The background features a large, abstract graphic composed of overlapping, semi-transparent blue polygons in various shades, ranging from light sky blue to deep navy blue. The shapes are arranged in a way that creates a sense of depth and movement, with some shapes appearing to recede into the distance while others come forward.

TA.12.WW07 Flooding and Pollution Strategies Business Case

September 2018
Version 1.0

1.Executive Summary

Name of business case	WW07 Flooding and Pollution Strategies
Context	We are on track to achieve our promise to protect customers' homes and businesses by reducing internal sewer flooding incidents by 25% in AMP6. However, our performance was only industry average for 2016-17. For external flooding (including severe weather), our 2016/17 performance was in Quartile 3 at 5,746 incidents and this improved to 4,724 incidents in 2017/18. Our performance for Category 1 to 3 pollution incidents has improved by 60% moving from Quartile 4 in 2013 to average in 2017. We have met and beaten our promise to customers to reduce pollution incidents by 50%. We will not achieve the level of performance our customers would like in AMP7 without a further step change in our approach.
Customer and stakeholder views	Customers and stakeholders expect us to 'do the basics brilliantly' and improve our assets to protect the environment from pollution and protect their properties from flooding.
Our aim	<ul style="list-style-type: none"> a) We aim to deliver Quartile 1 performance for internal flooding and pollution incidents b) We are targeting a 40% reduction in pollution incidents by 2024 in comparison to our performance in 2016 c) We aim to improve to industry average for external flooding d) Combining improved analytics with intelligent flow meters and monitors to create a smart network will enable us to detect, respond to and resolve potential flooding and pollution incidents before they impact on our customers and the environment.
Scope of this business case	Enhancement investment to implement our flooding and pollution strategies to meet the expectations of our customers and regulators.

	Internal Flooding¹	External Flooding	Pollution
Totex (£'m)	£10.2m	£5.8m	£10.7m
Opex (£'m)	£5.7m	£0m	£0.4m
Capex (£'m)	£4.5m	£5.8m	£10.3m
Residual, post-AMP7 capex (£'m)	-	-	-
20-year Whole life totex (£m)	£56,682	£3,194	£113,659
20 year cost benefit (£m)¹⁸	-£0.006m	-£70.6m	-£40.2m
Materiality (% 5 year Totex of Wastewater Networks Plus)	0.4%	0.2%	0.5%

¹ See Table 4

Relevant business plan table lines	WWS2 30 and WWS2 77 in TA.12.WW04 Sewers and Rising Mains	WWS2 30 in TA.12.WW04 Sewers and Rising Mains	WWS2 33 and WWS2 80 in TA.12.WW02 Network Pumping Stations
Enhancement for our flooding strategy			
Need for enhancement / investment	We need to improve our internal flooding performance to Quartile 1 and external flooding performance to average to meet our customers' and regulators' expectations.		
Overview of AMP7 proposals	Our investment includes enhancement to implement our flooding strategy through: 1) sewer level monitoring to support intelligent sewers (£1.3m) 2) predictive modelling of flooding (£2.7m) 3) extending our sewer misuse education campaigns (£1.7m) 4) SuDS and partnership schemes (£1.7m enhancement) 5) internal flooding mitigation – existing issues (£2.8m) 6) external flooding mitigation measures (£5.8m)		
Why the proposals are the best programme-level option for customers	<p>We have assessed five options for our internal flooding strategy:</p> <p>FI1 = Base Expenditure over AMP6 (See TA.12.WW04 Section 5.1, 9 incidents reduced per annum) – Low cost but low level of performance</p> <p>FI2 = Beyond Upper Quartile (£27.3m + Base, 57 p.a.) – Least performance risk, but high impact on bills</p> <p>FI3 = Zero Flood Zones (£12.5m + FI1, 32 p.a.) – Jetting and CCTV focused on high blockage zones. Reasonable cost but repeating standard activities and no focus on long term innovation.</p> <p>FI4 = Intelligent Sewers (£14.8m + FI1, 34 p.a.) – Reasonable cost but higher risk that innovative activities will not achieve benefits</p> <p>FI5 = FOG Education, Intelligent Sewers and SuDS (£10.2m + FI1, 34 p.a.) – Our preferred option is a mixture of cost effective activities for an affordable cost in AMP7</p> <p>We have assessed four options for our external flooding strategy:</p> <p>FE1 = Do Nothing (£0m) – Unacceptable performance for customers</p> <p>FE2 = Average performance (£5.8m , 30% reduction) – Our preferred option for a step change in performance at an affordable cost</p> <p>FE3 = Quartile 2 performance (£7m, 35% reduction) – High cost</p> <p>FE4 = Quartile 1 performance (£8.6m, 40% reduction) – Too high cost</p>		
Customer and stakeholder support	Our customers and stakeholders have asked us to do more to reduce internal and external flooding		
Need for a CAC	Not applicable		
Extent of management control (if relevant)	The required Quartile 1 performance for internal flooding incidents will be influenced by ourselves and other water and sewerage companies		
Robustness and efficiency	We have assessed costs and benefits from a range of activities to reduce flooding. We have selected lower cost options and accept a higher level of performance delivery risk, which protects customers.		

Customer protection (if relevant)	Our ODI for internal flooding incidents will protect customers from non-delivery of this enhancement investment
Affordability considerations	We have assessed whole life costs over 20 years for all internal and external flooding options. Preferred internal flooding option FI5 has the lowest whole life cost and would be affordable in AMP7. For external flooding, Option FE4 has the least whole life cost but would be unaffordable to our customers in AMP7 in comparison to our preferred Option FE2.
Board assurance (if relevant)	This enhancement business case has been externally reviewed by Jacobs, with no material exceptions identified
Enhancement for our pollution strategy	
Need for enhancement / investment	We need to improve our pollution performance to Quartile 1 performance to meet our regulators' and customers' expectations
Overview of AMP7 proposals	Our investment includes £10.7m of enhancement to implement our pollution strategy through: <ol style="list-style-type: none"> 1) installing flow meters at WPS that have no meters (£2.9m) 2) conditional alarms, criticality based enhanced maintenance (£3.3m) 3) smart pump activities to improve resilience at high risk sites and reduce power consumption (£4.1m) 4) targeting education campaigns on fats and wet wipes in sub-catchments where pumps are frequently blocked (£0.4m)
Why the proposals are the best programme-level option for customers	We have assessed five options for our pollution strategy: <p>PO1 = Base Expenditure over AMP6 (see TA.12.WW02 Section 5.1 , 9 incidents reduced per annum) – Low cost for low level of performance</p> <p>PO2 = Beyond Upper Quartile (£23m + Base, 29 p.a.) – Very high cost</p> <p>PO3 = Focus on Pumps (£14.4m + Base, 22 p.a.) – Standard activities</p> <p>PO4 = Focus on Blockages (£8.7m + Base, 16 p.a.) – Focus on sewers</p> <p>PO5 = Innovation, Reduced Flow and FOG Education (£10.7m + Base, 18 p.a.) – Our preferred option tackles several causes of pollution at an affordable cost</p>
Customer and stakeholder support	We have a responsibility to protect and improve the environment, and our customers, stakeholders and regulators rightly expect us to do this. Our plans for AMP7 aim for a 40% reduction in pollution from a 2016 baseline, supporting the Environment Agency's strategic ambition.
Need for a CAC	Not applicable
Extent of management control (if relevant)	The required Quartile 1 performance for pollution incidents will be influenced by ourselves and other water and sewerage companies
Robustness and efficiency	We have assessed costs and benefits from a range of activities to reduce pollution. We have selected lower cost options and accept a higher level of performance delivery risk, which protects customers.
Customer protection (if relevant)	Our ODI for pollution incidents will protect customers from non-delivery of this enhancement investment

Affordability considerations	We have assessed whole life costs over 20 years for all options for our pollution strategy. Our preferred Option PO5 has the least whole life cost and is affordable for our customers in AMP7.
Board assurance (if relevant)	This enhancement business case has been externally reviewed by Jacobs, with no material exceptions identified

Performance Commitments supported by this business case		
PC	How relevant is this business case?	Comment
Pollution incidents	High	Enhancement to aim for Quartile 1 performance
Internal flooding incidents	High	Enhancement to aim for Quartile 1 performance
External flooding incidents	High	Enhancement to aim for average performance

Schemes and scheme-level options			
Schemes over £20m	Options		
	Description	Cost	Selected option and rationale
None			

Contents

1. Executive Summary	2
2. Scope of Technical Annex	8
3. AMP6 Strategy.....	9
3.1. Investment Strategy	9
3.1.1 Flooding Reduction Strategy	9
3.1.2 Pollution Reduction Strategy	11
3.2. Customer Benefits and Resilience	12
3.2.1 Internal Flooding Incidents	12
3.2.2 External Flooding Incidents	13
3.2.3 Pollution Incidents	14
4. Drivers for Change.....	16
4.1. Customer and Stakeholder Views	16
4.2. Future Trends and Pressures	18
5. AMP7 Strategy.....	19
5.1. Investment Strategy	19
5.1.1 Internal Flooding Investment Strategy	19
5.1.2 External Flooding Investment Strategy.....	22
5.1.3 Pollution Investment Strategy.....	24
5.1.4 Medium and Long-Term Proposals	26
5.2. Innovation.....	28
5.3. Customer Benefits and Resilience	33
5.3.1 Internal Flooding Incidents	34
5.3.2 External Flooding Incidents	34
5.3.3 Pollution Incidents.....	35
5.3.4 Resilience	36
5.4. Value for Customers	37
6. Costing Strategy	38
7. Key Risks and Opportunities.....	38
7.1. Risks.....	38
7.2. Opportunities	39
8. Appendix 1: List of Named Schemes	39
9. Appendix 2: Further Information.....	39
9.1. Benefits of Internal Flooding Reduction Activities.....	39

9.2. Benefits of External Flooding Reduction Activities 40

9.3. Benefits of Pollution Reduction Activities 40

2. Scope of Technical Annex

This technical annex sets out the enhancement investment we propose to meet our AMP7 flooding and pollution reduction objectives. The total investment is £26.7m. It is comprised of:

- £10.2m on our internal flooding strategy to aim for Quartile 1 performance
- £5.8m on our external flooding strategy to improve to average from Quartile 3
- £10.7m on our pollution strategy to target Quartile 1 performance

Our internal and external flooding reduction investment forms part of [TA.12.WW04 Sewers and Rising Mains](#), while our pollution reduction investment forms part of [TA.12.WW02 Network Pumping Stations](#). This annex describes the enhanced activities and option assessment for these areas. Figure 1 sets our proposed flooding and pollution reduction investment within our total PR19 Wholesale Plan. £26.7m represents 1.1% of the Wholesale Wastewater Networks + Plan of £2,374m.

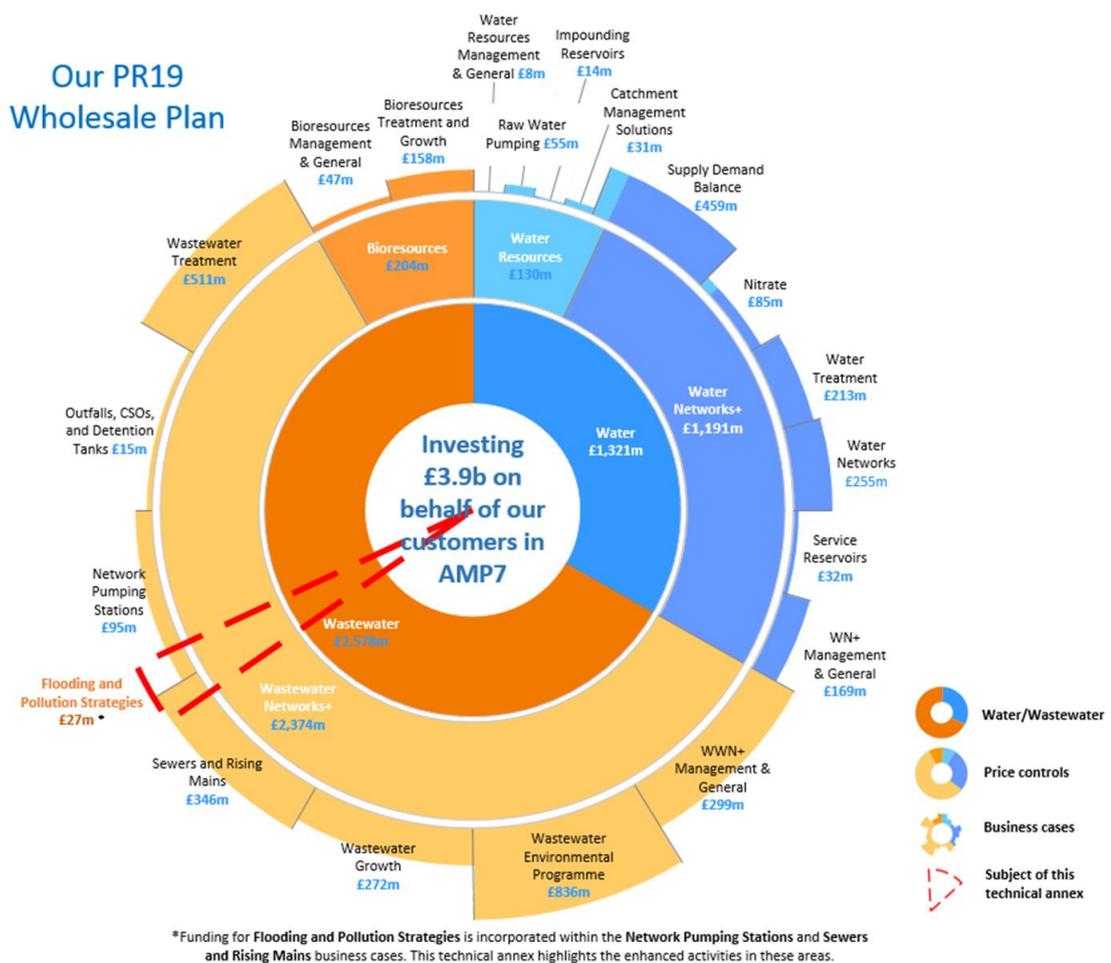


Figure 1: Our PR19 Wholesale Plan²

² Business case investment data (Gold Lockdown 4, SW, 2018)

3. AMP6 Strategy

3.1. Investment Strategy

3.1.1 Flooding Reduction Strategy

For AMP6 we promised to cut internal sewer flooding incidents by 25%³. We are on course to meet that promise.

Our focus during AMP6 is on tackling blockages, the cause of nearly three quarters (73%) of all such incidents (see Figure 2).

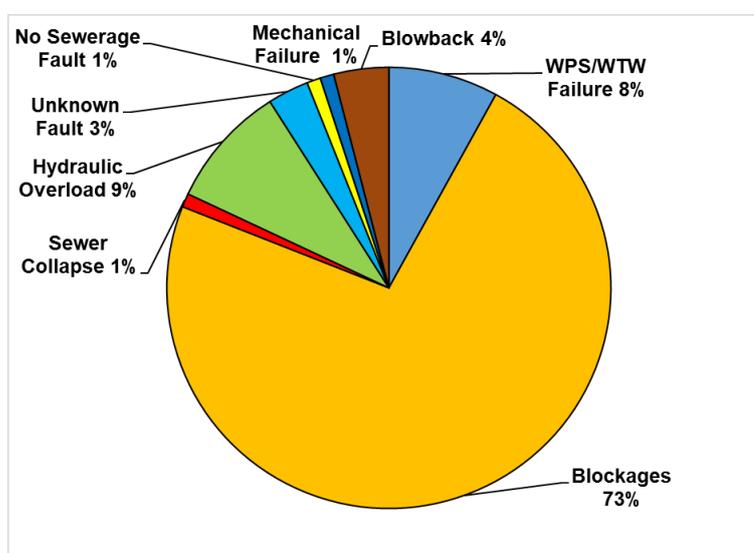


Figure 2: Root Causes of Internal Flooding (Average of 2013-14 to 2016-17)⁴

We are improving the quality of our data and analysis of external sewer flooding causes, as a lower investment priority in AMP6 our root cause analysis is more limited than for internal flooding. We estimate that external sewer flooding causes mirror those of internal incidents. We will improve our data and analysis in this area during AMP7.

Zero Flooding Zones

Our 2016 data indicates that most sewer flooding incidents (90%) occur in areas otherwise flood-free for the previous three years. 25% of those incidents, however, occurred within 100m of a historical flooding incident⁵. To improve prevention and remediation, we developed a zonal approach during AMP6, enabling us to target the incidence of repeat blockages, averting potential flooding in neighbouring sewers within the zone.

³ AMP6 commitments (Wholesale Monitoring Plan 2015-20 v7.8, SW, 2018)

⁴ Root causes of internal flooding (SIRF data, SW, 2017)

⁵ Zero flooding zones – AMP6 Flooding Pilots (SW, 2017)

We have significantly cut the number of incidents further through comprehensive monitoring (CCTV) and prevention (sewer jetting) and other activities in ten designated “zero flooding zones” (see Table 1). Figure 3 illustrates the impact of this approach in the Brighton zone.

Table 1: Selected Zero Flooding Zones⁵

No.	Zone location	No of properties flooded (Apr. 13 to Dec. 16)	No of repeat flooding incidents (Apr. 13 to Dec. 16)
1	Brighton	63	31
2	Eastbourne	21	7
3	Maidstone	9	6
4	Margate and	98	33
5	Herne Bay	27	9
6	Portsmouth	32	19
7	Queenborough	15	5
8	Ryde	24	27
9	Southampton	17	13
10	Worthing	24	7
	Total	330	157

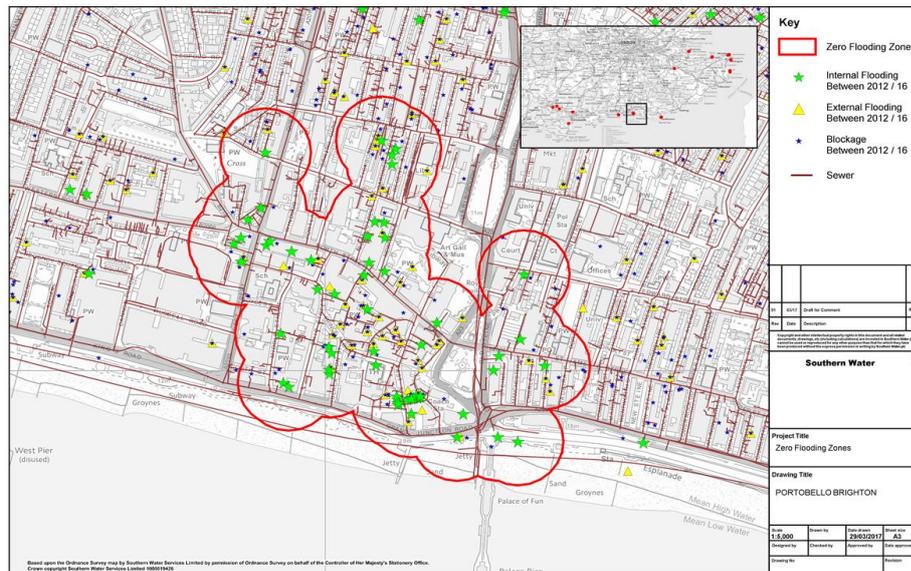


Figure 3: Extent of the Brighton Zero Flooding Zone⁵

FOG and Unflushables awareness

Around two thirds of blockages are caused by customers trying to dispose of fat, oil and grease (FOG), wipes and other sanitary materials through the wastewater network.⁵ We are raising awareness of the link between flushing and flooding, cost-effectively cutting sewer spills - and taking advantage of a brilliant opportunity to talk with and hear from thousands of customers. We are industry leading in this field and won the Gold Award in the Chartered Institute of Public Relations (CIPR) for the best “public



engagement campaign that seeks to raise the issue of internal domestic flooding. The campaign used humorous activities to convey its message; awareness of unflushable items increased by five per cent year on year as a result.”

We push our message hardest in communities where blockages re-occur as well as among intensive FOG-using food service establishments. We help other customers to get into hassle-free good habits through tailored home visits and high-impact communications. Some of our best results are where we have joined forces with local community groups, continuously reinforcing how easy it is to get rid of FOG and unflushables, while cutting disruptive flooding and protecting the environment in a cost effective way.



Figure 4: Images from our FOG and Unflushables Programme & Award

3.1.2 Pollution Reduction Strategy

At our customers’ urging, we pledged³ to halve the number of Category 3 incidents by 2017 and to eliminate Category 1 and 2 incidents by the end of AMP6. We promised to do this while keeping bills affordable and becoming more resilient.

With over a third of Category 3 pollution incidents in 2016 caused by wastewater pumping station failure we concentrated our resources on the highest risk wastewater pumping stations with the best investment-return ratio. This approach delivered a significant cut in Category 1 to 3 pollution caused by wastewater pumping stations, falling from 124 in 2014 to 35 in 2017.⁶

⁶ Pollution incidents attributed to WPS (SW report to the EA, 2010 to 2017)

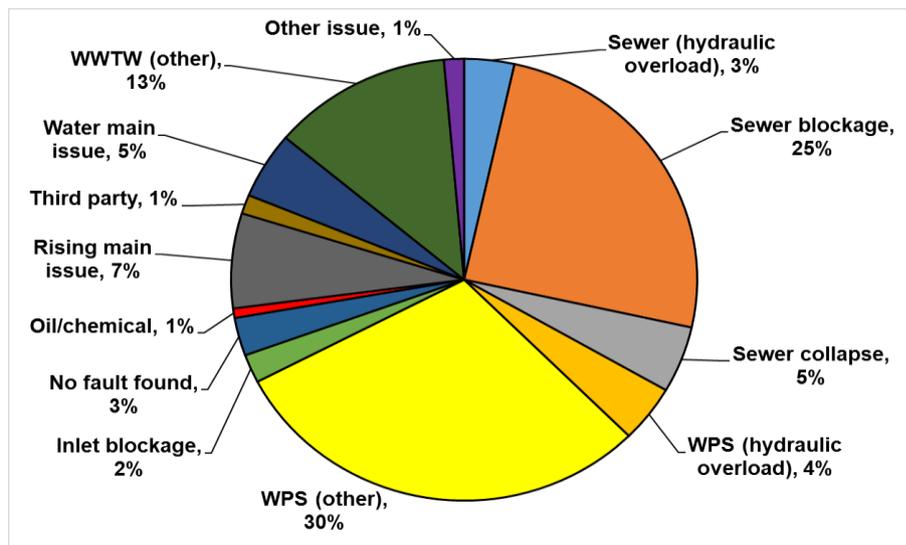


Figure 5: Root Cause of Category 3 Pollution Incidents in 2016⁷

Our strategy was underpinned by better evidence-gathering and reporting, more effective responses, a greater reliance on telemetry and more innovative, multi-skilled team working.

3.2. Customer Benefits and Resilience

3.2.1 Internal Flooding Incidents

We have delivered benefits for customers over AMP6, driving down internal flooding incidents (excluding severe weather) from 581 in 2013-14 to 401 in 2017-18.⁸ Section 3.1.1 explains what we have done to keep our AMP6 promise of a 25% reduction in these events on track. We can evidence the ambition of this target by comparing our performance to the industry average. This shows that we have risen from Quartile 3 in 2013-14 to median level in 2015-16 and 2016-17, the most recent year for which comparisons are available.

⁷ Root causes of pollution incidents (Incident data, SW, 2016)

⁸ Historical and forecast performance (Wastewater PC Predictions v15, SW, 2018)

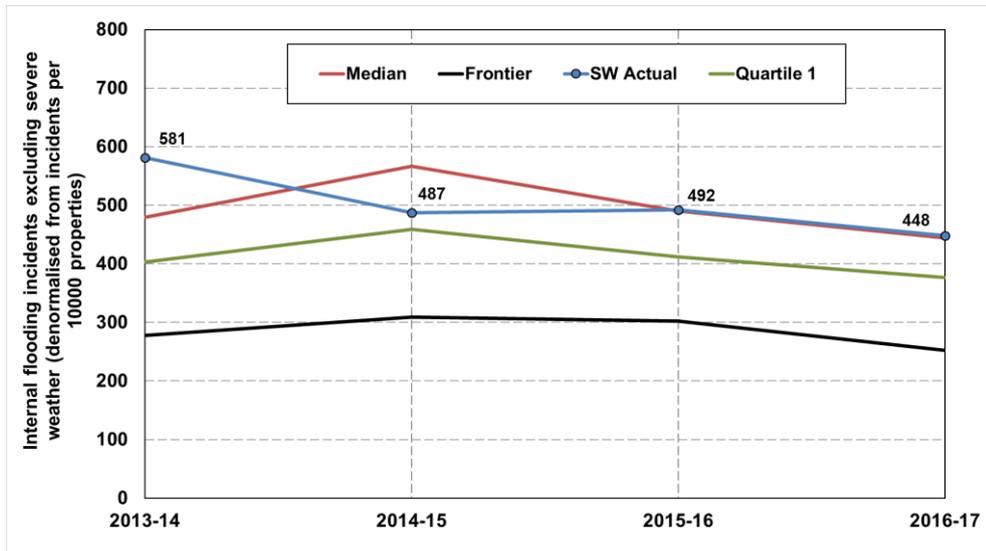


Figure 6: Historical Internal Flooding Incidents Excluding Severe Weather⁸

3.2.2 External Flooding Incidents

We have exceeded our customer promise to maintain our external flooding performance. Here, continuous improvements are key. In 2016/17 our region experienced 5,746 incidents of external flooding. By 2017/18 we were able to bring that down to 4,724. In terms of the industry benchmark, this puts us sixth out of 10 (see Figure 7). The industry comparable shadow reporting method for external flooding in gardens and private land was not established until 2016/17, making longer term comparisons impossible.

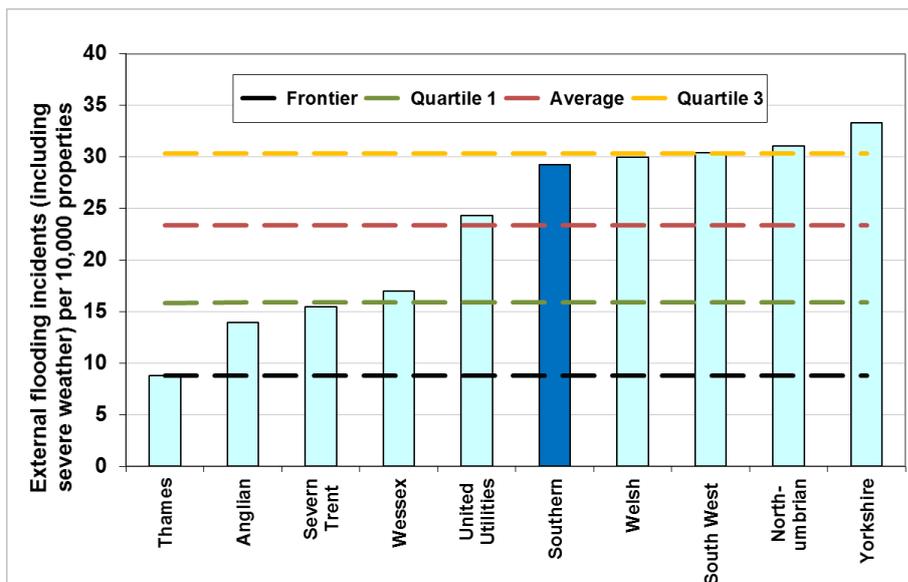


Figure 7: 2016-17 External Flooding Incidents Including Severe Weather⁸

3.2.3 Pollution Incidents

Customers agreed with us that a goal to halve pollution incidents³ by 2017 struck a good balance between affordability and improvement. We have exceeded that goal, reducing pollution incidents by 60%, making our rivers and bathing waters even more appealing to visitors and residents alike.

As part of our wider AMP6 strategy to protect the environment, concentrating investment on wastewater pumping stations has been crucial in cutting Category 1 to 3 pollution incidents (sewerage only) from 324 incidents in 2013 to 123 incidents in 2017 (see Figure 8)⁸ while FOG education and zero flooding zones underpinned our halving of pollution incidents attributed to foul sewer blockage between 2013 and 2017.

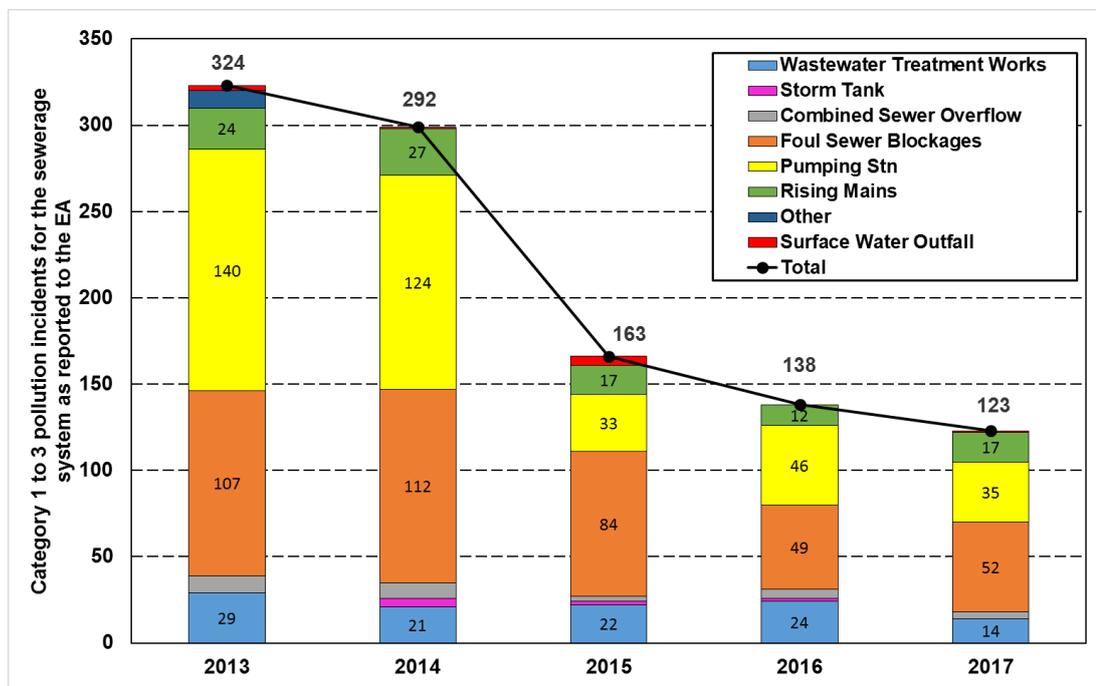


Figure 8: Historical Category 1 to 3 Pollution Incidents (by Asset Type)⁹

Together, this has lifted our relative performance in this area from Quartile 4 in 2013 to average in 2017 (see Figure 9).⁸

⁹ Pollution Stack Strategy Summary (SW, 2018)

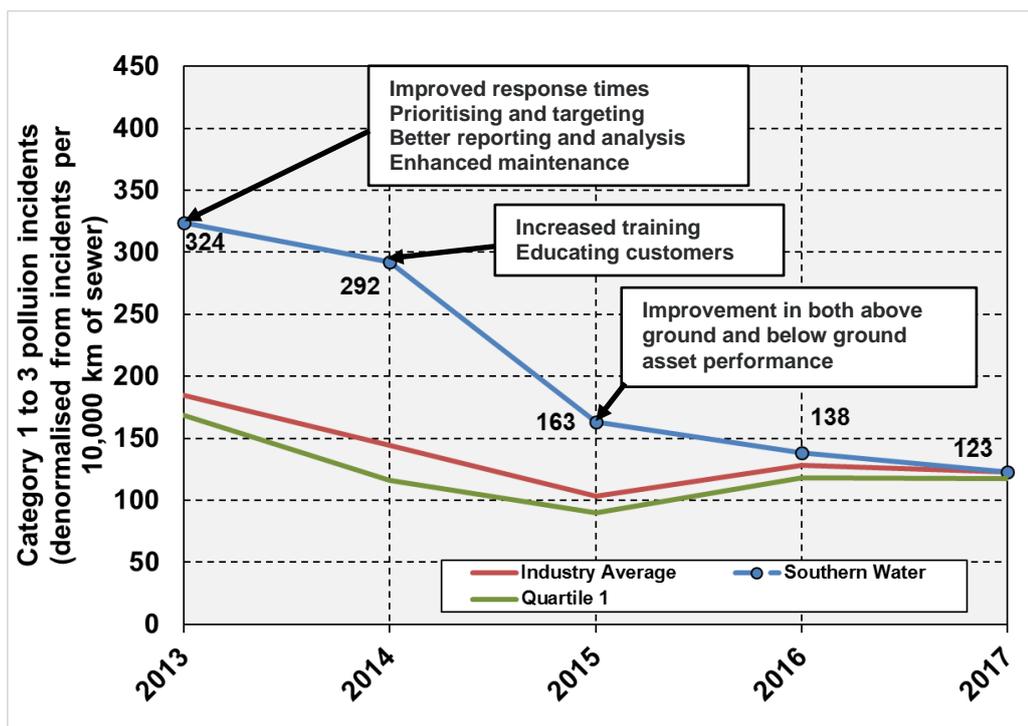


Figure 9: Comparative Performance for Pollution Incidents⁸

3.2.4 Resilience

These improvements were also a consequence of moving to the 4Rs concept of resilience (see Figure 10).

We addressed each of the 4Rs during AMP6

- **Reliability** – by targeting the jetting program in ‘zero flooding zones’ which have a high percentage of internal flooding incidents due to blockages
- **Response or recovery** – alarms and monitors
- **Redundancy** – removing Buchan traps
- **Resistance** – infiltration reduction and planned maintenance of sewers, rising mains and wastewater pumping stations

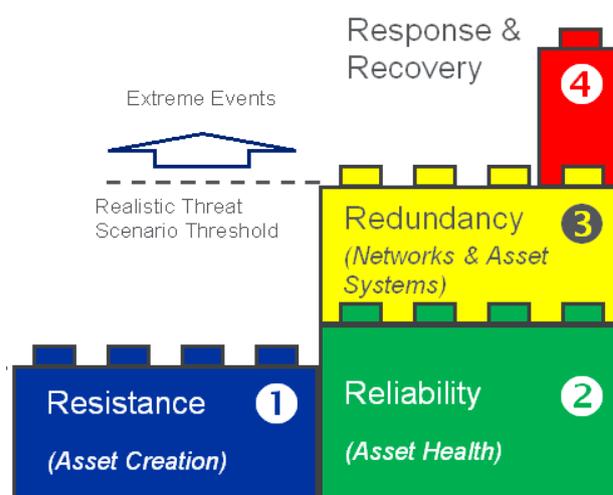


Figure 10: The 4 Rs Concept of Resilience

4. Drivers for Change

4.1. Customer and Stakeholder Views

As outlined in [Chapter 4: Customer Stakeholder Engagement and Participation](#) we have developed a deep and granular understanding of our customers' views and priorities when preparing this plan. This includes a range of non bill-paying customers from across our region, including the Environment Agency, Natural England and local authorities. The insight gathered from our customer and stakeholder engagement programme can be found in [Chapter 4](#).

Our customers believe we have a duty to protect and enhance the environment. They regard us avoiding harm as an absolute minimum, but expect us to do more and protect and enhance the natural environment as part of our standard service. Customers ascribe a high priority to us avoiding pollution, and they expect sludge to be disposed of in a safe manner. They want water and wastewater services to be delivered in an environmentally friendly way now and in the future. Overall, they see avoiding pollution incidents is a medium priority.

Prevention of internal sewer flooding is a high priority for customers. Customers regard such events as very serious and empathise for those who experience their consequences. Our performance was average for internal flooding but below average for external flooding. Despite improvements in performance in recent years they want us to go further.

Another high customer priority is for us to maintain the health of our water and wastewater assets. They expect us to deliver the same level of services in an environmentally friendly manner for future generations.

Our stakeholders expect us to reduce our impact on the environment and measure our environmental impact. Environmental groups, some local authorities and regulators want to see significant improvements on pollution. Blueprint for Water echo these sentiments and want us to aim for zero pollution incidents, 100% monitoring of CSOs and 100% self-reporting of incidents. Regulators and the Blueprint believe companies should not be rewarded through ODIs merely for complying with the statutory minimum. Customers of the future want us to focus on protecting and enhancing the environment in the short and long term and see treatment works compliance as part of this. As such, these customers give higher priority to this work.

Stakeholders also want to see strategic plans for wastewater which deliver long-term resilience. The Cabinet Office and the Environment, Food and Rural Affairs Committee want to see clearer communication around flood risk. We note also that the government's 25 Year Environment Plan commits to reducing the risk from flooding, including through greater use of natural flood management solutions.

Customers and stakeholders see protecting the environment from pollution as a partnership. They expect us to 'do the basics brilliantly' and maintain and operate our pumping stations (and other equipment) to protect the

environment from pollution. Our customers also understand the link between customer FOG and wet wipes deposits and pollution and want us to do more to raise awareness of what customers should do to adopt better habits, something echoed by stakeholders.

Our customers regard emerging technology as important to the task of improving many of these issues, identifying investment in technology as key means by which we can improve how we detect and manage sewage flooding.

Stakeholders support a range of activities to address sewer flooding, recognising that different methods are needed according to circumstances. Stakeholders see managing flows as critical and want it to be part of our core business. Innovation around improving techniques for monitoring sewers was a popular topic at our regional workshop during 2018. Figure 11 outlines customers' views on the level of priority for the performance commitment categories. The view was developed by triangulating the evidence from our customer engagement and our historic performance data for each performance commitment. The performance commitments were then grouped into categories based on similarity. The full results and approach can be found in [TA 4.3 Triangulation of Customer Priorities](#).

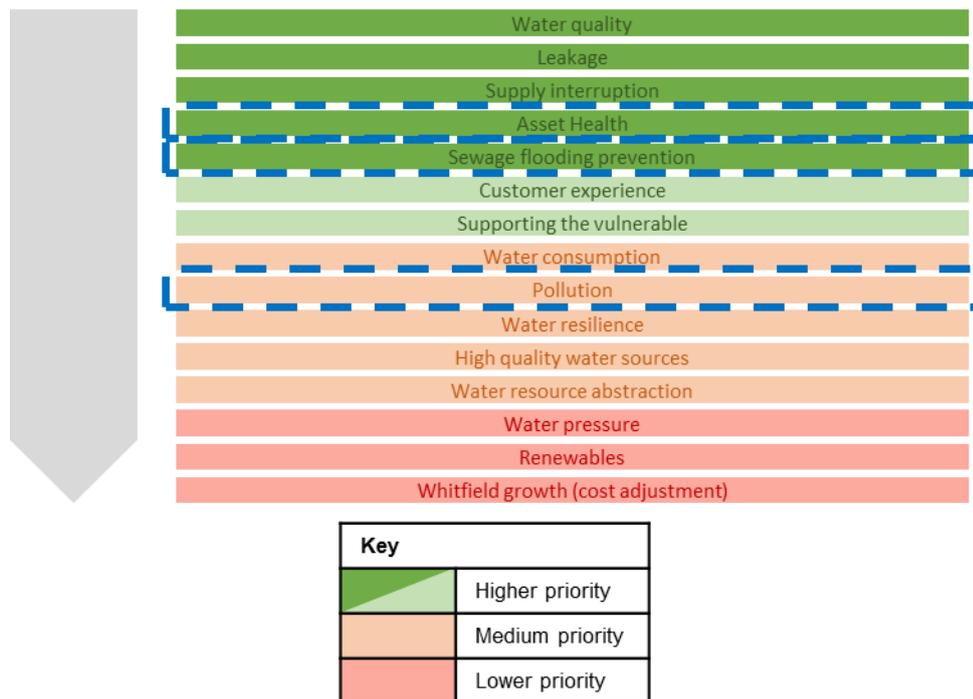


Figure 11: Relative Priority of Services According to our Customers

From this understanding of customer and stakeholder priorities we have defined our performance commitments and investment proposals. Our success in delivering against these priorities will be measured by those performance commitments.

4.2. Future Trends and Pressures

The following trends and pressures are likely to have a material bearing on the resilience of our sewer network:

1. Industry wide resilience issues

- Regulatory expectation of improvement to Quartile 1 performance for pollution and internal flooding
- A requirement to quantify and improve the long-term health of sewerage assets and their resilience to future pressures^{10,11}
- Potential increases in FOG, wet wipes and other unflushable materials. Population growth may drive this trend. We do recognise the opportunity of influencing product manufacturing to reduce this risk for the future.
- More extreme weather events¹², increasing surface water flows in pumping stations and rising mains.

2. Regional and Company resilience issues

- An estimated 15% increase in population growth in the South East¹³ By 2040, the regional population is predicted to grow with 400,000 new homes expected.¹³
- A related increase in the number of WPS from new developments (See [TA.12.WW02 Network Pumping Stations](#))
- Coastal pumping station vulnerability. Our region has over 700 miles of coastline¹⁴ with a high proportion of our pumping stations located in coastal towns and cities. Particular vulnerabilities include:
 - A rise in the sea level by a predicted 21-68cm for London between 1990 and 2095.¹⁵
 - Accelerated deterioration of assets in the harsh marine environment¹⁶
- The highest proportion of wastewater pumping stations per 1000 km of sewer of any water and sewerage company (see [TA.12.WW02 Network Pumping Stations](#))

Our response to the above challenges has shaped our thinking for AMP7 and future AMP periods.

¹⁰ Long Term Investment in Infrastructure (UKWIR, 2017)

¹¹ Wastewater resilience metric (Water UK, 2017)

¹² Increase in extreme storms (UK Climate Projections, Defra, 2009)

¹³ Population growth (Let's Talk Water, SW, 2017)

¹⁴ Coastline length (Let's Talk Water, SW, 2013)

¹⁵ Sea level rise (UK Climate Projections, Defra, 2009)

¹⁶ Practical guidance on determining asset deterioration (EA, 2013)

5.AMP7 Strategy

5.1. Investment Strategy

5.1.1 Internal Flooding Investment Strategy

We are on track to meet our promise³ to reduce internal flooding incidents by 25% in AMP6, moving us to industry average⁸. Our customers, stakeholders and regulators want further internal flooding reduction, as we aim for Quartile 1 performance. Our plans for AMP7 aim for a further 15% reduction which will be achieved through a range of base and enhancement activities.

Our base activities include:

- Sewer rehabilitation and rising main replacement
- CCTV monitoring and sewer jetting to locate and remove blockages
- Infiltration reduction, reducing flows and the risk of flooding by increasing capacity
- More planned maintenance of outfalls to reduce shingle blockage
- Buchan trap removal
- IT and GIS systems improvements to add unmapped sewers, updated incident data etc. to improve response to incidents
- Moving micro pumping stations to gardens
- Improving existing hydraulic models and creating new models to improve knowledge of flooding risk and solutions including understanding the impact of 50 year return period storms

Our flood mitigation programme is a successful part of our AMP6 strategy. These are small scale improvements which reduce the likelihood of properties flooding, even if not providing a more robust 1 in 30 year protection. We will continue this activity for AMP7 although opportunities will become much more limited.

Table 2: Investment in Flooding Mitigation in AMP7 Compared to AMP6²

	AMP6 Forecast	AMP7 Total	Difference (AMP7 – AMP6)	Technical annex for investment
Internal flooding mitigation (existing issues)	£7.4m	£2.8m	-£4.6m	TA.12.WW04 Sewers and Rising Mains
Internal flooding reduction (new additions)	£11m	£11.3m	+£0.3m	TA.12.WW05 Wastewater Growth
Internal flooding mitigation (sub-total)	£18.4m	£14.1m	-£4.3m	

Our growth programme includes £11.3m of expenditure to prevent new additions to our flood risk register arising through infill growth. These growth-

related costs will prevent a deterioration in flooding incidents rather than any performance improvement. Costs are based on our AMP6 level of activity with a standard efficiency reduction applied and adjusted to reflect an increasing level of growth in AMP7.

Table 2 shows our proposed AMP7 capex on internal flooding mitigation compared to AMP6 forecast expenditure. This investment is included in [TA.12.WW04 Sewers and Rising Mains](#) and [TA.12.WW05 Wastewater Growth](#).

Overall, our base plans and the additional enhancement expenditure of £2.8m of flood mitigation would provide for a forecast reduction of only 9 incidents per year, short of our customer targets. Further options for enhanced internal flooding reduction activities were therefore assessed:

Option FI1 (Base Expenditure with mitigation) – in this option we continue to deliver our current investment levels, managing our flooding performance through proactive flood mitigation activities etc. This includes a reduced mitigation programme for AMP7. We would expect internal flooding to reduce by approximately 9 incidents per year and assumes some benefit from continuous improvement to our approach.

Option FI2 (Beyond Upper Quartile) - this option would deliver improved flooding performance through increasing the level of activity for zero flooding zones, FOG education, intelligent sewers, SuDS. This option has least performance risk, with a forecast reduction in incidents of 48 per year, but has the highest cost.

Option FI3 (Zero Flooding Zones) – this option focuses on the prevention of blockages, achieved through an expansion of planned CCTV and jetting in zero flooding zones. Approximately 23 internal flooding incidents per year would be prevented. However, there would be little investment in the development of intelligent sewers, our medium to long term strategy to reduce flooding, and increase resilience.

Option FI4 (Intelligent Sewers) – this option would deliver the first step in our development of intelligent sewers through increased investment in sewer level monitors, predictive modelling and incident management to prevent 25 incidents per year. However, it is associated with a higher risk that the benefits of innovative activities will not be realised in the short term. This option also fails to directly tackle blockages.

Option FI5 – (Intelligent Sewers, FOG education and SuDS) – this option would reduce flooding incidents due to blockage through a continuation of our FOG education. We would invest in sewer level monitoring and predictive modelling as a step towards the development of an intelligent sewer network. A contribution to partnership SuDS schemes would prevent flooding due to surface water and increase the resilience of the network to climate change. We predict this would achieve a reduction of 25 to 48 internal flooding incidents per year as detailed in Appendix 2.

A cost benefit analysis for these five options, assessing the full whole life costs¹⁷ NPV¹⁸ over 20 years utilising customer willingness to pay is summarised in Table 3. We have also considered if the options have wider customer support and whether they meet the requirements of our customers and regulators.

Costs have been derived from our ongoing AMP6 pilot work zero flooding zones. Other costs are based on historical expenditure, studies we commissioned on intelligent sewers and advice from subject matter experts.

Table 3: Assessment of Options for our Internal Flooding Strategy in AMP7¹⁷

No.	Description	AMP7 Totex (£k) ¹⁷	Full Whole Life Cost ¹⁷ (20 years) NPV ¹⁸ (£k)	Willingness to pay support	Ofwat Priority	Other regulator priority	Customer priority	Business strategic alignment	Is this option recommended ?
F11	Internal Flood Mitigation Only	£2.8m TA.12. WW04 Sect. 5.6	£29,754	●	●	●	●	●	No – Low cost but low level of performance saving 9 incidents per annum
F12	F11+ Beyond Upper Quartile	F11 + £27,250	£8,075	●	●	●	●	●	No – This has the highest performance saving 57 incidents p.a. (incl. 9 base) It is also the highest short term cost and the impacts on customers' bills are not acceptable.
F13	F11 + Zero Flooding Zones	F11 + £12,500	£16,042	●	●	●	●	●	No – This is repeating standard activities. Saving 32 incidents p.a. (incl. 9 base) but has less focus on long term innovation
F14	F11 + Intelligent Sewers	F11 + £14,750	-£5,028	●	●	●	●	●	No – This is based on higher risk innovation activities which are less proven. This saves a potential 34 to 57 incidents p.a
F15	F11 + FOG Education, Intelligent Sewers and SuDS	F11 + £7.400	-£12,362	●	●	●	●	●	Yes – This has an optimal mix of risk / Innovation which has potential to outperform the traditional activities and provides steps towards the future. This saves between 34 and 57 incidents p.a.

Our preferred option, F15, tackles several causes of flooding with the best cost benefit, although we recognise it has a higher deliverability risk as it is based on more innovative

¹⁷ Whole life cost model v8.9 for flooding and pollution (SW, 2018)

¹⁸ Our whole life costs and cost benefit figures have been calculated by extracting a 20 year portion of costs/benefits from a 60 year model. Further details are included in [TA.14.5 PR19 Approach to Optioneering](#)

approaches. The enhancement activities included within this option for AMP7 are provided in Table 4.

Table 4: Enhanced Internal Flooding Reduction Activities in AMP7 (FI5)

Activity	Description	AMP7 Total ²	Technical annex for investment
Internal Flood Mitigation	Installation of non-return valves, flood barriers and other flood mitigation activities to prevent internal flooding	£2.8m	TA.12. WW04 Sewers and Rising Mains
Sewer misuse campaigns	FOG and Unflushables education continued from AMP6. Use bio-chemicals to digest FOG.	£1.7m	
Sewer level monitors	Linked sewer level monitors installed in key parts of the network with telemetry to supply real-time information on flows and levels to provide warning of potential flooding.	£1.3m	
Predictive modelling	Predictive modelling software in conjunction with real-time information to predict potential flooding to enable mitigation to be implemented and/or improve the response to incidents.	£2.7m	
SuDS and partnership schemes	We will contribute £1.7m (enhancement) on an Eastbourne SuDS scheme	£1.7m	
Total		£10.2m	

The total AMP7 investment of £10.2m is included in [TA.12.WW04 Sewers and Rising Mains](#).

5.1.2 External Flooding Investment Strategy

Our 2016/17 performance for external flooding put us in Quartile 3 at 5,746 incidents. We improved to 4,724 incidents in 2017/18 but our customers and stakeholders want us to go further.

Section 5.1.1 describes the activities to reduce internal flooding which will provide additional benefit for external flooding. However, additional enhancement activities will be required to provide a significant reduction and enable us to at least get to average performance.

At a programme level we have assessed four options for enhanced external flooding reduction activities:

Option FE1 (Do Nothing) – no focused activities to reduce external flooding in AMP7.

Option FE2 (30% Improvement) – this option would include the funding of a dedicated team to analyse external flooding data and co-ordinate the



installation of flood mitigation measures with priority given to repeat flooding properties. This would provide for a 30% reduction in external flooding incidents to improve to average performance in comparison to other water and sewerage companies.

Option FE3 (35% Improvement) – as Option FE2 but would provide for a 35% reduction in external flooding incidents to improve to between average and Quartile 1 performance.

Option FE4 (40% Improvement) – as Option FE2 but provide for a 40% reduction in external flooding incidents to improve to Quartile 1 performance.

Table 5 provides an assessment of all the options against customers’ willingness to pay and whole life cost analysis to ensure they provide value for customers. The costs have been based on historical expenditure for flood mitigation.

Table 5: Assessment of Options for our External Flooding Strategy in AMP7¹⁷

No.	Description	AMP7 Totex (£k) ¹⁷	Full Whole Life Cost ¹⁷ (20 years) NPV ¹⁸ (£k)	Willingness to pay support	Ofwat Priority	Other regulator priority	Customer priority	Business strategic alignment	Is this option recommended?
FE1	Do Nothing	£0	Base	●	●	●	●	●	No - No improvement in service which is not what customers want
FE2	Improve 30%. To Average performance	£5,800	-£70,624	●	●	●	●	●	Yes - This has the lowest 5 year cost and is fully supported by customers
FE3	Improve 35%. Move towards Quartile 1	£7,017	-£84,171	●	●	●	●	●	No - Higher increase in customers’ bills in the short term and deliverability is very uncertain
FE4	Improve 40%. Quartile 1 performance.	£8,632	-£95,373	●	●	●	●	●	No - The least whole life cost but there would be a larger increase in customers’ bills in AMP7 and deliverability is very uncertain

Our preferred option, FE2, has the lowest cost in AMP7 (excluding the ‘Do Nothing’ option) and will support a significant improvement from Quartile 3 to average performance, consistent with our customers’ expectations. Our understanding of root cause for external flooding is more limited which means options FE3 and FE4 are highly uncertain. For these reasons, our preferred option is FE2 which provides for the lowest impact on bills while still significantly improving performance. It enables a staged approach which we will build on for AMP8 and beyond. The AMP7 enhancement investment of £5.8m for our external flooding strategy is included in [TA.12.WW04 Sewers and Rising Mains](#) as our external flooding mitigation programme.

Option FE2 includes:

- Creation of a dedicated new team to focus on the data collection and analysis related to external flooding so that we can better understand the root causes
- Installation of external flooding mitigation measures such as anti-flood devices, flap valves and sealing manhole covers
- Targeting properties with the highest risk of a repeat external flooding incidents. Analysis has identified that 1051 external flooding incidents in 2016 were repeat incidents at 481 properties

5.1.3 Pollution Investment Strategy

Our plans for AMP7 aim for a 40% reduction in pollution incidents from a 2016 baseline, supporting the Environment Agency's strategic ambition¹⁹. Our aim for Quartile 1 performance will be achieved through a range of base and enhancement activities.

Our base activities include:

- Focused maintenance on critical sites where pollution is a high-risk consequence of asset failure
- Enhanced pump replacement programme
- Planned maintenance targeted on critical rising mains and air valves
- Infiltration reduction which will reduce flows and therefore reduce the risk of pollution by increasing capacity

At a programme level we have assessed five options for enhanced pollution reduction activities.

Option PO1 (Base Expenditure) - we continue to deliver our current investment levels, managing our pollution performance through base activities such as replacing poorly performing pumps and rising main replacement. We would expect pollution to reduce by approximately 9 incidents per year through continuous improvement and 'doing the basics brilliantly', but opportunities to reduce pollution further would be more limited.

Option PO2 (Beyond Upper Quartile) - this option would deliver improved pollution performance through targeted pump replacement, conditional maintenance, flow management, FOG education, planned jetting, increase in temporary pumps and critical spares. This option has least performance risk and is forecast to reduce the number of incidents by 20 per year. This is the highest cost option.

Option PO3 (Focus on Pump Failure) - this option would be focused on wastewater pumping stations which are the root cause of 34% of pollution incidents. This would be achieved through targeted pump replacement and conditional maintenance of pumping stations. Approximately 13 pollution incidents per year would be prevented. However,

¹⁹ Water Industry Strategic Environmental Requirements (WISER), Table 1 section on excellent performance

there would be little additional investment in planned jetting and FOG education to prevent blockages which are the root cause of 25% of pollution incidents.

Option PO4 (Focus on Blockages and FOG Education) – this option would focus on preventing pollution through blockage reduction. Activities would include planned jetting and targeted FOG education to prevent approximately 7 pollution incidents per year.

Option PO5 (Innovation, Pumps and FOG Education) – this option has a mixture of activities to tackle pollution due to pump failure and blockages. In addition, innovative flow management would enable issues at pumping stations to be detected quicker, contributing to our long-term strategy to develop an intelligent sewer network. A forecast 9 to 20 pollution incidents per year would be prevented as detailed in Appendix 2.

In Table 6, we have assessed these five options against the full whole life cost¹⁷ NPV¹⁸ over 20 years. We have also considered if the options have willingness to pay support and whether they meet the requirements of our customers and regulators.

Table 6: Assessment of Options for our Pollution Strategy in AMP7¹⁷

No.	Description	AMP7 Totex (£k) ¹⁷	Full Whole Life Cost ¹⁷ (20 years) NPV ¹⁸ (£k)	Willingness to pay support	Ofwat Priority	Other regulator priority	Customer priority	Business strategic alignment	Is this option recommended ?
PO1	Base Only Benefits	See TA.12. WW02 Sect. 5.1	£54,234	●	●	●	●	●	No – Low cost but low level of performance saving 9 incidents per annum (p.a.)
PO2	Pollution Beyond Upper Quartile	Base + £23,000	-£21,366	●	●	●	●	●	No – This has the highest confidence to reach upper quartile saving 29 incidents p.a. (incl. 9 base), however the short term impacts on customers' bills are not acceptable
PO3	Base + Focus on Pump Failure	Base + £14,400	£0.0045	●	●	●	●	●	No – This is repeating standard activities. Saving 22 incidents p.a. (incl. 9 base) but has less focus on blockage reduction.
PO4	Base + Focus on Blockage and FOG Education	Base + £8,650	£32,783	●	●	●	●	●	No – This is based on blockage reduction which saves the 2 nd lowest 16 incidents p.a. (incl. 9 base)
PO5	Base + Innovation, Pumps and FOG Education	Base + £10,700	-£40,236	●	●	●	●	●	Yes – This has a mix of innovation which is higher risk as well as traditional activities which provides steps towards the future. Saving between 18 and 29 incidents p.a.

To deliver our preferred option, PO5, to target Quartile 1 performance and meet our regulators' and customers' expectations, we plan to invest £10.7m on the activities shown in Table 7. We recognise this has a higher delivery risk as it

involves more innovative approaches. This investment is included in [TA.12.WW02 Network Pumping Stations](#).

Table 7: Enhanced Pollution Reduction Activities in AMP7

Activity	Description	AMP7 Total ²	Technical annex for investment
WPS FOG	FOG education campaign in sub-catchments where WPS are regularly blocked by FOG and have a history of pollution incidents.	£0.4m	TA.12.WW02 Network Pumping Stations
Flow management	Install flow meters at WPS that currently have no flow or level meters to detect issues early and prevent pollution.	£2.9m	
Pumping resilience	'Smart pump' activities to improve resilience at higher risk sites and reduce power consumption. Investigate the use of 3D printing to reduce lead times for replacement parts.	£4.1m	
Conditional alarms	Install alarms at WPS and use criticality based maintenance to reduce the risk of pollution.	£3.3m	
	Total	£10.7m	

5.1.4 Medium and Long-Term Proposals

Our long-term strategy for achieving zero pollution incidents is focussed around four core themes:

- **Operational Excellence** – addressing the basics of improving operational processes, new commercial arrangements to incentivise performance and a focus on preventing repeated incidents have delivered significant benefits. Further opportunities are limited but this will now move into a continuous improvement phase.
- **Smart networks** – we are currently trialling greater use of network monitoring and predictive analytics. We plan to roll this out into high-risk catchments and pumping stations, extending into the wider network in AMP8. We will start to introduce more automated management of flows.
- **FOG and Unflushables** – we will extend our FOG and unflushables campaign and continue to push for changes to how products are designed and marketed.
- **Sustainable Drainage 2030** – we will adopt new ways of working, with increased focus on collaboration with customers and local authorities. We work with local communities to remove surface water through soakaways, smart water butts, rain gardens and small scale SuDS systems. We see this as moving to a more collaborative infrastructure planning model in the longer term to improve resilience across all utilities.

Figure 12 provides a timeline of activities to enable us to reach our goal of zero pollution incidents.

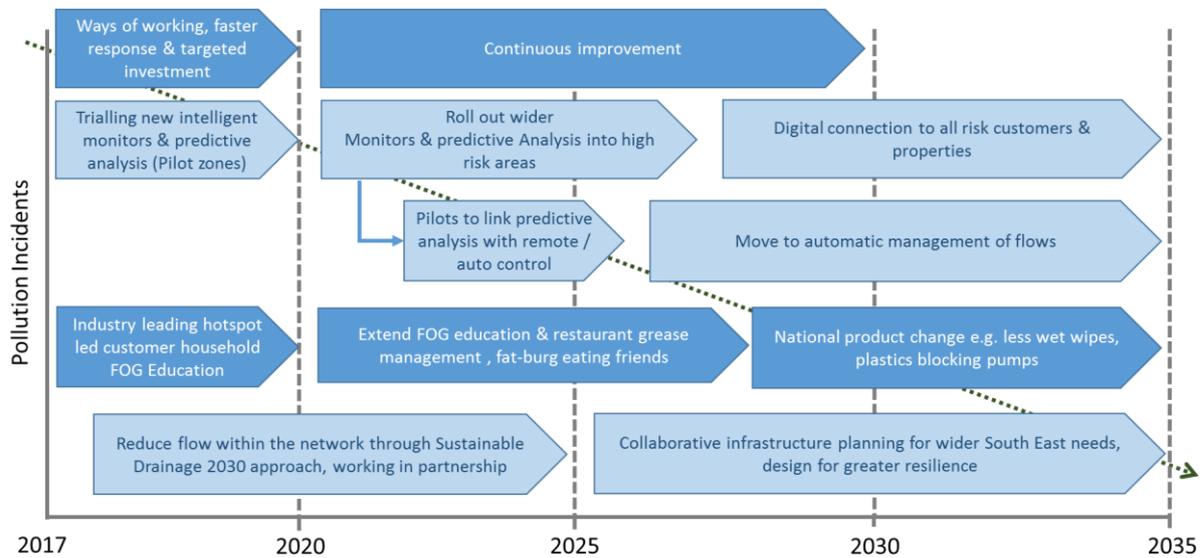


Figure 12: Our Long-Term Strategy to Reduce Pollution

Sewage flooding prevention is a high priority for customers, who want to see us improve our network to prevent sewage flooding.

With many of the root causes of flooding similar to pollution, the approaches for both have many areas of similarity. Figure 13 provides a timeline of activities to enable us to reach our goal of zero internal flooding incidents.

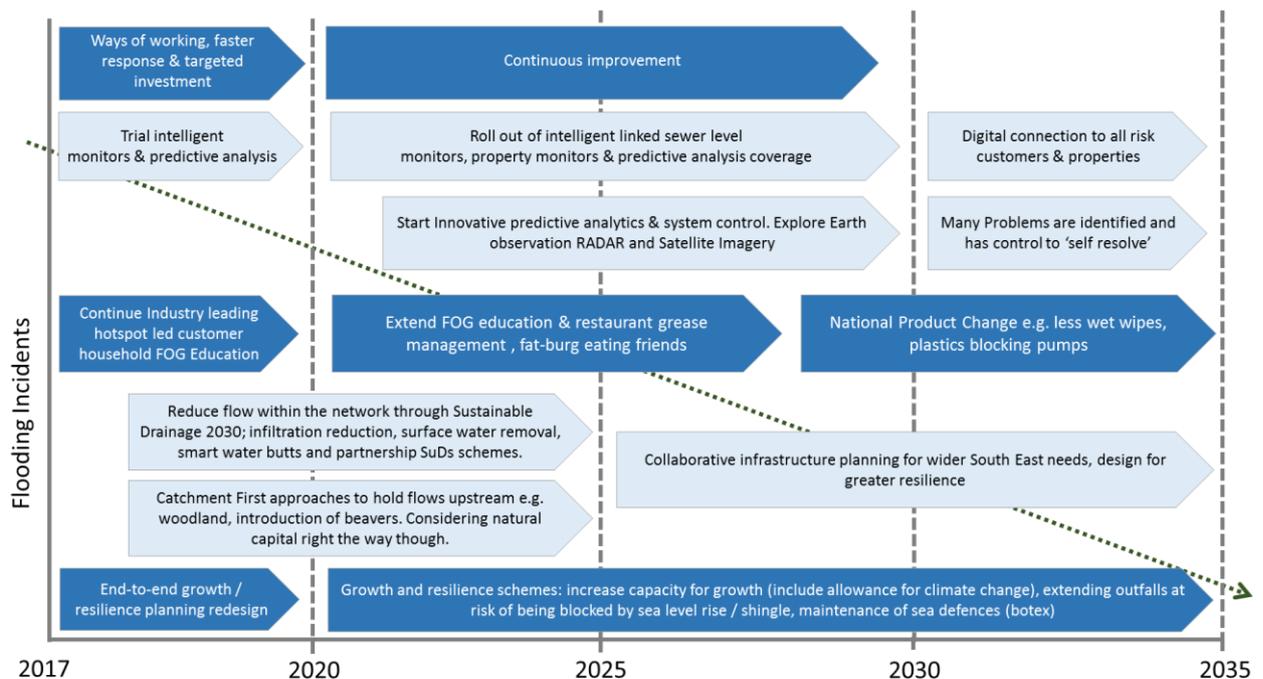


Figure 13: Our Long-Term Strategy to Reduce Flooding

5.2. Innovation

We propose to build on our innovative approaches from AMP6 and implement a number of innovations as part of the AMP7 flooding and pollution strategies. The development and use of innovative techniques enable us to obtain maximum benefit for our customers. These include key innovations as part of our AMP7 pollution and flooding strategies as shown in Figure 14.

Smart Networks

We are developing smart networks where intelligent systems will control flows automatically in sewers. In AMP5 and AMP6 we have been installing level and flow meters in the sewers and pumping stations.

In the remainder of AMP6 and in AMP7 we will install further sewer and pumping station monitors to measure levels and flow in the network. This will enable us to detect and locate hydraulic overloading, blockages, collapses and pumping station failures.

We will use predictive modelling to predict the location of potential flooding and pollution to enable mitigation to be implemented and/or improve the response to incidents.

By incorporating weather forecasts with intelligent systems, we aim to ensure that our pumping stations are prepared in advance to manage storm water. Intelligent systems would control the operation of pumping stations and their associated rising mains, so that they efficiently transfer storm water around the network to make best use of the available network capacity.

There would be an increase in coverage of telemetry on pumping stations and an improvement in the quality of data to reduce false alarms. Condition based monitoring would be used on all sites with telemetry to enable early interventions for increased risks due to asset failure or deterioration. The monitoring at the pumping stations in conjunction with network levels would provide a more targeted response to a potential issue.

Our plan to improve monitoring of the sewer network will be spread over 15+ years to keep bills affordable, and in AMP7 we will lay the foundations for increased monitoring and intelligent sewers.



Figure 14: Pollution and Flooding Innovation – Now and in the Future

Innovative FOG Education

To engage younger audiences with our FOG and Unflushables messages, Figure 15 shows an 'Augmented Reality Experience' being developed as a smart phone game to teach participants on the correct disposal of different objects. Initially this game will be used at our public events and in the next phase it will be made available for all smart devices from mobile stores. We are raising awareness of the link between flushing and flooding, cost-effectively cutting sewer spills - and taking advantage of a brilliant opportunity to teach and influence customer behaviour.



Figure 15: Augmented Reality Experience Game (Poster)

To enable us to reach every single school in our region and as many future customers as possible, we developed downloadable school assembly material with teachers' notes to share our FOG and Unflushables message. This is cost effective as teachers become part of our education resource to help increase awareness. This material can be used with or without a member of our team being present.

We have an estimated 28,000 food service establishments across our region. To reach as many of as possible we are engaging at senior level with multi-premises businesses and large chains. We explain the effect of FOG deposits in sewers, on customers and the environment and outline current legislation, regulations and responsibility for grease management. Food businesses can then implement their own management procedures across their sites.

Our dedicated FOG and Unflushables team is carrying out a continuous education campaign built around the animated film "The Unflushables" jointly-produced with the Consumer Council for Water. The supporting social and traditional media activity achieved almost 1.4 million views in one year. We will expand these activities to reach as many customers as possible to help protect the environment and keep bills affordable.



Figure 16: Multi-Premises Food Businesses We Are Working With in Our Region

We continue looking for new ways to educate customers and businesses in areas where FOG and unflushable materials are repeatedly blocking the sewers.

Use of Market Mechanisms

We will investigate new technology and approaches to create a modern, resilient and integrated sewer network. The use of market mechanisms will help reduce our costs and keep customers' bills affordable now and in the future. Mechanisms include:

- Implementation of our sustainable drainage 2030 strategy, including below:
- Collaborative working with third parties such as local authorities, regulators, highway authorities, Internal Drainage Boards, National Parks and developers on
 - Drainage and Wastewater Management Plans
 - Surface Water Management Plans
 - Reducing sewer misconnections through joint-inspections, monitoring and awareness raising
- Collaborative working with other water and sewerage companies in towns and areas close to the border of our region
- We will contribute to partnership SuDS schemes to remove surface water from the network and share SUDS tool analysis
- We will consider additional incentives for customers to reduce surface water flows in the network

Our Integrated Water Cycle Management approach recognises the interconnected, complex nature of issues which can impact water. We have been piloting this approach throughout AMP6 in two catchments with a combined area of over 3,200km², 106 wastewater treatment works and over 130 water bodies.

Our experience, based also on international best practice, informs our transformational Catchment First programme. Through this, we will consider additional market mechanisms such as payments to landowners to change land management practices to reduce flooding or protect water quality.

Wastewater Resilience Metric (1 in 50 year storm)

To inform our wastewater resilience performance commitment, we used Water UK's methodology to quantify the percentage of population at high risk of sewer flooding from a 1 in 50 year storm. We made use of hydraulic models of large and medium wastewater catchments which cover 90% of the customers in our region. Using hydraulic modelling, we determined the number and percentage of properties at risk of flooding from a 1 in 50 year storm as shown in the example in Figure 17.



Figure 17: Modelled Properties at Risk of Flooding From a 1 in 50 Year Storm

The flooding risk for the remaining 10% of customers was calculated through a manual assessment of the vulnerability of the catchment based on a range of characteristics as defined in the Water UK and Atkins guidelines shown in Figure 18.

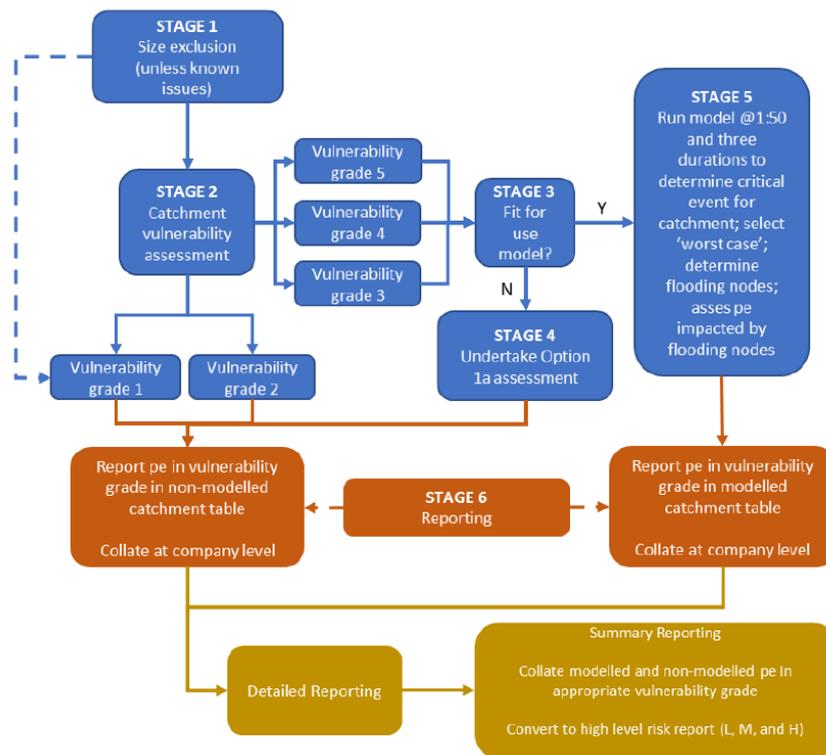


Figure 18: High Level Metric Process to Determine Vulnerability to Flooding²⁰

After combining the results, we calculate 7.6% of customers are at high risk if a region-wide 1 in 50 year storm occurred. We aim to reduce the percentage of properties at risk with the range of innovative measures to increase resilience described above. In addition, we will improve the hydraulic models and data analysis to increase confidence in the percentage and location of customers at risk.

5.3. Customer Benefits and Resilience

Our flooding and pollution strategies will contribute to the improvement on AMP6 performance as shown in Figure 19. The red line represents 2017-18 performance whilst the blue line represents our performance commitment targets in 2024-25.

²⁰ Developing and Trialling Wastewater Resilience Metrics (Atkins, 2018)

Measure	AMP6 2017-18	AMP7 2024-25	Quartile 1	Average	Quartile 4
Pollution Cat. 1 to 3	123	82			
Internal flooding (incl. severe weather)	417	350			
External flooding (incl. severe weather)	4724	3299			
Sewer collapses	234	225			

Figure 19: Summary of Projected Sewer Network Performance for AMP7⁸

Our investment will have most impact on the performance commitments for flooding and pollution as discussed in more detail in [Chapter 6: Outcomes, Performance Commitments and ODIs](#).

5.3.1 Internal Flooding Incidents

Figure 20 shows our forecast improvement towards Quartile 1 performance for internal flooding incidents. We assumed that Quartile 1 performance will gradually improve during AMP7 with poor performing companies improving more than companies who are already at upper quartile level.

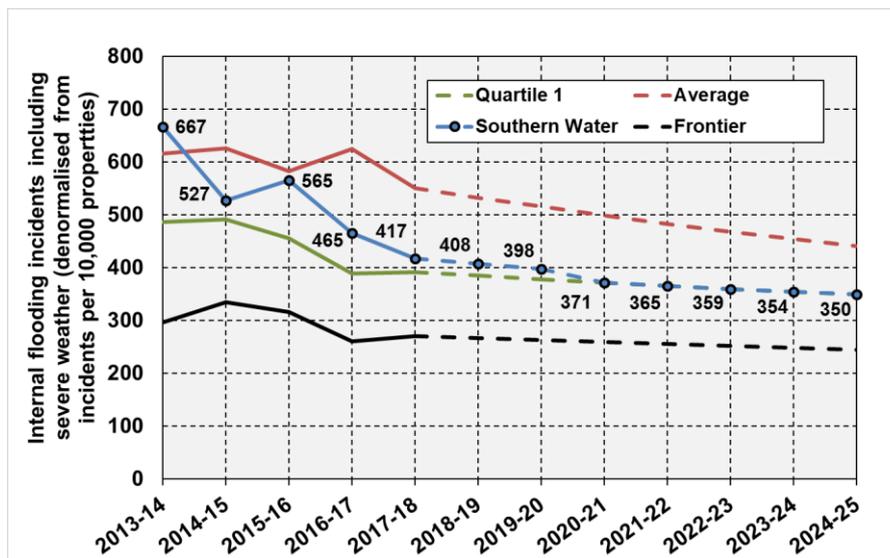


Figure 20: Forecast AMP7 Performance for Internal Flooding Incidents Including Severe Weather⁸

To enable us to achieve our target, the forecast reduction in internal flooding incidents for each base and enhancement activity are provided in Appendix 2.

5.3.2 External Flooding Incidents

Figure 21 shows our forecast improvement towards average performance for external flooding incidents.



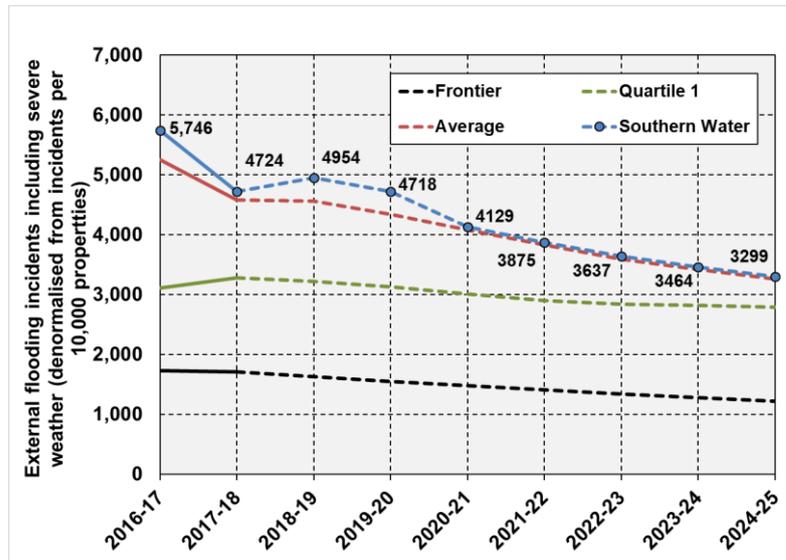


Figure 21: Forecast AMP7 Performance for External Flooding Incidents Including Severe Weather⁸

To enable us to achieve our target, the forecast reduction in incidents for our preferred external flooding reduction option is provided in Appendix 2.

5.3.3 Pollution Incidents

Figure 22 shows our forecast improvement towards Quartile 1 performance for pollution incidents.

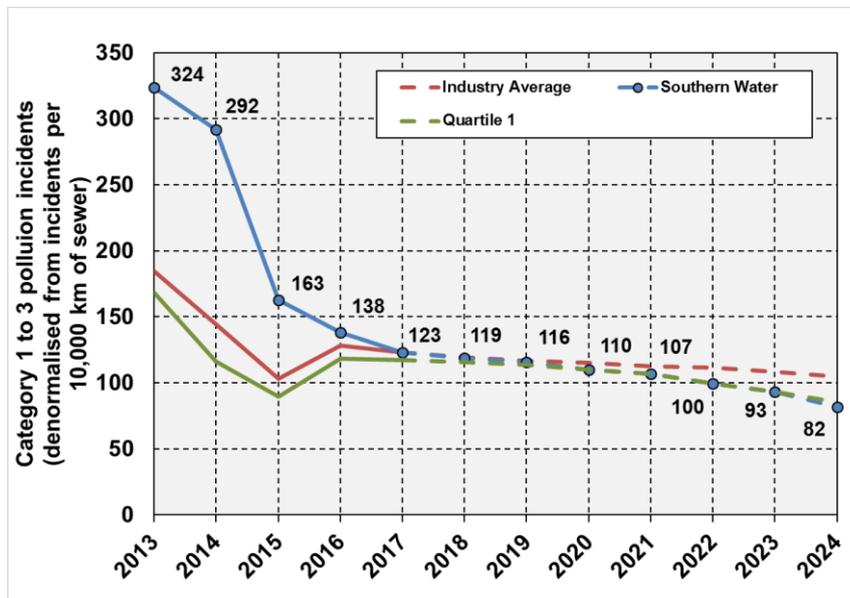


Figure 22: Forecast AMP7 Performance for Category 1 to 3 Pollution Incidents⁸

To enable us to achieve our target, the forecast reduction in pollution incidents for each base and enhancement activity are provided in Appendix 2.

5.3.4 Resilience

Our customers and resilience are at the heart of our plan and we will improve performance whilst keeping bills affordable as illustrated in Figure 23.

	 Resistance <i>Providing the strength or protection to resist a hazard or its primary impact, e.g. the design on an asset to an appropriate standard or expected level of service</i>	 Reliability <i>Ensuring that assets are maintained so that they continue to operate in the range that they are designed for</i>	 Redundancy <i>Designing and building capacity in the network or asset system, through duplication, interconnectivity or applying ecosystem-thinking</i>	 Response & Recovery <i>Enabling a fast and effective response to and recovery from disruptive events, through efforts to plan, prepare and exercise contingency plans in advance of events</i>	
Totex Solution Hierarchy	 Eliminate <i>Remove the root-cause of the principal threat or pressure</i>			<ul style="list-style-type: none"> • Surface Water Removal 	Not Applicable
	 Collaborate <i>Partner with stakeholders to develop mutually beneficial (and funded) solutions</i>	<ul style="list-style-type: none"> • 'Flushables' / Fats, Oils & Greases (FOG) 		<ul style="list-style-type: none"> • SuDS / Rainwater Gardens / Smart Water Butts 	
	 Operate <i>Operate and maintain assets and systems differently</i>		<ul style="list-style-type: none"> • Operational Excellence – Criticality of Assets; Reviewing Maintenance Strategy 		<ul style="list-style-type: none"> • Pumping Station Fast Response
	 Reinvigorate <i>Leverage existing asset capabilities or enhance headroom</i>		<ul style="list-style-type: none"> • Natural Flood Management • Condition Based Maintenance – Pumping Stations 	<ul style="list-style-type: none"> • Network Flow Monitoring (Building on Portsmouth surface water separation) 	
	 Fabricate <i>Construct new assets, on a 'designed to operate' basis, using efficient construction approaches</i>				<ul style="list-style-type: none"> • Strategic Spares Management

Figure 23: The 4 Rs of Resilience

Figure 23 shows the resistance of our sewers and pumping stations to FOG will be improved through targeted FOG education. The reliability of our sewerage network will be improved through a review of our maintenance strategy, achieving operational excellence and condition based maintenance at our pumping stations. We will increase capacity and redundancy in the sewers through surface water separation and the use of SuDS, rainwater gardens and smart water butts to manage stormwater. An increase in sewer flow and pumping station wet well monitoring will inform our intelligent sewers network. Our response and recovery will be improved through predictive modelling, contingency plans and tankering if required.

5.4. Value for Customers

The customer performance commitments affected by investment in flooding and pollution strategies are consistently shown to be high priorities for customers and stakeholders.

Our triangulation of the relative priority of our proposed PCs highlighted internal sewer flooding as the highest priority for customers and stakeholders. External sewer flooding is also a high priority for customers, and reported as a medium priority for our stakeholders. The number of pollution incidents are reported as medium priorities for our customers and a high priority for stakeholders.

Customers are highly averse to accepting reductions in service in exchange for lower bills, and in general are willing to pay for improvements in service levels for our proposed wastewater measures.

The total amount our customers would be willing to pay for a reduction of 1 in the number of cases of '**Sewer flooding inside customers' properties**' was **£100,207** per property per year.

The total amount our customers would be willing to pay for a reduction of 1 in the number of cases of '**Sewer flooding outside customers' properties**' was **£6,899** per property per year.

The total amount our customers would be willing to pay for a reduction of 1 in the number of '**Pollution incidents**' was **£708,481** per incident per year.

Our additional ODI research into willingness to pay for service level improvements indicates that our customers demand and are willing to invest in significant improvements to internal sewer flooding and pollution incidents. Customers are willing to pay for moderate improvements to external sewer flooding. Full detail on our customer engagement findings can be found in [Chapter 4: Customer and Stakeholder Engagement and Participation](#).

Table 8: Willingness to Pay for Wastewater Measures

Service Attribute	Unit	WTP [£/Unit/Year]		
		Central	Low	High
Sewer flooding inside customers' properties	Case/prop	£100,207	£75,641	£124,773
Sewer flooding outside customers' properties	Case/prop	£6,899	£5,237	£8,562
Pollution incidents	Incident	£708,481	£539,656	£877,305

Based on our customers' willingness to pay information provided in Table 8 we have determined the whole life costs for all of our internal flooding, external flooding and pollution options detailed in Section 5.1.

6. Costing Strategy

See Section 5.1 Investment Strategy for information on the costing of each strategy.

See [Chapter 14: Cost Efficiency](#) for further information on the efficient delivery of our business plan.

7. Key Risks and Opportunities

7.1. Risks

- Industry upper quartile performance for pollution and flooding incidents may improve at a higher rate than forecast. As a consequence, we may have to incur additional expenditure in order to achieve upper quartile performance.
- The innovative solutions detailed in these proposals do not deliver the targeted pollution and flooding benefits due to the implementation complexity e.g. 'smart networks', 'intelligent sewers' and FOG education schemes. As a consequence, we may need to invest more heavily than we have allowed or possibly resort to additional costly engineered solutions to deliver the levels of customer service which our customers require.
- Severe or exceptional weather events become more frequent and violent which in exceptional circumstances lead to flows that threaten to overwhelm our wastewater network.

7.2. Opportunities

- Novel improvements in ‘intelligent sewers’ telemetry, automation and control reduce flooding and pollution incidents more effectively than predicted.
- More effective joint stakeholder collaboration, working with local authorities, the EA, landowners, industry and academics achieves common goals. (e.g. SuDS)
- ‘Smart sewers’, improved telemetry and analytics used to enhance wastewater storage in the network and improve the performance of wastewater treatment work well during severe weather. We will be exploring these techniques in AMP6 and hope to be able to develop and test new ways of working in AMP7.

8. Appendix 1: List of Named Schemes

See [TA.12.WW02 Network Pumping Stations](#) and [TA.12.WW04 Sewers and Rising Mains](#) for details of schemes.

9. Appendix 2: Further Information

9.1. Benefits of Internal Flooding Reduction Activities

An improvement in base maintenance activities are forecast to reduce internal flooding incidents by nine per year in AMP7.²¹ The additional AMP7 investment of £10.2m on flooding reduction activities will reduce the number of incidents by a further 25 to 48 per year.²¹

The forecast benefits shown in Table 9 are based on advice from subject matter experts and historical benefits from expenditure on similar activities. Where we have lower confidence in potential benefits, we have been conservative in the forecast reduction in incidents.

²¹ Enhancement activities to reduce flooding (Internal_Flooding_Matrix_v4, SW, 2018)

Table 9 Activities to Improve Internal Flooding Performance in AMP7²¹

	Activity	Description	Estimated reduction incidents p.a.
Opt. FI1	Internal flooding mitigation activities		9
Opt. FI5	Intense FOG education (zones)	FOG and Unflushables education campaign in zero flooding zones that have a high concentration of incidents due to blockages	5 - 10
	Intense FOG education (industry)	As above, but focused on food establishments and industry that creates FOG that can find their way into the sewers	3 - 6
	FOG trial bio-chemicals	Use of bio-chemicals to break up FOG in the sewer	3 - 6
	Linked sewer level monitors	Sewer level monitors installed in the network to supply real-time information on flows to provide warning of potential flooding	3 - 6
	Predictive modelling	Predictive modelling software in conjunction with real-time information to predict the location of potential flooding	3 - 6
	Optimisation and control	Control high flows in the sewers to prevent flooding using real-time information, predictive modelling etc.	4 - 7
	SuDS	Use SuDS to manage or slow down surface water run-off	4 - 7
	Sub-Total Enhancement		
Total			34 - 57

9.2. Benefits of External Flooding Reduction Activities

In 2017/18, our performance for external flooding was 4,724 incidents. Our preferred option FE1 is estimated to reduce the number of incidents by 1,425 to 3,299 incidents which is average performance. This would be achieved by installing external flooding mitigation at 481 properties which are responsible for approximately 1,050 repeat incidents per year as reported in 2016. In addition, external flooding mitigation would be provided at a further 375 properties to achieve a total reduction of 1,425 incidents.

9.3. Benefits of Pollution Reduction Activities

Our base maintenance activities are forecast to reduce pollution incidents by 9 per year. For our preferred option PO5, the additional AMP7 investment of £10.7m on enhanced activities at wastewater pumping stations will reduce the number of pollution incidents by a further 9 to 20 per year.

The forecast benefits shown in Table 10 are based on advice from subject matter experts and historical benefits from expenditure on similar activities. Where we have lower confidence in potential benefits, we have been conservative in the forecast reduction in incidents.

Table 10: Activities to Improve Pollution Performance in AMP7²²

	Activity	Description	Reduction in incidents p.a.
Option PO1	WPS maintenance	Enhanced pump replacement programme on pumps with a history of pollution incidents	3
	Rising main maintenance	Planned maintenance targeted on rising mains and air valves with a history of pollution	4
	Flow reduction (infiltration)	Infiltration reduction will reduce flows which will reduce the risk of pollution by increasing capacity	2
		Sub-Total Base	9
Option PO5	WPS FOG	FOG education campaign in sub-catchments where WPS have a history of pollution incidents due to FOG	2 - 5
	Flow management	Install flow meters at WPS that currently have no flow or level meters to improve monitoring	1 - 4
	Pumping resilience	Increase pumping resilience at higher risk sites. 'Smart pump' activities to improve resilience and reduce power consumption.	2 - 5
	Conditional alarms	Install alarms at WPS and use criticality based maintenance to reduce the risk of pollution	4 - 6
		Sub-Total Enhancement	9 - 20
	Total		18 - 29

²² Pollution performance improvement v7 (SW, 2018)