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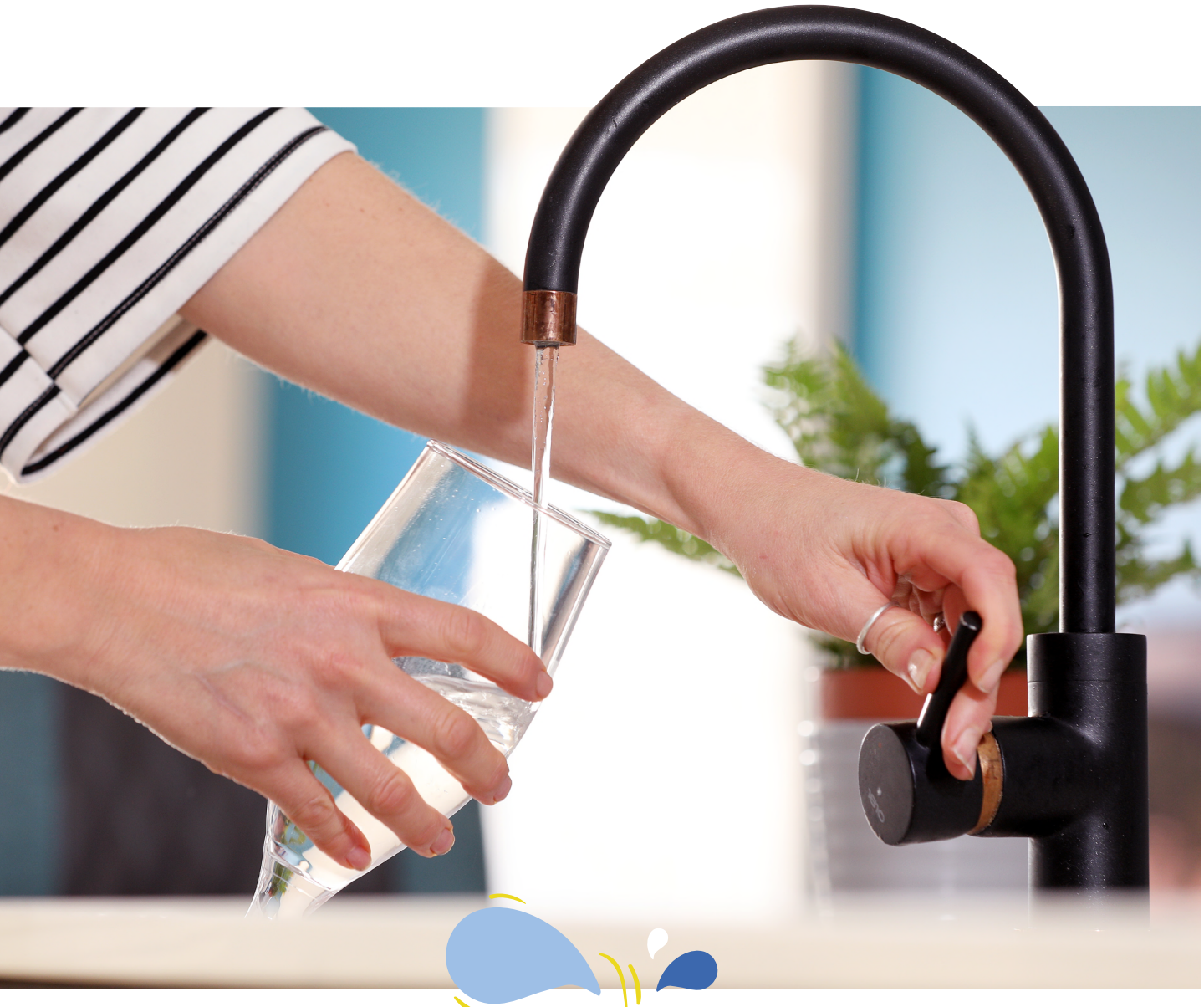
Long Term Planning for the quality of drinking water supplies



Safe, clean water

Contents

Long Term Planning for the quality of drinking water supplies

This document sets out a concise statement for significant new future risk mitigation measures, covering source to tap. It gives assurance that this provides a long-term view of our risk to drinking water supplies as required by the Guidance Note: Long term planning for the quality of drinking water supplies, published in July 2022. It provides an update to our previously submitted long term planning document from May 2018.

Our Strategic Direction Statement (SDS) sets out our vision for the future looking ahead to 2045. It assesses the long-term challenges we face and sets the scene for delivering the outcomes we have agreed with customers and for the environment in the face of those challenges.

In 2013 we agreed ten long-term outcomes that we will deliver for customers and the environment. These outcomes were reviewed as part of our revised SDS in 2017, and recently re-confirmed by our Board. Safe, clean water is one of our outcomes; customers view that delivering safe clean water is the most vital service we offer.

We have defined four strategies to deliver this outcome:

- Protect and improve raw water quality at source
- Increase resilience in our treatment processes
- Safeguard quality across our distribution system
- Ensure water is clean and safe within the home

Uncertainty – we face a number of common areas of uncertainty around future water quality risk, such as:

- The impacts of factors such as climate change, growth and planning across the region and the potential impact of sustainable housing and grey water use;
- Unknown political and policy changes for example the impact of leaving the EU particularly on agricultural policy, and future labour markets;
- The future of the EU Drinking Water Directive (DWD) legislation; the Drinking Water Inspectorate (DWI) are in the process of setting up a Drinking Water Quality Advisory Standards Board. Their role will be to review parameters and standards and make recommendations to DEFRA on changes to drinking water regulations. Due to the timing of the UK exiting the EU there will be no transposition of the revised DWD, however this new Drinking Water Quality Advisory Standards Board will be reviewing the revised DWD parameters and making recommendations to DEFRA on any changes required in UK legislation – we have no timeframes for this yet;
- Future impacts of existing and potential for further changes in regulatory guidance on PFAS;
- The potential for other emerging raw water pollutants which could impact on catchment management activity, and the potential for treatment challenges of unknown treatability by existing treatment processes;

  The new requirement from the Environment Agency (EA) in September 2022 to include an environmental destination appraisals options and investigations within our WRMP24, the scope of which is currently being developed and any cross over with this plan for future water quality risk planning. This could have particular significance with any acceleration on sustainable abstraction reductions within our region especially linked to changes in source or loss of blending of source waters;
- The requirement for new sources in the future which will move us towards new technologies such as desalination, we shall also have greater connectivity of differing sources;
- The pressures on natural capital, from abstraction, development, land management and other sources. We need to continue to explore these interdependencies and interactions and share this information with other stakeholders who we depend on and manage natural capital stocks in our region.

Areas of known future WQ risk and therefore potential investment – there are a number of common areas of risk identified. Importantly this requires us to cover asset health and infrastructure serviceability also; our maintenance programmes to ensure asset health are supported with risk assessments, condition assessments and reliability modelling where applicable.

- Ageing assets – including our raw water well fields, raw water abstraction pumping stations, our impounding reservoirs and our raw water distribution infrastructure.
- Our water treatment works in particular the early AMP treatment investment areas such as ozone, GAC and early nitrate removal plants. The asset life of the early AMP4 nitrate plants also needs assessment.
- Our storage points, boosters and distribution mains.

Throughout this document, all estimated costs are based upon 2022/2023 cost models unless otherwise stated.

Protect and improve raw water quality at source

The aim of catchment management is to protect water quality at its source by preventing pollution getting into the water rather than relying on costly, less sustainable, 'end of pipe' treatment. As this approach leads to cleaner raw waters, catchment management solutions typically offer other wider gains including biodiversity, habitat and recreational benefits. Cleaner raw waters can also be transferred from areas of plenty to those where water is scarce, enabling greater resilience of the public water supply to support housing development and growth.

We welcome the ambition of Farming Rules for Water and the positive impact this should have on future raw water quality deterioration caused by surface water run-off. However, we are cautious of the unintended impacts of the changes to the rules in relation to the use of organic fertilisers in particular Nutri-bio, and have raised with the Environment Agency our concern that the changes could lead to widespread incineration of sewage sludge.

We recognise that long term catchment management activities are required to prevent raw water pollution and the requirement for end of pipe treatment; we continue to actively promote working with others to improve ecological status and water quality across our catchments.

We will need to continue to expand our knowledge of historic and future activities in catchments to understand and predict changes; our Catchment Advisors underpin this approach. By engaging with key stakeholders we can understand how we need to change and develop our catchment management activities to keep up with changing agricultural and land management practices, the impact of non-agricultural practices, emerging pesticides and other new pollutants. We are actively developing partnership approaches to funding during AMP7 with a view to build on this in the future, for example LENS and Get River Positive.

Additional areas of catchment management are proposed under WINEP for AMP8 covering agricultural nutrient management (surface waters high risk – linked to algae challenges), total pesticides and turbidity investigations, with a potential investment of between £9.5 million to £16.9 million. All elements are intended to deliver a measurable improvement in drinking water quality as well as a range of co-benefits including enhanced customer engagement, carbon reduction, improved local biodiversity and climate change resilience.

Continuing our existing programme of work, with a forward look to AMP8 we will build on these catchment management activities.

These include:

- Focused catchment management investigations which include physical presence and insight into current and future land management practices within key local catchments. This will inform operational and strategic decision-making including abstraction management and climate resilience.
- Trials and engagement to include local field trials to demonstrate new and innovative farm management approaches which reduce the risk of diffuse pollution with the aim to reduce field and yard losses.
- Focused use of data and modelling using an extensive network of in-catchment sampling locations. Using local data via local field-based weather stations to inform farmer decision making at a local scale. Risk modelling to improve reactive operational decision making and enable greater security of supply.
- Pesticide risk management and continuation of our annual independent assessment of pesticide risk and usage data to inform our proactive monitoring programme.
- Continued focus on nitrate usage with a view of direct behaviour change – incentivising changes in practice to enable adoption of practices to reduce the risk of nitrate loss from the farming environment. These areas build on our day to day activities within the catchment management team of catchment advisor presence on the ground which includes:

Investigations

- Technical support for operational teams associated with the identification and management of potential pollution risks, in both surface and groundwater sites.
- Local investigations to identify and manage the source of any ad hoc pollution events.
- Physical presence and insight into current and future land management practices within key local catchments to inform operational and strategic decision-making including abstraction management and climate resilience.

Trials and engagement

- Local field trials to demonstrate new and innovative farm management approaches which reduce the risk of diffuse pollution.
- Insight into the practical impact/risks of different management approaches to reduce field and yard losses.

Data and modelling

- Extensive network of in-catchment sampling locations to provide contextual data for key risk actives.
- Collection and reporting of climatic data via local field-based weather stations to inform farmer decision making at a local scale.
- Risk modelling to improve reactive operational decision making and enable greater security of supply.

Risk management

- Annual independent assessment of pesticide risk and usage data to plan our risk based internal pesticide monitoring programme.

Nitrate

- Direct behaviour change - incentivising changes in practice to enable adoption of practices to reduce the risk of nitrate loss form the farming environment.
- Trials of new products and management approaches to reduce nitrate use in a practical farming environment.
- Training and knowledge transfer to influence farm management activities.

Water Resources Management and Sustainable Abstraction

The Environment Agency has classified the Anglian Region as being one of 'serious' water stress and have introduced widespread Sustainable Abstraction changes to our licences, the first of which came into force in AMP7.

Given these challenges we continue to work with the Environment Agency on the best way to deliver these sustainability reductions.

We currently hold 202 abstraction licences, authorising up to 1,657 Ml/d abstraction from both ground and surface water. The challenges that we face to ensure sustainable abstraction will result in more restrictive licenses. We know which sources are impacted in AMP8, but uncertain currently as to what those changes will be and are therefore uncertain in the longer term. There is an unknown risk of changes to existing abstraction regimes to accommodate this. The environmental destination appraisals requirement puts significant uncertainty in this area currently and we continue to develop the scope and work with the Environment Agency to understand this further.

As we work within the more restrictive licencing conditions, this may give us less operational flexibility such as less ability to blend for water quality parameters as an alternative to installing treatment processes.

Since our Water Resources Management Plan (WRMP)19, there has been a significant shift in expectations for abstraction licensing. Within our planning period for WRMP19 we committed and planned mitigation for capping our abstraction licenses to recent maximum peak values; this is applicable to a number of our Time Limited Licences. Recent guidance from the Environment Agency details that abstraction licenses in certain environmental scenarios will need to be capped at recent actual average volumes. This effectively restricts abstractions further than capping at recent maximum peak values. Table 1 below from our draft WRMP24 details the amount of supplies that will be lost on implementation of more recent actual average volumes for both time limited and permanent licences. Out of our 202 abstraction licences, 124 are time-limited.

	Agreed WRMP19 and PR19 AMP7 Sustainability Reductions (capping at peak)	Implementing recent actual average volumes on time-limited licences	Implementing recent actual average volumes on time-limited and permanent licences
By 2022	52 Ml/d	An additional 30 Ml/d to WRMP19 sustainability reductions	An additional 30 Ml/d to WRMP19 sustainability reductions
By 2025/26	33 Ml/d	An additional 11 Ml/d to WRMP19 sustainability reductions	An additional 63 Ml/d to WRMP19 sustainability reductions
Total	85 Ml/d	An additional 41 Ml/d to WRMP19 sustainability reductions	An additional 93 Ml/d to WRMP19 sustainability reductions

Table 1: The amount of supplies that will be lost on implementation of recent actual average volumes.

In addition to this shift, further potential acceleration is required following the requirement detailed in the Environmental Destination Options Appraisals Draft Proposal published by the EA in September 2022. This requires us to include an environmental destination appraisals options and investigations within our WRMP24, the scope is currently being developed.

Our draft Water Resources Management Plan (WRMP), which is currently in consultation, includes current known sustainable abstraction as a key driver.

Our draft WRMP lays out and identifies five key challenges to our region over the next 25 years from 2025 to 2050.

These are:

- Climate change adaptation (improving the region's resilience to drought and ensuring environment sustainability);
- Voluntarily reducing the amount of water we take from the environment (reducing our deployable output by 5.6% by 2025);
- Limited water supplies (which means we need to develop significant infrastructure such as strategic raw water storage and water reuse);
- Population growth (meaning we have to increase the capability of our water and water recycling facilities);
- A step change in demand management.

Consultation on our draft plan closes on 29 March 2023.

Through developing our WRMP we have used an adaptative planning approach to choose a least regrets pathway. We have used regional planning learning and further developed it to produce our WRMP. This long-term view, allows us to plan an affordable pathway to achieving a sustainable and secure supply of clean drinking water, while meeting the considerable challenges we face.

The plan proposed in AMP8 involves significant investment in demand side and supply side options. The demand side options include investment in smart metering, leakage and water efficiency. The smart metering programme will support water efficiency at a household level and be the most significant way by which we reduce leakage in AMP8. The key supply-side measures included in the WRMP include a continuation of the interconnector programme, a Colchester re-use scheme and a series of smaller supply-side schemes. Strategic Regional Options form a significant part of our overall long-term planning, with our proposals for two new water storage reservoirs in the east of our region, in the Fens and Lincolnshire.

Our first public consultation on these closed on 21 December 2022.

Overall this requires an investment of circa £700 million – £800 million for AMP8 with further investment in developing new resources in AMP9 and beyond.

Integral to our WRMP is the embedding of water quality subject matter experts within the development process, this is of particular relevance to our Strategic Pipeline Alliance. We have developed a drinking water safety planning framework to assess the risk of the movement of water from the north to the south of our region and a customer engagement strategy to support water transfer from one area of our region to another.

This framework forms the foundation for our water quality risk assessment for schemes developed under WRMP24, the current accelerated schemes. Additionally, taking the DWSP template developed for the All Company Working Group (ACWG), we have used this high level DWSP approach for the water quality risk assessments for the Fens and Lincolnshire reservoirs, with them being submitted as part of the RAPID Gate 2 requirements.

Water Resources and asset health

Enhanced monitoring of our groundwater sources and river abstraction assets to enable predictive analytics, for example remote performance monitoring, is being carried out during AMP7. This will improve our existing knowledge of when to refurbish or replace assets. Additionally, we have undertaken condition monitoring on our raw water pumping stations which will inform our AMP8 investment proposals.

Surface water abstraction

We have eight raw water reservoirs; these were predominantly built between 1955 and 1986 (although two are circa 1890) along with eight direct supply river intakes. In total we have 16 abstraction pumping stations. An on-going asset plan maintenance programme is in place for our raw water pumping stations.

The age and scale of these raw water abstraction assets presents an ongoing challenge, with the majority of the large custom-built assets being associated with long delivery times for investment interventions. Maintenance of these assets requires sound planning to minimise the potential 'down time' of key abstraction capabilities. We have a long-term plan of replacements and critical standby for these key assets.

Climate change may change future river flows such that we will need to adapt our pumping systems to maximise abstraction opportunities.

We have a contamination risk assessment for each of our surface water intakes. The risk assessment ensures that all known hazards in the catchment are identified and assessed.

Ground water abstraction

We have 200 groundwater sources comprising approximately 450 boreholes. These assets range in construction date from 1890 to 2022. The boreholes range in depth from 10 to 500 metres and penetrate a variety of aquifers. Each of these aquifer units presents a different hydro-chemical challenge, which can impact directly not only on the borehole asset health but on the accumulation of iron and manganese within the raw water mains associated with these sources. We have 689 kilometres of raw water mains, ranging in age from 1870 to 2013, with a third over 50 years old.

A proactive programme of maintenance has been developed during this AMP, which is supported by our 'raw water main iron and manganese risk assessment' and introduces a Planned Preventative Maintenance approach to our raw water mains.

Additionally, an on-going asset plan maintenance programme is supported by our 'assessment of borehole maintenance requirements', which also includes the requirement for borehole replacement. Our boreholes need replacing or refurbishing on a rolling basis to ensure we maintain supplies of water. Our current proposals include 15 new boreholes in AMP8.

The investment proposal for AMP8 is circa £7 million; we currently estimate a similar profile for future investment periods. New boreholes can result in unpredicted or unknown raw water quality challenges which are identified during initial investigation work (typically sampling during test pumping). This can generate the need for the potential to require new treatment to be installed at the water treatment works it supplies.

All of our licensed groundwater sources have a contamination risk assessment and are classified according to risk. This risk assessment ensures that all hazards and hydraulic pathways presenting a risk to the raw groundwater quality are identified and assessed. Our enhanced catchment surveillance approach at a number of our groundwater sources supports this risk assessment. We commissioned a project in 2021 to further develop our PFAS risk assessment methodology to better establish the risk to each of our groundwater sources. This has since been further aligned to further guidance from the Inspectorate in DWI Information Letter 03/2022 published 7 July 2022 and then subsequent additional guidance in Annex - IL 03/2022. Further information is provided within the emerging contaminants section - PFAS compounds.

Land use is changing and becoming more dynamic. For example, historically there would be one type of farming such as a dairy for decades, but increasingly this is moving towards 'pop up' farming practices which make it more difficult to predict what land use may be near or on catchments. We have evidence of raw water deterioration from 'pop up' pig farms, we did not get support for investment under WINEP from the Environment Agency for AMP7, however we continue to remain vigilant in this area. The dynamic change in land use will directly inform future catchment management activity, and it continues to be an area of focus for us.

Rapid housing growth and planning could impact on raw water, and we will ensure we are involved with planning consultation to protect our sources and ensure development does not impact on our sources or catchment areas.

Increase resilience in our treatment processes

We have more than 100 complex water treatment sites, many of which had technologically advanced treatment processes installed in the early 1990s, principally for the removal of nitrates and pesticides. These types of highly technological assets tend to have a shorter life span than more traditional treatment processes. Future investment opportunities will be used to take advantage of new advancements in treatment processes, bringing operational efficiencies, cost savings, and carbon savings to our asset investments.

We have 13 water treatment works with ozone treatment, 12 of which were installed in early AMP1 (as part of the Maximum Admissible Concentration (MAC) schemes) with the majority installed in 1992. The MAC schemes were designed to treat the key pesticide challenges which emerged in the 1980s such as atrazine and simazine. An on-going maintenance programme supports this asset group which is also supported by an ozone tank inspection programme to assess asset condition. The predicted asset life of these plants is circa 25 years. The exception to this is the ozone treatment stages at Morcott Water Treatment Works, which was commissioned in 2010. Extensive upgrade work was also undertaken to this asset base at Wing and Grafham water treatment works during AMP6.

The estimated cost of replacing these assets with 'like for like' treatment is £85.5 million (excluding Morcott).

We have 28 water treatment works with GAC adsorption processes, totalling 189 individual filters. GAC treatment was installed in early AMP1 (as part of the MAC schemes) with the majority installed in 1992. The exception to these are the GAC treatment stages at Morcott and Hall water treatment works; these works were commissioned in 2010 and 2015 respectively.

An on-going maintenance programme supports this asset group; additionally the 'maintenance of media' programme of work which delivers

the media regeneration programme is separately informed by our risk based 'regeneration assessment' approach.

The estimated cost of replacing these assets for 'like for like' treatment is £96m (£84m excluding Morcott and Hall GAC).

By the end of AMP7 we will have 26 ion exchange plants for nitrate removal, five of which were installed in early AMP1 (as part of the MAC schemes). The others have had a phased installation from AMP4 onwards. The later designed plants have a design horizon of 12 years aimed at ensuring compliance against our nitrate supply standard. The ion exchange resin within the ACWA plants has a predicted asset life of 15 years. An on-going maintenance programme supports this asset group, along with resin condition assessment where deemed necessary.

The estimated cost of replacing these assets for 'like for like' treatment is £35 million. This excludes the three plants installed in AMP7.

Through our Innovation team, and our strong links with academic partners at key Universities, we continue to work to understand what the next generation of water treatment processes will be.

This work is key to understanding what technologies will be required and available when we begin to replace processes such as ozonation, ion exchange and GAC. This work has evaluated new technologies such as a pilot plant of the 'Suspended Ion Xchange (SIX)' process and the use of alternative ion exchange resins.

Within this research we have also sought to further develop an understanding of the organic matter loading and characteristics of the raw water supplying our surface sites, using LC-OCD analysis and treatability through the SIX process. Our catchment management approach and activity, and our Water Resource Management Plan also informs this future thinking. Our WRMP introduces new technologies for us such as water reuse schemes and desalination plants. Our Colchester re-use scheme is currently being developed as a pilot plant, with the running of that plant planned for Year 1 of AMP8. We are working with Cranfield University on the design of that plant with a forward look of plant efficiency and waste stream management and potential for alternative waste stream strategies. We currently anticipate that we shall have a design for a desalination plant by 2025.

Customer engagement for these new technologies is underway and working with academic partners will take learning from the recently published DWI research Public Perception of Water Recycling for Drinking Water Use – Drinking Water Inspectorate (dwi.gov.uk).

PFAS brings an additional challenge as an emerging contaminant, the draft findings of our Cranfield research into the performance of PFAS removal by granular activated carbon concludes that removal is dependent on the number of carbons and chain length as well as functionality. The findings and conclusions of the Defra research into PFAS treatment option capability and efficiency (which commenced in late 2022), will be key to future optimised PFAS treatment technologies. Of key importance to this is the potential challenge of concentrated waste streams and what options are available to reduce the impact of those.

Our nitrate prediction models, which are managed by our Water Resources and Planning team, are reviewed on an annual basis. These are showing some positive results with us observing nitrates decreasing in a number of borehole sources within our region; however, we are still observing increasing nitrate levels in a significant number of sources which are included within the nitrate prediction models. It is therefore likely that additional nitrate treatment will be required in the short to medium term future.

Levels have been atypical in some aquifers in the last few years, with sharp increases observed at a few sites due to two consecutive wet winters in 2019/2020 and 2020/2021. While we have experience of increasing nitrate levels following aquifer recharge, the impact of changes in weather patterns has provided us with more information and we recognise that this is likely to be observed at an increased frequency in the future. The potential impact of climate change on our aquifers will inform our future thinking on nitrate levels in our groundwater sources. We are actively engaged in the Ofwat funded current research on Diffusing the nitrate time bomb, looking into model predictions within chalk aquifers.

We currently are proposing 12 nitrate reduction schemes, including new treatment plus uprated treatment for AMP8 with an investment total of £86 million. Further reviews are being undertaken which could reduce this down to nine schemes.

We have a number of large strategic water treatment works and processes, such as Grafham and Wing water treatment works. Assets of this scale periodically require planned maintenance investment which is

at significant cost. As highlighted previously these sites employ 'conventional' surface water treatment processes which may not provide protection for future pollutants.

Linked to the strategy of 'Protecting and Improving Raw Water Quality at Source', there are uncertainties with other emerging pollutants, which may become an issue in the future, such as micro plastics or new pesticides; while we will continue to explore opportunities to manage these at source, we may need to identify new treatment technologies to deal with these issues.

Additionally any new parameters and subsequent standards recommended by the Drinking Water Quality Advisory Standards Board could also result in the potential for additional treatment, in particular for those new parameters which are currently not a requirement for us to monitor for; therefore we are currently uncertain of the risk and possible risk mitigation measures which may be required. It is possible that investment in alternative treatment technologies will be required in AMP9 in readiness to meet any future standards requirements.

We will look to embrace any opportunities with our Innovation team, particularly focussed on our Innovation Shop Window. Located in Newmarket, it is a platform where we can accelerate innovation for our business. Where we consider innovation not just in terms of technology but across processes, people, information and then technology.

The aim is to create an incubator of Anglian Water's business for the future, by removing barriers to innovation, implementing innovative solutions and testing new ways of working across the whole water cycle.

We have expanded the boundaries of the Shop Window to cover operational areas which are more representative of our wider business. With a constant focus on scaling successes across the organisation we can learn how to face our current and future challenges, develop our people and ultimately achieve our strategic priorities through AMP7 and beyond.

We have developed Odour Removal Plans for four of our sites following extensive investigation work, these plans include optimal operation of the treatment plants to maximise the removal of natural sulphide odours from the raw waters. We have also carried out extensive investigations into a site to optimise the blending of the raw water sources. Our AMP8 plans build on this work to ensure the robustness of the treatment process. We have identified an investment proposal for £4.2m, to introduce additional treatment, wash water capability and enhanced blending of treated water.

Emerging contaminants

PFAS compounds

As previously mentioned, the introduction of DWI guidance on PFAS in October 2021 and subsequent additional guidance July 2022 requires an understanding of PFAS catchment risk and the introduction of sampling for 47 compounds at a risk-based frequency. PFAS final water tiers and actions requires the review of adequate control measures for Tier 2 final waters (less than 0.1 µg/l). Importantly it also requires the preparation of measures to prevent the supply of water to consumers with >0.1 µg/l PFAS. Tier 3 final waters requires the preparation of emergency contingency measures to prevent the supply of water to consumers with >0.1 µg/l PFAS.

In 2021 we commissioned Wood PLC to further develop our PFAS risk assessment methodology to better establish the risk to each of our groundwater sources, this review was refined following IL 03/2022. We are currently undertaking a review of the outcome of the project risk assessment, to include a review of our risk based sampling programme and subsequent sample results to date covering the full 47 compounds. We define our surface water sources as very high risk.

We have created an internal monitoring risk-based sampling programme for our raw and final waters, with monthly to quarterly sampling. This will inform our risk assessment. Sampling commenced of our very high and high risk raw waters as defined by our PFAS catchment risk assessment, with these raw and final waters sampled monthly for the 47 compounds. This sampling started in August 2022, we currently have 40 final waters and 71 raw waters (including our 16 surface waters), sampled monthly.

A number of our final waters are triggering Tier 2 with one of our ground water sources triggering Tier 3 in the raw water (this is a known PFOS contaminated site linked to activity from the local US military air base). With the limited sampling undertaken so far (which must be noted does not take into account seasonality), there is significant uncertainty around the existing PFAS risk, with the potential for existing guidance to be updated, the future risk also remains uncertain. Additionally, our understanding of the health risk of PFAS currently remains unclear, with tier levels set at precautionary values.

Granular Activated Carbon (GAC) is recognised as a treatment process which is effective at PFAS removal. It is unclear at what point specific compounds desorb and what the impact on regeneration frequency is likely to be.

We have commissioned research with Cranfield University to understand the PFAS breakthrough curves for our GAC at our Tier 3 raw water source. This research is based upon GAC bench scale testing with preliminary results due end of January 2023.We anticipate a final report at the end of March 2023. It must be noted that this research is based upon ground water challenged carbon not a surface water challenged carbon which will be more heavily laden with organics and therefore we anticipate the breakthrough curves will differ. Small chain PFAS compound breakthrough from organically laden surface water carbon versus groundwater carbon breakthrough, will be an additional gap in our knowledge despite the findings of this research project.

We are proposing investment in AMP8 to replace existing GAC with virgin GAC media at our very high catchment risk sites rather than undertake regeneration, so effectively optimising the existing GAC treatment stage to reduce the risk of PFAS short chain compound breakthrough. This includes a total of 21 sites, which includes our 16 surface water treatment works and five ground water treatment works. These sites have been identified based on the sites that have or are at risk of hitting the trigger for Tier 2 (<0.1 µg/l) on the final water. This includes our Tier 3 raw water source. This investment is circa £26.5m.

(Note disposal costs are not currently included).

We have 13 very high catchment risk sites without any PFAS treatment. The cost of delivering full GAC treatment at the 13 sites is £186m. However, only three of these sites are currently triggering Tier 2. The investment proposal for AMP8 is for new GAC installation at these 3 sites at a cost of £38.2m.

This would defer GAC installation at the remaining 10 sites (at a cost of £134m) into AMP9. It is proposed that it would be beneficial to defer investment in an area where understanding of treatment capabilities and treatment efficiency is under research (plus there is potential for additional DWI guidance), with a view that alternative solutions are developed during AMP8 (although there is no guarantee that this will be the case). Further sample data will also inform this decision.

Additional investment is required to install a backwash water handling system for our Tier 3 site to prevent any deterioration in the raw water PFAS levels from the current soakaway system. This investment is circa £2.3m.

Sample data is currently being reviewed and we are aligning the data with the PFAS catchment source risk assessment to provide further support for this investment. Additionally, our current research with Cranfield University will inform the approach of virgin GAC replacement against increased regeneration in the future.

In summary, the investment proposal for AMP8 is virgin replacement at 21 water treatment works and additional GAC treatment processes at three sites at a cost of £26.5m and £38.2m respectively. Investment for a wash water handling system at a raw water source at a cost of circa £2.3m. GAC media disposal costs are not currently included, (costs awaited from our framework suppliers).

Defras research into treatment capabilities and efficiencies between treatment technologies we understand will be published in 2024. The outputs of this research will be key in informing any future PFAS treatment requirements.

Other enduring or emerging contaminants

We have identified areas within the guidance note – long term planning for the quality of drinking water July 2022, which we currently understand are applicable to our drinking water safety planning and identification of water quality risk.

Microplastics are ubiquitous in the environment according to the WHO technical report Microplastics in drinking water August 2019. The Inspectorate welcomes further research and company investigations that consider microplastics. We will continue to support research in this area.

Endocrine Disrupting Chemicals (EDC's) have been identified as a potential cause for concern for human health by the WHO report State of Science Endocrine Disrupting Chemicals 2012. Literature verifies the occurrence of 17-Beta estradiol, Nonyl phenol, Bisphenol A. The DWI research has highlighted these three EDC's as of particular interest in terms of human health and have proposed recommendations for limits in drinking water. Limited information is currently available on concentrations of these substances in source/treated water or their removal using advanced drinking water treatment technologies.

Following the commissioning of research by the Inspectorate Likelihood of three endocrine disrupting substances reaching drinking water, no high levels of the three EDC's were noted that would be of concern, however the recommendation is that they should be monitored on a routine basis by water companies. We are currently identifying which laboratories can provide this analytical capability.

Safeguard quality across our distribution system

We continue to deliver significant investment within our distribution system maintaining the serviceability of our infrastructure and continuing to improve our performance on leakage. We employ advanced technology such as acoustic noise logging, and pressure transient monitoring to understand the performance of our distribution system. We optimise our networks through pressure management techniques to 'calm' the network and reduce pressure fluctuations. This reduces burst main rates and provides water quality benefits principally by reducing the risk of discolouration. Industry leading leakage levels also have positive water quality benefits. Our drive for advanced innovative technologies within this area brings the opportunity to provide further benefits to water quality risk. Further investments have been identified within these areas in AMP8.

These advances in technology allow a more informed move towards predictive analytics which provides further data information to feed into our optimised network approach.

We will continue with our planned Preventative Maintenance Programme (PPM) using initiatives such as sedimentation mains flushing, air valve and critical valve inspections. Sedimentation flushing remains our primary mitigation for managing discolouration within our network, and we are proposing similar levels of PPM flushing investment for AMP8, at a cost of £11m.

No investment need has been identified currently for mains rehabilitation or replacement for AMP8 linked to discolouration risk. Investment is based upon burst risk and resilience.

We are developing proposals for up to £300m of investment in replacing climate vulnerable mains in AMP8 under a resilience driver which will add benefits to any discoloration risk, details of which are provided later.

Storage Points and Asset Health

We have developed an 'asset condition-based risk' assessment which supports the inspection frequency of our storage points. Additionally, we have developed a storage point deterioration model which will inform future investment requirements.

Our storage point asset stock includes 128 water towers (more than any other company) with 32 per cent of the UK's stock in our region. We also operate 255 service reservoirs, and significant investment in this asset base will be required (as previously mentioned this is supported by an 'asset condition risk' assessment within this AMP). These assets range in construction date from 1871 to 2017, however the majority are greater than 50 years old.

Due to their nature, water towers suffer greater exposure and therefore faster deterioration and require regular repair and maintenance to ensure they remain serviceable. During AMP7 we are developing a long-term strategy for these assets, which will include a review of options around maintenance, replacement or abandonment, this will inform future investment periods.

We recognise that a smaller number of these storage points (one to two) will require substantial investment for refurbishment (>£1 million) per AMP. As an example, one of our service reservoirs has required complete replacement in AMP7 at a cost of over £4 million. Current inspection and remediation investment in storage point assets is circa £30m during this AMP, (this excludes the £4 million investment). Our risk based AMP8 investment is likely to be up to £50 million which includes an increase in inspection frequency to ensure we continue to meet best practise of below 10 years and an increased level of remedials required to due to asset age.

Water Mains and Asset Health

We have nearly a quarter of the UK's stock of water mains that were laid prior to 1900. Additionally, we recognise that water mains laid as part of the new town developments in the 1950's - 1970's used materials that have since been identified to be short lived in terms of their asset life.

Our asset stock of 38,200 kilometres of water mains includes 5,835 kilometres of uPVC mains, 10,574 kilometres of lined and unlined iron mains (with 3,461 kilometres of that being pre-1900), and 6,917 kilometres of asbestos cement (AC) mains.

Historically pipe replacement and rehabilitation programmes have been prioritised on burst frequency risk, through water quality drivers such as the Section 19 programme of work which was aimed at reducing discolouration risk, and latterly through drivers around interruptions to supply.

The estimated replacement cost of our uPVC pipes is £1.9 billion. For our lined and unlined iron mains this figure is £3.3 billion, and for our asbestos cement (AC) mains it is £2.3 billion. (Cost based upon January 2023 draft cost models). We are proposing a programme of mains renewal or rehabilitation up to £100 million in AMP8.

Epoxy lining and cement lining was undertaken as part of our Section 19 programme of work. Condition assessments for these mains was to be undertaken in AMP7 to understand the asset life in varying situations and to identify when these mains will need to be replaced. This assessment has moved into AMP8 and will inform future investment profiles.

Modern polyethylene pipe is the predominant material used for new and replacement water mains. The performance of polyethylene in terms of burst frequency has been very good in comparison to other materials. However, the material has only been in use for a relatively short period of time in comparison to other materials. It is uncertain whether the performance we are seeing will endure as the polyethylene mains age. We will continue to monitor the performance of this asset group to inform our future investment strategy.

We have more than 17,000 locations where our assets cross other infrastructure assets such as roads and railways; we need to understand, in more detail, the interaction between our infrastructure and that of other sectors. We need to ensure we understand which of these assets represent a risk to infrastructure, so we can take action where required by redirecting or protecting the asset. Work continues in this area.

Climate change impacts

We have completed detailed analysis of climate projections using the common reference scenarios within Long Term Delivery Strategy (LTDS) framework, using these to assess likely burst rates in the period to 2080. This shows that the level of bursts seen during summers like the one we just experienced in 2022 are likely to become normal in future unless steps are taken to renew those pipes most vulnerable to this failure mode. We have compared the actual mains bursts from this summer with those identified as high risk within our climate simulations and found a high degree of correlation.

Our analysis shows that the burst rates we saw over the summer are driven by ground movement associated with high soil moisture deficit in shrinkable soils. Movements of this nature have a greater impact on more rigid pipe materials and/or susceptible to failures at spigot and socket type joints (as found in Asbestos Cement and PVC).We define these pipes as 'climate vulnerable mains', which are rigid materials laid in those soils most susceptible to ground movement.

Resilience of our overall network

Climate vulnerable mains is currently expected to be the biggest investment area proposed within our resilience investment options for AMP8. This is a programme of work which will renew mains in the most climate vulnerable areas. This uses data such as that from our WISPA (Water Infrastructure Serviceability Performance Assessment) model which predicts with high accuracy where there will be extreme stresses on our network leading to premature asset failure in the form of burst mains (e.g. due to soil type and soil moisture deficits) This investment focusses on mains rehabilitation in those areas of the network. Our data suggests that over 6,000km of climate vulnerable mains exist in our network, and we estimate the cost to renew them at around £2.1 billion. Given that the most severe impacts of climate change occur over a long period, our risk based AMP8 investment is likely to be in the region of £300 million. We envisage a similar profile of replacement over six to seven AMP's to renew all climate vulnerable mains in our network.

The strategic interconnector programme (delivered by our Strategic Pipeline Alliance) will fundamentally change our network, and sites such as Elsham and Wing water treatment works are now more important than ever as they 'feed' the strategic grid and they therefore serve more customers. Protecting these water treatment works, storage points and pumping stations which are key to supplying the strategic grid and strategic third-party assets from foreseeable resilience hazards such as power, flooding and single point of failure is a key focus for investment in AMP8. This can be informed now by our Climate Resilience Demonstrator (CReDo) work with BT and UKPN which has revealed inter-dependencies across asset systems in different flood risk scenarios[1]. This investment is likely to be up to £10 million.

We have also identified an opportunity to improve resilience to failure at isolated rural sites that the AMP 8 interconnectors pass through or are close to. The aim to increase the resilience at these sites, reflecting the high-impact, medium-probability risk. Synergy savings can be made by building in resilience at the same time as rolling out the interconnector programme. This investment is likely to be up to £15 million.

We have identified investment to develop a dashboard to proactively identify precursors to operational resilience events at WTWs and in the network. This includes building a digital twin of our water treatment works which identifies a performance deterioration and asset failure creating a single point of failure and therefore risk to customers. Network risk visualisation harnesses the enhanced data from our existing sensors and future Smart systems technology to identify the precursors to resilience and interruption to supply events allowing proactive interventions to occur. This investment is circa £5 million.

1 What is CReDo? – DT Hub Community (digitaltwinhub.co.uk)

Introduction of the Asset Management Common Framework in AMP4 resulted in investment based on forward looking risk assessment. Intelligent information, innovation and targeted maintenance underpin our asset strategy and focus on optimisation of those assets to principally extend the life of those assets.

With the introduction of 'Water 2020', Ofwat consulted with the water sector on the future regulatory framework for the water industry; a key part of that consultation involved the long-term challenges which the industry faces.

'**Water 2020 – long term challenges and uncertainties for the water sector of the future**' represents an industry perspective of the issues the industry faces with respect to future challenges and drivers. Twelve key long-term challenges were identified, of which ageing assets are included within the list of uncertainty facing the sector. It was recognised that 'through innovation, intelligence around performance and prioritisation/targeting of investment companies have been successful in maintaining the serviceability of assets, thus maintaining and improving services to customers and the environment'.

This has since lead to the creation of a separate workstream with companies and Ofwat collaborating together on operational resilience.

One of the main implications raised within the industry perspective with respect to ageing assets was: '**Further innovation and risk management may not be sufficient in the future. A step increase will be required at some point.**'

The key question identified was '**how do approaches to maintenance planning and regulatory methodologies need to adapt so that we know what the triggers are and that we invest before assets start to fail and in a timely way**'.

There have been discussions with Ofwat at several forums and levels since the consultation where we have discussed both resilience and mains replacement rates being unsustainably low to guard against the future being different to the past. Ofwat's Final Methodology opens the door to more investment in resilience to external factors, with a revised definition of resilience in the context of enhancement investments[2].

2 Appendix–9-Setting-expenditure-allowances-1.pdf (ofwat.gov.uk)

Ensure water is clean and safe within the home

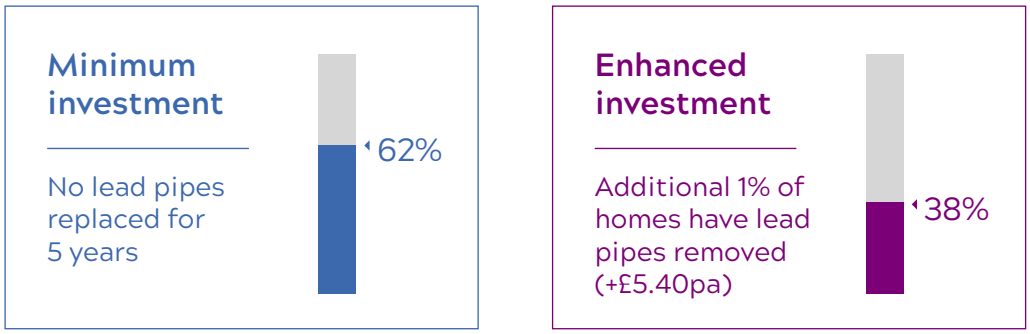
A significant proportion of our compliance failures, DWI reportable events and customer contacts are related to issues with domestic distribution systems. We believe that lead pipework, compliance with the Water Supply (Water Fittings) Regulations (referred to as Water Regulations below) and grey water use remain our most significant risk with respect to water quality within buildings. We anticipate changing customer behaviour, particularly to save water, as the population growth in the region increases.

The latest estimates are that we have 500,000 lead communication pipes within the Anglian and Hartlepool regions. Over the past three AMPs we will have replaced circa 19,000 lead communication pipes.

Working on the ambition to be lead free by 2050, under an even trajectory, we would need to renew/rehabilitate 100,000 lead service pipes in AMP8. However, due to the significant costs of this, the potential for more innovative solutions to be developed (e.g. internal structural lining) in the future and given the initial pushback from customers within this AMP on having their lead supply pipes replaced due to the significant personal disruption, we have targeted our plans for AMP8 to maximise learning within the industry. This includes delivery of our lead strategy with focus in our high risk areas, vulnerable customers and customer education on the health risk of lead.

This is supported by current customer insight gained so far that when asked about replacing lead pipes in homes that they are supportive of no lead pipes replaced for five years versus an enhanced investment option of plus £5.40 per annum bill increase as shown below.

Replacing lead pipes in homes



Customer engagement investment priorities wave 3 of 4 November 2022 – Trinity McQueen.

The Defra Strategic Policy Statement supports action by industry to trial approaches for reducing exposure of lead to customers from drinking water lead.

We continue to have representation on the Water UK lead steering group and take learning from the Ofwat Green Economic Recovery initiative lead trial work being undertaken currently. We have aligned our AMP8 lead strategy to the Inspectorate's expectation that companies should investigate and develop trial projects to better understand how we can deliver further reduction on lead in drinking water effectively and efficiently. Our lead proposals include the replacement of lead pipes at a reduced detection of 5 µg/l of lead rather than the PCV of 10 µg/l, planned pipe replacement with local authorities in our highest risk areas for lead, a replacement trial of lead pipe in schools and nurseries within our high risk areas for lead and continuation of our leading vulnerable customer work on informing our customers of the health risks of lead pipework. This investment is circa £24 million.

Our proposed Lead Strategy for AMP8 will inform our future thinking and proposed investment profile over a 50 plus year planning horizon. Our updated lead strategy will be submitted to the Inspectorate by the 31 March 2023 and will include specific reference to PR24 investment.

We will continue to actively support research into innovative pipe rehabilitation techniques and alternatives to plumbosolvency control.

To aspire to be lead free by 2050 would require a replacement rate of 125,000 pipes per AMP from AMP9. The estimated overall total cost of replacement and or rehabilitation to the lead pipes in the Anglian region is £2.7 billion (based upon our current cost models). There is significant challenge in delivering such a programme of work where it will also remain an area of focus for the rest of the industry, not least with respect of delivery resources. Support from customers to undertake replacement on the pipe which they own also comes with huge uncertainty and risk.

We will work to understand synergies with other delivery programmes to explore opportunities to identify lead pipework and where appropriate identify areas where we can work differently in the future for example on the smart meter programme and leak identification work. We welcome any future discussion on delivery models and funding mechanisms and how we can work with other key stakeholders to support this significant area of investment.

Future growth within the region, significant housing development and promotion of retro fits will almost certainly mean an increase in grey water reuse systems, predominantly in domestic properties. This introduces an increased risk of plumbing misconnections or cross connections between potable and non-potable systems.

These high-risk premises will have to be inspected, and plumbers and customers will continue to be educated on the risks through our 'Keep Water Healthy' campaign. Our 'Keep Water Healthy' campaign works in conjunction with our Water Regulations team and is actively promoted through our website and social media channels. It aims to raise awareness of potential water quality for our customers, and what can be done to prevent these problems.

We will continue our work to promote the WaterSafe scheme for approved plumbers and the Regulation 5 notification process. The future scale of the impact on future inspections is currently unknown and will be dependent on the rate of housing development. Through these additional inspections, there is the potential for an increase in infringements identified; this is an area of uncertainty to quantify.

We will continue to evaluate and develop our 'Water in Buildings' strategy and we recognise that we have a key role in informing customers of how they can impact negatively on water quality and how they can keep their water healthy.

Security and Emergency Measures Direction (SEMD) and Network Information Systems (NIS)

In Ofwat's Creating tomorrow, together; consulting on our methodology for PR 24 – Appendix 9 – setting expenditure allowances, they recognise that expenditure on the delivery of SEMD outcomes and NIS Regulations will also contribute to improved resilience to security threats and operational incidents. Further investment is required in AMP8 to improve the security at sites, this is reflective of new SEMD requirements and the continuation of the NIS compliance programme.

SEMD requirements for the future are driven by emerging risks and world threats. Level of risk to the industry and advice on specific threats comes from government through Defra, the DWI and the Centre for the Protection of National Infrastructure (CPNI).

Exploitation of changes in technologies and innovation by those wishing to access and or harm our assets leads to new threats. It is essential to continue to enhance security to maintain pace with this technological change.

Growth within our region will require new assets and infrastructure which must also meet the required levels of security.

Investment is required in AMP8 to further improve the physical security and security systems at two of our largest critical operational sites supplying together a population of circa. 1.7 million. These sites require security measures as guided by the Protective Security Guidance (PSG) and the Water Security and Electronic Standards. The PSG also requires companies to have at least once per Asset Management Period (AMP), a relevant external consultant sample a portion of their audits to ensure the audits remain robust. In accordance with those requirements we commissioned an external audit in 2022 by a Registered Security Engineer, which has identified enhancements in early alarm notification systems and some physical security hardening is required to maintain the required level of security. The investment required is circa. £1.4 million, subject to further scoping.

Our NIS proposals align to previous Cyber Assessment Framework (CAF) submissions and associated NIS compliance plans. Our approach to NIS compliance is driven jointly by the requirements of the CAF and by our NIS Directive Risk Assessment (a document that has been externally assured by Jacobs and submitted to the DWI and OFWAT during the 2022 CAF submission period).

Our AMP8 plan for NIS Compliance includes the rollout of NIS aligned security controls to all medium risk water supply systems (71 sites in total), enhanced cyber security tooling, enhanced cyber physical security at water supply assets and market research and subsequent trials to secure Industrial Control Systems technologies which will inform our technical strategy. The investment proposal is for £20 million.

Investment is proposed within AMP8 on our water recycling sites for enhanced security control under NIS, however detail is not included within this document.

Looking forward to future AMPs, emerging threats, risks and new technologies will drive the need for further investment in management tooling, network architecture and security controls. We plan to drive NIS compliance coverage to lower risk water supply systems. We anticipate water recycling assets to be brought into scope of NIS. We also anticipate that key CNI suppliers will be brought into scope. Also changes to SSP are anticipated which will likely lead to future investment needs.

Long Term Delivery Strategy

For PR24 Ofwat has asked companies to set out their business plans in the context of a 25 year Long Term Delivery Strategy (LTDS). As part of the development of our LTDS, we must identify strategic interventions that will support the delivery of our ambition by 2050. We have introduced four cross cutting themes that will shape the development of our LTDS and AMP8 business plan. These are digital, innovation, place-based thinking and working with others.

A cross cutting theme is a delivery approach that is common to multiple areas of investment and the delivery of multiple outcomes, the aim is to develop a progressive plan in how we deliver value to our customers and the environment. Quality enhancement is a key area which feeds into our LTDS and this concise statement sets a very high-level framework to further develop the water quality elements within our LTDS.

Conclusion

The current asset management approach has been successful in maintaining services and asset serviceability; this has been achieved with the use of better information, innovation, targeted maintenance and focussed investment.

However, consultation on Water 2020 recognises that the industry faces a number of future key common challenges and uncertainties, and a potential step change in investment may be required.

Given what we understand about the future, we have co-created the asset management maturity assessment in 2021 with Ofwat. We have been identified as leading in terms of asset assessment and risk modelling work and we have representation on the asset management improvement roadmaps and a maintenance standards regime, and the operational resilience workstreams. We have identified areas of significant potential future investment to maintain the resilience and health of our assets, some of which will require spanning multiple AMPs due to the large costs and delivery requirements involved. An overview of the potential areas of investment is detailed within Appendix 1 and includes the potential long-term investment up to 2050 in the form of a timeline at a source to tap level. This presents our ‘core pathway’ and our LTDS will set out more details on adaptive approaches to these investments.

We will continue to work with our customers and other stakeholders to develop our plans for the future as detailed within our SDS. Customers tell us that providing safe clean water is the most important thing we must do.

Toni Holtby
Water Quality Policy and Strategy Manager
31 January 2023

Long term planning for the Quality of drinking water supplies timeline

Area	Proposed investment/activity	AMP8 2025 - 30	AMP9 2030 - 35	AMP10 2035 - 40	AMP11 2040 - 45	AMP12 2045 - 50
Protect and improve raw water quality at source	Catchment management WINEP; Total pesticide, algae and turbidity	£9.5-£16.9m				
	Catchment management BAU	£10m	£10m	£10m	£10m	£10m
	WRMP	£700 - £800m				
	New boreholes	£7m	£7m	£7m	£7m	£7m
Increase resilience in our treatment processes	Ozone treatment plant replacement	NA	£85.5m			
	GAC treatment plant replacement	NA	£96m			
	Nitrate – Ion exchange plant replacement	NA	£35m			
	Nitrate reduction	£86m				
	Emerging contaminants – PFAS virgin GAC media replacement * does not include disposal costs currently ** dependent on further research	£26.5m *	£26.5m **	£26.5m **		
	Emerging contaminants – PFAS new treatment (GAC media treatment process installation)	£38.2m				
	Emerging contaminants – PFAS new treatment (costs based upon virgin GAC installation)	See above	£134.3m			
	Emerging contaminants – PFAS wash water handling system	£2.3m				
	Taste and odour – optimal treatment	£4.2m				
Safeguard quality across our distribution system	Storage point inspection and remediation programme	£ up to 50m	£50m	£50m		
	Storage point substantial investment	£4m	£4m	£4m	£4m	£over 7m
	Lead strategy (further detail will be provided in our lead strategy submission 31 March 2023)	£24.1m				
	Lead strategy – planned pipe replacement	Included in above	£670m	£670m	£670m	£670m
	Mains rehabilitation	£100m	£100m	£100m	£100m	£100m
	Climate Vulnerable Mains >6000km	£300m	£300m	£300m	£300m	£300m
Ensure water is clean and safe within the home	Water In buildings – Fittings regulations – BAU	£5.2m	£5.2m	£5.2m	£5.2m	£5.2m
SEMD	Various security enhancement	£1.4m *awaiting additional detailed scoping	£1.4m	£1.4m		
NIS	Various security enhancement	£20m	£20m	£20m		

Appendix one; This presents a single forecast of the 'core pathway' our LTDS will set out more details on adaptive approaches to these investments. Note some areas are still under development for scoping for AMP8 and therefore detailed costings could change.

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