Storm overflows

Wessex Water
YTL GROUP

An explanatory note on why they exist, what impact they have and what can be done about them

Introduction

There are two types of sewer system in the UK. The older one, called a combined sewer system, carries all the foul water from homes and industry, as well as surface water (run-off from roof gutters, patios, driveways and some highways), in one pipe. Storm water and foul water combine to flow to the water recycling centre for treatment. In 1858 it was the Great Stink in Parliament that initiated the first combined sewer system – Bazalgette's interceptor sewers in London.

The newer type, constructed since the 1960s, is a separated sewer system comprising one pipe for the foul water (from sinks, washing machines and toilets) and a separate pipe for all surface water. The surface water is discharged to a watercourse, the sea or, where it is permeable enough, into the ground. The foul sewage flows to the water recycling centre for treatment.

Why do storm overflows exist?

During rainfall, the volume of liquid that a combined sewer needs to carry increases many times (eg, an average house roof area generates the same amount of flow in a 25mm/hr rainfall event as 90-130 houses where only foul water is connected). Constructing pipes big enough to cope with all the rainfall, yet small enough to ensure sewage flows during dry weather (it needs a minimum velocity), proved uneconomic and unnecessary at the time.

The sensible and most cost-effective solution was to build sewers of a size that carried all dry weather foul flows and much of the wet weather flow. But this meant that during heavy rainfall, the mix of rainwater and foul water exceeded the pipe capacity. As a result, flows could back-up and exit through lowest point – which often led to homes and businesses flooding.

Storm overflows[1] were a pragmatic solution to this problem and designed to act as 'relief valves', allowing excess heavily diluted sewage to be released to rivers or the sea.

Pretty much all towns and cities in the UK have combined sewerage systems and consequently all have storm overflows to protect properties from flooding during heavy rainfall. There are about 15,000 storm overflows in England – 1,300 of them in Wessex Water's area.

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[1] "Storm Overflows" is the terminology used to encompass Combined Sewer Overflows (CSOs), settled storm tank overflows (SSOs) and overflows at pumping stations. Some campaigners and media incorrectly refer to CSOs when they mean Storm Overflows.

Legislation governing storm overflows

The way in which storm overflows are governed by law is covered by the Urban Wastewater Treatment Directive (UWWTD). The relevant clauses are contained in **Annex I**.

It recognises the inevitable need for storm overflows on combined sewer networks and requires Member States to ensure their operation is restricted to limit pollution. The UK approach is discussed later.

Monitoring their operation

Awareness of how many times and the duration for which they operate is only now being revealed after a multi-year programme to install monitors on them. Hitherto, the extent of their operation went largely un-noticed.

Whilst this monitoring programme is still not complete, companies have committed to reach 100% coverage of Event Duration Monitors (EDM) by Dec 2023. The information is published each year. A summary of stats from 2020 is below:

2020 EDM summary statistics	Anglian Water (AWS)	Dwr Cymru Welsh Water (DC/WW) (in England)	Northumbrian Water (NW)	Severn Trent Water (SvT)	South West Water (SWW)	Southern Water (SW)	Thames Water (TW)	United Utilities Water (UU)	Wessex Water (WSSX)	Yorkshire Water (YWS)	**Totals / Average**
Number of spill events in 2020 return	17,428	3,969	32,497	60,982	42,053	19,782	18,443	113,940	28,994	65,083	**403,171**
Average number of spills /	25	34	22	27	38	21	40	59	30	30	**33**
Duration (hrs) of spill events in 2020 return	170,547	21,300	178,229	558,699	375,372	197,213	215,886	726,450	237,035	420,419	**3,101,150**
Average duration of spill (hrs)	10	5	5	9	9	10	12	6	8	6	**8**
Percentage time operating ror average overflow	3%	2%	1%	3%	4%	2%	5%	4%	3%	2%	**3%**

The revelation of how often they operate has coincided with a new-found national surge in river use by swimmers and paddle-boarders etc.

Various individuals and groups have been lobbying hard to stop companies "dumping raw sewage in rivers" and the momentum in Government is now so significant that it has set up a **Storm Overflows Taskforce** to try and address the issue.

The Taskforce has been established to:
"Develop proposals to significantly reduce the frequency and impact of sewage discharges from storm overflows with a range of ambitions from reducing spills to phasing out overflows"

The media has run numerous stories on storm overflows – mostly starting from the premise that "raw sewage" should not be "dumped" into rivers. Only a few eNGOs recognise the complexities and costs with tackling the issue which has a relatively low environmental impact (discussed later), as measured by the Water Framework Directive, compared to agriculture and continuous discharges from water recycling centres.

As more policymakers and activists recognise the costs and disruption associated with addressing storm overflows (and the lower than portrayed environmental impact), so the ambition to eliminate them altogether has been revised to eliminating harm from them.

"Harm" can be categorised as environmental harm and/or public health harm. These are measured in different ways.

Annex II presents evidence of the level of environmental impact that storm overflows have.

Annex III discusses public health impacts of storm overflows.

What can be done to reduce storm overflow operation and/or impact?

There are basically eight ways of reducing the problem:

Stopping discharges increase in the future	Preventing additional surface water from being added to combined sewers
	Preventing additional subsoil or overland water ingress to combined sewers
	Ensuring existing sewer capacity is maximised at any given time
Reducing current discharge levels	Removing existing connected surface water from combined sewers
	Removing or limiting existing subsoil or overland water ingress into combined sewers
	Providing additional capacity to the existing sewers
	Providing additional hydraulic treatment capacity at water recycling centres
Reducing the impact of discharges	Providing adequate treatment to storm overflows to prevent harm

The top 5 of these 8 ways would benefit from changes to sewerage legislation to help enable the ambition to be fulfilled more cost effectively. The Legislative Options Review Task & Finish group which is part of the Defra-led Storm Overflows Taskforce is considering how legislation can be addressed. Several of these issues are discussed in Annex IV.

Solutions

Reducing discharges or impacts of discharges can be grouped into 4 main types of solution:

1. Separation of surface or groundwater to reduce discharges
2. Attenuation of combined sewage to reduce discharges
3. Increasing capacity of continuous treatment at water recycling centres
4. Treatment of intermittent discharges to reduce impact.

The pros and cons of different solutions are discussed in **Annex V**.

The UK approach: the Storm Overflow Assessment Framework

Addressing storm overflows (where they are causing environmental damage or public health concerns) not only requires additional investment and changes to legislation, but it also requires a new approach to assessing the costs and benefits of intervention.

This new approach is called the (SOAF) which is being implemented by sewerage companies throughout England and Wales from 2020.

It is a staged process (see **Annex VI** for overview), which analyses overflow operational and environmental impact data, followed by a cost-benefit assessment and a decision over investment or otherwise. Where there are already known environmental or public health impacts of overflows, they will be included in the framework.

The SOAF provides a much-needed, evidence-based approach to dealing with the issue of overflows and is the current tool used to determine whether the environmental benefits from investment exceed the costs. Speed of implementation is then down to funding mechanisms through the five-yearly price controls set by Ofwat. About £1.1bn will be invested in 798 storm overflows between 2020 - 2025.

Wessex Water's 2020-25 investment plan

Wessex Water has committed to deliver 54 investigations into frequently spilling storm overflows, improvements to 13 of them, and have the ability to outperform this target having built in a Performance Commitment to reflect outperformance of the targets that have been set.

We are also planning to increase Flow to Full Treatment at 13 water recycling centres (WRCs), increase storm tank capacity at 18 WRCs and make improvements to 2 sites to improve bathing water quality.

Our Drainage and Wastewater Management Plans are the main tool for planning further investment for the next investment period between 2025 and 2030.

Summary

- Storm overflows used to be a pragmatic solution to the problem of combined sewerage systems, preventing property flooding in heavy rain without polluting the environment.
- Public acceptability of storm overflows has declined as operational data has been obtained and made available
- Environmental impacts of overflow operation are still small compared to other sources
- The public's increase in recreational water use has raised concerns over their public health impacts though little data on water quality (measured by faecal bacteria) exists to quantify where overflows are the main source compared to continuous discharges or agricultural run-off
- Unless legislation is addressed to encourage the separation of surface water from pipes containing sewage, investment to reduce discharges is likely to involve substantial volumes of additional storage – which will have a high carbon cost impact

- Identified issues can either be resolved by reducing the frequency of spills by separation, attenuation, passing forward more to treatment, or reducing the impact through treatment.
- The Storm Overflow Assessment Framework is now in place and currently being used to decide where to invest to reduce discharges and their impact

Wessex Water is the leading company when it comes to influencing the way forward and addressing storm overflows. As a company we:

- have been influencing politicians (advising Philip Dunne on his Private Members Bill),
- are advising Government departments (we, along with industry body WaterUK, represent the sewerage companies on the Storm Overflows Taskforce)
- are providing additional resources to Defra (seconding an experienced member of staff to support the work of the Taskforce)
- have the large WINEP investigation and investment programme in 2020-2025 for addressing frequently spilling overflows
- are the only company with a Performance Commitment designed to recover costs for outperforming the WINEP programme
- are developing AI tools to enable near real-time bacteriological monitoring at popular bathing sites.

Annex I – Extract from the UWWTD covering storm overflows

A. Collecting systems (1)

Collecting systems shall take into account waste water treatment requirements.

The design, construction and maintenance of collecting systems shall be undertaken in accordance with the best technical knowledge not entailing excessive costs, notably regarding:

— volume and characteristics of urban waste water,

— prevention of leaks,

— limitation of pollution of receiving waters due to storm water overflows.

(1) Given that it is not possible in practice to construct collecting systems and treatment plants in a way such that all waste water can be treated during situations such as unusually heavy rainfall, Member States shall decide on measures to limit pollution from storm water overflows. Such measures could be based on dilution rates or capacity in relation to dry weather flow, or could specify a certain acceptable number of overflows per year.

Annex II – What environmental impact do storm overflows have?

Storm overflows were designed to have a negligible environmental impact when operating in heavy rainfall. The main polluting load of the contents of a sewer should flow to the treatment centre, allowing very dilute sewage to overflow when capacity is exceeded.

Analysis of the reasons why waterbodies in the UK do not achieve Good Ecological Status under the Water Framework Directive are derived from publicly available EA data. The Water Framework Directive measures over 80 parameters – ranging from nutrients to pharmaceuticals.

1 In the UK, there are currently 6,725 waterbodies that do not reach the WFD standard of Good Ecological Status (GES) and where the reason for failure is confirmed. 8,576 other waterbodies do not have 'confirmed' RNAGs (Reason for Not Achieving Good) so further work is required to determine the reason.

2 Of the 6,725 waterbodies which have a RNAG, 4,485 (67%) are confirmed as failing for issues not related to the water industry.

3 Of the 2,240 waterbodies which have a RNAG due to water industry impact, 1,559 are due to sewage discharge. 88% of these are due to continuous flows from water recycling centres. Of the 1,375 continuous discharge RNAGs, 1,083 are due to phosphate and/or nitrates (79%) i.e. nutrient levels

4 Of the 184 intermittent discharges (storm overflows) which are confirmed to be a cause of a RNAG, 77 of these are related to the amount of nutrients entering the watercourse.

5 Nationally, there are 99 storm overflows where sanitary pollution (ammonia, biochemical oxygen demand, dissolved oxygen, fine sediment) is the reason for not achieving GES.

6 Of these 99 storm overflows, there are none in the Wessex Water area.

Annex III – What public health impact do storm overflows have?

Answer: mostly unknown.

In 1976 the EU Bathing Water Directive introduced standards to limit the bacteriological loads at designated bathing water sites.

Companies invested millions improving treatment standards and adding ultra-violet disinfection to continuous discharges from water recycling centres. Nearby storm overflows also received additional investment to reduce spill numbers and improve bathing water quality.

When storm overflows operate, the dilute sewage contains high levels of faecal bacteria, but their operation does not mean a bathing water's quality is necessarily unfit for swimming; enteric bacteria generally do not survive long outside host organisms and are especially fragile when exposed to sunlight in seawater. Dispersion and dilution factors are also vital in determining the public health impact of sea water where overflow operation has occurred.

Sewerage companies provide near-real time information about when storm overflows (that might affect nearby bathing water quality) operate. We use a system called **Coast and rivers watch** and also supply the data to the Surfers Against Sewage SaferSeas App. Wessex also provides this information for storm overflows near 14 amenity sites as well as all designate bathing waters.

However, these alerts do not provide public health water quality information.

Bacterial sources in bathing waters can be varied and not just of human origin. In addition to continuous discharges from water recycling centres and intermittent discharges from storm overflows, agricultural run-off and animals such as seagulls are also common sources of bacterial load.

The biggest issue for the public wanting to engage more with the water environment is a lack of near-real time public health water quality information so that risk-based decisions can be made. The Bathing Water Directive does not require such monitoring to make assessments of bathing water standards – only 20 samples during the bathing season 15 May – 30 Sept.

The difficulty arises because measuring faecal bacteria levels is a laboratory-based process involving growing colonies of bacteria overnight on petri dishes. Real-time information is currently unobtainable.

Wessex are currently innovating in AI tools to try and accurately predict this public health information using other more easily obtainable data such as flow, temperature, turbidity, conductivity, pH, DO etc.

This work is being pioneered as part of our investigation into bacteria sources affecting Warleigh Weir (see photo) - a popular swimming location near Bath. A dedicated **web page** has been set up to report on progress.

Annex IV – Areas where legislation could change to enable the aims to be achieved more cost effectively

1 Existing legislation still allows rainwater to be connected to sewers that carry foul sewage

Section 106 (Right to communicate with public sewers) of the Water Industry Act currently only prohibits surface water being connected to foul sewers where there are separate foul and surface water sewers in existence. The Act does not recognise 'combined' sewers.

So, although separate pipes are laid to all new properties to drain surface water (eg, from roof areas), it is still possible for these to be connected to existing pipes containing foul water (ie, combined sewers) where there is no existing separate surface water sewer

Developers are encouraged to follow a sustainable drainage process where rainwater is discharged, starting with discharging to the ground, then to a surface waterbody, then to a surface water sewer and finally to a combined sewer.

They sometimes argue that discharging rainwater to the combined sewer system is the only affordable solution for their development. This passes the cost and problem further down the network, resulting in increases in overflow operation where overflows exist or a flooding risk where they don't.

What is needed? The Government could amend Section 106 of the Water Industry Act to address the 'right' to connect surface water drainage to combined sewer systems because it continues to increase flows, causing more overflow operation.

2 Existing legislation does not provide appropriate powers to tackle groundwater infiltration

Under much of southern England are water bearing layers of rock, eg, chalk, where the levels of groundwater vary throughout the year. In wet winters, these levels can reach the ground and cause flooding. Even before it reaches this level, groundwater will be above the level of the sewers and can often flow into and flood drains, sewers and inspection chambers for weeks at a time.

Overflows, which can operate for these prolonged periods, will often protect properties from losing their ability to drain their wastewater.

Sewerage companies carry out extensive sewer relining work each year, but this can be totally ineffective because privately-owned pipes, whose length is greater than sewerage company owned pipes (demonstrated here), are neglected.

Comparison of the length of privately-owned pipes (yellow) versus publicly owned (red and blue) on a typical development

What is required? The Government could address this issue by providing sewerage companies with both the power to enforce private drain maintenance or to carry out the work and recover costs from the pipe owners. This is already the case for water supply under Section 75 of the Water Industry Act which enables water companies to serve notice on consumers making them mend leaking water pipes.

3 Sewer capacity is frequently limited by wet wipes and other "unflushable" products

Wet wipes are the single biggest factor in restricting existing sewerage capacity. Partial and complete blockages are caused because they do not disintegrate quickly and are the main reason for premature overflow operation. In Wessex Water's area, we clear around 13,000 blockages a year and many thousands more occur in customer's own pipes.

Government and regulating bodies (such as the Advertising Standards Authority and Trading Standards) continue to allow manufacturers and retailers to advertise and sell products that claim to be 'flushable' but which sewerage companies refute.

What is required? The government must give legislative backing and full support to the organisations that deal with the problems caused by wet wipes (and other items labelled as 'flushable') rather than those who create them. Until such time this problem will continue to grow.

4 Legislation does not sufficiently support disconnection of surface water from combined sewerage systems

Powers to disconnect

Sewerage companies have the power to disconnect rainwater pipes, but the surface water has to be reconnected to a public sewer (which removes the ability to construct property level soakaways) and has to be done by consent and at the cost of the company.

Rainwater should be allowed to infiltrate the ground as close to where it lands where the ground conditions allow it to do so.

The Right to Discharge

Sewerage companies do not have a Right to Discharge rainwater to canals or watercourses. Permission can only be obtained through negotiation with the owner which can involve significant costs making any such initiatives cost prohibitive.

The same constraint applies to developers when planning where the rainwater from new development is going to discharge. The result is that they often take the easier and cheaper route and use their current 'right to connect' to a combined sewer (see above) rather than paying the riparian owner and discharging to a watercourse.

Highways authorities are often responsible for assets that drain surface water. But as they have no duty to drain properties, surface water can often end up being connected to a system of pipes carrying foul water i.e. combined sewers, rather than surface water drainage pipes such as highway drains.

What is required? Government should review the opportunities that legislative change can have to encourage the separation of rainwater from pipes carrying sewage.

5 Urban creep is not managed through the planning process

The term urban creep is used to describe the gradual increase of impermeable surfaces. This can be as a result of paving over front gardens to make space for parking cars, or where house, conservatory or patio extensions are made.

Where rainwater is connected to the same pipes as foul water, this increases the volume of flow the pipe is required to carry when it rains and increases the number of times storm overflows operate.

A 2009 UK Water Industry Research study using time-lapse aerial photography of more than half a million properties revealed that the increase in impermeable area amounted to between $0.4m^2$ to $1.1m^2$/property a year

Urban creep is not currently managed through the planning process and while before the impermeable area of a driveway is increased by >$5m^2$, this is not enforced by local authority planning teams.

What is required? Local authorities need to be made aware of the impact of the rainwater's destination through a better supply of information and communication with the organisation (sewerage undertaker or highways authority). They must also be prepared to deny permission or impose conditions, eg, soakaways or limiting run-off rates, on any application that could exacerbate storm overflow operation.

Annex V – Solution options:

Separation of flows or increasing the attenuation capacity of sewers

Separation of flow is a lower operating carbon solution compared to attenuation but more disruptive to construct, often more expensive and riskier. Separation directs rainwater to where it should go, ie, straight back into the environment, rather than where it need not go, ie, to a water recycling works where large amounts of energy and chemicals are used to treat sewage, before being returned to the environment.

Attenuation of flows means rainwater is still processed through the water recycling centre, but it is held for longer within the network by storing it. The required volumes of underground storage capacity can be immense. Because most overflows are in older urban areas there is often no physical space to construct the required storage to eliminate them apart from deep tunnels - a good example of this is the Thames Tideway a tunnel currently being constructed deep under the Thames. It is designed to reduce (not eliminate) storm spills from 34 overflows to operate about 5 times/year. The construction cost is nearly £5 billion.

In situations where overflows operate due to groundwater entering sewers, neither of the above solutions are practical or feasible as separation or attenuation would not have the desired effect. In this situation, all the underground assets need to be made watertight, including public and private manholes and pipes.

Both 'capacity' solutions are massively disruptive to society and expensive to our billpayers. Sewers are by far and away the biggest and deepest utility service and the only one that 'collects' from customers rather than 'providing to' them. Most of the flow is moved by gravity and sewers have to be laid to a specific gradient, below other utility services, and pumped frequently when they get too deep or flows need to travel uphill.

The disruption to the urban environment that would be caused by separating rainwater from foul water would be immense – as would the cost. For full separation, practically every street in every village, town and city (where properties were constructed before the 1960s) would need digging-up. In many instances this would be a serious technical challenge due to the busy network of services that already exist.

Mass disruption would last for decades and the cost of separation and/or attenuation of flows will be astronomical, and this impact would land on the billpayer through significant increases to their sewerage bills. Public acceptability of both bill impact and disruption are key factors that should be part of discussions about the public acceptability of overflow operation. As part of the Storm Overflows Taskforce, research work is ongoing to estimate the cost of different options for addressing harm.

Additional treatment

The environmental impact of overflows is generally low, due to the heavily diluted nature of the flow. However, there are some occasions where prolonged discharges do have an environmental impact (eg, the growth of sewage related fungus).

Reducing biological loads is usually achieved through a biological process (such as used at water recycling centres) and requires space and often energy and chemicals to facilitate the growth of the bacteria required to break down the passing organic load. Since most overflows are in urban areas, there is generally insufficient space for biological treatment. In situations where there is an environmental impact, these have usually been addressed through reducing spill frequency rather than additional treatment.

There are notable exceptions where constructed wetlands or reedbeds have been used to treat storm overflows, but the space required and the intermittent nature of the flows (leading to the drying out of the reedbed) can easily reduce the feasibility of such solutions.

Where an overflow operation affects public health/bathing water status, the key requirement is to kill the bacteriological load. This is usually done through ultraviolet (UV) light – chemically killing bacteria using chlorine dosing is prohibited.

However, while using UV on continuous discharges is a common, but energy intensive, approach to meet bathing water standards, using UV treatment for intermittent storm overflows can be unreliable (UV treatment relies of good transmissivity of the liquid being treated) and costly in terms of carbon emissions.

CASE STUDY

Wessex Water operates one UV treatment plant on a storm overflow at Highbridge, near Burnham Jetty bathing water.

It cost £5m to construct and can disinfect up to 600 l/s. However a bypass is required for that exceed this.

This UV treatment at a storm overflow, and a further £35m invested in other assets to reduce spills and improve treatment, has resulted in little change to quality of the bathing water which has subsequently been de-designated. It is thought that agricultural run-off is mostly now responsible for the poor water quality.

Annex VI - Storm Overflow Assessment Framework overview