Department for Environment Food & Rural Affairs

Storm overflows discharge reduction plan: Impact assessment

Updated: 25 September 2023

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Title: Updated Storm Overflows Discharge Reduction Plan **IA No:** **RPC Reference No: N/A** **Lead department or agency:** Defra **Other departments or agencies:** Environment Agency and Ofwat	**Impact Assessment (IA)** **Date:** 25/09/2023 **Stage:** Final **Source of intervention:** Domestic **Type of measure:** Other **Contact for enquiries:** defra.helpline@defra.gov.uk

Summary: Intervention and Options

RPC Opinion: Not Applicable

Cost of Preferred (or more likely) Option (in 2019 prices, 2020 present value)			
Total Net Present Social Value	**Business Net Present Value**	**Net cost to business per year**	**Business Impact Target Status** Not a regulatory provision
£ -42,690m	£ -44,930m	£1,597m	

What is the problem under consideration? Why is government action or intervention necessary?

Sewage discharges from storm overflows constitute a pollution externality, causing risks to the environment and public health. Older sewerage systems take sewage to treatment works but combine that flow with rainwater drained from streets, roofs and other paved areas. Storm overflows operate as safety valves in the system to discharge water to rivers, lakes or the sea when rainfall exceeds the capacity of the sewage system. This protects properties from flooding and prevents sewage backing up into streets and homes. The system is under increased pressure from growing population, more impermeable surfaces, and more frequent and heavier storms due to climate change.

What are the policy objectives of the action or intervention and the intended effects?

Under the Environment Act 2021, the government is required to publish a discharge reduction plan and sewerage companies have a duty to secure "a progressive reduction in the adverse impacts of discharges". The objective is for the Plan to direct future investment by the sewerage industry in their asset management planning periods from 2025 to 2050 to achieve this reduction by setting specific, measurable, achievable, realistic and time-limited objectives. The intended effect is that the nine sewerage companies, working with regulators Ofwat and Environment Agency, will reduce the external costs of storm overflows, to protect the water environment and public health from risks from untreated sewage in storm overflows.

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

The "Do Nothing" option would lead to continuing and increased risk to the water environment, public health and sewer flooding. Action by the regulated private sewerage companies is required to achieve the objective and will be guided by targets. Options for the scope, range, extent and timing of the targets were considered (see Evidence Base), with assessment of potential costs. The preferred option prioritises the greatest risks to ecologically important sites and to human health at bathing waters. The targets focus mainly on achieving specific outcomes for human health and the environment. This allows the sewerage companies to develop the most cost-effective solutions. It includes a review point in 2027 when the targets may be revised in the light of emerging information. In addition to the targets, the Plan includes actions for the government that will be subject to separate assessments of their impact.

Will the policy be reviewed? Yes **If applicable, set review date:** 2025 and 2027

Is this measure likely to impact on international trade and investment?		No		
Are any of these organisations in scope?	**Micro** No	**Small** No	**Medium** No	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)		**Traded:**	**Non-traded:** 8.035	

Summary: Analysis & Evidence

Policy Option 1

Description: Set targets for protecting the environment and public health from storm overflows by 2050

FULL ECONOMIC ASSESSMENT

Price Base Year 2019	PV Base Year 2020	Time Period Years 76	Net Benefit (Present Value (PV)) (£m)		
			Low: -53,622	**High:** -31,456	**Best Estimate:** -42,690

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	0		795	35,401
High	0		1,271	56,705
Best Estimate	0		1,034	46,133

Description and scale of key monetised costs by 'main affected groups'

The main costs in 2020 present value terms are: capital investment in equipment to contain and treat storm overflows (£24,643m to £38,913m), associated operating costs (£677m to £1,068m), and the cost of financing the investment (£9,523m to £15,037m). The direct impact of these costs would be on the nine regulated sewerage companies in England but would be passed to customers in their bills. Costs of embedded carbon (£558m to £1,687m) are treated as costs to the general public rather than costs to business.

Other key non-monetised costs by 'main affected groups'

All identified costs have been monetised.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0		143	3,084
High	0		183	3,945
Best Estimate	0		159	3,444

Description and scale of key monetised benefits by 'main affected groups'

The benefits affect the whole population but particularly those who make recreational use of affected waters or have an interest in or concern for the ecology of the water environment and water-dependent ecosystems. The monetised benefits fall into three groups: ecological (range in 2020 PV terms £410m to £748m), public health (£604m to £870m) and social, reflecting the degree of societal concern with the discharge of raw sewage to the environment (£2,070m to £2,328m).

Other key non-monetised benefits by 'main affected groups'

The ecological benefits to specially protected sites may be undervalued. The category "social benefits" has not previously been monetised so the approach here is undeveloped and may not capture the importance of this issue to the public. Few benefits relating to bathing waters have been monetised. This is because the available valuation approaches relate to the overall condition of sites, standards for which are set out in the Bathing Water Regulations. These are assessed by statutory monitoring by the Environment Agency, but it is difficult to ascribe a direct cause and effect to storm overflows due to a variety of pollution sources that affect bathing waters. This means it is not clear how conditions would be affected by reducing storm overflows.

Key assumptions/sensitivities/risks	Discount rate	3.5

There is a wide range of uncertainty in cost and benefit estimates. Better estimates will be possible as companies investigate initial investments in their business planning for the five-year price review period, PR24. The present value costs depend on the phasing required to deliver the timed targets, assumed here to be an evenly phased programme from 2025 to 2050. Impacts vary significantly between regions (i.e., companies). Adequate supply chain capacity is assumed. A discount rate of 3.5% is used to year 30 of implementation, then 3% up to year 75.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			Score for Business Impact Target (qualifying

Costs: 1,597	**Benefits:** 0	**Net:** -1,597	Not Applicable

Contents

Executive Summary

The Environment Act 2021 placed a duty on the government to produce a statutory plan to reduce discharges from storm overflows and their adverse impact before 1st September 2022. The Impact Assessment (IA) outlines the policy options considered and the final targets that will be placed on the water industry through the Storm Overflows Discharge Reduction Plan (the Plan). The targets in the Plan will be used as a mechanism to deliver the government's ambition to secure a significant reduction in the adverse impacts of storm overflows.

The Plan seeks to address the ecological harm and the risk to public health caused by the discharge of raw and partially treated sewage to waterbodies. Only the targets on water companies in the Plan are assessed in this IA. Any other legislative change or government interventions implemented as part of the overall Plan will be subject to their own IA where applicable.

This is set in the context of increasing public interest in the use of storm overflows following the passage of the Environment Act and the action the government has already taken. This includes the legally binding duty under section 141DC of the Water Industry Act 1991 (as inserted by s83 of the Environment Act 2021) which requires water companies to achieve a progressive reduction in the adverse impacts of storm overflows. The government has also given a clear direction to the economic regulator, Ofwat, through the Strategic Policy Statement for 2025-2029 that water companies should be challenged to achieve a significant reduction in the frequency and duration of storm sewage discharges.

Following a public consultation, which ran from 31st March 2022 until 12th May 2022, and a second public consultation which ran from 12th June 2023 to 24th July 2023, the Plan sets three specific headline targets for water companies to reduce the harm caused by storm overflows.

1. **Environment target:** Water companies will only be permitted to discharge from a storm overflow where they can demonstrate that there is no local adverse ecological impact. No local adverse ecological impact will be measured against the Urban Pollution Manual standards for Dissolved Oxygen and Ammonia.
2. **Public health target:** Water companies must significantly reduce harmful pathogens from storm overflows discharging near designated bathing waters, by either: applying disinfection; or reducing the frequency of discharges to meet Environment Agency spill standards.
3. **Rainfall target:** Storm overflows will not be permitted to discharge above an average of 10 rainfall events per year.

The environment target applies to all inland storm overflows as an ecological standard does not exist for coastal and estuarine waters. The public health target applies to all storm overflows discharging near designated bathing waters. The rainfall target applies to all storm overflows, regardless of location, including coastal and estuarine storm overflows. Storm overflows need to be improved to meet all applicable targets by the following dates:

- By 2035: all storm overflows discharging near designated bathing waters, and 75% of storm overflows discharging into or near 'high priority sites' (as defined in the updated Annex 1 of the Plan);
- By 2045: all remaining storm overflows discharging into or near 'high priority sites';
- By 2050: all remaining storm overflows.

In addition to meeting these targets, water companies will be required to ensure all storm overflows have screening controls. This requirement should be delivered together with all the

targets and sub-targets outlined in the Plan. So, for example, any storm overflows improved by 2030 to meet the bathing water or ecological standards, also need to meet the screening requirement.

The Plan does not specify precisely how the targets should be achieved as this will be determined through the water company business planning process and scrutinised by regulators. There are a range of possible solutions, ranging from traditional engineering approaches (such as building storage tanks) to solutions with a higher percentage of Sustainable Drainage Solutions, which combine blue-green infrastructure (such as wetlands). Solutions that make more use of blue-green infrastructure generally have higher benefits, but the costs are shown to be more uncertain and likely to be higher, at least at a national level. The government expects water companies to consider all options when achieving these targets, including what interventions can be achieved without additional burden on water consumers between 2022 and 2025. Ofwat will support companies in the use of green infrastructure where it is the most appropriate and best value approach. For the water company business planning process for 2025-2029 and beyond, efficient costs of interventions will be determined by the economic regulator, Ofwat. For actions in the Water Industry National Environment Programme the Environment Agency and Natural England will determine the actions required at a local level in line with statutory requirements and the strategic priorities of the government.

This IA considers the costs and benefits of the final targets to businesses, the public, wider society, and government spending where applicable.

This IA is an update from the IA published on 2 September 2022. The IA now covers all storm overflows from water companies wholly or mainly in England. This expansion of the rainfall target to all coastal and estuarine storm overflows changes the best estimate of the monetised net present value from -£39.6 bn to -£42.7bn. The number of sites which are prioritised for early action has also increased, with Marine Protected Areas and Shellfish Water Protected Areas now also prioritised for early action.

Problem under consideration and rationale for intervention

1. Overview

1. Storm overflows are safety valves built into the combined sewer system to discharge excess storm water, which includes untreated sewage, to rivers, lakes, or the sea when rainfall exceeds capacity. This is to protect properties from flooding and prevent sewage backing up into streets and homes during heavy storm events. As storm overflows were designed to discharge during storm events, any pollutants in the effluent should be diluted in large volumes of water in receiving water bodies and fewer people would be using the water for recreational use. However, a growing population, an increase in impermeable surfaces and more frequent and heavier storms due to climate change have increased pressure on the system. The frequency of discharges is at an unacceptable level.

2. The government has taken steps on multiple fronts to reduce the adverse impacts that storm overflows cause. The government's Strategic Policy Statement (SPS) to Ofwat makes clear that water quality should be a key priority in Ofwat's regulation of the water industry. It outlines the government's expectation that Ofwat will challenge water and sewerage companies to demonstrate how they will significantly reduce the frequency and volume of sewage discharges from storm overflows, so they operate infrequently, and only in cases of unusually heavy rainfall.

3. The Environment Act 2021 also contains multiple new duties on the government, water companies and regulators to reduce the harm caused by storm overflows including a duty for water companies to 'progressively reduce' the adverse impacts to the environment and public health caused by storm overflows.

4. The Environment Act also includes a duty on the government to produce a statutory plan to reduce discharges from storm overflows and their adverse impact to public health and the environment. The Storm Overflows Discharge Reduction Plan[1] (the "Plan") sets out these actions and fulfils this duty.

5. There is considerable variation across England in the frequency of discharges from storm overflows. This reflects local conditions such as climate, rainfall, company performance and the type of sewerage system. In 2022, around 20% of storm overflows did not discharge at all, and a further 20% spilled between 1 and 5 times during the year. At the other end of the scale, around 3% of storm overflows spilled more than 100 times. The government believes this is unacceptable and the overall number of discharges must be significantly reduced.

1.1. What are the current or future harms being tackled?

6. The scope of this Impact Assessment (IA) is limited to the three targets for water companies set out in the Plan, as well as their sub-targets and the screening requirement. The IA considers the costs and benefits to businesses, the public, and environmental goods. This IA should be read in conjunction with the Plan and the associated evidence report on elimination of storm overflows, as well as the Storm Overflows Evidence Project (SOEP).[2] An analysis of

[1] Defra (2022) *Storm Overflows Discharge Reduction Plan* Available at: https://www.gov.uk/government/publications/storm-overflows-discharge-reduction-plan
[2] Stantec (2021) *Storm Overflows Evidence Project*, Available at: https://www.gov.uk/government/publications/storm-overflows-evidence-project

impacts will be conducted for other measures outlined in the Plan such as potential legislative changes at the point when such changes are being implemented.

7. Water companies will be required to meet the targets set out in this Plan. The government expects Ofwat and the Environment Agency to support and challenge water companies to meet these targets. Ofwat is legally required to act in accordance with the Strategic Policy Statement, and with their duties under the Water Industry Act 1991. The Government expects Ofwat to enable appropriate investment for companies to meet these targets. The targets will be underpinned by changes to the conditions in Environment Agency permits issued to water companies. The Environment Agency will assess compliance with these permits, making use of monitoring data that will also be available to the public, and where necessary take enforcement action.

8. The targets will aim to tackle four main types of current harm (and future harm) caused by storm overflows:

Ecological harm:

9. Storm overflow discharges can impact water chemistry and lead to ecological harm. The latest Environment Agency data shows 372 waterbodies (approximately 8% of water bodies in England) had storm overflows as a reason for failing to reach Good Ecological Status (GES).[3] This is principally due to discharges from storm overflows causing intermittently low levels of dissolved oxygen and high levels of ammonia, which have negative impacts on freshwater ecosystems. These figures are based on existing Environment Agency sampling which is not always carried out close to storm overflows. The Environment Act placed new monitoring and reporting duties on water companies which will increase our understanding of ecological harm that can be attributed to storm overflows by ensuring impacts are measured close to discharge sites.

10. Discharges from storm overflows can also contain other pollutants such as microplastics, pharmaceuticals, nutrients, and heavy metals, as well as visible litter that is flushed down toilets. The impact of sewage discharges on ecology varies depending on the pollutants it carries, their concentration, and the flow and volume of the receiving water body. The smaller and more dilute the sewage discharge, and the larger and faster flowing the receiving river, the lower the ecological impact.

Harm to public health:

11. As the raw sewage in storm overflows discharges can contain high levels of harmful pathogens, such as viruses and bacteria, these discharges can pose a risk to the health of recreational users of waters. In addition, these discharges can also jeopardise the economic activity around bathing waters, which are predominantly coastal in England. This will be covered in more detail in Section 0 on non-monetised benefits. The full economic value of clean bathing waters is difficult to fully quantify, but the risks to public health from the increase in harmful pathogens have underpinned a number of developments, including standards for safe bathing under the Bathing Water Regulations 2013.[4]

Social harm:

[3] Environment Agency (September 2020), *WFD RBMP2 Reasons for Not Achieving Good Status*. Available at: WFD RBMP2 Reasons for Not Achieving Good Status - data.gov.uk.; 'Good Ecological Status' means the status of a body of surface water classified as such in accordance with the relevant provisions of Annex V of the Water Framework Directive (Directive 2000/60/EC) as transposed to UK lay by The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.

[4] The Bathing Water Regulations 2013 (legislation.gov.uk)

12. There has been a high level of public interest and concern over the operation of storm overflows and the frequency with which they discharge, especially following the passage of the Environment Act, which brought greater scrutiny to this issue.[5] The SOEP sought to define a third category of harm, that of 'social harm', as a method to quantify societal concern over the operation of storm overflows. This project laid out an impact pathway for the social impact of intervention where reduced spills lead to increased satisfaction for general users and non-users of watercourses thus reflecting public concern on this issue.[6]

Future harm:

13. Future harm from storm overflows includes the harms outlined above, compounded by other pressing external issues such as proliferation of surface water connections to the combined sewer system, increase of impermeable surfaces and climate change. These factors will drive an increase in usage of storm overflows and will therefore increase the impact of existing harms. Intervention must be future proofed to deal with these challenges. The SOEP shows that where no intervention happens there is a deterioration. For rivers, the number of water bodies not achieving Good Ecological Status (GES) increases by 83 (a 13% increase) and the length of river considered suitable for swimming decreases by 170km (13%).[7] This would also mean an increase in the social harm outlined above. This future harm is included in the counterfactual in the analysis.

14. Storm overflow discharges can also be conduits for other pollutants such as microplastics and heavy metals. The human health and ecological impacts are not yet fully understood for many emerging pollutants such as microplastics. This evidence base will develop and may show that storm overflows contribute harm that has not yet been assessed or where storm overflows are not currently known to be a source.

1.2. What sectors/markets/stakeholders will be affected, and how, if the government does intervene?

Water Industry:

15. Investment will be required by water and sewerage companies to achieve the targets outlined in the Plan. This is funded through the statutory business planning process. Water companies hold monopoly licences and therefore the economic activities and performance of water companies are heavily regulated.

16. Water industry investment is regulated through the Price Control Review process, which is independently delivered by Ofwat. This process sets the investment and service package that water companies deliver over a five-year period. As part of its price review process, Ofwat will consult upon and make determinations as to the revenues that companies can recover from customers. The current period (PR19) runs between 2020 and 2025. The next period (PR24) will run between 2025 and 2030.

[5] BBC (October 2021), Tory MPs defend votes after uproar over sewage proposals - BBC News.
[6] Stantec (2021), *Storm Overflows Evidence Project*, 3.38. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf.
[7] Good Ecological Status is defined in the is defined in The Water Environment Regulations 2017, Available at: https://www.legislation.gov.uk/uksi/2017/407/contents/made; Stantec (2021), *Storm Overflows Evidence Project*, 4.46-4.48. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf.

17. Ofwat are legally required to act in accordance with the Strategic Policy Statement for Ofwat (SPS), which sets out the government's strategic priorities for Ofwat.[8] Water companies develop a business plan for each five-year period, which they submit to Ofwat for review.

18. The government, Ofwat and the Environment Agency work with water companies on several planning processes, which inform these business plans. These include:

- **The Water Industry Strategic Environmental Requirements (WISER):**[9] This document is issued by the Environment Agency and Natural England and reflects expectations, relevant legislation and duties and best practice that water companies should consider in their business plans. The WISER contains a range of tiers of requirements – these storm overflow targets are on the top tier: obligations which must be met.

- **The Water Industry National Environment Programme (WINEP):**[10] The WINEP methodology is issued by the Environment Agency, in collaboration with Defra and Ofwat, and should be considered alongside legislative requirements and ministerial and government priorities. It is the way in which water companies and their partners, including regulators, identify actions that need to be taken to meet the environmental requirements on water companies. All WINEP actions should be included in water industry business plans and these business plans should reflect the targets under consideration in this IA for projects occurring in PR24.

- **Drainage and Wastewater Management Plans (DWMPs):** Drainage and Wastewater Management Plans will allow water companies to deliver the storm overflow targets in an integrated way. Water companies will set out in their DWMPs their long term (25 year) plan for their drainage and wastewater networks. This includes how they will work closely with local partners to meet their storm overflow targets in a strategic and joined-up way. Projects proposed as a result of DWMPs will be reviewed by the Environment Agency and Ofwat as part of the business planning process.

19. As the targets in the Plan will apply to water and sewerage companies in England, these targets will form part of the WINEP for PR24. The current WINEP (for 2020-2025) requirements must be implemented by 2025. See paragraph 28 for actions being taken on storm overflows.

Water bill payers:

20. For the purposes of this IA, it is assumed that investment to deliver the storm overflow targets will ultimately be borne by customers. Water companies will pass the costs of delivering the targets onto their customers through their water bills. There will be circumstances where improvements will have co-benefits and so costs will be shared with other actors. One example would be a local council re-paving a road. This could be done with sustainable drainage, reducing flood risk and improving water quality through decreasing sewage discharges. If the

[8] Defra (March 2022), *Strategic Policy Statement for Ofwat.* Available at:https://www.gov.uk/government/publications/strategic-policy-statement-to-ofwat-incorporating-social-and-environmental-guidance/february-2022-the-governments-strategic-priorities-for-ofwat. .; *The Water Industry Act 1991*, s2A. Available at: https://www.legislation.gov.uk/ukpga/1991/56/contents.
[9] Defra (May 2022), *Water Industry Strategic Environmental Requirements.* Available at: https://www.gov.uk/government/publications/developing-the-environmental-resilience-and-flood-risk-actions-for-the-price-review-2024/water-industry-strategic-environmental-requirements-wiser-technical-document
[10] Defra (May 2022), *Water Industry National Environment Programme (WINEP) Methodology.* Available at: Water industry national environment programme (WINEP) methodology - GOV.UK (www.gov.uk)

sustainable drainage includes green solutions there would be wider co-benefits, such as increased biodiversity, enhanced climate change adaptation and mitigation.

21. It is also possible that other actions taken as part of the Plan's scope will reduce the investment that needs to be recovered from customers, such as the implementation of Schedule 3 to the Flood and Water Management Act 2010. When implemented, this is expected to mitigate and prevent increases in surface water entering the sewage network by mandating Sustainable Drainage Solutions (SuDS) on new developments. SuDS use features such as soakaways, grassed areas, permeable surfaces, and wetlands, to reduce the amount of water being added to the sewer network, reducing the risk of surface water flooding, improving water quality and benefiting biodiversity. This reduction in additional surface water being added to the combined sewer network could also reduce future costs for water companies where the increase in surface water has already been factored into the calculations of costs. It is likely this could reduce overall costs of upgrades, although we are unable to quantify this at present.

22. To combat disproportionate impacts to water customers, the government has set targets which balance cost to consumers with the need to take action to reduce the harm caused by sewage discharges from storm overflows. The government has also sought to allow sufficient planning time for the water industry to deliver solutions with the most benefits, such as more Nature Based Solution delivery as opposed to traditional, grey infrastructure models. This can be incentivised through Ofwat's performance commitments and price review methodology. The government has also set a requirement in the Plan that water and sewerage companies must consider green infrastructure. The government has made clear in the SPS to Ofwat that where it represents good value for money, companies should also exceed these legislative requirements and deliver wider environmental benefits in the course of carrying out their functions.[11] The SPS also makes clear the importance of efficient investment across multiple priorities and how this can reduce costs where interventions have cross benefits, such as to reduce urban flooding. This may mean that costs are overestimated when investment is taken holistically across multiple priorities, but with the available evidence we are currently unable to quantify these opportunities and their effect on costs.

23. A review of the targets will be undertaken in 2027 to ensure they still represent the best balance of cost to the consumer and environmental improvement.

Government:

24. The government is committed to supporting the water industry in the delivery of targets by addressing some of the fundamental issues which underpin the use of storm overflows. These measures have not been assessed within this IA; further detail can be found in the Plan. These measures include:

    - tackling the proliferation of surface water entering the combined sewer through a suite of possible actions outlined in Section 1.3;
    - improving monitoring of the adverse effects of storm overflows;
    - ensuring water companies have the correct legal powers to act where needed;

[11] Defra (March 2022), *Strategic Policy Statement for Ofwat.* Available at:https://www.gov.uk/government/publications/strategic-policy-statement-to-ofwat-incorporating-social-and-environmental-guidance/february-2022-the-governments-strategic-priorities-for-ofwat.

- enabling investment to follow investigations as quickly as possible without waiting for the next 5-yearly water company planning cycle.

25. Progress towards the targets will be assessed in the regular progress reports of the Plan to Parliament required under the Water Industry Act 1991 (as amended by the Environment Act 2021).[12] The government expects Ofwat and the Environment Agency to support and challenge water companies to meet these targets. Ofwat is legally required to act in accordance with the SPS, and with their duties under the Water Industry Act 1991. See paragraph 7 for how the targets will be delivered.

26. The actions required to deliver these targets may affect a wide range of stakeholders and the public. There will be interest from the housing development industry on the use of Sustainable Drainage Systems, highways managers to manage run-off, environmental NGOs who are campaigning for better surface water management and the water industry supply chain.

1.3. Why is the government best placed to solve this issue?

27. As set out in Section 1.2, the water industry is heavily regulated and the government retains a large role in setting the strategic and environmental priorities for the industry, through both the PR process and legislation. This Plan sets out clearly the pace and scale of action required by water companies in order to protect people and the environment and meet acceptable usage of storm overflows. The Plan is the right place to set out targets that the government are placing on water and sewerage companies to tackle this issue.

28. Without targets, the market is only likely to deliver some of the desired improvements. For example, between 2020 and 2025, there are over 800 schemes in progress to reduce discharges from storm overflows and the water industry is investing £3.1bn (made up of £1.9bn on the Thames Tideway Tunnel and a further £1.2bn nationally). However, the scale and pace of change does not match the government's ambition and the public's increasing attention on the issue (see paragraph 44). Setting clear targets for the water industry ensures tackling the harm caused by storm overflows remains a key consideration in the PR process for years to come, setting a clear trajectory for long term investment and business planning.

29. The government will also play a key role in the delivery of the targets within the Plan. The government has responsibility for the legal mechanisms to address the issues of surface water drainage, such as the implementation of Schedule 3 to the Flood and Water Management Act 2010. Following a review, the government is in the process of implementing Schedule 3. When implemented, this would put in place mandatory Sustainable Drainage for new developments and alter the automatic right for developers to connect to public sewers. There will be a separate IA on the implementation of Schedule 3.

30. The government, utilising the expertise of the Environment Agency, will explore the development of an ecological standard for estuarine waters. Additionally, the government will consider the application of the rainfall target and its effectiveness for preventing ecological harm at coastal sites and subject to the results of that consideration may explore the development of an ecological standard for coastal waters. As part of the government's review of the Storm Overflows Discharge Reduction Plan in 2027, the government will consider

[12] Progress reports are required 3 years after first publication and every five years subsequently per the Water Industry Act (1991) (as amended) s141B. Available at: Water Industry Act 1991 (legislation.gov.uk)

whether any developments pertaining to ecological standards in estuarine and coastal waters require the Plan to be further updated.

2. Rationale and evidence to justify the level of analysis used in the IA (proportionality approach)

2.1 Overview

31. The setting of targets for the water industry is designed to deliver substantial improvements to the water environment, as well as significantly reduce the public health and social impacts of storm overflow discharges. It will form part of an overall suite of interventions to improve water quality more widely, including targets set under the Environment Act.

32. The Plan does not explicitly state how the targets should be achieved and instead provides guidance to the water industry on what approaches should be considered, as well as sub-targets setting milestones that water companies need to achieve. A range of solutions could be employed, from sewer maintenance and increased storage capacity to nature-based solutions. The solution chosen will determine the costs and benefits. At the national level, analysis shows that nature-based solutions deliver higher benefits but also higher costs.[13] In many local situations a sustainable drainage approach may be the most cost-beneficial solution once all the co-benefits of sustainable drainage have been properly taken into consideration. It is therefore appropriate that water companies, working with regulators and other parties, will be able to develop interventions of different types to be included in their business plans having full regard to the cost and benefit for their customers and the environment.

33. Some of the evidence base on the total extent and impact of discharges from storm overflows is relatively new, with extensive monitoring of frequency and duration of discharges not available before 2019. Previously, local studies using the Urban Pollution Manual standards have collected evidence to prove the need for investment through modelling, so there is an evidence base on the harm a subsection of storm overflows are causing and this is what has driven improvement in the past. Additionally, extensive water quality monitoring up and down stream of discharges by water and sewerage companies, as mandated by section 141DB of the Water Industry Act 1991 (as inserted by section 82 of the Environment Act 2021) will be installed. Once fully available, this will improve understanding of the impact of discharges on water quality and will provide evidence of whether storm overflow upgrades have eliminated ecological harm. Moreover, the assessment of costs and benefits nationally has required additional research to be commissioned and several key assumptions have been made (which are covered in greater detail in Section 10.1) and therefore further refinement through reviews of the Plan will be conducted. The government is confident that the evidence outlined in Sections 2.2 and 2.3 represents the best available evidence for intervention at the time of this assessment.

2.2 Assessment of the quality of evidence regarding environmental, public health and social impacts of storm overflow operation:

Environmental impacts:

[13] Stantec (2021), *Storm Overflows Evidence Project.* Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf.

34. There is robust monitoring data and evidence that demonstrates a clear link between storm overflow operation and environmental impact. The classification standards used to show ecological harm are set out in the Water Environment Regulations 2017 and those pollutants impacting water bodies are categorised as either confirmed, probable or suspected.[14] The Environment Act 2021 has put in place new monitoring and reporting requirements for water companies. As a result, it is plausible that increased monitoring, specifically focussed on locations where storm overflows are discharging, will find a greater number of storm overflows causing ecological harm and therefore the benefits laid out in the IA may be understated if this is the case. This is supported by anecdotal evidence from stakeholders and citizen science studies that it has not been possible to independently verify thus far. Further work will be needed to understand the true scale of ecological impacts by storm overflows.

35. To better understand this, section 141DB of the Water Industry Act 1991 (as inserted by section 82 of the Environment Act 2021) states that water and sewerage companies must monitor the water quality impact of their assets that discharge sewage, including storm overflows and continuous discharges from wastewater treatment works. This will provide continuous data and will significantly increase our understanding of the water quality of our rivers. The installation of new water quality monitors, in addition to the existing Event Duration Monitors will significantly increase our knowledge on the ecological harm caused by sewage discharges by storm overflows.

36. To assess 'harm,' the Urban Pollution Management Manual (UPM) water quality standards are used in relation to ecological status.[15] Appendix A sets specific toxicological standards for ammonia and dissolved oxygen levels amongst other key criteria, provides modelling tools to simulate the impact of discharges on the environment and design solutions to mitigate them. This helps to confirm whether discharges are contributing to ecological harm for the purposes of determining GES as well as more localised impacts.

37. There is also evidence of the frequency and duration of discharges from storm overflows in data provided by water companies to the Environment Agency. This is known as Event Duration Monitoring (EDM) and was instigated in 2013 by Defra. This required a significant expansion of monitors. In 2022, 91% of storm overflows provided this data, and the water industry has made a public commitment for this to cover 100% of storm overflows by the end of 2023.[16] EDM data must be reported to the Environment Agency by the water and sewerage companies and published annually. As well as this increase in coverage, EDM data will also be available in near real time to the public when section 141DA of the Water Industry Act 1991 (as inserted by section 81 of the Environment Act 2021) comes into force.

38. Evidence on the severity (rather than the occurrence and duration) of individual storm overflow discharges on the environment requires further development. Additional monitoring of specific storm overflows, as legislated for in the Environment Act, will be invaluable to water and sewerage companies in England as well as to regulators, stakeholders, and the public.

39. Less is known about the contribution of storm overflows to emerging issues such as microplastics and anti-microbial resistance. However, any reduction in storm overflow frequency and duration is likely to lessen this risk. The contribution of storm overflows to

[14] The Water Framework Directive was transposed into domestic legislation under The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, referred to in this document as the Water Environment Regulations. Available at: https://www.legislation.gov.uk/uksi/2017/407/contents/made

[15] Foundation for Water Research (2018) *Urban Pollution Management Manual 3rd Edition - Appendix A*. Available at: 2 (fwr.org).

[16] Defra (January 2021), *Storm Overflows Taskforce sets goal to end pollution from storm overflows.* Available at: Storm Overflows Taskforce sets goal to end pollution from storm overflows - Defra in the media (blog.gov.uk).

emerging contaminants will be accommodated through regular reviews of the Plan to take account of any emerging issues.

Impacts to public health:

40. While it is known that storm overflow discharges can contain high levels of harmful pathogens such as e-coli, the scale of the public health impacts from storm overflows is not clear. Stakeholders such as Surfers Against Sewage have tried to quantify this impact by reporting on the correlation between illness and sewage discharges, largely through self-reported data.[17] There are many different sources of pollutants which may affect water quality and public health. It is difficult to ascribe direct cause and effect to storm overflows in causing illness and there is a lack of definitive evidence. There is some correlation between open water swimming, micro-organisms, and illness and this has been made clear by stakeholders and through government guidance.[18]

41. There is a clear and evidence-based link between the presence of harmful micro-organisms with risk to public health. Designated bathing waters are managed to protect the health of swimmers in those areas and therefore set levels of acceptability of risk to public health. The water quality at designated bathing waters is classified annually based on regular sampling in the bathing season (May-September). Two faecal indicator organisms (FIOs), E. coli and intestinal enterococci, are used to assess whether there is faecal matter and hence dangerous pathogens in the water. The classifications reflect the average risk of bathers getting an illness after contact with faecally contaminated water. They are derived from recommendations from the World Health Organisation and empirical research of incidence of illness after coastal swimming.

42. The Bathing Water Regulations 2013 lay out the appropriate standards for the protection of public health, these are shown in the table below.

Bathing Water standards for inland waters:[19]

Parameter (colony forming units (cfu)/100ml))	"Excellent"	"Good"	"Sufficient"
Intestinal enterococci	200	400	330
Escherichia coli	500	1,000	900
Bathing water standards for coastal and estuarine waters:			
Parameter	"Excellent"	"Good"	"Sufficient"
Intestinal enterococci**.**	100	200	185
Escherichia coli	250	500	500

43. The '*Excellent*' and '*Good*' standards, outlined in the table above, are based on 95 percentile evaluation, which means 95% of the time, bathing waters must be below this threshold to be compliant, whereas '*Sufficient*' is calculated on a 90-percentile evaluation to reflect the lower standard. This is reflected in the sampling regime conducted by the Environment Agency and bathing water classifications are subsequently published.[20] These standards are derived from the EU Bathing Water Directive and were revised in 2006 in line with the findings of a review into their effectiveness.[21] The Plan includes a provision to review the Bathing Water

[17] Surfers Against Sewage, *Health Report Form*. Available at: Health Report Form • Surfers Against Sewage (sas.org.uk).
[18] Defra (June 2019), *Swim Healthy.* Available at: Swim healthy - GOV.UK (www.gov.uk)
[19] Bathing Water Regulations (2013) Sch 5 [1]. Available at: The Bathing Water Regulations 2013 (legislation.gov.uk).
[20] Defra (2022) Bathing Water Classifications 2021. Available at: Bathing water classifications 2021 - GOV.UK (www.gov.uk)
[21] Bathing Water Directive (2006/7/EC) Available at: EUR-Lex - 32006L0007 - EN - EUR-Lex (europa.eu)
https://www.legislation.gov.uk/eudr/2006/7/contents

Regulations 2013, where they apply to England, with the aim to complete the review by the end of 2024. This review does not form part of this impact assessment.

Social Harm:

44. There is less robust evidence on the amount of 'social harm' that results from storm overflow operation, where knowledge and visibility of storm overflows causes public concern about river health, public health, aesthetics and the proper operation of wastewater infrastructure. We do know that people are concerned by the prevalence of storm overflows especially once informed about them.

45. The SOEP found in 2021 that whilst 41% of the population have an awareness of storm overflows these people are three times more likely than others (35% to 11%) to attribute river quality problems to water company assets and practices. Overall, 36% of people surveyed place storm overflow concerns in their top three environmental issues with 8% citing it as their most important issue. Since the SOEP modelling was conducted, there has have been an increase in awareness of the issue of sewage discharges from storm overflows, in particular due to the increased attention to the issue of sewage discharges in the media since the summer of 2021. Research conducted by CCW in December 2021 found that untreated sewage is now seen as the biggest cause of river pollution in the eyes of the public. This has overtaken litter, fly tipping and business waste/chemicals since May 2021.[22]

46. The simple measure that SOEP used for social impact per water body is the volume weighted spill frequency (VWSF). In water bodies with a high VWSF the public is more likely to notice and be concerned by storm overflow activity, whether this has a significant impact on river and public health or not. Figure 3-6 of the SOEP illustrated how VWSF varied across England in eight categories.[23] Figure 8.4 further in the document shows the areas that have the highest numbers of storm overflow discharges. The SOEP analysis found that these areas were the places most likely to have high social impact from storm overflows suggesting visibility and knowledge led to social impact. This mostly covers areas in the midlands and north of England in Manchester and Yorkshire.

2.3 Assessment of the quality of evidence on the cost of intervention to the water industry and water consumers:

47. By setting long term targets for water and sewerage companies, the government has committed to taking a long-term approach to investment, recognising that a system that works in the enduring interests of consumers does not simply mean lower prices in the short-term at the expense of future generations. Water industry investment should be made in a way that secures long-term resilience and protects and enhances the environment, whilst delivering value for money for customers, society and the environment over the long-term.

48. All the targets proposed in the Plan have been designed with consideration to the deliverability by industry, regulators, and other actors.

Assessing overall programme costs:

[22] CCW (2022), *Awareness and Perceptions of river water quality*, Available at: https://www.ccwater.org.uk/wp-content/uploads/2022/04/Awareness-and-perceptions-of-river-water-quality.pdf

[23] Stantec (2021) *Storm Overflows Evidence Project*, Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf

49. In order to assess overall programme costs, a bespoke evidence project was commissioned, by the cross-industry Storm Overflows Taskforce. The SOEP was conducted by independent consultants, with high levels of experience in developing solutions for storm overflows. It considers a range of possible scenarios and associated costs (implemented over a 25-year period) and bill impacts. The scenarios included achieving a national discharge standard ranging from 40 spills to 0 spills per year, and a further scenario which targeted eliminating 'ecological harm' which was commissioned as an addendum to the original report.

50. The SOEP undertook a modelling approach to estimate the scale of solutions by requesting water company held data on the operation of storm overflows. The costs for each scenario carry a high degree of uncertainty and a wide range given the assumptions necessary for a national assessment (outlined in more detail in Section 10.1). More detail on the costs for water customers will be available once water and sewerage companies have written their complete business plans as they will have to plan upgrades at a local scale for individual storm overflows and assess the best option.

51. The SOEP sets out three implementation options:

    a) solely traditional engineering solutions (e.g., sewerage network storage)
    b) combination of traditional engineering solutions and 10% uptake of Sustainable Urban Drainage
    c) combination of traditional engineering solutions and 50% uptake of Sustainable Urban Drainage.

52. The costs, impact on consumer bills and embedded carbon costs are described for each of these options in the SOEP. A full separation scenario, where combined pipes for sewage and rainwater are completely separated was also considered. Addendum 1 to the SOEP considered the overall capital cost of a further scenario which assigned a storage requirement to reach good ecological status (for intermittent discharges) and what would be required to reach this marker, as an alternative to a spill limit.

53. In this IA, only the first option - to solely use traditional engineering solutions - is fully described. The other options have not been considered suitable for a national-level solution, but they can play an important role at local level.

54. The policy options provided a range of costs based on the different delivery scenarios. The results of this analysis for costs and benefits were increased by 30% to account for storm overflows with permits that could not be included in the analysis due to a lack of available data at the time of the project.

55. The initial SOEP modelling (along with addendum 1) also only considered nationally applied policies related to inland water bodies. A subsequent assessment was made of the costs for coastal and estuarine waters using more limited data.

56. It is possible that costs could reduce through innovation, better asset management and maintenance, and identifying more effective local solutions which have not been considered here. Due to the large range in investment figures, and uncertainty over delivery scenario, it is also feasible that costs could be higher than estimates. To address these uncertainties, the government will monitor water companies' delivery programmes and review the targets in 2027. This is ahead of the 2029-2034 water company planning cycle (PR29) once new information, including from companies' business plans, is available. By 2027, it will be possible to establish if some or all companies can go further and faster to achieve the targets in the

Plan without having a disproportionate impact on consumers' bills. The Plan can be updated to set faster delivery timelines if evidence shows delivery costs are reduced. However, it is not possible at this time to fully assess the contribution of these factors without detailed evidence that will be developed as a result of planned projects in water company business plans.

Assessing benefits:

57. The SOEP calculates the benefits of intervention at storm overflows impacting inland water bodies. Internal analysis was conducted by Defra officials to determine benefits of intervention at storm overflows impacting coastal and estuarine water bodies. The benefits include the potential improvements to water body ecology, changes to public health risks and changes to social impact risks.

58. It was found that, when taking into account social, public health and ecological benefits, none of the policies and scenarios examined were cost-beneficial when assessed on a national scale. However, the evidence emphasises that additional evaluation at local scales will be important to get a more accurate view of long-term costs and benefits and it is plausible that overall costs and benefits as modelled in this report will change. This is one of the reasons why the government has decided to review the targets in 2027, when more data is available at a local level.

59. The assessment of benefits drew on methodologies and studies used in the government appraisal and in the water companies' own business planning. SOEP used these to develop its own approach to estimating the "social impact" benefits category because the existing studies do not directly address the particular issues of storm overflows. This appraisal relies heavily on the SOEP approach and section 8.2 below considers non-monetised benefits and the sensitivity of the results to the inclusion of additional values.

60. There will also be multiple benefits to local schemes that will vary from those estimated at a national level and therefore will require additional data. For example, schemes designed to reduce flooding have been shown to also act to reduce the number of discharges from storm overflows.[24] Through their statutory Drainage and Sewerage Management Plans (also known as Drainage and Wastewater Management Plans (DWMPs)), water companies have set out how they will manage and develop their drainage and sewer systems over a minimum 25-year planning horizon, including how storm overflows will be addressed through these plans. Projects proposed as a result of DWMPs will be reviewed by the Environment Agency and Ofwat as part of the business planning process as outlined in Section 1.2.

Assessing impact to consumers:

61. As the targets outlined in the Plan would require water companies to make new investments through the PR mechanism (described in Section 1.2), this will impact the water bills of households and businesses. This IA uses industry data to estimate the likely impact of the targets on average water bills in England before inflation in Section 8.

62. Projected bill impacts were estimated as part of the SOEP using a simple formula. A revised analysis using the updated cost estimates has been undertaken using the internal Defra water bills model, which takes account of the pattern of capital expenditure over time and represents more accurately the changing asset base and capital charges.

[24] Susdrain, *Water quality management benefits.* Available at: Water quality management (susdrain.org)

63. Defra's water bills model was developed by consultants in 2021 and is a model in the programming language R. It is run as an R/Shiny application. Different policies and investment targets are used to estimate impact on customer bills taking into account a range of tailored, relevant variables such as GDP and population growth. Investment figures for relevant time periods can be split per company, and the regional impact is shown accordingly.

64. There is also significant regional variability in the number of storm overflows that require intervention and on the costs of improving those storm overflows, which means costs will not be evenly spread across water and sewerage companies in England. The impact this may have on consumers is outlined in more detail in Section 8, however these figures are for indicative purposes only due to the methodological uncertainty. This supports the case for a review in 2027 when better regional investment data will be available following business planning.

2.4 Assessment of evidence gathered through consultation and engagement:

Storm Overflows Taskforce engagement

65. The Storm Overflows Taskforce is a joint group established in August 2020 and has an objective to recommend actions to achieve the long-term aim of eliminating harm from storm overflows in England.[25]

66. The taskforce has 9 permanent members, drawn from the water industry, environmental non-governmental organisations, government representatives and regulators and is chaired by Defra.

67. The taskforce was consulted in the development of the targets. It has commissioned additional research, including into regulatory barriers to improving surface water management, and also commissioned the initial SOEP, to understand more about potential policy options to significantly reduce the frequency and impact of sewage discharges from storm overflows.

Consultation Methodology

68. A first public consultation on the proposed targets took place from 31 March 2022 until 12 May 2022. Information on the key findings and the government position can be found in the government response to the 2022 Storm Overflows Discharge Reduction Plan consultation.[26] The consultation informed this IA by giving a more sophisticated view of the impacts. We have gained greater understanding of the regional impact of the targets following water company responses and the challenges certain companies may face and taken this into account as well as the public response for greater action.

69. The consultation was hosted on the online platform Citizen Space and responses were also collected via email. The online platform consultation included closed-ended responses where respondents could choose one answer from a pre-defined selection of answers and open-ended questions where respondents could populate free text boxes. All closed-ended responses received through Citizen Space were categorised using automated methods.

70. A manual review and categorisation of all responses to closed-ended questions were performed for responses received through email.

[25] Gov.uk, *Storm Overflows Taskforce.* Available at: https://www.gov.uk/government/groups/storm-overflows-taskforce

[26] Defra (2022) Government Response to Consultation on Government's Storm Overflow Discharge Reduction Plan, Available at: Consultation on the Government's Storm Overflow Discharge Reduction Plan - Defra - Citizen Space

71. Responses to the open-ended questions were manually reviewed. These responses were analysed and classified into themes or categories and sub-categories. Where it was not possible to classify responses, they were categorised as “Other.”

72. The respondents were given a choice of answers to closed questions that included ‘strongly agree’, ‘agree’, ‘neutral’, ‘disagree’ and ‘strongly disagree’, as well as ‘don’t know’. In the report, references to respondents agreeing with the targets may include both strongly agree and agree responses. Similarly, references to respondents disagreeing with targets may include both strongly disagree or disagree responses.

73. In total, 21,831 responses to the first consultation were received, consisting of:

    - 21,776 responses received through online questionnaires available through Citizen Space and 38 Degrees, including 18,511 from campaigning organisations and 3,265 that were not identified as from a campaign.

    - 55 responses were received via email, of which one was related to a campaign, and 54 were not identified a part of a campaign.

74. A second public consultation on widening the scope of targets took place from 12 June 2023 to 24 July 2023. Information on the key findings from the second consultation and the government position can be found in the government response to the Storm Overflows Discharge Reduction Plan consultation.[27]

75. The consultation was hosted on the online platform Citizen Space and responses were also collected via email. The online platform consultations included closed-ended responses where respondents could choose one answer from a pre-defined selection of answers and open-ended questions where respondents could populate free text boxes. All closed-ended responses received through Citizen Space were categorised using automated methods.

76. A manual review and categorisation of all responses to closed-ended questions were performed for responses received through email.

77. Responses to the open-ended questions were also manually reviewed. These responses were analysed and classified into themes or categories and sub-categories. Where it was not possible to classify responses, they were categorised as “Other.”

78. In total, 846 responses to the second consultation were received, consisting of 836 responses received through the online questionnaire available through Citizen Space and 10 responses were received via email, of which 7 were from organisations. 38 Degrees ran an email campaign concurrent to the Government consultation, asking similar questions. These responses were received and considered by Government.

[27] Defra (2023) *Government Response to Storm Overflows Discharge Reduction Plan Consultation* Available at: Storm Overflows Discharge Reduction Plan - GOV.UK (www.gov.uk)https://www.gov.uk/government/consultations/storm-overflows-discharge-reduction-plan

3. Policy objectives

3.1 What are the intended outcomes?

79. The intended outcomes from setting the targets are to:

    - Eliminate the local adverse ecological impacts of storm overflows;
    - Significantly reduce the risk to public health at designated bathing waters; and
    - Limit pollution by ensuring that storm overflows can only be used in the rare case of unusually heavy rainfall, if at all.

80. The targets being assessed as part of this IA will result in a considerable reduction in the number and duration of storm overflow discharges. On the basis of the rainfall target alone, an estimated 80% reduction in the number of spills is anticipated by 2050, relative to a 2020 baseline. Details of this estimate can be found in Section 6. There will also be regular review points where progress can be assessed, with the first statutory review of the Plan three years after the Plan was first published on 26 August 2022 and further reviews every subsequent five years. An additional review of the targets, in light of enhanced local planning data provided by water companies, will also be conducted in 2027 ahead of decisions for the PR29 (2030-2034) asset management period. The process for collating and assessing the data will be determined once the Plan is in place.

81. All targets considered in this IA have been set as SMART targets. Associated spill counts can be objectively measured using Event Duration Monitoring (EDM) data. This must be reported in near real time and annually collated and published by the Environment Agency.[28] This will allow reductions in the frequency and duration of overall discharges to be objectively measured, while accounting for annual fluctuations due to issues such as increased rainfall. This will be relevant for assessing whether schemes are effectively protecting public health at designated bathing waters according to Environment Agency standards and for ensuring storm overflows do not discharge above 10 rainfall events on average.[29]

82. The Environment Act 2021 also introduced a requirement for water companies to install water quality monitors up and downstream of storm overflows.[30] As monitors are installed, chemical indicators of pollution will be recorded and results compared to the definition of local adverse ecological impact used within the Plan.[31] This will be used to verify the success of completed storm overflow improvement schemes towards the target of eliminating ecological harm. Where the target has not been met, the monitoring data can also be used to inform new improvements.

83. Storm overflow discharges are subject to permits issued by the Environment Agency under the Environmental Permitting Regulations 2016 and compliance with permits is regulated by the Environment Agency. The Environment Agency will assess compliance with these permits, making use of monitoring data that will also be available to the public, and where necessary take enforcement action. Ofwat will regulate investment by the water companies through the PR process, ensuring water companies are adequately funded to meet their obligations.

[28] Environment Act (2021), s81. Available at: https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted.
[29] Bathing Water Regulations (2013). Available at: The Bathing Water Regulations 2013 (legislation.gov.uk).
[30] Environment Act (2021), s82. Available at: https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted.
[31] This is defined as achieving the fundamental intermittent standards for dissolved oxygen and derived ammonia as laid on in Appendix A of the Urban Pollution Manual (FWR (2018)). *Urban Pollution Management Manual , 3rd Edition - Appendix A.* Available at: UPM Manual Version 3 (fwr.org)).

Consideration will need to be given to the Urban Wastewater Treatment Regulations 1994 and whether any amendments are necessary to support the implementation of the Plan.

84. Success from this intervention should show through several key metrics. Firstly, the overall number and duration of storm overflow discharges should decrease over time. While there may be some year-to-year fluctuations in national figures as a result of differing rainfall patterns, average spills should show significant reductions for individual storm overflows once works have been completed. Those reductions should be maintained over time as water companies manage additional pressures. There should also be no storm overflow that is causing local adverse ecological impacts (as defined in Section 3.1), and the government expects a particular focus on reducing ecological harm in the early phases of water company investment cycles. Finally, there should be a significant reduction in lost 'bathing days' due to storm overflow discharges and increased public confidence in using designated bathing waters, as well as other waters that will now receive fewer sewage discharges.

4. Description of options considered

4.1 "Do Nothing":

85. If no further government action was taken, some additional action would be delivered by the water industry in line with the current regulatory environment and water customer willingness to pay for environmental improvements. For example, water companies have committed to a programme of improvements to the monitoring and management of storm overflows over the 2020 to 2025 period, to comply with their existing regulatory obligations and duties as well as partly as a response to public interest in their operation and partly due to previous steers from the government. The government could drive higher ambition and more action from water companies through other means such as guidance to Ofwat or to the Environment Agency without the need to set targets.

86. However, the SOEP also estimated that if the government "does nothing" new on storm overflows then up to 83 additional water bodies could fail to achieve GES by 2050 because of their impact - an increase of 13% from the baseline. This estimate could increase further for the storm overflows with permits not analysed as part of this research. This deterioration is due to reduced river flows, population growth, urban creep, and changes in rainfall due to climate change.

87. For the same reasons, rivers currently used for recreation will see around a quarter of their length become unsuitable for swimming, a key driver in public concern.

88. The 'do nothing' option does not align with the government's existing environmental commitments in the 25 Year Environment Plan and commitments that have been made publicly specifically around tackling the adverse impacts caused by storm overflows.

4.2 Government targets:

89. Under the Environment Act 2021, the government is required to produce a plan for the purposes of reducing discharges from storm overflows and the adverse impacts of those discharges. This aligns with the action already taken by the government, such as the specific duty for "a sewerage undertaker whose area is wholly or mainly in England must secure a progressive reduction in the adverse impacts of discharges from the undertaker's storm

overflows".[32] The government has also been clear to Ofwat via the SPS that water companies must prioritise a significant reduction in the frequency and duration of storm overflow discharges. The Plan sets out clearly the pace and scale of action required by water companies in order to protect people and the environment and meet acceptable usage of storm overflows. Clear and specific expectations on the water industry are established by setting SMART targets in the Plan.

90. The government could choose to drive higher ambition and more action from water companies without setting formal targets, such as via guidance to Ofwat or to the Environment Agency's WINEP programme. However, actions to address storm overflows would take a lower priority in these processes, where statutory obligations must be funded. This would not result in the desired change. Furthermore, any improvements would be linked to existing regulatory requirements and would not address the wider issue of storm overflows discharges. Storm overflows in these waterbodies would still be upgraded, but only where it is cost-beneficial to do so in the existing methodology for the Water Environment Regulations 2017.[33] There would be a significant gap in achieving outcomes if no further government intervention was made.

4.3 What is the mechanism for setting targets?

91. Under section 141A of the Water Industry Act 1991 (as inserted by s80 of the Environment Act 2021) the government has a legal obligation to publish a plan for the purposes of reducing discharges from storm overflows and reducing the adverse impacts of those discharges. It was deemed holistic and complimentary to establish targets that achieve this via the Plan.

92. As the targets will be underpinned by changes to the conditions in Environment Agency permits issued to water companies, this will give sufficient flexibility to water companies to deliver the targets using the most appropriate mechanisms.

4.4 Developing Target options:

93. In developing the options for the targets, spill limits, elimination, outcomes-based models, and design standards were all considered. No individual option was deemed appropriate on its own to address the harm from storm overflows. The preferred option for the final targets (outlined in Section 5) represents a combination of discharge limits across all storm overflows, which acts as a backstop to guarantee a minimum standard of storm overflow operation to limit pollution, reinforced with outcome-based targets for ecological and public health in specific locations. The targets seek to achieve a balance between the ambition from the government and the public for action on storm overflows, locations where work should be prioritised, and the financial costs of delivering the improvements.

94. In considering the parameters for the targets set on the water industry as part of the Plan, multiple options were considered which are outlined below. As part of the options appraisal, options were tested with the Storm Overflows Taskforce, a cross-industry and stakeholder group who commissioned the initial SOEP.[34] The project used data provided by all water and sewerage companies in England on storm overflows operation to model the amount of storage required. More detail on this methodology is considered in Section 2. The project was commissioned to consider the costs and benefits of setting a national minimum storm

[32] Environment Act (2021), s83. Available at: https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted.

[33] The Water Framework Directive was transposed into domestic legislation under The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, referred to in this document as the Water Environment Regulations. Available at: https://www.legislation.gov.uk/uksi/2017/407/contents/made

[34] Gov.uk, *Storm Overflows Taskforce.* Available at: https://www.gov.uk/government/groups/storm-overflows-taskforce

overflows spill limit for inland waters only. Two subsequent addendums were also commissioned by Defra to test additional policy approaches, one to test the costs of a more outcomes-based approach for ecology only and a second to test the costs of expanding the rainfall target to include all coastal and estuarine waters. All three projects have been considered in developing the target options.

8*National spill limits for inland waterbodies:*

95. The SOEP considered the costs and benefits of setting a national minimum storm overflow spill limit.

96. The options tested set differing spill limits of 40, 20, 10, 5 and 0 spills, calculated as an annual average. The project then considered the various spill limits across three implementation scenarios to give high, low, and central estimates of cost for 15 policy options. These scenarios were:

- Achievement of the tested spill limits through a conventional engineering approach using solely sewerage network storage to prevent discharges, keeping, or returning them to the sewerage network for treatment at a later point.

- Achievement of the spill limits by controlling runoff from 10% of impermeable areas so that it never enters the sewage network by using sustainable drainage solutions (SuDS), with additional capacity required to meet the spill limit provided for by network storage solutions.

- Achievement of the spill limits by controlling runoff from 50% of impermeable areas so that it never enters the sewage network by using SuDS, with additional capacity required to meet the spill limit provided for by network storage solutions.

97. The research showed that reducing spill frequency through different policies progressively improves overall water quality (defined using existing GES standards derived from the Water Environment Regulations 2017).[35] However, the research also demonstrated that only an average spill limit of between 5 and 0 would completely eliminate the risk of adverse impacts to water quality from all storm overflows, with spill limits of 5 and above still leading to some water bodies not achieving GES as a result of storm overflows.

98. Costs for the 5 and 0 spills policies are significantly higher than those that would permit a greater number of spills on average due to significant infrastructure and storage demands, particularly in large cities. The research also shows that a national spill limit of 10 would make it possible for 75% of waters to achieve moderate ecological status where other pressures on the water environment have also been addressed. There is a need to appropriately balance investment, feasibility, and environmental gain.

99. The SOEP found the most economically advantageous policy (with the highest Benefit Cost Ratio (BCR) and Net Present Value (NPV)) was the least ambitious in terms of spill frequency reduction, and thus had the least environmental, public health and social improvement. BCRs decline as the control of spill frequency increases primarily due to a large increase in costs which outweigh the additional benefits we were able to monetise.

[35] Stantec (2021), *Storm Overflows Evidence Project*, 3.11. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf.; The Water Environment Regulations 2017. Available at: https://www.legislation.gov.uk/uksi/2017/407/contents/made.

100. SOEP notes the gaps in valuation evidence on storm overflows, especially recent evidence and treatment of this as a special issue (the "social value"), and suggest lines for future research and customer engagement.

101. Another area where greater benefits could be considered is in the role of SuDS. As a general rule, while increased SuDS as part of a storm overflow improvement scheme tend to have the highest benefits, capital costs are higher. This means cost benefit remains mostly static, with the SOEP showing a better high estimate of BCR than the wastewater only solutions for some SuDS scenarios.[36,37] There are uncertainties as unit costs of retrofitted SuDS (where they are installed on properties or land retrospectively, rather than as part of the planning process) are difficult to estimate as there is no established UK practice of implementation at scale. Additionally, the SOEP takes no account of potential green finance and future government legislation, such as the implementation of Schedule 3 to the Floods and Water Management Act 2010. This will potentially mean costs need to be revised when implemented as it would require all new developments to have sustainable drainage solutions as standard.

102. The SOEP makes several recommendations to improve the analysis of the costs and benefits of solutions involving SuDS, which may lead to reduced overall costs or higher benefits.[38] These include undertaking benefit evaluation studies to gain a greater and focused understanding of the wider benefits related to SuDS, especially focusing on quantifying the health and wellbeing benefits. The consultants also recommend reviewing the current large scale retrofit programmes being designed and undertaking a national level assessment on the synergies between urban drainage improvements to manage storm overflows and projects to reduce risk of flooding. DWMPs will allow water companies to plan to deliver the storm overflow targets in an integrated way, delivering multiple benefits and so lowering the cost and increasing the BCR. This is an area that would be explored more fully in a future review of the Plan. Nonetheless, this lack of certainty does not preclude water and sewerage companies assessing these solutions as part of their options appraisal for individual upgrade schemes and implementing them where viable. Green infrastructure solutions are encouraged in the Plan due to the multiple benefits available where they are cost effective.

Spill limits to improve safety of designated Bathing Waters:

103. While there is some uncertainty on the best spill limit to protect ecological harm, the concept of minimum spill standards for designated bathing waters to protect public health are well established and derived from Appendix B to the Urban Pollution Manual.[39] This details that 3 spills per bathing season is a sufficient limit to meet the standards of the Bathing Water Regulations (685 faecal coliforms per 100ml for 95% of samples). This is the basis for Environment Agency spill standards of between 2 and 3 spills per bathing season (depending on classification of the bathing water) for coastal, estuarine and lake bathing waters. The Environment Agency is currently assessing standards for rivers.

104. Even with very low spill frequencies, bathing in receiving water bodies during or shortly after storm overflow discharges will still present a public health risk. Additionally, any control of storm overflows does not preclude the presence of faecal contamination from other sources

[36] Stantec (2021), *Storm Overflows Evidence Project*, 4.55. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf

[37] Stantec (2021), *Storm Overflows Evidence Project*, 4.49. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf.

[38] Stantec (2021), *Storm Overflows Evidence Project*, 5.58. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf.

[39] FWR (January 2019), *Urban Pollution Management Manual 3rd Edition - Appendix B.* Available at: UPM Manual Version 3 (fwr.org).

such as agricultural run-off. The targets have been set on the basis of keeping the levels of harmful pathogens within the limits underpinned by the Bathing Water Regulations.

105. There is less certainty on spill standards for inland bathing waters. The Environment Agency's preliminary work shows the standards used for coastal and estuarine bathing sites would not be applicable to inland bathing waters due to lower dilution levels and further work to set out this justification will be outlined in future, but it is likely that these will be stricter than those used for coastal and estuarine bathing sites.

Advantages:

106. **Ease of understanding**: Due to the publicly available data from Event Duration Monitoring now being published annually by the Environment Agency, there have been a number of key figures reported in the media and in the wider public domain, which focus on average frequency, duration, and total hours of discharges from storm overflows.[40] Therefore, a spill limit would be easily understood by the wider public.

107. **Ease of regulation**: A nationally set spill standard is a clearly measurable objective and design standard that can be easily translated to permit requirements.

108. **Delivering continuous improvement**: A clear spill standard, once in permits, must be maintained in order to achieve compliance. This means it is a future proofed metric as water companies must take into account longer and more frequent rainfall events due to climate change in the design standard and future sewerage plans. Where storm overflows are not achieving this minimum standard in the future, water companies will be required to evaluate and upgrade their storm overflows accordingly.

Disadvantages:

109. **A single limit will not fully achieve the policy objectives to protect the environment and reduce the risk to public health**. As the SOEP shows for inland waters, reducing spill frequency does progressively improve water quality, with a step change in water quality at a 10-spill limit. A 10-spill limit is modelled to show that the percentage of water bodies that will not be prevented by storm overflows from achieving moderate status or better under this policy would be 75%. However, even at this level, not all water bodies achieve good status for the proportion of ecological harm that storm overflows cause, and there is a residual 25% that will require stricter design standards to eliminate ecological harm. This is also true for the policy objective to reduce the risk to public health wherever the discharge limit needs to be tighter.

110. **All storm overflows are treated equally:** A spill limit treats all storm overflows the same, regardless of the size of the spill, or the type of water it discharges into. A small storm overflow will have less environmental impact than a large storm overflow on the same river. However, size and speed of river also makes a difference on impact, for example, a large storm overflow with high volumes discharging to a small stream will have a much greater impact with a low number of discharges, than a very large river receiving a small volume of discharge more regularly.

111. This analysis also only accounts for the harm caused by storm overflows in isolation and does not guarantee achievement of overall water body standards due to other sources of harm such as diffuse agricultural pollution.

[40] Guardian (March 2022), *Raw Sewage Discharged into English Rivers 375,000 Times by Water Firms.* Available at: Raw sewage discharged into English rivers 375,000 times by water firms | Water | The Guardian.

National elimination of storm overflows:

112. Many stakeholders have called for the government to 'end sewage pollution'.[41] Consideration has been given to this by the government and a report considering the costs and benefits of eliminating storm overflows has been published.[42]

113. The SOEP considered two scenarios that could feasibly result in national elimination of storm overflows:

- Complete separation of wastewater and stormwater systems. This option means that surface water and sewage pipes across England would be entirely separated.

- Re-design of storm overflows to reduce discharges to an average of zero. This option means storm overflows are functionally eliminated for a year with average rainfall events, though storm overflows could still operate during extreme rainfall events.

114. According to the analysis in the SOEP, it was found that the separation option was the only way to fully eliminate all storm overflows. According to the SOEP methodology, this option was modelled to cost between £350 bn and £600 bn which could result in an increase in household bills between £569 and £999 per year. It was also found to be a highly disruptive and complex suite of projects to deliver nationwide and would involve major engineering works, often in big cities causing disproportionate disruption to public services and issues in the supply chain. Therefore, on the basis of this evidence, it was decided that this was disproportionate in response to the harm caused by storm overflows and would negatively impact on the public at a national scale.

115. The alternative definition of 'elimination' by re-designing all storm overflows so they average zero discharges was also shown to be disproportionately expensive. The SOEP methodology suggested that this could cost between £121bn and £216bn in capital expenditure. The project highlighted the experience of the Thames Tideway Tunnel, a major £4.2bn project designed to reduce the number of storm overflow discharges in central London to the River Thames as a case study of the scale of intervention required. However, it was highlighted that this project is only designed to reduce the need for storm overflows, not to reduce to 0 on an average year. It would be likely that projects of this scale and larger would need to be replicated in some circumstances in order to achieve this option nationally, which would again be disproportionate to the scale of the issue under consideration and impractical in some locations.

116. However, it may be appropriate to eliminate individual storm overflows, where deemed necessary for ecological or public health reasons. Approximately 10% storm overflows already discharge zero times per year on average.[43] There will be local circumstances where it may be appropriate to pursue a solution that eliminates a discharge. This includes areas where storm overflows may not spill very often, but receiving watercourses are very sensitive to such discharges due to either their ecological, public health or societal impacts. The Plan encourages the water industry to identify these opportunities and ensure that they are considered in their own options appraisal as part of their Business Plans. When the aim is to

[41] Surfers Against Sewage (November 2021), *2021 Water Quality Report.* Available at: https://www.sas.org.uk/wp-content/uploads/SAS-WaterQualityReport2021-DIGITAL.pdf

[42] Defra (2022) Report on feasibility of elimination of discharges from storm overflows Available at: https://www.gov.uk/government/publications/storm-overflows-discharge-reduction-plan

[43] This figure is based on the rainfall experience during the survey period, this is not to say that they would not operate under rainfall higher than that experience during the survey period.

eliminate untreated sewage discharges, schemes which provide for treatment of discharges before they enter water courses can also be considered when seeking to eliminate storm overflow discharges.

117. The Storm Overflows Elimination Report considers the overall feasibility of achieving the complete elimination of storm overflows in England.[44] The report concludes that complete elimination at a national scale is not feasible over the lifetime of these targets due to the costs to the consumer, society, and the environment but the government has been clear this should be a long-term aim for society.

Outcomes based model:

118. An alternative method of setting targets that has been considered is an outcomes-based model. This approach seeks to target elimination of ecological harm (defined using the Urban Pollution Manual (UPM) standards for Dissolved Oxygen and Ammonia) and reduction of public health harm by keeping Faecal Indicator Organisms within evidence-based standards.

119. The standards for UPM are well evidenced and are used for the Environment Agency's water quality sampling regime as key indicators of water quality. Where Dissolved Oxygen is too low or ammonia too high, it can lead to water bodies that can't sustain aquatic life.

120. The costs of this alternative scenario were considered in Addendum 1 to the SOEP by applying similar methodology to the full SOEP to calculate a storage requirement and subsequent cost of intervention but solely to achieve GES.

121. By setting a clear ecological standard rather than a spill limit, it means that all ecological harm can be eliminated at an appropriate level of investment proportionate to the harm caused. For example, a very sensitive site may require a much higher level of investment to remedy harm than a site with a high flow rate and high dilution. This can be planned at a more local level.

122. Another outcome-based approach would be to use the standards for bathing waters in relation to E. coli and intestinal enterococci that are accepted levels for 'safe' swimming and ensure that storm overflows are meeting this. These standards are robustly evidenced and set in regulation as outlined in more detail in Section 2.2. However, it is currently difficult and expensive to monitor these standards in a similar way to river ecology and given the different inputs to bathing water quality, it would be difficult to ascribe cause and effect to storm overflows.

Setting other national minimum design standards for storm overflows:

123. Another policy option considered was to revise the current minimum design standards for storm overflows. This would have meant an adaptation of existing methodology which uses pass forward flow (the amount of storm sewage that must make it to a treatment works before storm overflows are permitted to discharge). Most permits for storm overflows include pass forward flow (PFF) conditions.[45] This option would have increased the general multiplier applied, to make sure a minimum flow is passed forward to treatment while the storm overflow discharges to the environment. However, this was tested by Stantec in unpublished analysis and found to be a sub-optimal method of calculating a minimum standard. This was due to the

[44] Defra (2022) Report on feasibility of elimination of discharges from storm overflows Available at: https://www.gov.uk/government/publications/storm-overflows-discharge-reduction-plan

[45] Environment Agency (September 2018), *Water Companies: Environmental Permits to Storm Overflows and Emergency Overflows.* Available at: https://www.gov.uk/government/publications/water-companies-environmental-permits-for-storm-overflows-and-emergency-overflows/water-companies-environmental-permits-for-storm-overflows-and-emergency-overflows

difficulty of regulating this area because of the complexity, and the lack of future proofing to include population growth and climate change as the methodology which would set the standards would be based on a snapshot in time. There was also insufficient evidence that such an approach would be successful as an alternative to spill standards, as in times of heavy storms when storm overflows are necessary, flows in sewerage pipes can be reversed, making the pass forward flow negative.

5. Summary and preferred option with description of implementation plan

124. The first version of the Plan was subject to a public consultation, which ran from 31 March to 12 May 2022. A second public consultation ran from 12 June 2023 to 24 July 2023 on the possibility of extending the scope of targets in the first version of the Plan to also cover coastal and estuarine waters, as well as on whether any other areas should be added to the current list of 'high priority sites' in the Plan. A combination of the possible metrics and approaches discussed above were outlined to limit pollution and achieve ambitious outcomes for the environment and public health.

125. There are three headline targets, along with a number of sub-targets that will act as progress milestones set throughout the lifetime of the Plan. The final targets and their delivery dates are as follows:

Target	**Metric**
Protecting the Environment	
Headline Target: Water companies will only be permitted to discharge from a storm overflow where they can demonstrate that there is no local adverse ecological impact. Water companies must plan to achieve this target for all storm overflow sites by 2050.	'No local adverse ecological impact' will be measured against all storm overflows achieving the Urban Pollution Management Fundamental Intermittent standards for Ammonia and Dissolved Oxygen directly downstream of the discharge point.
Sub Target: 75% of storm overflows discharging into or near 'high priority sites' must have no local adverse ecological impact.	75% of storm overflows designated as discharging to 'high priority sites' to meet or exceed the Urban Pollution Management Fundamental Intermittent standards for Ammonia and Dissolved Oxygen.
Sub Target: Water companies will only be permitted to discharge from a storm overflow discharging into or near 'high priority sites' where they can demonstrate there is no local adverse ecological impact.	100% of storm overflows designated as discharging to 'high priority sites' to meet or exceed the Urban Pollution Management Fundamental Intermittent standards for Ammonia and Dissolved Oxygen.
Protecting public health in designated bathing waters	
Headline Target: Water companies must significantly reduce harmful pathogens from storm overflows discharging near designated bathing waters, by either: applying disinfection; or reducing the frequency of discharges to meet Environment Agency spill standards.	All storm overflows that meet this criteria must meet Environment Agency spill standards for bathing baters (a maximum of 3 per bathing season), or have disinfection applied by water companies.

Ensuring Storm Overflows only operate in unusually heavy rainfall events	
Headline Target: Storm overflows will not be permitted to discharge above an average of 10 rainfall events per year.	Storm overflows must operate in 10 or fewer rainfall events on average.

Target delivery dates	
The targets and sub targets above mean that in practice storm overflows need to be improved to meet all applicable targets by the following dates:	
2035	All storm overflows discharging near designated bathing waters, and 75% of storm overflows discharging into or near 'high priority sites' (as defined in the updated Annex 1 of the Plan)
2045	All remaining storm overflows discharging into or near to 'high priority sites'
2050	All remaining storm overflows

126. Additionally, all storm overflows will be required to have screening controls to limit discharge of persistent inorganic material, in line with Environment Agency standards, by 2050.

127. As considered in Section 1.2, the targets set under the Plan and evaluated as part of this IA are not considered statutory requirements and therefore do not constitute a 'regulatory measure' for the purposes of the better regulation framework. The targets will instead be translated to requirements for the water industry to achieve via Environment Agency permitting and through Ofwat's PR mechanisms.

128. The targets will come into effect immediately on publication, and work taking place as part of this PR (2020-2025) cycle will count towards achievement of the targets. Ofwat have already announced that all companies must show a reduction in storm overflows in this PR cycle.[46]

129. The targets will apply concurrently to ensure efficient investment, and therefore upgrades should apply the strictest standard depending on the classification of the water body. For example, an upgrade to meet the ecological standard must also meet the rainfall standard, and all upgrades must allow for sufficient screening where it is not already at the minimum required standard. In some instances, water companies may use grey infrastructure to deliver progress quickly. Blue-green infrastructure should always be considered and reviewed as a possible replacement for existing grey infrastructure in the long-term.

130. For the purposes of the public health and rainfall targets, a discharge or rainfall event is defined using the industry standard mechanism.[47] This aligns with the methodology for EDM installation by water and sewerage companies.

6. How the targets will achieve the policy objectives:

Protecting the Environment:

[46] Ofwat (June 2022), *Ofwat Press Notice 17/21.* Available at: PN 17/21: Ofwat calls for companies to meet "growing expectations" on storm overflows - Ofwat.

[47] 'Rainfall event' shall be defined as any discharge from a Storm Overflow within a maximum of 12 hours. For long duration discharges that occur beyond the initial 12-hour period, it will be counted as an additional rainfall event for the subsequent 24 hours and each 24 hours after that for the purposes of the target. When an overflow has ceased to discharge for a 24-hour period, the counting mechanism will reset.

131. This target seeks to achieve the policy objective to eliminate the ecological harm caused by storm overflow discharges. The target defines the achievement of this objective as 'no local adverse ecological impact' which means the achievement of the UPM Standards for Dissolved Oxygen and Ammonia directly downstream of storm overflows. Storm overflows will be monitored up and downstream by water companies as per the Environment Act which will objectively measure the success or otherwise of improvement schemes.[48] This means that water and sewerage companies will be able to objectively measure the ecological impact of individual or groups of storm overflows. This target will contribute to the 25 Year Environment Plan goal of restoring 75% of waters to be close to their natural state or better by 2042.[49]

Protecting public health at bathing waters:

132. The second target seeks to achieve a significant reduction in the risk to public health at designated bathing waters, in line with the Bathing Water Regulations limits discussed in Section 2.2. The target states that storm overflow usage must either meet the environmental standard that has also been set for bathing waters or water companies must apply disinfection at or near to (within 1km) of designated bathing sites by 2035. This prioritisation ensures water companies will urgently address the harm to human health that is posed by storm overflows discharges near designated bathing waters where people are most likely to use the water recreationally.

133. It is a weakness of the current methodology for storm overflow upgrades that a storm overflow must be shown to impact a bathing water in order for it to be upgraded. As impact on bathing waters is calculated on a single sampling point, at the area of highest density of bathers, this often misses public health risks to the overall bathing water site. Therefore, this target goes further than the Bathing Water Regulations by requiring upgrades to all storm overflows that discharge near a designated bathing water (within 1km upstream for coastal bathing waters and 5km for inland bathing waters) rather than those that affect a singular sampling point.

134. Water and sewerage companies may meet this target by applying Environment Agency spill standards for the classification of bathing water (detailed in Section 4.3) in the first instance. Companies may wish to apply ultraviolet treatment to sewage discharges as an enhancement or an alternative under exceptional and agreed circumstances. This has proven to be an effective way to significantly reduce the loadings of Faecal Indicator Organisms and both options are expected to be used as part of an options appraisal conducted by water and sewerage companies in implementing this target.[50]

135. Environment Agency analysis of water company EDM returns and bathing water data anticipate approximately 660 storm overflows will need upgrading to meet this standard and achieve the objective of a significant reduction in risk. The government also anticipates a significant decrease in the number of 'bathing days' lost as a result of a storm overflow discharge (where it is declared not safe to swim). Based on existing EDM data for the storm overflows requiring upgrades, a 70% reduction in the number of discharges during the bathing season is expected (May-September). Upgrade standards will also lead to reductions in discharges outside of the bathing season with Stantec specifying that 1 spill per bathing

[48] Environment Act (2021), s82. Available at: https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted.
[49] Defra (2018), A Green Future, Our 25 Year Plan to Improve the Environment, [25], Available at: 25-year-environment-plan.pdf (publishing.service.gov.uk)

[50] Adhikari, A. et al., (2020), 'Evaluation of ultraviolet (UV-C) light treatment for microbial inactivation in agricultural waters with different levels of turbidity', *Food Sci Nutr*, 14;8(2). Available at: Evaluation of ultraviolet (UV-C) light treatment for microbial inactivation in agricultural waters with different levels of turbidity - PubMed (nih.gov).

season is equivalent to 5 discharges per annum. However, precise discharge reductions as a result of this target have not been calculated due to the different ways in which water and sewerage companies can meet this target and so are not represented here.

Ensuring storm overflows only operate in unusually heavy rainfall events:

136. This target seeks to limit pollution, addressing the public health harm and the social impacts of storm overflows by restoring the original purpose for storm overflows to only operate in unusually heavy rainfall events. This is defined in the target as only operating in 10 or less rainfall events per year.

137. A 'rainfall event' is defined using the industry standard mechanism for calculating a spill to sufficiently regulate storm overflows. This terminology has been chosen to more closely align with public and stakeholder expectation that storm overflows should only operate in unusually heavy rainfall events.

138. Where a storm overflow only operates in 10 rainfall events, this should also significantly improve the quality of bathing waters.

139. This target will satisfy the impact pathway laid out in the SOEP, and a reduction in social harm is anticipated but hard to quantify. To further reduce the social harm, water companies will also be required to introduce screening (where it is not already in place) as part of any storm overflow to ease concerns about sewage debris polluting waterways.

140. We expect this target to lead to significant reductions in storm overflow use shown in Table 6.1 below relative to a 2020 baseline:

Table 6.1: Anticipated indicative reduction in storm overflow spills.

Year	**2030**	**2035**	**2040**	**2045**	**2050**
% of 'high priority site' storm overflows improved	38%	75%	87%	100%	100%
% of <u>total</u> storm overflows improved	20%	40%	60%	80%	100%
Indicative reduction in number of spills per year (relative to 2020 baseline)	64,000	128,000	192,000	256,000	320,000

141. These estimates of spill reductions are based on the effects of the rainfall target alone (maximum 10 spills per year) on the 90% of storm overflows that have Event Duration Monitor (EDM) data. We expect that meeting the ecology and public health targets in addition to the rainfall target will reduce spills still further, and the 10% of storm overflows that are currently missing EDM data will also see significant spill reductions. Some EDMs were also not operational 100% of the time, we also expect recorded spill numbers to increase once non-operation of monitors decreases. However, we do not currently have the data to quantify these effects.

142. Data here is only an indicative suggestion of likely spill reductions. We have kept a 2020 baseline for consistency with the previous version of the Plan and its associated Impact Assessment. Data for 2021 and 2022 is now available and would generate different estimates

of the likely reduction in spills owing to different weather conditions and data availability. The targets in the Plan do not depend on the baseline chosen.

143. Indicative anticipated % of storm overflows improved has been calculated by assuming that companies will complete improvements in a linear fashion to meet relevant targets and sub-targets.

Prioritisation

144. As the costs of all interventions are high, a prioritisation approach has been applied to spread costs effectively and to ensure the storm overflows causing the greatest harm are addressed first. All storm overflows near bathing waters will need to be improved to meet all applicable targets by 2035. Following both the initial consultation on the Plan, and the second consultation on expanding the Plan which asked about the most sensitive sites, the Plan also prioritises for early action sites defined as 'high priority'.

145. Sites defined as 'high priority' have been chosen due to their protected status and impact on conservation goals. These sites are: Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SAC), Urban Wastewater Treatment Regulations sensitive areas, chalk streams, waters which fail to achieve ecological standards due to storm overflows, Shellfish Water Protected Areas, Special Protection Areas (SPAs), Marine Conservation Zones (MCZs) and Ramsar sites.

146. Environment Agency analysis suggests there are 5,600 storm overflows discharging into or near 'high priority sites'. This figure has changed from the previous assessment of 5,500 storm overflows, due to a refining of the assessment methodology and the addition of Shellfish Water Protected Areas and the various areas that fall under the 'Marine Protected Area' definition to the 'high priority sites' list.

147. Storm overflows in 'high priority sites' will need to meet all applicable targets as follows:

- By 2035: 75% of storm overflows discharging into or near 'high priority sites';
- By 2045: 100% of storm overflows discharging into or near 'high priority sites'.

148. These dates have been set due to the need to balance the cost passed onto consumers through bill increases and to reflect the scale of the work required by the water industry to meet them, including time to investigate and model the best solutions and to allow the supply chain time to be able to operate at scale. The prioritisation does mean that a significant part of the work to achieve these targets will need to be completed by 2035. This will mean some frontloading of investment. Estimates of cost and an indication of how this may break down over subsequent PR periods are set out in Section 8. The exact solutions each water company will use to achieve the targets for all their overflows up to 2050 have not yet been determined in all cases. There is the possibility that a proportion of this work could be achieved through lower cost interventions that were not considered through the SOEP, such as improved asset maintenance.

149. Due to the uncertainty in the modelled data and regional disparities in investment required (detailed in Section 8) this target, and its related sub targets, will be assessed at the 2027 review point as outlined in the Plan.

7. Implementation plan:

150. The Environment Agency will review permits using their powers in the Environmental Permitting Regulations 2016.[51] This approach to implementation allows sufficient flexibility for piloting and experimentation for more challenging schemes.

151. The government expects water companies to achieve the targets set out in the Plan. Implementation of the targets assessed in this IA will be kept under review to ensure it is delivering the outcomes required.

152. The Environment Agency will be responsible for enforcement. The Environment Agency will assess compliance against the revised permitted standards and Ofwat will hold water companies to account to achieve the projects laid out in their business plans, agreed as part of each PR cycle.

8. Monetised and non-monetised costs and benefits of each option (including administrative burden)

153. The targets cover a period from 2025 to 2050 which corresponds to five water industry Asset Management Periods (or AMPs, which are the regulated business plan periods starting from privatisation of the industry in 1990 with AMP1 and now in AMP7 spanning 2020 to 2025). Analysis of the costs and benefits is based on a longer appraisal period from 2025 to 2100, reflecting the expected long asset life of constructed solutions.

Modelling:

154. The estimates of costs and benefits for inland storm overflows rely heavily on the SOEP and its addendum carried out by consultants Stantec, working with the government/industry Storm Overflows Taskforce as well as unpublished supplementary costings using the same methodology applied to discharges to coastal and estuarine waters. Additional work was done internally by Defra officials to estimate benefits for coastal and estuarine storm overflows.[52]

155. The SOEP used the results from simulations of around 9,300 storm overflows modelled by the water companies, from a total of 13,350 storm overflows known to discharge to inland waters. The simulations are considered to be a good representation of rainwater runoff from paved surfaces entering combined sewers of finite capacity and are based on the same modelling used in the companies' own long term planning. They also represent storm overflow structures and can be reliable at predicting storm overflow volumes which are important for considering river dilution and impact. Where available, model outputs for 2050 were used, reflecting projections of population, water consumption, rainfall, and urban growth, otherwise 2020 outputs were assumed to apply.

156. As covered in greater detail in Section 4, several scenarios were modelled representing different levels of ambition for reducing the frequency of storm overflow spills from the least ambitious of reducing spills to an average of 40 times a year from any one storm overflow, to the most ambitious of eliminating all spills from all storm overflows. Subsequent modelling

[51] The Environmental Permitting (England and Wales) Regulations 2016, Available at: https://www.legislation.gov.uk/uksi/2016/1154/contents/made.
[52] Stantec (2021), *Storm Overflows Evidence Project*, 5.58. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf.

supplemented these spillage frequency thresholds with additional analysis of storage that would be equivalent to the target of eliminating ecological harm.[53]

157. Allowance was made for the roughly 30% of storm overflows not covered by the modelling because not all drainage catchments and storm overflows are modelled, and some were omitted because of uncertainties about data quality and reliability.[54] Total costs for the overall programme were estimated by multiplying the estimated costs for the modelled 70% of storm overflows by a factor of 1.3 (range 1.2 to 1.4). The range was chosen by the consultants undertaking the SOEP due to having an uncertainty band in the data provided by water companies for the project, recognising that the unmodelled storm overflows are likely to be less significant in terms of spill volume and frequency.

158. Costs and benefits for coastal and estuarine waters were not included in the original SOEP project. In a follow up commission by Defra, additional storage to limit spills to ten per year in coastal and estuarine waters was estimated by Stantec on the basis of data submitted by water companies. Network storage construction cost estimates were then applied.

159. The central capital cost estimate to improve **all** storm overflows discharging to coastal and estuarine water bodies came to **£7bn**, of which **£3bn** would be required to improve storm overflows near bathing waters. Hence the extension of the rainfall target is estimated to add **£4bn** to total capital costs of the programme (given that bathing waters were already covered by the public health target), bringing the total estimated undiscounted capital cost of the programme from **£56bn** to **£60bn.**

160. One company with coastal and estuarine storm overflows did not respond to the commission for data on storage requirements for coastal and estuarine storm overflows. Storage requirements therefore had to be estimated using expert judgement. The estimated capital cost of storage required at coastal and estuarine storm overflows for this company represents only 0.6% of the total capital cost of the programme and is therefore unlikely to affect the overall national results presented.

161. Benefits were separately estimated by Defra officials by extending Stantec's analysis and employing regression analysis to plug gaps in data on ecological benefits where necessary.

Costs Methodology

162. The conventional approach is to capture spills from storm overflows using network storage (such as concrete tanks) large enough to capture spills and allow them to return slowly to the sewer network for treatment.

163. The project also analysed two other approaches: replacement of combined sewers with separate foul water and surface water run-off systems; and retrofitting SuDS to intercept and slow surface water flows to different extents (10% or 50% of impermeable area) and used in combination with conventional storage solutions. These all deliver considerably more additional benefits (e.g., amenity, landscape, habitat, urban cooling) but they are also considerably more expensive than the conventional tanks approach when costed at a national scale. For this assessment it is therefore assumed illustratively that conventional storage

[53] Stantec (2022) *Storm Overflows Evidence Project*, pers. commun, Stantec (2021), *Storm Overflows Evidence Project*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf

[54] Stantec (2021), *Storm Overflows Evidence Project*, 3.10. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf.

solutions would be used, although in practice there would be instances where another approach would be more cost-effective. The Plan states that the Environment Agency and Ofwat will encourage companies to consider green infrastructure in their proposals to achieve the targets set out in this Plan, and wider government priorities set out in the government's Strategic Policy Statement to Ofwat.

164. The SOEP used the hydrological modelling outputs to estimate the volume of additional storage required to achieve each of the appraised levels of spill frequency for each storm overflow. Table 8.1 shows an illustrative example for a notional storm overflow with an annual average spill volume of 60,000m^3 and an annual average spill frequency of 50.

Table 8.1: Worked example of storm overflows reduction at different discharge frequencies

	Average annual discharge frequency				
	40	20	10	5	0
Annual spill volume (m^3)	54,034	30,000	15,187	8,400	-
Network storage needed (m^3)	703	1,994	3,863	7,559	24,315
Additional treatment required (m^3/year)	5,966	30,000	44,813	51,600	60,000

165. The project then applied unit costs for network storage construction £1,300/m^3 to £2,000/m^3 derived from water company programmes of constructing storage tanks on combined sewer networks and from estimating tools based on the same data. Unit costs for upgrading existing wastewater treatment works for additional treatment capacity (to accept more rainwater which is no longer discharged to river but treated instead) were £12/m^3 to £25/m^3. Economies of scale have not been considered as part of this analysis and this may have an impact on the overall costs.

166. An additional allowance was made for the costs of screening all unscreened storm overflows to both inland, coastal and estuarine waters.

Costs:

167. The central estimated total 2020 present value of costs is £46bn, up from £43bn in the previous IA. This is due to the extension of the rainfall target to coastal and estuarine storm overflows. The total undiscounted capital costs of the modelled option were estimated to be between £46 billion and £73 billion (an increase from estimated costs of £43bn to £69bn in the previous IA due to extension of the rainfall target to coastal and estuarine storm overflows).

168. Operating costs were calculated from the same basic modelling and applying standard industry unit values as follows: additional treatment £0.02/m3, maintenance of storage tanks £2,150 (43 hours per tank per year at £50 per hour) and pumping £0.0096/m^3. For simplicity

here an annual value of one thousandth of the cumulative installed capital asset cost is applied.

169. As the capital works will be delivered by the private sewerage companies, finance costs have been calculated using the Ofwat current standard 3% real terms weighted average cost of capital (WACC) and a 40-year run-off period. This approach is consistent with HMT Green Book and further guidance.[55] Financing costs to deliver the targets total £35 billion (undiscounted central estimate).

170. The total cost to water companies to deliver the targets, phasing the capital expenditures evenly over the five business planning periods involved, would be between £35 billion and £57 billion in 2020 present value terms including financing and operating costs for the full appraisal period to 2100 and assuming that no assets needed to be replaced in that time.

171. These costs would fall on the water and sewerage companies. Costs don't fall evenly across the country. Water company regions with proportionately more older urban wastewater collection systems tend to have higher costs. One exception to this is London where major storm overflows have been or are being addressed by the Thames Tideway Tunnel. Costs would then be passed on to customers in the wastewater element of their water bills (in the case of London, that has already started).

Customer bill equivalent

172. Customer water bill impacts have been estimated using Defra's internal model. Bill increases are presented on top of a projected baseline scenario (scenario with no enhancement) of the respective year. Figures in this section show the estimated impact on consumer bills resulting from investment in storm overflows.

173. With investment split evenly across price reviews, but addressing the higher priority storm overflows first, national bills are estimated to increase in real terms by £13 p.a. (up from £12 p.a. increase in the first IA due to extension of the rainfall target to coastal and estuarine storm overflows) on average over the 2025 to 2030 period.

174. A breakdown of estimated bill increases can be seen in Table 8.2 & 8.3. Figures show the projected bill impact of the central enhancement estimate for storm overflow improvements. As highlighted throughout this impact assessment there is considerable uncertainty in the costs of this policy, so results presented here are indicative of the likely order of magnitude. They do not include other enhancement areas for PR24 which will result in bill impacts.

175. Estimates in Tables 8.2 & 8.3 are industry averages. It is important to note that there would be significant variation across years and water company regions since some water companies have a much larger share of storm overflow investment and other enhancement areas. Bill impacts for water company regions with the largest storm overflow programmes may be up to 3 times the national average and for those with the smallest programmes lower than one-sixth of the national average. Confidence in projections becomes lower in the long run due to the large number of assumptions required. These estimates may change if more accurate data is available in the future.

[55] Spackman, Michael (April 2018) 'Social Discounting: social opportunity cost, social time preference and risk', *Grantham Research Institute on Climate Change and the* Environment. 182. Available at: https://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2017/02/Working-Paper-182-Spackman-April-2018.pdf.

Table 8.2: Customer bill equivalents (for investment in storm overflows only) averaged per Price Review Cycle, previous Plan and updated Plan (2025-2049 central estimate)

	2025-29	2030-34	2035-39	2040-44	2045-49
Real terms increase in annual bill due to investment in storm overflow improvements, previous Plan (constant 2017 £)	£12	£32	£46	£56	£64
Real terms increase in annual bill due to investment in storm overflow improvements, updated Plan (constant 2017 £)	£13	£34	£49	£61	£70

Table 8.3: Customer bill equivalents (for investment in storm overflows only) per year (2025-2030 central estimate) for PR24, previous Plan and updated Plan

	2025/2026	2026/2027	2027/2028	2028/2029	2029/2030
Real terms increase in annual bill due to investment in storm overflow improvements, previous Plan (constant 2017 £)	£3	£8	£13	£17	£21
Real terms increase in annual bill due to investment in storm overflow improvements, updated Plan (constant 2017 £)	£3	£8	£13	£18	£22

Carbon costs

176. The SOEP estimated the carbon associated with the construction of sewer network storage, including only embedded carbon and a unit cost range from 212 to 286 kg/CO_2e per m^3 of network storage. The project's embedded carbon calculations were carried out in line with UK Water Industry Research's embodied carbon guidelines.[56] The estimates in this IA take the same carbon to capital cost of storage ratio and apply it to the larger capital costs here.

[56] UKWIR (2012) 'A Framework for Accounting For Embodies Carbon in Water Industry Assets' Available at: A Framework for Accounting for Embodied Carbon in Water Industry Assets (ukwir.org)

177. This gives a central estimate of 8.035MtCO_2e. For comparison, the embedded carbon for materials and construction activities for the £5 billion Thames Tideway storm overflow tunnel in London has been estimated as 0.79MtCO_2e.[57]

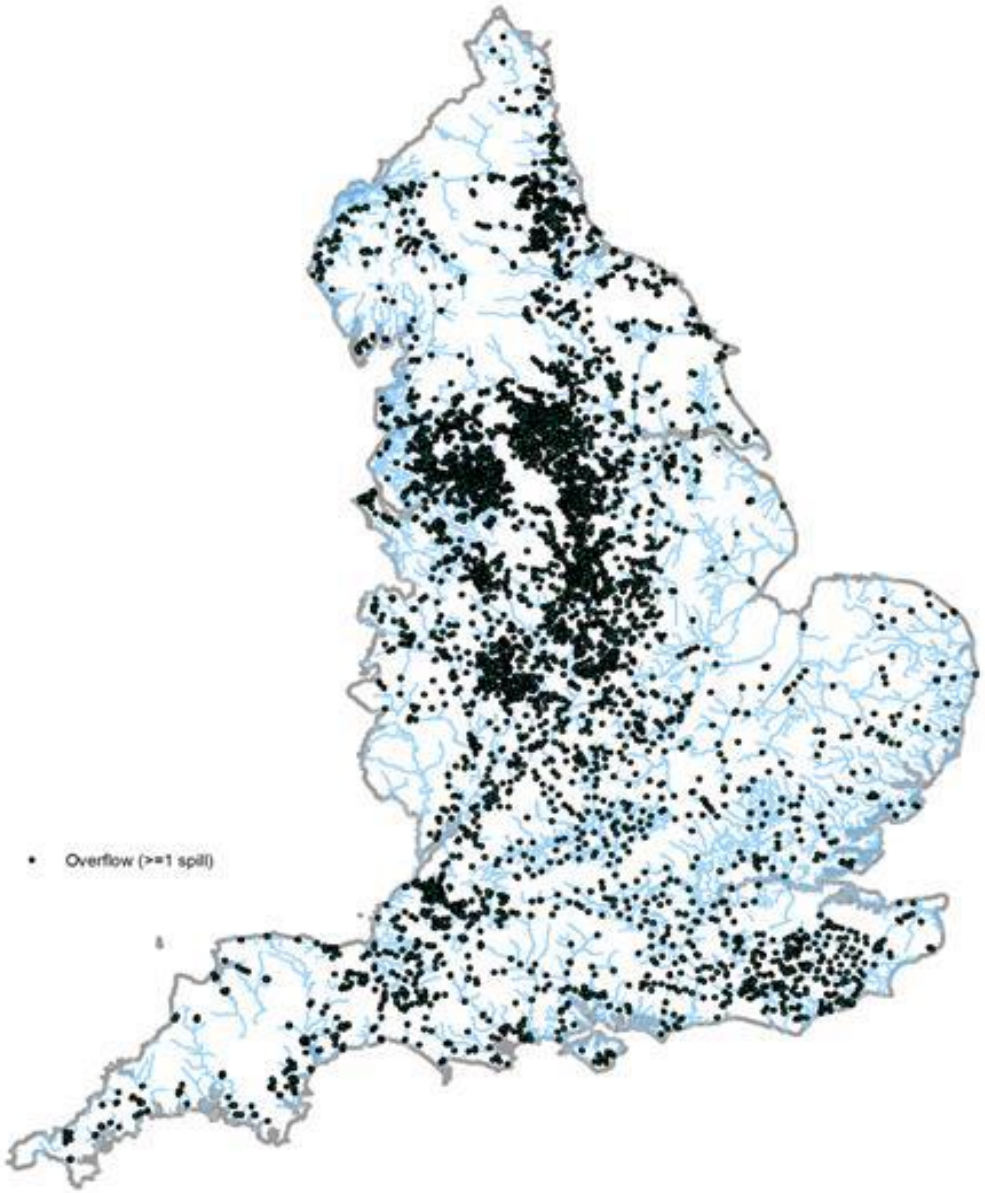
178. Carbon impacts are valued using the guidance from the department formerly known as the Department of Business, Energy and Industrial Strategy (BEIS).[58] The estimated total embedded carbon costs are between £1.2 billion and £3.5 billion (up from £1.1bn to £3.3bn in the first IA due to extension of the rainfall target to coastal and estuarine storm overflows).

Regional distribution of costs

179. The below Figure 8.4, reproduced from the SOEP, shows storm overflows with greater than zero spills in 2020 which gives some indication of the regional variation in storm overflows in England.[59]

[57] Thames Water (January 2013), *Energy and Carbon Footprint Report*. Available at: http://www.energyforlondon.org/wp-content/uploads/2013/05/Thames-Tideway-7.08_Energy_and_Carbon_Footprint_Report.pdf.
[58] BEIS (September 2021). *Valuation of greenhouse gas emissions: for policy appraisal and evaluation*. Available at https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation#annex-1-carbon-values-in-2020-prices-per-tonne-of-co2.
[59] Stantec (2021), *Storm Overflows Evidence Project*, 3.10. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf.

Figure 8.4: Map of storm overflows operating more than zero times in England.



180. This regional pattern of storm overflows is to be expected given the historical development of combined sewers, but the pattern may also reflect some regional differences in geology, as well as in the extent to which water companies have modelled networks and storm overflows within them.

181. The national aggregate capital cost estimate is built up from detailed local data and can accordingly be broken down to assess regional impacts. Inevitably the estimates become less reliable with increasing disaggregation. In table 8.5 below we present preliminary indicative figures which may be distorted to some extent by differences in the completeness and quality of modelling data used, as well as the wide range of uncertainty between low and high estimates used for the analysis in this IA. Nevertheless, they demonstrate the potential variation in impacts across the country. Benefits would be distributed in a similar pattern.

Table 8.5: Indicative regional distribution of capital costs (2025-2049).

Water company	% of capital cost (central estimate)	Size of customer base as % of customers in England
Anglian Water	1%	11%
Northumbrian Water	2%	5%
Severn Trent Water	15%	18%
South West Water	2%	3%
Southern Water	4%	8%
Thames	4%	24%
United Utilities	35%	15%
Wessex	11%	5%
Yorkshire Water	27%	10%
Total	**100% = £60bn capital investment**	**100% = 25m customers**

8.1 Monetised Benefits - Inland

182. Benefits accruing due to improvements at inland waters were considered separately from benefits due to improvements at coastal and estuarine waters. We begin by discussing benefits from inland storm overflow improvements, which were calculated in the Storm Overflows Evidence Project.

183. The SOEP considered three aspects of harm caused by storm overflows: river health (ecological harm), public health and social impact as outlined in more detail in Section 2.2. Benefits thus arise through contribution to ecological outcomes (storm overflows involve high oxygen demand to the detriment of availability to living things), safety for recreational contact through avoiding risk of illness to swimmers and others from contact with bacteria from faecal matter, and avoidance of events that generate social harm (raw sewage released into rivers and lakes). In each case, the project provided a physical simulation of the impacts that could then be valued to some degree.

184. None of the levels of ambition appraised in the SOEP correspond exactly to the investment programme for the targets now proposed. The closest scale of intervention considered in the project is the investment programme designed to achieve a maximum spill frequency of five per year and the benefits values for this option are used in the current appraisal. In fact, it would make very little difference to the results if the monetised benefits arising from the most ambitious programme were to be used instead. These values do not include any benefit from the targets relating to coastal and estuarine bathing waters, which were not considered in the SOEP.

185. The three elements of harm are now considered in turn: river health (or ecological impacts), public health and social impact.

186. For ecological impacts, the project estimated the length of water bodies that would be freed from storm overflow pollution to the extent that it would achieve good ecological status (in the absence of other sources of pollution). The value of ecological benefits is based on the National Water Environment Benefits Survey (NWEBS) approach included in the Defra appraisal guidance on Enabling a Natural Capital Approach (ENCA) and widely used in

appraisal of water policy and regulatory action. The approach requires an assessment of the extent of river in which the improvements will occur and applies a unit value in £/year/km of river improved.[60]

187. NWEBS elicited respondents' valuations of water quality encompassing six identifiable components: fish, invertebrates, plants, water clarity, flow and safety for recreational contact. The category of ecological impacts includes three of the six NWEBS components (fish, invertebrates and plants) that would be affected by storm overflows. In the absence of better information, it is assumed that the basic NWEBS values expressed in £/year/km of river improved is attributable equally to each of the six components so here the potential ecological value of addressing storm overflows is 3/6 (i.e., half) of the NWEBS value.

188. NWEBS values are based on survey work conducted in 2007. The unit values have therefore been updated to allow for changes in population and the value of money (using the GDP deflator). Again, this is the established standard approach. The updated annual values are: £22,051 for upgrading from Bad water body status to Poor, £25,373 for Poor to Moderate, and £29,464 for Moderate to Good (all per year per km of river).

189. The estimated annual value of ecological benefits using this method is in the range £30m to £43m p.a. when the modelled interventions are in full operation.

190. Public health impacts were assessed by comparing modelled storm overflows involving untreated faecal matter against the standards applied to designated bathing waters, assuming that any more than one single spill during the bathing season would lead to failure to achieve good bathing water quality, and further assuming that this would correspond to a maximum of five spills in a whole year (as most spills happen outside the season). The one sixth component of the NWEBS values relating to safety for recreational contact (see above) was used as a unit value to apply to length of river becoming swimmable. It was not possible to relate unit values from other valuation studies (water company customer surveys and studies of bathing waters) to this physical quantity because they typically cover an entire bathing water (e.g., a beach) and/or apply a unit value to numbers of recreational visits or visitors, which are not available for river sites.

191. The estimated annual value of public health benefits using this method is in the range £44m to £63m p.a. when the modelled interventions are in full operation.

192. The social impact of spills was assumed to be correlated with the frequency of spills, which make it more likely that a person would witness a spill or the resulting presence of sewage in the river. It has not been possible to find any valuation work that addresses this issue directly. The most comparable evidence identified in the SOEP was information from water company customer studies relating to pollution incidents. This requires a simplified assumption, here that a 10% reduction in sewage spills would be of equivalent value to a 10% reduction in pollution incidents. Pollution incidents are much more serious than sewage spills but also much less frequent (1,750 occurrences a year compared to 373,000 spills), so this approach values an individual spill as less than 1% of a pollution incident.

193. The estimated annual value of social impact benefits using this method is in the range £138m to £151m p.a. when the modelled interventions are in full operation. This is equivalent to 66% and 56% respectively of the total annual monetised benefits to inland water bodies, so

[60] Metcalfe et al (2012) "An assessment of the nonmarket benefits of the Water Framework Directive for households in England and Wales", Water Resources Research 48(3). Available at https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2010WR009592.

clearly this component is quite dominant, whilst being the proportion estimated with the least confidence.

8.2 Monetised Benefits – Coastal and Estuarine

194. In the previous Impact Assessment ecological benefits due to improvements of storm overflows impacting coastal and estuarine sites had not been quantified. For this Impact Assessment, a multiple non-linear regression of existing data on water bodies (their ecological status, area, number of storm overflows, annual number of discharges, whether sewage was a reason for not achieving good ecological status and whether they were estuarine or coastal) was employed to quantify these benefits. This is a different method to that used to estimate ecological benefits from improvements to storm overflows at inland sites.

195. The regression aimed to estimate the area of water bodies that would change ecological status if spills were limited to ten per year. NWEBS data on the economic value of status improvements for coastal and estuarine bodies per km^2 could then be applied to produce an estimate of the economic value from ecological improvements to coastal and estuarine water bodies. The central estimate of the regression was that there was no economic benefit due to ecological improvements from improving storm overflows. However, the regression did produce a high estimate of £11mn p.a. in ecological benefits.

196. We note that it is unrealistic to expect there to be no ecological benefits due to storm overflow improvements at coastal and estuarine sites. It is a weakness of the model that benefits are only monetised if a waterbody changes status. The regression predicted multiple water bodies improving ecologically, but not sufficiently to change status and therefore enable the monetisation of benefits. In this sense, we may treat ecological benefits as remaining unmonetised for coastal and estuarine sites.

197. Social impact benefits were estimated for coastal and estuarine storm overflows by estimating the spill reduction due to the rainfall target, and then applying the same economic values per spill as for inland storm overflows. Spill reductions relative to 2022 were used for the low estimate of benefits, as 2022 was a dry year with fewer spills. To estimate spill reductions relative to 2021 and 2020, the spill reduction relative to 2022 was inflated by the percentage more spills that occurred in 2021 and 2020 respectively.

198. Spill reductions relative to 2022 at coastal and estuarine sites were multiplied by the low estimate of social impact benefit per spill avoided to obtain the low estimate of social impact benefit which came to £12mn p.a. Spill reductions relative to 2021 and the central estimate of social impact benefit per spill avoided were used for the central estimate of social impact benefit which came to £15mn p.a. Spill reductions relative to 2020 and the high estimate of social impact benefit per spill avoided were used for the high estimate of social impact benefit which came to £17mn p.a.

8.3. Total monetised benefits

199. Summing all three components of monetised benefits over the full appraisal period to 2100, the total 2020 present value of monetised benefits is estimated to be between £3,084m and £3,945m, central estimate £3,444m.

200. Non-monetised benefits and uncertainty in valuation are discussed further below.

Summary and net impact

201. In 2020 present value terms, total costs are estimated in the range £35bn to £57bn, central estimate £46bn. The majority of the costs are the capital costs of network storage (PV £24.6bn to £38.9bn) and associated finance (PV £9.5bn to £15.0bn). Monetised benefits are in the region of one twelfth of the costs (PV £3.1bn to £3.9bn). Net present social value and benefit:cost ratios are shown in Table 8.6.

Table 8.6. Monetised costs and benefits (2020 present value terms)

	Central	Optimistic	Pessimistic
Costs	£46,133m	£35,401m	£56,705m
Monetised benefits	£3,444m	£3,945m	£3,084m
Net present social value	-£42,690m	-£31,456m	-£53,622m
Benefit:cost ratio (BCR)	0.07	0.11	0.05

8.4 Non-monetised benefits

202. The benefits above include impacts on the ecosystem and on the safety of recreational users, plus a broader category of social impact. Some of these monetised benefits may not capture the full value of the benefits considered and some benefits have not been included. This section describes the omitted benefits and issues of possible undervaluation. Finally, it discusses possible switching values, i.e., what would be needed for any omitted and undervalued benefits to generate sufficient additional value to enable total benefits to exceed total costs.

Coastal and estuarine water benefits

203. Public health benefits due to the rainfall target at coastal and estuarine sites have not been monetised. Benefits relating to the bathing water target which go beyond those accrued due to the rainfall target have not been quantified.

204. One previous study appraised a programme of potential improvements addressing public sewage outflows (more broadly than storm overflows which were not considered explicitly) and other sources of pollution (agriculture, local authority, private sewerage) to ensure that 72 "at risk" bathing waters in England would meet sufficient or better bathing water status.[61] A statistically estimated trip generation function predicted that 15% fewer visits would be made to an "at risk" site if it fails to meet sufficient status, and an individual travel cost model estimated a value per visit of approximately £5. These combine to give annual benefits valued at £66.5m across the 72 sites for meeting/maintaining bathing water status. The total annual value can be updated using the GDP deflator to £79.6m in 2022 prices and its present value if sustained over the period 2025 to 2100 can then be calculated to be £1,964 billion.

205. A similar total benefit value arises from applying the 15% reduction in visits and the £5 visit value to recent statistics on visits to England's beaches. There are around 37m day visits to beaches[62] and 20.6m overnight holiday trips to the seaside[63], which might be estimated to include about 70m beach visits (based on the assumption that seaside holidaymakers visit the

[61] Eftec, Ipsos MORI &The South West Research Company (2014) *Bathing Water Valuation Study*. Technical report to the Environment Agency, unpublished.

[62] Kantar, *The Great Britain Day Visitor 2019 Annual Report,* Available at: https://www.visitbritain.org/sites/default/files/vb-corporate/gbdvs_2019_annual_report.pdf

[63] Defra (August 2022) extraction of data, accessed via Kantar, *Visit England survey data*, Available at: https://gbtsenglandlightviewer.kantar.com/ViewTable.aspx .

beach most days of their stay but not every day). The loss of value to these visitors if all beaches were to lose their bathing water status would then amount to almost £80m a year, or £1.953 billion for the whole appraisal period to 2100 and inflating from the study's 2013 values.

206. The condition of bathing waters and the effect on the number of visitors also has important implications for the local economy of seaside towns and villages. The same 2014 study analysed the potential impact on the local economy of each of the 72 bathing waters based on the modelled reduction in visitor numbers. The total impact for all the sites amounted to a loss of gross value added of about £130m a year and a loss of 3,700 full time equivalent jobs. These values cannot be assumed to equate to benefits in a social cost benefit analysis, partly because of the issues of relating storm overflows to visitor behaviour (as mentioned above) and partly because of the difficulty of estimating how much – if any – of these impacts would constitute a net change in the national level of economic activity, as opposed to being a displacement to other locations or other businesses. Still, the potential scale of local impacts is a consideration and particularly relevant in the context of levelling up.

Issues in valuing the monetised benefits

207. There are recognised weaknesses in the established NWEBS valuation method. First, that it probably undervalues damage due to deterioration of water status (asymmetric value of gains and losses). Second, that it is a national average for all water bodies and so may not accurately account for an intervention targeted to higher value water bodies. The second issue is likely to be minor in this appraisal because there is no evidence that the damage caused by storm overflows in aggregate is unevenly distributed between high and low value waters.

208. It is possible that there are additional benefits relating to the risk of deterioration to protected areas (those of special ecological value) that are not captured by the NWEBS approach. This is considered further below under "Tipping points". Simplifying assumptions have been made about the extent of water body adversely affected by spills, namely that impacts are confined to the receiving water body and downstream of the spill in the case of inland water bodies. These appear reasonable as a generalisation based on present understanding but remain a source of uncertainty.

209. For human health benefits, SOEP applied the NWEBS approach with a simplistic one sixth of the maximum benefit value being attributed to the element of safety for recreational contact. Other approaches were considered and did not in fact produce materially different valuations.

210. The main alternative approach to monetising the human health benefits of storm overflow treatment is to consider the extent and magnitude of disease impact that may be avoided by intervention. One study[64] has estimated that 18% of beach visitors enter the water and 17% of those immerse themselves and so may be at risk of infection. Roughly one in 25 of these occasions may cause an episode of gastro-enteritic illness if significant infectious material is present in the water - the combined low probabilities make this an unlikely event. Gastro-enteritis is not the only type of health risk reported in the available studies, but it is by far the most important.[65] Each episode of illness can be valued using studies of willingness to pay to avoid illness or through cost of illness (including loss of earnings and cost of treatment). Based on stated preference, this approach generates total present values in the region of £70m only,

[64] Vivid Economics (2007) "PINS References APP/WQ/04/1829 and APP/WQ/05/2428 – 2433 (inclusive) Proof of evidence of Mr Robin Smale" Available at: https://www.vivideconomics.com/wp-content/uploads/2019/05/Vivid_Econ_Planning_Appendix.pdf

[65] WHO (2018) "recommendations on scientific, analytical and epidemiological developments relevant to the parameters for bathing water quality in the Bathing Water Directive (2006/7/EC)" Available at: https://www.who.int/publications/m/item/who-recommendations-on-scientific-analytical-and-epidemiological-developments-relevant-to-the-parameters-for-bathing-water-quality-in-the-bathing-water-directive-(2006-7-ec)

which is negligible in the context of the costs assessed here. Based on cost of illness[66], the total would be over £3 billion in present value to 2100, although the proportion of that value attributable to the proposed intervention is unknown.

211. The human health or visitor welfare benefits relating to inland bathing waters are inevitably rather low in comparison to those for coastal waters because the number of visitors (and so the number of potential illnesses or adverse behavioural responses to water quality) is relatively low. Based on very limited evidence, it appears that the number of visits to popular river water bathing sites is likely to be in the thousands per site per year, compared to hundreds of thousands for coastal bathing waters. Of course, this is not to belittle the impacts on any individual but the aggregate benefits for inland waters will always be relatively quite small because of the smaller average numbers of visitors.

212. More generally, moving beyond the quantifiable components of benefit value, the high degree of public interest in this issue may tend to support the view that some important aspect of value has not been captured adequately in the appraisal methods used to date, noting that there has been no primary valuation study specifically focused on storm overflows. Valuation approaches typically address the measurable outcomes, but it may be that there is a genuine public value in establishing the principle of eliminating harmful discharge of raw sewage independently of the measurable ecological and public health outcomes. The SOEP findings may support this speculative position, noting the divergence between public acceptability and objective demonstration of absence of ecological damage, in that "Policies targeting river quality outcomes have not generally maintained a high level of public support because spill frequencies can remain high and social acceptability low even though river health outcomes can be proven through modelling and tested by long term monitoring."[67]

Maximum feasible benefits

213. Given the uncertainties in benefit monetisation and the substantial deficit of monetised benefits against costs, it is relevant to consider the scale of physical quantified benefits that would be needed to tip the balance to deliver a positive net present value for the proposed intervention and a BCR greater than one).

8.2 To some degree, the benefits for coastal and estuarine bathing waters can be considered separately. On the cost side, addressing storm overflows that discharge to coastal and estuarine bathing waters is estimated to cost £2,550m in present value terms (range £1,967m to £3,133m) or average annual costs £50.6m (£39.2m to £61.9m). As set out above (in paras 204 and 205) the potential benefits of a nationwide improvement in bathing water status, or an avoided deterioration, or any equivalent change in visitor numbers or welfare value per visit, were assessed Monetised Benefits - Inland

214. to be in the region of £2 billion in present value terms. Therefore, the scale of intervention and currently estimated costs specifically for coastal and estuarine waters would be justified if the effect of improving or protecting those waters were to deliver something similar to the assumption set out above where avoided storm overflows leads to an avoided reduction of 15% fewer seaside trips.

[66] Vinson (2012) "Towards estimating the economic burden of waterborne illness in Canada" Available at: https://www.researchgate.net/publication/322869281

[67] Stantec (2021), *Storm Overflows Evidence Project*, 3.8. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf.

215. Moving on to the wider assessment of all storm overflows (mostly to inland waters), it is relevant to consider the three benefit categories: ecological, human health and wider social benefits. These would be set against the estimated total costs of 2020 present value £46 billion (central estimate).

216. On ecological impact, an immediate comparison is the estimated gross present value benefit of delivering the objectives of the river basin management plans as assessed by the Environment Agency.[68] This appraisal includes the benefits of preventing deterioration, delivering protected areas objectives, improving ecological status or ecological potential, and groundwater quantitative and groundwater chemical status. The valuation approach is based primarily on NWEBS. The measures to deliver these benefits are wide-ranging and involve several sectors, as well as storm overflows (arguably based on little data at the time) and continuous treated wastewater discharges. Adjusted to 2021 prices and population, and for the appraisal period to 2100, the benefits of that comprehensive set of outcomes from many interventions would amount to £39 billion in total present value.

217. The river basin management plan appraisal is focused on improvement. An alternative perspective on storm overflows is to consider them as a risk of deterioration. Based again on NWEBS values, the total present value to 2100 of avoiding deterioration of all England's water bodies from their current status to Bad status (the lowest) would be about £60 billion. Again, many other polluters and pressures in addition to foreseeable levels of storm overflows would need to be involved to cause such an extreme outcome.

218. NWEBS is heavily focused on the value of in-channel effects and the condition of river banks, and largely assesses a national average water body. Additional valuable benefits may arise where storm overflows damage or threaten sites of special ecological importance, although there are no readily available methods to assess those impacts quantitatively or to value them. One source of perspective on special sites is a study on the value of special sites[69], including those involving water. The study includes SSSI habitats of all types including separately these types which may be susceptible to storm overflows: Rivers and streams; Canals; Standing waters; Bogs; Fen, marsh and swamp; and Coastal and flood plain grazing marsh. For each type of site, the study estimates benefits in several categories covering all identifiable ecosystem services with values that can be monetised. The total value of maintaining the current level of these benefits (compared to allowing them to deteriorate without public funding) is estimated around £340m a year. Of this total, only a proportion could credibly be assumed to be affected by storm overflows as other pollution would drive some of the deterioration. If the whole of this value were at risk from storm overflows alone, then the present value to 2100 of potential benefit would be £4.377 billion. This may be a potential omitted or undervalued benefit but clearly amounts to at maximum less than a tenth of the costs of the proposed intervention.

219. On human health impacts, SOEP applied NWEBS values. The main alternative approaches would be stated preference (people's willingness to pay to avoid illness), quality adjusted life years (QALYs), and cost of illness (treatment costs plus loss of earnings whilst ill). About 3.5m

[68] Environment Agency (2015) "Impact assessment: Update to the river basin management plans for England's water environment", Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/500583/Impact_assessment_update_to_the_RBMPs_for_England_s_water_environment__2015_.pdf

[69] Christie and Rayment (2012) "An economic assessment of the ecosystem service benefits derived from the SSSI biodiversity conservation policy in England and Wales", Ecosystem Services 1. Available at: https://www.sciencedirect.com/science/article/pii/S2212041612000095

adults (16 and over) participate in open water swimming in any year[70], including all outdoor swimming except pools or lidos, with the majority likely to be in seawater.

220. Based on standard values and available relevant studies of gastro-enteritic illness, the costs of the proposed storm overflows intervention would be justified on human health grounds alone by either: 78% of open water swimmers having a one week long episode of illness per year based on QALY value, 32% of open water swimmers having an episode of hospitalisation based on cost of illness. The actual incidence of these events is not known but is certain to be very much smaller than these tipping points, so avoiding episodes of illness can justify only a very minor part of the total costs of the proposed intervention.

221. On the "social costs", where knowledge and visibility of storm overflows causes public concern about river health, public health, aesthetics, and the proper operation of wastewater infrastructure, without reference to the quantifiable impacts on ecology or human health this accounts for the majority of the benefits monetised. This component has not previously been investigated in valuation studies or the companies' studies of customer preferences. The SOEP highlighted the social harm had the most uncertain and unvalidated of the benefits it considered. There is evidence that public perceptions have shifted since the SOEP was undertaken: untreated sewage is now seen as the biggest cause of river pollution in the eyes of the public (paragraph 45). At this point we do not know what values might emerge from a new investigation of storm overflow valuation, which would need to be based on new and emerging factual evidence of the extent of storm overflows compared to other pollutants. If monetised benefits of the "social cost" element alone were roughly 20 times greater than currently estimated, this would lead to a BCR of 1. The 'social cost' was estimated using data which pre-dates the increased awareness of storm overflows since 2020.

222. Benefits associated with avoiding the risks of damage from microplastics and antimicrobial resistance in storm overflows cannot be quantified or monetised. These and similar emerging risks are important considerations but there is minimal evidence of the contribution that controlling storm overflows might play in mitigating them or the value of such intervention.

223. Storm overflow solutions that better manage surface water (like SuDS – see paragraph 21) have a host of other co-benefits that need to be taken into account. The largest one, greater than the currently monetised social benefit, would be the reduction in flood risk. Other co-benefits include the increase in amenity values, gains in biodiversity, benefits to air quality and benefits for climate change adaptation and mitigation. Not only are these benefits significant, but seeking to deliver these co-benefits opens the door to co-funding, and so lowering overall costs on water bill payers. See paragraph 20 for the water company long-term planning approach to deliver co-benefits and reduce costs on consumers.

224. **In conclusion,** there is a large number of non-monetised benefits, each with a significant range of potential benefit values. In this section we have considered each category of benefit separately. In reality, several or all of these benefits could arise simultaneously, each of them increasing the overall benefit. The number of individual non-monetised benefits, and the ranges of potential benefit values are such that it is not possible at this stage to say with any certainty whether the overall policy would have a BCR above 1 if all the identified benefits could be fully monetised.

[70] Defra (August 2022) extraction of data, accessed via https://activelives.sportengland.org/Home/AdultData adults participated in open water swimming in the past year (average of five six-monthly surveys)

9. Direct costs and benefits to business calculations

Equivalent annual net direct cost to business

225. The direct impact of the Plan's targets would apply to the nine combined water and sewerage companies supplying sewerage services in England. The companies would carry out a programme of capital investments over 25 years with associated minor operating costs for the whole appraisal period. The investments would require financing by some combination of equity and borrowing and the financing costs are included in the estimated costs.

226. Equivalent annual net direct cost to business (EANDCB) is estimated at £1,597 million over the period 2025 (capital investment commences) to 2100 (end of the appraisal period). These figures are derived from the BIT calculator (March 2022 version) and are rebased there to 2019 prices and 2020 present value base year. Table 9.1 gives full summary figures from the BIT calculator.

Table 9.1. Costs and benefits rebased in Business Impact Target Assessment Calculator (2019 prices, 2020 present value) £million

	Best estimate	Low	High
Total costs	46,133	35,401	56,705
Monetised total benefits	3,444	3,084	3,945
Net benefit	-42,690	-53,622	-31,456
Average annual costs	1,034	795	1,271
Average annual benefits	159	143	183
Equivalent annual direct impacts on business			
Costs	1,597		
Benefits	0		
Net cost (EANDCB)	1,597		
Appraisal period	76 years		
Business net present value	-44,930		

10. Risks and assumptions

10.1 Assumptions:

Cost assumptions

227. Costs applying to the sewerage industry and their onward transmission in equivalent customer bill amounts have been estimated according to central government economic appraisal methodology and Defra's analysis. They should not be taken as presuming any particular regulatory approaches or decisions by Ofwat in the five periodic reviews of industry

prices covering the target timescale, or necessarily as being a thorough representation of the price-setting process.

228. There are various assumptions that were made in assessing costs for the purposes of this IA both by Stantec for the SOEP and in reaching the final costs outlined in Section 8 above.

229. 30% of storm overflows were not modelled in the SOEP and a multiplication factor of 1.3 was applied to allow for these. This is an average within a range of uncertainty of between 20 and 40% and applies nationally. However, given available data at the time of the project, some companies may require less uplift as more complete data was available to the consultants and therefore regional investment figures may either be over or underrepresented affecting regional investment to an unknown degree. However, it is not anticipated that this would materially affect the final analysis.

230. The estimated capital costs may omit some elements such as water company management and overheading, as well as land purchase or rental where that may be required.[71] However, the cost range is wide and is believed to allow for costs in addition to direct construction costs. The consultants have indicated that the basis of total cost estimates is similar to that used by companies in the Drainage and Wastewater Management Plans.[72]

231. The assumption of a universal requirement for network storage solutions may overstate the total capital costs. Reduced costs could be possible where management approaches could reduce or eliminate the need for storage. This may be the case where storm overflows are caused wholly or partly by maintenance issues, blockages, mechanical/electrical failures, or blockages caused by materials flushed inappropriately by customers into sewers.[73] The project noted that hydraulic network models explain approximately 74% of measured spill incidents.[74]

232. Some storm overflow operation is caused by groundwater and rainwater infiltration. It is not clear from the data and modelling currently available whether this would tend to increase or decrease the national total capital costs of delivering the Plan.

233. Taking all the above together, it is not clear whether the central capital cost estimate is more likely to be an under- or over-estimate. There is some confidence that the cost range does cover the likely outturn. In contrast to many appraisals of large capital projects, optimism bias is not considered relevant here because the cost of network storage construction and delivery are well understood, although with wide site-specific variations. It remains essential that companies and regulators keep cost under review as part of the plan implementation. The government will review the Plan in 2027.

234. The above central analysis assumes that investments in improving the sewerage system would be phased evenly over the 25 years or five Asset Management Periods to 2050. As well as the approach based on network storage alone, the SOEP also appraised solutions that applied different scales of sustainable drainage, replacing impermeable surfaces with permeable ones to reduce storm run-off and reduce the need for extra storage. These

[71] Stantec (2021), *Storm Overflows Evidence Project*, 3.31. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf.

[72] Stantec (2022). *Storm Overflows Evidence Project*, pers commun.

[73] Stantec 2021, Storm Overflows Evidence Project pp2.4. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf

[74] Stantec 2021, Storm Overflows Evidence Project pp3.12. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf

solutions were estimated at national level to be significantly more expensive on the assumptions used, with extra costs that were only partly justified by co-benefits for the urban environment. However, they are likely to be appropriate in some particular cases. Detailed methodology and estimates of costs and benefits are available but are not presented here.[75]

235. For comparison, the SOEP also estimated the cost of eliminating storm overflows by full separation of rainwater from sewage.[76] This was modelled as replacement of all combined sewers (138,000km) with a new sewer (of same size and depth) leaving the original combined sewer for rainwater and the new sewer for wastewater. Total capital cost was estimated in the range £350 billion to £600 billion. This approach would involve substantial additional costs arising from the disruption caused by excavations on a major scale and installation of connections for every property to the new sewer.

236. Embedded carbon costs are monetised and included in total costs but are not included in costs to business or in the EANDCB calculation (i.e., effectively they are treated as costs to households or government). This is due to uncertainty about how embedded carbon relates to the carbon neutrality commitments and mechanisms appropriate to the sewerage sector over the appraisal period. The assumptions made about carbon do not allow for innovation and the development of low carbon products in the future.

Benefit assumptions

237. One-half of the total NWEBS value above is applied to river health improvements. This is in line with previous work in this area which assumes that three of the six components considered in NWEBS (fish, invertebrates, plants) are potentially improved. The length of water body improved is 50% of the actual water body length allowing for a distribution of storm overflows throughout the water body. The approach does not claim any benefits from consequential improvement in the condition of downstream water bodies and so may understate the ecological benefit.

238. In contrast, the approach assumes that eliminating harm from storm overflows is sufficient to improve the ecological quality of affected water bodies, which does not account for the possible existence of other sources of pollution or ecological harm (Stantec 2021 pp3.15-3.18). This means that the NWEBS valuations may be an overestimate of the technically measurable value of water body status improvements attributable to addressing storm overflows alone.

239. The project did consider scenarios where storm overflows were addressed to more stringent standards in locations known to be close to designated sites such as SSSIs and SACs. This makes it possible to cost programmes of work to target these sites but there was no methodology available to value the additional benefits of doing so.

240. Discharges from storm overflows carry other pollutants which are not considered, such as microplastics, metals, hydrocarbons, and nutrients. The impact of these pollutants is chronic (builds up over time) whilst this assessment of river health is focused on the acute (short lived)

[75] Stantec 2021, Storm Overflows Evidence Project. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf

[76] Stantec 2021, Storm Overflows Evidence Project pp3.28-3.29 Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf

impacts of recurring low oxygen and high ammonia known to be toxic to aquatic life and the basis on which storm overflow have been managed historically.

241. When calculating benefits of reductions in spills at coastal and estuarine sites, it was assumed that the value of social impact benefits per spill avoided at these sites would be the same as at inland sites.

10.2 Other risks and assumptions:

Uncertainty in cost of delivery:

242. As described in Section 8, the costs of delivery of the targets are uncertain. While the SOEP provides a national level assessment of the amount of storage required to meet the targets, this has several key limitations. One limitation is that the modelling has high degrees of uncertainty in their ranges. Costs for the whole suite of targets as set out in the Plan range in 2020 PV terms from a low estimate of £35bn to a high estimate of £57bn The IA includes a number of evidence-based assumptions related to delivery which are outlined in Section 10.1 above, but high degrees of uncertainty remain. It is also challenging to apply a national level modelled assessment of storage requirements, with what will happen on the ground once these targets are to be delivered and specific analysis at a granular level of what the best value solutions for each specific storm overflow will be is available. As our knowledge increases, in the future there might be a need to consider whether UPM standards require updating.

243. There is also high regional variability in delivering the targets. Three water companies (Yorkshire Water, Wessex Water and United Utilities) currently would require approximately 75% of the investment required with the other 6 water and sewerage companies in England making up the remaining 25%. This means that there will be varying levels of investment across the regional monopoly water and sewerage companies that needs to be carefully handled as it will be funded primarily through consumer water bills. The government will keep these targets under review, reviewing the targets in 2027 when greater regional investment data is available to ensure costs are manageable.

Impact on water industry achieving Net Zero targets:

244. Depending how water companies choose to meet the targets in the Plan, there may be high carbon costs associated with building new infrastructure. However, government expects water companies to prioritise a natural capital approach, considering carbon reduction and biodiversity net gain, as well as catchment-level and nature-based solutions that have lower carbon impacts, in their planning where it is cost effective to do so.

245. Storage and subsequent treatment of additional sewage will increase the loadings of phosphorus being treated at wastewater treatment plants which will make the Environment Act target on wastewater harder to achieve.

246. There may be changes to the proportion of road run-off which is treated at wastewater treatment sites versus the amount discharged directly to water bodies. This run-off contains a range of hazardous pollutants, and the impacts of this change are not well understood.

Accounting for changing climate science:

247. There are also some uncertainties around figures used to account for the future pattern of rainfall in the analysis as figures used for the SOEP are currently being revised following more

input data for the rainfall model to 2050. This revision will lead to increased costs as additional intervention will be needed for appropriate calibrations.

248. Testing of the revised tool has been undertaken across a small sample of catchments which shows that discharges from storm overflows might increase by between 10 and 40% over and above the existing methodology but the change is not universal and hard to predict or generalise. This means a comprehensive national picture is not yet available but will be in the future.

249. This revised rainfall data could mean that the investment required to reach the targets is increased and the fact that some data is already differing from that underlying current Water and Sewerage Company planning processes reflects a fast-moving area of research that has a fundamental impact on storm overflow operation. This is an area where the impact on cost assumptions and deliverability should be kept under review as the targets' life cycle progresses.

Accounting for changes in definition of local adverse ecological impacts:

250. The definition of 'no local adverse ecological impact' is based on the Urban Pollution Manual Fundamental Intermittent Standards (as described in Section 3.1). This is the best currently available metric for local adverse ecological impact, but the science may change and become more stringent over time. This is an unknown variable but could impact on the design of schemes and therefore overall cost. Any change in this standard will be considered through the regular review points of the targets.

Deliverability:

251. We have set targets which we think are deliverable based on engagement with Industry and trade bodies. However, some concerns remain about deliverability of the targets and the supply chain surrounding the water industry will also be impacted in the delivery of the targets within the Plan. This supply chain mainly includes materials and labour for water company internal capabilities, the engineering profession, environmental consultancies, and the construction industry, amongst others.

252. In the consultation on the proposed targets, water industry stakeholders did raise supply chain capacity as a potential risk to delivery given the size of the programme.[77] However, it has not been possible to fully quantify this risk at this stage beyond anecdotal evidence. Going further with the targets now would increase the risk, which is why we added a review point in 2027. It is likely that, given a proposed investment for storm overflows per PR cycle (assuming an even investment) will be approximately three times greater than the previous cycle, PR19 (which totalled £3.1bn, including work for the Thames Tideway tunnel) the supply chain will need to expand to be able to deliver these targets.

253. Ofwat has engaged with water companies and secured public commitments for discharge reductions that companies will achieve by 2025. This may help companies to prepare their supply chains for increasing investment from 2025 onwards and mitigate this risk. Ofwat also has transitional funding available for companies to use in the current PR cycle, which could also help companies to prepare their supply chain. £1.7bn of investment on storm overflows has been accelerated, contributing to a smoothing out of the supply chain increases which are

[77] In their response to the Consultation on the Government's Storm Overflows Discharge Reduction Plan, the Chartered Institution of Water and Environmental Management (CIWEM) estimated the workforce might need to increase in size by at least three times and also extend its skills and capability to deliver the targets.

required.[78] As the construction supply chain will need to mobilise materials and labour to deliver these targets, it is anticipated that this will create opportunities for employment and economic growth across England.

11. Impact on small and micro businesses

254. The major direct impacts on business are those on the water companies, which are all large businesses. Their direct costs would be passed through the regulatory price review process on to customers through the sewerage component of their water bills. The customers affected by this secondary, indirect impact would include households and businesses of all sizes.

255. There will also be impacts of construction work to the public and to businesses such as high streets as a result of the targets. These impacts have not been considered in detail, but we are aware that street works and congestion can have a significant impact on businesses. The government would expect water companies to take account of these costs as part of options appraisals.

12. Wider impacts

256. Actions to improve the water environment will touch on many other sectors and environmental outcomes, as water provides an essential ecosystem on which biodiversity, fish and plant life depends.

Nature and Biodiversity

257. Good water quality is essential for thriving biodiversity. Eliminating the ecological harm caused by storm overflows could contribute to restoring biodiversity. There are multiple pressures on the water environment and in many rivers, storm overflows will not be the only contributing factor to ecological damage. It will require action on multiple fronts in order to achieve nature recovery.

258. Targets on storm overflows are linked to specific locations. Where these sites overlap with areas of interest for biodiversity delivering the targets in the Plan will contribute to achieving biodiversity targets.

Climate change and sustainability

259. The Plan clearly sets out the government's expectation that water companies consider green-blue infrastructure solutions in order to deliver the targets. This includes nature-based solutions. Nature-based solutions will deliver co-benefits for biodiversity and Net Zero. The use of nature-based solutions to achieve the water targets may also provide positive co-benefits for climate change adaptation and mitigation, depending on the solution used. Equally, the SOEP demonstrated that irrespective of these solutions pursued by water companies, significantly reducing discharges from storm overflows will result in increased carbon emissions.

Marine

260. Rivers act as conduits for plastics as well as nutrients, sediments, and a wide range of other persistent and emerging contaminants to coastal and estuarine waters and the ocean. By taking action to achieve the targets in the Plan, there will be a reduction in pollutant loads

[78] https://www.ofwat.gov.uk/regulated-companies/price-review/2024-price-review/accelerated-investment-delivery-project/

flowing into marine waters. Marine Protected Areas have also been prioritised for early action, furthering the protection for these areas.

People/behaviour

261. People interact with the water environment in a number of ways, including recreationally. Improving the water environment may improve human health and wellbeing by increasing engagement with blue spaces. Determining how much people value this engagement and availability will impact the viability of some of the actions to achieve the targets and improve the water environment further. Reducing the frequency of storm overflow incidents will lead to an increase in amenity value of Bathing and Recreational Waters.

13. A summary of the potential trade implications of measure

262. The water and sewerage industries in Britain are non-traded sectors and impacts on them are not expected to have any international trade implications.

14. Monitoring and Evaluation

Monitoring:

263. The impact of the targets will be objectively monitored using a combination of additional monitoring of the water quality impacts of storm overflows as legislated for in the Environment Act 2021 and by using the existing monitoring and evaluation framework of the Environment Agency for assessing storm overflows and their impacts.

264. Section 141DB of the Water Industry Act 1991 (as inserted by the Environment Act 2021) requires water and sewerage companies to monitor the impacts that their discharges are having on the environment, requiring them to install monitors upstream and downstream of the discharge at riverine sites that measure key environmental markers including dissolved oxygen, ammonia, turbidity, pH and temperature. This will give a detailed understanding of the impacts that storm overflows are having on riverine waters and allow the water industry to assess whether their modelled upgrades have been successful in eliminating the ecological harm of a storm overflow. This may be more difficult to discretely ascertain in areas where there are multiple inputs, such as from agriculture that are also impacting the ecology of the river but will provide a lot of additional data that can be used to identify where these inputs may also be having an effect.

265. Monitoring of discharges has also increased dramatically since the programme began in 2013. Section 141DA of the Water Industry Act 1991 (as inserted by the Environment Act 2021) requires Event Duration Monitors to be installed by water companies at the vast majority of storm overflows and for these to report their data in near real time.

266. This monitoring data gives sight to the public and regulators of the scale of the challenge. Currently, 91% of storm overflows have Event Duration Monitors and the water industry has committed to monitoring all storm overflows by the end of 2023. This will allow water companies to report the frequency and duration of spills to the Environment Agency each year. The Environment Agency will assess this data and prioritise storm overflows for investigation that spill most often. This will also allow clear assessment against elements of the targets that assess impact using discharge limits such as the public health at bathing waters target and the minimum discharge standard.

267. The main external factors that may have an impact on success of the intervention will be supply chain and water industry capacity to install large scale solutions and the cost to industry. The ambition of the targets has been set to balance the impact on consumers with the need for action in this space but if costs are greater than those modelled to deliver these targets, then either the cost to the consumer would increase or the timeline for delivery of the targets would have to be reviewed. The regular review cycle built into the Plan will be the opportunity to assess the real-world data that has been submitted as part of PR24 water company business plans to achieve these targets and test this against the modelled costs. Schemes included in water company business plans will also be scrutinised for efficiency by Ofwat as the economic regulator.

268. Rainfall and future development will also be a key factor for the water industry to consider when designing schemes. The targets will be regulated through legally binding permits issued by the Environment Agency, and discharge limits will be included in those permits. Therefore, if individual water companies are to remain compliant in their permits, they will need to keep any schemes under review and design them to cope with future pressures, such as from development or increased rainfall as a result of climate change. To do this, the Environment Act requires water companies to produce Drainage and Sewerage Management Plans, which companies will use to map challenges for their networks over a 25-year planning horizon. The government will also retain a power of direction for these plans, so there is sufficient oversight and planning being put into schemes to achieve these targets as they go forward.

Evaluating progress to achieving the targets:

269. By using a combination of Event Duration Monitoring and water quality monitoring, it will be easy to assess the success and progress of each target objectively.

270. For the ecology target, by 2035, upstream and downstream monitoring should be installed to clearly show whether a storm overflow is having an ecological impact as these will be compared against the UPM standard. This will be supplemented with Event Duration Monitoring to ensure that the discharge standard does not exceed 10 spills per year on average.

271. To protect public health at bathing waters, Event Duration Monitoring would be assessed, and this would be compared against the Environment Agency baseline of acceptable spills during a bathing season for each classification of Bathing Water (3 for good, 2 for excellent and to be confirmed in 2022 (but expected to be 2 or less) for an inland bathing water). It will be clear to see if schemes have been successful when judged against these metrics.