TA.12.WW03 Outfalls, CSOs and Detention Tanks

Business Case

September 2018
Version 1.0

1. Executive Summary

Name of business case	WW03 Outfalls, Combined Sewer Overflows (CSO) and Detention Tanks
Context	We have a coastline of 700 miles which contains 1,514 coastal and estuarine outfalls. The number of internal flooding incidents due to the blockage of outfalls by shingle or tidal locking has increased from zero in 2013 and 2014 to 39 in 2015 to 2017. Additionally, we need to increase the inspection of our long sea outfalls to better understand their condition and maintenance needs. We will continue to reduce the number of pollution incidents attributed to CSOs and detention tanks which decreased from 14 in 2014 to 4 in 2017. CSO screens will reach the end of their asset lives in AMP7 and we need to improve the quality of rivers and bathing waters.
Customer and stakeholder views	Customers and stakeholders expect us to 'do the basics brilliantly' and maintain and operate our assets to protect the environment from pollution and protect their properties from flooding.
Our aim	a) We aim to deliver Quartile 1 performance for internal flooding and pollution incidents b) We will increase the resilience of our outfalls to blockage by shingle, sea level rises and more storms due to climate change c) We will further improve river and bathing water quality
Scope of this business case	All capital maintenance and base opex investment relating to 2,185 outfalls, 27 long-sea outfalls, 162 navigational aids, 791 CSOs, 148 emergency overflows and 85 detention tanks. Enhancement investment to extend Black Rock outfall.

	Botex	**Enhancement**	**Total**
Totex (£'m)	£10.6m	£4.5m	£15.1m
Opex (£'m)	£3.5m	£0m	£3.5m
Capex (£'m)	£7.1m	£4.5m	£11.6m
Residual, post-AMP7 capex (£'m)	-	£2.5m	-
20 year Whole life Totex (£m)[37]	£1.066	-	-
20-year cost benefit (£m)	-£557.044	-	-
Materiality (% 5 year Totex for WW Networks +)	-	-	0.6%
Relevant business plan table lines	WWS1 5, WWS1 12	WWS2 27	
Botex – Base maintenance of outfalls, CSOs and detention tanks			
Overview of AMP7 proposals	We are investing £10.6m over AMP7 which includes £2.5m for the maintenance of our short-sea outfalls to provide greater resilience to blockage by shingle and tidal locking. We will spend £0.7m to inspect and repair long-sea outfalls to help maintain and improve bathing water quality. We will continue to maintain navigational aids to meet our obligations for £3.4m. To maintain river and bathing water quality, we will invest £2.5m for the planned replacement of CSO screens.		

Why are the proposals the best programme- level option for customers	We have assessed three options for the maintenance of outfalls and five options for the maintenance of CSOs. Our preferred options would have the least whole life cost and be affordable to our customers. We have discounted options that would be unaffordable or would lead to an unacceptable deterioration in performance.
What we would like to highlight	We will increase efficiency through the use of key innovations in AMP7, which include investigating the use of thermal imagery from satellites to detect the leakage of relatively warm wastewater from outfalls and identify potential repairs. We will assess the use of automatic detention tank cleaning systems to reduce costs and increase safety.
Enhancement to extend Black Rock outfall in Brighton	
Need for enhancement / investment	An enhanced level of service is required to protect customers from flooding due to circumstances outside of our control
Overview of AMP7 proposals	Black Rock wastewater pumping station has a combined emergency overflow to protect properties in Brighton from flooding by high flows of stormwater. The overflow outfall is frequently blocked by shingle due to natural drift, wave action and a reduction in shoreline management by others. Removal of the shingle is futile as it builds up again within a week of clearance. Our enhancement investment of £4.5m will enable us to extend the outfall to prevent blockage.
Why the proposals are the best programme-level option for customers	An alternative solution would be the removal of a significant quantity of beach shingle between the outfall groyne and the Brighton Marina west wall. However, the shingle would eventually build up again at the outfall with the risk of blockage in the future.
Customer and stakeholder support	Prevention of internal and external sewer flooding is a high priority for customers.
Need for a CAC	Not applicable
Extent of management control (if relevant)	Shoreline management by others and sea level rises due to climate change are outside of our management control
Robustness and efficiency	Our cost estimating team have provided an estimated project cost based on robust cost-curves that have been benchmarked against actual costs. An efficiency factor has been applied to the cost estimate.
Customer protection (if relevant)	Our ODI for internal flooding incidents will protect customers from non-delivery of this enhancement investment
Affordability considerations	Extending the outfall would be beneficial to our customers compared to continual Opex to reprofile the beach and remove shingle. The potential cost of property flooding has also been taken into account.
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**
Internal flooding incidents	Low	Aim to achieve Quartile 1 performance for internal flooding supported by reducing incidents due to outfall blockage.
External flooding incidents	Low	
Pollution incidents	Low	Supports our aim to achieve Quartile 1 performance

Bathing water quality	Low	Increased maintenance of outfalls and CSO screen replacement will support an improvement in water quality
River water quality	Low	

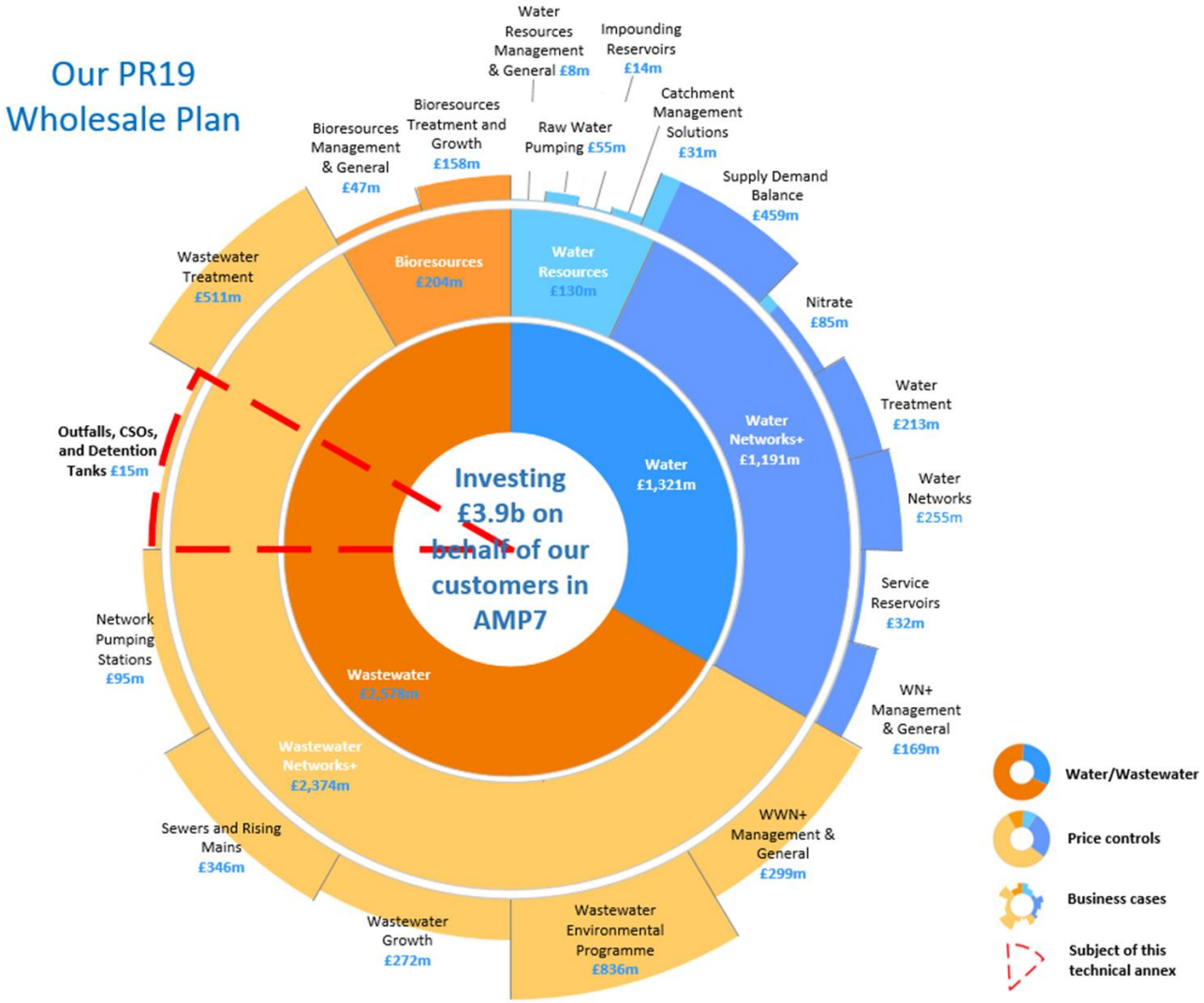
Schemes and scheme-level options			
Schemes over £20m	**Options**		
	Description	**Cost**	**Selected option and rationale**
None			

Contents

2. Scope of Technical Annex

This technical annex describes our proposed £15.1m investment relating to the maintenance of outfalls, CSOs and detention tanks. This represents 0.6% of the Wholesale Wastewater Networks + Plan of £2,374m.

Figure 1: Our PR19 Wholesale Plan[1]



[1] Business case investment data (Gold Lockdown 4, SW, 2018)

The following assets are within the scope of this plan:

- 2,185 outfalls which includes 1,514 coastal and estuarine outfalls[2]
- 27 long-sea outfalls[3]
- 162 navigational aids[4]
- 791 combined sewer overflows (CSO) [5]
- 148 emergency overflows (EMO)[5]
- 85 detention tanks[6]

Other assets on the sewer network are detailed in TA.12.WW02 Network Pumping Stations and TA.12.WW04 Sewers and Rising Mains.

The Bathing Water enhancement programme and event duration monitors at outfalls are detailed in TA.12.WW06 Wastewater Environmental Programme.

3. AMP6 Strategy

3.1 Investment Strategy

We halved the number of Category 3 pollution incidents between 2014 and 2017, meeting and beating our promise to customers. We are protecting customers' homes and businesses by reducing internal sewer flooding incidents by 25% in AMP6.[7]

Our Bathing Water Enhancement Programme will bring seven bathing waters up to the 'excellent' classification by 2020.[7] The performance of our outfalls and CSOs can potentially affect bathing water quality along with other factors such as misconnections of foul to surface water sewers, highway drainage and animals/birds will also have an impact.

The investment programmes in AMP5/6 related to outfalls and CSOs are outlined below:

- We have carried out inspections and reactive repairs of outfalls including tidal and flap valves.
- We have carried out planned inspection and repairs of navigational aids to meet our obligations under the Merchant Shipping Act (1995).
- Traditional methods to survey long-sea outfalls remain problematic, hence we are investigating new innovative methods for surveying.

[2] Number of SSO (PR19 Outfalls at Risk, SW, 2017)
[3] Number of LSO (Long Sea Outfall Inspection Proposal, Beasley Christopher Ltd, 2012)
[4] Number of navigational aids (AMP6 Investment Paper, SW, 2016)
[5] Number of CSOs and EMOs (2017-18 APR for Ofwat, SW, 2018)
[6] Number of detention tanks (Catalogue, SW, 2017)
[7] AMP6 commitments (Wholesale Monitoring Plan 2015-20 v7.8, SW, 2018)

- In AMP5, we constructed a new 2.5 km long-sea outfall to discharge treated effluent from the Peacehaven Wastewater Treatment Works which serves the Brighton area.
- We routinely carry out inspections, cleaning and maintenance of CSOs and detention tanks. If an incident occurs at a CSO, we will carry out an investigation to determine the cause and whether further work is required.
- In AMP6, we are installing Event and Duration Monitors (EDMs) at 489 overflows as part of the National Environment Programme (NEP).[7] Priority is being given to installing EDM at overflows that discharge into sensitive waters such as shellfish waters, protected areas and bathing waters.

Table 1 summarises the expenditure in AMP6 on the maintenance of outfalls, CSOs and detention tanks.

Table 1: AMP6 Expenditure (£m) on the Maintenance of Outfalls, CSOs and Detention Tanks (2017-18 Prices)[1]

	AMP6 Actual					
	2015/16	2016/17	2017/18	2018/19	2019/20	AMP6 Total
TOTEX	**0.797**	**2.073**	**3.442**	**0.606**	**0.571**	**7.490**
CAPEX	**0.411**	**1.499**	**3.242**	**0.035**	**0**	**5.186**
Short Sea Outfalls Reactive / Inspections	0	0.543	3.242	0	0	3.785
CSOs and detention tanks	0.411	0.956	0.000	0.035	0	1.401
OPEX	**0.387**	**0.574**	**0.199**	**0.571**	**0.571**	**2.303**
Navigational Aids and Outfalls	0.387	0.574	0.199	0.571	0.571	2.303

Note. AMP6 Actual comprises actual expenditure to the end of 2017-18 and current forecast expenditure in 2018-19 and 2019-20

In AMP6, our activities have been focused on inspections and reactive maintenance of short-sea outfalls. Although difficult to access, we recognise the need to increase inspection and maintenance of long sea outfalls. We have met our obligations under the Merchant Shipping Act (1995) regarding the maintenance of navigational aids.

Figure 2 shows the average annual number of activities[8] carried out on outfalls and navigational aids in AMP5 and AMP6.

[8] Number of activities relating to outfalls and navigational aids (Operational data, SW, 2017)

Figure 2: Average Annual Number of Activities Relating to Outfalls and Navigational Aids (2013-14 to 2015-16)

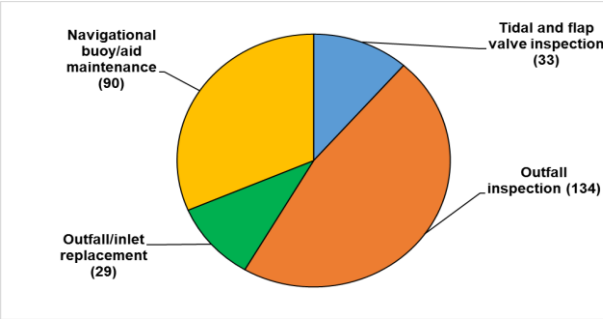


Figure 3: Number of Activities Relating to CSOs in 2015-16

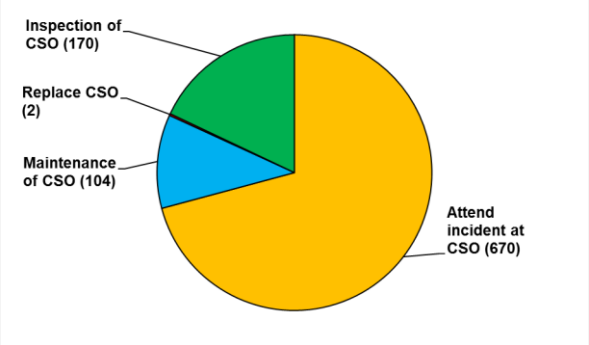


Figure 3 shows the number of activities[9] carried out on CSOs in a typical year in AMP6. The majority of our activities on CSOs are reactive attendance at incidents. We will rebalance the maintenance approach, with an increase in planned maintenance expected to reduce the number of incidents requiring attendance.

The installation of Event and Duration Monitors (EDMs) at 489 overflows in AMP6 will provide us with a greater understanding of discharges into sensitive waters. This will enable us to improve the quality of bathing waters, shellfish waters and protected areas which will benefit our customers, the environment and the local economy.

The low level of planned maintenance of outfalls and CSOs in AMP6 has informed our AMP7 investment strategy which is described in Section 5.1.

3.2 Customer Benefits and Resilience

Our investment has delivered stable serviceability and delivered positive outcomes for customers under the following sewer network performance commitments:

- We **reduced internal flooding incidents** (excluding severe weather) from 581 in 2013-14 to 401 in 2017-18 – placing us at the industry median in 2016-17[10]
- In comparison to other water and sewerage companies, our performance on **external flooding incidents** was below the median in 2016-17[10]
- We **reduced Category 1 to 3 pollution incidents** by 62% from 324 in 2013 to 123 in 2017 – a 62% reduction, though average performance in 2017[10]

[9] Number of activities relating to CSOs (Operational data, SW, 2017)
[10] Historical and forecast performance (Wastewater PC Predictions v15, SW, 2018)

- Of the 83 designated bathing waters across our region, 53 achieved **'excellent' bathing water quality** status in 2017[11] There were no 'poor' bathing waters in our region in 2017.

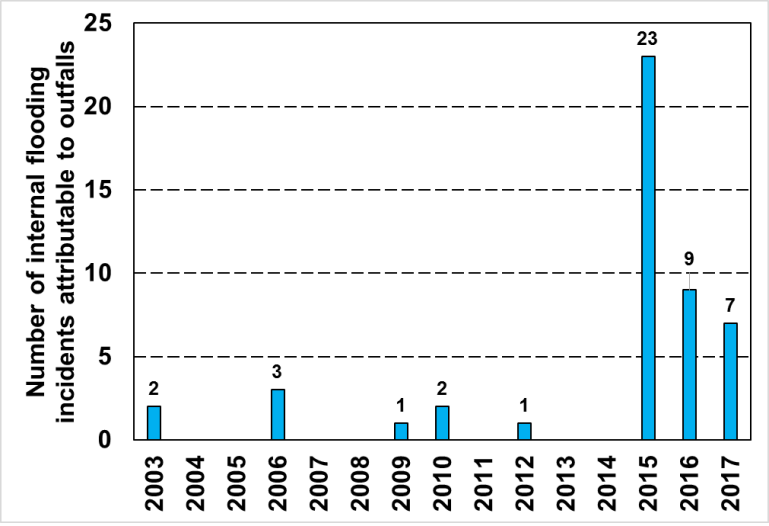
However, with regards to the serviceability and resilience of outfalls and CSOs, there has been a deterioration in performance:

- In AMP5, there were three internal flooding incidents due to outfalls but this increased to 39 incidents in AMP6 to date.[12]
- A reduction in shoreline management by third parties has caused outfall diffusers to become blocked which has contributed to the rise in internal flooding incidents caused by outfalls.

3.2.1 Flooding Incidents

Figure 4 shows that there were three internal flooding incidents due to outfalls in AMP5 (2010 to 2014) but this increased to 39 incidents in AMP6 to date (2015 to 2017). The significant increase in incidents in AMP6 is mainly due to an increase in blockages of outfalls by shingle caused by a reduction in shoreline management by third parties. Tidal locking of outfalls has also prevented discharges into the sea. This has increased risk / costs as clearing outfalls is slow and labour intensive. The increase in internal flooding incidents has impacted on our customers and has affected our performance commitment to reduce internal flooding incidents by 25% in AMP6[7]

Figure 4: Internal Flooding Incidents Attributed to Outfalls in AMP5 and AMP6[12]

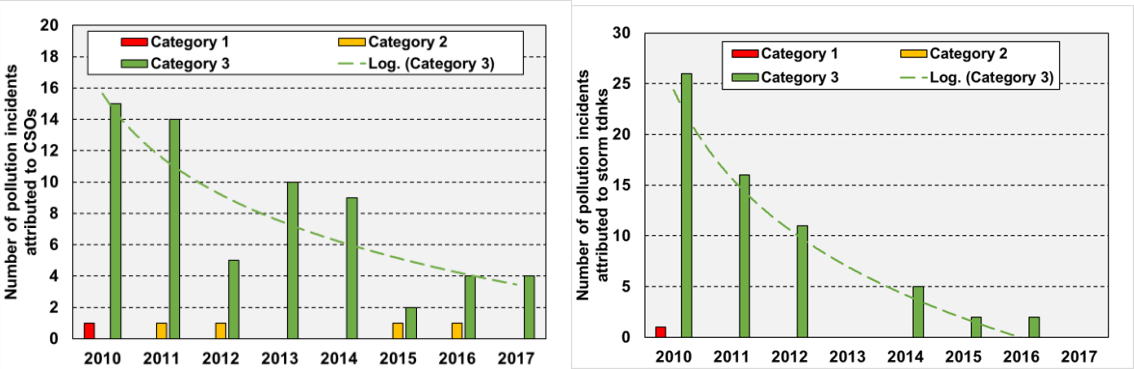


[11] Bathing water classification for 2017 (EA, 2017)
[12] Flooding incidents due to outfalls (SIRF data, SW, 2018)

3.2.2 Pollution Incidents

Figure 5 shows the number of pollution incidents attributed to CSOs and storm tanks in AMP5 and AMP6 (to date). Both graphs show a steady reduction in Category 3 pollution incidents between 2010 and 2017.

Figure 5: Pollution Incidents Attributed to CSOs and Storm Tanks[13]



The capital maintenance of our CSOs and detention tanks and other pollution reduction measures has improved their performance during AMP5 and AMP6. The maintenance has ensured that these assets continue to protect our customers' properties from flooding during storms and heavy rainfall.

The increase in monitoring of our CSOs in AMP6 will enable us to improve our compliance with the permits for releases at overflows which affect bathing or shellfish waters. We will develop a better understanding of the factors resulting in releases so that we can manage these better in the future and improve the quality of rivers and bathing waters in our region.

3.2.3 Resilience of Outfalls

We carry out surveys in a rolling programme to inspect our 1,514 coastal and estuarine outfalls[2] at regular intervals. If the surveys identify a defect that poses a risk to health and safety, then an emergency repair will be carried out. Other non-urgent maintenance is normally planned and carried out in the year following the survey.

Outfalls and flap valves have a design life of 50 years and 25 years respectively.[14] However, a coastal or estuarine environment can reduce outfall asset lives by approximately 20 years and flap valve asset lives by 4 years on average.[14]

Some of our outfall pipes have corroded resulting in leakage close to the shoreline. We replace corroded sections of pipe and also remove redundant outfalls that create a hazard

[13] Pollution incidents attributed to CSOs and storm tanks (SW report to EA, 2010 to 2017)
[14] Design lives for outfalls and flap valves (Practical guidance on determining asset deterioration, EA, 2013)

to shoreline users. Due to their relatively short life, we repair or replace flap valves more frequently. Major projects to repair or replace outfalls are evaluated as an ARM (Asset Risk Management) risk and are considered for inclusion in future business plans.

In AMP6, our short-sea outfalls have become increasingly buried in shingle due to natural wave movement and/or a lack of shoreline management by third parties.[15] The shingle blocks diffusers and outfall pipes which increases the risk of flooding of customers' properties and pollution from manholes etc. upstream of the outfall. Currently 53 outfalls are at risk of shingle movement.[16]

We need to work with other stakeholders who are responsible for shoreline management so that they understand the risk caused by shingle blocking outfalls and the potential impact on our customers.

Sea level rises are also restricting the operation of our outfalls with 62 outfalls currently at risk of tidal locking with 123 properties at risk of flooding (DG5 risk).[17]

3.2.4 Resilience of Long-Sea Outfalls

We operate 27 long-sea outfalls that range in length from 100 m to 4.5 km.[3] They discharge either treated effluent from wastewater treatment works or screened dilute wastewater from CSOs. The long-sea outfall enables the discharge to be at a location which reduces the impact on bathing water or shellfish water quality in the vicinity.

Outfalls are vulnerable to corrosion and they can also be damaged by ships' anchors or fishing activities. The inspection and maintenance of long-sea outfalls has been restricted in recent AMP periods. This is partly due to difficulties in inspecting long sea outfalls in storm conditions (when they are likely to be in use). This is why we are looking at innovative satellite imagery as an alternative means of inspection (see Section 5.3)

We need a greater understanding of the structural integrity of our long-sea outfalls particularly where leaks could potentially affect bathing water quality.

3.2.5 Resilience of Navigational Aids

We operate 162 navigational aids[4] which mark the location of our sea outfalls and help to prevent damage to shipping or the outfalls. These navigational aids include fixed metal painted poles, pillars and tripods which may have fixed or flashing lights. We are also responsible for maintaining a number of floating marker buoys which are kept in position by a chain fixed to a sinker block on the sea bed.

[15] Shoreline Management Plans (EA/ local councils, 2009)
[16] Outfalls at risk from shingle (PR19 Outfalls at Risk, 2017)
[17] Outfalls currently at risk from tidal locking (PR19 Outfalls at Risk, 2017)

Under the Merchant Shipping Act (1995) and the Port Marine Safety Code, we are responsible for ensuring that our aids to navigation meet guidelines and recommendations laid down by the Lighthouse Authorities and the International Association of Marine Aids to Navigation. To meet our responsibilities, we carry out regular inspections to check the structural integrity of our navigational aids and navigation lights. Buoys can be damaged by shipping or storm conditions and may require replacement. A failed lighting mechanism will be repaired as a matter of urgency to reduce the risk to shipping.

3.2.6 Resilience of CSOs

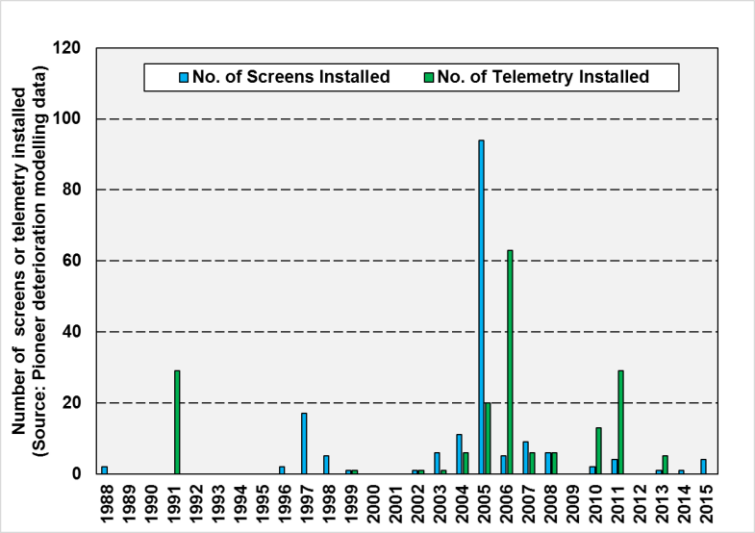
Our combined sewer overflows are generally comprised of a concrete weir which is overtopped during high stormwater flows so that the dilute screened wastewater is released to a watercourse rather than backing up through manholes or toilets. CSOs protect homes and businesses from flooding during high flows.

In the past, these long-life concrete assets have required minimal maintenance. However, since the beginning of AMP2, we have carried out environmental improvements at a number of CSOs. These improvements have included the installation of short and medium life assets such as screens to improve the visual quality of the wastewater released by the CSO. We have also installed telemetry to monitor the number and duration of releases into the environment.

Figure 6 shows that the majority of CSO screens and telemetry were installed in 2005 and 2006 at the beginning of AMP4. CSO telemetry installed in 2006 (on average) is now at the end of its 10 year asset life whilst CSO screens installed in 2005 (on average) will reach the end of their 20 year asset life by the end of AMP7.[18] The replacement or major refurbishment of these assets will be required in the near future.

[18] Asset lives for CSOs and detention tanks (Fixed Asset Review, Chandler KBS, 2008)

Figure 6: CSO Screen and Telemetry Installation Dates[19]



3.2.7 Resilience of Detention Tanks

Detention tanks are long-life concrete assets which require periodic inspection and maintenance to preserve the structural integrity of the tank. Due to the build-up of rag, silt and fat, these tanks also require cleaning to ensure that the tank has the maximum available volume for holding stormwater and wastewater. Detention tanks may also contain short and medium life assets such as storm pumps to empty the contents of the tank back into the sewer when the storm has passed. These pumps require ongoing refurbishment and will eventually require replacement.

4. Drivers for Change

4.1 Customer and Stakeholder Views

As outlined in Chapter 4 - Customer and Stakeholder Engagement and Participation, we used insight from our extensive programme of customer and stakeholder engagement to develop a deep understanding of their views and priorities. From an environmental perspective, we have also drawn on the views of a diverse range of non bill-paying customers who utilise water across our region through stakeholder panels, workshops and audits, including the Environment Agency, Natural England and local authorities. All insight gathered from our customer and stakeholder engagement programme can be found in Chapter 4.

[19] Installation dates for CSO screens and telemetry (Pioneer deterioration model data, SW, 2018)

Prevention of internal and external sewer flooding is a high priority for customers. Customers empathise with those that have experienced flooding and believe that it is a terrible event. Our performance was average for internal flooding but below average for external flooding. Despite improvements in performance in recent years there is a high desire to see us improve our network to prevent sewage flooding.

Our customers believe we have a duty to protect and enhance the environment. 'Doing no harm to the environment' has been outlined as a minimum requirement for customers, whilst protecting and enhancing the natural environment is the level of service that customers expect. Customers want water and wastewater services to be delivered in an environmentally friendly way now and in the future.

Maintaining the health of our water and wastewater assets is a high priority for customers. They expect us to ensure we can deliver the same level of services in an environmentally friendly manner for future generations. Avoiding pollution incidents is a medium priority for customers. Similarly, our stakeholders expect us to improve how we measure our environmental impact and to heavily reduce our impact on the environment. Environmental groups, some local authorities and regulators want to see significant improvements on pollution. Blueprint for Water has echoed these sentiments and want us to aim for zero pollution incidents, 100% monitoring of CSOs and 100% self-reporting of incidents. The Environment agency are pushing for a 40% improvement in performance from 2016 figure by 2025 as part of WISER. Regulators and the Blueprint believe companies should not be rewarded through ODIs for complying with the statutory minimum.

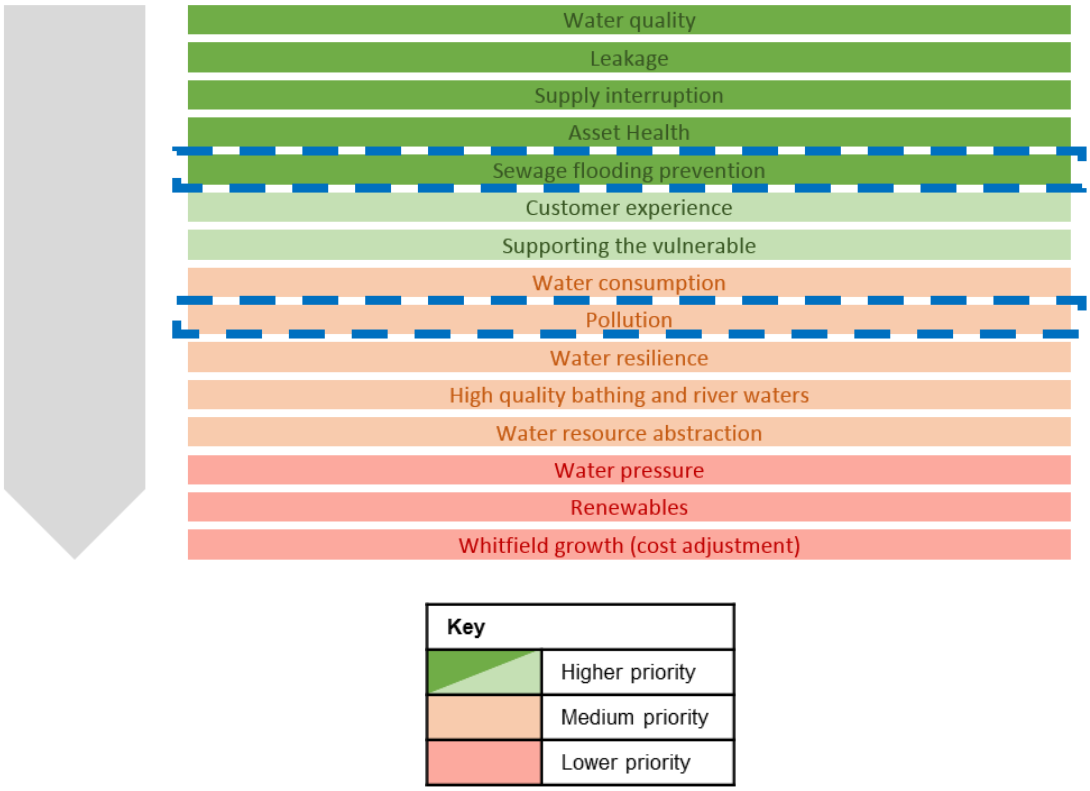
Customers and stakeholders see protecting the environment from pollution as a partnership. They expect us to 'do the basics brilliantly' and maintain and operate our pumping stations (and other equipment) to protect the environment from pollution. Our customers also understand that reducing blockages caused by customers placing fats, oils, grease and wet wipes into the network will help protect the environment and reduce pollution. Customers indicated that they would like us to help increase education on what they should and should not be disposing of down the drain and explore in-home innovations to limit this behaviour. Our stakeholders also express strong support for education/community engagement on FOG.

In line with customers' view of protecting and enhancing the natural environment, customers want us to ensure that the standard of river water quality is improved. Customers want to ensure that rivers in the surrounding area provide habitats for wildlife. Customers asked us to consider the impact of activity on marine wildlife. Customers expressed that we should prioritise areas of river water to be improved based on whether the areas are used for water based activity, such as sailing and bathing.

Customers and visitors to the region, and business customers in the local area, value and want bathing waters that are at the sufficient legal quality level. Customers see bathing waters as part of the natural environment and expect us to cause no harm to them. Our vulnerable customers are particularly focused on protecting the natural environment with around twice as many vulnerable customers as non-vulnerable customers indicating this as a key service area. Figure 7 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 7: Relative Priority of Services According to Our Customers



We have used this understanding of our customers' priorities to define a set of performance commitments and investment proposals, and validated then refined these over the course of our programme of customer engagement. Our success at delivering on these priorities for our customers will be measured by the performance commitments outlined in this technical annex.

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**

- Significant changes in regulatory expectations require an improvement to Quartile 1 performance for pollution and internal flooding.[20]
- Regulatory requirement to quantify and improve the long-term health of sewerage assets and resilience to future pressures.
- Potential increases in FOG, wet wipes and other unflushable materials. Population growth may drive this trend.
- More extreme weather events[21] increasing surface water flows in pumping stations and rising mains.

2. **Regional and Company resilience issues**

- The population in the South East is predicted to grow by 8.1% over the ten years to 2024.[22] By 2045, there will be 20% more people and 500,000 new homes[22], increasing wastewater flows and reducing existing capacity.
- We have over 700 miles of coastline[23] and a high proportion of our outfalls and CSOs are located in coastal towns and cities which makes them vulnerable to:
    - Sea levels rises which are predicted to be 21-68cm for London between 1990 and 2095[24] and is increasing the risk of tidal locking
    - Faster deterioration of assets due to saline sea, river and groundwater
    - Changes in shoreline management in our region by third parties[15] which has resulted in shingle building up against our outfalls.

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

[20] Chapter 6 - Outcomes, Performance Commitments and ODIs (SW, 2018)
[21] Increase in extreme storms (UK Climate Projections, Defra, 2009)
[22] Population growth (Let's Talk Water, SW, 2017)
[23] Coastline length (Let's Talk Water, SW, 2017)
[24] Sea level rise (UK Climate Projections, Defra, 2009)

5. AMP7 Strategy

5.1 Investment Strategy

By developing a clear understanding of the key future trends and pressures described above we have arrived at a proposed AMP7 totex of £10.6m on the base maintenance of outfalls and CSOs, a £3.1m increase in comparison to our AMP6 forecast actual expenditure. In addition, we are proposing enhancement expenditure of £4.5m to increase resilience by extending the outfall at Blackrock PS.

Our investment in outfall and CSO maintenance will contribute to an improvement towards Quartile 1 performance for internal flooding and Category 1 to 3 pollution incidents. This investment will improve our services to customers whilst keeping bills affordable.

Table 2: AMP7 Expenditure (£m) on the Maintenance of Outfalls and CSOs (2017-18 prices)[1]

	AMP7			
	Price Control	QBEG	Ofwat Table	AMP7 Total
TOTEX				**15.107**
CAPEX				**11.583**
LONG sea Outfalls	Wastewater networks +	Base Main - Infra	WWS1 Line 12	0.458
Short Sea Outfalls planned & Reactive	Wastewater networks +	Base Main - Infra	WWS1 Line 12	2.458
CSOs and detention tanks	Wastewater networks +	Base Main - Infra	WWS1 Line 12	4.163
Resilience (Blackrock CEO outfall)	Wastewater networks +	Enhancement	WWS2 Line 27	4.504
OPEX				3.524
Navigational Aids & Outfalls	Wastewater networks +	Base Main - Infra	WWS1 Line 5	3.354
Outfall Inspections Long Sea Outfalls	Wastewater networks +	Base Main - Infra	WWS1 Line 5	0.170

Our AMP7 investment strategy for the maintenance of outfalls and CSOs includes the following:

- We will invest £2.5m on the planned and reactive maintenance of short-sea outfalls. This investment will enable us to carry out improvements to outfalls where sea level rises and blockage by shingle is creating a high risk of internal flooding for customers' properties upstream of these outfalls.[16]

- Our business plan includes investment of £0.7m for the inspection and planned maintenance of long-sea outfalls as there has been minimal maintenance of these assets for over 15 years. A partnership scheme to maintain Seaford Groyne and the outfall at this location is included in TA.12.WW04 Sewers and Rising Mains.
- A further £4.5m of enhancement investment will improve the resilience of Blackrock outfall to blockage by shingle and protect homes and businesses from flooding.
- We will continue to meet our obligation to maintain navigational aids through our AMP7 budget of £3.4m.
- Our investment of £4.2m on CSOs and detention tanks includes £2.5m to replace or refurbish CSO telemetry and screens which will reach the end of their asset lives in AMP7.[18]
- The increase in planned expenditure in AMP7 will support an improvement towards Quartile 1 performance for internal flooding and pollution incidents whilst increasing the long term resilience of our outfalls to sea level rises and more extreme storms.
- This investment will also protect bathing water and shellfish water quality in our region.

5.1.1 Short-Sea Outfalls Planned and Reactive Maintenance (Capex)

We have carried out an assessment of short-sea outfalls which have a high risk of causing flooding to customers' properties due to tidal locking, sea level rises and blockage by shingle. We also looked at the risk of a blocked outfall causing pollution of designated sites or having a detrimental effect on bathing water and shellfish water quality.

Our study identified 62 outfalls where there is currently a high risk of internal flooding at 123 linked DG5 properties.[17] By 2095, this would increase to 84 outfalls creating a high risk of internal flooding at 147 linked DG5 properties due to the forecast rise in sea levels caused by climate change.[25]

We have considered three options for the planned maintenance of short-sea outfalls to prevent blockage by shingle, pollution of bathing waters and to maintain public safety:[26]

OU1 = Base option of 50 optimised schemes (£1.9m)
OU2 = Low cost schemes (36 selected £0.9m)
OU3 = All schemes with 4.6 year benefit return or less (£2.6m for 43 schemes)

Using whole life cost modelling we have identified our preferred option is to carry out 50 schemes in AMP7 for a budget of £1.9m. We have discarded options that have an

[25] Outfalls at risk of tidal flooding in 2095 (PR19 Outfalls at Risk, SW, 2017)
[26] See Section 5.2

unacceptable impact on customers' bills or serviceability performance. We have also included £0.6m for ongoing reactive inspections and maintenance of short-sea outfalls.

In addition, we will work with other stakeholders who are responsible for shoreline management to reduce the risk of shingle blocking our outfalls.

5.1.2 Navigational Aids Planned Maintenance (Opex)

Our AMP7 investment strategy for the maintenance of navigational aids will be £3.4m to enable us to carry out the inspection and repair of navigational aids to meet our obligations under the Merchant Shipping Act (1995).

5.1.3 Long-Sea Outfalls Planned Maintenance and Inspection (Capex and Opex)

We operate 27 long-sea outfalls that range in length from 100 m to 4.5 km[3]. The inspection and maintenance of long-sea outfalls has been restricted in recent AMP periods and there is a need to understand their current condition. Although outfalls have a relatively long life[14], they can be damaged by shipping and the movement of shingle. The corrosion of steel pipes or reinforcement bars in concrete structures can result in the leakage of final effluent from wastewater treatment works or diluted untreated screened wastewater from combined sewer overflows.

Climate change is predicted to increase sea levels[24] and increase the number of extreme storms in our region.[21] This would have an impact on the movement of shingle along our coastlines which could potentially damage or block our outfalls. An increase in stormy sea conditions could also potentially damage outfalls or cause shipping to damage them. We need to ensure that our long-sea outfalls are resilient to the pressures that are being imposed by climate change.

With the support of our customers we are committed to the improvement of our bathing waters in AMP7.[20] Of the 83 bathing waters in our region, 54 are in reasonable proximity to a long-sea outfall.[27] There is a risk that leaking outfalls could affect the quality of these bathing waters.

Our AMP7 investment for long sea outfalls includes £0.2m for inspection work which has been based on historical costs provided by a specialist marine contractor with extensive experience in the inspection of outfalls. We will investigate innovative new ways of inspecting outfalls using satellites and RADAR which may reduce inspection costs in the future.

[27] Number of bathing waters in close proximity to a long-sea outfall (SW, 2018)

We have also included a budget of £0.5m to carry out high priority repair works identified by the inspections. Medium to low priority repair work will be considered for inclusion in future AMP periods.

In TA.12.WW04 Sewers and Rising Mains, our budget includes our contribution to a partnership scheme to maintain our outfall and a groyne as part of the Seaford flood defence, this is part of a wider flood resilience programme being led by the Environment Agency. Seaford beach provides a 1 in 200 standard of protection to Seaford town from coastal flooding. Our outfall also acts as a terminal groyne for the beach, which prevents longshore drift from carrying the shingle past Seaford Head. Our outfall has been subjected to erosion from the sea and shingle and will need to be reinforced.

5.1.4 Black Rock Outfall Planned Improvements (Capex)

If stormwater flows are excessively high at Black Rock Wastewater Pumping Station (WPS), then the Combined Emergency Overflow (CEO) enables stormwater and dilute sewage to be released into the sea. The overflow was constructed to protect homes and businesses from flooding in low lying areas of Brighton.

Due to wave action, longshore drift and a reduction in shoreline management, shingle quickly builds up around the end of the sea outfall which causes it to block. This puts properties at risk of flooding including a DG5 property. Attempts to remove the shingle have been futile and expensive as the shingle builds up again within a week of clearance. The issue has been raised in our ARM (Asset Risk Management) system.[28]

Our AMP7 business plan includes £4.5m to extend Black Rock outfall to prevent blockage by shingle and protect local properties from flooding with a further £2.5m of investment in AMP8. Further information within document '*AM415 Blackrock outfall'* compares capex solutions against annual operational shingle re-profiling costs of £126,000 per year.

5.1.5 CSO and Detention Tanks Planned and Reactive Maintenance (Capex)

We have considered four options[26] for the planned maintenance of CSOs to improve the quality of bathing waters and to maintain public safety:

CS1 = Base option – Top 96% cost beneficial schemes (£2.5m)
CS2 = Top 88% cost beneficial schemes and Health and Safety planned (£2.4m)
CS3 = Top 94% cost beneficial schemes and HS planned (£2.8m)
CS4 = Top 97% cost beneficial schemes and HS planned (£3.6m)

[28] Black Rock CEO outfall (ARM, SW, 2018)

Using whole life cost modelling we have identified our preferred option of £2.5m on the planned maintenance of CSOs.[26] This will enable us to replace or refurbish CSO screens which will reach the end of their asset lives in AMP7.[18] We have discarded options that have an unacceptable impact on customers' bills or serviceability performance.

We have also included investment of £1.7m on the reactive maintenance of CSOs and detention tanks.

5.1.6 Strategic Initiatives

In addition to the activities described in this section, we will achieve the required improvement in sewer network performance through our flooding strategy which allows us to adapt for the future.

Flooding Strategy

To aim for industry Quartile 1 status for internal flooding[20] and to move to average industry performance for external flooding by carrying out the following activities:

- Focus CCTV and sewer jetting in blockage hotspot and high risk areas such as Zero Flood Zones.
- Sewer rehabilitation, rising main replacement and infiltration reduction.
- Expand the education team for fats, oils, greases and wet wipes.
- Increase telemetry and the number of sewer level monitors.
- ***Work on outfalls at risk of causing flooding due to blockage by sand or tidal locking.***
- Removal of Buchan traps and installation of Anti-Flood Devices
- Increase the use of sustainable urban drainage systems (SuDS) to remove surface water flow from the network.
- Create a new team to focus on the data collection and analysis related to external flooding.

Our flooding and pollution strategies are discussed in more detail in TA.12.WW07 Flooding and Pollution Strategies.

5.2 Plan Options

5.2.1 Plan Options for Short-Sea Outfall Maintenance

To inform our business plan, we have assessed three options for the planned repair, replacement or extension of short-sea outfalls using cost-benefit analysis:

OU1 = Base option of 50 optimised schemes (£1.9m)
OU2 = Low cost schemes (36 selected £0.9m)
OU3 = All schemes with 4.6 year benefit return or less (£2.6m for 43 schemes)

We carried out our assessment based on a desk top study of the risk of outfalls becoming blocked by tidal locking or shingle both now and in the future due to sea-level rises. We investigated the consequential risk of a blocked outfall causing the flooding of customer's properties or pollution of designated sites, bathing waters or shellfish waters. Our study identified 62 outfalls where there is a high risk of internal flooding at 123 linked DG5 properties. By 2095, this would increase to 84 outfalls creating a high risk of internal flooding at 147 linked DG5 properties due to the forecast rise in sea levels caused by climate change.[25]

A limited asset condition survey was carried out on 101 outfalls, where it was noted that 86 outfalls have operational defects ranging from minor to material. [29]

Risk categories

To inform the cost-benefit analysis, our coastal outfalls were assessed against the following risk categories with a risk score being assigned to each asset.

A. Customer Flooding: Number of internal DG5 properties at risk per outfall
B. Sea Level: Current tide level in relation to DG5 property level
C. Climate Change: Future tide level in relation to DG5 property level
D. Serviceability: Blockage by shingle
E. Serviceability: Damage to pipe/structure
F. Beach management: Recorded volumetric change in shingle per coastal management cell due to accretion or erosion
G. Public Health and Safety: Exposure of damaged pipe or support structure presenting a hazard to the public
H. Pollution: Impact to the environment

Each risk category was also assigned a weighting to reflect the significance of the risk. Multiplying the risk score with the weighting gave a weighted score where the overall weighted score of each outfall is the sum of its weighted scores for all the risk categories. The higher the overall weighted score the more priority the outfall has received for investment to reduce the risk.

Assessment of costs

For each risk, we determined the consequential costs to the business in terms of cleaning up after flooding or pollution, public health and safety, potential prosecution and adverse publicity.

Based on information from a specialist marine contractor, we also determined generic costs to carry out the following work on an outfall to mitigate the risks:

[29] Asset condition survey of 101 outfalls (PR19 Outfalls at Risk, SW, 2017)

1. Extend or replace an outfall pipe and support structure
2. Pipe repair or replacement
3. Flap valve replacement
4. Grill/ screen replacement

Options assessment

A matrix was produced which prioritises the outfalls for investment in AMP7 based on cost benefit analysis.[30] Priority has been given to carrying our improvements to outfalls with high overall weighted scores and low investment return periods

Table 3 lists the three options we have considered for planned maintenance of short sea outfalls and the impact of these options on the service we provide to our customers. Our preferred option is to carry out 50 schemes to improve outfalls for an AMP7 budget of £1.9m. We have discarded options that have an unacceptable impact on customers' bills or serviceability performance.

Table 3: Assessment of Options for the Maintenance of Short-Sea Outfalls in AMP7[30]

No.	Description	AMP7 Totex (£k)	Full Whole Life Cost (20 years) NPV [37]	Willingness to pay support	Ofwat Priority	Other regulator priority	Customer priority	Business strategic alignment	Is this option recommended ?
OU1	Base option – 50 schemes in AMP7	£1,871	-£557044	🟢	🟢	🟢	🟢	🟢	**Yes** - An increase on customers' bills but reduces risk at 96 DG5 properties Will increase long-term resilience of outfalls.
OU2	Low cost schemes only	£920	-£556356	🟢	🟡	🟡	🟡	🟡	**No** – Less impact on customers' bills but low investment means that risk remains high for flooding and pollution due to blocked outfalls.
OU3	Schemes with return period less than 4.6 years	£2,584	-£556638	🔴	🟢	🟢	🟢	🟢	**No** – There would be a higher impact on customers' bills. in the short term and does not have the lowest whole life cost

[30] Outfall risks and generic scheme costs (PR19 Outfalls at Risk_RISK MATRIX_v0.3, SW, 2017)

5.2.2 Plan options for CSO maintenance

We have considered five options for the planned maintenance of CSOs to improve the quality of bathing waters and to maintain public safety:

CS1 = Top 96% Cost benefit schemes
CS2 = Top 88% Cost benefit schemes and Health and Safety (HS) schemes
CS3 = Top 94% Cost benefit schemes and HS schemes
CS4 = Top 97% Cost benefit schemes and HS schemes

Table 4 provides further information on the four options and the impact of these options on the service we provide to our customers. We have calculated the costs and benefits to replace or refurbish assets and we have identified schemes that have a net cost-benefit where the benefits outweigh the costs. In each option, we have included the fixed replacement of assets related to maintaining the health and safety of our staff and the general public (e.g. lifting equipment).

Our preferred option is base option CS1 which will enable us to replace or refurbish CSO telemetry and screens that will reach the end of their asset lives in AMP7 for a budget of £2.5m. We have discarded options that have an unacceptable impact on customers' bills or serviceability performance.

Table 4: Assessment of Options for the Planned Maintenance of CSOs, Detention Tanks in AMP7[31]

No.	Description	AMP7 Totex (£k)	Full Whole Life Cost (20 years) NPV (£k)[37]	Willingness to pay support	Ofwat Priority	Other regulator priority	Customer priority	Business strategic alignment	Is this option recommended ?
CS1	Top 96% Cost Benefit schemes only	£2,507	-£12,633	🟢	🟢	🟢	🟢	🟢	**Yes** - This option has the best whole life cost and is the selected option.
CS2	Top 88% Cost benefit schemes and HS schemes	£2,462	-£11,407	🟢	🟡	🟡	🟡	🟡	**No** – Slightly less impact on customers' bills but insufficient planned replacement of screens and telemetry at the end of their asset lives
CS3	Top 94% Cost benefit schemes and HS schemes	£2,808	-£11,997	🟡	🟢	🟢	🟢	🟢	**No** – small increase in investment but not the best whole life cost
CS4	Top 97% Cost benefit schemes and HS schemes	£3,619	-£11,935	🔴	🟢	🟢	🟡	🟢	**No** – larger increase in investment but not the best whole life cost

[31] Plan options for CSOs and detention tanks in AMP7 (Pioneer deterioration model, SW, 2018)

5.3 Innovation

We propose to build on our innovative approaches from AMP6 and implement a number of key innovations as part of the AMP7 strategy for outfalls, CSOs and detention tanks. The development and use of innovative techniques will ensure we obtain the maximum benefit for our customers from our AMP7 investment on outfalls and CSOs. These include key innovations as part of our AMP7 pollution and flooding strategies as shown in Figure 8.

This includes our ten point 'Pollution Innovation' plan.

1. Use of predictive live analytics[32]
2. RADAR and satellite imagery to look for earth movements to find collapses, sinkholes and leakage from outfalls
3. Industry leading education on FOG and Unflushables[32]
4. Extend short-sea outfalls
5. Smart water-butts
6. Intelligent sewers (see below)
7. Fat-burg eating friends[32]
8. Partnership working[32]
9. FOG collection of energy[33]
10. Catchment First transformational programme[34]

The aim of these innovations are:

A. To tackle the root causes of pollution and reach our long term aspiration of zero pollution incidents
B. To enhance the environment as specified by our customers
C. To seek new affordable ways to improve performance and demonstrate good value for our customers.
D. Improve resilience now and in the long term and be able to cope with factors such as climate change.

[32] See TA.12.WW07 Flooding and Pollution Strategies
[33] See TA.12.BR01 Bioresources Treatment and Growth
[34] See TA.11.WR03 Catchment Management Solutions

Figure 8: Pollution and Flooding Innovation – Now and in the Future

Identification of leakage from outfalls – Satellite thermal Imagery

In AMP6 and previous AMP periods, the inspection and maintenance of outfalls has been relatively expensive as it requires qualified divers working from fully equipped dive support vessels. Poor weather can result in delays to the work and additional costs to keep boats and divers on standby for good weather.

To identify more cost-effective inspection of outfalls in AMP7 and future AMP periods, we will look at the use of satellite thermal imagery to determine if an outfall is leaking. The development of this technology is still in the very early days and is based on wastewater and surface water being warmer than seawater.

This method may be more suitable for outfalls with a continuous discharge. For outfalls with an intermittent discharge, the best time to identify leakage would be during high surface water flows caused by a storm event. However, this is likely to coincide with cloudy conditions and it is not clear if satellite imagery of leakage could be recorded through clouds. Alternatively, we will investigate the use of aircraft with thermal imaging cameras to identify leaks from outfalls if safe to do so in storm conditions.

The use of innovative surveying techniques could enable us to detect leaks and defects in outfalls more efficiently. This will direct our repair work to where it is most needed and this would maintain and improve the quality of bathing waters and shellfish waters in the vicinity.

Automatic cleaning of detention tanks

In AMP7, we will investigate the use of automatic cleaning systems to clean detention tanks at regular intervals.[35] This would prevent the build-up of sediment which can reduce the volume of the tank and would remove material that may potentially cause odour issues. Automatic cleaning would also reduce the risks associated with working in a confined space and would reduce the high cost to manually clean detention tanks.

Intelligent sewers

We are developing smart networks where intelligent systems will eventually control flows automatically in the sewers to protect customers' properties and the environment from flooding and pollution. 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.

Detention tanks and other forms of network storage will be key to managing peak flows when they are detected. The use of detention tanks for in-line storage of peak flows will enable us to minimise the operation of our CSOs.

[35] Automatic tank-cleaning technology (Technology company web-sites, 2018)

In combination with EDM, we will investigate the benefits of installing CCTV at key CSOs so that we can identify issues quickly and reduce the requirement to visit CSOs for planned or reactive inspections.

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.

Use of market mechanisms

We will work with other stakeholders who are responsible for shoreline management to reduce the risk of shingle blocking our outfalls.

We will investigate new technology and ways of working through our Sustainable Drainage 2030 transformational programme to create a more resilient and modern integrated sewer network. This will include:

- Collaborative working with local authorities, the Environment Agency, highway authorities, Internal Drainage Boards, National Parks, developers etc. through Drainage and Wastewater Management Plans and Surface Water Management Plans.
- Integrated Water Cycle Management (IWCM) recognises that issues related to water are complex and that the main causes of negative impacts are inter-linked. Greater collaboration and working with third parties, as well as enhanced technical understanding will be required to realise the expected benefits. Between 2015 and 2020, we are piloting IWCM in two catchments in Kent and West Sussex with a combined catchment area of over 3,200 km^2, 108 wastewater treatment works and over 130 water bodies. We will be identifying world-wide best practice and emerging methodology including catchment management and restoration, sensitive urban design, surface water management, wastewater re-use, changes in customer behaviour and adopting new technology.
- We will contribute to SuDS and partnership schemes to remove surface water from the network
- We already provide incentives for customers to disconnect surface water from the sewers in exchange for a surface water rebate on their bill. We will consider further incentives for customers to reduce surface water flows in the network.
- Illegal connections of surface water drainage to foul sewers can cause hydraulic overloading of sewers during heavy storms or prolonged rainfall. Foul drainage can also be illegally connected to surface water sewers which flow into watercourses or into the ground without treatment and consequently cause pollution. We are working collaboratively with local authorities, construction firms and property owners to reduce misconnections through:
    - collaborative inspection teams with local authorities
    - post-construction sewer flow monitoring
    - educating property owners, local building firms etc.

5.4 Customer Benefits and Resilience

Our programme of maintenance on outfalls and CSOs will contribute to the improvement on AMP6 performance as shown in Figure 9. The red line represents 2017-18 performance whilst the blue line represents our performance commitment targets in 2024-25. We have assumed that upper quartile performance will gradually improve during AMP7 with poor performing companies improving more than those companies who are already at upper quartile level.

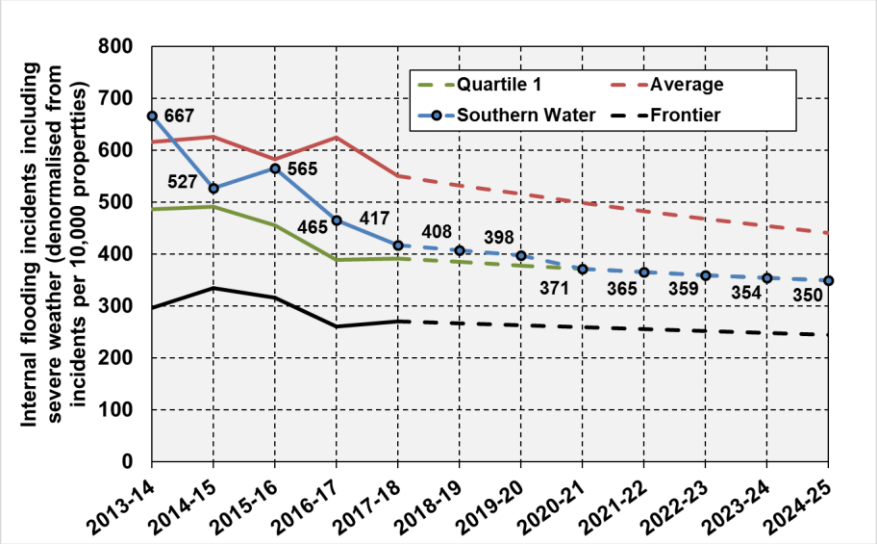
Figure 9: Summary of Projected Sewer Network Performance for AMP7[10]

Our AMP7 performance commitments are discussed in more detail in Chapter 6 - Outcomes, Performance Commitments and ODIs.

5.4.1 Flooding Incidents

Improvements planned for our outfalls are expected to reduce the number of internal flooding incidents by at least two per year in AMP7.[32] As part of our overall flooding strategy, the increased planned maintenance on outfalls and CSOs will help to drive internal flooding performance towards Quartile 1 as shown in Figure 10. We have assumed that Quartile 1 performance will gradually improve during AMP7 with poor performing companies improving more than companies who are already at Quartile 1.

Figure 10: Forecast AMP7 Performance for Internal Flooding (Including Severe Weather)[10]



5.4.2 Resilience

Our AMP7 investment strategy will increase the resilience of our short and long sea outfalls against sea level rises, the build-up of shingle and more extreme weather caused by climate change. Our customers and resilience are at the heart of our plan and we will improve performance whilst keeping bills affordable.

The planned and reactive expenditure on our outfalls and CSOs will also support the improvement of our bathing waters in AMP7 which will benefit residents and visitors to our region whilst supporting the economy of South-East England.

5.5 Value for Customers

The customer performance commitments that are impacted by investment in short-sea and long-sea outfalls, CSO screen replacements and maintenance of navigational aids are consistently shown to be at least medium priorities for customers.

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 that SW 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 year.

- the total amount that SW 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 year.

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

Our additional ODI research into willingness to pay for service level improvements indicated that our customers demand and are willing to invest in significant improvements to internal sewer flooding and pollution incidents. Customers reported willingness 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 5: 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

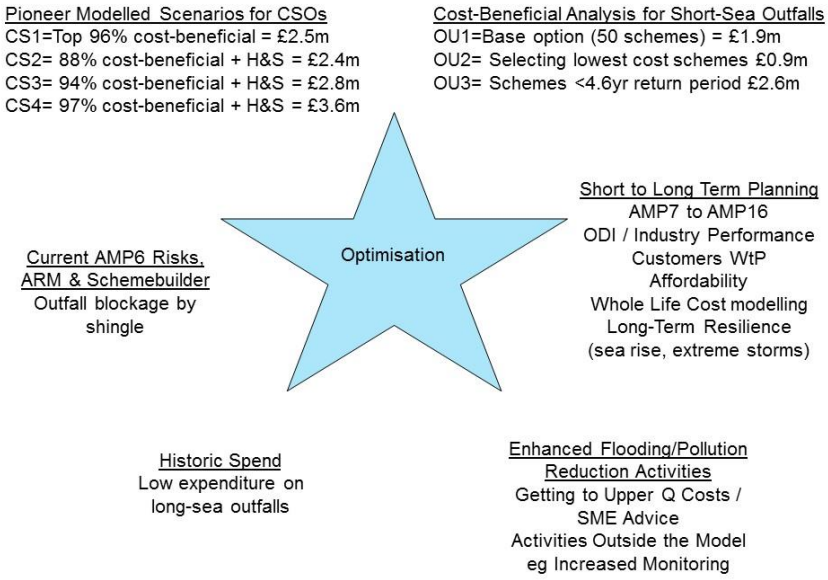
Based on our customers' willingness to pay information provided in Table 5, we have determined the whole life costs[36] over 20 years[37] for three investment options for the maintenance of short-sea outfalls and four investment options for planned maintenance of CSOs and detention tanks. Further details of the options are provided in Section 5.2.

[36] Whole life cost model v8.9 for outfalls, CSOs and detention tanks (SW, 2018)
[37] 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.

6. Costing Strategy

Figure 11 shows how we have optimised and balanced our proposed expenditure in AMP7 against a range of historical and future issues affecting the maintenance of outfalls and CSOs.

Figure 11: Costing Strategy



The costs shown in this business plan have been derived using one of the following methods:

- **Historic spend projection.** These costs are mainly for Opex investment where future costs will be a continuation of historical expenditure. We have assessed whether future costs will be different to historical costs due to improved efficiency, a change in planned work or a required improvement in performance.
- **Pioneer deterioration model/ triangulated view.** The cost for planned CSO and detention tank maintenance has been based on deterioration modelling as discussed in the plan options in Section 5.2. Our preferred option is based on maintaining serviceability in the short and long term whilst keeping bills affordable for our customers.
- **Function or detailed cost.** We have used Schemebuilder or detailed costing using cost curves where there is a high level of information on the scope of the scheme. These costs have the highest level of confidence.
- **Simple scheme cost based on a high level estimate**. These costs are for new work programmes where there is limited knowledge and less confidence in the likely cost. We have based the costs on advice from subject matter experts and estimated costs in studies we have commissioned.

7. Key Risks and Opportunities

7.1 Risks

- There is a risk that the CSO spill frequency trigger permits being introduced by the Environment Agency in 2020[38] are set at a higher level than we have anticipated. This will require us to carry out costly additional remedial works to ensure we are compliant with these more stringent permits.
- There is a risk that the industry upper quartile performance for pollution and flooding incidents may improve at a higher rate than we have forecast. This will mean we have to incur substantial additional expenditure in order to deliver the higher levels of performance required.
- There is a risk that at our next inspection of our long-sea outfalls we find they have deteriorated at a faster rate than expected and serious structural issues need to be addressed. This will mean we must significantly increase the planned maintenance of our long-sea outfalls in AMP7.

7.2 Opportunities

- There is an opportunity that the installation of CCTV could prove to be a more efficient and effective way of remote monitoring of CSOs during and after incidents. This could reduce the costly requirement for staff to inspect our CSOs after incidents and may reduce health and safety risks.
- There is an opportunity that our planned improvements in telemetry, automation and control as part of our 'intelligent sewers' strategy would reduce pollution incidents associated with CSOs and detention tanks to a greater extent than we have assumed. This will reduce the impact of incidents on the environment and our customers.
- There is an opportunity that at our next inspection of our long-sea outfalls we find they have deteriorated at a slower rate than expected and there are fewer serious structural issues which need to be addressed. This will mean we decrease the levels of planned maintenance of our long-sea outfalls in AMP7.

[38] Developing Spill Frequency Trigger Permits for Water and Sewerage Company Storm Overflows (EA, 2016)

8. Appendix 1: List of named schemes

Table 6: Major Schemes in AMP7[1]

Scheme Name	AMP7 Capex Total	Total AMP7 Opex AFC	AMP7 Totex	AMP8 Capex
Resilience (Blackrock CEO outfall) Extend the Outfall	4.504	0	4.504	2.530