TA.12.WW06 Wastewater Environmental Programme
Business Case

Version 1.0
September 2018

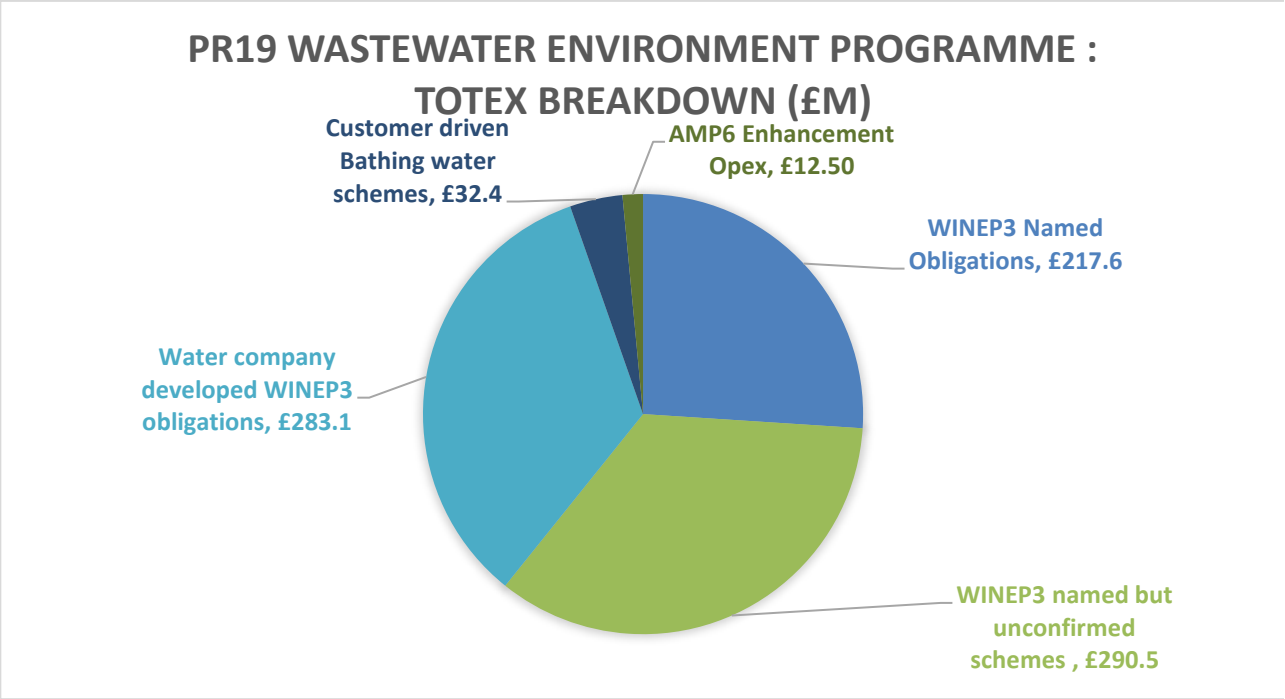
1. Executive Summary

Name of technical annex	TA.12.WW06 Wastewater Environmental Programme
Context	Southern Water is in the south-east of England and its region contains 700 miles of coastline, 3,400km of rivers including highly valued chalk rivers, and 83 bathing waters managed by 21 Local Authorities. There are numerous designated sites e.g. Sites of Special Scientific Interest (SSSIs), protected for the valuable biodiversity found there. This investment case sets out the wastewater environment programme for AMP7, to deliver environmental benefits considering customer affordability. Driven in the main by; what our customers are willing to pay for, our obligations defined in in the Water Industry National Environmental Programme 3 (WINEP3) and customer affordability.
Customer and stakeholder views	Our customers and stakeholders believe and expect we have a duty to protect and enhance the environment. Our customers are willing to invest now to prevent deterioration and enhance the environment for the future. Our customers have a concern across all elements of the environment, from river quality, marine wildlife and our coastal waters.
Our aim	Our aim is to transform the way we protect and deliver our environmental benefits by working more collaboratively with stakeholders such as farmers, local authorities, Environment Agency (EA), Natural England (NE). We will: • Improve 537km of rivers (from a total of 3,400km of rivers) • Improve an area of 4.27km2 for ponds and harbours (equivalent to almost 1.5 times the size of Bewl reservoir). • Designated sites e.g. SSSIs, restored or improved over 1459 hectares (equivalent to 1215 football pitches). • Improve the bathing water quality at 7 bathing waters to good or excellent (from a total of 83 bathing waters in the SWS region, of which only 30 are less than excellent). In addition to our obligations we are also planning to deliver a net gain in biodiversity through improvements to designated sites, and by delivering catchment schemes. To support development of wider environmental benefits, we will implement natural capital accounting in 3 river catchments.
Scope of this technical annex	Enhancement expenditure for mainly wastewater associated environmental schemes, studies and investigations. This technical annex does not cover water supply or water resources environmental obligations.

	Botex	**Enhancement**	**Total**
Totex (£'m)	n/a	£836m	£836m
Opex (£'m)	n/a	£68.2m	£68.2m
Capex (£'m)	n/a	£767.8m	£767.8m
Residual, post-AMP7 capex (£'m)	n/a	n/a	n/a

20-year whole life totex			
No. Schemes (Materiality) (% of the wholesale wastewater plan)	-	-	35%
Relevant business plan table lines	-	WWS2 Line 4 / WWS2 Line 9 / WWS2 Line 10 / WWS2 Line 11 / WWS2 Line 18 / WWS2 Line 19 / WWS2 Line 20	

Enhancement	
Need for enhancement / investment	Our environmental regulators the EA and NE require us to implement schemes and studies (investigations), aligned to specific drivers, to protect and improve our environment. The EA issued these to water companies in the 3rd issue of the Water Industry National Environment Programme (WINEP3). The requirements defined in WINEP3 were developed in conjunction with the EA, NE and Water Companies. A programme has been developed by Southern Water to meet these statutory obligations. Bathing water improvements were identified as a customer priority, and this has driven the need for investment to ensure our customers have the required standards of bathing waters they expect. Southern Water have several driver lines in WINEP3 with no permits identified by the EA due to current ongoing legal action. In these cases, a 'WATER COMPANY SCALE' entry has been provided against the driver, and the following comment 'There is an obligation for Southern Water to develop an appropriate programme of work for these drivers and include it within their business plan'. For these drivers we have developed a programme based on EA guidelines. The proportion of the water company developed WINEP3 obligation schemes that fall under this category are shown below in context of the rest of the wastewater environmental programme, covered by this technical annex.



Overview of AMP7 proposals	There are 3 principle drivers which make £544m (approximately 70%) of investment. These are: • Water Framework Directive (WFD) phosphorus (P) improvements (£257.2m). These are schemes to reduce phosphorus being discharged into the river. These are typically either phosphorus treatment at works, pump-away schemes (for treatment at another site), or catchment schemes. • Urban Waste Water Treatment Directive (UWWTD) flow capacity at Works (£151.7m). Schemes to increase flow capacity at wastewater treatment works. • UWWTD storm tank sizing (£130m). Schemes to ensure the capacity of storm tanks is appropriate A detailed table showing the breakdown of these can be found in section 3.

	We are extending our wastewater catchment management programme to deliver Phosphorus reductions in 5 catchments with an agreed extension to the delivery dates with the EA, and an additional catchment we have included to deliver a more efficient solution with greater benefits. In delivering these schemes we will work closely with key catchment partners such as rivers trusts, wildlife groups, EA, NE, catchment groups, etc. Bathing water quality continues to be a customer priority, our bathing water programme enhances the water quality at a further seven bathing waters. We will aim to deliver a net gain in biodiversity particularly supported by delivering four SSSI improvement schemes, 4 Habitats improvement schemes, five SSSI investigations, 2 Habitats investigations, 2 Marine Conservation Zones (MCZs) investigations, and an Invasive Non Native Species (INNS) scheme and study. Additionally, we are introducing a new performance commitment to use Natural and Social capital accounting that will also help to demonstrate biodiversity net gain. We will continue to test more innovative technologies through our Innovation programme.
Why the proposals are the best programme-level option for customers	Whole Life Cost assessment and Cost Benefit Analysis (CBA) have been applied where appropriate to identify the most beneficial solutions. Cost benefit is only required for some of the EA drivers, mainly 'Improvement' drivers. The EA are required to run, and pass CBA, for permits to be included in WINEP3. Additionally, we have also run CBA for these schemes based on our customers' willingness to pay. All permits detailed in WINEP3 (having passed the EA CBA) have been tested and all the drivers were passed with the exception of WFD Phosphorous improvements. For WFD Phosphorus, the overall programme of all schemes passed, but individually approximately 40% of permits were not cost beneficial. We are currently in the process of reviewing the CBA process completed by the EA to understand the differences. Where benefits (such as river length) are available, the most cost beneficial solution options have been selected. Where benefits are not available, options have been selected based on least whole life cost. Where appropriate, we have used our totex hierarchy to develop lower cost totex options, such as pump away options, and catchment schemes in addition to 'end of pipe solutions'.
Customer and stakeholder support	Customer acceptability testing demonstrates that customers support our proposed programme. Feedback from qualitative testing highlighted our environmental programme drove higher acceptability results, eg taking responsibility for the beaches, tourism and the economy[1] – in reference to our bathing water programme. Our proposals have been reviewed with the CCG to ensure customer priorities have been taken into account.

[1] see TA.4.4 (105) for customer acceptability testing

Need for a CAC (if relevant)	Cost Adjustment Claim associated with the Wastewater Environmental programme for extraordinary costs associated with: ▪ ***Bathing Water****- work to improve the bathing water quality and long-term resilience of seven bathing waters, enhancing the water quality, amenity value and economy in the local areas. Claim value £32.4m.* ▪ ***Thanet Groundwater****- this adjustment relates to the final phase of a three AMP programme to prevent exfiltration from the sewers, reducing the risk of contamination of the surrounding chalk. Claim value £32.9m.*
Extent of management control (if relevant)	Many of our proposed solutions are within our control. However, delivery of catchment schemes and bathing water improvements will be reliant upon collaborative working with landowners and local authorities. Experience from AMP6 provides confidence we will be able to successfully deliver our targets.
Robustness and efficiency	Our programme is in AMP7 is one of our largest environmental programmes. Our proposals for Bathing Water, Thanet Groundwater protection schemes are a continuation of similar previous schemes undertaken in AMP6.
Customer protection (if relevant)	To protect customers and the company, an adjustment mechanism has been included for areas of uncertainty, these are the drivers yet to be confirmed by the EA and drivers with 'un-named' schemes.
Affordability considerations	Although a large programme it still enables bills to be reduced overall for customers.
Board assurance	This enhancement technical annex has been externally reviewed by Jacobs, with no material exceptions identified in June 2018.

Performance Commitments supported by this technical annex[3]		
PC	**How relevant is this technical annex?**	**Comment**
River Water Quality	High	The Performance Commitment (PC) is a key measure of how we perform in delivery of our WINEP obligations. The enhancement being 537km of river length through improvements in the WFD programme.
Maintain bathing waters at Excellent	High	This PC is a key measure of the number of bathing waters that are classified at Excellent. It is in relation to the maintaining the levels of excellent bathing water sites delivered in AMP6.
Improve the number of bathing waters to at least good.	High	This PC is a key measure of Improving five bathing waters to at least good from a lesser classification (CAC).
Improve the number of bathing waters to excellent.	High	This PC is a measure of increasing at least two bathing waters to excellent from a lesser classification (CAC).
Natural capital	High	This PC is a measure of delivering natural capital accounting for 3 of our 10 river catchments
Combined sewer overflows monitoring.	High	This PC is measured the by provision of event duration monitoring coverage for all intermittent discharges in AMP7. This is to help promote

		and improve understanding and management of storm overflow events.

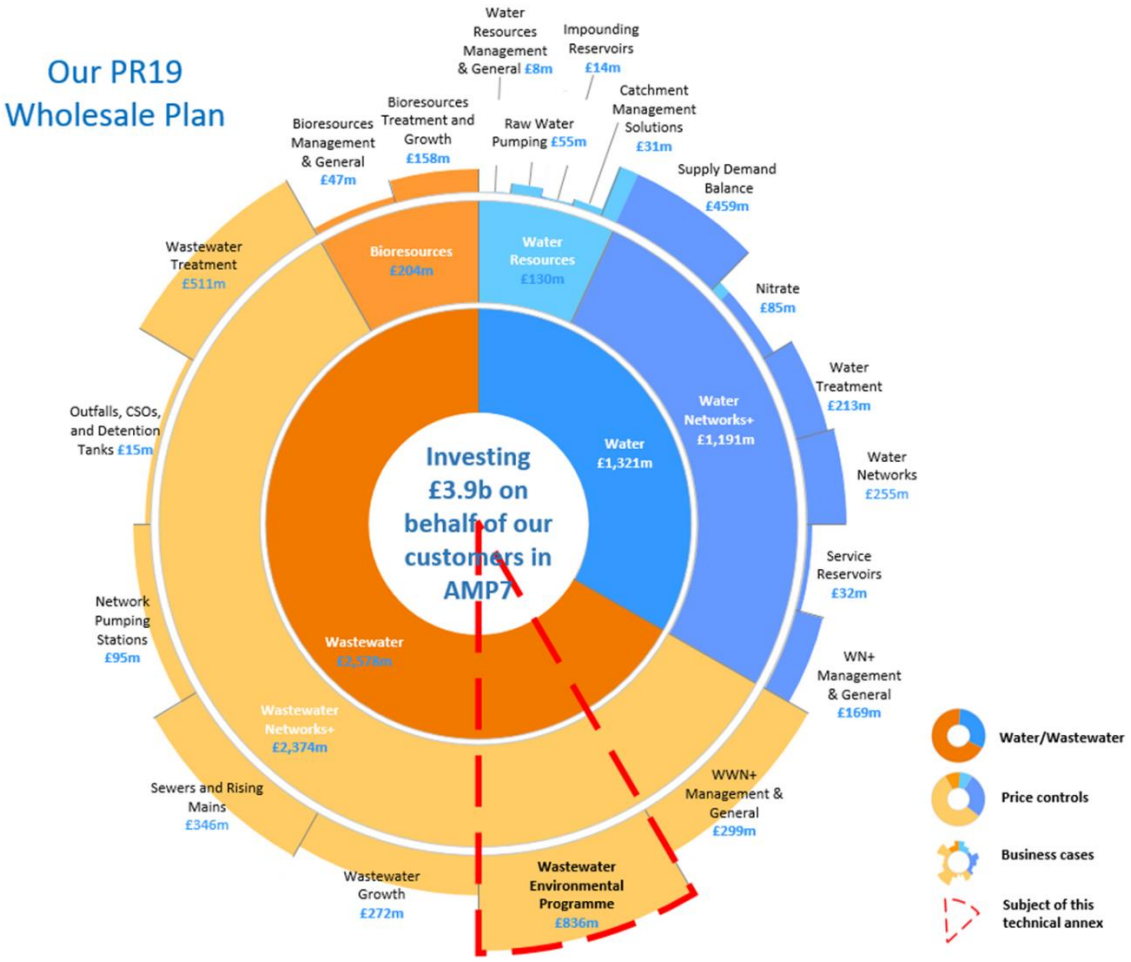
Schemes and options			
Schemes over £20m	**Options**		
	Description	**Cost (CAPEX)**	**Selected option and rationale**
Thanet Groundwater Phase 3	Sewer/adit lining in chalk adits under Margate	£32.9m	WINEP 3 confirmed scheme
Budds WwTW, UWW Flow compliance	Budds Farm increase in works flow capacity to ensure compliance	£37.7m	Only feasible option under IMP5 driver
Peel Common WwTW, UWW Flow compliance	Peel Common increase in works flow capacity to ensure compliance	£22.9m	Only feasible option under IMP5 driver
Millbrook WwTW, UWW Flow compliance	Millbrook increase in works flow capacity to ensure compliance	£20.7m	Only feasible option under IMP5 driver

Contents

2. Scope of Technical annex

Our Wholesale Plan for PR19 is worth a total of £3.9 billion. This technical annex addresses £823.6m planned investment in the Wastewater Environmental Programme during AMP7, plus an additional £12.5m OPEX arising from Capital, from AMP6. This provides a total of £836.1m within the Wastewater Network+ price control. This is illustrated in Figure 1 below.

Figure 1 Southern Water PR19 Wholesale Plan[2]



We collect and recycle wastewater for 4.5 million customers, protecting 3,400km of rivers, ground water supplies and 83 bathing waters.

Our Wastewater Environmental Programme includes:

- Investment to deliver our statutory obligations set out in the third phase of the Water Industry National Environment Programme (WINEP3)
- A customer driven bathing water enhancement programme

This investment does not include:

- All investment requirements for population growth (see; WWO5 Wastewater Growth)

[2] Figure 1 treats opex arising from AMP6 enhancement expenditure as ongoing enhancement spend in AMP7 in line with data tables WWS1 and WWS2. Our business cases, including this document, treat this as base expenditure, see section 6 below. The corresponding adjustment is found in TA.12.WW01 Wastewater Treatment.

- Base investment requirements to maintain stable performance (see; WW02 Network Pumping Stations, WW01 Wastewater Treatment, WW03 Outfalls CSO & Detention Tanks and WW04 Sewers)
- Bioresource treatment assets (see; BR01 Bioresource Treatment & Growth)

3 Summary of AMP7 Wastewater Environmental Programme

A summary of what is included in our 2021 – 2025 Business Plan in relation to our Wastewater Environmental Programme is set out below, also refer to section 6 for a breakdown of investment drivers and their data table line references.

Our ambitious Wastewater Environment Programme for AMP7 expects to deliver over 729 schemes that will be delivered at a Totex of £836.1 million (includes AMP6 Enhancement Opex costs). This programme has been driven, in the main, by the Water Industry National Environment Programme. This will provide water quality improvements to 537 km of river length and 4.27 km^2 of still water (harbour and ponds). In addition, we will enhance 1458 hectares of highly sensitive designated areas for our customers. The table 1 below provides an outline of the outputs that Southern Water customers will benefit from through the AMP7 environment programme.

Table 1 Summary of Outputs from the AMP7 Investment Programme

Driver	Obligations	River Length Improved (km)	Area Improved (Km2)	Hectares of Designated Site Restored or Improved	Quality Totex (£m)	Ofwat table
Bathing Waters	7	-	-	-	32.4	WWS2 37
WFD Improvements	65	423	1.7	-	261.6	WWS2 18, 19, 20
WFD No Deterioration	29	73	2.6	-	70.9	WWS2 17, 18, 19, 20
Habitats Directive	6	-	-	1228	14.3	WWS2 18, 19
SSSI	9	-	-	230	13.7	WWS2 18
INNS	1	-	-	-	0.2	WWS2 51,
Urban Waste Water Treatment Directive (UWWTD)	106	14	-	-	290.8	WWS2 9, 10, 11, 18, 19, 20, 56, 57
WFD Chemical Permits	10	27	-	-	46.1	WWS2 12, 59
Shellfish Waters	7	-	-	-	33.0	WWS2 4, 21, 51, 68
Thanet Groundwater	1	-	-	-	32.9	WWS2 15
Monitoring	488	-	-	-	4.7	WWS2 6, 7, 16
Studies and Investigations	89	-	-	-	23.1	WWS2 4, 13, 16, 63
AMP6 Enhancement Opex Adjustment	-	-	-	-	12.5	WWS2 65, 66,67
Totals	**811**	**537**	**4.3**	**1458**	**836.1**	

The three largest statutory obligations within the Quality programme are Water Framework Directive Improvements, schemes to increase Flow to Full treatment (U_IMP5) and schemes to increase storm tank capacity (U_IM6), the last two are within the urban waste water driver.
Details of the projects which will deliver the Wastewater Environmental Programme are presented as Appendix 1. Appendix 2 lists the EA environmental 'drivers' which are unnamed and unconfirmed in WINEP3.

4 Managing Uncertainty

4.1 PR14 Managing Uncertainty

During the development of our PR14 Wastewater Environmental programme, the EA introduced a concept of managing uncertainty. This approach was needed to account for a 12-month difference in timeline between PR14 Planning (December 2014) and the 2nd cycle of river basin management planning for the Water Framework Directive (WFD) (December 2015). This difference meant that full details of the requirements to achieve WFD water body status objectives could not be included in the National Environment Programme (precursor to WINEP) nor the PR14 company business plan. Under the managing uncertainty approach, the EA provided sufficient information on scale and scope of likely action required to meet WFD status objectives, at a catchment level, to enable Water Companies to make informed cost allowances within business plans. No site-specific measures were identified at that time. OFWAT were involved and supportive of this approach and made allowance for funding prices for the managing uncertainty programme across all companies.
In 2015, the specific measures developed through the managing uncertainty programme and river basin management planning were updated by the EA with the confirmed programme of measures for the 2015 river basin management plans, including all requirements up to 2021 (phase 5 NEP).
Although the scope of works changed for this programme of work, the overall costs remained similar, when compared on a like-for-like basis[3]. The PR14 Final Determination was £129m and after adjustment for scope changes revised costs were £122m, well within No. Schemes (Materiality) constraints.
Delivery costs for the Water Framework Directive schemes being delivered in 2021 are included within this assessment and have therefore no additional costs have been included for PR19.

4.2 PR19 Managing Uncertainty

For PR19, the time difference between the business plan final determination and ministerial signoff of the cycle three river basin management plans has increased to two years (2019 and 2021 respectively). Thus, we have applied the EA's national traffic light system to reflect the different levels of uncertainty associated with the development of measures, economic appraisal and ministerial decisions.

Table 2 below summarises the criteria used in the WINEP managing uncertainty traffic light coding.

[3] Both converted to 2012/13 prices and using the same costing methodology

Table 2: WINEP managing uncertainty traffic light coding

Traffic light	Certainty	Status of Measure	Justification		
			Evidence that water company action is needed	Evidence that measures are cost beneficial	Ministerial agreement on affordability
Green	High	Certain	✓	✓	✓
Amber	Medium	Indicative	✓	✓	×
Red	Low	Unconfirmed	✓	×	×
Purple	Minimal	Provides a direction of travel	×	×	×

The traffic light system will apply to all measures (improvements, investigations or monitoring) under all drivers in the WINEP. The four light system reflects the different levels of evidence available and degrees of uncertainty. The highest certainty is associated with green and the lowest with red. As the level of uncertainty increases the measure will progress from red to green.
Information associated with the purple traffic light is intended to provide a direction of travel for potential future work area that may inform business plans beyond PR19.
Overall, the PR19 environmental measures are more certain than PR14 since economic analysis is complete, there is an established list of specific measures and a technically achievable limit for phosphorus has been agreed.
Table 3 below shows the key environmental drivers, their respective WISER categories and associated level of certainty.

Table 3 Overview of the 2021-2025 Business Plan against the Southern Water, Wastewater Environmental Programme

Type	Part	EA Driver	Description	WISER Category	EA Status	EA WINEP3 Named Schemes	Custo-mer Driven	Adjustment Mechanism included
Bathing Waters	6.1	n/a	Customers 'Willingness to Pay' enhanced bathing waters	n/a	n/a	x	✓	
WFD Improvements	6.2	WFD IMP (NH3)	Ammonia permits	S+	Amber	✓		✓
		WFD IMP (P)	Phosphorous permits	S+	Amber	✓		✓
		WFD IMP (BOD)	BOD permits	S+	Amber	✓		✓
WFD No Deterioration	6.3	WFD ND (NH3)	Ammonia permits	S	Green	✓		
		WFD ND (P)	Phosphorous permits	S	Green	✓		
		WFD ND (BOD)	BOD Permits	S	Green	✓		
		WFD ND (N)	Nitrogen permit	S	Green	✓		
Habitats Directive	6.4	HD IMP	Phosphorous permits	S	Green	✓		

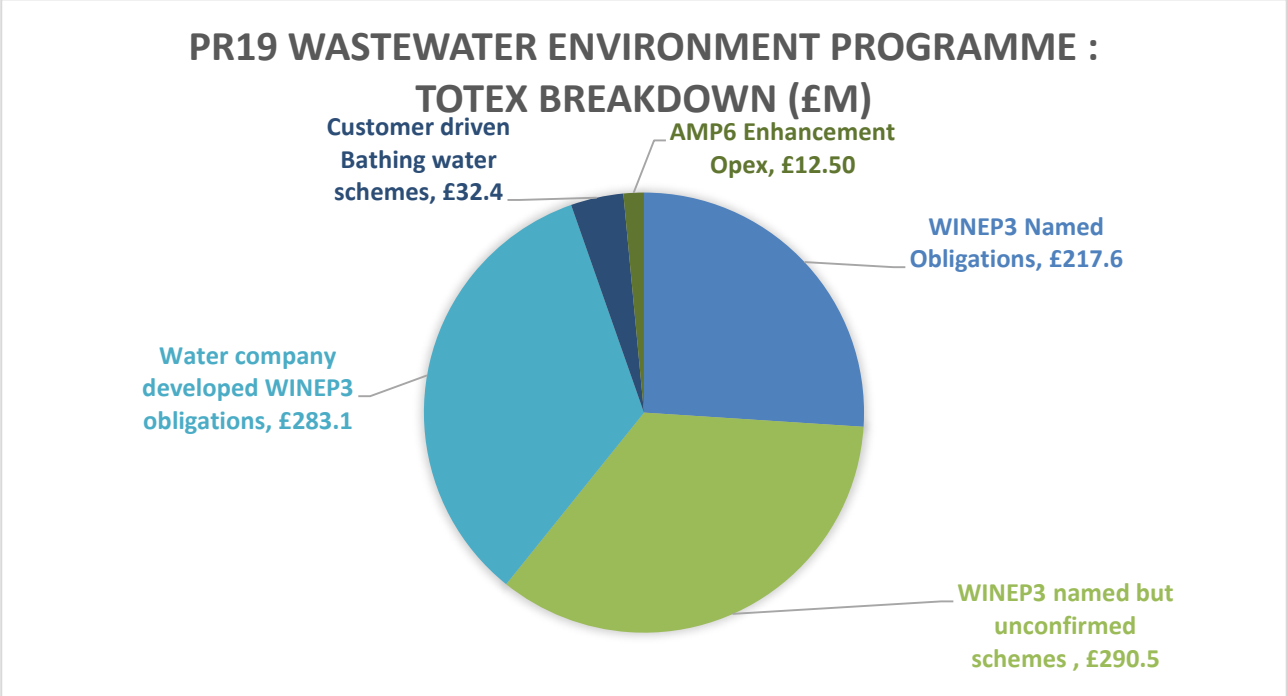
Sites of Special Scientific Interest	6.5	SSSI IMP	Phosphorous permits	S+	Green	✓		
Invasive Non-Native Species	6.6	INNS ND	Training to prevent deterioration by reducing the risks of spread of INNS	S+	Green	✓		
Urban Waste Water Treatment Regulations	6.7	U IMP1	Urban Waste Water Treatment Regulations	S	Green	✓		
		U IMP4	UWWTR spill frequency reduction scheme	S	Green	X		✓
		U IMP5	Increasing WwTW flow to full treatment capacity	S	Green	X		✓
		U IMP6	WwTW storm tank capacity increase	S	Green	X		
WFD Chemical Permits	6.8	WFD IMP Chem	Iron permit	S+	Amber	✓		✓
		WFD ND Chem	Chemical permit to prevent deterioration	S	Green	✓		
		WFD NDLS Chem	Chemicals permits to prevent deterioration	S	Green	✓		
Shellfish Waters	6.9	SW ND	To prevent deterioration in current water body status	S	Green	X		
Groundwater Thanet	6.10	WFDGW ND GWQ	Thanet sewers in chalk adits (Margate region)	S	Green	✓		
Monitoring	6.11	U MON1	Event and duration monitoring (EDM)	S	Green	✓		
		SW MON	EDM for shellfish waters	S	Green	some named		
		BW MON	EDM for bathing waters	S	Green	some named		
		U MON3	EDM to WwTW storm tank monitoring	S	Green	X		
		U MON4	Install MCERTS flow monitoring at WwTW	S	Green	X		
		U MON5	MCERTS flow monitoring for the first time at WwTW	S	Green	✓		

4.3 PR19 Undefined Environmental Obligations

Several driver lines in WINEP3 do not have individual schemes identified by the Environment Agency because of the current legal proceedings. In these cases, a 'WATER COMPANY SCALE' entry is provided. These are shown in table 3 as 'EA WINEP3 Named Schemes' and are marked with an 'x', with more details provided in Appendix 2. The figure below presents the proportion of totex for each certainty criteria as described above.

.

Figure 2 Proportion of Wastewater Environment Programme against WISER classification



Except for the customer driven bathing water enhancements, the only part of the wastewater environmental programme not driven by WINEP obligations (named/unnamed) is a set of permit changes required to Event and Duration Monitoring, for which the EA charge a fee (value aprox. £0.1m). This is not shown on the diagram above given the scale of investment. More information is provided in Table 29: Summary of Event Duration Monitoring Related Investment.

4.4 Our Approach to Unconfirmed Requirements

We have developed a cost adjustment mechanism that ensure customers are fully protected from changes in the Environmental Programme required by the Environment Agency after the final determination.

Our mechanism recovers all costs, utilising the same cost curves that we have used in the development of our overall programme, to ensure a legitimate and transparent approach to protecting customers.

Through this approach we have created a link between expenditure for unconfirmed requirements, our outcomes and appropriate unit costs. We propose that the unit costs are used to determine the adjustment necessary at the end of the control period, based on the volume of work ultimately confirmed by the Environment Agency as required and demonstrated to be delivered by us.

Our proposal is that this is a symmetrical two-sided mechanism. We have identified in this Technical Annex those sub programmes where changes are most likely and where cost changes could be material.

Scope of the programme covered by this mechanism

We have reviewed the current maturity of the WINEP3 and the certainty of the associated drivers. There are a number of drivers that we consider are to be covered by this mechanism, these are set out below, together with a brief rationale;

Table 4 - Scope and Rationale of the mechanism

Driver	Permit Determinants	Rationale
Water Framework Directive Improvements WFD_IMPg/m	Phosphorous, BOD, NH4	To cover AMBER schemes in WINEP3 where ministerial guidance may remove the obligations To cover RED schemes in WINEP3 where ministerial guidance results in additional obligations
Water Framework Directive U_IMP5	FFT	Due to the unnamed nature of our programme in this area we will need to reconcile our assumptions against the requirements set out by the Environment Agency
Water Framework Directive U_IMP6	Storm Tank Capacity	Due to the unnamed nature of our programme in this area we will need to reconcile our assumptions against the requirements set out by the Environment Agency

Due to the nature of our Chemicals programme we do not consider that a change mechanism is required. The requirements identified have been done so through an industry wide research programme and as a result the likelihood of further change is considered non-material. We also propose that this mechanism would not apply to our Bathing and Shellfish requirements as set out in WINEP3. Whilst these programmes could be subject to change, the nature of the change is challenging to forecast and the use of cost curves based on volume adjustment is considered unsuitable to protect customers, we would therefore propose that changes to these environmental requirements are treated on a bespoke basis, should change arise.

Unconfirmed requirements methodology

We consider the WINEP3 to be our baseline programme, following the publication of Ministerial guidance on Cost Benefit in 2021, we will complete a reconciliation against the drivers identified above. We propose the following step by step approach. Our intention is to have assessed the likely consequence of the changes by 2022 and seek financial reconciliation at the end of the price control, including assurance of delivery. We consider that this is in the best interest of customers as it limits bill volatility in period, which we have understood from our customer research is something that concerns them.

Step	Commentary	Input documents
1.	Review WINEP3 against 2021 Ministerial Guidance on Affordability, identify variations and document in *"WINEP unconfirmed requirements workbook"*.	WINEP 3

<table>
<tr><td></td><td></td><td>2021 Ministerial Guidance on Cost Benefit</td></tr>
<tr><td>2.</td><td>Upon the completion of early AMP7 investigations and the findings of the Ministerial Guidance on Affordability and no later than April 2022, we will present to CCG an assessment of the scale of change in respect of:
Changes in scheme requirements (no longer needed or new additions)
Changes in costs based on proposed unit costs
Changes in river length benefits used within the river length performance commitment
Net financial effect and bill impact
Following review from our CCG, we will present this view to Ofwat as part of our Annual Performance Report.</td><td>WINEP 3
2021 Ministerial Guidance on Cost Benefit</td></tr>
<tr><td>3.</td><td>Compare our list of schemes delivered against those in WINEP and provide assurance of delivery. Consolidate evidence of output sign off from Environment Agency to validate scheme completion.</td><td>AMP7 Delivery Programme as 31st March 2025</td></tr>
<tr><td>4.</td><td>List schemes in “WINEP unconfirmed requirements workbook” where an allowance was made and no longer required to be delivered through WINEP.</td><td></td></tr>
<tr><td>5.</td><td>List schemes in “WINEP unconfirmed requirements workbook” where no allowance was made, and a new requirement was confirmed through WINEP.</td><td></td></tr>
<tr><td>6.</td><td>Confirm and document in “WINEP unconfirmed requirements workbook” the volume delivered for each scheme using the unit denominator for each scheme added and removed from programme. Units are;<table><tr><th>Driver</th><th>Determinant</th><th>Unit denominator</th></tr><tr><td>Water Framework Directive Improvements WFD_IMPg/m</td><td>Phosphorous, BOD, NH4</td><td>P.E.</td></tr><tr><td>Water Framework Directive U_IMP5</td><td>Flow</td><td>l/s</td></tr><tr><td>Water Framework Directive IMP6</td><td>Flow</td><td>m^3</td></tr></table></td><td></td></tr>
<tr><td>7.</td><td>For WFD_IMPg/m an additional step is required to establish the permit parameter that has changed and for Phosphorous the permit level that was required, to establish which solution cost curve to use. Document the determinant and permit limit in “WINEP5 unconfirmed requirements workbook”</td><td>WINEP and Environmental Permit</td></tr>
<tr><td>8.</td><td>Determine from the unit cost curves ,the revenue which would be allowed for each of the schemes based on the specific volume delivered.</td><td>Unit cost curve data as confirmed through Final Determination</td></tr>
<tr><td>9.</td><td>Summate the total reductions in revenue allowance because of removed volume requirements in WINEP in the “WINEP unconfirmed requirements workbook”.</td><td></td></tr>
<tr><td>10.</td><td>Summate the total additions in revenue allowance because of volume additional requirements in WINEP in the “WINEP unconfirmed requirements workbook”.</td><td></td></tr>
<tr><td>11.</td><td>Reconcile the net position in revenue.</td><td></td></tr>
</table>

12.	Complete third-party assurance against the above steps.	WINEP unconfirmed requirements workbook
13.	Present outcome of analysis to CCG for endorsement no later than 30th April 2025.	
14.	Submit evidence pack to Ofwat through AMP7 reconciliation mechanism.	WINEP unconfirmed requirements workbook and GW4 Output certificates

Unit costs evidence to support adjustments

Southern Water's business plan cost estimation principles and process have been designed to enable us to deliver a high-quality business plan with fully justified cost estimates that are reliable, accurate, customer insight led, efficient, and appropriately allocated. Further information on how we assure that our unit costs are efficient can be found in TA.14.4 Bottom-up Cost Estimation.

WFD_IMPg/m Phosphorous

Where we must complete more or less work associated with reducing Phosphorous in water bodies the unit cost incurred or avoided will depend on the permit limit which is to be achieved. In Table 5 we show which treatment technology and therefore cost curve would be used to determine the cost adjustment.

Table 5 - Aligning Cost Curves to Permit Limits

Permit Limit (P mg/l)	Treatment Technology
Greater than 1	Ferric Dosing
Between 0.95 & 0.3	Deep Bed Sand Filter (DBSF)
Less than 0.29	Meccana

Figure 3 – Unit Cost Curve for Ferric Dosing

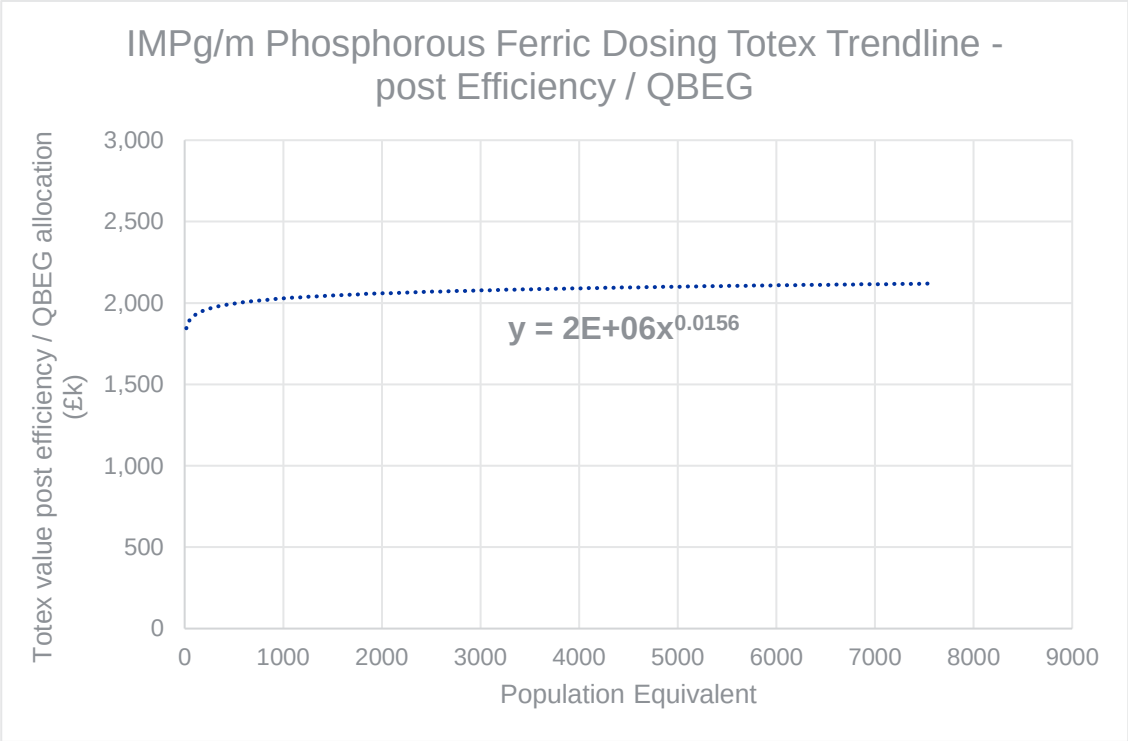


Figure 4 - Unit Cost Curve for Deep Bed Sand Filters

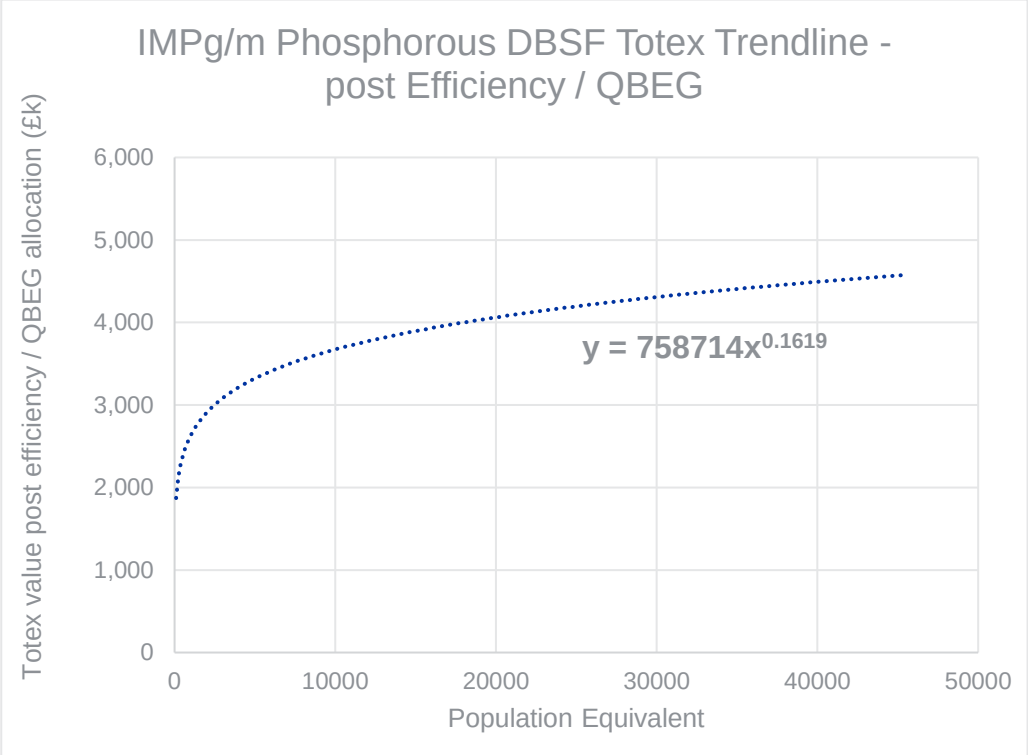
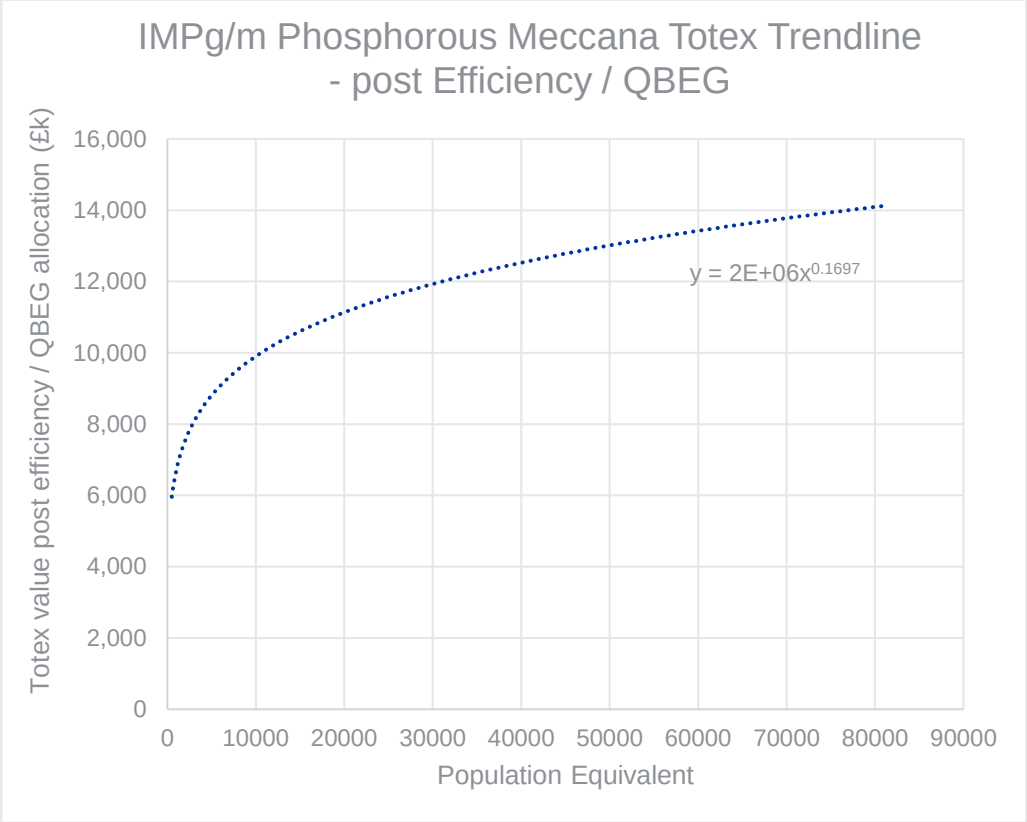


Figure 5 - Unit Cost Curve for Meccana



WFD_IMPg/m Biochemical Oxygen Demand

WINEP3 confirmed only one scheme under this driver at Chiddingfold WwTW. Because of this we completed a full bottom up costing exercise at this single location to determine the cost of delivery, rather than developing a cost curve, we took this approach as responding to feedback from PR14 this was considered to be a more efficient approach when the volume of work required was identified to be small. Should this scheme be identified as not being required in WINEP5 we will reconcile the revenue allowance down by the amount allowed in the FD for this scheme.

Through discussions with the Environment Agency ahead of the publication of WINEP5, if it is identified that further BOD requirements are to be delivered to protect and enhance the environment for customers, we will develop a cost curve for the schemes based on P.E. present this to CCG and Ofwat no later than 31st December 2021 with an independent third party assurance report to seek endorsement for our statutory expenditure.

WFD_IMPg/m Ammonia

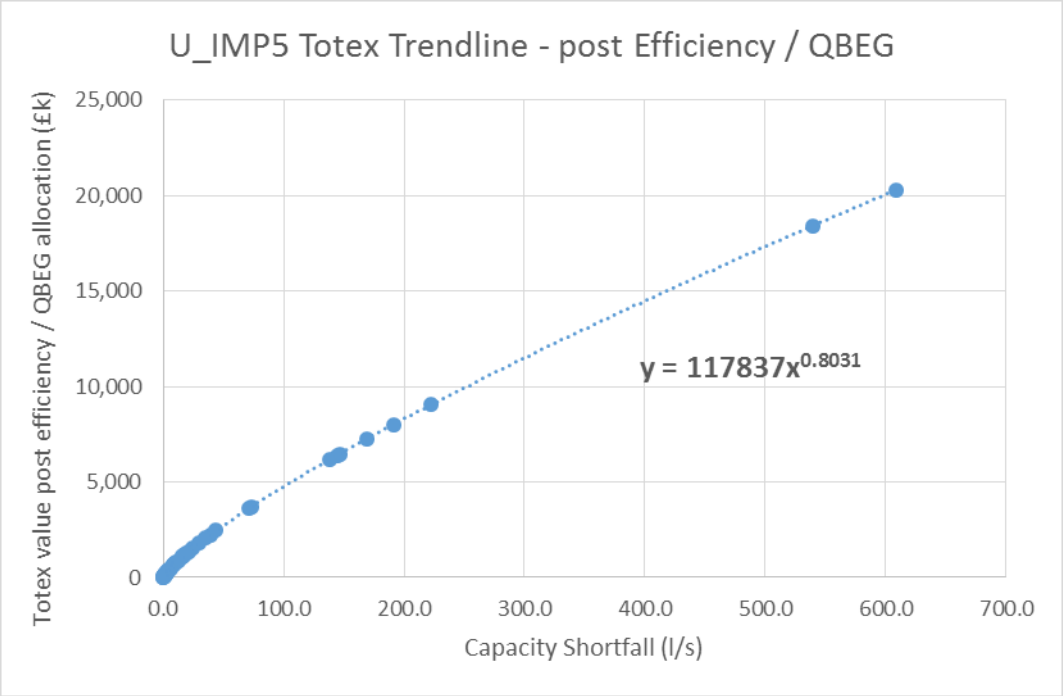
WINEP3 confirmed only one scheme under this driver at Buriton WwTW. As a result of this we completed a full bottom up costing exercise at this single location to determine the cost of delivery, rather than developing a cost curve we took this approach as responding to feedback from PR14 this was considered to be a more efficient approach when the volume of work required was identified to by small. Should this scheme be identified as not being required in WINEP5 we will reconcile the revenue allowance down by the amount allowed in the FD for this scheme.

Through discussions with the Environment Agency ahead of the publication of WINEP5, if it is identified that further Ammonia requirements are to be delivered to protect and enhance the environment for customers, we will develop a cost curve for the schemes based on P.E. present this to CCG and Ofwat no later than 31st December 2021 with an independent third-party assurance report to seek endorsement for our statutory expenditure.

Water Framework Directive U_IMP5

For U_IMP5 drivers we propose to use a single cost curve which provides recovery or cost allowance based on the shortfall in treatment capacity addressed.

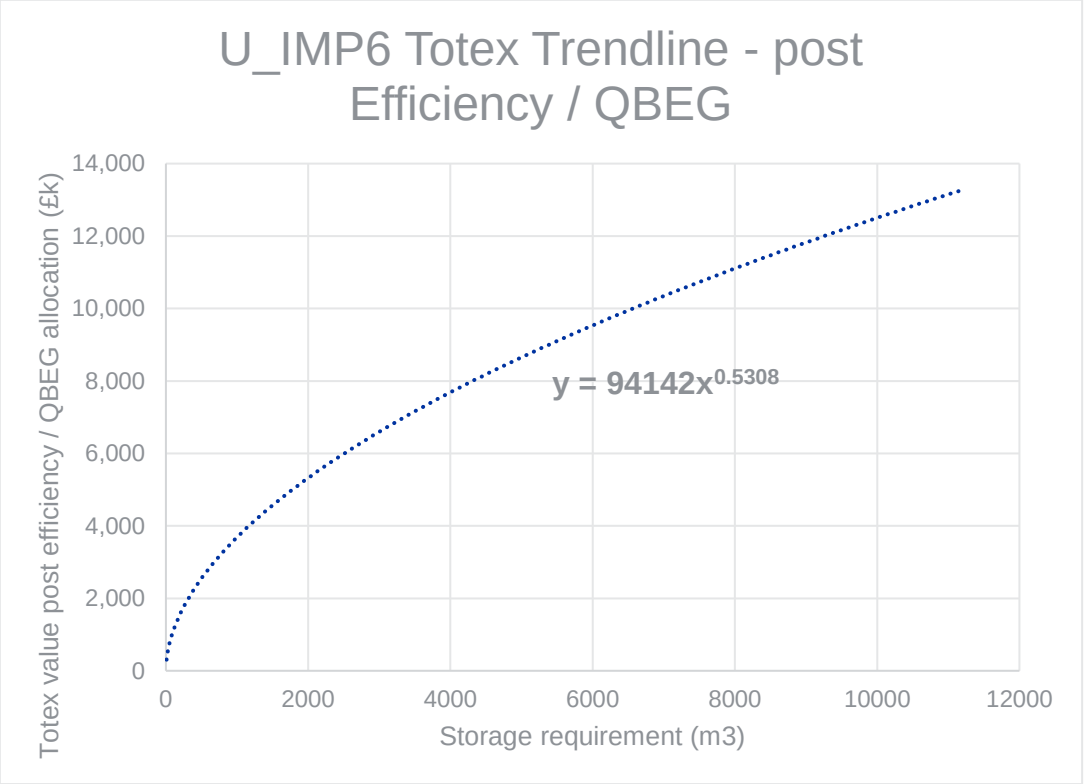
Figure 6 – Unit Cost Curve for U_IMP5



Water Framework Directive U_IMP6

For U_IMP6 drivers we propose to use a single cost curve which provides recovery or cost allowance based on the storm tank capacity avoided or required.

Figure 7 - Unit Cost Curve U_IMP6



5 Drivers for Change

5.1 Customer and Stakeholder Views

As outlined in Chapter 4 - Customer and Stakeholder Engagement, we used insight from our extensive programme of customer and stakeholder engagement to develop a deep understanding of the views and priorities of our customers. All insight gathered from our customer and stakeholder engagement programme can be found in the technical annex to Chapter 4 - Engagement deliverables (index) (TA.4.4).

.

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 service 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. Regulators and the

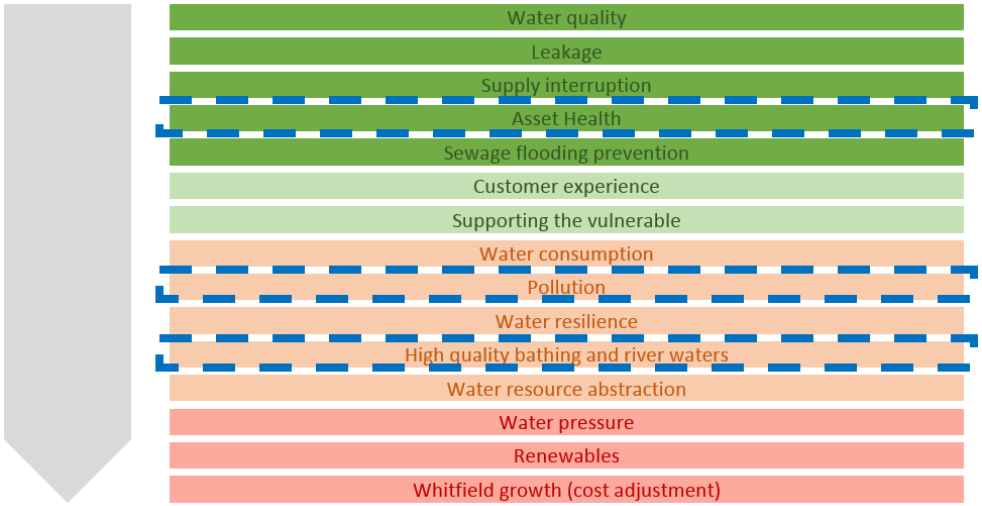
Blueprint group both believe companies should not be rewarded through ODIs for complying with the statutory minimum. The focus of our customers of the future is on protecting and enhancing the environment in the short and long term. They relate treatment works compliance to protecting the environment, and as such, generally rank this measure higher other customer groups.

Customers and visitors to the region, and business customers in the local area, value and want bathing waters that are at least the sufficient legal quality level. Customers see bathing waters as part of the natural environment and expect us to cause no harm to them. Business customers in the local area, value and want bathing waters that are above the sufficient legal quality level. Our vulnerable customers are particularly focused on protecting the natural environment (Ensuring the quality of bathing water is good for swimming, Ensuring beaches are clean and free from litter and dog mess, Southern Water goes beyond the legal minimum to improve the natural environment, Ensuring the quality of bathing water is excellent for swimming) with around twice as many vulnerable customers as non-vulnerable customers indicating this as a key service area.

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 wish to ensure that there is enough water in rivers for natural eco-systems. Customers disliked drought orders, because of the implications on the environment of removing more water from sources.

Figure 8 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 and 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.

5.2 Value for Customers

The customer performance commitments that are impacted by investment in environmental programmes are consistently shown to be medium to high priorities for customers.
Our triangulation of the relative priority of our proposed PCs highlighted pollution as a medium priority for customers and stakeholders. Improving the number of bathing waters at "good" was reported as a high priority for stakeholders and a medium priority for customers. Maintaining bathing waters at "excellent" was reported as a medium priority for both customers and stakeholders. Improving river water quality was reported as a medium priority for customers and a high priority for stakeholders.

Customers are highly averse to accepting reductions in the levels of service provided against these measures in exchange for lower bills, and in general are willing to pay for improvements in service levels, through an increase in their annual wastewater bills.
The customer and stakeholder engagement programme and associated insight gathering activities have shown that our customers would be willing to pay:

- **£708,481** per year above what they already pay for water and wastewater services for each reduction of 1 in the number of **Pollution incidents**
- **£939,704** per year above what they already pay for each **Bathing water site improved from less than Excellent to Excellent**
- **£3,549,387** per year above what they already pay for each **Bathing water site improved from less than Good to Good or better**
- **£91,273** per year above what they already pay **for every 1km of river improved to Good status**

Table 6 Insight gathered on customer willingness to pay for wastewater service improvements

Service Attribute	Unit	WTP [£/Unit/Year]		
		Central	Low	High
POLLUTION INCIDENTS	Incident	£708,481	£539,656	£877,305
BATHING WATER at beaches or lakes improved to Excellent	Bathing water site	£939,704	£723,129	£1,156,278
BATHING WATER at beaches or lakes improved to Good or better	Bathing water site	£3,549,387	£2,729,575	£4,369,197
RIVER WATER QUALITY in the Southern Water region	Km river	£91,273	£69,913	£112,634

Cost benefit is only required for some of the EA drivers, mainly 'Improvement' drivers. The EA are required to run, and pass CBA, for permits to be included in WINEP3. Additionally, we have also run CBA for these schemes based on our customers' willingness to pay. All permits detailed in WINEP3 (having passed the EA CBA) have been tested and all the drivers were passed with the exception of WFD Phosphorous improvements. For WFD Phosphorus, the overall programme of all schemes passed, but individually approximately 40% of permits were not cost beneficial. We are currently in the process of reviewing the CBA process completed by the EA to understand the differences.

Many of the sites and catchments we have selected have been through a rigorous optioneering and challenge process to drive innovation and efficiency.
A significant number of the initial solutions we developed were high cost / low risk approaches to delivering the outcomes required. We challenged these solutions through our Asset+ process to explore innovative approaches and ultimately lower costs. These alternative solutions often increased some form of risk, however for each site our Asset+ process allowed for an objective level of risk to be agreed.

We have undertaken several challenge and review sessions focused on the environment portfolio, designed to place targeted efforts on key catchments, sites or asset types to drive efficiencies. These sessions have generally been successful and allowed greater confidence in the extrapolated efficiencies.
Appendix 3 describes the options we have assessed to develop this plan. This process is described in full in TA.14.4 and TA.14.5.

5.4 Future Trends & Pressures

The main future trends, pressures and opportunities for our Wastewater Environmental Programme can be divided into industry-wide, region-specific and company-specific.

Industry-wide:

- Climate change will drive increasing pressure on the water environment in the future. Increased intensity of rainfall events will both impact on flooding and our storm discharges to environment, as well as increase pollutant load in water bodies.
- Increase focus is being placed on including the environmental cost benefit of schemes within economic evaluation through the use of natural and social accounting.
- Catchment management and co-delivering schemes with our catchment partnerships are becoming more viable following increased experience and understanding in the timeframes and mechanisms involved to deliver successful schemes.
- Emerging understanding around the wastewater treatment process and its role in introducing microplastics into the water environment could drive significant future investment in the medium term.

Region-specific:

- Forecast population growth of 15% by 2040 is likely to drive tighter permits at our sites for the following reasons:
    - Sites breaching UWWTD Population Equivalent thresholds and requiring monitoring and permit levels.
    - Development of tighter permits in order to facilitate new housing growth.
    - Increased growth could drive an increase in impermeable drainage area resulting in pressure upon our discharge and storage permit constraints.

Company-specific:

- The scale of new permits and investigations being driven by this programme are one of the largest we will have delivered. This will place pressure in terms of the availability of both skilled third parties to help us deliver these schemes, as well as increased demand for resources to help us deliver the programme, for instance chemicals or specialist surveying companies.

6 AMP7 Wastewater Environmental Programme

This section details the different environmental schemes that make-up our proposed Wastewater Environmental Programme for AMP7.

The following section is composed of the below elements, covering the environmental drivers. Each driver is presented and considered against the following criteria

- Description and needs
- Costing options and CBA
- What is included in our business plan?

Table 7 Summary of drivers covered in section 6

Type	Part	EA Driver	AMP7 Totex (£m)	Description
Bathing Waters	6.1	n/a	32.4	Customers 'Willingness to Pay' enhanced bathing waters
WFD Improvements	6.2	WFD IMP (NH3)	1.2	Ammonia permits
		WFD IMP (P)	257.2	Phosphorous permits
		WFD IMP (BOD)	3.2	BOD permits
WFD No Deterioration	6.3	WFD ND (NH3)	35.7	Ammonia permits
		WFD ND (P)	27.1	Phosphorous permits
		WFD ND (BOD)	5	BOD Permits
		WFD ND (N)	3.1	Nitrogen permit
Habitats Directive	6.4	HD IMP	14.3	Phosphorous permits
Sites of Special Scientific Interest	6.5	SSSI IMP	13.7	Phosphorous permits
Invasive Non-Native Species	6.6	INNS ND	0.2	Provide INNS/biosecurity training material to all staff
Urban Waste Water Treatment Regulations	6.7	U IMP1	8.6	Urban Waste Water Treatment Regulations
		U IMP4	0.4	UWWTR spill frequency reduction scheme
		U IMP5	151.7	Increasing WwTW flow to full treatment capacity
		U IMP6	130	WwTW storm tank capacity increase
WFD Chemical Permits	6.8	WFD IMP Chem	2.6	Iron permit
		WFD ND Chem	6.8	Chemical permit to prevent deterioration

		WFD NDLS Chem	36.7	Chemicals permits to prevent deterioration
Shellfish Waters	6.9	SW ND	32.9	To prevent deterioration in current water body status
Groundwater Thanet	6.10	WFDGW ND GWQ	32.9	Thanet sewers in chalk adits (Margate region)
Monitoring	6.11	U MON1	1.1	Event and duration monitoring (EDM)
		SW MON	2.3	EDM for shellfish waters
		BW MON	0.1	EDM for bathing waters
		U MON3	0.9	EDM to WwTW storm tank monitoring
		U MON4	0	Install MCERTS flow monitoring at WwTW
		U MON5	0.24	MCERTS flow monitoring for the first time at WwTW
Studies and Investigations	6.12	See Table 3.4	23.3	Investigations and studies to determine future WINEP driven scheme obligations.

Individual scheme costs are detailed in Appendix 1

6.1 Bathing Waters

Our customers consistently tell us that the quality of the bathing waters in our region is a key priority for them. High quality bathing waters help to protect the health of bathers, and the resilience of local economies. We responded to this feedback in AMP6, going beyond the statutory minimum quality standard for bathing water (being 'Sufficient' bathing water quality) with our programme to improve an additional seven bathing waters to 'Excellent'. As part of our long term strategy to bring all coastal waters at bathing beaches up to the standards required to achieve Blue Flag status by 2040 (assuming there is still customer support to do so) we are making further commitments in AMP7 to improve more of our bathing waters to 'Good' or 'Excellent' where there is proof of customer support. This investment is customer-driven and discretionary, and goes beyond statutory minimum environmental standards, and has therefore been promoted under a Cost Adjustment Claim.

Description

The results of a broad suite of research and engagement completed in support of the AMP7 plan demonstrate that bathing waters are a priority for our customers and stakeholders and they are willing to pay extra for the delivery of enhancements. The average willingness to pay for each bathing water area to improve from 'less than Good' to 'Good' is £3.5 million per year, and from 'Good' to 'Excellent' is £0.9 million per year.

Any overlap of investment between this claim, WINEP3, and known uncertainty within WINEP3 has been removed. Bathing waters will be selected based on certainty of outcome, deliverability, amenity, cost to deliver, natural capital and social capital criteria, as used in the AMP6 process. It is envisaged that the Customer Challenge Group (CCG) will have a similar role as in AMP6 to guide the investment in AMP7 and we will continually engage with customers throughout the delivery process.

'Needs'

Site specific requirements are not detailed in WINEP3. In WINEP3 all three bathing water improvement drivers, and a no deterioration driver have been designated as: 'WATER COMPANY SCALE'.
We have undertaken named NEP bathing water investigations during AMP6. No schemes were identified from the AMP6 NEP investigations for AMP7.

The Bathing water sites proposed by Southern Water are summarised in the Bathing Waters Cost Adjustment Claim (CAC01).

Following the analysis of a comprehensive study into customer's preferences, attitudes, priorities and willingness to pay for improvements at bathing waters, it was found that although customers are prepared to pay extra on their bills for bathing waters to be improved to 'Excellent' status, in fact improving bathing waters to 'Good' status is a higher priority for them. The Cost Adjustment Claim therefore reflects this priority and identifies five bathing waters to be improved to 'Good' status and a further two improved to 'Excellent' status. A range of options and sites were identified, and a cost analysis undertaken on 32 sites, with the following bathing waters being selected for improvement measures under the terms outlined in the CAC:

Bathing Waters to be taken to 'Good' classification:

- Broadstairs, Viking Bay
- Littlestone
- Lancing, Beach Green
- Hastings, Pelham Beach
- Felpham

Bathing waters to be taken to 'Excellent' (two from four):

- Gurnard
- Seagrove
- Ramsgate Sands
- Pevensey Bay

Please refer to Bathing Waters Cost Adjustment Claim for more information.

What is included in our business plan?

Our plan includes 7 schemes to improve bathing waters.

Table 8 Summary of investment related to improving bathing waters 'to Good' and 'to Excellent' where there is proof of customer support

Driver	Activity	No. Schemes (Materiality)	Totex (£'m)	Ofwat data table	Source	Benefit
CAC01	Improve 5 bathing waters to Good and 2 to Excellent	7	32.4	WWS2 37	Customer Driven	Improvement in WFD bathing water status at 7 sites

6.2 Water Framework Directive Improvements

An extensive programme to improve the quality of rivers has been proposed in WINEP3 for delivery in AMP7. Measures include reductions in ammonia, phosphorus, and BOD, in order to meet Water Framework Directive (WFD) standards in rivers, transitional and coastal waters.

Improving river water quality is a priority for Southern Water customers and the benefit can be measured via the length (km) of river improved.

6.2.1 WFD Improvement - Ammonia

Description and 'Needs'
Reduce ammonia discharged from WTWs in order to meet WFD ammonia standards in rivers.

Specific permit requirements are detailed in WINEP3.

Costing, options and CBA
Permit specific costs were developed using the Southern Water PR19 costing process by ETS and CET.

End of pipe solutions were developed for ammonia permits. Pump away options were also assessed. The schemes were tested for CBA and identified as cost beneficial.

What is included in our business plan?

Our plan includes upgrade to a single wastewater treatment works at a Totex of £1.2 million.

Table 9: Summary of investment related to reducing ammonia in rivers to meet WFD standards

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
WFD IMP (NH3)	New ammonia permit	1	1.2	WWS2 20	'WINEP3'	4km of river length improvement

Detailed scheme costs are found in Appendix 1

6.2.2 WFD Improvement - Phosphorus

Description and 'Needs'
The guidance received from the Environmental Agency is to reduce phosphorus at wastewater treatment works in order to meet WFD phosphorus standards in freshwater rivers or lakes/reservoirs affected by eutrophication.

Specific permit requirements are detailed in WINEP3.

Costing, options and CBA
The type of options assessed, and the notional solutions developed included catchment schemes, pump-away to another site/connection, and enhanced treatment processes, where the existing site could not already meet the new permit.

- Catchment Scheme

Catchment schemes were tested for all WFD Improvement phosphorus permits. The process used the EA Source Apportionment Geographical Information System (SAGIS) model to identify possible catchment schemes. Catchment schemes were proposed in 2 formats:

1. Catchment only solutions
2. Combined catchment and Works treatment solution

Catchment schemes were developed, informed both by our own internal experience from our Phosphorus catchment management work during AMP6 (Monks Gate Catchment P scheme – please refer to the Section 8 of this document: Innovation), and using a third party consultancy who developed interventions and costs using industry recognised models including SAGIS and Farmscoper.

- Pump-away

All WFD improvement permits were tested for pump-away options following a pump away assessment process. The pump-away process applied certain criteria to filter out any schemes that were likely to incur disproportionate costs e.g. if the nearest connection point was further than a certain distance away, relative to size. Pump away options were assessed and developed by the standard PR19 process using ETS and CET.

- Treatment process

Phosphorus permits were worked into notional solutions assuming a treatment process. Where there was a need to improve treatment, the improvement would follow 1 of the 3 types of improvement detailed in Table 10 below, each process type determined by the permit level detailed in WINEP3.

Table 10: Phosphorus treatment type relative to permit level

Permit Level (mg/l)	Treatment
Above 0.1	Ferric
0.3 – 0.95	Ferric and Deep Bed Sand Filter
0.25	Mecana

A number of schemes were costed per treatment type using the PR19 standard ETS and CET costing process. These were selected to provide a random sample for each of the 3 types of treatment. The sample of costed solutions, per process type, were used to develop a cost curve i.e. 3 separate cost curves relative to treatment type. The cost curve could then be used to extrapolate the cost for a scheme using the treatment type (defined by permit level), and using population equivalent for scale.

The WFD Improvement Phosphorus programme was calculated as cost beneficial across the complete programme, although a number of individual sites were not cost beneficial. The overall programme was included on the basis it was cost beneficial as a whole.

The programme selected was the least ‘whole life cost’ and the most ‘cost beneficial’ feasible solution identified.

What is included in our business plan?

Our plan includes 63 improvement permits for Phosphorus. This is split as follows:

- 1 ‘no build’ i.e. no solution/cost required (South Ambersham WwTW)
- 6 Catchment P schemes (catchment only and combined). This includes 5 agreed with the EA including a programme extension, and 1 site where we have chosen to take on the additional

programme risk delivering to existing WFD timescales, in order to deliver a more efficient plan with potentially enhanced benefits.

- 1 Pump away solution (Kilndown WwTW)
- 55 Works treatment improvements schemes

Appendix 1 contains the detailed scheme lists, Appendix 3 details the individual scheme options assessed for this driver.

Note: A permit at East End WwTW has 2 lines in WINEP3, to deliver benefits in Sowley pond and Sowley stream. Only 1 scheme and associated cost has been included for both benefits.

Table 11: Summary of investment related to reducing phosphorous in rivers to meet WFD standards

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
WFD IMP (P)	New phosphorous permit	63	257.2	WWS2 18,19	'WINEP3'	418km of river length improvement

Detailed scheme costs are found in Appendix 1

6.2.3 WFD Improvement - Biological Oxygen Demand

Description and 'Needs'

The guidance received from the Environmental Agency is to improve Biological Oxygen Demand (BOD). There are no standards for BOD in rivers. Measures with this driver code are to help meet WFD dissolved oxygen standards in rivers.

Specific permit requirements are detailed in WINEP3.

Costing, options and CBA

A solution and cost was developed using the Southern Water PR19 costing process by ETS and CET on a scheme specific basis.

End of pipe solutions were developed for BOD permits. Pump away options were also assessed.

The scheme developed was tested for CBA and identified as cost beneficial.
Appendix 3 details the individual scheme options assessed for this driver.

What is included in our business plan?

Our plan includes upgrade to an existing wastewater treatment works for compliance with the BOD permit at a totex of £3.2 million

Table 12: Summary of investment related to reducing dissolved oxygen in rivers to meet WFD standards

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
WFD IMP (BOD)	New BOD permit	1	3.2	WWS2 20	'WINEP3'	3km of river length improved (accounted for through a Phosphorus scheme at same site

Detailed scheme costs are found in Appendix 1

6.3 WFD No Deterioration

The Water Framework Directive (WFD), no deterioration driver states the requirements to prevent deterioration in current water body status within receiving water bodies from sewage treatment work effluent discharges.

6.3.1 WFD No Deterioration in Ammonia

Description and 'Needs'

The guidance received from the Environmental Agency is to meet requirements to prevent deterioration in ammonia.

Specific permit requirements are detailed in WINEP3.

Costing, Options, and CBA

Notional solutions and costs were developed using the Southern Water PR19 costing process by ETS and CET on a scheme specific basis.

End of pipe solutions were developed for ammonia permits. Pump away options were also considered following a pump away assessment process.

The no deterioration drivers are statutory (S) schemes.

What is included in our business plan?

Our plan includes upgrades to existing wastewater treatment works for compliance with a new reduced ammonia permit at a totex of £35.7 million.

Table 13: Summary of investment related to prevent deterioration in ammonia

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
WFD ND (NH3)	New ammonia permits	10	35.7	WWS2 20	'WINEP3'	18 km of river length improved

Detailed scheme costs are found in Appendix 1

6.3.2 WFD No Deterioration in Phosphorous

Description and 'Needs'

Requirements to prevent deterioration in phosphorus within receiving water bodies from sewage treatment work effluent discharges.

Specific permit requirements are detailed in WINEP3.

Costing, options and CBA

The type of notional solutions assessed included pump to another site/connection, and permits assuming a treatment process. If feasible, these options were developed into costed notional solutions. Catchment schemes were not considered favourable for No Deterioration drivers from discussion with the EA given the short timeline to deliver the outcome.

Pump away and treatment solutions were developed using the same approach as the WFD Improvement driver.

Pump-away

All WFD No Deterioration permits were tested for pump-away options following a pump away assessment process. Pump away options were assessed and developed by the standard PR19 process using ETS and CET.

Treatment process

Phosphorus permits were worked into notional solutions assuming a treatment process. Where there was a need to improve treatment, the improvement would follow 1 of the 3 types of improvement detailed in Table 10 below, each process type determined by the permit level detailed in WINEP3.

Table 14: Phosphorus treatment type relative to permit level

Permit Level (mg/l)	Treatment
Above 0.1	Ferric
0.3 – 0.95	Ferric and Deep Bed Sand Filter
0.25	Mecana

A number of schemes were costed per treatment type using the PR19 standard ETS and CET costing process. These were selected to provide a random sample for each of the 3 types of treatment. The sample of costed solutions, per process type, were used to develop a cost curve i.e. 3 separate cost curves relative to treatment type. The cost curve could then be used to extrapolate the cost for a scheme using the treatment type (defined by permit level), and using population equivalent for scale.

The no deterioration drivers are statutory (S) schemes.

What is included in our business plan?

Our plan includes upgrade to existing wastewater treatment works for compliance with a new reduced phosphorous permit at a totex of £27.1 million

Table 15: Summary of investment related to prevent deterioration in phosphorous

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
WFD ND (P)	New phosphorous permits	12	27.1	WWS2 18,19	'WINEP3'	56 km of River length improved

Detailed scheme costs are found in Appendix 1

6.3.3 WFD No Deterioration in BOD

Description and 'Needs'

Requirements to prevent deterioration in dissolved oxygen within receiving water bodies from sewage treatment work effluent discharge.

Specific permit requirements are detailed in WINEP3.

Costing, Options and CBA

Notional solutions and costs were developed using the Southern Water PR19 costing process by ETS and CET on a scheme specific basis.

End of pipe solutions were developed for BOD permits. Pump away options were also considered following a pump away assessment process.

The no deterioration drivers are statutory (S) schemes.

What is included in our business plan?

Our plan includes a totex of £4.9 million.

Table 16: Summary of investment related to prevent deterioration in dissolved oxygen

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
WFD ND (BOD)	New tightened BOD permit from 20mg/l to 10mg/l	1	5	WWS2 20	'WINEP3'	3km of River length Improved

Detailed scheme costs are found in Appendix 1

6.3.4 WFD No Deterioration in Nitrates

Description and 'Needs'

The guidance received from the Environmental Agency is to meet requirements to prevent deterioration of nitrates in Transitional and Coastal (TraC) water bodies from sewage treatment works effluent discharge.

A single line for this driver was provided in WINEP3: 'Proposed permit: Sidlesham WWTW to 12mg/l (total N) '

Costing, Options and CBA

Notional solutions and costs were developed using the Southern Water PR19 process by ETS and CET on a permit specific basis.

A few options were considered proposing treatment at/between Sidlesham WWTW and neighbouring site Paham WWTW. These are summarised as below:

- Split treatment between each of the works.
- All treatment at Pagham WwTW
- All treatment at Sidlesham WwTW

The preferred solution is to upgrade treatment at Sidlesham WwTW considering Whole Life Cost, and assuming the permit suggested for Sidlesham in WINEP3 i.e. 12mg/l N.

This was an obvious selection given the existing N permit at Sidlesham, there is no step change in solution required at Sidlesham (this would only be required at 10mg/l), and as a result the scheme at Sidlesham required significantly less scope than the other options.

The no deterioration drivers are statutory (S) schemes.

What is included in our business plan?

Our plan includes upgrade to Sidlesham wastewater treatment works for compliance with a new reduced Nitrates permit at a totex of £3.1 million.

Table 17: Summary of investment related to prevent deterioration in nitrates

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
WFD ND (N)	New tightened Nitrates permit of 12 mg/l	1	3.1	WWS2 17	'WINEP3'	3km2 of designated area improved

Detailed scheme costs are found in Appendix 1

6.4 Habitats Directive - Improvements

Description and 'Needs'

The Habitats and Wild Bird Directives (92/43/EEC and 79/409/EEC respectively) has established protected areas of national and international importance called 'Natura 2000' sites, which include Special Areas of Conservations (SACs) which support rare, endangered or vulnerable natural habitats, plants and animals (other than birds) and Special Protection Area (SPAs) which support significant numbers of wild birds and their habitats.

The directive contributes towards protecting and enhancing biodiversity through the conservation of natural habitats and species most in need of conservation in Europe.

The guidance received from the EA is to contribute towards meeting the conservation objectives of a 'Natura 2000' or Ramsar[4] site.

Specific permit requirements are detailed in WINEP3.

Costing, Options, and CBA

The options development and costing source was the same as the one developed for the Phosphorus schemes under the WFD Phosphorus Improvement driver. This included the following types of possible solutions:

- catchment scheme,
- pump to another site/connection,
- permits assuming a treatment process.

If feasible, these options were developed into costed notional solutions.

Please refer to the WFD Improvement Phosphorus 'Costing Source' for more information.

The no deterioration drivers are statutory (S) schemes.

What is included in our business plan?

Our plan includes a totex of £14.3 million

Table 18: Summary of investment related to meet conservation objectives

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
HD_IMP	New phosphorous permits	2	14.3	WWS2 18, 19	WINEP3	304 hectares of designated site restored improved

Detailed scheme costs are found in Appendix 1

[4] Ramsar sites are wetlands of international importance, designated under the Ramsar convention.

6.5 Sites of Special Scientific Interest - Improvements

Description and 'Needs'

Investigation or schemes to contribute to, maintain or meet Favourable Condition Table targets for Sites of Special Scientific Interest (SSSI). Schemes or investigations will be required because of new sites, new evidence or technology, or agreed measures identified on Natural England's database of remedies and threats (CMSi), implementation of PR14 investigations, or revision since PR14 of targets required to meet Favourable Condition.

Southern Water had 4No Phosphorus Improvement permits all on the River Test. The reason for action defined as 'New targets required to meet conservation objective standards since PR14 (CSMG)'.

Specific permit requirements are detailed in WINEP3.

Costing, Options and CBA

The costing source was the same as the one developed for the Phosphorus schemes under the WFD Phosphorus Improvement driver. This included the following types of notional solutions:

- catchment scheme,
- pump to another site/connection,
- permits assuming a treatment process.

Please refer to the WFD Improvement Phosphorus 'Costing Source' for more information.

The options considered were developed in the same way as the WFD Phosphorus Improvement driver. The options assessed are presented above in section 6.2.2 – Costing, Options and CBA. If feasible, these options were developed into costed notional solutions.

Please refer to the WFD Improvement Phosphorus 'Costing Source' for more information.

CBA assessment is not required under this driver

What is included in our business plan?

We have included a totex of £13.7 million to meet conservation objectives that impacts Sites of Special Scientific Interest (SSSI)

Table 19: Summary of investment to meet conservation objectives impacting sites of special scientific interest.

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
SSSI IMP	Phosphorus permits	4	13.7	WWS2 18	Phosphorus cost curves	354km of designated area improved

Detailed scheme costs are found in Appendix 1

6.6 Invasive Non Native Species (INNS)

Description and 'Needs'

This driver includes schemes to deliver the new Invasive Alien Species regulation and the GB strategy for INNS, focussing on the pathways of introduction and spread. The scheme contributes to prevention of deterioration for WFD.

The only scheme identified was for a no deterioration driver. The obligation is to undertake a company-wide scheme to prevent pathways of spread. The scheme is defined as 'Provide INNS/biosecurity training material to all staff'.

Specific requirements are detailed in WINEP3.

Costing Source, **Options and CBA**

Given the nature of this scheme i.e. training of staff on environmental issues, rather than construction, this was costed by the Southern Water Environmental Enabling Team.

The requirement detailed in WINEP3 (presented above), is clearly defined as training. No other option was considered.

Cost benefit is not required given the No Deterioration driver.

What is included in our business plan?

Table 20: Summary of investment to reduce the risk of the spread of Invasive Non Native Species

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
INNS ND	Training	n/a	0.2	WWS2 51	WINEP3	Other-reduced risk of INNS transfer

This driver component forms part of overall studies and investigations programme for AMP7, see Appendix 1.

6.7 Urban Waste Water Treatment Directive

The environment is protected from the adverse effects of discharges of urban wastewater through the Urban Waste Water Treatment Directive (UWWTD) (91/271/EEC.) It is implemented by the Urban Wastewater Treatment Regulations (UWWTR) 1994. This requirement should be seen in the context of the general duties to provide, improve and extend the wastewater system imposed by Section 94 of Water Industry Act (WIA) 1991.

6.7.1 Urban Wastewater Treatment Regulations – Improvement 1 (U_IMP1)

Description and 'Needs'

8 sites require improvements. 2 sites have a 2 mg/l phosphorus permit, for discharges to 3.08km2 of freshwater Sensitive Areas (eutrophication). Site specific monitoring requirements are also required, consistent with the Urban Wastewater Treatment Regulations.

The obligations are defined by the Environment Agency in WINEP3, which provides specific permit requirements.

Costing Source, Options and CBA

For the Phosphorus permits, in addition to works upgrade options, pump-away options were also assessed, but were not considered appropriate following the process presented above in section 6.2.2.

Catchment phosphorus solutions were not considered appropriate for an urban waste water driver from discussion with the EA given the short timeline to deliver the outcome.

Site and scheme specific notional solutions and associated costs were developed by Engineering Technical solutions (ETS) and Commercial Estimating Team (CET).

There is no cost benefit analysis required as this requirement is a statutory obligation.

What is included in our business plan?

The plan includes sampling at 8 wastewater treatment works and 2 sites require 2 mg/l phosphorus permits.

Table 21: Summary of U_IMP1 related investment

Driver	Activity	No. Schemes (Materiality)	Outcome	Totex (£m)	Ofwat data table	Source	Benefit
U_IMP1	Sampling and works upgrades for permits	8	Phosphate reduction leading to an improvement in water quality of 16.2km river length and 3.1 km2 area	8.6	WWS2 18,19,20	WINEP3	14 Km river improvement and 3 km" of designated area improved

Detailed scheme costs are found in Appendix 1

6.7.2 High frequency spilling overflows (U_Imp4)

Description and 'Needs'
The guidance received from the Environmental Agency is to address high frequency spilling intermittent discharges adopting the Storm Overflow Assessment Framework (SOAF) process and the associated CBA process.
Both the SOAF process and the associated CBA process can be found on the WaterUK website: https://www.water.org.uk/policy/improving-resilience/21st-century-drainage/long-term-planning

In WINEP3, the driver is listed by the Environment Agency as a 'WATER COMPANY SCALE' and no site specific requirements are detailed. Southern Water has identified the schemes proposed, and completed the cost benefit analysis, using the guidance detailed above.

Southern Water applied the Storm Overflow Assessment Framework methodology in AMP6 to identify 'high spilling' storm overflows discharging to fresh-water bodies. Intermittent discharges to transitional and coastal (TraC) waters were not assessed given there was no equivalent process at the time.
The SOAF process was applied to all freshwater intermittents with event duration monitoring at the time, which included 353 No. intermittents.

Costing Source, Options and CBA
Site and scheme specific notional solutions and associated costs were developed by Engineering Technical solutions (ETS) and the Commercial Estimating Team (CET).
Options to reduce intermittent discharges were assessed using hydraulic modelling, following the approach below:

- 10% reduction in surface water contributing area
- 40% reduction in surface water contributing area
- Network storage
- Infiltration reduction by sewer rehabilitation
  SUDS were also considered as part of the first two points.

A specific Water UK cost benefit assessment framework was used to inform the process for the cost benefit analysis of the sites proposed from the SOAF process.

In line with the cost benefit analysis process for high frequency spillers, different scale solutions were also developed to test the different cost benefit scenarios. As solutions were proposed, this required the different benefit valuations to be calculated, leading to the most cost beneficial solution. The benefit valuation changed using this specific Water UK method to include an assessment of biodiversity, human health, amenity value, etc.
The output of this was a single scheme proposed for PR19.

What is included in our business plan?
The plan includes one scheme at Dittons Road Polegate CSO, which passed cost benefit analysis. It has a totex cost of £0.4 million and its details are shown below:

Table 22: Summary of investment related to high frequency spilling CSOs

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
U_IMP4	The provision of additional offline storage	1 CSO improvement	0.4	WWS2 11	WINEP3 states 'Water Company Scale'.	Other-reduced spills to the environment

					SWS developed Need	

Detailed scheme costs are found in Appendix 1

6.7.3 Flow Compliance at Works (DWF:FFT) (UWWTR - U_IMP5)

Description and 'Needs'

The guidance received from the Environment Agency is to ensure that wastewater treatment works treat all flows in normal weather conditions. If all the raw sewage is not able to be treated it can have a low level but chronic environmental impact.

The requirement of the UWWTR Improvement 5 driver is to prevent the operation of storm sewage overflows to and from storm tanks in dry weather, to 2025 flow forecasts. The requirement is to not spill to storm tank on dry day, and the defined solution is to increase the wastewater treatment works Flow to Full Treatment capacity, to a limit of 3*permitted Dry Weather Flow (DWF).

In WINEP3, the driver is listed by the Environment Agency as a 'WATER COMPANY SCALE' and no site specific requirements are detailed. Southern Water has identified and developed the schemes proposed. Our approach, based on the EA guidance for this specific PR19 driver, is summarised below.

We have developed a programme of work to ensure storm overflows do not operate in dry weather under normal operating conditions, aligned to the EA driver '*Increasing Flow to Full Treatment (FFT) at Wastewater Treatment Works with Low Permitted FFT/Dry Weather Flow (DWF) Ratios and Increasing Low Permitted Storm Tank Capacity' Version 3 (14th Dec 2017).*
A summary of our approach is outlined below:

- Collect event duration monitoring to identify spills to storm for sites.
- Following a review of this monitoring we removed sites where the data did not justify investment under this driver.
- For the remaining sites we then compared the spill record with our rainfall records to confirm individual spill events and identify rainfall events from flow data.
- Identify infiltration through viewing diurnal flow profiles.
- Remove schemes where no storage capacity is required.

Costing Source, Options and CBA

A sample of sites were costed to generate cost curves (capex and opex). The sites were costed using the standard PR19 ETS/CET costing process. The cost curves were developed using capex/opex (y-axis) and the shortfall in works FFT capacity (x-axis). This approach was used because:

- it provides a more efficient way to cost the large number of obligations
- the updated guidance on the drivers provided by the Environment Agency changes the method defined for developing 'needs'.

The cost curves developed for this specific driver enabled us to extrapolate the value for specific schemes (that had not been individually costed), and produce a costed programme.

No options were considered appropriate for assessment under this driver. The driver states under the 'Driver Code: Description'
The WwTW FFT must be increased to up to 3PG + IMAX + 3E but no less than maximum daily peak flow (MDPF).

The U_IMP5 and U_IMP6 schemes will contribute to compliance with the Urban Waste Water Treatment Regulations. UWWTR are 'must do' and so are not subject to cost-benefit appraisal.

What is included in our business plan?

Our plan includes 61 named schemes that will remove a treatment capacity shortfall at a totex of £151.7 million.

Table 23: Summary of investment related to U_IMP5 UWWTD Flow Compliance

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
U_IMP5	Increased FFT capacity	61	151.7	WWS2 9, 56	'Water Company Scale' in WINEP 3	Other-reduced spills to the environment

This driver is also covered in Appendix 2 and has been defined as explained in section 4 of this document.

6.7.4 Storm Tank Capacity (UWWTR - U_IMP6)

Description and 'Needs'

Southern Water will fulfil the requirements of the UWWTD IMP6 driver by increasing the storm tank capacity for all wastewater treatment works storm tanks to provide either 68 litres/head or 2 hours storage at maximum flow through the tanks. The performance outcome of this investment is that all wastewater treatment works storm tank assets will be more resilient and will not discharge prematurely. The works proposed will eliminate frequent, high strength and long duration discharges from storm tanks entering receiving waters in our region.

In WINEP3, this driver is listed by the Environment Agency as a 'WATER COMPANY SCALE' and no site specific requirements are detailed. Southern Water has developed a programme of work.

Our approach was developed to align with the EA driver *'Increasing Flow to Full Treatment (FFT) at WwTW with Low Permitted FFT/Dry Weather Flow (DWF) Ratios and Increasing Low Permitted Storm Tank Capacity', Version 3 (14th Dec 2017).*

Costing, Options and CBA

Using a similar approach to the UWW IMP5 driver, a sample of sites were costed to generate cost curves (capex and opex). The sites were costed using the standard PR19 ETS/CET costing process. The cost curve was developed using capex/opex (y-axis) and the shortfall in storm tank capacity required by the EA driver (x-axis). This approach was taken given:

- a more efficient way to cost the large number of obligations
- revisions issued for the EA guidance i.e. changes the method defined for developing 'needs'.

The cost curves developed for this specific driver enabled us to extrapolate the value of schemes for additional sites (that had not been individually costed).

No options were considered appropriate for assessment under this driver. The driver states under the 'Driver Code: Description'

The WwTW storm tank capacity must be increased to either 68 litres/head in line with the permitted DWF or to 2 hours at max flow through the tanks following any increase in FFT proposed under U_IMP5.

The U_IMP5 and U_IMP6 schemes will contribute to compliance with the Urban Waste Water Treatment Regulations. UWWTR are 'must do' and so are not subject to cost-benefit appraisal.

What is included in our business plan?

Our plan includes upgrade to storm tanks assets at a totex of £130 million.

Table 24: Summary of AMP7 investment related to U_IMP6, Storm Tank Sizing

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
U_IMP6	Increase storm tank capacity	45 storm tanks assets upgraded	130.0	WWS2 10, 57	'Water Company Scale' in WINEP3	Other- reduced spills to the environment

Detailed scheme costs are found in Appendix 1

6.8 WFD Chemical Permits

6.8.1 WFD Chemicals Improvements (IMP), No Deterioration (ND) and No Deterioration Load Standstill (NDLS)

Description and 'Needs'

For the Chemical Investigation Program, CIP1, carried out in AMP5, sampling was carried out across sites to understand specific chemicals contained within final effluent discharges.

The Chemical Investigation Programme, CIP2 is a monitoring programme in AMP6, currently ongoing between 2015 and 2020 covering more chemicals, works and locations at a much larger scale.

Permits were developed by the Environment Agency for WINEP3, based on the data collected for chemicals from CIP1 and the first half of CIP2. These permits are only required for metals in our region.

Specific permits are listed in WINEP3, including 1 improvement permit; 1 'No Deterioration' permit, and 8 No Deterioration Load Standstill permits.

Costing, Options and CBA

PR19 site specific costs were generated by ETS and CET.

Options were investigated using the following approaches:

- Identify potential traders using trader permits and catchment knowledge, before identifying possible options including undertaking work within the catchment to reduce the chemical loading at our works.
- Assess possible pump away scenarios, both influent, and effluent.
- Relocating outfalls to the main river, if discharging to a small effluent carrier.

At Newbury Lane Cuckfield WTW we have developed a combined solution, in conjunction with the WFD Improvement phosphorus scheme, to propose a lower whole life cost solution.

For a single site (Lidsey WTW) we identified a trader that is likely to be the cause of some of the metal concentration coming into the site. For this site we have assumed this will be confirmed, and proposed a more risky (solution needs to be confirmed as delivering the outcome) alternative including a pump-away, to deliver a lower cost solution. This was the only site where we could identify a likely alternative option.

Given only 1 improvement permit, only this permit required CBA.

A single improvement scheme (Cuckfield Works) was tested for CBA and identified as cost beneficial.

Where permits overlapped at a site e.g. a No deterioration permit required part of, or the same solution, as an improvement driver, costs were removed to prevent double counting.

What is included in our business plan

Our plan includes a totex of £2.6 million, £6.8 million and £36.7 million respectively for WFD Chem Improvement, No Deterioration and No Deterioration Load Standstill.

Eden Vale WTW and Newbury Lane Cuckfield WTW sites have multiple permit conditions under this driver.

Table 25: Summary of investment related to WFD Chemical Permits

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
WFD_IMP Chem	Tighter Iron Permit	1	2.6	WWS2 12, 59	'Water Company Scale'	7km of river length improved
WFD_ND Chem	Tighter Cadmium Permit	1	6.8	WWS2 12, 59	'Water Company Scale'	3km of river length improved (captured in benefit total above)
WFD_ND LS Chem	Tighter Cadmium, Nickle, Iron and Zinc permits	5	36.7	WWS2 12, 59	'Water Company Scale'	21 km of river length improved

Detailed scheme costs are found in Appendix 1

6.9 Shellfish Waters

The guidance received from the Environment Agency is to improve discharges to meet the WFD microbial standard where recommended by previous investigations and where required at newly designated waters.
The Shellfish Waters Directive (SWD) was repealed at the end of 2013 and its requirements transferred to the Water Framework Directive (WFD). The environmental requirements for shellfish water protected areas in England are expressed through the Water Environment (WFD) (Amendment) Regulations 2016 and the Shellfish Water Protected Areas Directions 2016. The Environment Agency is the appropriate agency in England for the purposes of the Regulations and Directions.
Upon transfer to the WFD, all the provisions of the WFD became applicable to shellfish water protected areas including no deterioration, cost-benefit and the use of exemptions where appropriate. The amended Regulations set environmental objectives under WFD (to comply with Articles 4 and 7) and the Environmental Quality Standards Directive (EQSD) in addition to a specific microbial standard of 300 E.coli/100g shellfish flesh and intravalvular fluid the quality of shellfish flesh that we must endeavour to observe in all shellfish waters.

Site specific requirements are not detailed in WINEP3. In WINEP3 against the driver there is 'WATER COMPANY SCALE'.

This driver has been developed under the managing uncertainty methodology and is covered in Appendix 2.

6.9.1 Shellfish Water improvements

Description and 'Needs'
There were 2 methods used to identify possible 'needs' under a shellfish water improvement driver:

1. Shellfish water studies were completed in AMP6 at Portsmouth Harbour, Langstone Harbour, Cowes and Medina. These investigations confirmed assets to be improved under a shellfish water improvement driver. However, these schemes were identified as non-cost beneficial and therefore not included in the PR19 Environmental Programme.
2. Secondly, where shellfish waters are identified as failing, the PR19 Shellfish Waters Driver Guidance states assets discharging directly to a shellfish water could be included without the need for investigation, where there is high confidence in asset performance data. Shellfish waters are identified as failing where they do not consistently (an average of 80% of the time or 8 years in 10 or 4 years in 5) meet the WFD (Shellfish Directions 2016) microbial flesh standard. On this basis a number of other shellfish waters, identified as failing WFD, were checked for any assets discharging directly into the shellfish water. Those assets discharging directly were checked to ascertain whether they met the WFD microbial standard design criteria. The design criteria are:
   - Direct continuous discharges – 6.6 log reduction between influent and the water column after initial dilution;
   - Intermittents – 10 significant spills or less per year as a long term (10 year) average.

   Based on these analyses, schemes per shellfish water were proposed. Schemes per shellfish water were then assessed for CBA.

Costing, Options and CBA
Site specific costs were developed using the Southern Water PR19 costing process by ETS and CET on a scheme specific basis.
For storage solutions for intermittent discharges, ETS used modelling methods to assess the feasibility of different options. The different options assessed included:

- 10% reduction in surface water contributing area
- 40% reduction in surface water contributing area

- Network storage
- Infiltration reduction by sewer rehabilitation

SUDS is covered under the first two items

For continuous discharges ultra-violet treatment processes were developed to provide disinfection for shellfish protection.

The Shellfish Waters Improvement driver SW_IMP is a Statutory + driver and therefore requires CBA. We considered an initial shortlist of sites for which to undertake a CBA based on their compliance and deterioration risk. As part of this CBA we commissioned analysis to investigate the value of potential changes to the classification of shellfish waters to allow a calculation of the value of any benefit. The valuation benefits per shellfish water were then modelled against the cost of improvement schemes required for the same shellfish water, to determine if any passed cost benefit analysis.

The results of the cost benefit analysis showed that no shellfish waters passed cost benefit analysis and therefore were no scheme were included in the PR19 environmental programme under a shellfish water improvement driver.

6.9.2 Shellfish Water No Deterioration

Description and 'Needs'

Of the 16 shellfish waters in our area, the Environment Agency had previously identified deterioration of shellfish water at Southampton Water as 'Very Likely'.

Using a weight of evidence approach, where a shellfish water is showing a statistical deterioration from the expected quality for that water (deterioration assessed as 'Very likely') and expert judgement corroborates this, a SW_ND improvement driver is assigned to assets discharging to or near the shellfish water protected area. Such improvements are not subject to tests of cost-benefit.

Following the No Deterioration method, analysis of the published shellfish flesh quality data and Southern Water asset spill data were used to assess the potential impact on shellfish flesh quality. Using this evidence and also investigations conducted in AMP5 on the same shellfish water, intermittent and continuous discharges were considered and defined as having a direct impact requiring a 10 spills/annum solution or disinfection or if an indirect impact, require an investigation to understand the level of the impact which may require a solution.

Costing, Options and CBA

Site specific costs were developed using the Southern Water PR19 costing process by ETS and CET on a scheme specific basis.

For proposed storage solutions, ETS used modelling methods to assess the feasibility of different options. The different options assessed included:

- 10% reduction in surface water contributing area
- 40% reduction in surface water contributing area
- Network storage
- Infiltration reduction by sewer rehabilitation

SUDS is covered under the first two items

For continuous discharges ultra-violet treatment processes was developed to provide disinfection for shellfish protection.

7 schemes were defined as being required under the shellfish no deterioration driver. For storage schemes any overlap in funding with the UWW U IMP6 driver (storm tanks increased capacity) was removed. This applied to Millbrook where all the scope will be delivered by the IMP6 scheme, so no funding was required to deliver the Shellfish storm storage scheme required here. Removal of the IMP6 scheme here would require the Shellfish water scheme to be funded.

What is included in our business plan?

Our plan includes 7 schemes to prevent the deterioration of Shellfish Waters: This includes:

- 2 ultraviolet treatment schemes
- 5 storm storage schemes (CSO and storm tanks)

Table 26: Summary of investment related to prevent deterioration recommended by shellfish waters no deterioration assessment methodology.

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source
SW_ND	Increased storage/ Ultra violet treatment	7	32.9	WWS2 4, 21 51, 68	WINEP3 'Water Company Scale'. SW developed 'needs'

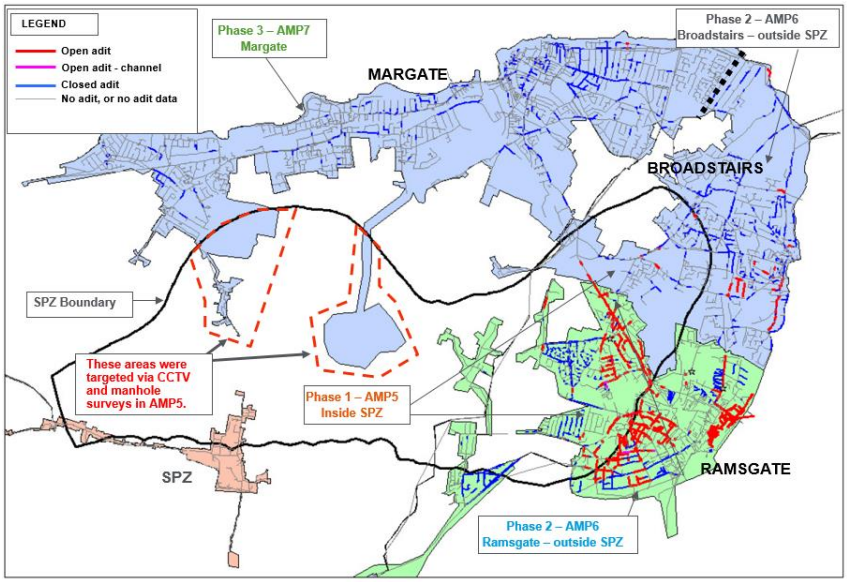
Site specific requirements are not detailed in WINEP3. In WINEP3 against the driver there is 'WATER COMPANY SCALE', see Appendix 2 .
Detailed scheme costs are found in Appendix 1

6.10 Thanet Groundwater (Margate region)

Description and 'Need'

The Thanet Sewers scheme is a groundwater protection scheme to prevent sewage coming into contact with the chalk aquifer. The Environment Agency categorises the SPZs based on the local arrangements for drinking water abstraction. The scheme is a regulatory output with Ofwat and the Environment Agency to be delivered in 3 phases over AMPs 5, 6 and 7. The phasing of the scheme is shown in Figure 3. Phase 3 (AMP7) is required to deliver improvements in Margate.

Figure 9 Summary of Thanet groundwater phasing



The Thanet sewerage catchment area in North East Kent consists of the towns of Margate, Ramsgate and Broadstairs. It has a complex sewerage infrastructure in a region with a significant aquifer from which raw water is extracted and treated for use within the local water supply network. The complexity of the infrastructure is increased by the fact that some of the sewers were laid in the 1920s and 1930s in underground chalk tunnels rather than in traditional open cut trenches. The tunnels are also commonly referred to within Southern Water as adits[5] or headings. The figure below shows an example of these structures.

Figure 10 Example of the Thanet Adits

[5] A horizontal passage leading into a mine for the purposes of access or drainage

The network consists of sewers which are in part pipes and in part open channels laid within unlined adits excavated in the chalk. The use of such adits for sewerage infrastructure is unique for the United Kingdom and is associated with the risk of sewage spill into adits during storm events, leading to the effluent being in contact with the chalk bedrock.
For the purpose of the Thanet Scheme adits have been split into the following four groups;

- Open adits - where the end of the adit is open at both manholes.
- Closed adits - where adits were sealed at both ends.
- Blind adits - where an adit has been found to be sealed at one end only.

Partially closed adits - where the adit has not been fully blocked at the ends, or at least not blocked to a modern construction standard. There are fewer adits in this group than in the other three groups.

The AMP 6 scheme covers Ramsgate and Broadstairs outside the SPZ showcased in Figure 9.

The AMP6 work included panoramic manhole surveys and sewer CCTV surveys have been undertaken to confirm the length of tunnels, sewers, accuracy of records and condition of sewer pipes.

The AMP 7 works will form Phase 3 of the project and will address potential defects in the 222km of sewer system within the Margate catchment which lies outside the SPZ. (10km of network in Margate lying inside the SPZ was addressed in AMP5).

The technical solutions are expected to be similar to those used for the AMP5 and AMP6 projects with two main components;

1. Sewer rehabilitation of defective pipes to address the pathway of foul from the pipes into the adits.

2. Sealing the adits or formalising storage within them via cast in place pipe (CIPP) liners, to prevent ingress of foul into the adits from open ends in the manholes

The works required for the Thanet AMP7 scheme will mitigate the risk of exfiltration from the sewer network, within the town of Margate. The main works scope will be similar to that in AMP5 and AMP6:

Please refer to the Thanet Cost Adjustment Claim for more information.

What is included in our business plan?

Our plan includes a totex of £32.9 million

Table 27: Summary related to Thanet Groundwater

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
Thanet Groundwater	Sewer rehabilitation and lining	1	32.9	WWS2 15	'Water Company Scale'	Improvements in 222 km of sewer

6.11 Monitoring

Flow monitoring has a vital role in protecting water quality by ensuring that permitted flow limits are not exceeded and providing data to understand the volumetric impact of discharges on the water environment.

Investment in monitors (flow and event, duration monitoring) will enable us to monitor spill event frequency and duration of significant discharges at critical discharges points and monitor flow to and from works. Monitoring data provides valuable information to understand the performance of sewers and works, informing compliance.

The benefits of monitoring include; improving our resilience, inform long term drainage strategy planning and will highlight high frequency spilling or unsatisfactory overflows. This will provide evidence to support assessments of performance, particularly for compliance and environmental investigations and schemes.

We are planning to have 100% coverage of storm overflows by the end of AMP7.

There are 6 monitoring sub-drivers to the ***WINEP3 programme***. A summary of our AMP7 proposals for each of these sub-drivers is shown below:

Table 28: Summary of AMP7 monitoring drivers

Driver	Sub-drivers	No. Schemes (Materiality) (schemes)	AMP7Totex (£m)
Monitoring	**Total Outputs**	**488**	**4.7**
	U_MON1	260	1.1
	SW_MON	166	2.3
	BW_MON	18	0.1
	U_MON3	40	0.9
	U_MON4	0	0
	U_MON5	4	0.24

The following sections discuss each of these sub-drivers in more detail.

6.11.1 Storm Discharge Monitoring (U_MON1)

Description and 'Needs'

Install event duration monitoring on storm discharges identified as high significance, other than bathing and shellfish waters (under the Risk Based Approach to the Monitoring of Storm Discharges). The specification for monitoring is that the frequency and duration of a spill event is measured at the storm overflow and is recorded via telemetry. This driver is a continuation of the Event Duration Monitoring work started in AMP6.

There a 3 types of scheme included for this driver:

1. There are 12 sites detailed in WINEP3 requiring installation of event duration monitors, where no monitoring is currently installed.
2. 130 sites detailed by the EA in WINEP3 requiring an upgrade to comply with new technical standards, increasing the frequency of reporting from 15 minutes interval to 2 minute interval.
3. 118 sites identified as requiring permit changes to ensure compliance with the 2-minute reporting requirements. No scheme is proposed for these, only the EA fee for the change in permit. These are not listed in WINEP3 but requested by the EA.

These schemes were developed following an internal review and assessment of our sites and their monitoring. Other sites not included were determined to already meet requirements/not require investment.

Costing

The investment requirement for the planned AMP7 obligations has been based on historic AMP6 event duration monitoring costs with AMP7 efficiency and overheads applied

What is included in our business plan?

Our plan includes a Totex of £1.1 million. This is broken-down in Table 5 below.

Table 29: Summary of Event Duration Monitoring related investment

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
U_MON1	Upgrade existing EDM to comply with standards, which will increase reporting frequency from 15 minutes to 2 minutes	130	1.1	WWS2 6	WINEP3	Other-enhanced monitoring capability
U_MON1	Brand new EDM installations with mains power, new signals, outstation and transducers	12		WWS2 6	12 listed in WINEP3	Other-enhanced monitoring capability
U_MON1	Only EDM permit application fee required for change from 15 minutes reporting requirement to 2 minutes	118		WWS2 6	Not listed in WINEP3 as no capital works is required.	Other-enhanced monitoring capability
Total		260			-	

6.11.2 Storm Overflow Monitoring for shellfish and protected areas (SW_MON) and Bathing Waters (BW_MON)

Description and 'Needs'

The guidance received from the EA is to provide event and duration monitoring on storm overflows (under the Risk Based Approach to the Monitoring of Storm Discharges), impacting on shellfish waters and significant storm overflows impacting on bathing waters.

In AMP7 there are 166 shellfish water sites identified by the EA in WINEP3 as requiring an upgrade to comply with new technical standards[6] to increase reporting from 15 minute interval to 2 minute interval.

In AMP7 there are 18 bathing water schemes identified by the Environment Agency in WINEP3 as requiring an upgrade to comply with new technical standards[7] to increase the frequency of event duration monitoring reporting from 15 minute interval to 2 minute interval.

Costing

The investment required for the AMP7 obligations has been based on historic AMP6 costs with AMP7 efficiency and overheads applied.

What is included in our business plan?

Our plan includes an upgrade to existing event duration monitors at 166 locations of storm overflows impacting shellfish waters at a totex value of £2.3 million.

Table 30: Summary of event duration monitoring on storm overflows impacting shellfish waters and bathing waters

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
SW_MON	Upgrade existing event duration monitors to comply with standards, which will increase reporting frequency from 15 minutes to 2 minutes	166	2.3	WWS2 6	WINEP 3	Other-enhanced monitoring capability
BW_MON	Upgrade existing EDM to comply with standards, which will increase reporting frequency from 15 minutes to 2 minutes	18	0.1	WWS2 6	WINEP 3	Other-enhanced monitoring capability

6.11.3 Storm Tank Monitoring (U_MON3)

Description and 'Needs'

Provide event duration monitoring on overflows to storm tanks to record when spills to storm tanks start and stop at intervals no greater than 2 minutes.

The spill is recorded when the permitted pass forward flow to full treatment setting for the waste water treatment works is exceeded and ensures compliance with pass forward flows. Where there is no storm tank associated with the waste water treatment work, event duration monitors must record when last in line storm discharge overflow/s start and stop operating.

In WINEP3, the driver is listed by the Environment Agency as a 'WATER COMPANY SCALE' and no site specific requirements are detailed. Southern Water has identified the schemes proposed.

We undertook a review of all 365 wastewater treatment works to assess what storm alarms are available for each site. The assumption being that monitors must be in place on site to allow an alarm to be recorded and that the alarm descriptions are correct. It was identified that 40 sites require new

monitors to be installed to record operation of the WwTW or last in line overflow discharging into the storm tank or offline storm storage plus discharge from storage to the environment.

Costing Source

The investment for the planned AMP7 obligations has been based on historic AMP6 costs with AMP7 efficiency and overheads applied.

What is included in our business plan?

Our plan includes 40 sites that require new installations of event duration monitors at a totex of £0.9 million.

Table 31: Summary of U_MON3 related investment consisting of new EDM installations on storm tanks

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
U_MON3	New event duration monitor installations with mains power, new signals, outstation and transducers	40	0.9	WWS2 6	Internal investigation	Other-enhanced monitoring capability

6.11.4 Flow monitoring for monitoring FFT compliance (U_MON4)

Description and 'Need'

The guidance received from the Environmental Agency is to provide MCERTS flow monitoring for the first time at WwTW where permitted DWF or maximum daily flow is greater than 50m3/d.

It is driven by the requirement to record the total daily volume of 'treated effluent discharge' with a target combined uncertainty of ± 8%. The flow monitoring should be installed as close to the storm separation point as practicable and where it is suitable and cost-effective, existing flow monitoring should be used. Non-MCERTS installations can be MCERTS Certified under this driver.

The Environmental Agency provides site specific named schemes for this statutory obligation in WINEP3. Southern Water also defined site specific monitoring requirements consistent with the Urban Wastewater Directive.

The final guidance for measuring compliance with pass forward flow (PFF) to, Wastewater Treatment Works (WwTW) provided by the Environment Agency, sets out a stepped process to identity the appropriate solution at each site to deliver FFT compliance as described below.

Southern Water carried out a review of MCERTS monitoring that is currently in place at our waste water treatment works. This showed that all 365 sites either have flow from works (FFW) or flow to full Treatment (FTT) MCERTS in place (98 sites with FFW but most of these have FFT monitors covered by site MCERTS certification)

A priority order of solution identification was undertaken as follows:

1) Use existing inlet MCERTS flow monitor
2) Get an existing inlet flow monitor MCERTS certified
3) Use existing back end MCERTS flow monitor (if not possible go to 4, if unsure of suitability go to 5)

4) Install new inlet MCERTS flow monitor

5) Investigate whether existing back end MCERTS flow meter can be used an d if so then use in AMP7

6) If it can't be used then install new inlet MCERTS flow monitor under a PR24 driver.

MCERTS certification for new or existing inlet flow monitoring will offset initial investigation and ongoing compliance assessment and reporting costs associated with a back end MCERTS flow monitor.

If a new front end monitor will require extensive civil engineering then a back end monitor can be used.

Costing

The investment for the planned AMP7 sites has been based on the unit cost for a site investigation from the main MCERTS flow project that Southern Water carried out between 2000 and 2010.

What is included in our business plan?

Our plan includes 98 site investigations and reporting at a totex of £0.12 million.

Table 32: Summary of U_MON4 Flow Monitoring related investment

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source	Benefit
U_MON 4	Site investigations and reporting / recommendations as per standard Scope of Works documents (method statements)	98 site investigations and reporting	£0.1 (Included in S&I in Table 1 and Appendix 1)	WWS2 16	Internal investigation	Other- enhanced monitoring capability

6.11.5 Flow Monitoring where DWF exceeds 50m3/dayU_MON5

Description and 'Needs'

Install MCERTS flow monitoring on sites where the DWF permit is greater than 50m^3/day.

5 sites were identified for this driver in WINEP3. One of these sites, Coolham WTW has a pump away solution planned in 2020. No monitoring is expected to be required. Fulking WTW, Warninglid WTW, Forest Green WTW and Blackwater WTW will need to be fully certified.

Costing

Site and scheme specific notional solutions and associated costs were developed by Engineering Technical solutions (ETS) and Commercial Estimating Team (CET).

There is no cost benefit analysis required as this requirement is a statutory obligation.

What is included in our business plan?

Our plan includes 4 site investigations and reporting at a totex of £0.2 million.

Table 33: Summary of U_MON5 MCERTS flow monitoring related investment

Driver	Activity	No. Schemes (Materiality)	Totex (£)	Ofwat data table	Source	Benefit
U_MON5	Install new MCERTs flow monitoring on sites	4	0.2	WWS2 7	WINEP3	Other-enhanced monitoring capability

6.12 Studies and Investigations

Description and 'Needs'

An ambitious programme of studies and investigations is proposed for AMP7, to enable Southern Water to identify the most appropriate and cost beneficial future programme of work to deliver greatest environmental benefit, where appropriate.

The Studies and Investigations Programme includes studies defined in WINEP3 and 'Water Company Scale' studies not defined in WINEP3. Where schemes have not been defined in WINEP3 we have undertaken our own investigations to determine the scope and number of investigations required.

Table 34: Summary of studies and investigations programme

Driver Code	Description	No. of studies
BW_NDINV	Bathing Water Investigation no deterioration	5
BW_INV1	Bathing Water Investigation with a current planning class of poor	1
BW_INV2	Bathing Water Investigation at risk of deterioration to a planning class of poor	2
BW_INV4	Bathing Water Investigation at risk of not achieving good	31
SW_INV1	Shellfish Investigation	9
WFD_INV	BOD/P/DO Investigations and UPM River Catchment Studies	16
U_INV UWWTR	Spill Frequency Reduction Investigation	1
HD_INV	Habitats Directives Investigation	2
MCZ_INV	Marine Conservation Zone Catchment Investigation	2
SSSI_INV	Sites of Special Scientific Interest Investigation	5
INNS_INV	Invasive Non Native Species Investigation	1
WFD_INV_CIP3; 1-14 CHEM Drivers	Chemical investigations	38
Total number of studies and investigations		**113**

Costing

Costs for Bathing Water, UWWTD and WFD studies and investigations were provided by consultants Stantec. Costs for Habitats Directive, MCZs, NERC and SSSI were provided by consultants Mott McDonald. Costs for INNS were provided by ETS Enabling Team. Costs for Chemicals Investigations are provided by ETS, and third parties with experience in this area.

What is included in our business plan?

Our plan includes a totex of £23.1 million

Table 35: Summary of investment related to the S& I programme

Driver	Activity	No. Schemes (Materiality)	Totex (£m)	Ofwat data table	Source
S & I Programme	89 investigations	113	23.1	WWS2 4,13, 16, 63	WINEP3

7 Performance Commitments

To provide a layer of customer protection we have proposed several performance commitments and the ones supported by this case are detailed in the table below:

Table 36- Performance commitments supported by this case (WW06)

Performance Commitments supported by this technical annex		
Performance commitment	**How relevant is this technical annex?**	**Comment**
River water quality	High	The Performance Commitment (PC) is a key measure of how we perform in delivery of our WINEP obligations. The enhancement being 537km of river length through improvements in the WFD programme.
Maintain bathing waters at excellent	High	This PC is a key measure of the number of bathing waters that are classified at Excellent. It is in relation to the maintaining the level of excellent bathing water sites achieved during AMP6.
Improve the number of bathing waters to at least “good”	High	This PC is a key measure of Improving five bathing waters to at least good from a lesser classification (CAC).
Improve the number of bathing waters to “excellent”	High	This PC is a measure of increasing at least two bathing waters to excellent from a lesser classification (CAC).
Natural capital	High	This PC is a measure of delivering natural capital accounting for 3 of our 10 river catchments.
Combined sewer overflow monitoring	High	This PC is a measure of verified event monitoring for our combined sewer overflows, providing transparency and supporting environmental resilience.

8 Innovation

We are committed to achieving environmental outcomes using new and innovative approaches, so that we can continue to provide customers with best value services. A number of these approaches build upon work we are already taking in AMP6 in order to develop better solutions in AMP7 and are described as case studies below.
For instance we propose to deliver our largest wastewater catchment management programme to date with six phosphorous schemes proposed in AMP7. This has been very much informed by the innovative work we have been undertaking in AMP6.

Hailsham- Delivering our lowest ever Phosphorus discharge consent

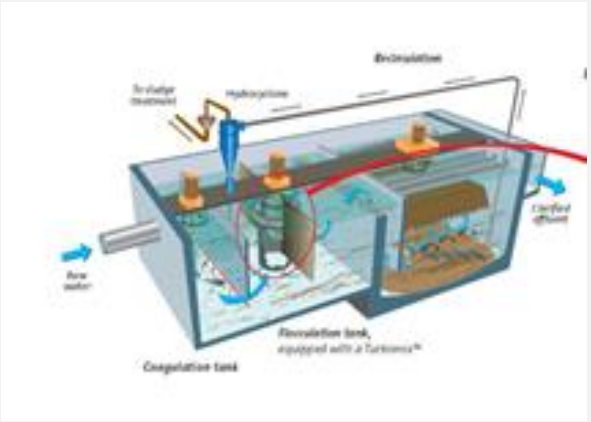
We are installing innovative technology at our Hailsham WTW to deliver our lowest ever Phosphorus consent levels.

The problem:

Both our treatment works at Hailsham discharge into the Pevensey levels, Pevensey Levels is one of the most biodiverse lowland ditch systems in the United Kingdom. It is of international importance for its migratory wildfowl (RAMSAR designated) and its outstanding assemblage of invertebrates and plants. Pevensey is also a Special Area of Conservation (SAC) for its population of *Anisus vorticulus.* Improving the Pevensey Levels to 'favourable status' is a priority target for Natural England on a regional and national scale. The need to restrict water quality to 0.1mg/l P in the Levels is an identified action to achieve this alongside other measures that fall to the EA and Natural England concerning water levels and the control of invasive species. This resulted in the Environment Agency (EA) issuing Total Phosphorous (TP) consents of 0.1 mg/l to the effluent discharges from Hailsham North and Hailsham South WTW. At the time of issuing these consents, there were few technologies available to meet these consent levels.

The solution:

With constraints on more traditional solutions to meet this problem, such as pumping away limited by the flow required in the Levels, we took this as an opportunity to try and identify new innovative technologies that could be applied in this situation. We trialled technology that is currently used in our Drinking water business called Actiflo. This technology promotes increased coagulation and flocculation in the tertiary treatment at our works, essentially helping to bind phosphorous and filter it out at this treatment stage. These trials showed the technology could deliver the improvements we required and the chemicals used would be environmentally friendly. We are now installing full scale Actiflo treatment in order to meet the 2021 deadline.



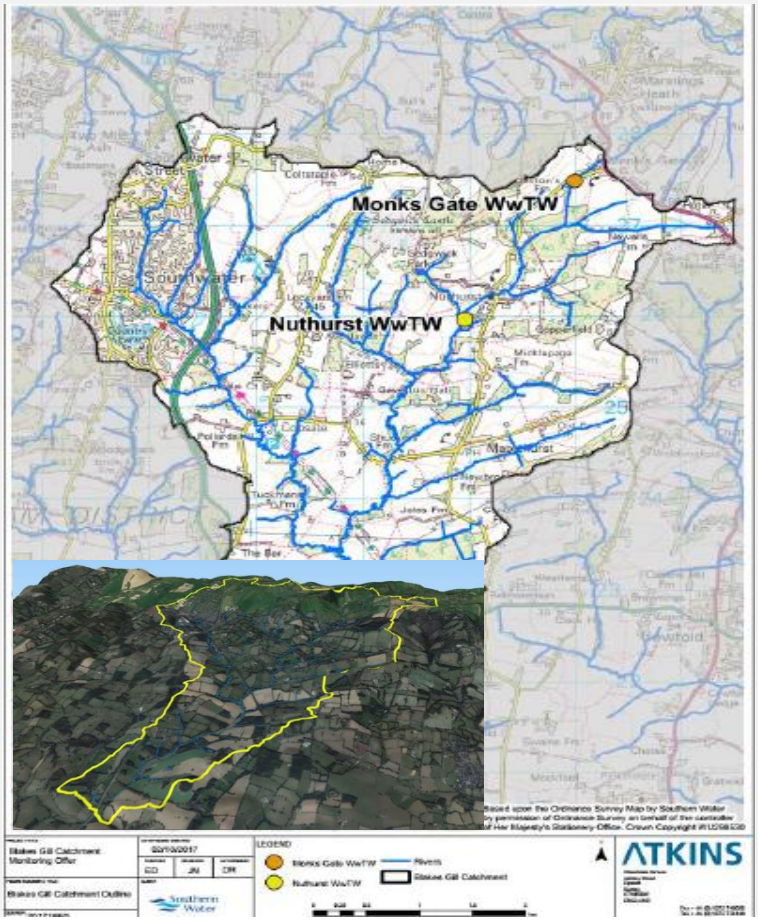
Monks Gate- our first wastewater catchment management scheme

We are working with catchment partners to deliver an in catchment reduction in Phosphorous.

Background

Blakes Gill is a small tributary of the River Adur situated just to the south east of Horsham in West Sussex. This water body is not currently at good status due to high Phosphorous levels. We operate two wastewater treatment works in the catchment, at Nuthurst and Monks gate, which contribute to the Phosphorus load of the catchment. To reduce this, the Environment Agency issued us with a 1mg/l P permit to be delivered by 2021 at Monks gate, a small works serving a population of 200, a traditional solution would be to pipe away to a neighbouring larger works. However the catchment also has a large proportion of Phosphorous loading derived from agriculture as well as septic tank discharges. The catchment is also predominately clay and currently at a low level of stewardship, all of which make it a good candidate for enacting catchment management schemes to negate the need of a traditional capital solution.

Our plan



We have undertaken preliminary work to confirm the suitability of the catchment and that the Phosphorous reduction required could be delivered. We have also developed a monitoring plan to enable us to obtain a baseline of measurements to better inform the impact of our future catchment activities. We will be undertaking monitoring and initial landowner engagement in the Autumn of 2018. Following 12 months' worth of baseline monitoring we will then begin our programme of interventions with landowners in the catchment. We will co-deliver this project working with the Environment Agency, the local Rivers Trust and catchment partnership. We have agreed with the Environment Agency, that we will have our catchment measures in place by 2021,but have until 2023 in which to see the benefits of the scheme be delivered in terms of lower phosphorus levels

2019 and beyond

We have proposed 6 catchment management schemes to reduce phosphorous levels in this plan. We aim to build on the learning from Monks Gate and from our Drinking Water Catchment teams as outlined in the **TA.11.WR03 Catchment Management Solutions** technical annex.

Innovative approaches to Phosphate Treatment – Absorptive Media

Innovation and partnership case study: Phosphorous removal As part of our R&D programme, we are looking at phosphorus removal at our Innovation Hub – based at Petersfield WTW In collaboration with the University of Portsmouth. The Hub's skilled scientific and analytical team focuses on trials for phosphorus removal for our many small WTWs – sites with fewer than 5,000 population equivalent. Where WINEP targets are driving focus for our programme, we aim to find passive solutions that have the least impact on the environment. Projects include:-

- Investigating materials which eliminate phosphorous without using chemicals
- Trialling package plant solutions
- Trials of innovative technologies and approaches
- A PhD programme focused on the efficacy of adsorptive media.

9 Key Risks and Opportunities

The major risks and opportunities we face in defining, designing and delivering our Wastewater Environmental Programme are as follows:

9.1 Risks

- There is a risk that work in our programme which is requested by customers, such as bathing water improvements, is not funded because it is not a formal EA requirement. This means we would be unable to deliver the outcomes our customers and other stakeholders expect.

- There is a risk that where (in the absence of agreement from the Environment Agency) we have had to develop proposals for AMP7 using the WATER COMPANY SCALE that this work may prove difficult or expensive to deliver by the regulatory deadlines. This is because any changes in cost or delivery dates will need to be processed through our unconfirmed requirements process [See section 4].

- There is a risk that some of the technical solutions that we are developing to resolve complex pollutants, such as toxic metals or pesticide removal or very high levels of phosphorous removal, may not prove to be as effective as we expect. This could lead to substantial additional costs, and possibly delays in delivery, as we seek to use traditional solutions to address these issues.

9.2 Opportunities

- There is an opportunity that the delivery of joint catchment management schemes with our catchment partners (including the Environment Agency, Natural England, River trusts and Farmer cluster groups) to resolve water resources/quality or wastewater issues could generate more savings than we have assumed.

- There is an opportunity that we may be able to develop better technical solutions than those already developed to resolve complex pollutants such as Phosphorous, toxic metals and pesticide

Appendices

Appendix 1. Projects and schemes in AMP7

Driver	Scheme Description	Totex	Permit (if applicable)
Bathing Water	Covered in Bathing Water cost adjustment claim	£32,378,014	
WFD Improvement	Ammonia	£1,204,705	No Schemes : 1
	Buriton WWTW	£1,204,705	8 mg/l
	Phosphorus	£257,203,866	No. Schemes : 63
	Ashington WWTW	£ 3,596,857	0.5 mg/l AA
	Balcombe WWTW	£ 1,088,029	0.5 mg/l AA
	Barcombe New WWTW	£ 4,204,558	0.25 mg/l AA
	Battle wwtw	£ 3,088,827	0.5 mean
	Bethersden wwtw	£ 4,167,278	0.25 mean, 5 max
	Bishops Waltham WWTW	£ 3,457,181	0.4 mg/l AA
	Blackstone WWTW	£ 873,047	2 mg/l AA
	Boldre WWTW	£ 2,569,139	1 mg/l AA
	Brockenhurst WWTW	£ 9,196,588	0.5 mg/l AA
	Burgess Hill Goddards Green WWTW	£ 10,669,717	0.25 mg/l AA
	Buriton WWTW	£ 2,162,891	0.7 mg/l AA
	Calbourne WWTW	£ 1,898,322	0.5 mg/l AA
	Charing wwtw	£ 2,685,658	0.5 mean
	Chiddingfold WWTW	£ 3,220,121	0.4 mg/l AA
	East Boldre WWTW	£ 5,069,415	0.25 mg/l AA
	East End WWTW	£ 1,833,996	2 mg/l AA
	East Meon WWTW	£ 3,278,104	0.6 mg/l AA
	Eden Vale wwtw	£ 3,425,627	0.3 mean
	Edenbridge wwtw	£ 3,256,587	0.5 mean
	Fairlight wwtw	£ 2,531,079	0.5 mean, 5 max
	Felbridge wwtw	£ 7,765,949	0.25 mean
	Flexford Lane Sway WWTW	£ 3,318,575	0.4 mg/l AA
	Forest Green WWTW	£ 2,558,787	1 mg/l AA
	Fulking WWTW	£ 1,948,314	0.5 mg/l AA
	Godshill WWTW	£ 2,592,925	0.5 mg/l AA
	Godstone wwtw	£ 4,337,241	0.3 mean
	Grayswood WWTW	£ 2,163,789	0.3 mg/l AA

Driver	Scheme Description	Totex	Permit (if applicable)
	Handcross WWTW	£ 2,428,366	0.5 mg/l AA
	Herne Bay wwtw	£ 3,965,656	0.3 mean
	High Halden	£ 4,164,894	0.25 mean, 5 max
	Horsham WWTW	£ 35,408,807	0.25 mg/l AA
	Horsted Keynes WWTW	£ 1,299,437	2 mg/l AA
	Kilndown wwtw	£ 1,561,946	0.5 mean
	Lenham wwtw	£ 4,902,001	0.5 mean
	Limpsfield and Oxted wwtw	£ 8,529,778	0.25 mean
	Lingfield wwtw	£ 8,209,841	0.25 mean
	Mannings Heath WWTW	£ 2,392,907	0.4 mg/l AA
	Netherfield wwtw	£ 2,074,692	0.5 mean
	Newnham Valley wwtw	£ 2,509,799	1.0 mean
	Northchapel WWTW	£ 2,166,248	0.7 mg/l AA
	Ockley West WWTW	£ 1,714,602	1 mg/l AA
	Pagham WWTW	£ 7,878,086	0.25 mg/l AA
	Petersfield WWTW	£ 3,633,472	0.6 mg/l AA
	Poynings WWTW	£ 2,131,973	0.5 mg/l AA
	Redlynch WWTW	£ 4,016,749	0.3 mg/l AA
	Roud WWTW	£ 3,049,551	0.3 mg/l AA
	Rudgwick WWTW	£ 2,675,651	0.4 mg/l AA
	Scaynes Hill WWTW	£ 10,072,487	0.25 mg/l AA
	Sedlescombe wwtw	£ 1,442,497	0.7 mean
	Sellindge wwtw	£ 3,148,222	0.5 mean
	Shalfeet WWTW	£ 2,107,648	1 mg/l AA
	Shrub Lane (Burwash Village) wwtw	£ 2,456,557	0.9 mean
	Slinfold WWTW	£ 2,430,184	0.4 mg/l AA
	Small Dole WWTW	£ 1,241,018	1 mg/l AA
	South Ambersham WWTW	0	1.5 mg/lAA
	South Harting WWTW	£ 2,354,705	0.7 mg/l AA
	Staplefield WWTW	£ 1,415,957	0.5 mg/l AA
	Storrington WWTW	£ 3,182,572	0.5 mg/l AA
	Tangmere WWTW	£ 6,163,137	0.25 mg/l AA
	Ticehurst wwtw	£ 829,187	0.3 mean
	Tunbridge Wells South wwtw	£ 9,354,869	0.25 mean
	Whiteparish WWTW	£ 579,334	0.3 mg/l AA
	Wingham (Dambridge) wwtw	£ 8,753,031	0.25 mean
	BOD	£ 3,171,539	No Schemes:1
	Chiddingfold WWTW	£ 3,171,539	10 mg/l(95%ile)

Driver	Scheme Description	Totex	Permit (if applicable)
WFD No Deterioration	Ammonia	£35,733,965.03	No Schemes : 10
	Brockenhurst WWTW	£5,778,332	2 mg/l(95%ile)
	Pagham WWTW	£3,636,456	2.5 mg/l(95%ile)
	Kirdford WWTW	£2,756,247	4 mg/l(95%ile)
	Northchapel WWTW	£1,556,256	4 mg/l(95%ile)
	Chiddingfold WTW	£2,686,360	3 mg/l(95%ile)
	Speldhurst wwtw	£4,232,970	9 Look up table (33 UT)
	Crowborough Redgate Mill wwtw	£7,651,748	3 Look up table (all year), 6 UT Summer, 12 UT Winter
	Netherfield wwtw	£2,688,289	5 Look up table
	Stubbs Lane Brede wwtw	£1,669,844	3 Look up table (all year)
	Hawkhurst South wwtw	£3,096,489	3 Look up table (all year), 12 UT (all year)
	Phosphorus	£27,110,238.08	No Schemes : 12
	Cherry Gardens Goudhurst wwtw	£ 2,109,773.63	4.5 mean
	Cranbrook wwtw	£ 2,476,776.48	1.2 mean, 5 max
	Ham Street wwtw	£ 2,177,795.29	2.6 mean
	Lydd wwtw	£ 2,295,320.05	5.6 mean
	Pembury wwtw	£ 2,404,702.66	3.0 mean
	Quickbourne Lane Northiam wwtw	£ 2,192,271.96	4.4 mean
	Robertsbridge wwtw	£ 2,221,400.75	4.7 mean
	Rolvenden Layne wwtw	£ 2,115,409.85	2.3 mean
	Ticehurst wwtw	£ 2,290,110.05	4.6 mean
	Ulcombe wwtw	£ 2,624,506.23	0.7 mean, 5 max
	Whiteparish WWTW	£ 2,246,548.70	5.2 mg/l AA
	Wickham WWTW	£ 2,496,836.39	5 mg/l AA
	BOD	£4,971,951	No Schemes : 1
	Vines Cross	£4,971,951	10 mg/l(95%ile)
	Nitrates	£3,069,266	No Schemes : 1
	Pagham Harbour WWTW nitrogen reductions	£3,069,266	Sidlesham WWTW to 12mg/l (total N) suggested
Habitats Directive	Improvement schemes	£14,276,829.41	No Schemes : 2

Driver	Scheme Description	Totex	Permit (if applicable)
	Chickenhall WWTW	£5,012,793	Phosphorus - 0.6 mg/l AA
	Harestock WWTW	£9,264,037	Phosphorus - 0.25 mg/l AA
SSSI Improvements	SSSI_Improvements	£13,656,357.69	No Schemes : 4
	Barton Stacey WWTW	£3,143,943	Phosphorus - 0.3
	Fullerton WWTW	£4,571,508	Phosphorus - 0.4
	Gratton Close WWTW	£2,045,514	Phosphorus - 2
	Romsey WWTW	£3,895,393	Phosphorus - 0.5
UWWTD	UWWTR - U_IMP6 (Storm Tanks)	£129,997,295	
	UWWTR - U_IMP5 (DWF:FFT)	£151,749,453	
	U IMP 1 :Improvement 1	£9,070,159.74	No Schemes : 8
	Bidborough wwtw - P	£1,770,546	P 2.0 mean, Fe: 3.5mg/l (95%) 8mg/l (UT)
	Buxted WWTW	£105,680	UWWTD conditions to be added to permit
	Godshill WWTW	£68,266	UWWTD conditions to be added to permit
	Hurst Green wwtw	£3,492,191	Add: BOD Upper Tier 47 mg/l, NH3(N) Upper Tier 12 mg/l summer, 27 mg/l winter
	Luxfords Lane East Grinstead wwtw - P	£2,512,148	P 2.0 mean, Fe: 4mg/l (95%) 8mg/l (UT)
	Maresfield WWTW	£133,578	UWWTD conditions to be added to permit
	Playden and Iden wwtw	£444,147	Add: BOD Upper Tier 70 mg/l, NH3(N) Upper Tier 27 mg/l
	Quickbourne Lane Northiam wwtw	£96,294	Add: BOD Upper Tier 50 mg/l, NH3(N) Upper Tier 20 mg/l summer, 37 mg/l winter
	Imp_4: High frequency spilling overflows	£447,308	No Schemes : 1
	DITTONS ROAD POLEGATE CSO Option 01	£447,308	

Driver	Scheme Description	Totex	Permit (if applicable)
WFD- Chemical Removal Programme	Improvements	£2,561,389	No Schemes : 1
	Newbury Lane Cuckfield WTW	£2,561,389	Chem Imp:Iron: 1.5 mg/l (95%ile) 4 mg/l (UT):
	No deterioration	£6,788,903	No Schemes : 1
	Eden Vale WTW	£6,788,903	Chem_ND: Cadmium 3.3 ug/l (95%) 39.7 ug/l (UT)
	No deterioration load standstill	£36,731,437.44	No Schemes : 8
	Eden Vale WTW	0	Zinc: 78 ug/l
	Eden Vale WTW	0	Cadmium : 3.8 ug/l (95%)
	Newbury Lane Cuckfield WTW	0	Iron :3 mg/l (95%ile)
	Lidsey WTW	£527,269	Nickel (dissolved) 9 ug/l (mean)
	Sidlesham WTW	£9,385,907	Nickel (dissolved) 6 ug/l (mean)
	Tunbridge Wells North WTW	£12,925,094	Zinc (dissolved) 37 ug/l (mean)
	Vines Cross WRC	£8,333,183	Zinc (dissolved) 39 ug/l (mean)
	Billingshurst WTW	£5,559,984	Zinc (dissolved) 52 ug/l (mean)
WFD Shellfish Waters	No deterioration	£32,971,596.91	No Schemes: 7
	Southampton Water - Millbrook	£8,290,972	UV and Storm tank
	Southampton Water - Slowhill Copse	£5,170,529	UV
	SLOWHILL COPSE MARCHWOOD WTW	£13,074,344	Storm Tank
	BLECHYNDEN TERRACE SOUTHAMPTON CSO	£1,188,383	
	ENSIGN PARK HAMBLE CEO/WPS	£1,615,740	
	DOWNES PARK TOTTON CEO	£3,620,952	
Groundwater (Thanet AMP6)	Thanet PR19 OPTION 2	£32,948,999	
Monitoring	U_Mon 1 Storm discharge monitoring	£1,104,933	
	SW_ Mon Storm overflow monitoring for shellfish	£2,292,353	
	BW_Mon Storm overflow monitoring for bathing water	£101,250	
	U_Mon 3 Storm tank monitoring	£920,502	

Driver	Scheme Description	Totex	Permit (if applicable)
	U_ Mon 4 Flow monitoring for measuring FFT Compliance	£0 (costs are included in Studies and investigations programme)	
	U_Mon 5 Flow monitoring where DEF exceeds 50m3/day	£241,651	
Studies &I Investigations Programme		£23,296,578	

Appendix 2. WINEP3 Drivers with no named schemes

Driver	Sub driver	Description
Monitoring	SW&BW MON	Shellfish & Bathing Water Monitoring
	U_MON3	Installation of monitoring on storm tanks
	U_MON4	Installation of MCERTS monitoring at the storm separation point
Urban Wastewater Treatment Regulations (UWWTR)	U_IMP4	Investment to reduce spill to environment frequency
	U_IMP5	Increasing flows to Full Treatment
	U_IMP6	Increasing Storm tank sizing
	INV	Storm Overflow Assessment Framework Investigation
Shellfish Waters	SW_IMP & ND	Investing to improve WFD Shellfish waters status and to prevent deterioration
Shellfish Waters	SW_INV1, 2	Shellfish Water investigations
Bathing Waters	BW_IMP1, 2, 3 & ND	Investing to improve WFD Bathing waters status
	BW_INV1, 2, 3, 4 & NDINV	Bathing Water investigations
	BW_ND	Investing to prevent deterioration in WFD Bathing waters status

Appendix 3. Costed options

Driver	Scheme	Description	Totex (£k)	WLC (£k)	CBA (£k)
WFD_IMP P	Ockley West WTW	End of Pipe	£5,648.45	£5,269.70	-£4,047.64
		Catchment	£1,734.98	£2,352.96	-£6,964.38
	Staplefield WWTW	End of Pipe	£2,380.68	£2,605.58	£742.11
		Catchment	£1,432.78	£1,943.12	£79.66
	Barcombe New WTW	End of Pipe	£5,359.56	£5,733.07	£275.77
		Catchment	£4,757.43	£5,598.25	£140.95
	Ashington WTW	End of Pipe	£5,573.89	£5,449.96	-£3,201.86
		Catchment	£796.05	£1,079.59	-£7,572.22
	Blackstone WTW	End of Pipe	£2,504.31	£2,625.77	£1,427.82
		Catchment	£883.42	£1,198.09	£0.14
		Pumpaway	£1,676.59	£1,225.23	£27.29
	Sedlescombe wwtw	End of Pipe	£2,934.44	£3,211.66	-£13,825.76
		Catchment	£1,459.64	£1,979.55	-£15,057.87
	Lingfield WTW	End of Pipe	£10,575.09	£11,731.63	£417.72
		Catchment	£5,028.24	£5,830.84	-£5,483.07
	Bethersden wwtw	End of Pipe	£5,494.37	£6,095.27	£3,433.17
		Catchment	£4,659.12	£5,626.92	£2,964.82
	High Halden WTW	End of Pipe	£5,909.07	£6,555.32	£3,227.69
		Catchment	£2,915.89	£3,234.78	-£92.84
	Kilndown	End of Pipe	£2,477.19	£2,509.95	-£950.78
		Pumpaway	£1,919.94	£1,922.63	-£1,538.09
	Horsham	Conventional EoP	£42,063.79	£45,927.82	£39,139.48
		Innovative EoP (Nareda)	£52,224.43	£57,875.19	£51,086.84
WFD_CHEM	Lidsey	Pumpaway	£538.79	£602.40	-£4,322.47
		End of Pipe	£21,551.25	£21,785.20	£16,742.38
	Cuckfield	ferric dosing, alkalinity dosing, Mecana feed PS	£2,773.92	£2,548.25	-£6,902.19
		Provide alkalinity dosing, ferric dosing pumps	£6,197.21	£6,050.74	-£3,399.70
U_IMP 4	Ditton Polgate Rd	Offline pump return tank solution, option 1	£484.65	£520.31	-£223,732.26
		Offline pump return tank solution, option 2	£416.42	£448.56	£76,255.29