takes into account specific aspects of the biological quality elements, for example the “composition and abundance of aquatic flora” or “composition, abundance and age structure of fish fauna”.

Ecosystem

A community of living organisms and non-living components of their environment – such as air, water and soil – interacting as a system.

Environmental Information Regulations (EIR)

Legislation that gives the public a right to access to environmental information held by public authorities.

General Binding Rules

A set of legal requirements set out by the government that are regulated by the Environment Agency and/or Natural Resources Wales.

Green infrastructure

Natural and semi-natural features, green spaces and waterways that provide services to society. For example: green roofs and street trees that soak up rainwater.

Intermittent

Occurring at irregular intervals; not continuous or steady.

Invertebrates

Animals that neither possess nor develop a vertebral column (backbone).

Ofwat

The Water Services Regulation Authority, or Ofwat, is a non-ministerial government department responsible for economic regulation of the privatised water and sewerage industry in England and Wales.

Package Treatment Works

A unit that breaks down sewage through both primary and secondary treatment. They differ from septic tanks by enabling the growth of aerobic bacteria by introducing air into the treatment plant. This results in higher quality effluent.

Pathogen

A bacterium, virus, or other microorganism that can cause disease.

Price review

Ofwat’s five-yearly review of water company investment and setting of price caps. The current review will conclude in late 2019, referred to as PR19.

Precautionary principle

States that if an action or policy has a suspected risk of causing harm to the public, or to the environment, in the absence of scientific consensus, the burden of proof that it is not harmful falls on those taking that action.

Sentencing guidelines

In force to help judges and magistrates decide the appropriate sentence for a criminal offence.

Septic tank

A tank, typically underground, in which sewage is collected and allowed to decompose through bacterial activity before draining by means of a soak-away.

Sewage

Wastewater and excrement conveyed in sewers.

Sewerage

The physical facilities (e.g. pipes, lift stations, and treatment and disposal facilities) through which sewage flows.

Sludge

Thick, soft, viscous mixture of liquid and solid components, a product of the sewage process.

Serious Pollution Incident

Includes category 1 and category 2 pollution incidents as classified by the environmental regulators, which have significant medium to long term impact on the environment in terms of fish and invertebrate mortalities.

Surface Water Drainage Rebate

Rebate to which customers are entitled when rainwater from their property does not drain into a public sewer due to the presence of a soak-away, or similar.

Sustainable drainage systems (SuDS)

Provide effective surface water drainage, aiming to mimic within urban areas the way rainfall drains in natural systems. For example, soak-aways, swales and ponds.

Swales

Shallow, broad and vegetated channels designed to store and/or convey runoff and remove pollutants.

Urban Waste Water Treatment Directive (UWWTD)

An EU directive concerning urban wastewater collection, treatment and discharge for populations of over 2000 and more advanced treatment in populations greater than 10,000 in sensitive areas. Available at: eur-lex.europa.eu

Wastewater

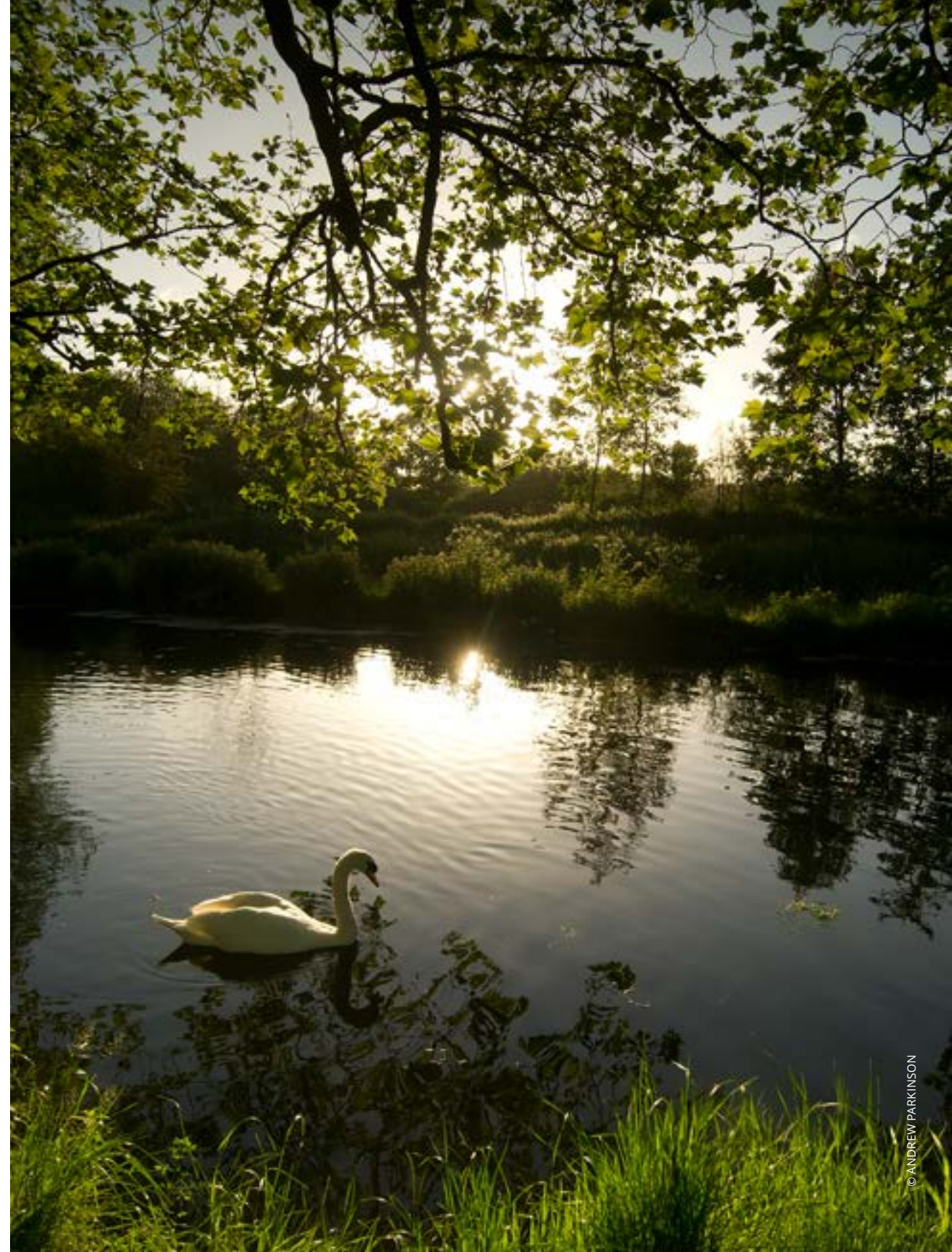
Water that has been used in the home, in a business, or as part of an industrial process.

Water Framework Directive

An EU directive which commits EU member states to achieve good qualitative and quantitative status of all water bodies. Available at: eur-lex.europa.eu

Water UK

A membership organisation which represents and works with the major water and wastewater service providers in England, Scotland, Wales and Northern Ireland.



REFERENCES

1. Mersey Basin Campaign. 2010. Who saved the Mersey? Available at: www.merseybasin.org.uk/archive/assets/176/original/Who_Saved_the_Mersey.pdf [accessed 06 July 2017]
2. Defra. 2016. Statistics on English coastal and inland bathing waters. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/565710/STATS_bathing-water-release-2016v1.pdf [accessed 06 July 2017]
3. Artesia Consulting. 2017. Rivers on the Edge - an assessment of the impact of sewage pollution.
4. Environment Agency. 2014. A consultation on the draft update to the river basin management plan. Part 3: Economic analysis. Available at: www.bawag.co.uk/1/documents/economic-analysis-extended-report.pdf [accessed 06 July 2017]
5. Environment Agency. 2011. Briefing - 2010 WFD Classification Results.
6. Artesia Consulting. 2017. Rivers on the Edge - an assessment of the impact of sewage pollution.
7. BBC History. 2014. John Snow. Available at: www.bbc.co.uk/history/historic_figures/snow_john.shtml [accessed 06 July 2017]
8. Davies, C. 2015. Downstream: A History and Celebration of Swimming in the River Thames. Aurum Press, London.
9. Ofwat. 2015. The evolution of the regulatory model in water. Beesley lecture by chief executive Cathryn Ross, 15 October 2015. Available at: www.ofwat.gov.uk/publication/beesley-lecture-15-october-2015-the-evolution-of-the-regulatory-model-in-water-cathryn-ross-chief-executive/ [accessed 06 July 2017]
10. Department for Environment, Food and Rural Affairs. 2011. Water for Life. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/228861/8230.pdf [accessed 06 July 2017]
11. Water UK, England & Wales (Apr 2016 - Mar 2017). www.discoverwater.co.uk/treating-sewage. [Accessed 10 October 2017]; Water UK. 2016. 21st Century Drainage Programme: Protecting health, supporting communities, securing the environment now and for the future. Available at: www.water.org.uk/policy/improving-resilience/21st-century-drainage [Accessed 12 October 2017]
12. Wessex Water. AMP6 Environmental Investigations. Phosphorus removal trials: Warminster. Available at: gis-services.wessexwater.co.uk/Storymaps/Environment/Stour/documents/Investigations/4692.pdf [accessed 06 July 2017]
13. Water Briefing. 2017. Thames Water and Cranfield in reed bed trials for phosphorus removal. Available at: www.waterbriefing.org/home/technology-focus/item/13442-thames-water-and-cranfield-in-reed-bed-trials-for-phosphorus-removal [accessed 06 July 2017]
14. Water Briefing. 2017. Severn Trent begins new phosphorus removal technology rollout. Available at: www.waterbriefing.org/home/technology-focus/item/13856-severn-trent-begins-new-phosphorus-removal-technology-rollout [accessed 06 July 2017]
15. Utility Week. 2016. Putting the focus on phosphorus. Available at: utilityweek.co.uk/news/putting-the-focus-on-phosphorus/1220872#.WTE_p02GPI [accessed 06 July 2017]
16. Water and Wastewater Treatment. 2013. European first as Thames P-plant produces fertiliser. Available at: wwtonline.co.uk/news/european-first-as-thames-p-plant-produces-fertiliser#.WSPp9-vyupp [accessed 06 July 2017]
17. Thames Water. 2016. Energy from sludge. Available at: sustainability.thameswater.co.uk/delivering-efficient-operations/sludge-as-a-resource/energy-from-sludge [accessed 06 July 2017]
18. Energy in demand. 2016. Paris pool uses sewer heat to cut cost and emissions. Available at: energyindemand.com/2016/10/08/good-example-of-using-heat-from-sewers [accessed 06 July 2017]
19. Karáth, K. 2016. World's first city to power its water needs with sewage energy. *New Scientist* 1 December 2016. Available at: www.newscientist.com/article/2114761-worlds-first-city-to-power-its-water-needs-with-sewage-energy [accessed 06 July 2017]
20. Chartered Institute of Plumbing and Heating Engineering. 2017. Plumbing Misconnections. Available at: www.ciphe.org.uk/consumer/safe-water-campaign/plumbing-misconnections [accessed 06 July 2017]
21. Chartered Institute of Plumbing and Heating Engineering. 2017. Plumbing Misconnections. Available at: www.ciphe.org.uk/consumer/safe-water-campaign/plumbing-misconnections [accessed 06 July 2017]
22. Chartered Institution of Water and Environmental Management. 2004. Policy Position Statement: Environmental impacts of combined sewer overflows (CSOs). Available at: www.ciwem.org/wp-content/uploads/2016/04/Environmental-impacts-of-combined-sewer-overflows.pdf [accessed 06 July 2017]
23. Department for Environment, Food and Rural Affairs. 2013. Communication to Ofwat and Water Companies by letter regarding combined sewer overflows. 18 July 2013.
24. Department for Environment, Food and Rural Affairs. 2017. Available at: www.gov.uk/permits-you-need-for-septic-tanks [accessed 06 July 2017]
25. Environment Agency. 2015. Update to the river basin management plans in England National Evidence and Data Report. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/514944/National_evidence_and_data_report.pdf [accessed 06 July 2017]
26. Boxall, A., Keller, V., Straub, J., Monterio, S., Fussell, R. and Williams, R. 2014. Exploiting monitoring data in environmental exposure modelling and risk assessment of pharmaceuticals. *Environment International*. 73:176-185.
27. Bean, T., Boxall, A., Lane, J., Herborn, K., Pietravalle, S. and Arnold, K. 2014. Behavioural and physiological responses of birds to environmentally relevant concentrations of an antidepressant. *Philosophical Transactions of the Royal Society B: Biological Sciences* 369(1656).
28. Jobling, S., Williams, R., Johnson, A., Taylor, A., Gross-Sorokin, M., Nolan, M., Tyler, C., van Aerie, R., Santos, E. and Brighty, G. 2016. Predicted exposures to steroid estrogens in U.K. Rivers correlate with widespread sexual disruption in wild fish populations. *Environmental Health Perspectives*. 114(S-1): 32-39.
29. Discover Water. 2017. Sewer Flooding. Available at: www.discoverwater.co.uk/sewer-flooding [accessed 13 September 2017]
30. Marine Management Organisation. 2016. UK Sea Fisheries Statistics 2015. Office for National Statistics. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/598208/UK_Sea_Fisheries_Statistics_2015_full_report.pdf [accessed 06 July 2017]
31. *The Environmentalist*. 2017. Sewage pollution near shellfish beds costs water company more than £200k. Available at: www.environmentalstonline.com/article/sewage-pollution-near-shellfish-beds-costs-water-company-more-ps200k [accessed 06 July 2017]

32. National Assembly Wales. 2017. Oral Answers, The Breach of Clean Water Rules, 11 May 2017.
33. Environment Agency. 2017. Water and sewerage companies' performance. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/627158/Water_company_performance_report_2016.pdf [accessed 18 July 2017]
34. Discover Water. 2017. Environmental Performance. Available at: www.discoverwater.co.uk/environmental-performance [accessed 20 September 2017]
35. Artesia Consulting. 2017. Rivers on the Edge - an assessment of the impact of sewage pollution.
36. Sentencing Council. 2014. Environmental Offences Definitive Guideline. Available at: www.sentencingcouncil.org.uk/wp-content/uploads/Final_Environmental_Offences_Definitive_Guideline_web2.pdf [accessed 06 July 2017]
37. BBC News. 2017. Thames Water fined £20m for sewage spill. Available at: www.bbc.co.uk/news/uk-england-39352755 [accessed 06 July 2017]
38. Thames Water. 2017. Preventing pollution - progress towards a better environment. Available at: blueprintforwater.org.uk/2017/06/preventing-pollution-progress-towards-a-better-environment [accessed 06 July 2017]
39. Environment Agency. 2017. Prosecutions January 2000-March 2017. Available at: data.gov.uk/dataset/environment-agency-prosecutions/resource/708ed25c-14b3-4cbf-98ff-9ca22be953a3 [accessed 06 July 2017]
40. BBC News. 2016. Fish die as sewage pollutes River Trent. Available at: www.bbc.co.uk/news/uk-england-stoke-staffordshire-37320815 [accessed 06 July 2017]
41. Office for National Statistics. 2015. Natural population projections. Available at: gov.wales/statistics-and-research/national-population-projections/?lang=en [accessed 06 July 2017]
42. Population Matters. 2016. ONS population projections England. Available at: www.populationmatters.org/documents/ONS%20projections%20Regions%20and%20Local%20Authorities.pdf [accessed 06 July 2017]
43. Department for Communities and Local Government. 2017. Fixing our Broken Housing Market. Housing White Paper. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/590464/Fixing_our_broken_housing_market_-_print_ready_version.pdf [accessed 06 July 2017]
44. Water UK. 2016. 21st Century Drainage Programme: Protecting health, supporting communities, securing the environment now and for the future. Available at: www.water.org.uk/policy/improving-resilience/21st-century-drainage [Accessed 12 October 2017]
45. Department for Environment, Food and Rural Affairs. 2016. National Flood Resilience Review. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/551137/national-flood-resilience-review.pdf [accessed 07 July 2017]
46. Royal Horticulture Society. 2015. Why we all need Greening Grey Britain. Available at: www.rhs.org.uk/communities/pdf/Greener-Streets/greening-grey-britain-report.pdf [accessed 06 July 2017]
47. Artesia Consulting. 2017. Rivers on the Edge - an assessment of the impact of sewage pollution.
48. 21st Century Drainage Programme. 2016. Communications document. Available at: dl.dropboxusercontent.com/u/299993612/Publications/21st%20Century%20Drainage/21st%20Century%20Drainage.pdf [accessed 06 July 2017]
49. British Water. 2013. Code of Practice Flows and Loads - 4 Sizing Criteria, Treatment Capacity for Sewage Treatment Systems.
50. Environment Agency and Ofwat. 2013. Drainage Strategy Framework. Available at: www.ofwat.gov.uk/wp-content/uploads/2015/12/rpt_com201305drainagestrategy1.pdf [accessed 06 July 2017]
51. River Chess Association. 2016. Chesham Sewage Treatment Work Flows provided to WWF by request.
52. River Chess Association. 2016. Sewage Pollution in the Chess Again. Available at: www.riverchessassociation.co.uk/news/57/57/Sewage-Pollution-in-the-Chess-Again.html [accessed 06 July 2017]
53. Chiltern Town Council. What Will Chesham Look Like in 2036? Available at: www.chesham.gov.uk/Article/Detail.aspx?ArticleUid=0b73de2f-754f-4bee-a537-22254e4cf67a [accessed 06 July 2017]
54. Norfolk Rivers Trust. Upper Mun Restoration Project. Available at: www.norfolkriverstrust.org/trust_project/upper-mun-restoration-northrepps-wetland-project [accessed 06 July 2017]
55. Environment Agency. 2017. Use of Event Duration Monitoring (EDM) Data from Storm Overflow Monitoring. Presentation to WWF 29 March 2017.
56. Environment Agency. 2017. Use of Event Duration Monitoring (EDM) Data from Storm Overflow Monitoring. Presentation to WWF 29 March 2017.
57. Letter from Deputy Director of Water Quality, Environment Agency, to Mark Lloyd, Chief Executive of Angling Trust and Fish Legal, 10 February 2017.
58. Environment Agency. 2016. Event Duration Monitoring data for two companies. Provided on request by email 26 May 2017.
59. Welsh Water. 2017. Sewer Overflow Monitoring South West Wales. Available at: www.dwrwymru.com/en/Devmap172/CSO-Monitoring/South-West-Wales.aspx [accessed 06 July 2017]
60. 21st Century Drainage Programme. 2016. Communications document. Available at: dl.dropboxusercontent.com/u/299993612/Publications/21st%20Century%20Drainage/21st%20Century%20Drainage.pdf [accessed 06 July 2017]
61. BBC News. 2017. Bury inlet sea sewage breach - European Court of Justice. Available at: www.bbc.co.uk/news/uk-wales-39805395 [accessed 06 July 2017]
62. EUR-Lex. 2017. Judgement of the Court (Ninth Chamber) of 4 May 2017. Available at: www.eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A62015CJ0502 [accessed 20 September 2017]
63. Chartered Institution of Water and Environmental Management. 2015. Environmental Impacts of Combined Sewer Overflows. Available at: www.ciwem.org/wp-content/uploads/2016/04/Environmental-impacts-of-combined-sewer-overflows.pdf [accessed 07 July 2017]
64. Water UK. 2016. 21st Century Drainage Programme: Protecting health, supporting communities, securing the environment now and for the future. Available at: www.water.org.uk/policy/improving-resilience/21st-century-drainage [Accessed 12 October 2017]
65. Office for National Statistics. 2013. 2011 Census: Population and household estimates for the United Kingdom, March 2011. Available at: www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/populationandhouseholdestimatesfortheunitedkingdom/2011-03-21 [accessed 06 July 2017]
66. Natural England. 2015. Natural England Commissioned Report NECR170: The impact of phosphorus inputs from small discharges on designated freshwater sites.
67. Populus. 2017. Rivers on the Edge: Public Opinion Poll.

68. WWF mystery shopper exercise into surface water drainage rebates, conducted February-March 2017.
69. Fish Legal. 2015. Fish Legal wins historic judgement to prevent water industry hiding its dirty secrets. Available at: www.fishlegal.net/page.asp?section=1073# [accessed 06 July 2017]
70. Grant, L., Chrisholm, A. and Benwell, R. 2017. A Place for SuDs? CIWEM and WWT.
71. WWF. 2011. Dealing with the Deluge: Urban Water Management in a changing climate. Available at: www.wwf.org.uk/sites/default/files/publications/May17/Dealing%20with%20the%20Deluge.pdf [accessed 07 July 2017]
72. Blueprint for Water. 2014. Blueprint for PR14: An environmental assessment of water company plans. Wildlife and Countryside Link. Available at: www.wcl.org.uk/docs/Blueprint_for_PR14_Assessment.pdf [accessed 07 July 2017]
73. Welsh Water. 2017. Rainscape. Available at: www.dwrcymru.com/en/My-Wastewater/RainScape.aspx [accessed 07 July 2017]
74. Goldman Sachs. 2017. Available at: www.goldmansachs.com/media-relations/press-releases/current/dc-water-environmental-impact-bond-fact-sheet.pdf [accessed 06 July 2017]
75. Grant, L., Chrisholm, A. and Benwell, R. 2017. A Place for SuDs? CIWEM and WWT.
76. Cabinet Office. 2008. The Pitt Review - Learning lessons from the 2007 floods. Available at: webarchive.nationalarchives.gov.uk/20100812084907/http://archive.cabinetoffice.gov.uk/pittreview/_/media/assets/www.cabinetoffice.gov.uk/flooding_review/pitt_review_full%20pdf.pdf [accessed 06 July 2017]
77. ENDS report. 2017. Sustainable drainage policy 'exposes communities to flood risk'. Available at: www.endsreport.com/article/56157/sustainable-drainage-policy-exposes-communities-to-flood-risk [accessed 06 July 2017]
78. ENDS report. 2017. Wales moves to mandate sustainable drainage. Available at: www.endsreport.com/article/56412/wales-moves-to-mandate-sustainable-drainage [accessed 06 July 2017]



Cover Image: © Jonathan Lewis 2016



For a future where people and nature thrive | wwf.org.uk

© 1986 panda symbol and ® "WWF" Registered Trademark of WWF, WWF-UK registered charity (1081247) and in Scotland (SC039593). A company limited by guarantee (4016725)

