SRN-DDR-042: Industrial Emissions Directive (IED) Enhancement Cost Evidence Case

28th August 2024

Version 1

WATER for LIFE

from Southern Water

Contents

1 Introduction

1.1 Draft Determination

Ofwat's draft determination (DD) has applied substantial cost challenges to our Industrial Emissions Directive (IED) programme. We have received a 59% (£103m) reduction in our total programme cost, which is detrimental to our ability to fulfil our regulatory obligations in AMP8. A summary of our requested Totex and Ofwat's DD allowance is presented below.

IED component	Requested totex (£m)	DD allowance (£m)	Delta (£m)	Delta (%)
Secondary containment	99.91	44.88	-55.03	-55%
Tanks covering	1.14	6.2	+5.06	449%
Other	73.26	19.45	-53.81	-73%
Total	**174.31**[1]	**70.59**	**-103.72**	**-59%**

Table 1: IED Requested and DD Allowance

Ofwat has used a top-down assessment approach to estimate efficient cost allowances. We believe this approach lacks statistical robustness and is not appropriate for IED costs, which are highly site and company specific.

This document presents our argument for a deep dive assessment and provides the necessary evidence to enable Ofwat to reconsider its DD assessment and allow our full funding request.

1.2 Changes Since the October Submission

We have continued to refine the scope and cost of our IED Enhancement Business Case since its original submission to Ofwat in October 2023. Key changes are described below. Cost updates have already been communicated to Ofwat in our re-submission of costs in December 2023 (in response to Query 124), and our response to Query 247. They have been reflected in Ofwat's DD assessment but are listed here for completeness:

1. Revision to Opex figures provided in *OFW-OBQ-SRN-124 - IED Information request November 2023.xlsx.* Our Opex figures now reflect a better understanding of the waste (sludge and commercial) sampling requirements following discussions with local permitting officer on site in November 2023, who helped to clarify the scope. The outcome was an increase from £2.9m AMP8 Opex to £36.6m. This is detailed in Section 8.
2. Site designs have been externally costed and benchmarked to validate our funding request. This is detailed in Section 8.
3. Additional evidence has been collated to give better context to Ofwat of the significant scope variation between our various IED sites as well as a view on the key cost criteria. This is detailed in Sections 7-10.
4. We have updated our proposed PCD. This is detailed in Section 10.
5. In our answer to Query 247, we highlighted to Ofwat the risk associated with delivering elements of IED scope through a Market-Based Delivery route and the impact this could have on the timescales to achieving compliance. For that reason, the IED scope originally part of the Market-Based delivery scope has now been transferred back to the main plan (£17.15m of Totex). This change has already been reflected in Ofwat's DD assessment.

[1] Ofwat has included our total IED forecast cost of £174.31m in its model. This value includes £2.2m of AMP7 permitting costs which have been assessed under Botex. To account for this, Ofwat applied a 99% reconciliation factor to its final allowance.

2 Key Issues with Ofwat's Assessment

Ofwat has assessed secondary containment, and tank covering costs individually, and then grouped sampling, control and monitoring, permitting, and other cost line items into one single cost category also called 'Other'. Across these three cost categories, Ofwat used a hybrid modelling approach to set IED allowances:

- **Secondary containment:** scheme level econometric modelling using ordinary least squares (OLS) linear regression with one independent variable (cost driver). Ofwat's selected cost driver was bund wall length (m). The model allowance was then multiplied by the industry upper quartile 'efficiency' score of 0.66. Ofwat calculated efficiency scores as the ratio between a company's model allowance using this Ofwat model and totex request.
- **Tank covering:** scheme level econometric modelling using OLS linear regression with one cost driver, tank surface area (m2). The model allowance was then multiplied by the industry median 'efficiency' score of 0.37.
- **'Other':** Company level unit cost benchmarking. Each companies' 'Other' costs were converted to unit costs based on their annual total dry sludge (TDS) production. Ofwat then re-calculated 'Other' allowances for each company using the upper quartile industry unit cost (£0.17/TDS).

For us, this Ofwat modelling process resulted in significant material cost reductions for secondary containment (-£55m) and 'Other' (-£53m) as well as a cost allowance increase for tanks covering (+449%). An overview of the key issues with Ofwat's assessment method for these cost categories is presented below. This sets out the need for an alternative assessment approach.

Secondary containment:
The econometric modelling approach for secondary containment and tank covering used linear regression models to estimate the totex based on total length of SC bund walls (in m) and total area of tank covered (in m^2), respectively. Both models have low R^2 values (0.20 and 0.08 for secondary containment and tank covering, respectively), indicating they are a poor fit. R^2 is one of Ofwat's 'high' importance tests for model robustness, which raises serious concerns about using the model[2]. We have recreated Ofwat's model and assessed it against Ofwat's other tests for model robustness. The results are presented in Section 3.1. Because the model has low predictive power, we do not consider it to be sufficiently robust for predicting cost allowances.

Ofwat then applies a 66% efficiency factor to secondary containment allowances, based on its analysis that an upper quartile efficiency performance implied costs that were 66% of the model allowance. We do not consider it appropriate to directly apply an upper quartile adjustment to the model results, given that the model is not a credible source to predict costs. There is regulatory precedent that a less demanding benchmark may be appropriate in cases where there is low confidence in the modelling results. At PR14 the CMA allowed an industry-average efficiency benchmark for Bristol Water, instead of the upper quartile benchmark imposed by Ofwat. This was based on its finding that *"the effect of modelling error and limitations will tend to mean that an upper quartile benchmark will require levels of efficiency that are, in practice, greater than the upper quartile."*[3]

Other:
Consolidating the cost types comprising sampling, control and monitoring, permitting, and other cost line items into a single 'Other' category and assessing this based on unit cost efficiency in terms of sludge production does not align with engineering rationale. Sludge production is not in any known circumstance considered a relevant cost driver for most cost lines Ofwat has grouped together in the 'Other' category. For example, there is no apparent link between the permitting costs submitted by companies and the TDS produced at that site. Three companies submitted the same costs for permitting each of their sites

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[2] Ofwat. April 2023. *Econometric base cost models for PR24* (Section A)
[3] CMA. 6 October 2015. *Bristol Water plc – A reference under section 12(3)(a) of the Water Industry Act 1991.*

irrespective of the TDS produced, and three companies submitted no permitting costs at all. Most of our 'Other' costs will be incurred on a per unit or per site costs and should therefore be assessed on this basis.

Ofwat states that it has developed scheme level econometric models for secondary containment and tank covering as these cost types form the majority of total IED costs. However, Ofwat has not clearly stated a threshold for determining material costs and has not provided justification why 'Other' costs were not assessed using the same scheme level model approach. 'Other' is approximately 24% of the total IED totex, which we consider to be material enough to warrant scheme level assessment. A breakdown of the total industry IED forecast costs with respect to Ofwat's assessment categories is presented in Table 1.

Totex type	Model approach	Industry forecast (£m)	Portion of total IED
Secondary containment	Scheme level econometric model	559.67	36.27%
Tank covering	Scheme level econometric model	609.24	39.49%
'Other'	Company level unit cost benchmark	374.02	24.24%
Total		**1,542.93**	**100.00%**

Table 2: IED enhancement totex breakdown.

Need for Deep Dive Assessment

We have conducted our own econometric modelling to determine whether a more statistically robust model can be made using the cost and cost driver dataset provided by Ofwat. This is presented in Section 3.1. We have also explored econometric modelling of 'Other' costs. This is presented in Section 3.3. Alternative models have been tested in line with Ofwat's criteria for model robustness. Ultimately, we have not been able to create a model that is sufficiently robust for cost estimation. As such, a bottom-up assessment method is required. Evidence to support this assessment is provided in Sections 6-10.

3 Model Analysis

3.1 Secondary Containment

Ofwat states in its DD that *"engineering rationale suggests that longer wall length, that prevents spillage issues from digesters and sludge holding tanks, results in higher secondary containment costs."* While we understand this rationale, wall length is only one driver of secondary containment costs. Our secondary containment model analysis aimed to determine whether a better model fit could be achieved using alternative or additional cost drivers. We have tested alternative models using the same tests Ofwat has used in its DD STATA code. These align with Ofwat's model robustness tests as set out in Table 1 of its PR24 Methodology – Econometric base cost models for PR24.

We used the six cost drivers also considered by Ofwat in our model analysis, as well as a seventh cost driver, bund wall area (bund wall length multiplied by bund wall average weighted height). The cost drivers considered were:
1) Bund Wall Length (m)
2) Sludge Produced
3) Volume of tanks (m^3)
4) Volume of bund (m^3)
5) Impermeable surface area upgraded (m^2)
6) Bund wall weighted average height (m)
7) Bund wall area (m^2)

We created seven OLS linear regression models for secondary containment totex (totexbrenhsc) that considered each of the above cost drivers in isolation. We used the same code as that provided by Ofwat in its STATA DO file. As such, the models have been subject to the same regression tests as Ofwat's model. The results are presented in Table 2.

Explanatory variable	SC OLS 1	SC OLS 2	SC OLS 3	SC OLS 4	SC OLS 5	SC OLS 6	SC OLS 7
Sludge produced	0.039						
	{0.152}						
Volume of tanks		0.054					
		{0.125}					
Volume of bund			0.190**				
			{0.012}				
Impermeable surface area				0.065			
				{0.242}			
Bund wall weighted average height					0.603		
					{0.508}		
Bund wall length						0.005***	
						{0.000}	
Bund wall area							0.005***
							{0.000}
Constant	4.057***	3.965***	3.488***	4.152***	4.150***	0.969	2.104***
	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.268}	{0.003}
Dependent variable	totexbrenhsc	totexbrenhsc	totexbrenhsc	totexbrenhsc	totexbrenhsc	totexbrenhsc	totexbrenhsc

Explanatory variable	SC OLS 1	SC OLS 2	SC OLS 3	SC OLS 4	SC OLS 5	SC OLS 6	SC OLS 7
Econometric model	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS
Observations	85	85	85	85	85	85	84
vce	ols	ols	ols	ols	ols	ols	ols
Adjusted R squared	**0.025**	**0.028**	**0.074**	**0.016**	**0.005**	**0.201**	**0.175**
RESET P value	0.357	0.689	0.378	0.096	0.822	0.542	0.554
VIF statistic	1	1	1	1	1	1	1
Pooling							
Normality	0	0	0	0	0	0	0
Heteroscedasticity	0	0	0	0	0	0	0

Table 3: OLS linear regression considering one cost driver only.

An explanation of the statistical tests used to assess the models is provided in Appendix 1. The results show that bund wall length and area appear to be the most significant predictors of secondary containment cost. However, a low R^2 remains a concern, indicating that the models do not adequately explain the variation in the dependent variable.

One of the key assumptions of linear regression is that the residuals are distributed with equal variance at each level of the predictor variable. This assumption is known as homoscedasticity. When this assumption is violated, we say that heteroscedasticity is present in the residuals. When this occurs, the results of the regression become unreliable. All models also fail the heteroscedasticity test, including Ofwat's. We have not applied any corrections to the models to account for heteroscedasticity on the basis that Ofwat has not done so for its DD model.

All models have RESET P-values above 0.05, suggesting no evidence of misspecification and are normally distributed. As there is only one independent variable, there is no multicollinearity (VIF statistic is one). Pooling is not applicable to these models as they only consider one dataset.

Ofwat's justified its use of bund wall length as the modelled cost driver because it explains the highest variation in secondary containment costs between companies out of all the cost drivers considered. Our results also show this, as the R^2 for our single variable model using bund wall length (OLS SC 6[4]) is significantly higher than for the other cost drivers considered by Ofwat. However, the single variable model using bund wall area (OLS SC 7) has a similar R^2 value and is therefore considered of similar performance to Ofwat's model. However, we still consider both R^2 values low to justify the models use.

We then set out to explore combinations of multiple cost drivers to see whether this would better explain cost variability. We created 51 OLS linear regression models considering different permutations of between 1 and 6 cost drivers[5]. The top four performing models are presented below.

Explanatory variable	SC OLS 18	SC OLS 33	SC OLS 35	SC OLS 36
Sludge produced		-0.019		-0.022
		{0.593}		{0.542}

[4] Note the data set underpinning our models is slightly smaller (85 compared to Ofwat's 90 observations). Ofwat's dataset excluded data entries that were Welsh Water sites, or sites with zero values for secondary containment cost or bund wall length. Our dataset also excluded data entries that had zero values for the other cost drivers assessed.
[5] Models with bund wall area as an independent variable did not have bund wall length or area as well to avoid multicollinearity issues.

Explanatory variable	SC OLS 18	SC OLS 33	SC OLS 35	SC OLS 36
Volume of tanks		0.01	-0.001	0.002
		{0.787}	{0.972}	{0.953}
Volume of bund	0.174**	0.207***	0.171**	0.189**
	{0.014}	{0.010}	{0.025}	{0.022}
Impermeable surface area		-0.063	-0.054	-0.054
		{0.272}	{0.357}	{0.359}
Bund wall weighted average height			0.774	0.822
			{0.396}	{0.371}
Bund wall length	0.004***	0.005***	0.005***	0.005***
	{0.000}	{0.000}	{0.000}	{0.000}
Constant	0.426	0.326	-0.287	-0.348
	{0.619}	{0.708}	{0.802}	{0.762}
Dependent variable	totexbrenhsc	totexbrenhsc	totexbrenhsc	totexbrenhsc
Econometric model	Pooled ols	Pooled ols	Pooled ols	Pooled ols
Observations	84	84	84	84
vce	ols	ols	ols	ols
Adjusted R squared	0.264	0.280	0.284	0.287
RESET P value	0.555	0.382	0.439	0.599
VIF statistic	1.01	1.75	1.81	1.81
Pooling				
Normality	0	0	0	0
Heteroscedasticity	0	0	0	0

Table 4: Top four performing alternative models with multiple cost drivers.

Table 2 shows that introducing additional cost drivers into the model increases the R^2 which indicates a better model fit. In all four alternative models, the estimated coefficients of the drivers ‘volume of bund’ and ‘bund wall length’ in the models have the correct sign, are of a reasonable magnitude, and are statistically significant. The other variables do not appear to have a significant impact on secondary containment costs.

With the models including multiple cost drivers, the VIF statistic is greater than one. However, it is lower than 4 which Ofwat considers the threshold for medium collinearity risk.

We have recalculated secondary containment allowances using SC OLS 7 and SC OLS 18. These models were chosen as they are the simplest of all the alternative models that offer similar or improved R^2 values. We do not consider the variation in statistical variables between the alternative models to be significant enough to warrant the use of a more complex model such as Models 33, 35 and 36. The re-modelled secondary containment allowances are presented below.

Company	Totex requested	Ofwat model allowance	SC OLS 7 allowance	SC OLS 18 allowance
Anglian	14	33	45	31
Northumbrian	11	10	20	5
United Utilities	29	33	42	36
Southern	100	68	79	59
Severn Trent	52	80	66	67
South West	9	2	4	3
Thames	140	119	119	113
Welsh	10	14	21	16
Wessex	32	22	24	27
Yorkshire	18	37	42	28
Total	**415**	**417**	**463**	**384**

Table 5: Re-modelled secondary containment allowances (all values are in £m)

Table 4 shows that using SC OLS 7 results in an increase to our funding allowance compared to Ofwat's model and using SC OLS 18 results in a decrease. The results from all three models are a significant cost reduction compared to our totex request. We do not consider this cost reduction to be justifiable by the model's statistical performance.

3.2 Efficiency Challenge

Ofwat has applied an upper quartile efficiency challenge for secondary containment on top of the modelled allowance. This is achieved by multiplying each companies modelled allowance by an upper quartile industry 'efficiency score'. Efficiency scores for each company are presented in Table 5 below based on Ofwat's DD allowances and the re-modelled allowances calculated in the previous section.

Company	Ofwat model	SC OLS 7	SC OLS 18
Anglian	0.43	0.32	0.46
Northumbrian	1.05	0.53	2.11
United Utilities	0.89	0.68	0.80
Southern	1.47	1.26	1.69
Severn Trent	0.66	0.79	0.78
South West	3.99	2.15	3.57
Thames	1.17	1.17	1.23
Welsh[6]	N/A	N/A	N/A
Wessex	1.44	1.35	1.19
Yorkshire	0.50	0.44	0.67
Upper quartile	**0.66**	**0.53**	**0.78**
Range	**3.56**	**1.83**	**3.11**

Table 6: Efficiency scores based on Ofwat's DD allowance and the re-modelled allowance.

As shown in Table 5, the variation in efficiency scores decreases slightly for SC OLS 18 and more significantly for SC OLS 7. However, we still consider the efficiency scores to be beyond a sensible range. As as per the CMA's PR14 redetermination for Bristol Water[7] (referencing the Competitions Commission's

[6] Welsh Water was assessed separately by Ofwat.
[7] CMA. 6 October 2015. *Bristol Water plc – A reference under section 12(3)(a) of the Water Industry Act 1991.*

(CC) Northern Ireland Electricity price determination), this can be attributed to weaknesses or limitations in the model and results in an unfair benchmark:

"Weaknesses or limitations in the econometric models and any errors or inconsistencies in the data set we used will contribute to the variance in costs... We would expect this variance to introduce a bias that overstated the relative performance of companies ranked better than the median level of performance and understated the relative performance of companies ranked worse than the median."

Applying the upper quartile efficiency challenges presented in Table 5 to their corresponding model allowance results in an even greater funding gap for our IED programme. The use of an upper quartile benchmark materially impacts our ability to achieve IED compliance and is not justifiable based on the identified deficiencies of the underlying model.

3.3 'Other'

We do not agree with Ofwat's approach to assessing costs for control and monitoring, sampling, permitting, and other items. Consolidating these cost types into a single 'Other' category and assessing these based on unit cost efficiency in terms of sludge production does not align with engineering rationale. The range of scope within this category is vast and much of it is not related to sludge production volumes.

We have created a linear OLS regression model using Ofwat's 'Other' costs as the dependent variable (totexbrenhtot) and sludge production (sludgeprod) as the sole independent variable. The results are presented in Table 6 below. These show the statistical coefficient for sludge production does not have the correct sign, is not of reasonable magnitude and is not statistically significant. The R^2 value is zero. This shows that there is no apparent relationship between 'Other' costs and sludge production, highlighting the issues with Ofwat's DD assessment.

Explanatory variable	'Other' OLS 1
Sludge produced	-0.001
	{0.973}
Constant	2.601***
	{0.000}
Dependent variable	totexbrenhtot
Econometric model	Pooled OLS
Observations	74
vce	ols
Adjusted R squared	0
RESET P value	0.709
VIF statistic	1
Pooling	
Normality	0
Heteroscedasticity	0

Table 7: OLS linear regression for 'Other' costs considering sludge production as cost driver.

We then explored whether a modelling approach would work for disaggregated 'Other' costs. Each cost type grouped into Ofwat's 'Other' category was modelled separately, considering the relevant cost drivers for that cost type. The results are presented in Table 7.

Explanatory variable	CM OLS1	LS OLS 1	LS OLS 1	LS OLS 1	PA OLS 1	OTH OLS 1
Sampling frequency		-0.013				
		{0.162}				
No. of sample points			0.335***			
			{0.000}			
No. of sample determinands				-0.004***		
				{0.000}		
No. of monitors	0.021***					
	{0.000}					
No. of sites with permitting costs					0.097	
					{0.226}	
No. of sites with other costs						1.987
						{0.120}
Cons.	0.202***	0.941***	-0.098	1.245***	0.851	12.546
	{0.002}	{0.000}	{0.509}	{0.000}	{0.377}	{0.252}
Dependent variable	totexbrenhcm	totexbrenhls	totexbrenhls	totexbrenhls	totexbrenhper	totexbrenhother
Econometric model	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS
Observations	74	99	99	99	7	7
vce	ols	ols	ols	ols	ols	ols
Adjusted R squared	0.461	0.02	0.348	0.134	0.276	0.412
RESET P value	0	0	0	0	0.206	0.299
VIF statistic	1	1	1	1	1	1
Pooling						
Normality	0	0	0	0	0.198	0.533
Heteroscedasticity	0	0.168	0.307	0	0.812	0.225

Table 8: Control and Monitoring (CM), Liquor Sampling (LS), Permitting (PA), and other (OTH) OLS models using relevant single cost drivers.

Table 7 shows that estimating permitting and other costs on a per site basis is not appropriate across the whole industry, as the number of sites for these costs is not a statistically significant variable, and the resulting model does not have sufficient explanatory power (as indicated by the low R^2). However, we (and at least three other companies, according to the Ofwat DD dataset) have estimated permitting and other costs on a per site basis. This highlights a difference in costing approaches between companies, which requires a deep dive assessment to understand.

Table 7 also shows that the relevant cost drivers for monitoring and sampling are statistically significant. Based on these results, we explored a combined monitoring and sampling model using all relevant cost drivers. The results are presented below.

Explanatory variable	CM&LS OLS1
No. of monitors	0.023***
	{0.000}
Sampling frequency	0.083***
	{0.000}
No. of sample points	0.401***
	{0.000}
No. of sample determinands	-0.005***
	{0.000}
Cons.	0.217
	{0.108}
Dependent variable	totexbrenhms
Econometric model	Pooled OLS
Observations	93
vce	ols
Adjusted R squared	0.779
RESET P value	0.004
VIF statistic	1.679
Pooling	
Normality	0
Heteroscedasticity	0

Table 9: Combined control and monitoring (CM) and liquor sampling (LS) model.

Table 8 shows the statistical coefficients are of reasonable magnitude and are statistically significant. We consider them to have the correct sign, with a negative coefficient for no. of sample determinands highlighting the economies of scale that may be gained by testing for multiple determinands in one sample.

The R^2 value is 0.779, which we consider sufficient, particularly when compared to the R^2 values of the secondary containment models presented in Section 3.1. These results show that a top-down econometric model may be appropriate for estimating monitoring and sampling costs.

We have re-calculated monitoring and sampling allowances based on the model in Table 8 and applied an upper quartile efficiency challenge. The results are presented below.

Company	Totex requested	CM&LS OLS1	Efficiency score	Updated allowance
Anglian	2	6	0.32	5
Northumbrian	12	8	1.65	6
United Utilities	18	16	1.14	12
Southern	13	17	0.75	13
Severn Trent	18	18	1.01	13
South West	1	1	0.51	1
Thames	50	46	1.10	34
Welsh[8]	N/A	N/A		-
Wessex	18	17	1.07	13
Yorkshire	12	9	1.25	7

[8] Welsh Water was assessed separately by Ofwat.

Total	**144**	**138**		**138**
Upper quartile			0.75	
Range			**1.33**	

Table 10: Re-modelled control and monitoring and liquor sampling costs.

Table 9 shows a much more reasonable range of efficiency scores than those for secondary containment, indicating the model underpinning these scores is more statistically robust. Unlike for secondary containment, we consider these scores to be a credible measure of efficiency and therefore an upper quartile benchmark appropriate in this scenario.

3.4 Conclusion

We have assessed Ofwat's assessment method and investigated alternative top-down assessment approaches for secondary containment and 'Other' costs. For secondary containment, Ofwat's model and our highest performing alternative models do not meet Ofwat's criteria for model robustness. For 'Other', we have shown that TDS is not a significant cost driver for these costs, and explored whether a top-down assessment of the disaggregated costs within this category is more appropriate.

We have developed an alternative model for monitoring and sampling costs that we consider to be sufficiently robust for estimating these costs. However, we have not been able to do so for permitting and other costs. These costs are more complicated as the scope and cost allocation to these categories is highly likely to vary between companies, particularly for other costs which is highly subjective. To assess the efficiency of these cost types requires understanding of the scope underpinning them, which can only be achieved through a deep dive assessment.

Given that secondary containment, permitting, and other costs comprise most of our programme, we do not believe that a top-down assessment is appropriate for assessing our funding request and a bottom-up approach is required.

4 Risk and Uncertainty

4.1 Ofwat's View

We understand that Ofwat believes IED scope uncertainty is driving overly conservative cost estimates for some companies, and that these costs will not materialise in practice. As stated in its DD:

"There was a significant range in costs submitted by companies, with a general trend for companies further progressed with achieving compliance, such as Northumbrian Water and Yorkshire Water, to propose lower unit costs. This indicates that the high costs proposed by companies who have less developed proposals are unlikely to materialise and will be lower in practice. We have accounted for this when assessing costs, resulting in a strong efficiency challenge for some companies. We propose to provide enhanced cost sharing rates (25:25) to manage the risk that costs do not reduce."

While we welcome the enhanced cost sharing mechanism proposed by Ofwat, this does not sufficiently mitigate the delivery risk associated with the efficiency challenge that has been imposed. We disagree with Ofwat's conclusion that cost variation is due to scope uncertainty. IED costs vary significantly between companies because they are highly sensitive to both company and site-specific factors. This was acknowledged by the CMA at PR19, who stated in their final redetermination:

"In general, we observed that IED compliance costs appear highly sensitive to the assessment of detailed requirements at specific sites."

We disagree with Ofwat's reliance on Northumbrian Water and Yorkshire Water as benchmarks of IED efficiency. Firstly, Northumbrian and Yorkshire's true costs may be underestimated in Ofwat's assessment due to their advanced compliance progress. Both companies received funding for IED activities in AMP7 which may not be fully captured in Ofwat's chosen unit cost basis. Secondly, Northumbrian's limited number of IED sites and lack of tank covering costs further skew the comparison. For these reasons, Northumbrian and Yorkshire's lower unit costs in some areas may not reflect genuine efficiency. Ultimately, comparing companies with different site characteristics and compliance requirements is misleading and does not provide a meaningful benchmark.

We have conducted our own unit cost analysis and found there is significant variation in unit costs across different water companies. Company efficiency can vary between cost types, and even within cost types depending on the unit cost basis. Yorkshire Water generally has lower unit costs than the median across most cost types and drivers. However, Northumbrian Water's costs vary depending on the cost type and driver. Our unit cost analysis is presented in Appendix 2. The significant variation of unit costs across different water companies, provides strong evidence to support the CMA's finding that IED costs are highly sensitive to detailed requirements and site-specific factors. This highlights the importance of considering these factors when assessing the efficiency of different companies and setting appropriate funding allowances.

Ofwat's DD statement (above) also assumes that companies have accounted for IED uncertainty and risk by inflating their costs. We have not taken this approach. Instead, we have scoped our IED programme based on the scope we are confident we will have to deliver in AMP8. Our actual approach to risk and uncertainty is evidenced in the next section.

4.2 Our Approach to Uncertainty and Risk

We fully accept the need to progress IED delivery with a certain level of risk and uncertainty. Some of the requirements to meet IED BAT are new to the industry and have not yet been fully defined. Furthermore, we will not know each site's specific IED solution requirements until a permit has been awarded by the EA for that site. In lieu of this information for every site, we have developed an IED programme that reflects current

EA guidance, and which has been informed by other water companies' experience and issued permits. We continue to work closely with the EA and wider industry to understand solution requirements as they evolve.

We have a high degree of confidence in our secondary containment scope as the solution requirements are well defined. This accounts for approximately 75% of the total IED programme capex. Less defined scope items included in our IED programme relate to solution requirements that are widely acknowledged as necessary in AMP8, but for which specific details are still pending. We have purposely excluded scope items that are highly uncertain to avoid customers paying for solutions that may not be required.

The following sections explain the key uncertainty and risk elements associated with our IED programme, and how we are managing these. For clarity, the following related actions are not considered to be part of IED scope:

- Additional treatment requirements arising from outcomes from IED Waste Characterisation testing, this is excluded due to the significant uncertainty in the scale of the requirements, potentially including treatment technology that is not currently available.
- Upgrades to non-STC sites to meet Appropriate Measures, on the basis that IED only applies to STC sites.

The industry is collectively proposing to mitigate this uncertainty by extending the sharing mechanism for IED (25:25) proposed by Ofwat at DD to these uncertainties - as well as others – as described in further detail in Appendix 3.

4.2.1 Assumed Permit Requirements

Each site's IED scope can only be fully understood once a permit has been awarded by the EA which sets out the Improvement Conditions (ICs) required. From 31st July 2024 and up to the time of writing this document, we have only received one permit from the EA National Permit Team (NPT). Permit applications for all our 16 IED sites were originally submitted between March 2021 and September 2022. However, the permitting process has evolved since the initial applications and further work is required.

The EA directed us to other water companies' permit ICs (and EA guidance) as an example of our own likely scope requirements. We have done this. However, there are limited permits available to consider, variations between these available permits, and varying degrees of relevance to our own sites. As of March 2024, only 6 permits had been awarded across the industry out of a total 125 applications. The ICs specified within each of these 6 permits are highly site specific and therefore vary significantly. Furthermore, some of the IC wording has been changed by the EA[9]. The EA has outlined that only Local Installation Officers (LIOs) can agree IC plans, but the permitting process also restricts engagement with LIOs until permits are issued[10].

As such, there is no way for us to know with certainty what our ICs will be and therefore the IED scope required. Therefore, there is a risk that the ICs we have assumed for our own sites based on other companies' permits will be different to what the EA eventually imposes on our sites. This is out of our control.

To avoid customers paying for uncertainty, we have developed our IED programme based on what we assume will be required based on BAT requirements and EA guidance. We have also tried to challenge the EA where we believe its guidance does not offer best value for customers. For example, we have proposed a risk-based approach to secondary containment which would allow for alternative, lower-cost solutions. This is detailed in Section 7.

4.2.2 Key Scope Exclusions

[9] e.g., revision from Task and Finish (TaF) group on 24.07.24
[10] Georgina Collins letter (EA) of 18.03.14

As discussed above, the full scope of IED compliance is not yet known. We have only included IED scope in our enhancement funding request that we are confident will be required in AMP8. We are currently working to understand the remaining compliance risks for which mitigation measures are currently excluded from scope. These are detailed below.

Waste Characterisation and Treatment
Under the IED we are required to carry out a waste characterisation to ensure our waste streams are properly classified and managed. Waste streams include:

- On site liquors (various/multiple), gas condensates, surface drainage, bund drainage
- Sludge imported from co-located and tankered wastewater treatment plants.
- Trade Wastes from third parties and company activities

This characterisation activity will inform new sampling and treatment requirements. 174 different determinands are now being considered under IED, many of which are new determinands for which treatment requirements are not well understood. There is a risk that the existing infrastructure is not sufficient to ensure compliance with the new acceptable limits. However, this risk cannot be fully understood until the investigation is complete. As the need for investment is not yet defined, we have excluded it from our current IED programme.

Residual Biogas Potential (RBP) Mitigation
Under the IED we must identify all potential sources of residual biogas emissions and quantify the amount of biogas that could be emitted from these sources. This quantity is referred to as residual biogas potential (RBP). The EA intends to set an acceptable RBP value based on the data it obtains from industry. If our RBP is outside the acceptable limit eventually set by the EA, we will need to implement appropriate mitigation measures. This may include additional covering (beyond our known TC scope), digestion capacity, de-gasing technologies or gas abatement techniques. However, until we know what the EA imposes as an ‘acceptable’ RBP limit, we do not know whether investment is required. As such, works relating to RBP reduction have been excluded from our current IED programme.

4.2.3 Transitional Funding

We welcome Ofwat’s acknowledgement that funding is required to achieve IED compliance in AMP8. We have allocated £7.4m of transitional funding to progress the compliance work required and demonstrate best endeavours to the EA as soon as practical. Uncertainty remains around what compliance looks like by 31st of March 2025, particularly with respect to Improvement Conditions to be agreed beyond that date.

5 Need for Deep Dive Assessment

Ofwat's assessment of efficient costs for IED is detrimental to our ability to fulfil our regulatory obligations in AMP8. While we welcome the favourable cost sharing mechanism, this alone will not mitigate the delivery risk associated with the cost challenge Ofwat has imposed. We are confident in the scope of works we must deliver to achieve IED compliance, and therefore the costs we expect to incur.

We fundamentally disagree with the top-down modelling approach adopted by Ofwat as it assumes each company's scope is comparable. This is not the case for IED, which is highly company and site-specific. We have explored a wide range of cost models and found none to have sufficient explanatory power to warrant their use as cost estimation tools. Instead, we request Ofwat undertakes a deep-dive review of our IED costs. This aligns with the EA's view, according to the CMA PR19 redetermination:

"Accurate estimates of the costs attributable to IED will only be available once all the site and company specific factors have been assessed and the review or issue of permits has been completed[11]."

While we have not yet received permits for our IED sites, we have been working closely with the EA and industry to understand our unique requirements. We are confident that these are accurately and efficiently captured in our funding request.

The following sections of this report provide additional evidence for our IED schemes to enable Ofwat to conduct a deep-dive assessment. These have been structured in line with Ofwat's enhancement criteria:

- Need for enhancement investment.
- Best option for customers
- Cost efficiency
- Customer protection

We have also provided a detailed scope and cost breakdown for each of our IED sites.

[11] CMA. 17 March 2021. *Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations Final report*

6 Need for Investment

This investment is required to enable us to fulfil our statutory requirements set out by the Environment Agency (EA) under the IED. The need for this investment is clearly set out in greater detail in our business case SRN37 – Bioresources IED.

7 Best Option

The following section describes the approach we have followed to select the best options to achieve IED compliance at our sites. Our methodology – relying on sound engineering practices and assumptions - is comprehensive and appropriate for the scope of work to be undertaken, leading to a more realistic estimate than Ofwat's approach to the costing.

7.1 Consideration of Alternatives

We have considered alternative options to determine the best value solution to meet our IED compliance needs. Our optioneering process was informed by our standard Risk and Value approach described in our business plan's technical appendix SRN15 – Optioneering and Costing Methodology. This section describes the IED-specific optioneering activities carried out when developing this programme. The purpose of this evidence is to show Ofwat how our IED scheme options were fairly, consistently, and transparently considered and appraised, taking into account the risk and uncertainty already described in section 4 above.

Our initial development therefore focused on assessing alternative secondary containment solutions for our IED schemes, as this was the most material scope item (approximately 75% of our total IED capital cost). Most other material scope items fall under Ofwat's 'Other' cost category and are mostly packaged equipment units. These will be delivered by equipment specialists who will conduct further options appraisals.

The requirements for secondary containment are defined by the standard (CIRIA C736) which has been picked by the EA as the basis for meeting IED BAT compliance. The EA has outlined that in order to be considered compliant the SC requires a bunded area that can hold the larger of; 110% of the largest tank, or 25% of the total tanks within that area.

The options that have been considered relate to how the storage tanks on a given site are grouped. This drives the length and height of new walls and the amount of new impermeable surface. An appropriate balance between walls and impermeable area is key to determining the most cost-effective solution. The materials used for each also offers an additional variable with respect to cost, but with some practical constraints on the suitability for a given application. This was the focus of our secondary containment solution development process, which is described in the following section.

7.2 Secondary Containment Solution Development

An overview of how we assessed secondary containment alternatives is provided in Figure 1 below.

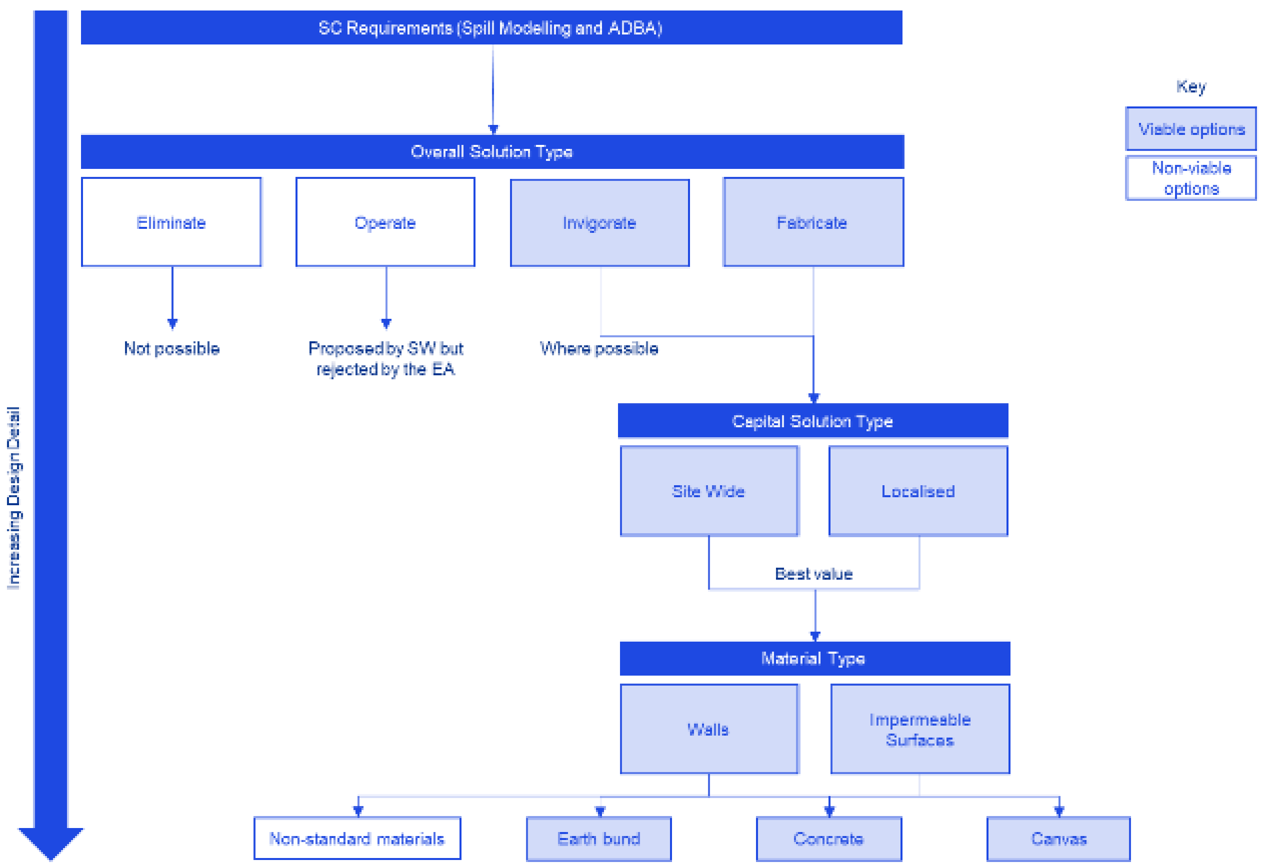


Figure 1: Overview of SC alternatives considered as the design progressed.

We conducted individual spill assessments to determine the secondary containment requirements for each site. We collated asset and topographical data and engaged specialist spill modelling services to understand the nature of flow dissemination on a given site. Drainage and topographical surveys were commissioned and undertaken in support of this work to provide an appropriate basis for the spill modelling. Spill assessment outcomes for each site are shown in Section 10.

Spill assessments were used to inform the risk assessment carried out for each site using the Anaerobic Digestion and Bioresources Association (ADBA) secondary containment tool. The ADBA tool calculates an overall site risk rating which prescribes the class of SC required and the associated design requirements. We were requested by the EA to use this tool to identify suitable SC solutions for our initial permit applications.

We applied a Totex hierarchy approach to determine the best-value secondary containment solution for each site. Where we considered it appropriate, we proposed operational solutions (e.g., increased tank inspections) in lieu of new capital assets. A risk-based argument was made for operational solutions at sites where there is incredibly low probability of tank failure. However, this approach was rejected by the EA. In their guidance to us, the EA stated that operational solutions would not achieve IED compliance, and that capital works are required.

As our proposed operational solutions were ruled out, we considered secondary containment options which broadly fit into two types: site-wide and localised containment solutions. Site-wide solutions typically require very large new impermeable areas and invite additional protection measures for existing operational areas and equipment. Localised bunds require less impermeable surfaces but require higher new walls (and typically a greater total length of wall), posing a different operational constraint for access and egress. Cost efficiency is typically driven by the right balance of walls and impermeable area. This is often dictated by the availability of space and existing impermeable surfaces. Further variability between sites arises from:

- The presence of existing buildings, pits, ducts, and other normal operational assets;
- Topographical, land availability, and land ownership constraints; and
- Environmental, ecological, biological, and natural capital considerations.

Site-wide and localised containment solutions were reviewed for each site considering the wall height, length and new impermeable area required, and with respect to each site's specific opportunities (e.g., existing structures) and constraints (e.g., topography).

Initial cost estimates were derived for each design with support from our Cost Intelligence Team (CIT), as described in Section 8. Both cost and non-cost performance criteria was considered when selecting the preferred option. Non-cost criteria comprised compliance, constructability, operability, safety, and environmental impact (embodied and operational carbon). In all cases, the preferred option was also lowest cost solution.

Once the preferred design had been identified, we explored options within that design by considering alternative construction materials. The criteria used to assess alternative materials are presented below:

Criteria	Narrative/requirement
Impermeability	Demonstrated to meet EA requirement for 10^{-9}m/s.
Lifespan	Relate to each other, with general consideration for maintenance process/cost and general repair
Chemical compatibility	Compatibility with sludge. Not anticipated to be long term contact, rain will wash it off and major spill would only be the duration of clean up.
Installation	Complexity, labour, plant, access and related costs for install. Known details/solutions for the application(s) identified. Secondary works; underground services diversion, drainage, tie-ins to existing)
Carbon	Carbon footprint of installed solution, company Objective to reduce embodied and operational carbon.
Cost	Huge impact on overall cost. Estimate of whole life cost. Overall responsibility to determine cost effective solutions.
Operational suitability and ease of repair	Ease and cost to complete repairs from damage (mechanical, fix something underground/ underneath, wear and tear). Need for repair apparent from visual inspection. Includes consideration of operational impact: walking route, slips, moving equipment across it.

Table 11: Solution evaluation framework for alternative materials.

Concrete walls are required as it offers an assured level of compliance with the required standard. However, where space and topography permit, we have selected earth bank walls as a more cost-effective, lower-carbon alternative. Additional wall types were also considered but discounted due to risk of non-compliance with the required standard. Our assessment is provided in Appendix 5.

We also considered alternative impermeable surfaces beyond those listed in the applicable design standard (CIRIA C736). Our assessment is provided in Appendix 5. Alternatives were assessed based on their cost and ability to meet compliance standards and lifespan expectations. The outcome was the selection of concrete canvas as a preferred material, which is considered an appropriate balance of cost and performance. We have based our forecast costs on using this material, but acceptance remains subject to detailed design development and appropriate sign off.

We have considered a range of alternative solutions at progressive stages of the secondary containment solution design and, at all stages, have tried to maximise value. As such, we are confident that our secondary containment solutions are well-defined, compliant, and cost-effective.

7.3 Kent IED Sites

As mentioned in our business case SRN37 – Bioresources IED, the consolidation of our STCs in Kent provides an opportunity for cost efficiencies by reducing the compliance requirements to IED (see SRN36

Bioresources Strategy document). For the sites impacted by the Kent consolidation strategy our solution development went further, and two solutions were derived:

- 'Conservative solutions' which contain the full investment required to achieve IED compliance based on a site's current operating status. It does not consider the proposed development and future use under the Kent consolidation strategy.
- 'Risk-proportional solutions' which look to balance the level of investment against the required remaining asset life and the environmental risk whereby;
    - The digestion assets which would be fitted with secondary containment under IED and subsequently retired in 2030 have a lower level of compliance and therefore investment.
    - Assets retained beyond 2030 (when the sites would become dewatering sites) would be provided with an IED-compliant level of containment.

As an example, the conservative and risk-proportional solutions considered for the Ashford site are presented below. Note that the costs presented below were prepared as part of our initial costing process for relative comparison of options (see Section 8). Note that this shows the cost for secondary containment solutions only and not the total site cost included in our business plan.

Our IED programme is based on delivering risk-proportional solutions at all sites impacted by the Kent consolidation strategy. The EA's acceptance of these solutions remains subject to receipt of the relevant permits and subsequent engagement and agreement with local EA installation officers.

[redacted]

7.4 Scope Variability Between Sites

7.4.1 Secondary Containment Scope Variability

Secondary containment scope requirements vary significantly between sites. This variability is typically driven by the existing topography and presence of existing assets, rather than the size of the operation. This is demonstrated in the following three site solution examples. Table 11 provides a breakdown of each site's secondary containment scope elements to demonstrate the variability across our entire IED programme. This table shows that scope variation cannot be attributed to one scope element, but rather occurs across multiple scope elements at any given site.

Bexhill & Hastings STC

[redacted]

- [redacted]
- [redacted]
- [redacted]

[redacted]

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]

[redacted]

[redacted]

- [redacted]
- [redacted]
- [redacted]

[redacted]

Programme Scope Variability

Table 11 provides a breakdown of each site's secondary containment scope elements to demonstrate how this varies significantly between sites and across the whole programme. Each site's secondary containment cost is also included to show the impact scope variability has on cost. These costs have been estimated according to the process outlined in Section 8. Cost breakdowns for each site are provided in Section 10.

SC scope element	Units	Line Measure Total	Ashford STC	Aylesford STC	Bexhill & Hastings STC	Budds Farm Havant STC	Canterbury STC	East Worthing STC	Ford STC	Fullerton STC	Goddards Green STC	Gravesend STC	Ham Hill STC	Millbrook STC (inc. Slowhill)	Motney Hill STC	Peacehaven STC	Queenborough STC	Sandown STC
0.4m RC wall	m	2,465	-	250	125	120	85	200	300	250	450	160	35	200	120	-	-	170
1.5m Earth bund wall	m	1,855	150	25	150	150	-	-	600	-	-	-	-	-	300	-	160	320
1.5m RC wall	m	2,480	15	-	160	120	-	250	-	270	350	85	-	700	-	350	100	80
Kerbs (new/remediate)	m	1,680	50	100	50	100	360	100	220	-	70	80	150	100	150	50	50	50
Speed humps	m	1,360	200	100	50	100	100	70	100	-	20	80	150	100	100	50	70	70
New Impermeable Surface	m²	38,600	500	750	2,400	4,500	1,000	2,700	5,000	1,500	5,200	2,000	300	5,900	750	500	800	4,800
Access and egress (re. new walls)	each	51	4	2	4	-	-	6	2	4	8	3	2	10	3		3	
Bund sump & pumping system(s)	each	52	2	3	2	3	3	5	3	4	4	3	3	5	3	3	3	3
Containment Lagoon (or repurpose area)	m³	7,200	2,400				600						1,200					
Drainage Modifications	m	3,350	250	100	50	100	100	200	400	250	150	250	100	250	250	400	250	250
Earthworks (excavate/level)	m³	3,150	300	600		1,750									500			
Extg. hardstanding improvements	m²	9,350	120	200	120	250	6,800	120	-	120	120	120	900	120	120		120	120
Pipework modifications to accommodate containment	m	1,100	50	100	100	-	-	150	-	100	150	-	100	300	50	-	-	-
SMR (structural soil remediation (sub-base))	m²	38,300	500	750	2,400	4,500	1,000	2,700	5,000	1,500	5,200	2,000		5,900	750	500	800	4,800
Total SC capital cost	**£m**	**99.11**	**4.35**	**2.51**	**5.30**	**8.54**	**6.24**	**6.42**	**10.06**	**4.52**	**14.17**	**4.27**	**2.91**	**13.13**	**2.77**	**2.40**	**2.46**	**9.06**

Table 12: Secondary containment (SC) scope breakdown for each IED site.

7.4.2 Non-Secondary Containment Scope Variability

As previously described, secondary containment has been the primary focus of our scope development due to its materiality and high variability between sites. Nonetheless, other areas of scope also vary significantly between sites depending on their existing infrastructure and operation. These are discussed in Table 12.

The cost impacts of these elements can be seen in each site's detailed cost breakdown, provided in Section 10.

Scope Item	Scope & nature of variance between sites	Examples of variance
Covering of tanks	Depends on the number of uncovered tanks per site. Considerations should also be given to more functionally or cost-effective alternative solution(s).	Covering of single tank at Canterbury. Instead of covering a tank at Ham Hill (large, post-digestion tank), the most suitable solution is thought to be replacement with two new covered tanks.
Waste characterisation	The number of sample points, samples and laboratory testing activities are related to the number of relevant flows at a given site and the number of dewatering sites the STC receives waste from	Budds Farm: 12 sample points Gravesend: 5 sample points
Monitoring & Measurement requirements	The number of flow or energy meters, sensors/devices (and the required data connections) are related to the number of assets on a site and the distances and complexity of the modifications required to provide the required solutions	Variation in the count of and distance between the following: tanks, OCUs, pipework, MCCs and the nearest suitable data and power connections.
Periodic monitoring of emissions	Site visits by specialists, frequency is typically fixed/defined but the number required relates to equipment count or site's geographical situation.	For bioaerosol monitoring, the number of monitoring locations relates to the number of receptors in the proximity of a given site.
Environmental Management System (EMS) documents	Person-hours required to complete this relates to the types of processes completed at a site and time to make documents site-specific (references etc)	Minor variation between sites based on the activities completed at the site

Table 13: Other examples of scope variability between sites.

8 Efficient Costs

Following the appropriate scoping and selection of best option to ensure compliance of our sites, this section below describes how the above was efficiently costed through the use of available cost curves and other costing information. A large proportion of the resulting costing also showed efficiency against industry benchmark.

8.1 Capital Expenditure

8.1.1 Methodology

Direct capital cost estimates for secondary containment were initially derived based on unit rates for the purpose of assessing alternative solutions. The following major scope items were costed to estimate the relative cost-effectiveness of each option. Our dedicated CIT, formed of professional cost estimators and data modellers, set values for each rate using historical cost data.

- Impermeable surfaces: costed using a unit rate for £/m^2 area covered, for both mass concrete and concrete canvas.
- Walls: costed using a unit rate for £/m length, for reinforced concrete (at 0.4m and 1.5m height) and earth bank at 1.5m height (in line with typical utilisation).
- Speed humps and kerbs: costed using a unit rate for £/m length.

Once we had identified a preferred secondary containment solution, we further developed the site's overall IED solution for costing. Cost estimates for each scope item were derived using a mixture of unit rates, package equipment costs, and site-wide allowances. Where possible, scope items were costed by CIT using cost curves based on historical data or bottom-up estimates. These items represent 62% of our total programme scope and were subject to benchmarking. The remaining 38% scope could not be costed by CIT due to lack of historical data or scope uncertainty. For these items, costing was informed by our Engineering Team and suppliers where possible, based on our current understanding of the works required. This is explained further in the following subsections.

A cost multiplier was then applied to direct cost estimates in accordance with our PR24 costing methodology to determine the total project related costs including in-direct costs, risk, and corporate overheads. Cost multipliers have been developed and benchmarked according to the methodology described in SRN15 – Cost and Option Methodology. Benchmark results show that our indirect, risk and corporate overheads are efficient both individually and at an aggregate level.

The breakdown of our programme cost in terms of cost estimation method is show in Figure 13, where:

- *Measured* costs are costs that have been calculated based on design measures and unit rates (e.g., wall length multiplied by per m unit rate)
- *Equipment* costs are package equipment costs which have been estimated per count (e.g., £ per meter multiplied by no. of meters)
- *Site-wide* costs are standard costing which have been estimated per site. These are typically independent of site/solution size or equipment count (e.g., IT systems upgrades, gas testing).

The figure below demonstrates that most of the IED capital costs is based on measured rates or package costs, for which we have a high level of confidence.

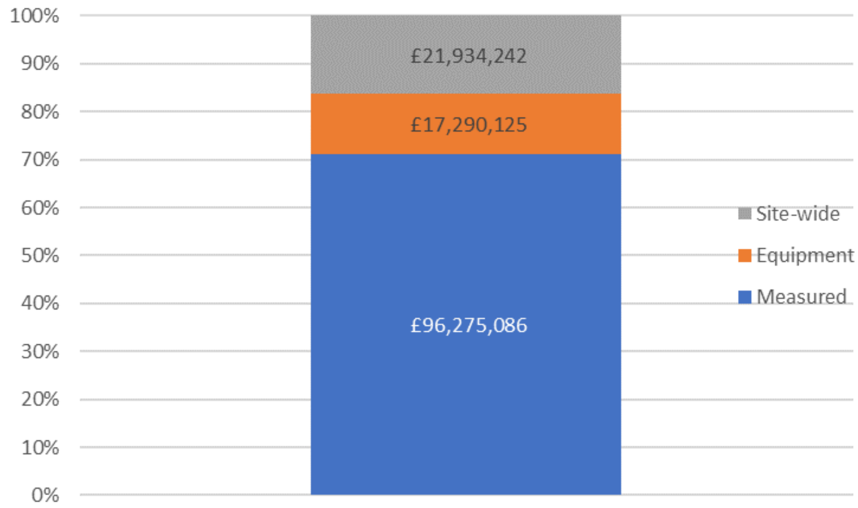


Figure 13: Breakdown of total capital cost by cost estimation methods

8.1.2 Capital Scope Externally Costed and Benchmarked

Table 13 below presents the scope costed by CIT and externally benchmarked, as well as the cost estimation method used and Ofwat cost category to which the cost has been allocated. This table, combined with the benchmarking results below, show that most of our material scope items have been externally assured and found to be lower than the industry benchmark. This demonstrates that our costs are efficient for work required. Given that the scope has been developed in line with the latest EA guidance and industry knowledge, we are confident that our funding request is sound and efficient.

Scope element	Description	Cost estimation method	Data table cost category
Soil structure remediation (SMR)	Preparation works for impermeable surface, e.g., soil excavation or treatment	Measured (unit rate £/m2)	Secondary containment
Improvements to existing hardstanding	Repairs to, and small-area replacement of, existing tarmac and concrete areas that are within a new bunded area. Existing condition is variable, detailed surveys required.	Measured (unit rate £/m2)	Secondary containment
Lagoons	New lagoons or remediation of existing tanks for use as lagoon to provide additional containment volume. Limited use due to site space restrictions.	Measured (unit rate £/m3)	Secondary containment
Drainage	Drainage modifications required to support new SC solution. Measure as allowance at this stage.	Measured (unit rate £/m2)	Secondary containment
Tank replacement or provision of collar on existing tanks	For single outlier tanks requiring SC solution, evaluated to be more cost effective and less impactful than provision of new bund.	Measured (unit rate £/m2)	Secondary containment
Tank covering	New covers for tanks, limited number required	Measured (unit rate £/m2)	Tank covering

Road surfaces	Road layout modifications where required to accommodate secondary containment solution	Measured (unit rate £/m2)	Other
Pipework	Modifications to existing pipework to accommodate new containment solution. Based on secondary containment configuration.	Bottom-up estimate	Secondary containment
Sump and pumps	Sump pumping system to transfer rainwater, overflows, and spills. Based on secondary containment configuration, anticipated falls and accommodating existing drainage where required.	Bottom-up estimate	Secondary containment
Bund access and ingress	Steps and steelwork allowance. Based on secondary containment configuration, anticipated impact thereof, wall heights and anticipated routes.	Bottom-up estimate	Secondary containment
Manhole/pit covers	Sealed covers within bunded area as alternative to [expensive] changes to/replacement of pit and duct systems	Equipment (unit cost £/no.)	Secondary containment
Lighting	In relation to changes for access and egress and other SC related shadowing of key routes.	Site-wide (allowance £/site)	Secondary containment
Physical protection measures	In relation to new bunds and road changes, bollards, and barriers	Measured (unit rate £/m2)	Other
Flow meters and telemetry	Flowmeters and supporting power and telemetry upgrades. Required for liquor inventory & reporting.	Equipment (unit cost £/no.)	Liquor Sampling
Weather stations	To provide the required monitoring data.	Equipment (unit cost £/no.)	Other

Table 14: Scope items costed by CIT and subsequently benchmarked.

As shown in Table 13, the scope costed and then externally benchmarked includes secondary containment works plus several other known assets where there is sufficient information to establish a basis for identification of comparable work. For example, concrete walls, lined earth banks, kerbs and speed humps, impermeable surfaces, and soil remediation. The full benchmarking report is provided in Appendix 4, and the results are presented below. This shows that our total capex cost estimate for the scope assessed is 9.2% more efficient than the industry benchmark. Site specific scope and benchmark values are provided in Section 10.

Project Name	Scope benchmarked	Variance (estimate – benchmark)
Goddards Green	97%	-6%
Bexhill & Hastings	94%	-9%
Budds Farm	94%	-10%
East Worthing	88%	-6%
Ford	95%	-5%
Fullerton	95%	-3%
Gravesend	92%	-20%
Millbrook	97%	1%
Ham Hill	90%	-24%
Peacehaven	80%	-7%
Ashford	87%	-15%

Aylesford	90%	-12%
Motney Hill	85%	-19%
Queenborough	89%	-21%
Sandown	92%	-12%
Canterbury	91%	-5%
Total	**92%**	**-9.2%**

Table 15: Benchmarking results

8.1.3 Capital Scope Internally Costed

The following scope items were costed internally by our Engineering Team. In general, these costs relate to company-wide solutions/systems that are likely to be split equally across all sites. They are site and company specific, and therefore not suitable for external benchmarking by CIT due to lack of comparable historical data. It can be seen from Table 15 that these scope items mostly relate to cost categories grouped into Ofwat's 'Other' allowance. It is important to note that none of these costs relate to a site's sludge processing capacity (TDS), which is the basis upon which they have been assessed by Ofwat. This demonstrates the need to consider these cost types separately and on a more appropriate basis.

Estimate Basis	Scope Summary	Cost estimation method	Capex cost	Total Count	Data table cost category
Cost allowance per unit **and** count of equipment **(based on outline design solution)**	**Sampling Points -** liquor sampling for testing, re. characterisation and waste acceptance	Equipment (unit cost £/no.)	£5k	74 (based on provisional count of flows)	Liquor Sampling
	Loading/receipt points upgrades for compliance	Equipment (unit cost £/no.)	£64k	32 (based on count)	Other
Cost allowance of one per site (in lieu of sufficient scope detail)	**SCADA** updates to accommodate new monitoring devices and PLC mods	Site-wide (allowance £/site)	£50k	16	Control & Monitoring
	Security upgrades – small allowance for compliance checks, existing projects to implement new standards will cover majority	Site-wide (allowance £/site)	£25k	16	Other
	Design – for secondary containment (other design within packages by specialists completing the work)	Site-wide (allowance £/site)	£50k	16	Other
	Surveys – for secondary containment and related scope, to inform design (other surveys within packages by specialists completing the work)	Site-wide (allowance £/site)	£75k	16	Other
	Underground pipework testing – as part of LDAR, allowance anticipated to even out between sites	Site-wide (allowance £/site)	£90k	16	Other

Estimate Basis	Scope Summary	Cost estimation method	Capex cost	Total Count	Data table cost category
	OCU – testing, additional monitoring/instruments & related power, data and pipework mods	Site-wide (allowance £/site)	£180k	16	Other
	Gas testing for characterisation. (Subsequent BAU (and all fluid sampling) as Enhancement OpEx)	Site-wide (allowance £/site)	£11k	16	Other
	Underground site condition sampling solution (e.g. boreholes)	Site-wide (allowance £/site)	£40k	16	Control & Monitoring
	IT systems for inventory and reporting – in recognition of the extent of new systems and changes required	Site-wide (allowance £/site)	£40k	16	Control & Monitoring
	New **instrumentation** for monitoring required parameters – procure & install to provide the required data (various equipment)	Site-wide (allowance £/site)	£88k	16	Control & Monitoring
	Improvements for **smaller volume** stores - IBC bunds and similar	Site-wide (allowance £/site)	£25k	16	Other
	LDAR remedial work allowance (risk basis allowance only, unknown-unknown subject to OGI)	Site-wide (allowance £/site)	£35k	16	Other
Costs **equally shared between all sites (based on intended use)**	Optical Gas Imaging (**OGI**) cameras and related equipment – based on quote	Site-wide (allowance £/site)	£35k	16	Other

Table 16: Scope internally costed due to lack of comparable historical data.

8.2 Operational Expenditure

8.2.1 Changes Since the October 2023 Submission (Reflected in the DD)

Enhancement Opex will be incurred with respect to several new activities that IED has introduced to the operational basis. It excludes relevant IED compliance activities that we already undertake as business as usual (BAU).

Our initial evaluation of IED requirements focussed on the capital elements of scope, as Opex depends on the finalisation and implementation of this scope. We put an initial estimate of £2.9m in our October 2023 submission but have since worked to improve our understanding of Opex, including further high-level guidance received from a local EA permitting officer in November 2023.

Our revised AMP8 Opex costs are £36.6m and split on an equal basis per year within the AMP. This was reflected in the updated data table provided to Ofwat in response to query OFW-OBQ-SRN-124 (December 2023). These costs were developed following:

- Development of the IED operational documentation
- Further guidance from, and discussions with, the EA and other water companies which helped to clarify the expectations and anticipated scope. This includes the availability of example permits issued to other companies, feedback on permits including relevant emission points (sample locations), and references to additional guidance.
- Engagement with wider teams and Subject Matter Experts (SMEs) to collate more data to improve understanding of the scope required.

8.2.2 Costing Basis

The most significant IED Opex driver is the sampling and testing of liquors, sludge transfers and trade wastes. The detail of sampling requirements for these waste streams have not been confirmed and remains the subject of discussion within industry forums and with the EA. Concerns over supply chain capacity and technical achievability of indicative sampling requirements is driving more uncertainty. In lieu of finalised requirements, we have developed the following basis for our most material Opex costs using company operational data and existing sampling and testing procedures:

- **Liquors**: Continuous monitoring is required for each individual stream on site (typically 3-5 streams per site). Our current costing is based on sampling frequencies as set out in other companies permit ICs.
- **Trade waste and sludge transfers:** Sampling and testing is based on current understanding of EA view of BAT requirements. The number of tests required for BAU is thought to be subject to the outcomes of the waste characterisation activities which at this stage are not known. Our approach (which has yet to be approved by the EA) focuses on periodic sampling at provenance sites.

  The cost per test for some of the determinands that the EA requires is not yet fully understood. Some tests may not be technically possible to carry out at present by our laboratory services provider. Investigation is ongoing as to how best to undertake this. The EA has advised that we must use a ‘risk assessed basis’ for estimating ongoing testing requirements. Our current cost reflects this and is based on the following:
  - Cost per test: a value of £200 is assumed based on discussions with our Operational Team. This value considers the current average cost per test, plus the expected additional costs for contracted resources to complete the sampling in line with the new UKAS qualification requirement.
  - Sludge transfers: we have allowed for a total of c. 20,600 samples a year. This is based on weekly samples at our 365 wastewater treatment works and twice weekly samples at our 16 STCs.
  - Trade waste: 8,260 imports per year. This is based on existing tanker data.

Further Opex arises from:

- New activities for contractors or specialist consultants relating to new maintenance requirements for new assets, systems, or devices associated with IED. These have been allocated a cost total of £0.5m per year for all 16 sites. This is anticipated to be an uplift on existing contracts.
- A specific cost of £10k p.a. per site has been made for the maintenance of new secondary containment solutions. This is in recognition of them being largely passive civil assets but requiring some new drainage pumps, lighting, drain cleaning, access and lifting solutions to facilitate safe operation.

9 Customer Protection

Completion of the IED programme and compliance of our sites through our enhanced approach will ensure the wider environment will be protected. Environmental benefits for our customers include protection of nearby receptors through reduction of odour and fugitive emissions or containment of any leaks as a result of catastrophic asset failure for example sludge holding tanks.

Ofwat has set a scheme specific price control deliverable (PCD) based on the number of sites completed, which aligns with the PCD we proposed in our business plan. However, we fundamentally disagree with Ofwat's timescale proposal to get our 16 sites compliant with IED requirements by 2024/2025 – as per PCD document for IED published at DD. With funding only made available from the beginning of AMP8 (2025/2026), all the work described in this document and SRN37 (IED Enhancement Business Case) will be completed by the end of AMP8.

Our current understanding is that if by 31st of March 2025 we can demonstrate best-endeavours to achieve compliance, the EA will not seek to take enforcement action in respect of our sites given the previous and ongoing uncertainty and funding only being made available in AMP8, amongst other relevant factors. However, at present, it is unclear if the EA will consider our sites as being truly "Compliant" by March 2025, which would not align with Ofwat's current wording in IED PCD document (as per above paragraph). We expect improvement conditions to be attached to our permits with a clear timeline to be agreed with the EA, we anticipate for the completion deadline to be within AMP8.

The details of our proposed PCD are set out in **Error! Reference source not found.** below. Updates from initial PCD (presented in Section 6 in our SRN37 document – Table 10) are in-line with all other PCDs across our PR24 submission post-Draft Determination. The updates include:

- Addition of a *Materiality of future scope alterations* section
- Addition of a *Condition on allowance* section
- Addition of an *Assessment of PCD* section
- Removal of late penalty

Component	Output based on Capacity
Description	Bring 16 sites up to the required environmental standards and to meet the permit conditions to provide additional protection to the environment and allow on-going operation
Output	16 sites completed by March 2030
Total Cost	£172.1m
Unit cost	£1.721m per% completion
Penalty rate	£1.721m/% completion (no cost sharing assumed)
Materiality of future scope alterations	£1.721m (1% of total cost)
Output delivery date with current scope	March 2030
Gated dates	Assurance of the scheme will be delivered on time 31st of March 2026

Component	Output based on Capacity
Conditions on allowance	Should we receive confirmation from a regulator of a necessary change to the timing or scope of a scheme, or in fact the change of scheme to address the core issue being it, either change in the benefit delivered or the solution being more expensive, the implication of this change would be reflected in the PCD. Where this change leads to a material variance greater than 1% of the original enhancement investment, then the PCD would symmetrically account for this change in a reconciliation at the end of the AMP.
Assessment of PCD	In the event of not delivering the output by the end of AMP8 (i.e., by 31st March 2030), but the need is still required, this PCD remains in place until the end of AMP9 (i.e., 31st March 2035). Ofwat will assess the completion of this PCD by 31st March 2035 as part of the PR34 process.
Late penalty	Not required
Measurement	Progress and performance will be reported in our annual performance report (APR)
ODIs to be netted off in the event of non-delivery	n/a
Assurance	Third party APR assurer will assure that the output and conditions have been met.

Table 17: PCD Summary

10 Site Specific Evidence

As per sections **Error! Reference source not found.** and **Error! Reference source not found.** above, we disagree with Ofwat's modelling to calculate allowances for IED compliance, particularly for the assessment of containment solutions and "Other" section and have expressed the need for deep dive assessment.

To help with this, solution overviews, direct capital cost breakdowns and benchmarking for each site are provided in the following subsections. Both 'conversative' and 'risk-proportional' solutions developed for sites impacted by the Kent consolidation strategy are shown, including the added value for our customers for the "risk-proportional" option. Cost breakdowns are based on the risk-proportional solutions.

All cost values are direct costs only. These have been uplifted by an indirect cost multiplier (which includes in-direct costs, risk, and corporate overheads) in accordance with our PR24 costing methodology to determine the total project related costs.

10.1 Ashford

[redacted]

Direct capital cost breakdown						
DD grouping	SW grouping	Scope	Estimate type	Unit	Sizing basis	Direct capital cost
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	15	[redacted]
		0.4m RC wall	Measured	£/m	0	
		Earth bund wall @1.5m high	Measured	£/m	150	
		Speed humps	Measured	£/m	200	
		Kerbs (new/remediate)	Measured	£/m	50	
	Imp.surface	New Impermeable Surface	Measured	£/m²	500	
		SMR	Measured	£/m²	500	
		Extg. hardstanding improvements	Measured	£/m²	120	
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	2400	
		Drainage replace/divert/repair	Measured	£/m	250	
		Bund sump & pumping system(s)	Equipment	ea.	2	
		Pipework modifications	Site-wide	£/m	50	
		Earthworks (excavate/level)	Measured	£/m³	300	
		Access and egress	Equipment	each	4	
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	0	
Other	Control & Monitoring	New weather station	Equipment	per site	1	
		UG site condition sampling solution	Site-wide	per site	1	
		New inventory system to PI & reporting setup	Site-wide	per site	1	
		Instrumentation (additional/replace)	Site-wide	per site	1	
		SCADA Upgrades	Site-wide	per site	1	
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	5	
		Sampling Points	Equipment	£/each	5	
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	
		Tank Coverings (IED driven)	Measured	£/m²	0	
		Design for Major Capital	Site-wide	per site	1	
		Surveys for Major Capital	Site-wide	per site	1	
		Underground pipework testing	Site-wide	per site	1	
		Road layout modifications	Site-wide	per ea.	1	
		Physical protection measures	Measured	£/m	100	
		Site security	Site-wide	per site	1	
		Fuel/poly/chemicals improvements	Site-wide	per site	1	
		LDAR remedials allowance	Site-wide	per site	1	
					Sum of direct capital cost	3,029,500

Capital Cost Benchmarking				
Scope suitable for benchmarking	Benchmarked scope	Coverage	Benchmark	Delta
2,089,384	1,818,142.09	87%	2,134,989.05	-15%

10.2 Aylesford

[redacted]

Direct capital cost breakdown						
Ofwat grouping	SW grouping	Scope	Estimate type	Unit	Sizing basis	Direct capital cost
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	0	[redacted]
		0.4m RC wall	Measured	£/m	250	
		Earth bund wall @1.5m high	Measured	£/m	25	
		Speed humps	Measured	£/m	100	
		Kerbs (new/remediate)	Measured	£/m	100	
	Imp.surface	New Impermeable Surface	Measured	£/m²	750	
		SMR	Measured	£/m²	750	
		Extg. hardstanding improvements	Measured	£/m²	200	
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	0	
		Drainage replace/divert/repair	Measured	£/m	100	
		Bund sump & pumping system(s)	Equipment	ea.	3	
		Pipework modifications	Site-wide	£/m	100	
		Earthworks (excavate/level)	Measured	£/m³	600	
		Access and egress	Equipment	each	2	
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	0	
Other	Control & Monitoring	New weather station	Equipment	per site	1	
		UG site condition sampling solution	Site-wide	per site	1	
		New inventory system to PI & reporting setup	Site-wide	per site	1	
		Instrumentation (additional/replace)	Site-wide	per site	1	
		SCADA Upgrades	Site-wide	per site	1	
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	3	
		Sampling Points	Equipment	£/each	3	
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	
		Tank Coverings (IED driven)	Measured	£/m²	0	
		Design for Major Capital	Site-wide	per site	1	
		Surveys for Major Capital	Site-wide	per site	1	
		Underground pipework testing	Site-wide	per site	1	
		Road layout modifications	Site-wide	per ea.	1	
		Physical protection measures	Measured	£/m	40	
		Site security	Site-wide	per site	1	
		Fuel/poly/chemicals improvements	Site-wide	per site	1	
		LDAR remedials allowance	Site-wide	per site	1	
					Sum of direct capital cost	2,117,425

Capital Cost Benchmarking				
Scope suitable for benchmarking	Benchmarked scope	Coverage	Benchmark	Delta
1,351,979	1,213,226	90%	1,376,009.	-12%

10.3 Bexhill & Hastings

[redacted]

Direct capital cost breakdown						
Ofwat grouping	**SW grouping**	**Scope**	**Estimate type**	**Unit**	**Sizing basis**	**Direct capital cost**
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	160	[redacted]
		0.4m RC wall	Measured	£/m	125	
		Earth bund wall @1.5m high	Measured	£/m	150	
		Speed humps	Measured	£/m	50	
		Kerbs (new/remediate)	Measured	£/m	50	
	Imp.surface	New Impermeable Surface	Measured	£/m²	2400	
		SMR	Measured	£/m²	2400	
		Extg. hardstanding improvements	Measured	£/m²	120	
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	0	
		Drainage replace/divert/repair	Measured	£/m	50	
		Bund sump & pumping system(s)	Equipment	ea.	2	
		Pipework modifications	Site-wide	£/m	100	
		Earthworks (excavate/level)	Measured	£/m³	0	
		Access and egress	Equipment	each	4	
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	0	
Other	Control & Monitoring	New weather station	Equipment	per site	1	
		UG site condition sampling solution	Site-wide	per site	1	
		New inventory system to PI & reporting setup	Site-wide	per site	1	
		Instrumentation (additional/replace)	Site-wide	per site	1	
		SCADA Upgrades	Site-wide	per site	1	
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	5	
		Sampling Points	Equipment	£/each	5	
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	
		Tank Coverings (IED driven)	Measured	£/m²	0	
		Design for Major Capital	Site-wide	per site	1	
		Surveys for Major Capital	Site-wide	per site	1	
		Underground pipework testing	Site-wide	per site	1	
		Road layout modifications	Site-wide	per ea.	1	
		Physical protection measures	Measured	£/m	100	
		Site security	Site-wide	per site	1	
		Fuel/poly/chemicals improvements	Site-wide	per site	1	
		LDAR remedials allowance	Site-wide	per site	1	
					Sum of direct capital cost	**3,480,000**

Capital Cost Benchmarking				
Scope suitable for benchmarking	**Benchmarked scope**	**Coverage**	**Benchmark**	**Delta**
2,067,808	1,936,958	94%	2,134,741	-9%

10.4 Budds Farm

[redacted]

Direct capital cost breakdown						
Ofwat grouping	SW grouping	Scope	Estimate type	Unit	Sizing basis	Direct capital cost
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	120	[redacted]
		0.4m RC wall	Measured	£/m	120	
		Earth bund wall @1.5m high	Measured	£/m	150	
		Speed humps	Measured	£/m	100	
		Kerbs (new/remediate)	Measured	£/m	100	
	Imp.surface	New Impermeable Surface	Measured	£/m²	4500	
		SMR	Measured	£/m²	4500	
		Extg. hardstanding improvements	Measured	£/m²	250	
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	0	
		Drainage replace/divert/repair	Measured	£/m	100	
		Bund sump & pumping system(s)	Equipment	ea.	3	
		Pipework modifications	Site-wide	£/m	0	
		Earthworks (excavate/level)	Measured	£/m³	1750	
		Access and egress	Equipment	each	0	
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	0	
Other	Control & Monitoring	New weather station	Equipment	per site	1	
		UG site condition sampling solution	Site-wide	per site	1	
		New inventory system to PI & reporting setup	Site-wide	per site	1	
		Instrumentation (additional/replace)	Site-wide	per site	1	
		SCADA Upgrades	Site-wide	per site	1	
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	5	
		Sampling Points	Equipment	£/each	5	
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	
		Tank Coverings (IED driven)	Measured	£/m²	0	
		Design for Major Capital	Site-wide	per site	1	
		Surveys for Major Capital	Site-wide	per site	1	
		Underground pipework testing	Site-wide	per site	1	
		Road layout modifications	Site-wide	per ea.	2	
		Physical protection measures	Measured	£/m	160	
		Site security	Site-wide	per site	1	
		Fuel/poly/chemicals improvements	Site-wide	per site	1	
		LDAR remedials allowance	Site-wide	per site	1	
					Sum of direct capital cost	5,041,800

Capital Cost Benchmarking				
Scope suitable for benchmarking	Benchmarked scope	Coverage	Benchmark	Delta
2,680,316	2,523,856	94%	2,813,635	-10%

10.5 Canterbury

[redacted]

Direct capital cost breakdown						
Ofwat grouping	SW grouping	Scope	Estimate type	Unit	Sizing basis	Direct capital cost
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	0	[redacted]
		0.4m RC wall	Measured	£/m	85	[redacted]
		Earth bund wall @1.5m high	Measured	£/m	0	[redacted]
		Speed humps	Measured	£/m	100	[redacted]
		Kerbs (new/remediate)	Measured	£/m	360	[redacted]
	Imp.surface	New Impermeable Surface	Measured	£/m²	1000	[redacted]
		SMR	Measured	£/m²	1000	[redacted]
		Extg. hardstanding improvements	Measured	£/m²	6800	[redacted]
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	0	[redacted]
		Drainage replace/divert/repair	Measured	£/m	100	[redacted]
		Bund sump & pumping system(s)	Equipment	ea.	3	[redacted]
		Pipework modifications	Site-wide	£/m	0	[redacted]
		Earthworks (excavate/level)	Measured	£/m³	0	[redacted]
		Access and egress	Equipment	each	0	[redacted]
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	250	[redacted]
Other	Control & Monitoring	New weather station	Equipment	per site	1	[redacted]
		UG site condition sampling solution	Site-wide	per site	1	[redacted]
		New inventory system to PI & reporting setup	Site-wide	per site	1	[redacted]
		Instrumentation (additional/replace)	Site-wide	per site	1	[redacted]
		SCADA Upgrades	Site-wide	per site	1	[redacted]
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	3	[redacted]
		Sampling Points	Equipment	£/each	3	[redacted]
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	[redacted]
		Tank Coverings (IED driven)	Measured	£/m²	250	[redacted]
		Design for Major Capital	Site-wide	per site	1	[redacted]
		Surveys for Major Capital	Site-wide	per site	1	[redacted]
		Underground pipework testing	Site-wide	per site	1	[redacted]
		Road layout modifications	Site-wide	per ea.	1	[redacted]
		Physical protection measures	Measured	£/m	100	[redacted]
		Site security	Site-wide	per site	1	[redacted]
		Fuel/poly/chemicals improvements	Site-wide	per site	1	[redacted]
		LDAR remedials allowance	Site-wide	per site	1	[redacted]
					Sum of direct capital cost	4,044,250

Capital Cost Benchmarking				
Scope suitable for benchmarking	Benchmarked scope	Coverage	Benchmark	Delta
1,875,762	1,711,390	91%	1,809,985	-5%

WATER for LIFE from Southern Water

10.6 East Worthing

[redacted]

Direct capital cost breakdown						
DD grouping	**SW grouping**	**Scope**	**Estimate type**	**Unit**	**Sizing basis**	**Direct capital cost**
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	250	[redacted]
		0.4m RC wall	Measured	£/m	200	
		Earth bund wall @1.5m high	Measured	£/m	0	
		Speed humps	Measured	£/m	70	
		Kerbs (new/remediate)	Measured	£/m	100	
	Imp.surface	New Impermeable Surface	Measured	£/m²	2700	
		SMR	Measured	£/m²	2700	
		Extg. hardstanding improvements	Measured	£/m²	120	
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	0	
		Drainage replace/divert/repair	Measured	£/m	200	
		Bund sump & pumping system(s)	Equipment	ea.	5	
		Pipework modifications	Site-wide	£/m	150	
		Earthworks (excavate/level)	Measured	£/m³	0	
		Access and egress	Equipment	each	6	
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	0	
Other	Control & Monitoring	New weather station	Equipment	per site	1	
		UG site condition sampling solution	Site-wide	per site	1	
		New inventory system to PI & reporting setup	Site-wide	per site	1	
		Instrumentation (additional/replace)	Site-wide	per site	1	
		SCADA Upgrades	Site-wide	per site	1	
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	5	
		Sampling Points	Equipment	£/each	5	
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	
		Tank Coverings (IED driven)	Measured	£/m²	0	
		Design for Major Capital	Site-wide	per site	1	
		Surveys for Major Capital	Site-wide	per site	1	
		Underground pipework testing	Site-wide	per site	1	
		Road layout modifications	Site-wide	per ea.	1	
		Physical protection measures	Measured	£/m	100	
		Site security	Site-wide	per site	1	
		Fuel/poly/chemicals improvements	Site-wide	per site	1	
		LDAR remedials allowance	Site-wide	per site	1	
					Sum of direct capital cost	**4,009,650**

Capital Cost Benchmarking				
Scope suitable for benchmarking	**Benchmarked scope**	**Coverage**	**Benchmark**	**Delta**
3,624,971	3,189,686	88%	3,411,041	-6%

WATER for LIFE from Southern Water

10.7 Ford

[redacted]

Direct capital cost breakdown						
DD grouping	**SW grouping**	**Scope**	**Estimate type**	**Unit**	**Sizing basis**	**Direct capital cost**
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	0	[redacted]
		0.4m RC wall	Measured	£/m	300	[redacted]
		Earth bund wall @1.5m high	Measured	£/m	600	[redacted]
		Speed humps	Measured	£/m	100	[redacted]
		Kerbs (new/remediate)	Measured	£/m	220	[redacted]
	Imp.surface	New Impermeable Surface	Measured	£/m²	5000	[redacted]
		SMR	Measured	£/m²	5000	[redacted]
		Extg. hardstanding improvements	Measured	£/m²	0	[redacted]
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	0	[redacted]
		Drainage replace/divert/repair	Measured	£/m	400	[redacted]
		Bund sump & pumping system(s)	Equipment	ea.	3	[redacted]
		Pipework modifications	Site-wide	£/m	0	[redacted]
		Earthworks (excavate/level)	Measured	£/m³	0	[redacted]
		Access and egress	Equipment	each	2	[redacted]
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	0	[redacted]
Other	Control & Monitoring	New weather station	Equipment	per site	1	[redacted]
		UG site condition sampling solution	Site-wide	per site	1	[redacted]
		New inventory system to PI & reporting setup	Site-wide	per site	1	[redacted]
		Instrumentation (additional/replace)	Site-wide	per site	1	[redacted]
		SCADA Upgrades	Site-wide	per site	1	[redacted]
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	5	[redacted]
		Sampling Points	Equipment	£/each	5	[redacted]
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	[redacted]
		Tank Coverings (IED driven)	Measured	£/m²	0	[redacted]
		Design for Major Capital	Site-wide	per site	1	[redacted]
		Surveys for Major Capital	Site-wide	per site	1	[redacted]
		Underground pipework testing	Site-wide	per site	1	[redacted]
		Road layout modifications	Site-wide	per ea.	1	[redacted]
		Physical protection measures	Measured	£/m	100	[redacted]
		Site security	Site-wide	per site	1	[redacted]
		Fuel/poly/chemicals improvements	Site-wide	per site	1	[redacted]
		LDAR remedials allowance	Site-wide	per site	1	[redacted]
					Sum of direct capital cost	**5,730,950**

Capital Cost Benchmarking				
Scope suitable for benchmarking	**Benchmarked scope**	**Coverage**	**Benchmark**	**Delta**
3,352,859	3,196,399	95%	3,352,065	-5%

WATER for LIFE from Southern Water

10.8 Fullerton

[redacted]

Direct capital cost breakdown						
DD grouping	**SW grouping**	**Scope**	**Estimate type**	**Unit**	**Sizing basis**	**Direct capital cost**
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	270	[redacted]
		0.4m RC wall	Measured	£/m	250	
		Earth bund wall @1.5m high	Measured	£/m	0	
		Speed humps	Measured	£/m	0	
		Kerbs (new/remediate)	Measured	£/m	0	
	Imp.surface	New Impermeable Surface	Measured	£/m²	1500	
		SMR	Measured	£/m²	1500	
		Extg. hardstanding improvements	Measured	£/m²	120	
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	0	
		Drainage replace/divert/repair	Measured	£/m	250	
		Bund sump & pumping system(s)	Equipment	ea.	4	
		Pipework modifications	Site-wide	£/m	100	
		Earthworks (excavate/level)	Measured	£/m³	0	
		Access and egress	Equipment	each	4	
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	187	
Other	Control & Monitoring	New weather station	Equipment	per site	1	
		UG site condition sampling solution	Site-wide	per site	1	
		New inventory system to PI & reporting setup	Site-wide	per site	1	
		Instrumentation (additional/replace)	Site-wide	per site	1	
		SCADA Upgrades	Site-wide	per site	1	
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	5	
		Sampling Points	Equipment	£/each	5	
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	
		Tank Coverings (IED driven)	Measured	£/m²	187	
		Design for Major Capital	Site-wide	per site	1	
		Surveys for Major Capital	Site-wide	per site	1	
		Underground pipework testing	Site-wide	per site	1	
		Road layout modifications	Site-wide	per ea.	2	
		Physical protection measures	Measured	£/m	100	
		Site security	Site-wide	per site	1	
		Fuel/poly/chemicals improvements	Site-wide	per site	1	
		LDAR remedials allowance	Site-wide	per site	1	
					Sum of direct capital cost	**3,227,340**

Capital Cost Benchmarking				
Scope suitable for benchmarking	**Benchmarked scope**	**Coverage**	**Benchmark**	**Delta**
2,600,624	2,479,164	95%	2,546,268	-3%

10.9 Goddards Green

[redacted]

Direct capital cost breakdown						
DD grouping	**SW grouping**	**Scope**	**Estimate type**	**Unit**	**Sizing basis**	**Direct capital cost**
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	350	[redacted]
		0.4m RC wall	Measured	£/m	450	[redacted]
		Earth bund wall @1.5m high	Measured	£/m	0	[redacted]
		Speed humps	Measured	£/m	20	[redacted]
		Kerbs (new/remediate)	Measured	£/m	70	[redacted]
	Imp.surface	New Impermeable Surface	Measured	£/m²	5200	[redacted]
		SMR	Measured	£/m²	5200	[redacted]
		Extg. hardstanding improvements	Measured	£/m²	120	[redacted]
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	3000	[redacted]
		Drainage replace/divert/repair	Measured	£/m	150	[redacted]
		Bund sump & pumping system(s)	Equipment	ea.	4	[redacted]
		Pipework modifications	Site-wide	£/m	150	[redacted]
		Earthworks (excavate/level)	Measured	£/m³	0	[redacted]
		Access and egress	Equipment	each	8	[redacted]
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	0	[redacted]
Other	Control & Monitoring	New weather station	Equipment	per site	1	[redacted]
		UG site condition sampling solution	Site-wide	per site	1	[redacted]
		New inventory system to PI & reporting setup	Site-wide	per site	1	[redacted]
		Instrumentation (additional/replace)	Site-wide	per site	1	[redacted]
		SCADA Upgrades	Site-wide	per site	1	[redacted]
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	5	[redacted]
		Sampling Points	Equipment	£/each	5	[redacted]
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	[redacted]
		Tank Coverings (IED driven)	Measured	£/m²	0	[redacted]
		Design for Major Capital	Site-wide	per site	1	[redacted]
		Surveys for Major Capital	Site-wide	per site	1	[redacted]
		Underground pipework testing	Site-wide	per site	1	[redacted]
		Road layout modifications	Site-wide	per ea.	1	[redacted]
		Physical protection measures	Measured	£/m	100	[redacted]
		Site security	Site-wide	per site	1	[redacted]
		Fuel/poly/chemicals improvements	Site-wide	per site	1	[redacted]
		LDAR remedials allowance	Site-wide	per site	1	[redacted]
					Sum of direct capital cost	**7,675,050**

Capital Cost Benchmarking				
Scope suitable for benchmarking	**Benchmarked scope**	**Coverage**	**Benchmark**	**Delta**
4,261,503	4,133,043	97%	4,385,931	-6%

WATER for LIFE from Southern Water

10.10 Gravesend

[redacted]

Direct capital cost breakdown						
DD grouping	SW grouping	Scope	Estimate type	Unit	Sizing basis	Direct capital cost
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	85	[redacted]
		0.4m RC wall	Measured	£/m	160	
		Earth bund wall @1.5m high	Measured	£/m	0	
		Speed humps	Measured	£/m	80	
		Kerbs (new/remediate)	Measured	£/m	80	
	Imp.surface	New Impermeable Surface	Measured	£/m²	2000	
		SMR	Measured	£/m²	2000	
		Extg. hardstanding improvements	Measured	£/m²	120	
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	0	
		Drainage replace/divert/repair	Measured	£/m	250	
		Bund sump & pumping system(s)	Equipment	ea.	3	
		Pipework modifications	Site-wide	£/m	0	
		Earthworks (excavate/level)	Measured	£/m³	0	
		Access and egress	Equipment	each	3	
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	0	
Other	Control & Monitoring	New weather station	Equipment	per site	1	
		UG site condition sampling solution	Site-wide	per site	1	
		New inventory system to PI & reporting setup	Site-wide	per site	1	
		Instrumentation (additional/replace)	Site-wide	per site	1	
		SCADA Upgrades	Site-wide	per site	1	
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	5	
		Sampling Points	Equipment	£/each	5	
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	
		Tank Coverings (IED driven)	Measured	£/m²	0	
		Design for Major Capital	Site-wide	per site	1	
		Surveys for Major Capital	Site-wide	per site	1	
		Underground pipework testing	Site-wide	per site	1	
		Road layout modifications	Site-wide	per ea.	1	
		Physical protection measures	Measured	£/m	100	
		Site security	Site-wide	per site	1	
		Fuel/poly/chemicals improvements	Site-wide	per site	1	
		LDAR remedials allowance	Site-wide	per site	1	
					Sum of direct capital cost	3,234,775

Capital Cost Benchmarking				
Scope suitable for benchmarking	Benchmarked scope	Coverage	Benchmark	Delta
1,796,931	1,657,471	92%	2,068,456	-20%

10.11 Ham Hill

[redacted]

Direct capital cost breakdown						
DD grouping	SW grouping	Scope	Estimate type	Unit	Sizing basis	Direct capital cost
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	0	[redacted]
		0.4m RC wall	Measured	£/m	35	[redacted]
		Earth bund wall @1.5m high	Measured	£/m	0	[redacted]
		Speed humps	Measured	£/m	150	[redacted]
		Kerbs (new/remediate)	Measured	£/m	150	[redacted]
	Imp.surface	New Impermeable Surface	Measured	£/m²	300	[redacted]
		SMR	Measured	£/m²	0	[redacted]
		Extg. hardstanding improvements	Measured	£/m²	900	[redacted]
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	1200	[redacted]
		Drainage replace/divert/repair	Measured	£/m	100	[redacted]
		Bund sump & pumping system(s)	Equipment	ea.	3	[redacted]
		Pipework modifications	Site-wide	£/m	100	[redacted]
		Earthworks (excavate/level)	Measured	£/m³	0	[redacted]
		Access and egress	Equipment	each	2	[redacted]
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	375	[redacted]
Other	Control & Monitoring	New weather station	Equipment	per site	1	[redacted]
		UG site condition sampling solution	Site-wide	per site	1	[redacted]
		New inventory system to PI & reporting setup	Site-wide	per site	1	[redacted]
		Instrumentation (additional/replace)	Site-wide	per site	1	[redacted]
		SCADA Upgrades	Site-wide	per site	1	[redacted]
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	5	[redacted]
		Sampling Points	Equipment	£/each	5	[redacted]
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	[redacted]
		Tank Coverings (IED driven)	Measured	£/m²	375	[redacted]
		Design for Major Capital	Site-wide	per site	1	[redacted]
		Surveys for Major Capital	Site-wide	per site	1	[redacted]
		Underground pipework testing	Site-wide	per site	1	[redacted]
		Road layout modifications	Site-wide	per ea.	1	[redacted]
		Physical protection measures	Measured	£/m	100	[redacted]
		Site security	Site-wide	per site	1	[redacted]
		Fuel/poly/chemicals improvements	Site-wide	per site	1	[redacted]
		LDAR remedials allowance	Site-wide	per site	1	[redacted]
					Sum of direct capital cost	2,940,419

Capital Cost Benchmarking				
Scope suitable for benchmarking	Benchmarked scope	Coverage	Benchmark	Delta
3,352,859	3,196,399	95%	£3,352,065	-5%

10.12 Millbrook (Including Slowhill Copse)

[redacted]

Direct capital cost breakdown						
DD grouping	**SW grouping**	**Scope**	**Estimate type**	**Unit**	**Sizing basis**	**Direct capital cost**
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	700	[redacted]
		0.4m RC wall	Measured	£/m	200	
		Earth bund wall @1.5m high	Measured	£/m	0	
		Speed humps	Measured	£/m	100	
		Kerbs (new/remediate)	Measured	£/m	100	
	Imp.surface	New Impermeable Surface	Measured	£/m²	5900	
		SMR	Measured	£/m²	5900	
		Extg. hardstanding improvements	Measured	£/m²	120	
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	0	
		Drainage replace/divert/repair	Measured	£/m	250	
		Bund sump & pumping system(s)	Equipment	ea.	5	
		Pipework modifications	Site-wide	£/m	300	
		Earthworks (excavate/level)	Measured	£/m³	0	
		Access and egress	Equipment	each	10	
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	0	
Other	Control & Monitoring	New weather station	Equipment	per site	1	
		UG site condition sampling solution	Site-wide	per site	1	
		New inventory system to PI & reporting setup	Site-wide	per site	1	
		Instrumentation (additional/replace)	Site-wide	per site	1	
		SCADA Upgrades	Site-wide	per site	1	
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	5	
		Sampling Points	Equipment	£/each	5	
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	
		Tank Coverings (IED driven)	Measured	£/m²	0	
		Design for Major Capital	Site-wide	per site	1	
		Surveys for Major Capital	Site-wide	per site	1	
		Underground pipework testing	Site-wide	per site	1	
		Road layout modifications	Site-wide	per ea.	3	
		Physical protection measures	Measured	£/m	100	
		Site security	Site-wide	per site	1	
		Fuel/poly/chemicals improvements	Site-wide	per site	1	
		LDAR remedials allowance	Site-wide	per site	1	
					Sum of direct capital cost	**7,195,750**

Capital Cost Benchmarking				
Scope suitable for benchmarking	**Benchmarked scope**	**Coverage**	**Benchmark**	**Delta**
5,195,926	5,015,831.	97%	4,962,469	1%

10.13 Motney Hill

[redacted]

Direct capital cost breakdown						
DD grouping	SW grouping	Scope	Estimate type	Unit	Sizing basis	Direct capital cost
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	0	[redacted]
		0.4m RC wall	Measured	£/m	120	[redacted]
		Earth bund wall @1.5m high	Measured	£/m	300	[redacted]
		Speed humps	Measured	£/m	100	[redacted]
		Kerbs (new/remediate)	Measured	£/m	150	[redacted]
	Imp.surface	New Impermeable Surface	Measured	£/m²	750	[redacted]
		SMR	Measured	£/m²	750	[redacted]
		Extg. hardstanding improvements	Measured	£/m²	120	[redacted]
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	0	[redacted]
		Drainage replace/divert/repair	Measured	£/m	250	[redacted]
		Bund sump & pumping system(s)	Equipment	ea.	3	[redacted]
		Pipework modifications	Site-wide	£/m	50	[redacted]
		Earthworks (excavate/level)	Measured	£/m³	500	[redacted]
		Access and egress	Equipment	each	3	[redacted]
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	131	[redacted]
Other	Control & Monitoring	New weather station	Equipment	per site	1	[redacted]
		UG site condition sampling solution	Site-wide	per site	1	[redacted]
		New inventory system to PI & reporting setup	Site-wide	per site	1	[redacted]
		Instrumentation (additional/replace)	Site-wide	per site	1	[redacted]
		SCADA Upgrades	Site-wide	per site	1	[redacted]
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	5	[redacted]
		Sampling Points	Equipment	£/each	5	[redacted]
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	[redacted]
		Tank Coverings (IED driven)	Measured	£/m²	131	[redacted]
		Design for Major Capital	Site-wide	per site	1	[redacted]
		Surveys for Major Capital	Site-wide	per site	1	[redacted]
		Underground pipework testing	Site-wide	per site	1	[redacted]
		Road layout modifications	Site-wide	per ea.	1	[redacted]
		Physical protection measures	Measured	£/m	100	[redacted]
		Site security	Site-wide	per site	1	[redacted]
		Fuel/poly/chemicals improvements	Site-wide	per site	1	[redacted]
		LDAR remedials allowance	Site-wide	per site	1	[redacted]
					Sum of direct capital cost	2,356,920

Capital Cost Benchmarking				
Scope suitable for benchmarking	Benchmarked scope	Coverage	Benchmark	Delta
£1,589,634.09	£1,346,102.41	85%	£1,671,138.47	-19%

10.14 Peacehaven

[redacted]

Direct capital cost breakdown						
DD grouping	**SW grouping**	**Scope**	**Estimate type**	**Unit**	**Sizing basis**	**Direct capital cost**
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	350	[redacted]
		0.4m RC wall	Measured	£/m	0	[redacted]
		Earth bund wall @1.5m high	Measured	£/m	0	[redacted]
		Speed humps	Measured	£/m	50	[redacted]
		Kerbs (new/remediate)	Measured	£/m	50	[redacted]
	Imp.surface	New Impermeable Surface	Measured	£/m²	500	[redacted]
		SMR	Measured	£/m²	500	[redacted]
		Extg. hardstanding improvements	Measured	£/m²	0	[redacted]
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	0	[redacted]
		Drainage replace/divert/repair	Measured	£/m	400	[redacted]
		Bund sump & pumping system(s)	Equipment	ea.	3	[redacted]
		Pipework modifications	Site-wide	£/m	0	[redacted]
		Earthworks (excavate/level)	Measured	£/m³	0	[redacted]
		Access and egress	Equipment	each	0	[redacted]
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	0	[redacted]
Other	Control & Monitoring	New weather station	Equipment	per site	1	[redacted]
		UG site condition sampling solution	Site-wide	per site	1	[redacted]
		New inventory system to PI & reporting setup	Site-wide	per site	1	[redacted]
		Instrumentation (additional/replace)	Site-wide	per site	1	[redacted]
		SCADA Upgrades	Site-wide	per site	1	[redacted]
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	3	[redacted]
		Sampling Points	Equipment	£/each	3	[redacted]
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	[redacted]
		Tank Coverings (IED driven)	Measured	£/m²	0	[redacted]
		Design for Major Capital	Site-wide	per site	1	[redacted]
		Surveys for Major Capital	Site-wide	per site	1	[redacted]
		Underground pipework testing	Site-wide	per site	1	[redacted]
		Road layout modifications	Site-wide	per ea.	0	[redacted]
		Physical protection measures	Measured	£/m	100	[redacted]
		Site security	Site-wide	per site	1	[redacted]
		Fuel/poly/chemicals improvements	Site-wide	per site	0	[redacted]
		LDAR remedials allowance	Site-wide	per site	1	[redacted]
					Sum of direct capital cost	**2,057,550**

Capital Cost Benchmarking				
Scope suitable for benchmarking	**Benchmarked scope**	**Coverage**	**Benchmark**	**Delta**
1,258,303	1,005,722	80%	1,083,161	-7%

10.15 Queenborough

[redacted]

Direct capital cost breakdown						
DD grouping	**SW grouping**	**Scope**	**Estimate type**	**Unit**	**Sizing basis**	**Direct capital cost**
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	100	[redacted]
		0.4m RC wall	Measured	£/m	0	
		Earth bund wall @1.5m high	Measured	£/m	160	
		Speed humps	Measured	£/m	70	
		Kerbs (new/remediate)	Measured	£/m	50	
	Imp.surface	New Impermeable Surface	Measured	£/m²	800	
		SMR	Measured	£/m²	800	
		Extg. hardstanding improvements	Measured	£/m²	120	
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	0	
		Drainage replace/divert/repair	Measured	£/m	250	
		Bund sump & pumping system(s)	Equipment	ea.	3	
		Pipework modifications	Site-wide	£/m	0	
		Earthworks (excavate/level)	Measured	£/m³	0	
		Access and egress	Equipment	each	3	
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	0	
Other	Control & Monitoring	New weather station	Equipment	per site	1	
		UG site condition sampling solution	Site-wide	per site	1	
		New inventory system to PI & reporting setup	Site-wide	per site	1	
		Instrumentation (additional/replace)	Site-wide	per site	1	
		SCADA Upgrades	Site-wide	per site	1	
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	5	
		Sampling Points	Equipment	£/each	5	
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	
		Tank Coverings (IED driven)	Measured	£/m²	0	
		Design for Major Capital	Site-wide	per site	1	
		Surveys for Major Capital	Site-wide	per site	1	
		Underground pipework testing	Site-wide	per site	1	
		Road layout modifications	Site-wide	per ea.	1	
		Physical protection measures	Measured	£/m	100	
		Site security	Site-wide	per site	1	
		Fuel/poly/chemicals improvements	Site-wide	per site	1	
		LDAR remedials allowance	Site-wide	per site	1	
					Sum of direct capital cost	**2,688,606**

Capital Cost Benchmarking				
Scope suitable for benchmarking	**Benchmarked scope**	**Coverage**	**Benchmark**	**Delta**
1,331,488	1,185,528	89%	1,497,999	-21%

10.16 Sandown

[redacted]

Direct capital cost breakdown						
DD grouping	SW grouping	Scope	Estimate type	Unit	Sizing basis	Direct capital cost
Secondary Containment	Walls	1.5m RC wall	Measured	£/m	80	[redacted]
		0.4m RC wall	Measured	£/m	170	
		Earth bund wall @1.5m high	Measured	£/m	320	
		Speed humps	Measured	£/m	70	
		Kerbs (new/remediate)	Measured	£/m	50	
	Imp.surface	New Impermeable Surface	Measured	£/m²	4800	
		SMR	Measured	£/m²	4800	
		Extg. hardstanding improvements	Measured	£/m²	120	
	S.C. Other	Lagoon @1.5m deep	Measured	£/m³	0	
		Drainage replace/divert/repair	Measured	£/m	250	
		Bund sump & pumping system(s)	Equipment	ea.	3	
		Pipework modifications	Site-wide	£/m	0	
		Earthworks (excavate/level)	Measured	£/m³	0	
		Access and egress	Equipment	each	0	
Tank Covering	Cover & abatement	Tank Coverings (IED driven)	Measured	£/m²	0	
Other	Control & Monitoring	New weather station	Equipment	per site	1	
		UG site condition sampling solution	Site-wide	per site	1	
		New inventory system to PI & reporting setup	Site-wide	per site	1	
		Instrumentation (additional/replace)	Site-wide	per site	1	
		SCADA Upgrades	Site-wide	per site	1	
	Liquors Sampling	Metering & additional instruments	Site-wide	£/each	5	
		Sampling Points	Equipment	£/each	5	
	Other	Loading/receipt points upgrades (pipe, OCU/other)	Equipment	per point	2	
		Tank Coverings (IED driven)	Measured	£/m²	0	
		Design for Major Capital	Site-wide	per site	1	
		Surveys for Major Capital	Site-wide	per site	1	
		Underground pipework testing	Site-wide	per site	1	
		Road layout modifications	Site-wide	per ea.	1	
		Physical protection measures	Measured	£/m	100	
		Site security	Site-wide	per site	1	
		Fuel/poly/chemicals improvements	Site-wide	per site	1	
		LDAR remedials allowance	Site-wide	per site	1	
					Sum of direct capital cost	5,255,950

Capital Cost Benchmarking				
Scope suitable for benchmarking	Benchmarked scope	Coverage	Benchmark	Delta
2,809,556	2,597,122	92%	2,955,626	-12%

11 Business Plan Dependencies

This document is supported by our SRN37 Industrial Emissions Directive (IED) enhancement case submitted in October 2023.

Data Tables impacted by the representation:

Table/s Impacted	Data Lines Impacted
CWW3	146/147/148 Sludge treatment - Other; (WINEP/NEP)
CWW12	183 Sludge enhancement (quality) - capex

All documents and tables referenced above can be found on our website here: [Business Plan 2025-30 - Southern Water]

Appendices

Appendix 1 – Statistical Tests

Adjusted R-squared: R-squared measures the variation of a regression model and increases when new predictors are added. Adjusted R-squared is used for multiple regression models and considers the goodness of fit, adjusting for the number of predictors. Adjusted R-squared is more conservative and decreases if additional variables do not contribute significantly to the model's explanatory power.

A higher r-squared indicates more variability is explained by the model and is preferred.

Test for Multicollinearity (VIF): Multicollinearity occurs when independent variables in a regression model are correlated. This correlation is a problem because independent variables should be independent. Multicollinearity reduces the precision of the estimated coefficients, which weakens the statistical power of your regression model.

VIFs start at 1 and have no upper limit. A value of 1 indicates that there is no correlation between this independent variable and any others. VIFs between 1 and 5 suggest that there is a moderate correlation, but it is not severe enough to warrant corrective measures. VIFs greater than 5 represent critical levels of multicollinearity where the coefficients are poorly estimated.

Normality: The Chi-Square Test for Normality allows us to check whether a model follows an approximately normal distribution. If the chi-square statistic is larger than the table value, it may be concluded that the data is not normal.

As the chi-square value is 0, the model is normally distributed.

Heteroscedasticity: One of the key assumptions of linear regression is that the residuals are distributed with equal variance at each level of the predictor variable. This assumption is known as homoscedasticity.

When this assumption is violated, we say that heteroscedasticity is present in the residuals. When this occurs, the results of the regression become unreliable.

The Breusch-Pagan test is used to determine whether heteroscedasticity is present in a regression model. The test uses the following null that "Homoscedasticity is present (the residuals are distributed with equal variance)". If the p-value of the test is less than some significance level (i.e. $\alpha = .05$) then we reject the null hypothesis and conclude that heteroscedasticity is present in the regression model.

Ofwat's models have failed the BP test. The probability value of the chi-square statistic is less than 0.05. Therefore, the null hypothesis of constant variance can be rejected at a 5% level of significance. It implies the presence of heteroscedasticity in the residuals.

Appendix 2 – Unit Cost Analysis

We have conducted our own unit cost assessment using the STATA dataset provided by Ofwat in its DD IED model. This assessment considers unit costs for each of the separate IED cost line items based on the relevant cost driver's information requested by Ofwat. Table 17 below shows how costs have been mapped to relevant cost drivers. An additional cost driver – 'wall area' – has been considered for secondary containment. This is equal to the total wall length multiplied by the average weighted wall height for each site.

Table 18: Totex cost types and relevant unit cost basis.

Totex type	Unit cost basis
Secondary containment	Volume of bund (m3),
	Impermeable surface areas upgraded (m2)
	Containment bund wall length (m),
	Containment bund wall weighted average height (m)
	Containment bund wall area (m2)
Tank covering	No. of tanks covered
	Surface area provided (tanks) (m2)
Control and monitoring	Average sampling frequency/month (no. days/month)
	No. of sample points (no./site)
	Average number of determinands per sample point
Liquor sampling	No. of monitors
Permit application	No. of sites with permitting cost
Other	No. of sites with 'other' cost
All totex	TDS/year treated by the site (TDS/year)
	Volume of tanks (m3)
	Total no. of sites

Ofwat has explicitly called out Northumbrian Water and Yorkshire Water for having lower unit costs and used this to justify their efficiency challenge. As such, we have focused on comparing our unit cost performance (relative to the rest of the industry) with Northumbrian and Yorkshire's performance. The results are presented in Figure 14.

While Yorkshire appears efficient across all unit costs, Northumbrian's apparent efficiency varies both across different cost categories and within the categories themselves, depending on the cost driver. For example, Northumbrian's SC costs are low compared to the rest of industry based on wall height and area, but closer to the median when considering bund volume, impermeable surface area and wall length. It has the highest cost across the industry for the monitoring and other totex per site.

Figure 14 shows that we are a frontier company for total programme unit cost based on both number of sites and sludge produced. Our tank covering and most 'Other' costs are also lower than most of the industry, but we have high secondary containment unit costs. This could be attributed to our inclusion of ancillary scope items, such as sump pumps and access infrastructure, within this cost line item. Other companies may not have included these items or may have allocated them elsewhere.

All unit costs for each company are presented in Tables 18 to 22. There is a high variation in unit costs between companies for all cost types and drivers considered. In most instances, the highest unit cost is more than 10 times the lowest. This indicates a single unit cost metric fails to capture the various factors driving the cost, such as site-specific conditions and cost type allocation. It is therefore not an appropriate method to draw meaningful comparisons between companies.

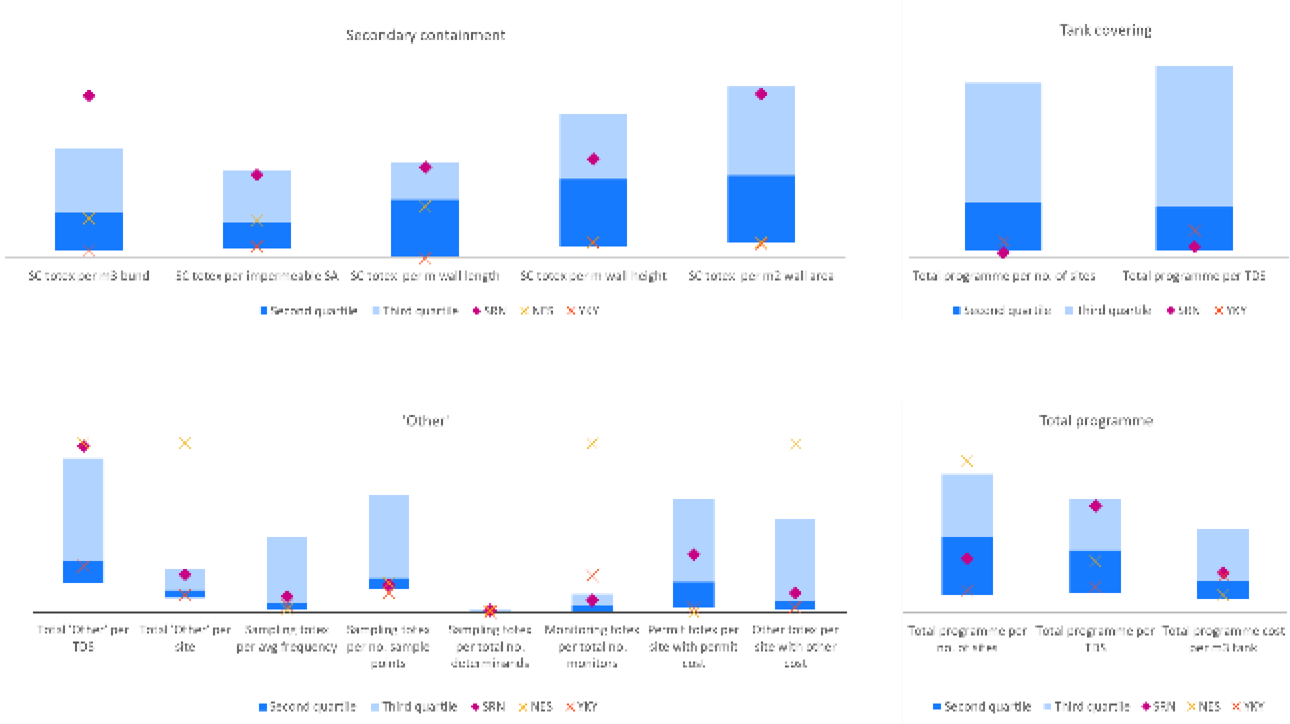


Figure 14: Industry distribution and Southern Water (SRN), Northumbrian Water (NES) and Yorkshire Water (YKY) position for various unit costs.

Table 19: Unit cost analysis - total IED programme

	Total IED programme totex £m	Total no. of sites No.	Total IED totex per no. of sites £/no. sites	Annual sludge production TDS/year	Total programme per TDS £/TDS/year	Total tank volume m3	Total programme cost per m3 tank £/m3
ANH	29.11	10	2,911,155	181,953	160	44,828	649
NES	52.26	2	26,129,500	80,000	653	95,200	549
NWT	281.53	16	17,595,520	189,482	1,486	390,031	722
SRN	174.31	16	10,894,466	143,724	1,213	185,383	940
SVE	195.49	23	8,499,475	323,735	604	670,774	291
SWB	47.13	2	23,567,361	54,000	873	15,865	2,971
TMS	529.50	25	21,179,908	496,755	1,066	162,470	3,259
WSH	14.25	6	2,375,800	107,000	133	59,143	241
WSX	148.09	5	29,618,419	78,840	1,878	114,586	1,292
YKY	71.26	12	5,938,094	180,364	395	81,057	879
Median	**109.67**	**11**	**14,244,993**	**162,044**	**763**	**104,893**	**800**

Table 20: Unit cost analysis - secondary containment

	Secondary containment (SC) totex	Bund volume	SC totex per m3 bund	Impermeable surface area	SC totex per impermeable SA	Bund wall length	SC totex per m wall length	Average weighted bund wall height	SC totex per m wall height	Bund wall area	SC totex per m2 wall area
	£m	m3	£/m3	m2	£/m2	m	£/m	m	£/m	m2	£/m2
ANH	18.97	74,717	254	124,000	153	6,829	2,777	11	1,773,352	7,565	2,507
NES	10.79	18,920	570	16,652	648	1,680	6,424	4	2,691,521	3,229	3,342
NWT	74.34	305,199	244	159,616	466	9,992	7,440	14	5,344,099	11,778	6,312
SRN	99.91	53,775	1,858	79,730	1,253	10,730	9,312	13	7,519,280	9,081	11,003
SVE	69.94	62,531	1,118	274,921	254	19,092	3,663	10	7,362,049	9,546	7,327
SWB	40.42	17,700	2,284	14,291	2,828	2,300	17,573	3	13,472,938	3,450	11,716
TMS	160.55	162,470	988	105,383	1,523	20,429	7,859	17	9,210,929	14,271	11,250
WSH	9.55	64,678	148	13,139	727	3,519	2,715	5	1,884,576	2,754	3,470
WSX	53.57	76,400	701	91,700	584	5,020	10,671	4	12,754,756	4,117	13,012
YKY	21.63	96,006	225	69,803	310	8,426	2,567	8	2,660,603	6,657	3,249
Median	**46.99**	**69,698**	**636**	**85,715**	**616**	**7,628**	**6,932**	**9**	**6,353,074**	**7,111**	**6,819**

Table 21: Unit cost analysis - tank covering

	Tank covering (TC) totex	No. of tanks	TC totex per no. tanks	Tank area covered	TC totex per m2 tank area covered
	£m	No.	£/no. tanks	m2	£/m2
ANH	4.90	6	815,925	1,306	3,747
NES					
NWT	137.68	76	1,811,525	32,244	4,270
SRN	1.14	4	284,208	943	1,206
SVE	69.97	309	226,456	70,936	986
SWB	0.99	3	329,668	1,313	753
TMS	307.15	115	2,670,905	31,030	9,899
WSH	4.70	2	2,350,000		
WSX	58.33	34	1,715,726	5,812	10,037
YKY	24.38	60	406,322	12,959	1,881
Median	**24.38**	**34**	**815,925**	**9,386**	**2,814**

Table 22: Unit cost analysis - liquor sampling

	Liquor sampling totex	Average sampling frequency	Sampling totex per avg frequency	No. sample points	Sampling totex per no. sample points	No. determinands (no. sample points x avg no. determinands per point)	Sampling totex per total no. determinands
	£m	no. days/month	£/no.days/month	No.	£/no. sample points	No.	£/no determinands
ANH	2.25	20.0	112,500	25	90,000	37,500	60
NES	1.49	40.0	37,250	14	106,429	5,796	257
NWT	13.22	179.6	73,630	32	413,229	78,400	169
SRN	2.77	16.0	172,819	28	98,754	11,200	247
SVE	17.52	10.3	1,699,929	57	307,429	177,612	99
SWB	1.24	2.3	530,617	2	619,230	49	25,105
TMS	46.92	25.0	1,876,683	100	469,171	47,500	988
WSH		32.0		109		16,241	
WSX	1.54	150.0	10,251	11	139,782	9,570	161
YKY	2.16	31.0	69,677	31	69,677	48,360	45
Median	**2.25**	**28.0**	**112,500**	**30**	**139,782**	**26,871**	**169**

Table 23: Unit cost analysis - remaining 'Other' costs (control and monitoring, permitting, other)

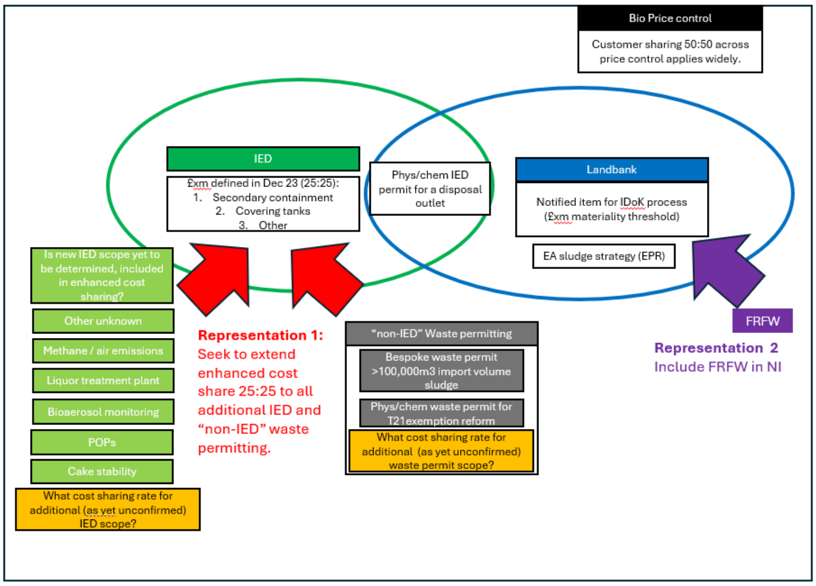
	Control and monitoring totex	No. monitors	Monitoring totex per total no. monitors	Permitting totex	No. sites with permit costs	Permit totex per site	Other totex	No. sites with other costs	Other totex per site
	£m)	No.	£/no. monitors	(£m)	No.	£/site			£/site
ANH	-	20					3.00	10	300,000
NES	10.90	10	1,090,400	0.02	1	22,000	29.05	1	29,050,000
NWT	9.74	348	27,978	1.60	12	133,333	44.95	14	3,210,856
SRN	9.97	131	76,134	3.80	16	237,500	56.72	16	3,545,094
SVE	6.15	546	11,267	2.75	23	119,444	29.15	1	29,151,002
SWB	0.99	60	16,483	0.90	2	448,360	2.60	2	1,301,360
TMS	5.50	100	55,000				9.38	21	446,667
WSH		8					-	-	
WSX	20.52	389	52,762	3.29	5	658,371	10.83	5	2,166,700
YKY	10.76	46	233,916	0.45	12	37,786	11.87	10	1,187,352
Median	**9.74**	**80**	**52,762**	**1.60**	**12**	**133,333**	**11.35**	**8**	**2,166,700**

Appendix 3 – Uncertainty and sharing mechanism – Collective approach with the rest of the industry

Following the draft determination, we understand that Ofwat proposes that these areas of uncertainty in IED enhancement expenditure are managed within the scope of the 25:25 IED enhancement expenditure cost sharing mechanism, with Ofwat stating, "*this applies for enhancement IED expenditure only. Additional base expenditure for companies to improve asset health to help achieve full IED compliance will continue to attract the base cost sharing rates*[12]".

We welcome this proposal from Ofwat and we agree it is an appropriate mechanism to manage on-going uncertainty in IED compliance requirements and costs. However, when considering Bioresources waste permitting requirements more broadly than the implications of the IED, there are further potential changes that may drive material new investment requirements in the Bioresources sector but these are not addressed by Ofwat's draft determination proposals for managing uncertainty. We present in Figure 155 a Venn diagram to summarise the risks.

Figure 155: Venn diagram showing the waste permitting uncertainties that we propose are managed through an enhanced 25:25 cost sharing mechanism



Waste permitting requirements, outside the IED, continue to evolve and the industry risks iterative and ad hoc new requirements over the course of AMP8 in the absence of a clear regulatory timeline. As these requirements are not yet confirmed, companies have not included costs to address any potential requirements in their business plans.

Potential changes outside IED include, but are not limited to, the following:

- **Waste exemption reforms[13]:** The Environment Agency proposals are not yet finalised and will be subject to consultation (postponed from May 2024). The latest government advice states that changes to the exemptions are likely to start in 2025 but timescales have not been finalised. Direct implications of the proposals are twofold:
    - **Charging for exemptions:** Significant elements of our bioresources business operate under registered waste exemptions (this negates the need to obtain a permit for those activities). The introduction of charging will introduce new costs into the Bioresources price control.

[12] Footnote 185 on page 162
[13] Insert link

  - **Prohibition of registering exemptions on a permitted site:** Registered exemptions on a permitted site will be prohibited at the end of a 6-month transitional period. Sites which carry out a permitted activity (e.g. import waste to the inlet of a wastewater treatment works) will no longer be able to register an exemption for a different activity on the same site. By default, the currently 'exempt' activity e.g. physical-chemical sludge treatment must now be incorporated within the site permit, if within the same operational boundary. This will require waste permit variations, but significantly for sludge treatment activities, the requirement for a permit makes compliance mandatory with Appropriate Measures guidance. Under a waste exemption, operators 'may refer to' Appropriate Measures standards but meeting these standards is not a legal requirement. In obtaining a waste permit the obligation to meet Appropriate Measures guidance becomes mandated through the permitting process.

- **Environmental permit competence requirements:** Changes to technically competent manager attendance requirements (resources qualified under a technical competency scheme e.g. WAMITAB[14]). A consultation on the proposed reforms closed in December 2023 and the output of the consultation is not yet available. The consultation proposed an increase to attendance hours currently undertaken by technically competent staff which may drive an increase in the required headcount to operate our sites.

- **Appropriate Measures Guidance:** Updates to Appropriate Measures Guidance are iterative and we have no timetable for updates to guidance. For example, Appropriate Measures for the Biological Treatment of Waste was published in September 2022. However, there have been iterative updates and in February 2024 new specifications were introduced for leak detection and repair (LDAR) monitoring. We expect further changes in guidance in AMP8 but the scope, scale and timing of those changes are unknown. The changes will impact sites permitted under the IED and non-IED permitted sites.

- **Renewal of Regulatory Position Statements, such as RPS231[15]:** The industry relies on this RPS to allow the storage and treatment of sewage sludge under an S3 or T21 waste exemption. RPS are time limited, and the latest government advice is "*This RPS will be reviewed by 31 January 2024. You will need to check back then to see if it still applies.*" Should there be changes to the scope of Regulatory Position Statements this may drive further significant (but unknown) cost into the Bioresources Price Control in AMP8.

Under Ofwat's draft determination proposals, each and all these costs, if not incurred directly as a result of IED permit requirements, would be managed by 50:50 cost sharing in the Bioresources price control. We do not believe that this is a satisfactory management of the risk, as it does not recognise the different regulatory framework in which Bioresources now operates, and the increased likelihood of changing requirements in AMP8.

We instead propose that the uncertainty in wider waste permitting risks is managed by broadening the scope of the enhanced cost sharing (25:25) for IED compliance to include equivalent risks at non-IED sites. We believe that enhanced cost sharing is the best approach to allow companies to invest in new and emerging waste permitting needs. The scope of the expanded costs sharing would include new improvement conditions arising within waste permits, statutory guidance or the requirements to meet exemption criteria. This could be either as a variation to an existing permit (or exemption), or from the creation of a new permit.

We believe our proposal is the right option to balance managing the risks for companies and protecting customers from inefficient expenditure. It avoids companies seeking to recover significant additional amounts

[14] The CIWM (WAMITAB) operator competence scheme is designed to allow permitted waste facilities in England and Wales to demonstrate they employ technically competent people with the knowledge and skills to ensure waste sites comply with Environmental Permitting Regulations (2007).
[15] Waste codes for sewage sludge materials: RPS 231 - GOV.UK (www.gov.uk)

up front from customers and then refunding them if those investments are not required and has multiple additional benefits:

- The proposed approach is consistent with how equivalent IED waste permitting risks are proposed to be managed. Ofwat's approach to managing permit compliance expenditure should be consistent across the Bioresources price control and not be differentiated by the type of permit held – the need for expenditure and cost recovery is the same whether a site holds a registered exemption, a bespoke waste permit or an IED permit.

- The enhanced cost sharing would reflect that bioresources now operates under the Waste Framework Directive. The resulting investment requirements to ensure compliance with new and evolving waste regulation obligations are excluded from the WINEP and consequently are without the WINEP planned look ahead of future requirements. There is, however, a high confidence that there will be change and the approach to cost recovery must be updated to reflect the changing regulatory framework and the application of that framework on our activities. Given the high confidence that risks will materialise, and the additional costs that will be incurred, this warrants a more balanced cost-risk share with customers.

- We have discounted reliance on the IDoK mechanism to manage broader waste permitting uncertainty, given that the implementation of the IED was not considered a Relevant Change in Circumstance (RCC). It is preferable for waste permitting risks to be managed through enhanced cost sharing as the scale of the potential changes are lower in magnitude than landbank risks, which we propose are managed through a Notified Item.

- This would be a common industry approach. The changes will likely impact all companies and therefore funding mechanisms must be considered and applied consistently at an industry level. We have worked collaboratively across the industry to develop a proposal that is supported by the vast majority of companies

Without an appropriate flexible funding arrangement to manage broader waste permitting risks there is a systemic risk to the capability of the industry to deliver environmental obligations. If we are not funded to efficiently comply with our regulatory requirements, we may be unable to provide a resilient sludge management service.

Appendix 4 – Cost Benchmarking

MOTT MACDONALD

PR24 Enhancement Case Review
Bio Resources

Project:	Bio-Resources		
Our reference:	NA	**Your reference:**	NA
Prepared by:	[redacted]	**Date:**	02/07/2024
Approved by:		**Checked by:**	[redacted]
Subject:	Bio resources IED projects benchmark		

1.1 Introduction

Following the PR24 Enhancement case reviews study conducted by Mott Macdonald in January to provide cost confidence on the costs submitted for the Bio-resource business cases, MM were engaged to repeat the study to increase cost confidence. The study below focuses on the 16 solution costing projects called IED which are part of the Bio-resources business cases.

1.2 Methodology

Benchmarking was carried out on the 16 cost estimates produced by the Cost Intelligence Team(CIT). The individual costed items of the 16 IED projects identified and benchmarked against Mott Macdonald's industry database where comparable data was available. The MM database includes data from 8 UK Water and Wastewater companies (WaSCs), of comparable scale and operating model to Southern Water (SWS). Companies have been selected as the closest peers to SWS and data normalised for location and date to ensure comparisons are appropriate.

To make like-for-like comparisons, the comparator data has been adjusted for inflation (and deflation) to 1Q2023 using the published CPIH figures.

To account for regional variations in the base cost of the resources needed for water projects, the location factors published by the BCIS were used to adjust comparator data to a SWS base. This adjustment seeks to remove any 'skewing' of the comparison due to data being sourced from companies across the UK, which experience local differences in resource cost due to factors including availability; the general local economy and average rates of pay; logistical or access constraints caused by the preponderance of urban or rural communities within their catchment areas; and variances in productivity.

Occasionally, costed items were factored to adjust costs to reflect market changes, replacement costs and additional assumptions. These factors have been used in the benchmark costs as well to make equal comparisons.

Every costed item is either referenced by a SWS cost curve or is referenced by the term "Custom Asset". Custom Assets denoted to different construction works, therefore a description next to term Custom Asset has been assigned to easily identify them. The Custom Assets related to containment walls, impermeable sheets and SMR impermeable surfaces capture 39% of the total project costs and their descriptive names have been shaped as if Custom Asset-Concrete Containment wall 0.4 height, Custom Asset- Concrete Containment wall height 1.5, Custom Asset-Impermeable Sheet and Custom Asset- SMR impermeable surface.

Limited information for the coverage of the Custom Assets made benchmarking these items more difficult to address this issue assumptions regarding the inclusions and exclusions have been made and the closest available comparable curves have been selected from the MM database. The costed items with no available comparable data have been excluded from the study.

1.3 Analysis and Results

This section of the report provides the results and analysis of the benchmarking process. Table 1 below presents the coverage which reflects the % of the project cost that has been benchmarked and the variance which represents in percentage terms the cost difference between SWS cost for the scope benchmarked and the industry benchmark. For example, 8% variance implies that scope benchmarked is 8% more expensive than the benchmark.

Table 1 Project Coverage and Benchmark results per project.

New Schemes					
Project Name	**Project cost**	**Scope Benchmarked**	**Coverage**	**Benchmark**	**Variance**
Goddards Green	£4,261,503.33	£4,133,042.75	97%	£4,385,930.83	-6%
Bexhill & Hastings	£2,067,807.52	£1,936,958.17	94%	£2,134,741.16	-9%
Budds Farm	£2,680,316.11	£2,523,856.11	94%	£2,813,635.17	-10%
East Worthing	£3,624,971.29	£3,189,686.15	88%	£3,411,040.50	-6%
Ford	£3,352,858.82	£3,196,398.82	95%	£3,352,065.11	-5%
Fullerton	£2,600,624.14	£2,479,164.14	95%	£2,546,268.19	-3%
Gravesend	£1,796,930.90	£1,657,470.90	92%	£2,068,456.64	-20%
Millbrook	£5,195,925.82	£5,015,831.31	97%	£4,962,468.62	1%
Ham Hill	£1,857,148.44	£1,679,198.80	90%	£2,196,441.01	-24%
Peacehaven	£1,258,303.25	£1,005,721.78	80%	£1,083,161.11	-7%
Ashford	£2,089,383.77	£1,818,142.09	87%	£2,134,989.05	-15%
Aylesford	£1,351,978.46	£1,213,226.23	90%	£1,376,009.07	-12%
Motney Hill	£1,589,634.09	£1,346,102.41	85%	£1,671,138.47	-19%
Queensborough	£1,331,487.79	£1,185,527.79	89%	£1,497,999.28	-21%
Sandown	£2,809,556.24	£2,597,122.42	92%	£2,955,626.46	-12%
Canterbury	£1,875,762.07	£1,711,389.98	91%	£1,809,985.09	-5%
Total	**£39,744,192.05**	**£36,688,839.86**	**92%**	**£40,399,955.77**	**-9.2%**

The table above suggests that coverage is equal to or above 80%. This coverage figures increase the robustness of the benchmark study. Notably, the Ham Hill, Gravesend and Queensborough projects present the highest variances but given their assigned project cost do not have great cost impact on the total project cost.

1.4 Conclusion.

The primary purpose of this study is to bolster confidence in the IED project estimates by increasing benchmarked coverage and by using latest available comparable data. The study has achieved 80% or greater coverage to every project and an average of 92%. This increases the robustness of the study and fulfils the primary reason for this exercise.

The total variance is -9.2% which means SWS total benchmarked scope is 9.2% lower than the total benchmark cost.

The projects with the greatest variances are Ham Hill, Gravesend and Queensborough but these projects represent a small portion of the total project cost.

Finally, the caveat remains that part of this study concerns items called "Custom Assets" with unclear specifications hence, assumptions of what are the inclusions and exclusions are incorporated to complete the study. Consequently, part of the cost variance in Custom Assets might be influenced by these assumptions.

Appendix 5 – Solution Selection

Intended to demonstrate an informed and considered outline design with aligned costs. It does not represent fully developed design decisions and remains subject to further development.

Summary

- Intro: IED requirements include a need for new impermeable surfaces. Concrete has been adopted as the base case in concept and we are not yet in a position to realise opportunities for alternative, cheaper solutions as we cannot be confident that the EA will accept our proposals.
- Root cause: EA referenced materials requires specific impermeable surface performance criteria and there are industry norms for solutions. SWS wants to challenge the norm on risk assessment and technical basis to provide the most reasonable and practicable solution to ensure demonstrable value for our customers.
- Plan is to develop our design and build our overall case, this will then be presented to the EA with appropriate evidence.
- Relates to specific technical elements of impermeable surface solutions and the application for STCs
- Realising the opportunity too soon (i.e. in the EC application) risks budget shortfalls later
- EC costings completed on limited information as a RoM and includes ±%risk
- Emerging scope and further design development may identify additional costs not included in concept

Impermeable Surfaces

- Various solutions used in industry e.g. concrete slabs, bentonite, synthetic membranes
  - Each requires different overall scope e.g. removal of stones & spoil, sub-base install, top covering
  - Each may lead to different secondary scope under TotEx considerations e.g. diversion of underground services
- Evaluation for STC use is ongoing and alternatives e.g. concrete canvas looks to challenge the norm
- Estimated total area required at concept for SWS STCs is ~60,000m^2
  - Further opportunities for Kent consolidated sites (BioResources strategy) being further reviewed
- Supplier engagement ongoing and awaiting some outcomes/reports, recommend some further testing undertaken given the potential saving
- Wider considerations include;
  - Chemical compatibility, required asset life and TotEx, embodied carbon, operational impacts (access, slips, trips & falls, secondary changes (e.g. pipework)
- IED design is early stage and the industry-wide approach is not yet clear, risk of EA default to highest performance offered across WASCs
- Changing guidance from the EA gives limited confidence in what they will consider compliant, some anecdotal, some documented. Further clarity anticipated to become available as companies discuss this in more detail in industry fora.
- The type of surface is not defined by EA but based on us 'stating solutions are compliant', we need to technically evaluate this to gain the confidence required to make this statement. Requesting discussion and derogations too soon without the required evidence risks undermining the probability of realising the opportunity later

Cost Summary

- Containment is ~75% of overall IED concept cost – aligns to Atkins report
- Solutions look to balance new impermeable areas against the cost of containment walls (and other works to the area to ensure impermeable)
- Initial costings completed with basic rate from CIT put the overall number at ~£106m
- Estimate for rate saving to same area gave the opportunity at ~£45m
- Costs remain highly sensitive to a given site measured requirements
- Subsequent exercise with CIT to give an idea of the relative cost of the options based on an example area and anticipated overall scope for the type of surface (basis of 1,000m^2)
- CIT further costing of concept ongoing.

Solution	Example Cost	Relative cost	Notes
Concrete Slab	£ 1,076,871	100%	Base case
Bentonite Matting	£ 728,408	68%	Requires sub base & top cover
Concrete Canvas	£ 552,821	51%	Likely shallow sub-base
Sprayed Concrete	£ 592,124	55%	Asset life/integrity concerns
Synthetic Textile	£ 538,208	50%	Asset life/integrity concerns & requires top cover

4

Note: Rates shown are not necessarily final rates used. Further scope development post this exercise provided additional info, this was used as a relative comparator for solutions.

Further detail

- IED guidance references Best available Techniques (BAT) and Appropriate Measures (AM)
- Includes CIRIA C736 for containment solutions which includes impermeable surfaces. This is more typically applied to perochem sites. We will not look to challenge all requirements but some of the details.
- Various impermeable surface solutions are listed therein and further review is required to determine the most cost effective compliant solution(s) within our operational needs:
  - Areas are typically ‘beach stones on soil’ and challenges to address include; pit and ducts, underground services, concrete pads/ foundations, it can be complex to retrofit some impermeable surface types
- CIRIA C736 references ‘agreement with regulators’, we need to establish a case and possibly submit derogations to formalise acceptance of the solution
- EA has advised their acceptance will be based on a competent engineer agreeing it meets CIRIA C736, design to be developed to establish the best solution(s)
- Level of protection required depends on risk assessment (class), completed by Motts for permit application and typically Class 2 or 3 for SWS STCs (based on local receptors & pathways)
- Specific Challenge to:
  - Performance impermeability of 10^{-9}m/s
  - Type of surface used, Concrete canvas may offer overall benefits
  - Requirement for 1m of impermeable soil under the impermeable surface with an impermeable layer over the top

CIRIA Table 8.2

Table 8.2 Lining system options (HSE, 2009a)

Option	Advantages	Disadvantages	Fire resistance	Cost*
Synthetic				
Polyethylene (HDPE)	▪ resistant to water, hydrocarbon and most chemicals.	▪ requires protective layer ▪ potential hidden problems around seals and penetrations ▪ base ground to be prepared well, ie remove stones, requires a layer of gravel and sand/geotextile before the liner ▪ requires specialist installer to weld joints.	▪ very low ▪ burns readily if unprotected	Medium
Polypropylene (PP)	▪ resistant to water and oils ▪ easier to lay than HDPE.	▪ limited resistant to fuels ▪ requires protective layer ▪ potential hidden problems around seals and penetrations ▪ base ground to be prepared well, ie remove stones, requires a layer of gravel and sand/geotextile before the liner ▪ requires specialists installer to weld joints.	▪ very low ▪ burns readily if unprotected	Medium
Synthetic rubber and EPDM	▪ resistant to water.	▪ not resistant to oils and fuels ▪ requires protective layer.	▪ very low ▪ burns readily if unprotected	Medium
Polyvinylchloride (PVC)	▪ resistant to oils and water.	▪ not resistant to fuels ▪ requires protective layer ▪ potential hidden problems around seals and penetrations ▪ base ground to be prepared well, ie remove stones, requires a layer of gravel and sand/geotextile before the liner ▪ requires specialist installer to weld joints.	▪ very low ▪ burns readily if unprotected	Medium
Polyurethane (PU)	▪ water resistant	▪ not resistant to oils and fuels ▪ requires protective layer	▪ very low ▪ burns readily if unprotected	Medium
Structural				
Concrete	▪ proven durability ▪ able to cast around penetrations ▪ well suited to small congested areas ▪ hydrocarbon resistance.	▪ requires joints for construction and movement ▪ requires regular maintenance of joint and penetration sealants and cracks ▪ can buckle under heat ▪ net excavation waste can be high ▪ potential for settlement and cracking.	▪ very good ▪ joints and penetrations are the weakness	High

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CIRIA Table 8.2

Table 8.2 Lining system options (HSE, 2009a)

Shotcrete (spray applied concrete)	▪ ease and speed of installation as concrete is sprayed on ▪ plant can be operated from outside the bund if necessary ▪ proven durability ▪ able to cast around penetrations ▪ hydrocarbon resistance.	▪ specialist contractors required ▪ requires joints for construction and movement ▪ requires regular maintenance of joint and penetration sealants and cracks ▪ can buckle under heat.	▪ very good ▪ joints and penetrations are weakness	Low
Sand bitumen	▪ remains flexible after installation ▪ resistant to puncture ▪ cracks can be repaired easily using hot bitumen ▪ hydrocarbon resistance.	▪ specialist contractors required ▪ requires joints for construction and movement ▪ requires regular maintenance of joint and penetration sealants and cracks ▪ can buckle under heat.	▪ very good ▪ joints and penetrations are weakness	Low
Fibreglass	▪ easy application ▪ suited to small areas ▪ hydrocarbon resistance.	▪ inflexibility needs to be catered for in design to allow for thermal movements and avoid overstress and de-bonding.	▪ low ▪ may require additional fire protection measures	Low
Mineral				
Bentonite (geosynthetic clay liner) (pre-hydrated or dry bentonite requiring *in situ* hydration)	▪ hydrocarbon resistance ▪ lower maintenance ▪ self-sealing properties if punctured ▪ pre-hydrated can be laid at performance specification required.	▪ requires a protection layer ▪ potential hidden problems at penetrations ▪ potential for drying out on slopes ▪ *in situ* hydration to dry system to achieve performance specification required ▪ can be uncertain.	▪ good as geotextile mat protected by layer of soil/stone	Medium
Clay	▪ inert material that has retained plasticity once in place ▪ hydrocarbon resistance.	▪ labour intensive, weather dependent and time consuming activity in spreading and compacting the clay requiring significant vehicle movements ▪ may not be safe to carry out installation while tanks are in service due to machinery requirements.	▪ high (non-flammable thick malleable layer) ▪ normally covered with top soil layer which provides further resistance	Medium

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Solution Initial Evaluation

- The following evaluation criteria has been used as **initial basis,** subject to discussion and development, weightings provisional, every heading to include HS&E risks.
- BAT guidance 11.13

Criteria	Narrative/requirement
Impermeability	Demonstrated to meet EA requirement for 10^{-9}m/s.
Lifespan	Relate to each other, with general consideration for maintenance process/cost and general repair
Chemical compatibility	Compatibility with sludge. Not anticipated to be long term contact, rain will wash it off and major spill would only be the duration of clean up.
Installation	Complexity, labour, plant, access and related costs for install. Known details/solutions for the application(s) identified. Secondary works; underground services diversion, drainage, tie-ins to existing)
Carbon	Carbon footprint of installed solution, company Objective to reduce embodied and operational carbon.
Cost	Huge impact on overall cost. Estimate of whole life cost. Overall responsibility to determine cost effective solutions.
Operational suitability and ease of repair	Ease and cost to complete repairs from damage (mechanical, fix something underground/ underneath, wear and tear). Need for repair apparent from visual inspection. Includes consideration of operational impact: walking route, slips, moving equipment across it.

Bund Wall

- Bund walls as containment boundary, two types covered in CIRIA and are most widely used.
  - Earth mound bund wall
  - Reinforced concrete (RC) walls
- Some alternatives may be appropriate when considered **with an impermeable lining**, subject to EA acceptance – potential compliance issues remain with respect to CIRIA C736
  - King post
  - Pre-cast wall + toe sections
  - Interlocking pre-cast concrete blocks
  - Gabion Basket
- Kerbs and speed humps proposed in some scenarios to limit the extent of the 'spread' of a spill
- Various solutions for pipework penetrations but new walls will not have penetrations, local re-route of the pipework

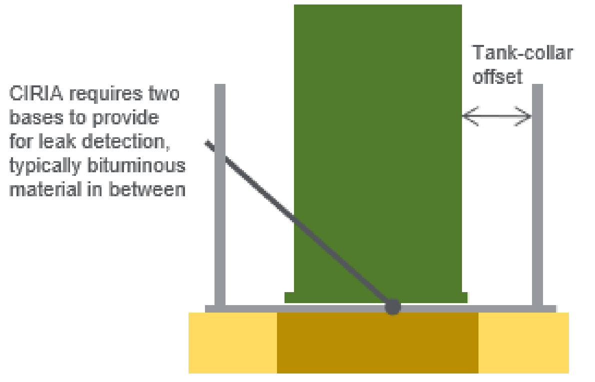
Basis used is for RC walls and Earth bunds aligned to CIRIA C736

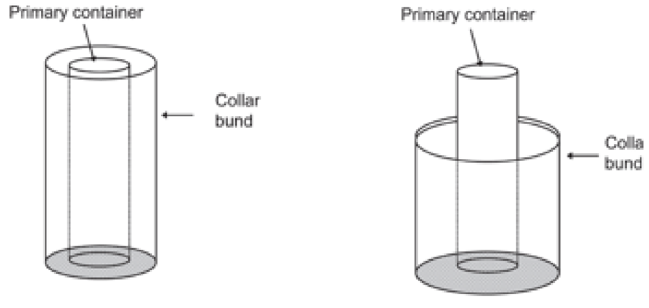
- No option fully discounted but further Contractor input required to fully understand the application considerations and relative costs
- as appropriate for local conditions (geospatial, underground services, ground conditions, logistics)
- Other appropriate options may be identified by Consultant or Contractor as design develops.




Collar bunded tanks

- Cost effective solution in some applications typically where:
  - Smaller tanks are stand alone – less complex than a bund and wall
  - Initial cost estimate shows this is also cost effective where **two** tanks are in close proximity
- Collar sized for 110% of tank based on CIRIA
  - Essentially allows for rainfall
- Requires re-route of local pipework
  - All valves/instruments/controls to **outside** collar
  - Potential impact on process **pump performance** if rerouted 'over collar wall'. Mitigate with pipe through collar (avoid head change)
- Tank-collar **offset dimension** requires further review in design development
  - Space would not be accessed frequently, **~900mm** is typical and thought appropriate
  - Rain cover may be suitable but small **drainage pump** with sensor thought more effective/appropriate with periodic sampling for leaks
  - ! Space would very likely become a **confined space**
- Reuse of existing tank may be possible (next slide)





(a) full height collar bund (b) three-quarter collar bund

Figure 6.2 Collar bunds

Cost calculations are based on 2x previous SWS tank install rates at £/m³. Further supplier discussions required, Permastore is common supplier and offers 'tank within tank'.

Collar bunded tanks cont.

- Reuse of existing tank may be possible….
- Additional foundation area required (diameter) and should be tied to existing (re. differential settlement)
  - Appropriateness/solution depends on foundation type (concrete ring, pad, piled)
  - Remains subject to design development and likely a case-by-case review
- Tank lifting is possible
  - existing tank condition may invite risk, subject to inspection and detailed review
  - Asset remaining life review
  - Potentially reduced operational impact for replace