south east water

Water Quality

PR19 Supporting Appendix 6

3 September 2018

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What does this appendix do?

This document supports the submission of South East Water's business plan for 2020-2025 and provides:

- Our approach to long term planning to maintain and improve the quality of drinking water supplies
- our risk assessment and approach to managing risk to the maintenance of all drinking water supply systems

The evidence you will find in this appendix

The following evidence is included in this document:

- Appraisal of options to provide resilient, technically satisfactory and cost effective solutions to each scheme
- measurement of water quality performance against current and future performance commitments
- Our customers' views on water quality priorities

The decisions we have made based on this evidence

We have made the following decisions based on this evidence:

- Specific treatment schemes to address deteriorations in water quality
- Continuation of the catchment management approach to address metaldehyde and other pesticides at source
- Capital maintenance investment to improve resilience of treatment works
- Mains rehabilitation / replacement to improve resilience of distribution network

Where we address our plan's four key themes

Customer Service	Affordability	Resilience	Innovation
Section 2.1 Section 2.3.7 Section 2.4.3 Section 2.4.4	Section 3.1.2 Section 3.2.2	Section 2.2 Section 2.3 Section 3.4	Section 2.1 Section 3.1 Section 3.2

Other evidence and data that supports our decisions

You will find additional evidence in the following documents:

- PR19 supporting appendices 1, Engagement and 10, Environmental Resilience
- Need further information?

Please email yourwateryoursay@southeastwater.co.uk if you require further information or wish to clarify anything in this document.

Contents

Executive Summary

Water quality is a priority for our customers, stakeholders and society. To ensure we meet these expectations we have improved our long term water quality strategy. This strategy does the following:

It builds on the excellent performance in the 2020-25 period where we have delivered the three water treatment solutions we committed to.

- Installation of ultrafiltration at Waterworks Road treatment works to address increasing E.coli and coliforms in the raw water (March 2016)
- installation of ultrafiltration at Stockbury treatment works to address increasing E.coli, total coliforms and turbidity in the raw water (December 2016)
- installation of ultrafiltration at Kingston treatment works to address increasing turbidity in the raw water (March 2017)

We have delivered a stable performance on Mean Zonal compliance at 99.95% compliance or greater.

We have halved the number of customers who have felt the need to contact us about discoloured water and reduced all hotspot areas to acceptable levels.

The assets that are key to delivering excellent water quality are all assessed as stable across four key metrics.

The strategy includes customer priorities and risks to produce four key water quality related performance indicators:

1. Compliance risk index (CRI)
2. Event risk index (ERI)
3. Contacts from customer about the appearance of their water
4. Contacts from customers about the taste and smell of their water.

We have set stretching targets for all four of these measures, aiming at 100 per cent compliance for CRI and ERI and over a 40 per cent reduction in contacts for appearance and taste and odour.

To ensure we protect water quality in the short term we have identified two key schemes that remove the risk posed by a deterioration in the raw water quality.

1. Removal of nitrates at Woodgarston
2. Removal of chromium at College Avenue

Both these schemes have been supported by the Drinking Water Inspectorate (DWI).

In the long term we are continuing to use new and evolving ways to ensure the catchments we abstract from are more resilient to climate change and land use changes via the Water Industry National Environment Programme (WINEP) and that all future risks have been adequately assessed and play a part in our future plans.

1. Setting the Scene – Water Quality Overview

1.1 Current Water Quality Performance 2015-20

The maintenance of a constant supply of clean, healthy and palatable water was a fundamental expectation of all of our stakeholders and customers, as part of the company's business plan covering the price review period 2015-20. To ensure that the company delivered on this commitment, three specific water quality schemes were identified to address raw water deterioration, along with a continuation of the company's innovative work on catchment management, primarily to address increasing concentrations of metaldehyde. The three identified schemes were:

- Installation of ultrafiltration at Waterworks Road treatment works to address increasing E.coli and coliforms in the raw water (March 2016)
- installation of ultrafiltration at Stockbury treatment works to address increasing E.coli, total coliforms and turbidity in the raw water (December 2016)
- installation of ultrafiltration at Kingston treatment works to address increasing turbidity in the raw water (March 2017)

All three schemes were delivered on time, on budget and met all regulatory and stakeholder expectations with regard to performance.

The company's water quality performance in the price review period 2015-20 is measured against the agreed OFWAT performance commitments in three areas:

- Mean Zonal Compliance (MZC)
- discolouration contacts and
- asset health serviceability

Performance against these commitments is outlined below.

1.1.1 Mean Zonal Compliance

The overall Mean Zonal Compliance is a measure of the water quality at customers' taps against both the European Directive and national parameters in Schedule 1 of the Water Supply (Water Quality) Regulations. The measure is comprised of the average of the MZC percentage figures for 39 different parameters that are tested to establish the quality of water.

The frequency of sampling is set out in the regulations at a water supply zone level and is dependent on the nature of the parameter and is proportional to the population

within each a supply zone. Given the nature of the mean zonal compliance calculation, which looks at the percentage of samples failing, the impact of a failure increases as the overall sample size decreases.

Performance over the past four years is shown in Table 1.

Table 1: South East Water mean zonal compliance performance 2014-17

Measure	2014	2015	2016	2017
South East Water MZC	99.96%	99.96%	99.95%	99.95%
Performance commitment	100%, penalty occurs at 99.94% or lower			
Total No. of failures at customer tap	49	51	44	24
No. of tap failures contributing to MZC	27	29	29	18

There were 24 samples taken from customer's taps in 2017 in which a parameter failed to meet standards, which represents a significant improvement on the previous three years which saw an annual average of 48 sample failures.

The greatest improvement has been seen for total coliforms which dropped from an average of 20 per year to six in 2017.

Iron has reduced from an average of 11 failures per year to seven in 2017 as a result of the sequential flushing and SeaQuest installations which form part of the Company's discolouration management strategy.

Despite the reduction in the number of failures, the MZC remains at 99.95 per cent as a result of increased impact of the low sampling frequency for a third of all failures.

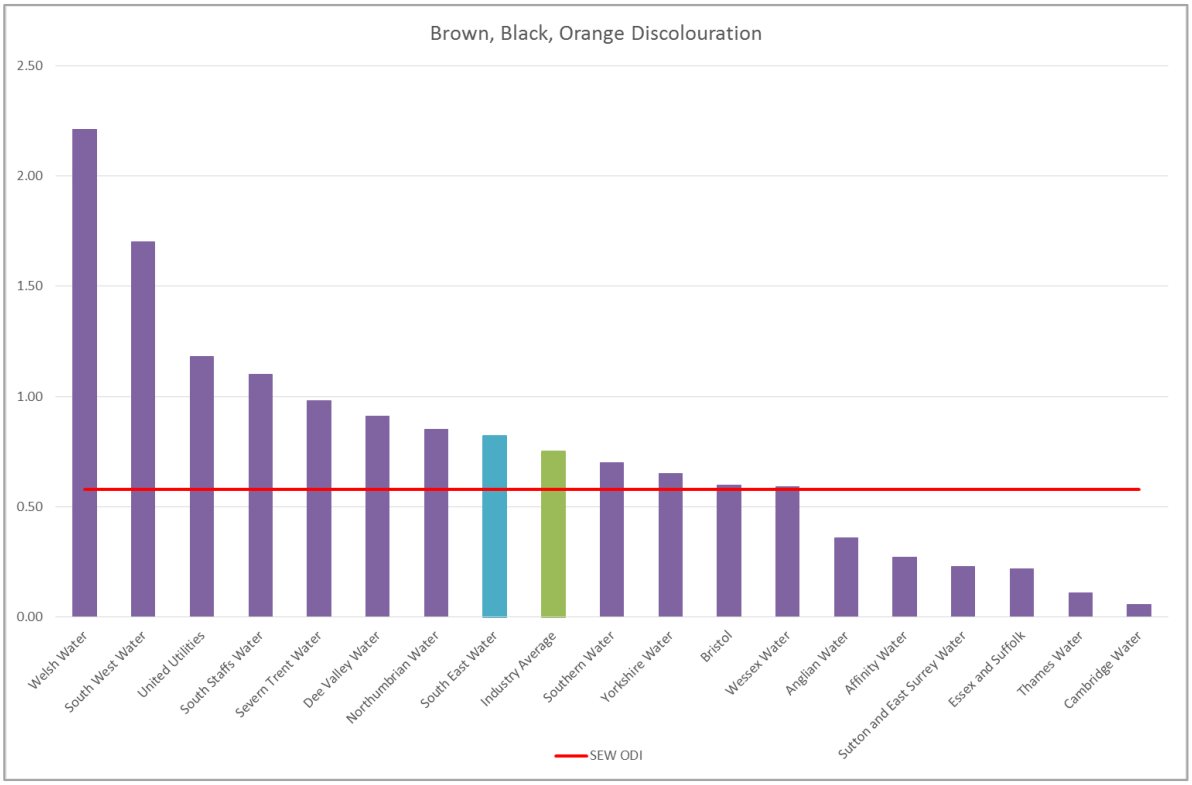
The company has an established methodology for identifying, recording and managing risks, which is designed to embed risk reporting into day-to-day management activity. Risks are managed at a corporate level as documented in our company monitoring framework and corporate risk register and through our drinking water safety plan approach (DWSP) to water quality risk management.

1.1.2 Discolouration Contacts

We have a company performance commitment for discolouration, which measures the number of consumer contacts for black, brown or orange water per 1000 consumers in a calendar year. This target measures the background levels of contacts received by the company and excludes contacts received during DWI reportable events.

Discolouration performance per 1000 population in 2017, is shown in Figure 1, with data obtained from an industry data share.

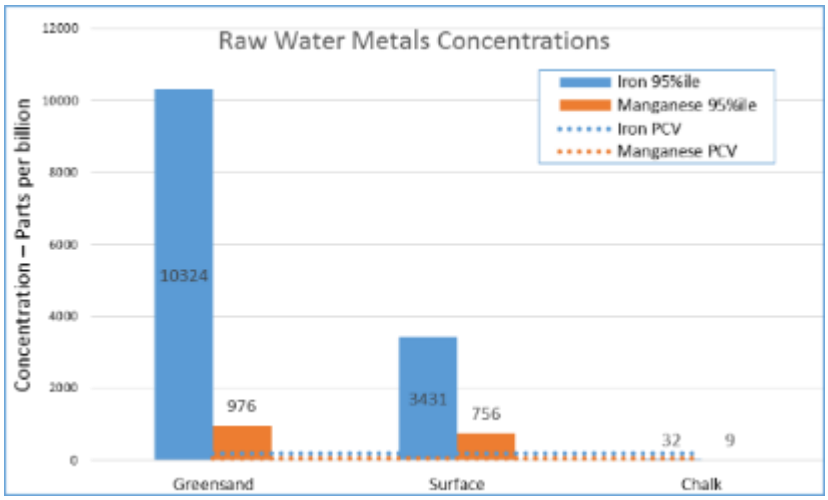
Figure 1: Black brown orange discolouration 2017 (industry data share)



The industry does not face the same level of risk of discolouration across companies. For example, companies with predominantly chalk or surface water treat water with lower levels of iron and manganese (the naturally occurring metals that cause the water to appear brown / black) and are likely to have less deposits within the main.

The comparative concentrations of iron and manganese within each raw water type are shown, using our own sources, in Figure 2. This demonstrates the magnitude of the raw water challenge in greensand aquifers with respect to these two parameters.

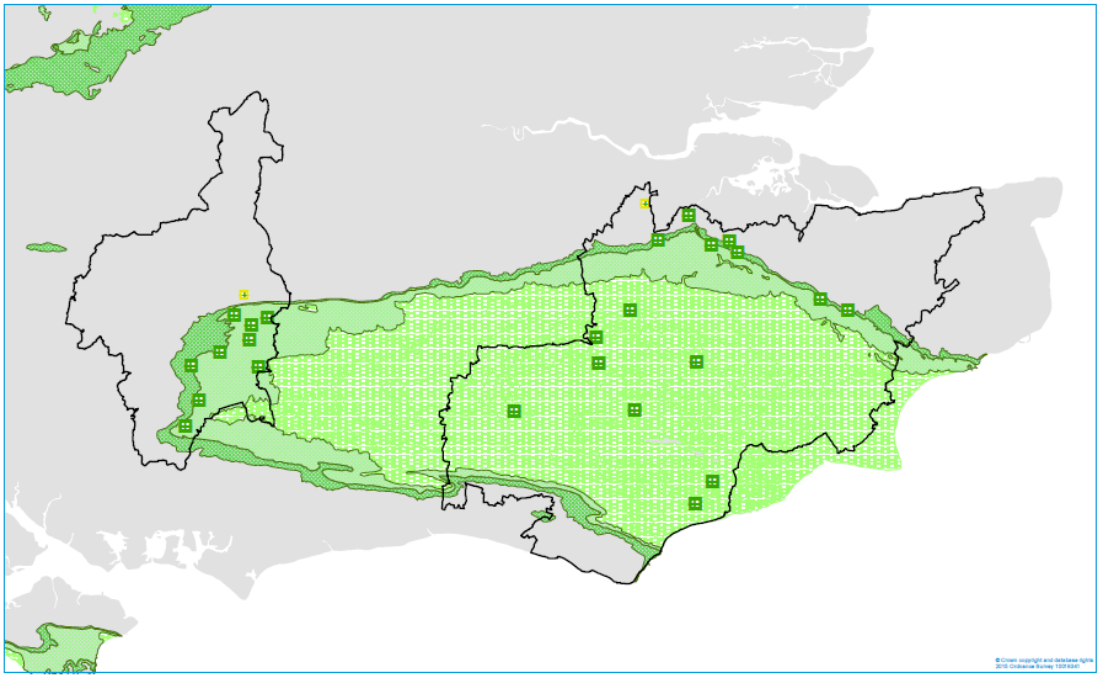
Figure 2: 95%ile concentrations of iron and manganese in source waters



We have a number of significant challenges with regard to discolouration:

- Unique treatment challenge posed by raw waters excessively rich in iron and manganese from greensand boreholes
- We are unique from a geological perspective, in abstracting 30 per cent of all raw water from aquifers with these high concentrations, due to the lack of viable alternatives in the water scarce south of England. Baseline performance is therefore not wholly comparable with that from companies with primarily chalk / surface water abstractions.

Figure 3: Greensand aquifer locations in South East of England



The green shaded area in Figure 3 shows the geographic distribution of greensand formations and the squares represent our abstractions from these aquifers.

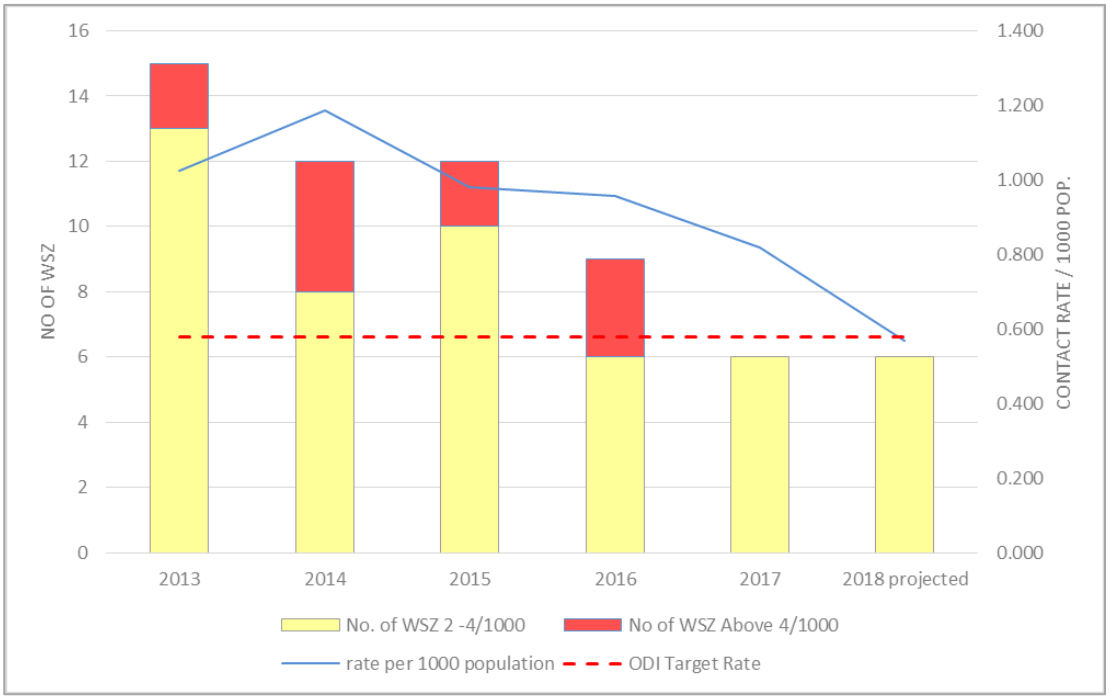
It is these challenges that have been reflected in the ambition we have shown on our Outcome Delivery Incentive (ODI) to reduce contacts in this area. For our company, upper quartile performance is not possible because we rely so heavily on greensand water which poses challenges related to iron and manganese. We believe that we are currently performing at or close to the upper quartile position of companies that have similar treatment challenges to us.

There has been a significant programme of work from 2012 to date to reach the industry average position. We have identified areas where an elevated number of customer contacts were received, particularly with respect to discolouration. Our discolouration strategy has been in place since 2012 to address these identified issues.

In line with the DWSP approach, this strategy considers all aspects from source to tap. The work to date has focussed on improvement of performance at treatment works, increased cleaning frequency of key service reservoirs, installation of SeaQuest (an agent designed to prevent deposition of iron and manganese within the system) dosing to minimise deposition within the distribution network and a programme of sequential flushing of our mains.

The discolouration management strategy was aimed to reduce the number of water supply zones (WSZ) which experienced a contact rate above 2/1000 population. The strategy was amended following the introduction of the Ofwat ODI target of an overall company rate of 0.58 contacts per 1000 population. Figure 4 shows the ongoing improvement in performance with regard to discolouration contacts. Six WSZ had a contact rate above 2/1000 compared with nine in 2016. For the first time on record, no WSZ had a contact rate over 4/1000.

Figure 4: Discolouration performance WSZ and overall rate



The ODI target set for discolouration contacts was very stretching, requiring a reduction of 50% in the contact rates received in the period 2010-15. The performance targets and current contact rates at an overall company level are shown in Figure 5.

Performance has improved year on year as a result of the actions outlined within the company's discolouration management strategy. Performance in 2018 after six months is in line with the current target rate of 0.58 per 1000.

The company's discolouration management strategy to reduce the number of customer contacts received and to reduce iron and manganese concentrations in the distribution system covers a number of areas including:

- Continual review of customer contacts to identify WSZs with persistent problems
- enhanced operational sampling to gain understanding of metals concentrations within WSZs
- use of online water quality monitors, installed in strategic locations, to gain real time understanding of sediment movement and pressure changes in the system

The above information, coupled with other factors including planned work and burst history is used to develop a discolouration action plan to implement across the business. Two key risk mitigation actions are currently being taken as part of this work:

1. A systematic flushing programme covering approximately 1400 km, or 10%, of the company's mains network to remove historic deposits per year
2. installation of SeaQuest dosing at key water treatment works where elevated customer contacts without distinct hotspots have been identified in the downstream supply system. SeaQuest is an approved chemical, dosed into the water supply system which inhibits corrosion of water mains and prevents discolouration of supplies at the customer tap.

In certain circumstances the mains distribution system is investigated to ascertain the mains condition. This enables the company to make key decisions on long-term mitigation such as mains replacement or rehabilitation. Rehabilitation can be completed in a number of ways including, cleaning, relining, replacing or slip-lining of the existing main. The company is currently developing a toolkit to identify the best mitigation strategy for specific issues. Costs for mains investigation and rehabilitation or replacement are included within the capital maintenance allocation in the business plan.

Alongside the above work a number of other operational risk mitigation actions have been implemented including:

- Calm valve operation scheme which ensures any changes to the distribution system as gradual and the effects of valve operation are minimised
- regular flushing of certain locations where deposits are known to accumulate historically such as dead-ends and hydraulic null-points
- proactive reservoir cleaning programme.

The current projection is that the ODI target of 0.58/1000 will be met by the end of the current business plan period and all zones should have a contact rate below two contacts /1000 population.

1.1.3 Above Ground Asset Health

Above ground asset health performance comprises of four serviceability indicator outlined below, performance is then assessed as stable or marginal. These indicators use mainly water quality measures to assess if investment in the assets has been effective and that the performance of the asset has been at least stable, as shown in Table 2.

Table 2: Above ground asset performance

Composite index			2015-16	2016-17	2017-18	2018-19	2019-20
Indicator	**Unit**	**Performance bands**	Stabl e	Stabl e	Stable	Stable	Stable

WTW coliforms non-compliance	**%**	High	0.08	0.04	0.08	0.04	0.03	0.03
		Ref	0.05					
Service reservoir coliforms non-compliance	**%**	High	0.84	0.00	0.00	0.00	0	0
		Ref	0.21					
Turbidity non-compliance	**Nr**	High	11	0	0	0	0	0
		Ref	4					
Enforcement	**Nr**	High	1	0	0	0	0	0
		Ref	0					

Performance in this metric has been assessed as stable for each of the three years of the current business plan reporting period 2015-20. Performance is expected to remain stable for the remainder of the period. The measures identified to achieve the target for asset serviceability form the key part of our overall water quality approach:

- Drinking Water Safety Plan approach to assessing all risks within the company area Source to Tap (continuation and improvement of current approach)
- targeted treatment works investment programme, prioritising water quality
- online monitoring at all treatment works with alarm and shut down for critical parameters
- risk based maintenance regime for water quality monitors
- catchment investigation and management to reduce catchment risks and minimise hazards at treatment works
- comprehensive operational sampling regime, significantly over and above monitoring required for regulatory self-reporting purposes to identify and monitor potential hazards in our catchments and ensure that treatment works are performing satisfactorily against these challenges
- risk based cleaning and inspection programme for all treatment works and vessels

2. Future Water Quality Strategy

To formulate a water quality strategy for the future we have sought intelligence from a number of sources. We have carried out extensive customer and stakeholder research across all areas of service including but with particular relevance to water quality, their overall priorities, their expectations on resilience, and their expectations on our behaviours as a responsible business.

We have also analysed the risks we have in the short and long term from the environment in which we operate using the DWSP as a primary tool.

A further consideration is that we need to ensure that our strategy allows us to comply with statutory guidance and expectations on all elements relating to water quality.

These inputs are detailed below and have fed our strategy and associated performance targets and our associated investment programme.

2.1 Customer Expectations

Our engagement for our 2020 to 2025 business plan has been extensive with 11,000 household and non-household customers engaged with so we can understand their needs, expectations and priorities for the next five years, but the longer term too.

Common themes emerged from that research around what customers' and stakeholders' priorities are for their water supply, both now and in the future:

What they said:				
Protect:	The quality of the water that comes out of our taps	The natural environment and the wildlife it supports	Customers who need extra support – financial or otherwise	Our water supply service – by becoming more resilient in the round
Tackle:	Leakage – and reduce it further and more quickly	Demand for water – and give us the information and tools to help do our bit too	The level of greenhouse gases you emit	
Keep:	Future water supplies secure by investing to make them more resilient	Educating current and future customers about water		

The maintenance of a constant supply of clean, healthy and palatable water remains the fundamental priority for all of our stakeholders. Our customers continue to place a high priority on both the quality and reliability of the water supply service, both in terms of the safeguarding of the chemical and microbiological quality of the water and also in terms of the aesthetic properties, such as taste and odour and appearance that they can judge themselves on a day to day basis. Further details on the engagement priorities are found in Appendix 1, Engagement and Appendix 3, Responsible Business.

We have listened to our customers and selected performance commitments that align with their priorities i.e. the safety, appearance and taste of their water.

During the engagement in particular within open focus group sessions on both priorities and resilience customers raised the issue of hard water as a reoccurring theme. We felt the need to assess this in the creation of our water quality strategy for the future. To set the context over three quarters of the water that we supply comes from underground aquifers, with a large proportion of these aquifers being formed of rocks with a high chalk (calcium and magnesium carbonate) content. As water is stored within these aquifers and moves through them as we abstract it, some of the chalk is dissolved in the water which makes the water hard.

Our customers raised concerns associated with common aesthetic issues associated with hard water, including the formation of scale in kettles, poor lather formation when using soap and white marks on stainless steel surfaces. Research shows that hard water is perfectly safe and there is lots of evidence that it can even be good for our health, as it contributes toward our daily intake of calcium.

Large scale softening of water supplies is possible, through lime and soda ash precipitation, ion exchange or reverse osmosis. While all methods will reduce the hardness of the water they all add significant cost to the water treatment process, reduce the mineral content and can lead to water that is corrosive to metal pipes.

Through our customer research, we have identified that the majority of our customers (54 per cent) are satisfied with the hardness of their water. While this is slightly below the industry average figure of 55 per cent%, we do not feel that this gives us a mandate to impose water softening across our supply area.

We will therefore provide further advice on dealing with hard water on our website and if individual customers prefer to soften their water we are happy to provide them with advice on who to contact to do this safely. Many devices are available for water softening, but a number of these can lead to water with an increased level of sodium which should not be used for drinking or cooking.

We will continue to monitor customer opinion on the issue of hardness and will react accordingly if there is a significant change to the current position.

2.2 Identifying the Water Quality Risks

In addition to seeking customers' views on their preference around water quality we also analyse potential risks to include within our future strategy. Our main tool for this is the Drinking Water Safety Plan supported by strong governance.

2.2.1 Drinking Water Safety Plan Approach and Governance on Water Quality

The company has a risk assessment and risk management approach to the maintenance all drinking water supply systems, assessing risks from source to tap as part of the embedded DWSP. These DWSP risk assessments are updated on a monthly basis with analytical results from the scheduled monitoring programme as well as any change we become aware of such as change to land use in the catchment. DWSP also incorporate information from recent water quality incidents and the number of consumer contacts. This information all feed into the company's asset management strategy to ensure that water quality is maintained.

Any unacceptable risks to human health or consumer acceptability which are identified will lead to a programme of remedial works to address the risk. Where the risk is associated with a new obligation or a change such as deterioration of source water quality, proposals will be discussed with the DWI to determine whether a legally binding programme of work is required.

In addition to the DWSP assessment of each water supply system, wider water quality risks and emerging risks are identified through a number of mechanisms. Key areas where emerging risks are identified include:

- Learning from company and industry events
- published literature
- industry research, for example; UK Water Industry Research (UKWIR) and Water Research Centre (WRc) projects, Sensors for the Water Industry Group (SWIG) & Smart Water Networks Forum (SWAN) groups
- DWI funded research
- academic research, including Cranfield water science group
- seminars and conferences
- networking through Water UK
- horizon scanning through Asset Innovation Team.

Any significant risks identified through the above channels are assessed for incorporated into the water quality departmental risk register which feeds up into our corporate risk register.

This mechanism enables the company to keep a watching brief on a number of long term risks and plan necessary mitigation measures in advance. Using this model, additional costs can be built in to the ongoing capital maintenance budgets in the longer term and therefore reduce significant unexpected economic shocks on the traditional five yearly investment cycle.

The company has a strong water quality focus to its board. Water Quality performance is reported monthly to the Executive and Board:

- All failures & events are reviewed as well as key WQ customer contact rates
- bi-monthly Strategic WQ Meeting take place to discuss all ongoing and arising water quality related issues. Attendees include, Asset & Operations Directors, MD, Operational Department Heads, WQ Team members. The agenda covers:
  - strategic review of WQ performance and targets
  - monitor existing strategies to address arising concerns
  - quarterly Report to Board
  - emerging risk review
- we produce a detailed annual Water Quality Board update that includes:
  - overview of company and industry performance
  - targets for the following year
  - key risk mitigation actions

2.3 Water Quality Compliance

The final consideration in building the strategy relates to the statutory obligations we will need to meet including guidance from government and regulators.

The DWI issued a guidance note on the long term planning for the quality of drinking water supplies in September 2017.

http://www.dwi.gov.uk/stakeholders/guidance-and-codes-of-practice/ltpg.pdf

This document outlines the main statutory obligations that apply to water companies who are wholly or mainly in England and Wales over the price review period 2020-2025 and beyond. In particular there must be due regard to the need for public water supplies to be safe, clean and compliant with all the regulatory standards, and to provide for a sustainable level of asset maintenance to maintain public confidence in drinking water quality.

In line with issued guidance, we have identified a number of statutory and non-statutory drivers to be considered for the 2020-2025 period which are summarised below:

- Catchment management

- resource and supply management
- raw water deterioration
- pesticides
- water treatment
- water distribution
- consumer acceptability
- lead and other point of use considerations
- radioactivity
- other emerging risks

Schemes identified under the drivers described above require formal sign off from DWI and will form part of the investment programme.

Companies must also ensure that they allocate sufficient funds for maintaining compliance with the regulatory standards and to prevent drinking water quality deteriorating, this aligns with our own compliance related outcomes.

The following sections discuss the key elements and drivers we have used to shape the water quality strategy.

2.3.1 Catchment Management and raw water deterioration

The company has a large scale catchment management programme in place during the current business plan period, in line with the 2015 Water Industry National Environment Programme (WINEP) as agreed with the Environment Agency. Further details on this programme can be found within Appendix 10 – Environmental Resilience.

This programme includes work on 6 surface water catchments (covering the rivers Cuckmere, Wallers Haven, Eastern Rother, Ouse, Medway and Thames) and eight groundwater catchments (covering our abstractions at Hartlake, Pembury Springs, Tonbridge, Boxalls, College Avenue, Woodgarston, Borough Green and Beenhams Heath).

The company has finalised with the Environment Agency the requirements of our 2020 to 2025 WINEP. The scope of this programme has increased considerably since the last business plan. The majority of this work targets emerging and deteriorating trends in our raw water sources, there are only three identified drivers that present a risk to final water quality in the business plan period 2020-25:

- Metaldehyde in surface water catchments
- Nitrate at Woodgarston treatment works
- Chromium at College Avenue

Other drivers and risks form the remainder of the WINEP programme which focuses on long term catchment solutions to reduce the risks and prevent the need for additional future treatment steps, further detail can be found within Appendix 10 – Environmental Resilience.

Metaldehyde

Metaldehyde is a molluscicide used as the most prevalent active ingredient in slug pellets, to control slug and snail populations within the UK, Europe and North America. Metaldehyde is used on a variety of crops but oil seed rape and winter wheat are the most commonly affected, slug pellets are also used on crops such as potatoes, cereals and soft fruits. It is not easily removed by water treatment and we have therefore been progressing a programme that aims at preventing it entering the water system in the first place.

The investigation phase for metaldehyde within six surface water catchments commenced during the business plan period 2010-15 (Rother, Cuckmere, Medway/Teise, Wallers Haven, Thames and Ouse), primarily through delivery of an enhanced monitoring programme. This allowed us to pin-point where Metaldehyde was entering our catchments and also provided us with improved data on those priority areas where we should focus our catchment management activities.

Catchment management for metaldehyde is in the delivery phase during the business plan period 2015-20 for all 5 remaining surface water catchments (Cuckmere, Medway/Teise, Wallers Haven, Thames and Ouse), with the key objectives to:

- Achieve a reduction in the number of exceedances above the PCV by 2020;
- reduce the overall tonnage of slug pellets used containing metaldehyde in each relevant surface water catchment by 2025;
- work with key stakeholders to engage with the farming community and promote good agricultural practice surrounding the application of slug pellets;
- develop and improve the detailed sampling and analysis programme to provide evidence of the effectiveness of mitigation measures

Our current WINEP is delivered in partnership with Catchment Sensitive Farming (CSF). We have made our engagement and activity very collaborative – in essence it is that partnership approach which has delivered mutually beneficial outcomes by improving soil health and crop yields, while also protecting the local environment and improving raw water quality.

The one-to-one collaboration with farmers in our catchments include:

- One-to-one confidential on-farm advice
- specialist reports with recommendations tailored towards the farm business

- workshops and events providing up-to-date guidance and advice
- soil husbandry and nutrient planning advice (including standard soil sampling)
- calibration of fertiliser applicators, slug pellet machinery and pesticide sprayers

In addition to the support services listed above, we have developed a Capital Grant Scheme to aid farm infrastructure improvements:

- Livestock and machinery tracks
- dedicated pesticide sprayer filling and wash down area
- resurfacing of gateways
- new gutters and down pipes
- rainwater harvesting equipment

The proposed approach for the business plan period 2020-25 is to continue and expand the current catchment management approach through the measures outlined above.

Nitrate

Nitrates represent a long term problem for the water industry. As a company we see a particular challenge within the chalk aquifers, where a number of sources, including many years of sub-optimal farming practices have contributed to a gradual build-up of nitrates within the groundwater. We have a number of raw water sources with deteriorating nitrate trends and have targeted these sites for further investigation as part of our WINEP to identify, characterise and model the extent of the issue and put in place remedial measures at a catchment level to reduce and hopefully negate the need for additional treatment across these sites in the future.

Following analysis of the risks of nitrate presence in the raw water across all of our sources we have seen a worsening trend requiring short term mitigation in one catchment, the Woodgarston catchment.

A full catchment investigation was completed in the Woodgarston catchment to identify the possible sources of nitrate leaching into groundwater. The assessment included:

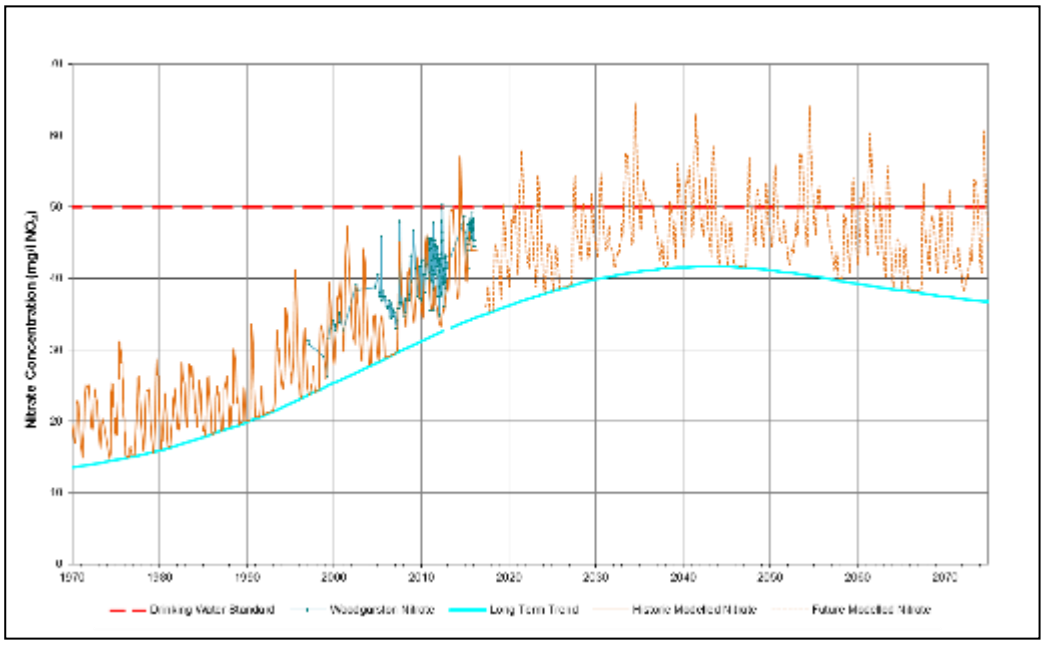
- Characterising the catchment
- land use surveys
- walkover surveys
- studying historical maps and aerial photographs
- nitrate modelling
- catchment Monitoring
- stakeholder engagement

- cover crop trials

The land in the catchment area is primarily used for agriculture, mainly arable and pasture, and has not significantly changed over the past 80 years.

Source modelling was carried out to understand the potential sources of the nitrate and predict future concentrations. The results of this modelling suggested groundwater nitrate concentrations will exceed the nitrate standard in the period 2020-25 and will continue to rise until 2035. Post-2035 concentrations may decline slightly but will not drop below the PCV unless the inputs of nitrate into the catchment are significantly reduced, these results are shown in Figure 5.

Figure 5: Modelling of Woodgarston No. 2 borehole nitrate concentration (1970 – 2075)



With an anticipated 50% reduction in nutrient leaching as a result of identified catchment measures, nitrate concentrations will reduce below the drinking water standard in the medium term.

As a consequence of these deteriorating trends, however, a short to medium mitigation of nitrate treatment is required to safeguard water quality in addition to the identified catchment measures.

Chromium

DWI released two information letters (04/2015 and 02/2017) with respect to the presence of chromium at levels of potential health concern, but significantly below the current PCV of 50 µg/l. Il 02/2017 identified three treatment works in the United Kingdom where the average concentration of chromium leaving site was above 3

µg/l. College Avenue treatment works is one of the three identified treatment works with elevated chromium levels, above 3 µg/l.

South East Water has continued to monitor the raw and treated water for chromium from May 2017. This monitoring has confirmed the treated water regularly exceeds 3 µg/l for both chromium and chromium VI.

Further catchment investigations are on-going, including discussions with the Environment Agency. Investigations in the College Avenue catchment area will be included as part of our WINEP scheme to be undertaken in the business plan period 2020-25. Current treatment at the site is not sufficient to reduce the chromium levels below the guidance level of 1 µg/l. While a catchment management approach is underway for this parameter, treatment is required in the short – medium term before the full benefits of the catchment management work can be realised.

2.3.2 Resource and Supply Management

South East Water acknowledges the duties and responsibilities outlined within the Water Industry Act, with regard to all aspects including development of water resource plans.

As part of the development of the company's Water Resource Management Plan, the options chosen for investigation were all subject to a water quality assessment to ensure that they would not represent a deterioration in the quality of the source water.

To confirm that the company complies with its duties on drinking water quality matters in its broader resilience and resource planning arrangements, a written assurance in the form of a signed statement from the Board Level Contact for each company that the company's draft Water Resources Management Plan (WRMP) takes account of all statutory drinking water quality obligations, and that the WRMP includes plans to meet their statutory obligations in full will be submitted to the Inspectorate.

2.3.4 Pesticides

The company has advanced treatment at all surface water sites and high risk ground water sites to mitigate the risk of pesticides. Treatment performance is monitored and assessed as part of the DWSP approach.

Metaldehyde is the only pesticide of concern for us at present. Catchment management measures in place to address metaldehyde issues are discussed in section 2.3.1, Metaldehyde.

2.3.5 Water Treatment and Storage

The company have introduced a risk assessment and risk management approach to the maintenance of drinking water supplies consistent with the obligations set out in the 2016 Regulations, through the development of our Drinking Water Safety Plans.

Asset management strategy within our company is accredited against PAS55 and the objectives link directly to the company's corporate objectives. With regard to water quality, these objectives relate the aim of 100 per cent compliance, improved consumer acceptability and satisfaction with the taste, odour and appearance of the water and the operation and maintenance of our assets.

Failure to invest appropriately in the maintenance and replacement of our assets presents a significant risk to the business. Within the company, deterioration modelling is used to plan asset interventions to ensure that the company's assets are both reliable and resilient and that all potential risks are mitigated.

Deterioration modelling has been carried out to determine the optimum level of interventions to maintain a stable level of service both during 2020 to2025 and beyond. Historic data gathered since 1991 has been used to provide evidence to develop robust asset performance forecasts and so to determine a long term plan, based on models run over 25 years. Recognising that different asset types have particular asset lives and failure rates, we have determined the best combination of replacement and maintenance for each group asset to ensure that our investment in our assets is effective and efficient.

We have determined the specific risks associated with different groupings of assets, for example, pipes are considered in a different way to motors as the mode and the consequences of failure are very different. This has then compared probability and consequence of failure for each of the individual assets and assessed the best option to maintain service levels to achieve our Outcomes commitments.

- Investment in assets is determined by reviewing historic performance, investment amounts and techniques, and using this information to predict the optimal level and type of expenditure to maintain stable levels of service
- this approach using Pioneer modelling software, based on the UKWIR Common Framework, has been in place within our company 2002 and significant improvements to the model have been made during this planning cycle. Key advantages of the approach are as follows:
  - In keeping with best practice in asset management investment planning
  - focused on the provision of service to customers and the environment
  - risk-based and forward-looking
  - founded on the principles of the Common Framework
  - able to identify an optimal set of interventions to meet a chosen objective

- provides an improved understanding of future serviceability risk.

The combination of a risk based deterioration Pioneer model with our Unit Cost Database (UCDB), allows for accurate costing of asset interventions. The UCDB, which is regularly reviewed and updated, has been constructed using costs derived from a combination of historical company costs, preferred supplier data and standard price book information.

Water Treatment Works

Capital maintenance at treatment works is planned in line with the deterioration modelling as described above. While the modelling takes into account a wide range of information in the overall assessment, the company's risk management approach also feeds in to the capital maintenance process. A comprehensive review of information about recent water quality incidents, breaches of standards and the number of consumer complaints all feed into the company's asset management strategy as well as from site operators, water quality monitoring, water quality audits, alarms each site will be used along with site visits to verify the investment needs at a treatment works site. This ensures that the risk of future non-compliance with the statutory water quality standards and a greater likelihood of a deterioration in the aesthetic quality of drinking water (as measured by consumer contacts reporting discolouration or an objectionable taste or odour) is minimised.

Costs for maintenance of treatment works are included within the capital maintenance budget.

The increasing investment in on online monitoring offers significant benefits for the reliable operation of treatment works, however the greater complexity of these monitors and reduced lifetime presents a potential challenge, especially in light of the expectations in terms of demonstration of performance. It is anticipated that there will be an increase in costs with regard to the maintenance and ongoing replacement of these monitors, however we will work with manufacturers and across the industry to minimise the impact of this on the company.

The company is considering resilience across all areas of the business operation. At a catchment level we are seeking to improve raw water quality and ultimately reduce the treatment need through co-ordinated delivery of catchment management with key stakeholders. We are also targeting strategic investment at our treatment works and in the distribution network to improve the company's response to a number of identified resilience issues, including single sources of supply, drought and metaldehyde.

It is not anticipated this will lead to any significant net increase in costs that will qualify for specific business plan proposals at PR19.

We propose to complete asset replacement and refurbishment at 69 treatment works and 151 pumping stations during 2020 to2025 period, see Appendix 11, Our Investment Plan for further details. In addition, we plan to replace GAC at ten of our 13 treatment works.

Service Reservoirs

Integrity of service reservoir vessels forms a fundamental part of the security of the water supply chain. Significant investment is included within the company's capital maintenance budget for reservoir inspections and maintenance.

Across the company area, the age profile of service reservoirs is regularly reviewed along with the internal and external structure through a robust reservoir inspection programme. With a small number of assets dating back to the early 1900's, the ability to repair and maintain these vessels becomes more challenging over time.

It is recognised within the WRMP that an increasing demand will be placed upon the company's assets and infrastructure. In addition to the investment outlined within the WRMP, the company is investing in new technologies, such as flow cytometry, which will help to improve understanding of the challenges and optimise the remedial programme.

A coordinated plan to consolidate and replace ageing reservoir infrastructure has been developed within the company and will continue over the period 2020-2045 with an estimated cost of £10m. These costs form part of the company's capital maintenance programme over this period.

We plan to inspection 322 (out of 365) vessels and build three new reservoirs during the AMP7 (2020-2025) period, see Appendix 11, section 8.3.6 for further details.

2.3.6 Water Distribution

Capital replacement of the mains network is planned in line with the deterioration modelling as described above. The modelling takes into account a wide range of information in the overall assessment, including the age and composition of the main, burst rate and WQ contacts received in the area. Costs for mains replacement are included within the capital maintenance budget.

We plan to continue to flush 10 per cent of our network each year (1400km) and as well as renew approximately 226km mains, during the 2020-2025 period, see Appendix 11 Our Investment Plan, for further details.

Network Resilience

As part of our overall resilience strategy within the WRMP, the company is investing to improve network connectivity to address multiple resilience issues including drought, metaldehyde and single source of supply see Appendix 9 – Resilience in the round for further details. The options chosen for investigation were all subject to a water quality assessment to ensure that they would not represent a deterioration in the quality of the source water and that they will also contribute to water quality resilience,

One of the key resilience risks highlighted during the 2020-25 resilience assessment is customers on a single source of supply. Should there be an issue in that area, customers will lose supply and may have an extended event if rezoning is not possible. We propose a number of schemes for delivery between 2020 and 2030 to lay additional strategic mains into these areas to provide more resilience to customers. This will require approximately 45km of new main to be laid through six key schemes throughout the company area.

Relining Lifetime

The company had a significant relining programme, under Section 19 undertakings (DWI ref SE034), with over 1000km of relining / replacement delivered between the late 1990's and 2008. At the time of this work, relining was viewed as a cost effective alternative to the largescale replacement of unlined iron pipes and satisfactorily addressed the consumer issues experienced. It was acknowledged at the time that this remediation did not extend the structural life of the pipes. The lifetime of the epoxy lining applied to the mains was not fully known at the time of application with worst case estimates in the order of 20 years.

Having reached 20 years since the earliest relining was completed, the company have identified the potential risks posed by a deterioration in the quality of this lining.

The ongoing monitoring of sample results and customer contact data forms a key part of the company's discolouration management strategy. This data is assessed across the whole supply network to identify any hot spot areas at a water supply zone (WSZ) or district metered area (DMA) level for further action. Where flushing or SeaQuest dosing are not satisfactory in addressing identified issues, the structural integrity of the pipe and any associated lining will be assessed. This information feeds into the below ground investment programme along with areas identified through deterioration modelling. Costs for mains investigation and rehabilitation / replacement are included within the capital maintenance allocation in the business plan.

2.3.7 Consumer Acceptability

The company introduced a discolouration management strategy to reduce the number of customer contacts received, improve satisfaction and reduce iron and manganese concentrations in the distribution system. The strategy covers a number of areas including:

- Continual review of customer contacts to identify WSZs with persistent problems.
- enhanced operational sampling to gain understanding of metals concentrations within WSZs
- use of online water quality monitors, installed in strategic locations, to gain real time understanding of sediment movement and pressure changes in the system.

The above information, coupled with other factors including planned work and burst history is used to develop a discolouration action plan to implement across the business. Two key actions are currently being taken as part of this work:

1. The development of an annual systematic flushing programme covering approximately 1400 km, or 10%, of the company's mains network to remove historic deposits
2. installation of SeaQuest dosing at key water treatment works where elevated customer contacts without distinct hotspots have been identified in the downstream supply system. SeaQuest is an approved chemical, dosed into the water supply system which inhibits corrosion of water mains and prevents discolouration of supplies at the customer tap.

In certain circumstances the mains distribution system is investigated to ascertain the mains condition. This is completed by evaluation of mains cut-outs or internal CCTV surveys. This enables the company to make key decisions on long-term mitigation such as mains replacement or rehabilitation. Rehabilitation can be completed in a number of ways including, cleaning, relining or slip-lining of the existing main. The company is currently developing a toolkit to identify the best mitigation strategy for specific issues.

Alongside the above work a number of other improvements in the working methodology in distribution system have been implemented including:

- Calm valve operation scheme which ensures any changes to the distribution system as gradual and the effects of valve operation are minimised
- introduction of winter and summer settings at treatment works for chlorine residuals to improve the company's taste and odour performance

- regular flushing of certain locations where deposits are known to accumulate historically such as dead-ends and hydraulic null-points

All this activity relates directly to the customer expectation activity described in Section 2.1

2.3.8 Lead

Lead is not present in the water within the company's water supply network. Prior to 1970, many small water pipes were made from lead. Although lead pipes have not been permitted for over four decades, in older properties it remains possible that part, or all, of the underground service pipe and some internal plumbing may be made from lead.

Lead represents a health risk, due to its potential to bio-accumulate within the body. It presents a particular risk to mental development in infants and children and may also be factor in behavioural problems. Worldwide it is recommended that human exposure to lead is kept to a minimum and lead is therefore controlled in air, soil, food and water.

We implement a risk based strategy to minimise the amount of lead found within its supply area, which is kept under constant review. The key areas of focus are as follows:

1. Identification of high, medium and low risk zones

We have an enhanced sampling programme at customer properties to monitor lead concentrations. Sample results are incorporated into South East Water's DWSP and regularly reviewed to confirm each water supply zones risk status. Currently no zones are classified as at high risk for elevated lead concentrations.

2. continuation of, and if necessary further enhancement to plumbosolvency control measures

We dose orthophosphoric acid at 26 treatment works throughout the region to control plumbosolvency and minimise the lead at the customer tap, benefiting a population of over 700,000 customers. The effectiveness of this dosing is regularly reviewed to ensure it is fully optimised and adjustments are made where required.

We have not identified any areas which would benefit from additional dosing to control plumbosolvency.

3. replacement of lead communications pipes where the standard is not met, and consideration of the benefits of replacement of the customer service pipe.

Customer tap samples may be taken in accordance with the Water Quality Regulations, at the customer's request or in accordance with our enhanced monitoring programme. If any failure occurs through these sampling programmes South East Water will complete a detailed investigation. This investigation including a Water Fittings Inspection at all properties where lead concentrations at the customer tap are detected above the standard, to identify the cause of the lead exceedance.

We replace all lead communications pipes which are found during the Water Fittings Regulations inspections and will advise the customers of all necessary actions which should be taken, including the replacement of any other lead pipe work which is found.

Following the completion of work on a property to remove lead pipe work we take additional samples to confirm the effectiveness of the remedial works. In some instances additional work may be required (e.g. removal of lead solder) to achieve full compliance.

4. consideration of the benefits of opportunistic lead communications and service pipe replacement (e.g. in association with the installation of meters)

We are currently completing a compulsory metering programme throughout its area. If any lead communication pipework is found during the installation of a meter it will be replaced. The customer will also be provided with appropriate advice.

In addition, if lead communication pipework is determined through other planned or reactive work, this pipe work would also be replaced.

5. Work with Local Authorities to identify vulnerable customers and identify appropriate solutions e.g. when refurbishment work is completed in local authority housing

We are planning to develop and expand its communication and education regarding the risks associated with lead in association with the Local Authorities.

6. Work with health protection teams to identify vulnerable customers and identify appropriate solutions, e.g. schools and nurseries

We are currently completing Water Fittings Regulations inspections at all schools throughout its supply area. If any lead pipework is determined during these inspections we put in place appropriate action plans and monitoring to ensure completion.

We will continue to develop and expand its communication and education regarding the risks associated with lead in association with the health protection teams.

7. Have in place a communication and education strategy to make consumers, and other stakeholders, aware of the risk of lead in tap water, what can be done to mitigate the risk and who has responsibility for the lead pipe work

Information may be found on our website regarding the risk associated with lead pipework and appropriate mitigating actions. Information is also available on the website regarding customer responsibility for service pipework. All customers are entitled to a free sample to determine lead concentrations in their drinking water on request.

We are fully supportive and engaged with industry wide awareness campaigns through Water UK and the Water Regulations Advisory Service (WRAS).

We will continue to develop and expand its communication and education regarding the risks associated with lead.

The company has an aspiration to be lead free on the company side within 25 years (estimated costs of £0.5 million per year) and on customer side by 2070. Cost estimates for this work are in line with those for replacement of communication pipes, however the mechanisms for achieving lead removal on the customer side are still under discussion but include adoption and replacement of supply pipe or potential for relining.

Phosphate dosing would be switched off once the company had demonstrated removal of all lead on both the company and customer side within a water supply zone.

2.3.9 Radioactivity

We have carried out catchment risk assessments, taking into account the geology and any artificial sources that could lead to an increase in natural background levels of radioactivity utilising data obtained from the Environment Agency to verify the results of monitoring undertaken.

No radioactivity has been detected in any of our supply sources, and the catchment risk assessment confirms that it is unlikely to be detected, as a consequence the company have applied for and been granted a waiver under Regulation 6(12) from monitoring for indicative dose (ID), tritium and radon is not required.

We will continue to review risk assessments when new information comes to light and operational monitoring at a low frequency will be continued.

2.3.10 Drinking Water Directive Revision.

During 2018 a draft EU Drinking Water Directive was issued for consultation. The main areas of focus are detailed below with detail on any potential impact, which are currently being assessed.

- Tighter standard for lead (5µg/l) based on new evidence regarding health risks, see section 2.3.8 for further detail
- tighter standard for Chromium (25µg/l), this is unlikely to have any significant impact to our company
- inclusion of additional parameters (e.g. endocrine disruptors, coliphages and chlorate), there may be some impact on operating practices at treatment works
- increased frequency of sampling in certain locations, with a minor impact
- reduction in the turbidity standard from 4 NTU to 1 NTU at customer properties
- turbidity at treatment works, 0.3 NTU 95%ile and not >0.5 NTU for 15 consecutive minutes, there may be some impact on operating practices at treatment works
- inclusion of DWSP as a Directive requirement, this has no impact to our company

2.4 Measuring Water Quality Performance 2020-25

Having assessed the customer and stakeholder preferences, the risk and the need for a consideration of all elements of compliance we have developed a suite of performance commitments to ensure we deliver on these priorities.

2.4.1 Compliance Risk Index (CRI)

A new drinking water quality measure was required to replace the current Mean Zonal Compliance Index for a number of reasons, including those provisions in the Water Supply (Water Quality) Regulations 2016 (as amended) that will allow companies to move away from the current monitoring programme (based on sample numbers) to a risk based monitoring methodology to assess compliance.

The new Compliance Risk Index (CRI) calculates the risk associated with all failures to meet the prescribed values within the Regulations in terms of potential health risk, population affected and a DWI assessment of the company's actions to the failure. CRI considers the risk posed by all failures at the company's water treatment works and service reservoirs as well as failures at the customer tap. In comparison with MZC which considered a selection of the parameters tested at the customer's tap only.

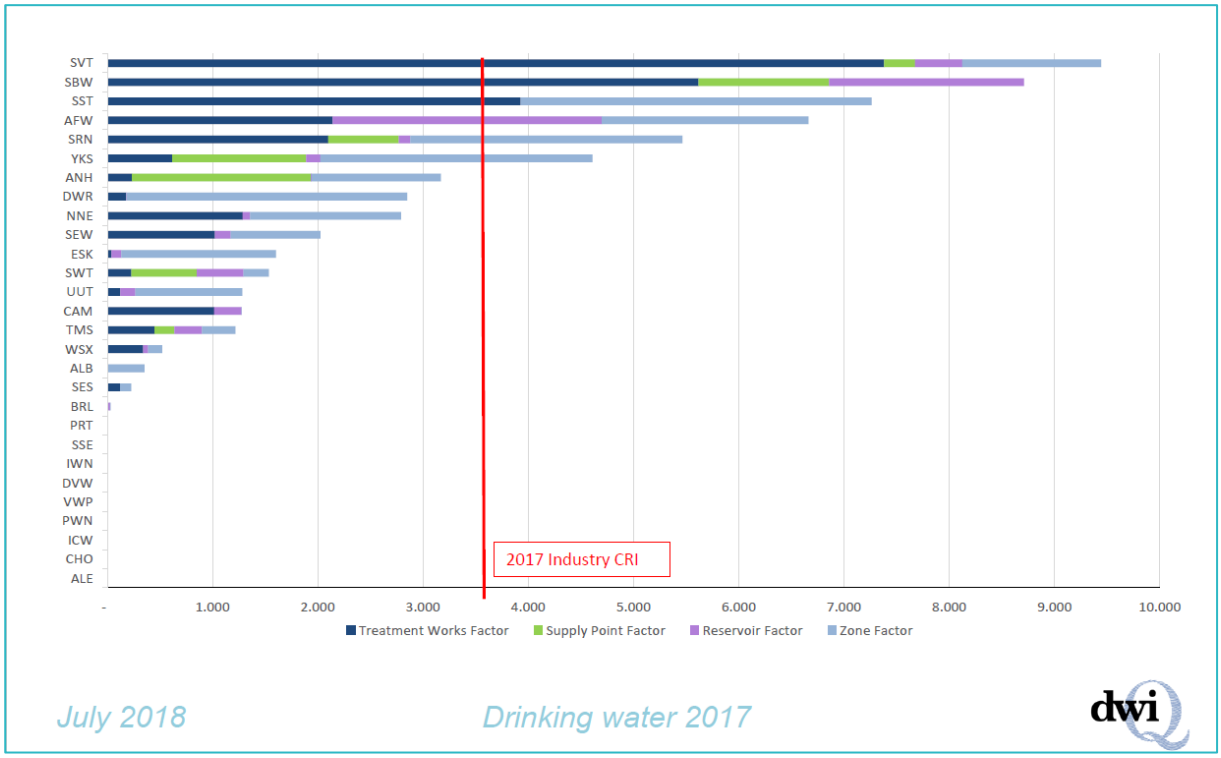
The calculation of CRI is as per the DWIs documented methodology:

http://www.dwi.gov.uk/stakeholders/price-review-process/CRI_Def.pdf

The inclusion of a DWI assessment of the company's actions in response to each failure as a multiplier within the risk assessment scoring calculation adds a subjective element to the risk calculation.

Published performance for CRI in 2017, as per DWI Chief Inspector's Report is shown in Figure 6.

Figure 6: Industry CRI Performance 2017



The metric is made up of three components:

- A parameter score, with a focus on health based impact
- the DWI assessment of the failure / response
- the volume / population affected

This measure replaces the mean zonal compliance performance commitment and also the above ground asset performance assessment in the current business plan period.

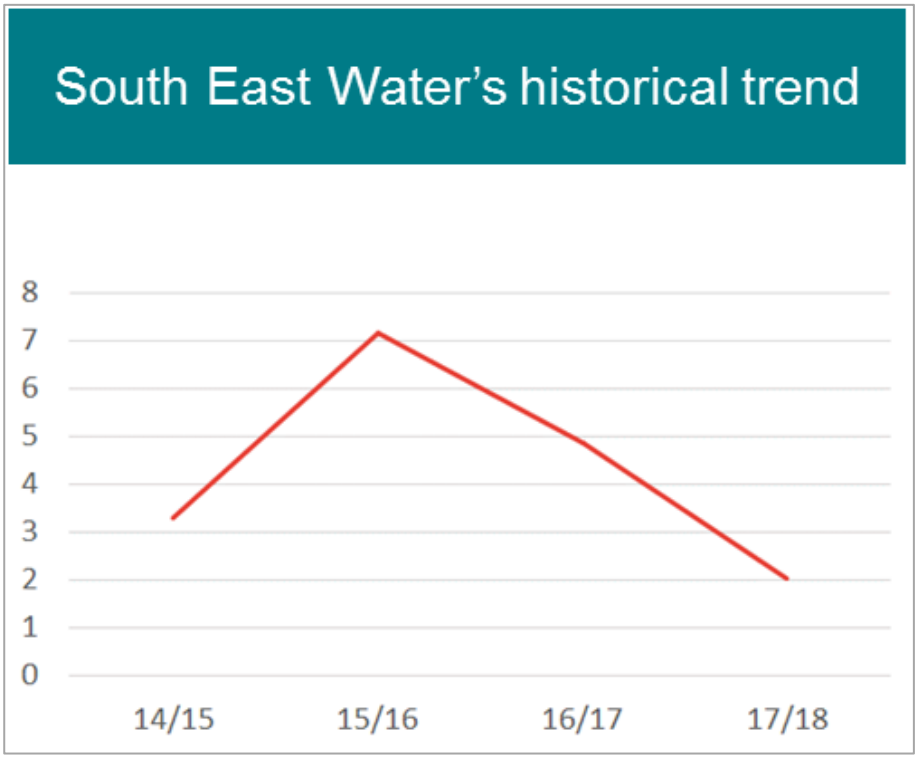
Within the DWIs response to Ofwat's methodology consultation "Delivering Water 2020: Consulting on our methodology for the 2019 price review" they set the following expectations regarding CRI:

> *'For CRI, as with MZC, we would propose a penalty only ODI. As every compliance failure (or event) represents a failure of the*

company to meet their statutory obligations it is not appropriate to offer rewards. As such, in terms of a target, companies should aim for CRI (and ERI) scores of zero and thus aspire to continuous improvement and results of at least at a level that is equal to or below the national average.'

CRI is an immature measure and as shown in the plot below, there is a significant amount of volatility in results year on year which makes it difficult to accurately predict and measure performance. Our CRI performance over the period 2014-2017 is shown in Figure 7, with an average value of 4.34.

Figure 7: South East Water historic CRI trend

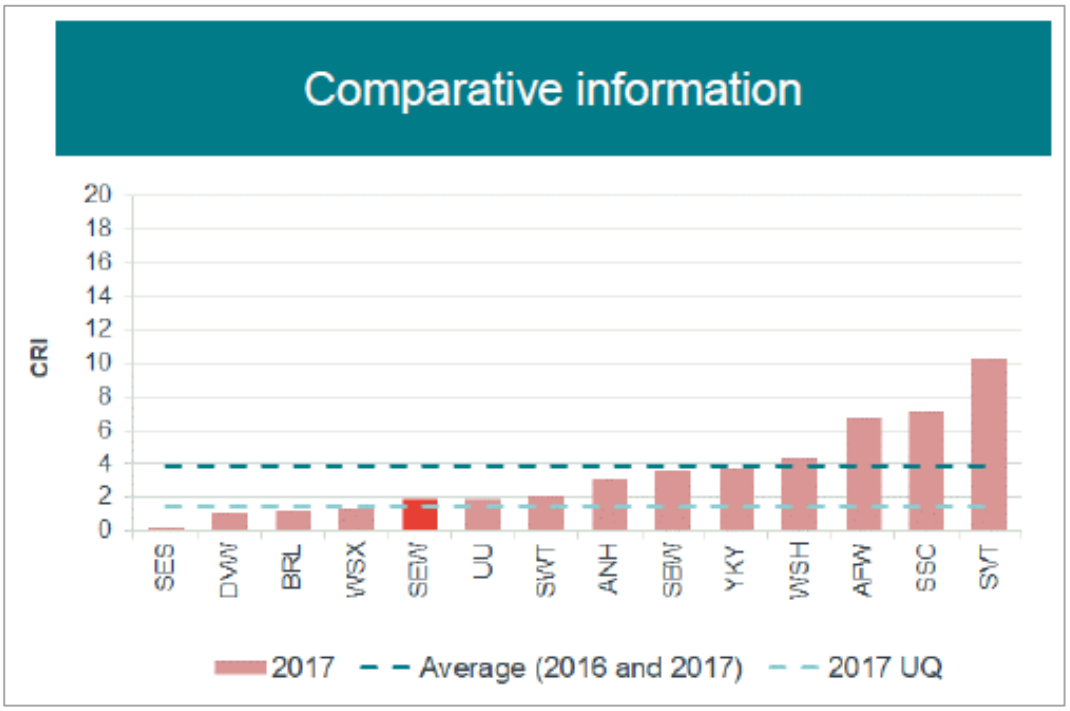


In line with the expectations of the DWI and that we always strive for 100 per cent compliance on water quality, so the PC level for CRI is set at zero and we propose to set the performance dead band at 3.7 for each year of the period 2020-25, based on the industry average of performance across 2016 and 2017. This meets both the criteria of continuous performance and outperforming the industry average.

Figure 8 shows industry data for 14 companies in 2017 against the proposed ODI value of 3.7. The upper quartile performance is also shown on this plot. It should be noted that this information is based on company derived scores and therefore includes an estimate of the DWI assessment for some failures and may not wholly represent the final industry position.

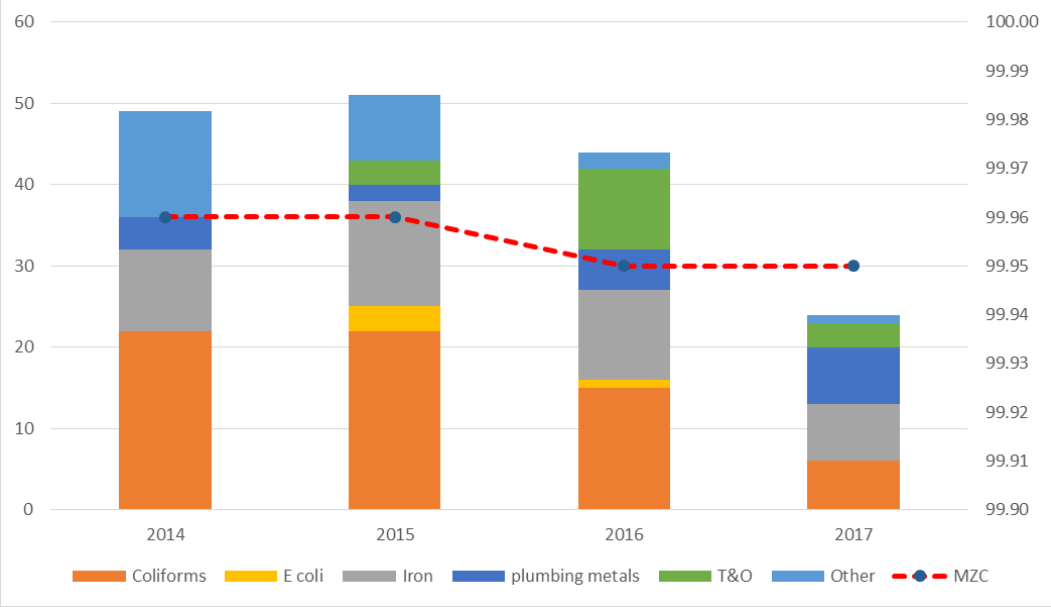
We are currently performing well in this measure.

Figure 8: 2017 CRI data – industry data share



CRI is only relevant to the water industry, there are no non water industry benchmarks for this measure. As the measure has replaced MZC, it is legitimate to compare performance across the two measures. Mean Zonal Compliance vs total number of failures at customer tap is shown in Figure 9.

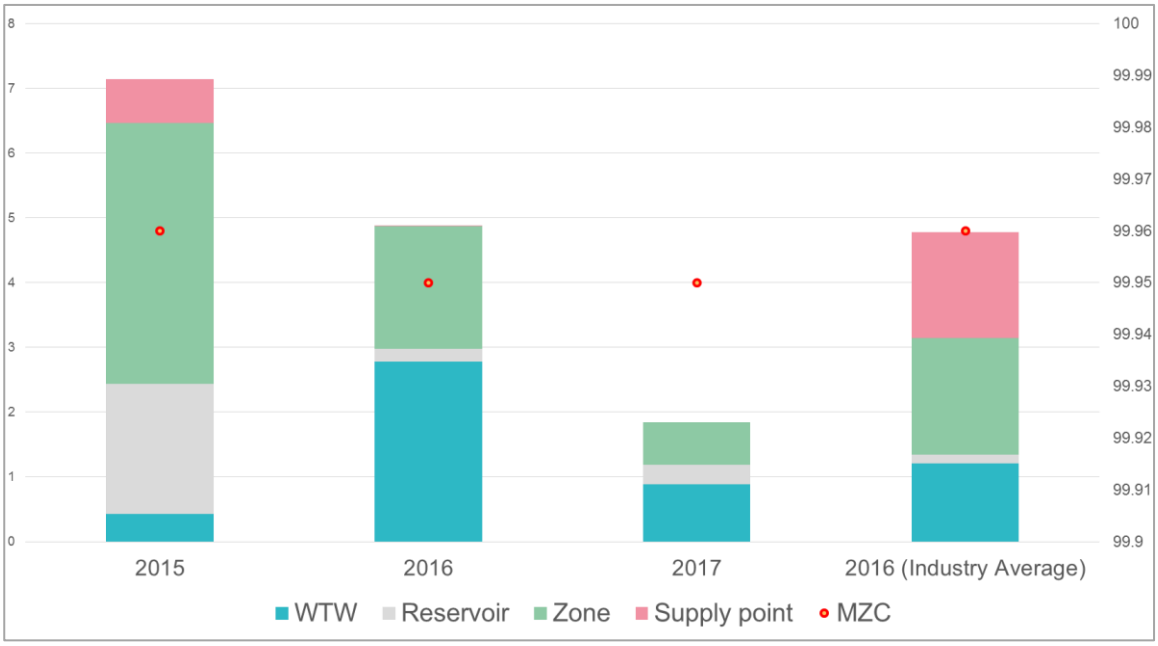
Figure 9: MZC vs CRI 2014-17 – sample failure numbers



There were 24 samples taken from customer's taps in 2017 that failed to meet standards, which represents a significant improvement on the previous three years which saw an annual average of 48 sample failures. The greatest improvement has been seen for total coliforms and iron. Total coliform failures dropped from an average of 20 per year to 6 in 2017, as a result of improvements at treatment works and disinfection techniques at the customer property. Iron failures have dropped from an average of 11 per year to 7 in 2017 as a result of the sequential flushing and SeaQuest installations which form part of the Company's discolouration management strategy. Despite the reduction in the number of failures, the MZC remains low as a result of the low sampling frequency for a third of all failures, which increases the relative impact of each failure.

When CRI is looked at in comparison, there is a commensurate reduction in CRI score as a direct consequence of this reduction in the number of failures, as shown in Figure 10.

Figure 10: CRI score vs MZC 2015-2017



The measures identified to achieve the target for CRI form the key part of our overall water quality approach:

- Drinking Water Safety Plan approach to assessing all risks within the company area source to tap (continuation and improvement of current approach)
- targeted treatment works investment programme, prioritising WQ
- online monitoring at all treatment works with alarm and shut down for critical parameters
- risk based maintenance regime for WQ monitors
- catchment investigation and management to reduce catchment risks and minimise hazards at treatment works
- comprehensive operational sampling regime, significantly over and above monitoring required for regulatory self-reporting purposes to identify and monitor potential hazards in our catchments and ensure that treatment works are performing satisfactorily against these challenges
- risk based cleaning and inspection programme for all treatment works and vessels
- a programme of Water Treatment Works and Service Reservoir audits which feeds directly into our capital maintenance / investment programme
- deterioration modelling which informs the capital maintenance programme is optimised to minimise water quality risk.

2.4.2 Event Risk Index (ERI)

The Event Risk Index (ERI) is a new measure, introduced by the DWI in 2017 to illustrate the risks arising from water quality events, in line with their risk based approach to regulation. Like CRI, the measure assigns a value to the significance of an event, the number of consumers that are potentially affected, the event duration and also an assessment of the company's response.

The calculation of ERI is as per the DWIs documented methodology:

http://www.dwi.gov.uk/stakeholders/price-review-process/ERI_def.pdf

The inclusion of a DWI assessment of the company's actions in response to each failure as a multiplier within the risk assessment scoring calculation adds a subjective element to the risk calculation. Historic evidence points to an inconsistency within the DWI with regard to the assessment of failures between different Inspectors and across different companies. This highlights the need for a positive working relationship with the DWI at a company and industry level to improve this element of consistency.

There is limited data published to date on ERI, with individual companies having received their own ERI scores and an industry average position as shown in Table 3:

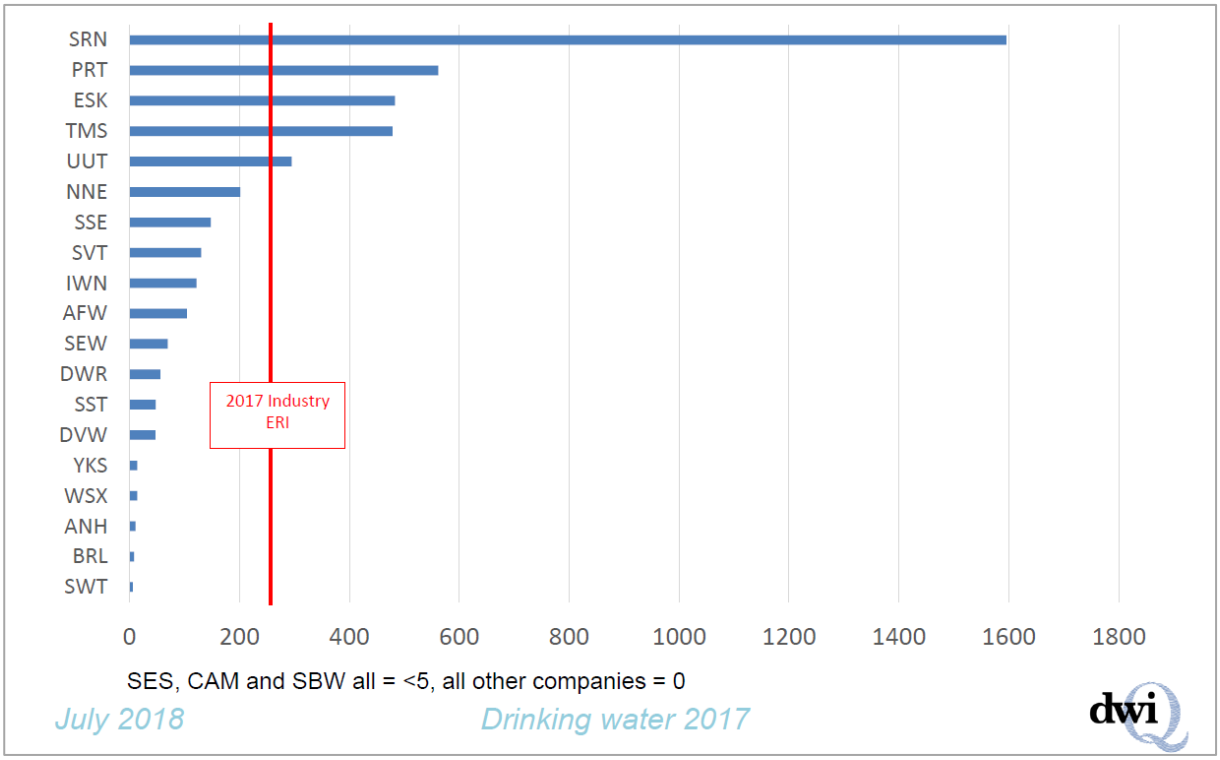
Table 3: ERI scores 2015-16

Company	2015/16	2016/17	2017/18	Average
South East Water	148.9	11.5	69.2	76.5
Industry average	209.4	225.2	201.0	211.9

DWI have indicated that the individual company and industry average scores for this measure are still subject to change and 2017 data will not be confirmed until April 2019.

At the launch of the 2017 Chief Inspector's report, on 19th July 2017, industry data on ERI was presented, as shown in Figure 11.

Figure 11: Industry ERI Performance 2017



Within the DWIs response to Ofwat's methodology consultation "Delivering Water 2020: Consulting on our methodology for the 2019 price review" they set the following expectations regarding ERI:

> *'For CRI, as with MZC, we would propose a penalty only ODI. As every compliance failure (or event) represents a failure of the company to meet their statutory obligations it is not appropriate to offer rewards. As such, in terms of a target, companies should aim for CRI (and ERI) scores of zero and thus aspire to continuous improvement and results of at least at a level that is equal to or below the national average.'*

ERI is an immature measure and as shown in Table 5 and Figure 11, there is a significant amount of volatility in results year on year which makes it difficult to accurately predict and measure performance. South East Water average ERI performance over the period 2016-2017 was 76.5.

In line with the expectations of the DWI while we are aiming for an ERI score of zero, we propose to set the performance dead band at 212 for each year of AMP7, the industry average of performance across 2016 and 2017. This meets both the criteria of continuous performance improvement and outperforming the industry average.

2.4.3 Appearance Contacts

Appearance of drinking water is a key priority for customers and as such needs to be included within our suite of performance commitments.

During the current business plan period there are a number of different metrics in use across the industry with regard to the quality of the water supplied, ranging from contact rate for discolouration (black, brown and orange) to all contacts received reporting appearance, taste and odour and illness.

For the period 2020-25, the approach has been standardised across the industry to record the number of times companies were contacted by customers about the appearance of their tap water (per 1000 people supplied). Contacts are recorded in line with the definition as in DWI information letter 1/2006 dated 6 January 2006:

http://dwi.defra.gov.uk/stakeholders/information-letters/2006/01_2006.pdf

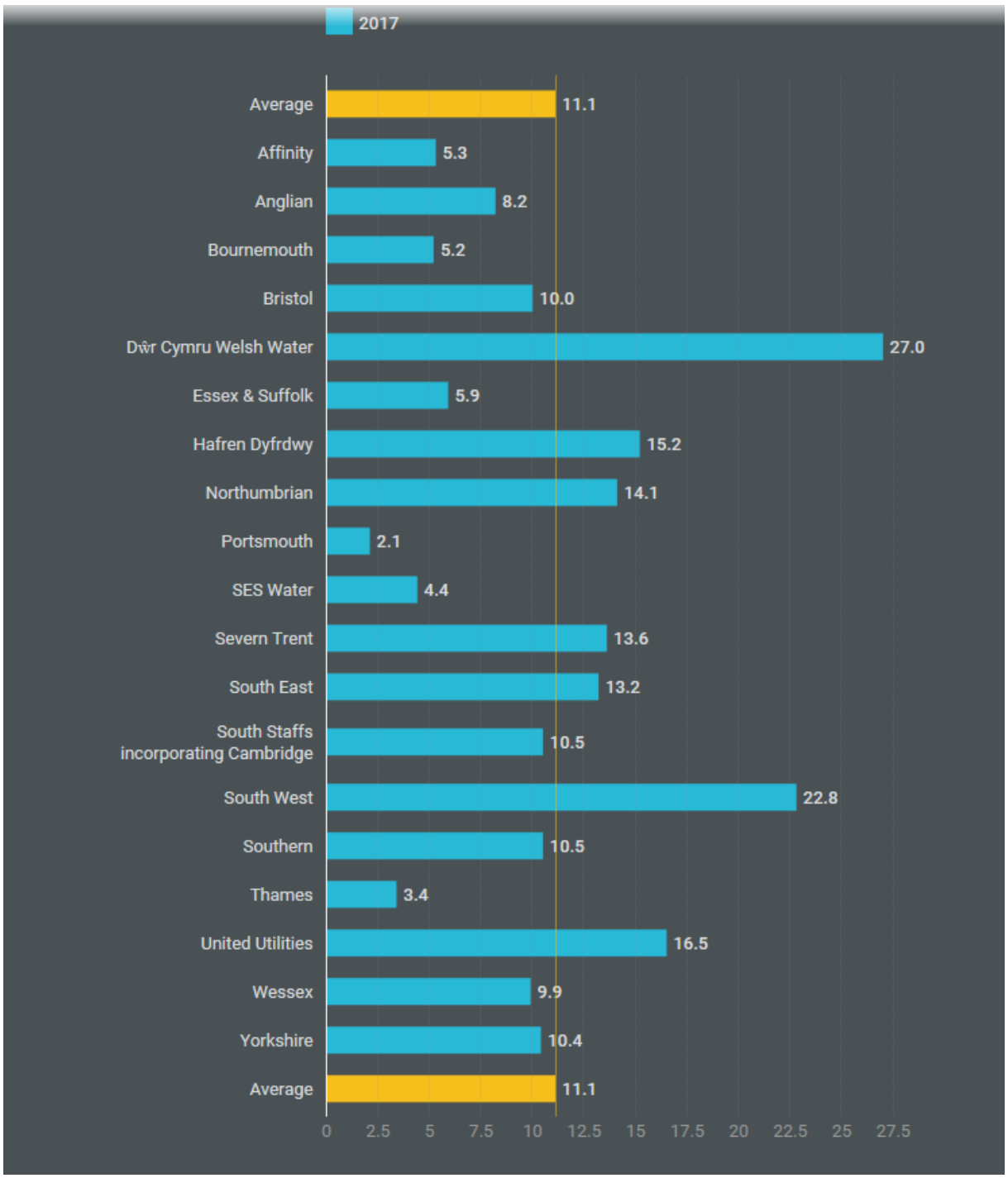
Performance for the industry for the calendar year 2017 is shown in Figure 11.

We are currently performing in line with industry average for discolouration contacts, as a result of the significant work within the current business plan period. As shown in Figure 12, we are above industry average for appearance measure.

The appearance target for the business plan period 2020-25 is based on the recent successes delivering significant reductions in the discolouration contact rate. There is an acknowledgement that to work to date has produced significant benefits, but that these cannot be extrapolated in a linear manner from 2020 to 2025, given the unique challenges we face, outlined in section 1.1.2.

It is clear from our customer research, across all attitudinal segments, that the delivery of clean drinking water is viewed as a priority by all of our customers. From the quantitative willingness to pay survey, it was clear that customers expected to have clear drinking water at all times as part of their base level of service, the Supercharge willingness to pay survey ranked discoloured water 4th out of the 9 elements considered in terms of priority. We have included appearance contacts as one of our bespoke performance commitments on the basis of this priority, in order to demonstrate our commitment and ongoing performance in this area of fundamental importance to all of our customers.

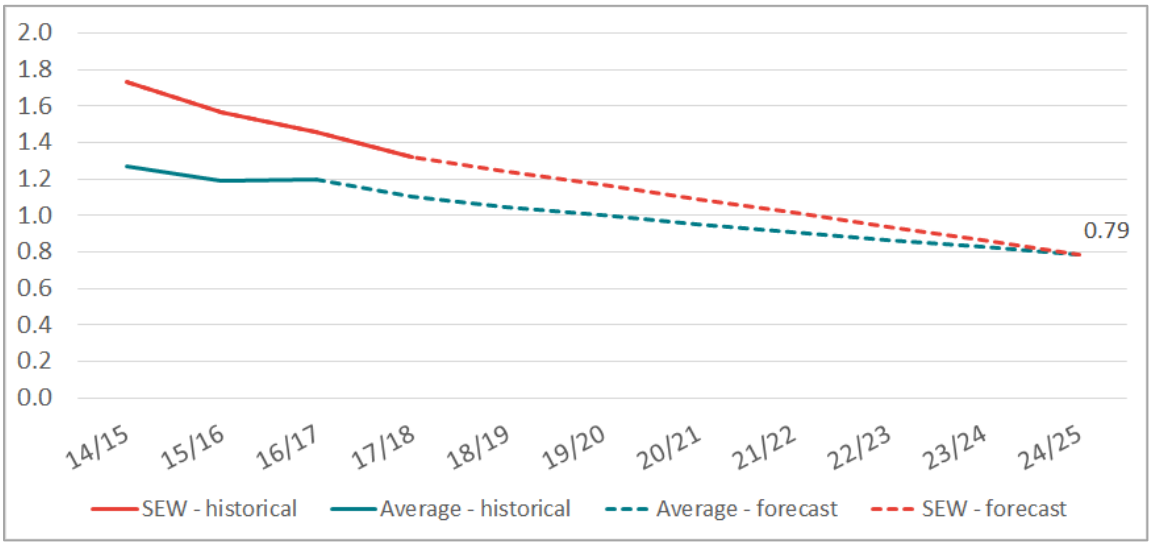
Figure 11: Number of times companies were contacted by customers about the appearance of their tap water in 2017 (per 10,000 people supplied)



We have reviewed comparative and historical information, reflecting min/max levels, and cross-checked this using expert judgement.

We propose to set the PC at the forecast industry average for 2024/25 (0.79) and we propose to have a projection to that level from our current performance levels, as shown in Figure 12.

Figure 12: Appearance performance commitment 2020-25



We have cross-checked this level against our CBA, which suggests this level is not cost-beneficial.

Our PC levels for 2020 to 2025 are shown in the text below. We will achieve our ambition of the forecast industry average by the end of the period, with improvement during the period to get to that ambition.

PC level	2020/21	2021/22	2022/23	2023/24	2024/25
Appearance of water – number of contacts per 1,000 customers supplied	1.09	1.02	0.94	0.86	0.79

Overall, we have set our PC levels in-line with the forecast industry average. This is a stretching PC for us, as we will need to deliver materially higher levels of improvement than we have in the past, and an overall change of around 40 per cent by 2024/25. This will position us below the cost beneficial level. We have proposed this stretching PC level as a result of its importance to our customers, and, based on the comparative industry information available.

Our long-term aim for PC levels in the future is shown in Appendix 1, Performance commitments and outcome delivery incentives. Our aim is to continue delivering improvements so that by 2040 we have a performance level of 0.5 contacts per 1,000 population, this represent a stretching targets as it is a 40.3 per cent reduction over 5

years and a 65.7 per cent reduction to 2040. We have set out our long-term forecasts so that we deliver an annual average improvement of around 3 per cent. This is our expert view of what is stretching but achievable in future.

When considering the possibility of a target that seeks to go further than a forecast of future average there are a number of highly relevant considerations, the main one being companies that exhibit upper quartile contact rates typically have raw water quality that poses considerably less of a challenge to treat i.e. the geology in their areas gives a natural advantage, than others (see section 1.1.2 for further details). We believe the target we have set in effect will put us at or close to the upper quartile position of companies that have similar treatment challenges to us.

We propose that this measure has rewards and penalties attached to it.

This measure is included within Ofwat's long list of asset health performance commitments and replaces the discolouration contacts performance commitment in our 2015 to 2020 business plan.

The company has a bespoke strategy to deliver improvements in discolouration, the key activities within this strategy are as follows:

- Drinking Water Safety Plan approach to assessing all risks within the company area Source to tap (continuation and improvement of current approach)
- targeted treatment works investment programme
- comprehensive operational sampling regime to identify and monitor potential hazards in our catchments and ensure that treatment works are performing satisfactorily against these challenges
- a programme of Water Treatment Works and Service Reservoir audits which feeds directly into our capital maintenance / investment programme
- deterioration modelling which informs the capital maintenance programme is optimised to minimise water quality risk
- method statement review – improving planned works
- innovative treatment solutions (SeaQuest)
- targeted treatment works investment programme
- flushing plan >10% of network per annum
- adoption of innovative techniques for trunk main renovation
- smart network monitoring programme
- customer engagement through website, outgoing messaging service (UMS), social media and magazine
- calm valve operations
- online monitoring at all treatment works with alarm and shut down for critical parameters

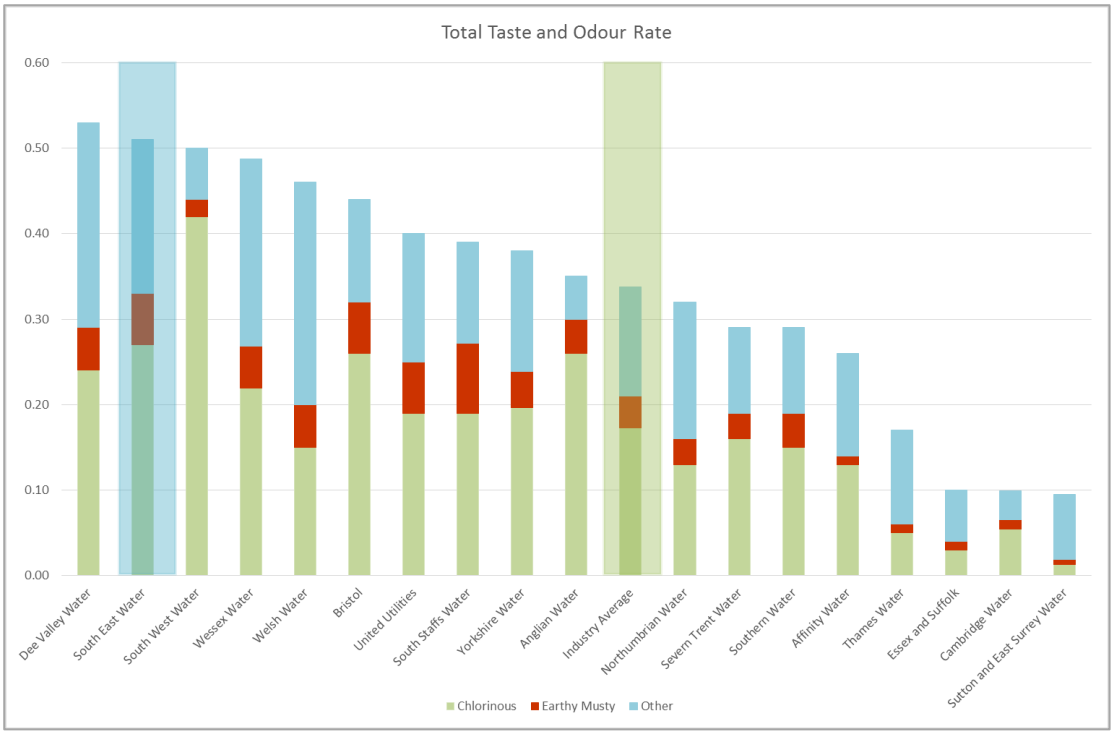
- risk based maintenance regime for WQ monitors
- risk based cleaning and inspection programme for all treatment works and vessels.

2.4.4 Taste and Odour Contacts

It is clear from our customer research, across all attitudinal segments that the taste and odour of the water we supply is of paramount importance to our stakeholders and customers, along with the delivery of a clean reliable drinking water supply. From the quantitative willingness to pay survey, it was clear that customers expected the taste and odour of their drinking water to be satisfactory at all times as part of their base level of service, the Supercharge willingness to pay survey ranked taste and smell third out of the nine elements considered in terms of priority. We have included this measure of taste and odour contact rate within our bespoke performance commitments to ensure that our business plan reflects the importance that our customers place on this measure. This measure ensures that we will continue to demonstrate our commitment and ongoing performance in this area which is of fundamental importance to all of our customers.

Industry contact rates regarding taste and odour are shown in Figure 13 for 2017.

Figure 13: 2017 Industry contact rates concerning taste and odour



The rate of taste and odour contacts received at a company and industry level has remained relatively stable over the past ten years. Taste and odour is a very

subjective parameter and customer perceptions can vary considerably and these perception can be hard to alter. Significant changes to operation and treatment of treatment works made over recent years have resulted in only marginal improvements in performance.

Disinfection is the most fundamental part of the water treatment process, to ensure that all microorganisms present within the raw water are rendered harmless.

Most companies use free chlorine as a primary disinfectant and while this acts as a very effective disinfectant, it can dissipate as water passes through the distribution network and as a consequence additional chlorine dosing at service reservoirs is required in some systems to achieve a chlorine residual at the customer's tap.

We have a number of large distributions systems with multiple treatment works inputs and chlorination dosing in place to ensure that all the quality of all water supplied is protected to the customer's tap.

While the addition of chlorine is fundamental to the disinfection process and it is essential to maintain a residual presence of chlorine in the distribution system right up to the customer's tap, the presence of chlorine is also the single biggest contributor to customer contacts of taste and odour within almost all companies.

An alternative approach to disinfection is to use chloramine as a disinfectant. Chloramine is an odourless chemical compound which is formed by the addition of chlorine and ammonia. Chloramine is a less powerful disinfectant, but does persist throughout the distribution system. Where practised, chloramination must be carried out in a hydraulically discrete area or across the whole of a company's network, as the mixing of chloraminated and un-chloraminated waters can result in the formation of extremely unpleasant odours.

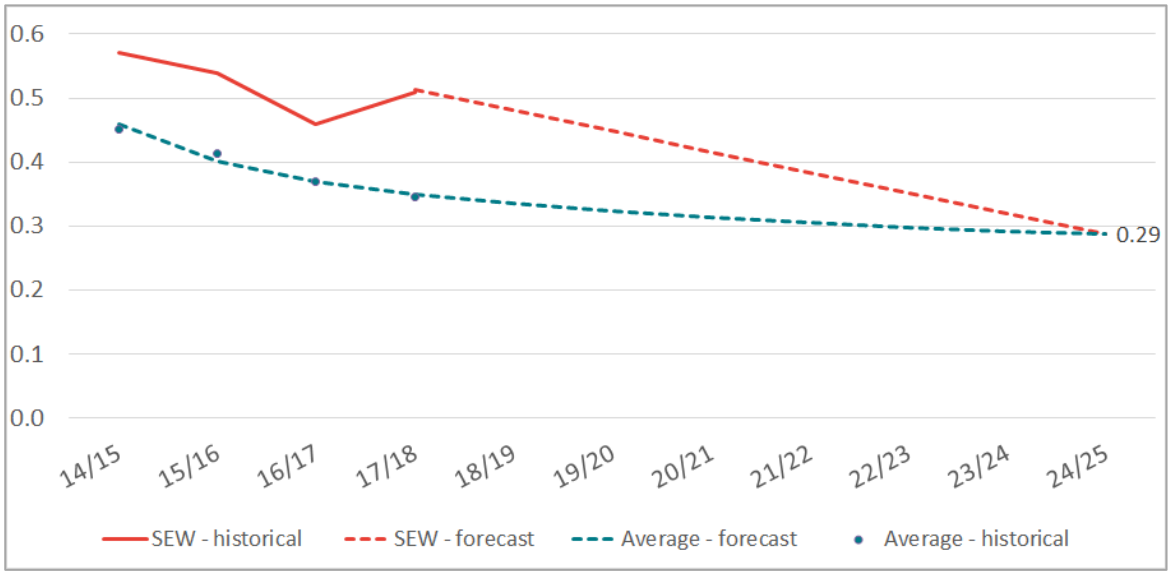
Chloramination is practiced across the whole supply area of the three best performing companies with respect to taste and across a significant percentage of the fourth best performing company. The performance of these three companies drives down the industry average significantly.

While the introduction of chloramination would undoubtedly bring a reduction in chlorine taste and odour contacts, the nature of our supply system and the interconnectivities between South East Water and neighbouring companies would require this to be done across the whole water supply network. The estimated cost of this would be a minimum capital cost of £40 million with >£1 million a year of increased operational expenditure. This additional expenditure is not supported by our customer's willingness to pay research.

Due to the scarce availability of raw water resources within our supply area, there is a need to transfer water from our larger, typically surface water works such as Barcombe Water Treatment Works (WTW) a significant distance across a rural environment to meet customer demand, leading to increased water age. To ensure that this water remains wholesome on this long journey to the customers at the ends of our distribution system additional chlorine dosing is needed ensure that the quality of all water supplied is protected to the customer's tap. As a consequence of our large, interlinked distribution systems, we have a need to add an amount of chlorine to the water which is above average for the industry to maintain water quality. This is reflected in the elevated level of customer contacts received relating to chlorine taste and odour and places us at a disadvantage to other companies with respect to this measure. Our mains investment strategy takes into account the requirements to minimise water age and balances this against the need to maintain a minimum of 24 hours storage. Where possible our investment looks to reduce water age and as a consequence reduce the chlorine requirements.

We propose to set the performance commitment at the forecast industry average for 2024/25 (0.29) and we propose to have a projection to that level from our current performance levels, as shown in Figure 14.

Figure 14: Taste and odour contact rate 2020-25 (per 10,000 customers)



The text below summarises our PC levels for 2020 to 2025. We will achieve our ambition of the forecast industry average by the end of the period, with improvement during the period to get to that ambition. We propose that our long-term target is set at 0.09 by 2040.

PC level	2020/21	2021/22	2022/23	2023/24	2024/25

Taste and odour – number of contacts per 1,000 customers supplied	0.42	0.38	0.35	0.32	0.29

In light of the challenges outlined above, our performance commitment is to achieve the industry average level of performance, from our current position which in effect places us at the upper quartile of companies that do not chloraminate.

This performance commitment sets a stretching target for us as we will need to deliver materially higher levels of improvement than we have in the past, and an overall change of around of 44 per cent over 5 years and 82 per cent to 2040.

We have reviewed comparative and historical information, reflecting min/max levels, and cross-checked this using expert judgement. We have also cross-checked this performance level against our CBA, which suggests this level is not cost-beneficial, but we propose to set a more stretching performance commitment level based on the comparative information, due to the importance of this measure to customers.

We propose that this measure has rewards and penalties attached to it.

Our long term vision is to safeguard and improve our scarce raw water resources, invest in new sustainable water supplies to meet growing demand, maintain and enhance the resilience of our existing water treatment and storage assets to cope with these increasing demands from a growing population and changing climate and to ensure that our supply network preserves the excellent quality of treated water throughout its journey to the consumer's tap.

We have a bespoke strategy to deliver improvements in taste and odour, the key activities within this strategy are as follows:

- Drinking Water Safety Plan approach to assessing all risks within the company area Source to tap (continuation and improvement of current approach)
- targeted treatment works investment programme
- introduction of winter and summer chlorine settings across all treatment works
- adoption of new technologies to improve and optimise chlorine control and dosing
- comprehensive operational sampling regime to identify and monitor potential hazards in our catchments and ensure that treatment works are performing satisfactorily against these challenges
- a programme of Water Treatment Works and Service Reservoir audits which feeds directly into our capital maintenance / investment programme

- adoption of innovative techniques for trunk main renovation
- smart network monitoring programme
  - In situ monitoring of chlorine in network
  - Improved water turnover
  - Optimal use of service reservoirs
- customer engagement through website, UMS, social media and magazine
- online monitoring at all treatment works with alarm and shut down for critical parameters
- risk based maintenance regime for WQ monitors
- risk based cleaning and inspection programme for all treatment works and vessels.

3. Delivering the Plan

3.1 Nitrate Treatment at Woodgarston Treatment Works

Our Woodgarston source abstracts water from two production boreholes in the Chalk aquifer The Woodgarston abstraction is at risk from nitrates. Water at this site is currently blended with water from West Ham treatment works to ensure compliance

Our investigations, completed as part of the WINEP, has shown that there is a link between abstraction rates, groundwater levels and nitrate concentrations. Source apportionment found significant nitrate loading from arable land use, both historical and current. The major contributor to nitrate loading in the Woodgarston catchment is from oil seed rape, wheat and temporary grassland.

Nitrate trend modelling was also undertaken for our investigation. This showed that nitrate concentrations in borehole 1 will continue to rise until 2030 and until 2040 in borehole 2. Post 2030/40 Nitrate trends will decline but will not significantly dip below the drinking water standard unless nitrate loading within the catchment could be reduced. With 50% reduction in nitrate loading within the catchment nitrates could reduce to below the drinking water standard in the future.

Our WINEP Options Appraisal identified that catchment measures would be beneficial, in the medium to long term but as a consequence of these deteriorating trends, a short to medium mitigation of nitrate treatment is required to safeguard water quality in addition to these identified catchment measures. West Ham treatment works catchment has been included within our WINEP for the period 2020-2025 for investigation with respect to deterioration in both nitrate and bacteriological parameters. Further detail on this work can be found within Appendix 10 – Environmental Resilience.

A study has been carried out to produce a deliverable solution to address rising nitrate concentrations in the raw water at Woodgarston Water Treatment Works (WTW) by 2022. In addition to catchment management approaches that we have been implementing to date and plan for further measures, a review of available end-of-pipe treatment options to guarantee compliance of future supply from Woodgarston Service Reservoir (SR) within an acceptable timeframe for DWI compliance.

The study considered the available treatment technologies and option development to assess the combination of blending and nitrate removal processes to achieve our company target of 40 mg/l nitrate into supply. Initial options were drafted leveraging

the outputs of previous work undertaken; literature review of nitrate removal processes and findings from site visits. Following a qualitative review of site constraints and process viability, a number of identified potential options have been discounted due to deliverability issues, with the remainder being taken forward for costing and further feasibility assessment.

Mass balance calculations were produced to determine blending ratios and treated water nitrate concentrations, in order to size side stream nitrate removal processes. Suppliers of commercially available nitrate removal processes have been contacted to share industry knowledge and provide budget quotations. An outline process flow diagram and scope of work have been developed for each option being considered viable, and whole life cost estimates generated using our Unit Cost Database (UCDB).

A final assessment was undertaken of the priced options considering the option against process risks, site constraints and whole life cost to determine a view on overall deliverability of each option.

3.1.1 Options Considered

Following a review of the outputs of previous work undertaken, the findings from site visits and identification of viable process technologies, the options set below has been produced. This set of options consider locations available for blending/treatment and viable nitrate removal processes to address rising nitrate concentrations at Woodgarston treatment works.

As outlined in section 3.1, this set of options will deliver a short to medium term solution and run in conjunction with the catchment management work set out in Appendix 10 – Environmental Resilience.

Locations available for blending/treatment:

1. Nitrate removal at Woodgarston treatment works
2. nitrate removal at Woodgarston SR
3. nitrate removal at Whitedown SR
4. nitrate removal at West Ham treatment works:
    - blending at Woodgarston SR
    - blending at Whitedown SR
    - raw water transfer pipeline from Woodgarston treatment works to West Ham treatment works
    - decommission Woodgarston treatment works
5. nitrate removal at Woodgarston treatment works and West Ham treatment works

Viable nitrate removal processes considered:

- Ion exchange
- reverse osmosis
- electro dialysis
- biological denitrification

Based on the findings of the options screening assessment, the following options were taken forward for further feasibility assessment and costing:

Table 4: Nitrate options appraisal Woodgarston

Option	Location	Ion Exchange	Reverse Osmosis	Electro dialysis	Biological Denitrification
1	Woodgarston WTW	X			
2	Woodgarston SR				
3	Whitedown SR				
4a	West Ham WTW	X			
4b	West Ham WTW				
4c	West Ham WTW	X			X
4d	West Ham WTW				
5	Woodgarston WTW	X			
	West Ham WTW	X			X

Both ion exchange and biological denitrification offer a robust treatment process having been installed for industrial application across Europe for the application of drinking water. Ion exchange holds DWI approval for nitrate selective resins and has been implemented widely across the UK as the preferred technology for most water companies. Biological denitrification has greater operational complexities compared to ion exchange that should be considered as a risk element against this technology. Furthermore, ion exchange offers a marginally smaller footprint when compared to biological denitrification plants with the same throughput.

Table 5: Cost of nitrate removal options

	Option 1.IX	Option 4a.IX	Option 4c.IX	Option 5.IX	Option 5.IX (West Ham WTW)	Option 5.IX (Woodgarston WTW)	Option 4c.BDN	Option 5.BDN	Option 5. BDN (West Ham WTW)
CAPEX	£3,117,950	£9,380,232	£8,316,985	£6,278,259	£3,221,402	£3,056,857	£12,186,216	£9,587,918	£6,533,450
OPEX/year	£376,069	£1,094,456	£378,281	£580,785	£247,493	£333,292	£397,043	£600,134	£269,515
Overheads	£404,495	£1,223,509	£1,071,107	£816,709	£420,183	£396,526	£1,575,789	£1,248,404	£852,189
Tender to Out-turn	£324,890	£958,054	£1,014,994	£662,642	£343,444	£319,198	£1,381,708	£970,373	£651,397
Risk Allowance	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC
Whole Life Cost	£8,980,474	£26,707,854	£13,117,304	£15,380,798	£7,148,210	£8,232,589	£17,984,597	£19,671,076	£11,458,601
Life Cycle Cost	£11,631,301	£34,725,795	£14,233,669	£19,416,265	£8,871,614	£10,544,651	£19,440,923	£24,085,877	£13,570,070

3.1.2 Option Selection

Table 5five shows a cost breakdown for each of options taken forward for costing. The capex of biological denitrification options is approximately 30per cent greater when compared to ion exchange. The OPEX of the two technologies is similar. As the whole life cost, for options 4c and 5, is approximately £5m more for biological treatment process over ion exchange, this technology is not recommended due to additional cost and process risk. Therefore, ion exchange is the recommended nitrate removal process for this scheme.

Option 4a is not recommended due to lack of resilience, concern with feasibility of blended solution and whole life cost. Reduction in resilience is also a concern for option 4c. It is uncertain whether for option 4c, West Ham treatment works has spare capacity to treat additional flows from Woodgarston treatment works, and whether there is capacity in the network to accommodate this option. For the aforementioned reasons, option 4c is not recommended.

The lowest whole life cost option proposed is option 1, ion exchange at Woodgarston treatment works. Nitrate removal at West Ham treatment works is likely to be a requirement in the period 2025-30, following completion of a WINEP study in AMP7. Comparison of the CAPEX cost at Woodgarston treatment works in Option 1 and Option 5 show that a CAPEX saving of approximately £60,000 could be made on Woodgarston costs if treatment is also installed at West Ham treatment works. As this is only a minor saving, pursuing option 5 offers little reward, whilst moving nitrate removal at West Ham treatment works forward an AMP.

3.1.3 DWI Support

A detailed scheme was submitted to the DWI on 28th December 2017 detailing the investment. A letter of support for this scheme was received on the 30th May 2018, a copy of the letter is enclosed in Annex A.1.

3.1.4 Spend Profile 2020-25

Project Title	Regulatory Category	Type of Project	Expected Start Date	Expected Finish Date	AMP 7					Total Cost
WQ Woodgarston Option 1 Ion Exchange	Quality	Raw Water Deterioration Schemes	04/01/2020	31/03/2022	£1,557,054	£1,557,054	£0	£0	£0	£3,114,108

3.2 Chromium Treatment at College Avenue treatment works

As outlined in section 2.3.1, College Avenue treatment works is one of the three identified treatment works in England and Wales with elevated chromium levels, above 3 µg/l.

In addition to catchment management approaches that we have implemented to date, and included within our WINEP for the period 2020-2025 a study of available end-of-pipe treatment options to guarantee compliance of future supply within an acceptable timeframe for DWI compliance has been completed.

The study considered the available treatment technologies and option development to assess the combination of blending and chromium removal processes to achieve levels below our company target of 3 µg/l chromium into supply. Initial options were drafted leveraging the outputs of previous work undertaken; literature review of chromium removal processes and findings from site visits. Following a qualitative review of site constraints and process viability, a number of identified potential options have been discounted due to deliverability issues, with the remainder being taken forward for costing and further feasibility assessment.

Suppliers of commercially available chromium removal processes have been contacted to share industry knowledge and provide budget quotations. An outline process flow diagram and scope of work was developed for each option being considered viable, and whole life cost estimates generated using our Unit Cost Database.

A final assessment was undertaken of the priced options considering the option against process risks, site constraints and whole life cost to determine a view on overall deliverability of each option.

3.2.1 Options Appraisal

A literature review was undertaken of available chromium removal processes to assess the most viable treatment option to be applied at College Avenue treatment works. Owing to a lack of case studies involving the implementation of chromium removal processes at U.K. treatment works, literature has predominantly been sourced from the U.S. and continental Europe. Consideration has been made to any regulatory approval that may be required from the DWI.

Four potential options were identified for chromium removal:

- Reduction/Coagulation/Filtration (RCF)
- ion Exchange (IX)
- weak Based Anion (WBA)
- strong Based Anion (SBA)
- reverse Osmosis (RO)
- granular Activated Carbon (GAC).

RCF is by far the most understood and proven technology for chromium removal. Because of this RCF has been taken forward for further feasibility assessment and costing. Space is limited at College Avenue treatment works and consideration must be given to available footprint to house a RCF process and associated wash water and sludge treatment processes required to minimise volumes of hazardous waste for disposal.

Ion exchange will also be taken forward for further feasibility assessment and costing. However, only chromium selective SBA resins will be considered. From literature it has been identified that WBA resins have potential benefits over SBA resins. For instance, WBA resins have been shown to have an increased chromium capacity over SBA resins. Furthermore, disposal of spent WBA resin is economically viable, avoiding the need for regeneration using a brine solution, which is the main set back of SBA resins.

Full-scale implantation of WBA for chromium removal has not been well documented in literature, where as there are suppliers of commercially available chromium selective SBA ion exchange plants, such as Ionex. SBA resins are more proven, and provide greater confidence in process performance as compared to WBA resins. For this reason, only SBA resins were taken forward for further assessment.

Through discussions with the supplier of a commercially available chromium selective SBA ion exchange plant, Ionex, it was identified that the waste brine produced following weekly regeneration can contain concentrations of hexavalent chromium in the order of 3 g/l. Reduction using coagulant, followed by wash water and sludge treatment will be required to minimise the volumes of hazardous waste for disposal. Location of new plant will require consideration due to the space constraint at College Avenue treatment works. Furthermore, agreement with the sewerage provider will be required to dispose of waste brine to sewer following wash water and sludge treatment. Weekly regeneration is likely to produce more manageable waste volumes as compared to RCF and RO.

RO will be taken forward for further feasibility assessment and costing as the removal mechanism is well understood. Commercially available RO package plants are available and can be supplied on a skid, allowing for quick installation. RO requires a relatively small footprint as compared to other treatment technologies evaluated, making its implementation at College Avenue treatment works attractive. However, the main set back of RO is the waste volumes produced. Pre-treatment and post-treatment requirements make RO relatively complex as compared to alternative treatment processes.

There is limited literature on removal of chromium from drinking water using GAC, and no examples of full-scale implementation were identified. Since the application of GAC for chromium removal is relatively unproven, it is considered to pose too much process uncertainty as compared to alternative treatment options available. As such, GAC will not be taken forward for feasibility assessment and costing.

The costings in Table 6 were completed using our UCDB costing tool. Cost of discharge consents and disposal of hazardous waste have not been accounted for.

Furthermore, cost of DNO applications have not been included in the UCDB costing exercise.

Table 6: Cost of proposed treatment options for implementation at College Avenue Treatment Works

	RCF	SBA IX	RO
CAPEX	£13,825,387	£14,446,208	£19,912,479
OPEX/year	£1,301,657	£1,167,549	£2,239,014
Overheads	£1,800,847	£1,714,277	£2,598,138
Tender to Out-turn	£1,339,809	£1,267,140	£1,914,756
Risk Allowance	TBC by SEW	TBC by SEW	TBC by SEW
Whole Life Cost	£36,280,882	£34,292,144	£58,316,354
Life Cycle Cost	£46,578,521	£43,456,890	£76,662,389
Opex/Ml	£52,105	£46,627	£89,303

3.2.2 Option Selection

RO is a very robust treatment process for removal of multiple contaminants from drinking water and can achieve very high water quality. However, the whole life cost is almost twice that of alternative treatment options shown in Table 6. Furthermore, waste volumes produced, OPEX costs, and operational complexity make RO unpractical for implementation at College Avenue treatment works.

The cost of SBA IX compared with RCF shown in Table 6 is marginally cheaper, both from a CAPEX and OPEX point of view. The cost of SBA IX presented may be an overestimate for chromium selective resins based on the assumptions from UCDB. RCF is a more proven technology, however performance of chromium selective ion exchange plants quoted by IONEX is promising. Both technologies are considered to be reliable for removal of total chromium to concentrations less than 2 µg/l. Jar testing of coagulants and pilot trials of chromium selective ion exchange resins will be required to validate process performance. Furthermore, chromium selective ion exchange resins will need to gain DWI approval for implementation in the U.K.

Larger waste volumes are likely to be produced by the RCF process, however a large proportion of these may be recovered using wash water treatment. Disposal of waste brine will be more problematic than dirty wash water produced by RCF filtration processes, with no obvious option for recovery. Both processes will require disposal of hazardous waste. A more detailed assessment is required to understand the relative waste disposal costs of each option.

Literature case studies have shown that SBA IX requires a slightly smaller plant footprint than RCF for the same throughput. With space and discharge route being the main constraints at College Avenue treatment works, these will need to be balanced when determining the preferred option between RCF and WBA IX.

3.2.3 DWI Support

A detailed scheme was submitted to the DWI on 28th December 2017 detailing the investment. A letter of support for this scheme was received on the 30th May 2018, a copy of the letter is enclosed in Annex A.2.

3.2.4 Spend Profile 2020-25

Project Title	Regulatory Category	Type of Project	Expected Start Date	Expected Finish Date	AMP 7					Total Cost
WQ College Ave Option 2 IX SBA	Quality	Raw Water Deterioration Schemes	04/01/2020	31/03/2025	£722,310	£722,310	£2,889,242	£5,056,173	£5,056,173	£14,446,208

3.3 Other Capital Investment

In addition to the DWI supported schemes, there are a number of discrete water quality related projects included within the overall capital maintenance budget, to address identified issues.

This investment on a small number of water treatment works has arisen following surveys which have been completed and consequential remedial actions which are required. The survey programme assessed each treatment works to ensure adequate facilities were in place to ensure resilient disinfection under all design conditions and verification of disinfection could be achieved. We have used our UCDB to assess the costs of surveys and interventions required during 2020-25. To ensure resilient and adequate disinfection is achieved under all design conditions, as required by Regulation 26 (1) of the Water Supply (Water Quality) Regulations 2016 (as amended), a small number of sites require upgrades to their disinfection processes, for example through the installation of baffles in contact tanks or new contact tanks to ensure demonstrable verification of disinfection can be achieved, as required under Regulation 26 (2)(b), small number of remedial actions are required to some treatment works sites to ensure adequate sampling facilities and sufficient online water quality monitoring facilities are in place. Lastly, dechlorination will be installed after the disinfection processes at some treatment works to ensure the final

chlorine residual received by our customers is satisfactory and disinfection processes remain resilient. Details of these schemes are shown in Table 7.

Table 7 Additional Water Quality Expenditure

Project Title	Regulatory Category	Type of Project	Resource Zone	Expected Start Date	Expected Finish Date	Total
Disinfection Scheme - Baffles	Quality	WTW Upgrading - Quality Programme	Various	01/04/2020	31/03/2025	£ 548,495
Disinfection Scheme - Contact Tanks	MNI	AG2048 : WTW Capital Maintenance (MNI)	0	01/04/2020	31/03/2025	£ 1,182,815
Disinfection Scheme - Coombe Down	Quality	WTW Upgrading - Quality Programme	RZ2	01/04/2020	31/03/2025	£ 65,360
Disinfection Scheme - Dechlorination Plant	MNI	AG2048 : WTW Capital Maintenance (MNI)	0	01/04/2020	31/03/2025	£ 2,926,620
Disinfection Scheme - Saddlescombe SR	Quality	WTW Upgrading - Quality Programme	RZ2	01/04/2020	31/03/2025	£ 191,640
Disinfection Scheme - Sheet SR	Quality	WTW Upgrading - Quality Programme	RZ5	01/04/2020	31/03/2025	£ 347,175
Raw Water Sample Tap - Various Sites	MNI	AG2048 : WTW Capital Maintenance (MNI)	0	01/04/2020	31/03/2025	£ 151,800
Reservoir Inlet Sample Tap - Various Sites	MNI	AG2048 : WTW Capital Maintenance (MNI)	0	01/04/2020	31/03/2025	£ 56,925
Water Quality-Chlorine Monitors	MNI	AG2048 : WTW Capital Maintenance (MNI)	0	01/04/2020	31/03/2025	£ 1,226,535

3.4 Assessing the Long Term Risks to Water Quality

Through the risk approaches mentioned above, we identify and manage current risk mitigation measures. In addition we collect and assess future risk to ensure the long term maintenance of water quality and consumer confidence in water supplies and services provided.

Any significant risks identified are assessed for incorporation into the departmental risk registers which feeds up into the corporate risk register.

This mechanism enables the company to keep a watching brief on a number of long term risks and plan necessary mitigation measures in advance. Using this model, additional costs can be built in to the ongoing capital maintenance budgets in the longer term and therefore reduce significant unexpected economic shocks and ensure the risks are dealt with in a timely manner.

Using this approach and relying on a number of sources to identify and highlight risks we create a “long list” of water quality risks.

This long list of risks under current consideration is detailed below:

- Nitrate increases across our chalk sources
- chromium at one of our sources
- emerging chemicals including, pesticides and disinfection by products
- micro plastics in raw water

- climate change, including the potential impact and degradation of chalk block aquifers
- climate change causing more algae blooms and other impacts to raw water and site performance
- saline intrusion in particular at our south coast chalk sites
- extreme weather events, single events that present a risk to the quality of water supplied
- change in agricultural policy via Brexit that may increase the intensity of farming
- land use changes that also threaten the quality of the raw water
- sustainable reductions leading to change in availability and quality of raw water sources and changes in water quality as a result of changing the source mix
- risk associated with effluent reuse and desalination in WRMP and potential downstream impact on water quality
- increased reliance on monitors with limited life needing comprehensive regular replacement cycles
- reservoir drainage risks e.g. Franklaw event
- system weak points – reservoirs
- ageing distribution system including relining end of life issues
- resilience of network configuration as population grows
- risk of interconnectivity associated with bulk supplies i.e. water mixing - Flint case study
- lead predominantly from customer side plumbing
- customer expectations on information increasing, risk to trust, customer increasingly tell us they would like more information on water and its use
- ageing workforce the need for skills transfer and new skills
- risks of impact on WQ of interruption and leakage targets, consideration of whether activities to achieve this have the potential to impact water quality
- changes in regulatory regime (Drinking Water Directive) – tightening standards, increased monitoring and new risk parameters
- risks associated with customer behaviour changes around water use and potential pollution impacts
- risks to water supply sufficiency and reliability.

Following more detailed assessment the key long term risks to the business over the period 2020-2045 from this long list are identified and assessed within Table 8:

Table 8: Long term risks to water quality within South East Water

Identified Risk	Timescale	Mitigation Measure	Estimated cost
Nitrates	2020-2025	Catchment management work identified within WINEP. Installation of Treatment at Woodgarston treatment works	£11.8 m included within Business Plan (BP) £3.4m included within BP
	2025-2045	Possible treatment solutions needed in medium term, as evidenced by outcomes of WINEP investigation	~£1m / ML/d estimated up to £30 million
Chromium,	2020-2045	Installation of Treatment at College Avenue WTW. No further works at significant risk Catchment management work identified within WINEP.	£15.5 m included within BP £0.42m included within BP
Emerging chemicals including pesticides and DBPs	2020-2045	Collaboration on research projects to develop methodology.	Costs included within capital base OPEX
Metaldehyde	2020-2045	Catchment management work identified within WINEP, product substitution, abstraction management	£7.6mincluded in our Business Plan (BP)
Micro-plastics – consumer confidence concerns, limited information available	2020-2025	Collaboration on research projects to develop methodology.	Costs included within capital base OPEX
Climate change	2020-2045	The impact of climate change on water resources in the South East was assessed as part of the company's WRMP	All current costs included within BP under WRMP
Extreme weather events	2020-2045	Contingency plans to mitigate the potential water quality risks have been identified through improved resilience of assets, investment in additional treatment at key works and mobile treatment options for deployment to lower risk sites.	Costs included within BP under WRMP
Change in agricultural policy via Brexit - potential for more intense farming	Post 2020	Increased catchment management	£22.4 m included in our Business Plan (BP) in total for catchment management. High potential for ongoing investment. Currently assumed at same rate
Ageing infrastructure	2030-2045	Long term strategy for replacement	Costs included within BP in capital maintenance budget

Identified Risk	Timescale	Mitigation Measure	Estimated cost
Risks of interconnectivity and blending of incompatible water types	2020-2045	WQ involvement and sign off on the development of the WRMP	Costs included within BP under WRMP
Lead	2020-2045	Phosphate dosing within high risk areas in place to minimise risks to consumers Replacement of communication pipes Replacement of pipes consideration for long term past 2025.	£0.5m per annum , included within BP in capital maintenance budget
	2045-2070	Replacement / relining of pipes on customer side Phasing out of phosphate dosing across all areas	£25 million not included in current planning
Impact of OFWAT Interruption and Leakage PCs on Water Quality	2020-2025	Thorough risk assessment of all activities to be undertaken will be incorporated into company strategies to meet all PC	Costs included within BP
Changes in regulatory regime	2025-2045	Involvement in the consultation and lobbying at a strategic level.	Costs estimated at £5-10 million, not included within current budget
Changes in customer behaviour	2025-	Development of resilient customer concept to improve understanding of and influence behaviour to safeguard supplies	Cost included in maintenance and engagement activity

Table 8 gives us comfort that we are capturing both the potential long term and short term risks within our strategy and that the processes we currently have in place will allow the strategy to be adaptive to ensure we are providing excellent water quality for now and future generations.

Annex A DWI Letters of Support

A.1 SEW02 Woodgarston Treatment Works – Nitrate – DWI Letter of Support

dwi
guardians of drinking water quality

DRINKING WATER INSPECTORATE
Area 1A
Nobel House
17 Smith Square
London
SW1P 3JR

Enquiries: 030 0068 6400

E-mail: milo.purcell@defra.gsi.gov.uk
DWI Website: http://www.dwi.gov.uk

30 May 2018

Mr David Hinton
Asset and Regulations Director
Rocfort Road
Snodland
ME65AH

Dear Mr Hinton

PERIODIC REVIEW 2019: South East Water
DWI Scheme reference: SEW02 – Woodgarston Nitrate

FINAL DECISION LETTER

The Inspectorate has completed its detailed assessment of the scheme proposed by South East Water to provide nitrate removal facilities to secure or facilitate compliance with the nitrate standard for drinking water quality reasons at Woodgarston WTW.

The detailed assessment also took in to consideration the outcome of the risk assessment report submitted to the Inspectorate as required by regulation 28(1) of the Water Supply (Water Quality) Regulations 2016 for the connected Woodgarston WTW supply system.

A summary of the outcome of our assessment of this scheme is attached. Based on the information submitted by the Company, the Inspectorate supports the need for a scheme to reduce nitrate concentrations in treated water for water quality reasons, and the supported scheme shall be included by the Company in its Final Business Plan, subject to the caveats listed in the attachment.

In this instance the Inspectorate intends to issue a Notice under Regulation 28(4) of the Water Supply (Water Quality) Regulations 2016 that requires the Company to mitigate the risk of Nitrate that has been identified as a potential danger to human health from the water supplied from Woodgarston WTW.

It is expected that the Company will continue to monitor treated water nitrate concentrations, and that it will take all reasonable steps to prevent contraventions of the nitrate standard.

I am copying this letter to:

- Jon Ashley and Kevin Ridout at Ofwat;
- Elinor Smith and John Collins at the Environment Agency;
- Tony Redmond (CCW Chair, London and South East)
- Zoe McLeod (Chair of Customer Challenge Group)

Please contact Sue Pennison (Sue.Pennison@defra.gsi.gov.uk) with any queries relating to this letter.

Yours sincerely

Milo Purcell
Deputy Chief Inspectorate (Regulations)

Department for Environment, Food and Rural Affairs | Home Page: www.dwi.gov.uk E mail: dwi.enquiries@defra.gsi.gov.uk | Llywodraeth Cymru Welsh Government

PERIODIC REVIEW 2019

SUMMARY OF DWI ASSESSMENT – LETTER OF SUPPORT

	Comment
Water company:	South East Water
DWI scheme reference(s):	SEW01
Scheme name:	Woodgarston – Nitrate
Proposal:	Provision of nitrate removal treatment at Woodgarston to secure or facilitate compliance with the nitrate standard for drinking water quality reasons.
Supporting evidence:	Risk assessment report 2017/759538 for Woodgarston WTW dated 01 November 2017, submitted on 04 January 2018. Letter reference SEW Woodgarston Nitrate scheme 28/12/2017
Conclusion:	Subject to the caveats listed below, the Inspectorate supports the need for the following scheme: Install and operate a permanent nitrate removal system at Woodgarston WTW with associated controls and monitoring
Timescale:	Completion date: no date supplied
Estimated cost:	Estimated capital costs: £3.1m Estimated net additional operating costs: £376k/pa
Legal Instrument Required:	Notice under Regulation 28 (4)
Caveats:	1. Subject to agreement to, and completion of, more intensive investigation to provide further information to confirm steps to be taken and project completion dates 2. Subject to the continuation of blending measures 3. Subject to continuation of catchment management efforts
Comment:	DWI has no role in determining proportional allocation of expenditure. Where DWI technical support is given, this should not be taken by the company to imply that the scheme will be partially or wholly funded as a Quality item.

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A.2 SEW01 College Avenue Treatment Works – Chromium – DWI Letter of Support

dwi
guardians of drinking water quality

DRINKING WATER INSPECTORATE
Area 1A
Nobel House
17 Smith Square
London
SW1P 3JR

Enquiries 030 0068 0400

E-mail: milo.purcell@defra.gsi.gov.uk
DWI Website: http://www.dwi.gov.uk

30 May 2018

Mr David Hinton
Asset and Regulations Director
South East Water Ltd
Rocfort Road
Snodland
Kent
ME6 5AH

Dear Mr Hinton

PERIODIC REVIEW 2019: South East Water
DWI Scheme reference: SEW01 – College Avenue WTW – Chromium

FINAL DECISION LETTER – SUPPORT

The Inspectorate has completed its detailed assessment of the scheme proposed by South East Water to install treatment facilities to secure or facilitate compliance with the chromium standard for drinking water quality reasons at College Avenue WTW.

The detailed assessment also took in to consideration the outcome of the risk assessment report submitted to the Inspectorate as required by regulation 28(1) of the Water Supply (Water Quality) Regulations 2016.

A summary of the outcome of our assessment of this scheme is attached. Based on the information submitted by the company, the Inspectorate supports the need for a scheme to reduce chromium concentrations in treated water for water quality reasons, and the supported scheme shall be included by the company in its Final Business Plan, subject to the caveats listed in the attachment.

In this instance the Inspectorate intends to issue a Notice under regulation 28(4) of the Water Supply (Water Quality) Regulations 2016, as amended, that requires the company to mitigate the risk of chromium that has been identified as a potential danger to human health from the water supplied from College Avenue WTW.

It is expected that the company will continue to monitor treated water chromium concentrations, and that it will take all reasonable steps to prevent contraventions of the chromium standard.

I am copying this letter to:

- Jon Ashley and Kevin Ridout at Ofwat;
- Elinor Smith and John Collins at the Environment Agency;
- Tony Redmond (CCW Chair, London and South East)
- Zoe McLeod (Chair of Customer Challenge Group)

Please contact Sue Pennison (Sue.Pennison@defra.gsi.gov.uk) with any queries relating to this letter.

Yours sincerely

Milo Purcell
Deputy Chief Inspector

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PERIODIC REVIEW 2019

SUMMARY OF DWI ASSESSMENT – LETTER OF SUPPORT

	Comment
Water company:	South East Water
DWI scheme reference(s):	SEW01
Scheme name:	College Avenue – Chromium
Proposal:	To install treatment facilities to reduce chromium concentrations in the treated water
Supporting evidence:	SVT College Avenue WTW Chromium PR19 submission, final December 2017
Conclusion:	Subject to the caveats listed below, the Inspectorate supports the need for the following scheme: To install treatment facilities to reduce chromium concentrations in the treated water
Timescale:	Completion date: 31 December 2025
Estimated cost:	Coagulation and filtration TOTEX: £15,250,847 Ion Exchange TOTEX: £13,420,713
Legal Instrument Required:	Notice under regulation 28 (4)
Caveats:	The results of the investigation into the proposed treatment option
Comment:	DWI has no role in determining proportional allocation of expenditure. Where DWI technical support is given, this should not be taken by the company to imply that the scheme will be partially or wholly funded as a Quality item. Schemes that require a legal instrument are considered necessary to meet statutory drinking water quality requirements. These schemes will be transposed to formal programmes of work by DWI as soon as possible and their implementation and completion will be monitored, audited and closure confirmed by DWI.

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south east water

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