Appendix 5.3.A.1 - PR19 Drinking Water Quality submission to DWI

Wessex Water

September 2018

Wessex Water
YTL GROUP

Business plan section		Supporting document	
	Board vision and executive summary		
1	Engaging customers		
2	Addressing affordability and vulnerability		
3	Delivering outcomes for customers		
4	Securing long term resilience		
5	Markets & innovation: wholesale	5.1	Protecting and enhancing the environment
		5.2	Using water efficiently
		5.3	**Providing excellent drinking water quality**
		5.4	Minimising sewer flooding
		5.5	Bioresources
		5.6	Maintaining our services
		5.7	Accommodating growth and new development
		5.8	Water resources bid assessment framework
		5.9	Water resources RCV allocation
		5.10	Bioresources RCV allocation
6	Markets & innovation: open systems & DPC		
7	Markets & innovation: retail		
8	Securing cost efficiency		
9	Aligning risk and return		
10	Financeability		
11	Accounting for past delivery		
12	Securing trust, confidence and assurance		
13	Data tables and supporting commentaries		

Document revisions

Major version number	Details	Lead contact	Date
1	Draft issued for review	Natalie Doran	Dec 2017
2	Final version	Julian Welbank	Dec 2017

Executive summary

Wessex Water's headline compliance with mandatory drinking water quality standards has not fallen below 99.95% for over 10 years. For the new Compliance risk index, which takes a broader view of compliance, we were the leading water company in 2016.

Our objective and long term strategy for drinking water quality is to provide "*Safe, wholesome and pleasant drinking water which complies with mandatory standards and supports the wellbeing of our customers and communities".*

In developing our programme of drinking water quality improvements for the period 2020 to 2025 and beyond, we have aimed to:

- develop an ambitious business plan that delivers for customers
- adopt a progressive approach incorporating cultural improvements, working practices and innovation
- build on our leading performance on the new Compliance Risk Index
- take a long term view to ensure resilient and future proofed projects.

In summary our drinking water quality improvement programme comprises:

Drinking water quality driver Main water quality hazard	Brief description	Number of schemes	Regulatory support
Raw water deterioration			
Nitrates	Blending asset solution at two sites to ensure compliance: • Fonthill Bishop • Sturminster Marshall	2	DWI support requested
Nitrates	First time catchment management to arrest rising trends	6	Supported in Environment Agency's WINEP[1]
Metaldehyde	Trial of market tool, Entrade, on River Tone upstream of abstraction point for Durleigh WTW	1	Supported in Environment Agency's WINEP
Lead	Further expansion of our proactive lead pipe replacement – working in partnership with customers	1	DWI support requested

This submission seeks support from the Drinking Water Inspectorate for blending asset solutions at Fonthill Bishop and Sturminster Marshall and further expansion of our proactive lead pipe replacement programme.

[1] WINEP = Water industry national environment programme. Version 3 is due to be issued in March 2018

Contents

1. Introduction

This submission has been prepared in response to the information letter from the Drinking Water Inspectorate (DWI) dated 12 September 2017 (information letter 03/2017).

Our approach and an outline of the programme was presented to the DWI at a meeting on 30 November 2017 with Milo Purcell, Sue Pennison and Tim Williams. The feedback from the meeting is included in our proposals set out in this submission.

The submission comprises:

- an overview report including an outline of our approach, related plans and long term drinking water quality considerations
- a completed annex for each of the schemes that we are seeking support for
- supporting technical appraisal documents.

Our submission has been developed from consideration of:

- the priorities set out in our Strategic Direction Statement – *Our strategic direction*
- DWI Guidance Note: Long term planning for the quality of drinking water supplies, published in September 2017
- Drinking Water Safety Plan hazardous event and action scores
- modelling of long term nitrate trends
- operational performance trends
- outline appraisal of options covering technical, costs and benefits.

There has recently been a move from mean zonal compliance (MZC) as a metric for comparing performance to compliance risk index (CRI). We are proud to have achieved an industry leading position for CRI in 2016. We intend to maintain this position through a proactive, risk based approach and by setting ourselves ambitious targets and high standards.

To ensure we achieve this we need specific support from the Inspectorate for three schemes:

1. A nitrate blending scheme at Fonthill Bishop WTW
2. A nitrate blending scheme at Sturminster Marshall WTW
3. Expansion of our lead strategy.

We have provided indicative costs for solutions and options, where applicable. As the drinking water quality submission has been prepared ahead of the company's business plan some of the information prepared has not been subject to all of our internal business plan review processes so the costs may be subject to change. However, we can confirm that where provided the estimates will provide sufficient information to compare the cost effectiveness of alternative solutions, which we understand to be the Inspectorate's main requirement at this stage.

2. Strategic Direction Statement

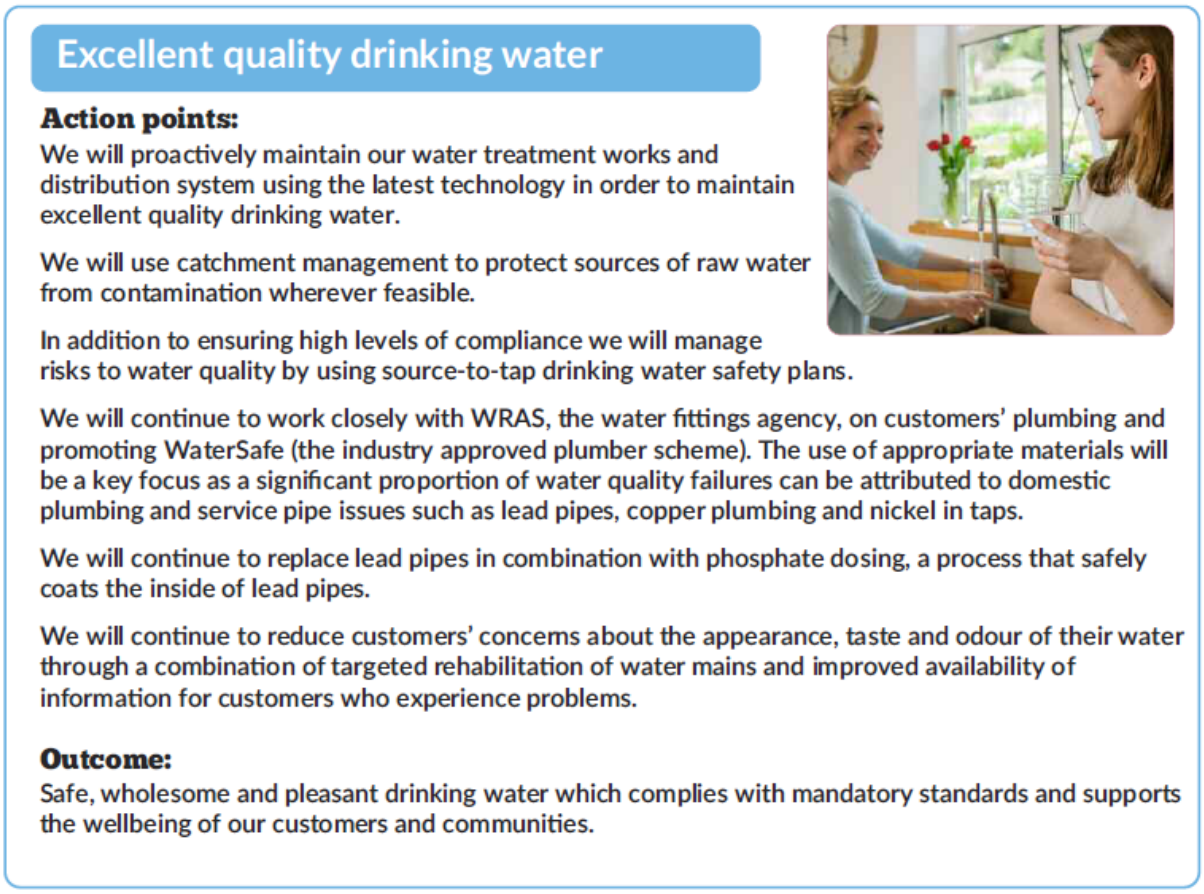
Wessex Water's mission is *"to provide outstanding, sustainable water and environmental services"*. Providing a resilient service and meeting future challenges in a sustainable way that is affordable for customers will require continued innovation and ambition.

In July 2017 we published our strategic direction statement entitled *Our strategic direction* which sets out our key long-term future priorities and reaffirms our commitment to providing excellent quality drinking water. We developed the statement after wide and continuous engagement with customers, staff, young people and other stakeholders.

Our strategic direction sets out what we aim to deliver for customers, wider society and the environment. We have also set out the strategy by which we will deliver, focusing wherever possible on forming partnerships with others and harnessing market forces where they can help deliver more cost beneficially.

Our strategic direction informs and supports both our water resources plan and business plan proposals. Within the document is a specific section on our drinking water quality priorities (Figure 2-1), including continued use of catchment management and replacement of lead pipes. The target outcome is *"Safe, wholesome and pleasant drinking water which complies with mandatory standard and supports the wellbeing of our customers and communities".*

Figure 2-1: Drinking water priorities included in our Strategic Direction Statement



3. Principles of Approach

Our approach to long term planning and identifying proposals for drinking water quality improvements involves a combination of the following methodologies:

- priorities set out in *Our Strategic Direction* (25 year vision)
- Drinking water safety plans
- review of compliance and operational performance, including customer contacts
- horizon scanning of future obligations, include DWI's guidance note on long term planning
- our internal Asset Management Strategy for Water, including our ongoing programme of strategic and minor capital maintenance
- modelling of long term water quality trends
- review of people and systems.

Furthermore drinking water is not considered in isolation and our business planning process aims to take into account and integrate all of the relevant factors, including:

- water resources
- resilience
- customer service
- asset management and base maintenance.

As part of our internal governance process for the business plan, the outcomes from the methodologies have been tested through a series of internal risk and challenge meetings ahead of inclusion in this report.

3.1 Drinking Water Safety Plans

Drinking Water Safety Plans (DWSP) enable us to understand risk to water quality from source to tap. Our plans have transformed the way we think and act about drinking water safety and enable us to maintain a proactive, risk based approach.

Our Drinking Water Safety Plans comprise a detailed site-by-site risk assessment. For each of our sources, water treatment works, distribution sites and water quality zones they comprise:

- Four stages from source to tap: catchment, treatment, distribution and customer
- Three categories: public health, compliance and serviceability
- Risk scoring of hazards based on consequence and likelihood in a 5 x 5 matrix
- Mitigation actions for each hazard/hazardous event.

The DWSP process is reliant on the compilation and continual assessment of data, knowledge and information by catchment specialists, process scientists, production and network operatives and customer services staff. The accompanying DWSP methodology is a 'live' document kept under continuous review to ensure further changes and improvements can be captured as plans continue to develop. We have a DWSP scientist to ensure that risks are scored consistently, which is then verified by a monthly meeting to further ensure consistency.

The DWSP process generates a large database of actions and risk scores, which are then used to prioritise investment and inform a rolling programme of capital maintenance.

3.2 Review of recent performance

The new Compliance Risk Index (CRI) is included in Ofwat's list of 14 mandatory performance commitments (PCs) as published in their final PR19 methodology statement.

Table 3-1 summarises recent performance with regard to headline compliance, including the five indices used by the Drinking Water Inspectorate (DWI) to monitor performance and the new Compliance Risk Index. We aspire to continue to maintain and build upon our industry leading performance.

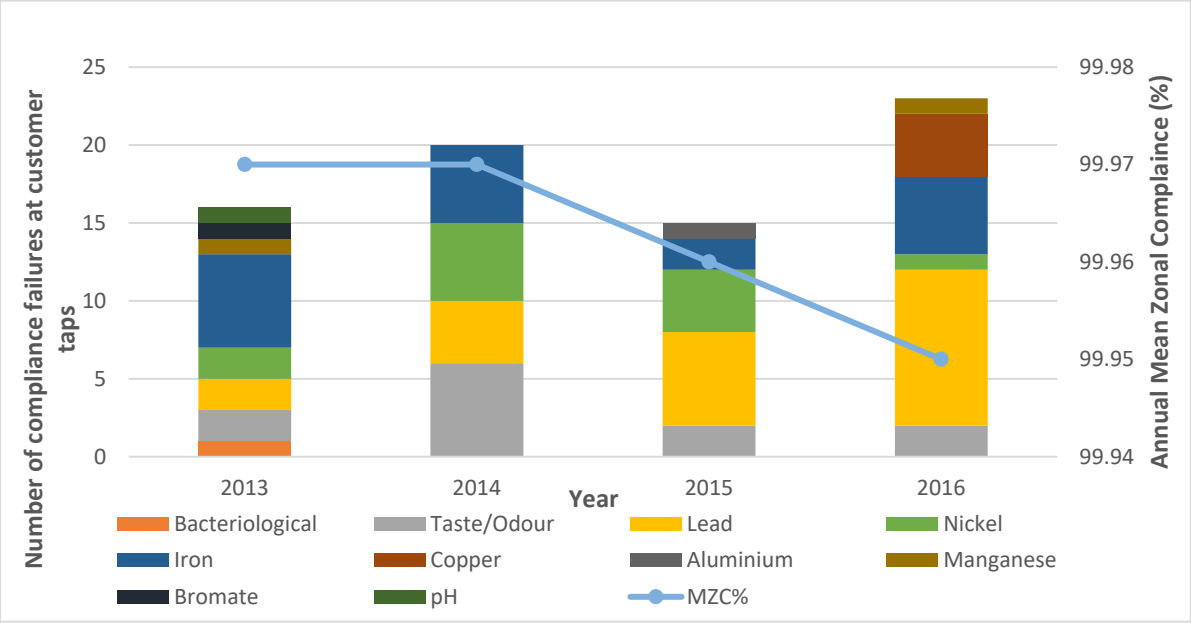
Table 3-1: Compliance performance overview

	2013	2014	2015	2016	2017 YTD*
Mean Zonal Compliance	99.97%	99.97%	99.96%	99.95%	99.96%
Compliance Risk Index	Unknown	3.842	0.179	0.739	1.28
Process Control Index	99.98%	100.00%	99.96%	100.00%	99.97%
Disinfection Index	99.89%	99.96%	100.00%	100.00%	99.98%
Distribution Maintenance Index	99.91%	99.94%	99.98%	99.89%	99.88%
Reservoir Integrity Index	99.96%	99.96%	99.97%	99.97%	99.98%
Building Water Systems Index	99.91%	99.87%	99.85%	99.81%	99.96%

*YTD to end of October 2017

As shown in Figure 3-2, there has been an improvement in bacteriological and taste/odour compliance failures at customer taps. Lead, nickel and iron remain notable issues, which are used to prioritise our investment plans and consider enhanced programmes of work, such as for lead.

Figure 3.1: Breakdown of the number of compliance failures at customer taps 2013 -2016 by parameter



With regard to operational performance; site shutdown and outage data has been interrogated to better understand areas of inefficiency, improvement and further investment.

3.3 Consumer Contacts

Consumer contacts are reported annually in the Chief Inspector's report published by the Drinking Water Inspectorate. Recent data is summarised in Table 3-2. Over the past five years both the number and rate of consumer contacts continues to reduce. This is a result of the continued investment into our distribution network and water treatment works, risk assessment and pro-active communication with customers ahead of planned work within the network. Room for continued improvement remains, particularly with regard to discoloured water, which we will addressing through our ongoing programme of mains replacement, improved network operation and customer relationship management systems.

Table 3-2: Customer contact overview

	2013	2014	2015	2016	2017 YTD*
Informing customers	1296	1464	1364	1135	941
Rate per 1,000 population (informing customers)	1.042	1.149	1.064	0.881	0.725
Acceptability of water to customers	2893	3006	2431	2172	1723
Rate per 1,000 population (Acceptability of water to customers)	2.326	2.359	1.896	1.686	1.327
Complaints to DWI	3	1	0	0	0
Discoloured water contact per 1,000 population	0.914	0.967	0.677	0.595	0.492

*YTD to end of October 2017

3.4 Our asset management strategy

Our asset management strategy for water sets out the approach to delivery of the commitments and objectives made in our strategic direction statement and the business plan.

The asset management strategy covers all water supply assets as detailed in Table 3-3. It is reviewed annually with major updates every five years. We are accredited to ISO 55001, the international standard for asset management.

Table 3-3: Summary of asset functions and groups

Asset Function	Asset Group
Water Resources and Raw water	Dams and impounding reservoirs Raw water aqueducts Raw water pumping stations Boreholes and springs
Water Treatment	Water treatment works
Water Distribution	Trunk mains Distribution mains Service pipes Service reservoirs Booster pumping

Our asset management strategy is risk based, targeting the assets and asset groups that will provide the most benefit to our business, our customers and our stakeholders, whilst taking into account cost, benefit, time and quality.

The capital maintenance needs of assets is managed through the following programmes:

- strategic capital maintenance – identified as part of the business planning process with predominantly major schemes optimised and delivered by our in house engineering and construction team
- minor capital maintenance – annual block allocations for minor works and routine cyclic asset replacement with budgetary responsibility held by our operations team
- fixed plant renewals - reactive and planned work to single assets (e.g. pump replacement etc.) with budgetary responsibility held our operations team
- health & Safety - to address health and safety issues as they arise with budgetary responsibility held by Operations.

Further detail of the above programmes is available, if required.

3.5 Our people and processes

We are well aware that successful delivery of the drinking water outcome is not just about assets and that our people and the systems are also vitally important.

We have carried out a gap analysis comparing the Inspectorate's long-term planning guidance principles with our own approach and are confident that both align, as shown in Table 3-4 below.

Table 3-4: Gap analysis comparing DWI principles and Wessex Water approach

Principles	Wessex Water approach	
Source to tap approach Use of drinking water safety plans	✓	Drinking water safety plans Long term trending of nitrates
Efficient, sustainable, long term benefit Transparent about short and long term Current and future generations	✓	Strategic direction statement (25 year vision) Catchment management and alternative approaches where feasible Customer research including young people's panel
Drinking water accounted for in all aspects of planning: • Event management • Drought management • Water resources • Maintenance • Operations	 ✓ ✓ ✓ ✓ ✓	 Consequence management plans and local emergency plans that are regularly tested and reviewed Water quality impacts for pumped storage and abstraction considered in the drought plan Water quality accounted for in WRMP Water quality main driver for maintenance planning Main focus; dedicated water quality manager and scientists
Sustainability & resilience • Supply chain, skills, knowledge	✓	Apprenticeship programme Secondments to DWI In house teams for key functions (e.g. service reservoir refurbishment, automation) Education programme for schools
Operational resilience • Containment & recovery	✓	Auto shutdown systems Elimination of stand alone sources Run to waste facilities
Proactively meet statutory obligations, addressing changes to risk profile	✓	High risks addressed through annual maintenance programme Additional Reg 28 notices agreed and track record of delivery
Relationship with customers, culture, staff behaviours	✓	Highest SIM score in the industry BEST initiative Water Smart

All operators are required to complete the internal 'Water Smart' training to ensure they have knowledge and awareness of good hygiene practice in the water environment, and receive a signed and dated passport to record that this has been undertaken. This training includes

water supply and Water Smart awareness and guidance on how to enter a treated water space. Completion of the National Hygiene Code of Practice (water supply) training and the possession of a valid hygiene card is required for entry to a water treatment works site. The competent operator programme also includes training for site-specific issues.

3.6 Progress with regulatory notices

All of our current Regulation 28 notices and Section 19 undertaking have either been completed or are on target for completion by the due date. Appendix A includes a table of current regulatory notices.

This demonstrates that in addition to the schemes submitted as part of the periodic price review process, we have declared new risks as they have arisen and promoted projects to mitigate the risk.

4. Resource management and resilience

Our drinking water quality proposals are fully integrated with our water resources management plan and resilience planning.

4.1 Water Resources Management Plan

We have completed our draft water resources management plan which demonstrates a small regional surplus of supply over demand for the next 25 years.

Water quality, together with business resilience was carefully considered when compiling the plan. The Water Resources Management Plan (WRMP) is integrated with our drinking water quality programme and our maintenance programme, in order to ensure consistency across all areas for both business planning and delivery.

This small annual average surplus of between 21Ml/d and 26Ml/d which has been projected for a dry year provides resilience to our security of supply and is a valuable resource for trading with other companies through bulk supply agreements.

The surplus has been achieved by reducing demand and developing our integrated Grid to connect areas with surplus with areas with less resource, rather than developing new resources.

4.1.1 Bulk supply agreements

Bulk supply agreements for either import or export are in place with Bournemouth Water, Bristol Water, SSE (export only), Southern Water, South West Water, Veolia Water and Thames Water providing further resilience. Regular liaison meetings occur and procedures are in place to ensure that any risks to water quality are efficiently and effectively communicated and actioned. Ongoing liaison takes place regarding future sufficiency and cost of supplies.

Our largest import is from Bristol Water into Bath with an annual average import of 11.37Ml/d; however, this is forecast to reduce to 4.40Ml/d from 2019. Bristol Water experiences seasonal Metaldehyde peaks at the supplying ✂ water treatment works and protocols are in place to ensure effective communication when pesticides levels are high. We are alerted when Metaldehyde levels are above limits of detection (LOD) and daily monitoring is triggered. When Metaldehyde levels on the import are forecast to be elevated we are in the fortunate resource position to be able to stop the import on order to safeguard water quality.

In AMP 6 new boreholes have been drilled at our Arn Hill, Cattistock and Codford water treatment works. The requirement for the new boreholes was driven by water quality rather than sufficiency. No new sources or resource requirements are anticipated for AMP 7. The focus instead will be on water efficiency and demand management.

4.2 Resilience

We maintain a long-term view to ensure we have resilient and future proofed services.

Resilience is the ability to cope with, and recover from, disruption, and anticipate trends and variability in order to maintain services for people and protect the natural environment, now and in the future.

Resilience remains one of our key priorities in *Our Strategic Direction*, with the outcome of "*High quality, reliable and secure services to customers and the environment in the face of acute shocks and gradual stresses"* (Figure 4.1).

Figure 4-1: Resilient services extract from *Our Strategic Direction*

Resilient services

Action points:

We will annually assess our resilience in relation to our business, assets, services and the wider environment.

We will set targets to ensure that objectives and working practices are aligned, and make sure we learn from events.

We will identify further opportunities to work at a wider catchment level to increase the resilience of our resources.

We will also:

- actively promote and assist changes in customer behaviour that can add resilience to our services and to the environment
- develop our risk management processes to facilitate targeted investment in the areas at greatest risk now and in the future
- engage with our customers to understand their resilience priorities and target our investment to meet them
- invest in up to date cyber security systems
- improve incentives for developers to build in greater resilience at a local level
- work with flood risk authorities to share data and plans, and protect our assets from flooding
- ensure that our future water resources plans have adequate headroom and allowances for population growth and climate change
- form partnerships with neighbouring companies and other organisations which have an impact on our water catchments, to build resilience into our services and to the ecosystems that provide our resources.

Outcome:

High quality, reliable and secure services to customers and the environment in the face of acute shocks and gradual stresses.

Water supplies are a basic requirement for life. Our current customer research suggests that in general customers have a low appreciation for future risks and the need to build resilience in to the water infrastructure. Customers expect water companies to be planning for the future as a matter of course. Providing resilient water services to our customers is not a new issue for us. We have consistently taken the long-term view of investing to improve the resilience of our service in line with customer preferences and expectations.

As a result of our proactive investment and resource management we have not imposed restrictions on water use since 1976 and have kept leakage under control throughout recent cold winter periods. As part of the way we manage risk we have implemented a programme to protect critical assets and improve security of supply including the development of the strategic grid network. We continue to assess the resilience of service to our customers against a wide range of hazards and threats to ensure we deliver against customer and stakeholder expectations.

4.2.1 The Grid

An example of our long term resilience planning and integrated resilience approach has been the development over the last two business review periods of our strategic integrated water supply grid (Figure 4-2). Once complete in 2018, this will enable better use of resources across our region; facilitating the optimisation of blending and source utilisation for water quality and security of supply.

The Grid provides multiple benefits including:

- security of supply and resilience
- it enables us to meet current and future demand for water
- helps to improve the ecology of sensitive rivers
- enabling us to continue to meet drinking water standards
- the opportunity to trade with neighbouring water companies
- the Grid optimiser software enables optimum use of sources – when demand is low, use most economical sources in preference to other sources

With the grid system in place and the current forecast supply demand balance in the region, we are now a potential donor region with a relatively robust drought resilience compared with other neighbouring regions.

Figure 4-2: Wessex Water Integrated Supply Grid

Parts of the Grid network will be remotely controlled through our optimiser system, which manages the network semi-autonomously by interpreting a series of inputs and constraints to ensure consistency and quality of supply whilst managing cost. Sweetening and conditioning of the main will take place routinely and automatically to ensure the network remains 'supply ready'. The optimiser automatically recalculates the best way to operate the network to mitigate an outage improving the resilient operation of our water supply system. Following the success and efficiency of this system there are plans to extend the optimiser and remote control across more of our network.

The development of the grid has also enabled the opportunity to provide additional resilience by connecting with neighbouring water companies to provide support during emergencies.

4.2.2 Service resilience

Resilience of critical infrastructure and essential services can be secured through four key strategic components:

- resistance to the hazard
- reliability of the asset
- redundancy built in to the systems
- response and recovery when an event occurs

We take resilience and business continuity seriously. They are part of the ways we manage risk and we use all of the four key strategic components of resilience to manage the risks and ensure a resilient service to our customers.

Figure 4-3: The 4 R's of Resilience

As part of the way we manage risk and have already implemented a programme to protect critical assets and improve security of supply. We continue to assess the resilience of service to our customers against a wide range of hazards and threats to ensure we deliver against customer and stakeholder expectations.

4.2.3 Resistance

Resistance is preventing damage or disruption by providing the strength or protection to resist the hazard or its primary impact.

We have assessed our water treatment sites to flood risk with resistance to the flood hazard being the most appropriate management of the risk. This was initially undertaken as part of the 2009 business plan development to determine where further analysis was required. Twelve sites were identified as flood vulnerable sites, and these underwent a detailed flood risk assessment, which included topographical surveys, river modelling and further site inspections. This modelling took into account climate change with a standard of 20% increase in fluvial flow. From the results of the modelling work, flood mitigation works were proposed for each site. For ten sites this involved only minor improvements and two sites required significant flood protection measures to provide resistance to the hazard. These were addressed by flood protection investment works completed in 2012.

In early 2016, Defra requested data from us to inform the National Flood Resilience Review looking at assets serving more than 25,000 population in greater detail. The flood resilience of our 28 water treatment works of this size was based on:

- the Environment Agency's flood maps for 1 in 50 and 1 in 100 year flood events

- the flood risk assessment work undertaken to support the 2009 and 2014 business plans
- discussions with operational staff of sites with a history of flooding.

The review highlighted that seven sites would be affected by flooding with regard to the output from the water treatment works, not through damage of assets, but rather prevention of access to site, and shut-down of operations due to raw water turbidity detection or flood level sensors onsite.

Greater focus is being placed on critical infrastructure and their associated resilience. Therefore, all of our larger sites and those highlighted at risk of flooding were subject to review to a 1:1,000 year flood event, termed an 'Extreme Flood Outline'. The flood risk assessment conducted at each site assessed the source of flooding from potential sources including impacts of climate change up to the 2050 horizon for the following return periods:

- fluvial flood risk (1 in 100 year, 1 in 1000 year event)
- tidal flood risk (1 in 200 year, 1 in 1000 year event)
- surface water flood risk (1 in 30 year, 100 year and 1000 year event)
- risk of flooding from reservoirs.

An example model extract is shown in Figure 4-4.

Figure 4-4: Extract from flood management database

A hierarchy of mitigation methods have been used to assess ways of improving the resilience to an extreme flood event and any investment is subject to an appropriate cost benefit assessment.

4.2.4 Redundancy

Redundancy is concerned with the design and capacity of the network or system. The availability of backup installations or spare capacity will enable operations to be switched or diverted to alternative parts of the network in the event of disruptions to ensure continuity of services.

Due to the investment in planning for resilience services we have not imposed restrictions on water use since 1976. We have completed our draft water resources management plan which demonstrates a small regional surplus of supply over demand for the next 25 years, of between 21Ml/d and 26Ml/d in a dry year.

The surplus has been achieved by reducing demand and developing our integrated Grid to connect areas with surplus with areas with less resource, rather than developing new resources.

The Water Resources Management Plan is integrated with our drinking water quality programme and our maintenance programme, in order to ensure consistency across all areas for both business planning and delivery.

4.2.5 Reliability

Reliability is ensuring that the infrastructure components are inherently designed to operate under a range of conditions, and hence mitigate damage or loss from an event.

A key priority for customers is to maintain the quality, reliability and resilience of water supply services. Customers want services to be delivered in a sustainable way by reducing our carbon footprint and maintaining our assets for future generations.

We follow Common Framework principles, with risk management embedded in day to day decision making. Our asset management framework, which includes asset strategies and asset group plans, provides business-as-usual asset management processes aimed at ensuring our strategic objectives are achieved.

We aim to strike the optimal balance between maximising performance, long term asset stewardship and managing risk, subject to affordability constraints. We therefore use a mix of asset renewal and refurbishment strategies depending upon the asset type and criticality of the asset.

Our business as usual asset management framework and the findings from bottom up assessments and life cycle analysis have been used to formulate a long term investment programme for our key sites. These are refurbished or renewed as part of a long term proactive strategic programme.

For some assets such as boreholes, dams and service reservoirs we undertake proactive cyclical maintenance inspections which lead to asset maintenance and refurbishment programmes. For other assets we use a run to fail model resulting a set of reactive capital maintenance tasks. The result is the delivery of a resilient supply service to customers in a cost efficient manner whilst maintaining an appropriate level of risk.

4.2.6 Response and recovery

Response and recovery is the ability to provide a fast and effective response to, and recovery from, disruptive events. The effectiveness of this element is determined by the thoroughness of efforts to plan, prepare and exercise in advance of events.

Our long-term vision is one of continual innovation and specifically to include more real-time monitoring and control in our business operations to provide a more resilient service to customers.

The PRISM visual platform is the core network management tool used to understand the operation of our assets. The regional telemetry system collects data, alerts and alarms from our distributed assets providing near real time information. PRISM converts this information into an accessible format and enables the business to develop decision support capability by highlighting the most important and relevant information and providing an early warning of supply system issues. PRISM enables a level of logic to be applied to alarms to bring together disparate signals into a higher-level overview of network operation so the most

important alarms are highlighted enabling root cause analysis and ensuring efficient response and recovery to any asset failure and minimising customer service impacts.

5. Overview of long term drinking water quality considerations

The section provides an overview of our current and future considerations for:

- raw water
- water treatment
- distribution
- lead
- point of use.

It also includes a summary of our long term plans.

5.1 Raw Water

5.1.1 Catchment Management

We use catchment management to protect sources of raw water from contamination and deterioration. Catchment management is both cost effective and sustainable in helping to negate the need for additional water treatment processes, reducing the quantity of chemicals used, and improving the overall environmental quality of our water sources.

We are committed to continuing to use catchment management as the starting point to manage nitrate, pesticide and *Cryptosporidium* risk as well as to maintain, if not improve the quality of our raw water sources

The raw water category of our sites is frequently reviewed using sample data to ensure appropriate treatment is in place. This also forms part of our disinfection policy.

5.1.2 Pesticides

Surface water sources

Pesticides are primarily a risk at our surface water sites. Granular Activated Carbon (GAC) plants are installed at all our surface water sites and a number of groundwater sites for removal of pesticides. This successfully controls our current pesticide risks however Metaldehyde remains a specific threat, as our existing treatment processes cannot achieve significant concentration reductions.

Data shows that pesticides, including Metaldehyde, have been effectively managed at Ashford, Durleigh and Sutton Bingham reservoirs through our ongoing programme of catchment management. The main measure at these sites has been a grant to assist farmers to switch from Metaldehyde to iron phosphate based slug pellets. This intervention will continue until such times as Metaldehyde usage is restricted, or the agricultural industry voluntarily make the substitution.

The ongoing presence of Metaldehyde in the River Tone which supplies Durleigh Reservoir via the Bridgwater & Taunton canal continues to present a risk to compliance. Limited catchment work has been carried out to date due to the large scale of the catchment (38,000 ha up to the point of the canal offtake) however upstream sampling at the canal inlet enables

us to monitor pesticide levels approximately three days ahead of the water entering Durleigh Reservoir. Should pesticide levels be high then we have the option not to pump from the canal into Durleigh Reservoir. We currently only pump from the canal when we are confident that the Metaldehyde level is low, and likely to remain low for the proceeding days/weeks. The current mode of operation has an impact on the overall water resource yield of the system and thus the output of the treatment works.

In an effort to mitigate the risk in the River Tone catchment we are proposing to trial our innovative EnTrade platform in three of the River Tone catchments in 2018 and 2019. EnTrade is an online tool designed to achieve cost effective catchment improvements via a reverse auction process. EnTrade facilitates efficient catchment action with the objective of achieving environmental improvements in the most effective manner possible. It allows buyers of environmental offsets to create an online auction for particular measures and quickly estimate the resulting savings for measures that sellers (typically farmers and landowners) choose to bid for. This then allows the seller to enter their cost and see the resulting cost saving per unit on which their bid will be judged. The trial is supported by the Environment Agency in Water Industry National Environmental Programme (WINEP). Should the trial be a success then further implementation across the catchment in AMP7 will be considered.

Groundwater Sources

There are a small number of groundwater sites where sporadic elevated pesticides are observed, for example at ✂ and ✂ water treatment works.

The pesticide Bentazone is routinely detected at ✂ and whilst concentrations are predominately below drinking water standards, the potential for peaks has resulted in an ongoing programme of catchment management. Investigations to date indicate that the source of the pesticide is likely to be historic agricultural applications that are persisting in the aquifer. Local farmers have been made aware of the issue through catchment management and as a result, there have been no applications of the pesticide in the immediate catchment in recent years.

✂ source has a history of pesticide detection associated with turbidity peaks and the site has been subject to catchment management since AMP4. The catchment geology is fractured and faulted making it difficult to identify a distinct source or pathway. The introduction of no spray agreements largely addressed the issue between 2004 and 2009, however a significant peak of MCPB in 2009 was attributed to a new farmyard source. A subsequent ‘no spray’ agreement has successfully eliminated pesticides from the immediate catchment and no pesticide peaks have been experienced in the raw water since. Investigation of detections of Mecoprop-P in November 2016 identified a potential source and the target catchment was subsequently widened with further mitigation measures scheduled.

Future Strategy

A review of pesticide occurrence across Wessex Water sources has been undertaken by our catchment team to assess the requirements for managing water quality up to 2025.

In the long term, it is difficult to predict when a source that is not already at risk of pesticides might become vulnerable if there is no historic record. In the case of trend prediction for pesticides, these most commonly manifest as 'occurrences' or 'peaks' rather than 'trends'. Whilst it is likely that pesticide peaks will continue to occur in the surface reservoirs, the situation is improving through ongoing catchment management and large events that would result in treatment works being removed from service are anticipated to become more unlikely.

Catchment management has led to significant raw water quality improvements and our future strategy is to maintain this through ongoing funded work as detailed in Table 5-1.

The risk of pesticide contamination on bulk imports will continue to be monitored very carefully. As previously mentioned, protocols are in place with Bristol Water to ensure effective communication when pesticides levels are high.

Table 5-1: Ongoing pesticide strategy

Source	Parameter	Proposal
River Tone	Metaldehyde	EnTrade Trial which has received support from the Environment Agency in WINEP.
Durleigh	Metaldehyde	Continue with product substitution, training and advice.
	General Pesticides	Continue to encourage runoff reduction measures, training and advice.
Ashford/Hawkridge	Metaldehyde	Continue with product substitution, training and advice.
	General Pesticides	Continue to encourage runoff reduction measures, training and advice.
Sutton Bingham	Metaldehyde	Continue with product substitution, training and advice.
	General Pesticides	Continue to encourage runoff reduction measures, training and advice.
Friar Waddon	General pesticides	Complete new agreement on a return to low dosage, low solubility pesticides, with associated monitoring. If problematic return to long term no-spray agreement.
Fonthill Bishop	Bentazone	Monitor and continue to investigate source. If this fails and peaks continue and rise, treatment may be required
Fovant, Clarendon, Tatworth	General pesticides	No action required apart from a watching brief, treatment already available.

5.1.3 Nitrates

Background

Nitrate concentrations in groundwater from historical agricultural activities continues to present a significant water quality issue.

Catchment management forms a fundamental part of our source to tap approach to managing nitrate in water supplies. When carrying out future planning we prioritise catchment management with treatment solutions only considered as a last resort once catchment management solutions have been thoroughly investigated and trialled. Much progress has been made by the catchment delivery team since work started at four sites in 2005 and to date no new nitrate treatment plants have been constructed on sites subject to catchment management.

Our current nitrate position is:

- catchment management is currently taking place at 14 sites and is considered to be working successfully at 11 of the 15 sites
- nitrate treatment takes place at three sites (Black Lane, Clarendon and Fovant)
- blending and substitution solutions are in place at a number of sites
- catchment management has been terminated at four sites, either as a result of an improvement in nitrate trends or source abandonment

Existing Undertakings

We currently have a nitrate undertaking under Section 19(1)(b) of the Water Industry Act 1991 (Reference: WSX 2892) associated with the supply system supplied by Bulbridge, Chirton, Dunkerton, Fonthill Bishop, Hooke, Sturminster Marshall and Wylye water treatment works.

The long term measure specified for both Fonthill Bishop and Sturminster Marshall was substitution of the site. This involves removing borehole(s) from supply when nitrate levels are high and bringing in compliant water from other sources. Construction of the integrated network grid has enabled this option, in parallel with catchment management. We have completed the period of monitoring the effectiveness of the solution and are in the process of completing the completion report, which has a regulatory completion date of April 2019.

This solution was based on the nitrate trending data available in 2007. At that time it was anticipated that catchment management would be successful at reducing seasonal nitrate exceedances to short durations e.g. during wet winters, with output from the sources available for the majority of the time.

The updated nitrate trend data and current data as detailed below indicates that nitrates will exceed the standard more frequently and for longer than predicted in 2007, and therefore an alternative strategy is needed to protect water quality and ensure these sources are available to maintain our supply demand balance in the future. Substitution of individual borehole (s) or the entire site by the integrated grid is only viable for short events in the

winter. Otherwise there is an unacceptable loss of deployable output with implications for resource resilience. Continuing with the current strategy will also increase the risk of compliance failures.

Findings of latest nitrate modelling

Detailed nitrate trending across Wessex Water sources was undertaken in 2013 using a bespoke model to assess the requirements for managing water quality up to 2030. Nitrate, due to its persistence in the environment, manifests as a trend to which visual assessment and/or statistical analysis can be applied to determine the date at which compliance will be threatened. The model has been updated with observed nitrate data in order to assess whether the model is accurately representing reality.

Of the existing 15 nitrate sites currently under catchment management, four sites continue to be of concern in that nitrate concentrations in the raw water are regularly close to, or exceeding the prescribed concentration value (11.3 mg N/l or 50mg NO_3/l) during the winter. These are Deans Farm, Fonthill Bishop and Sturminster Marshall/Shapwick which all experience peaks that already breach the standard. Observed nitrate values far exceed the modelled trajectory and show a continuing rising upward trend. Trending work has shown that these sites will pose a compliance threat in AMP7, even with continued catchment management.

At Sturminster Marshall and Shapwick (which due to their proximity are managed as one catchment) and Fonthill Bishop despite persistent catchment management for over ten years, the nitrate trend is high and rising with seasonal peaks that exceed compliance levels. No nitrate treatment (or other asset solution) is currently in place at the sites so we are proposing a more robust solution as detailed further in Section 6. Blending has been assessed to be the most suitable solution to sustainably address the rising nitrate levels. A blending solution is already in place at Deans Farm.

As a result of the modelling process two further sites, Briantspuddle and Cherhill, have been identified as requiring first time catchment management schemes. Cherhill is expected to breach nitrate compliance levels seasonally within the next 18 years (to 2035) (Figure 5-2). Briantspuddle has observed nitrate values which shown an upward trend and exceed those projected by the model (Figure 5-3), which indicates that some intervention is required..

Figure 5-2: Cherhill observed and modelled winter nitrate trends

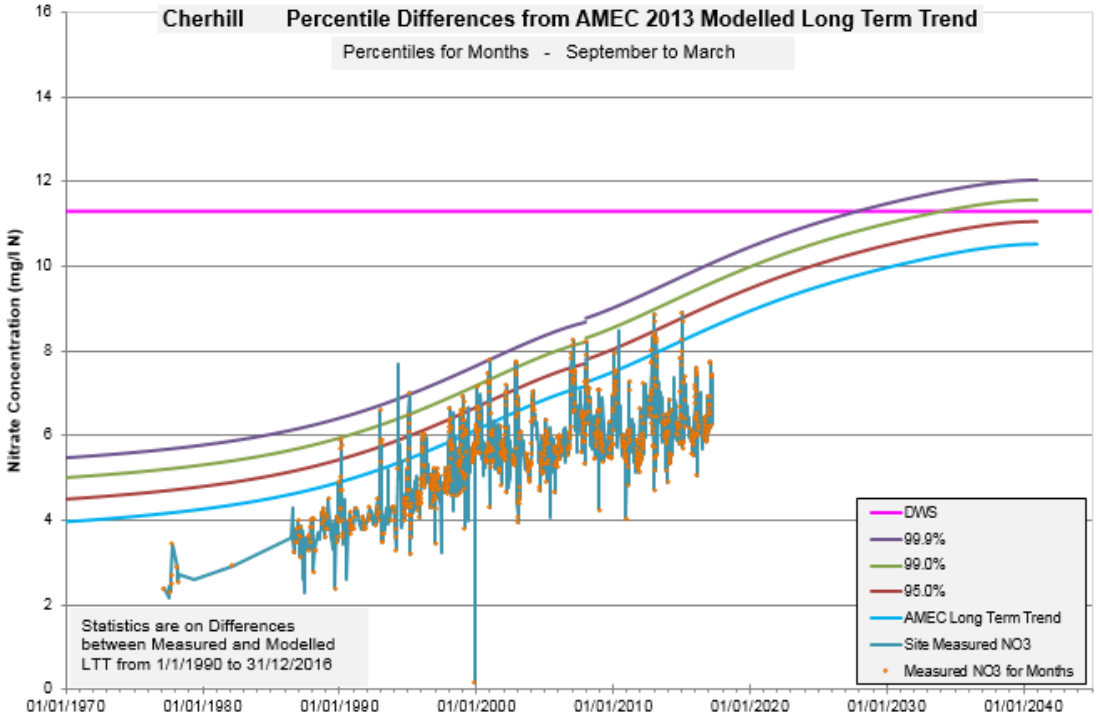
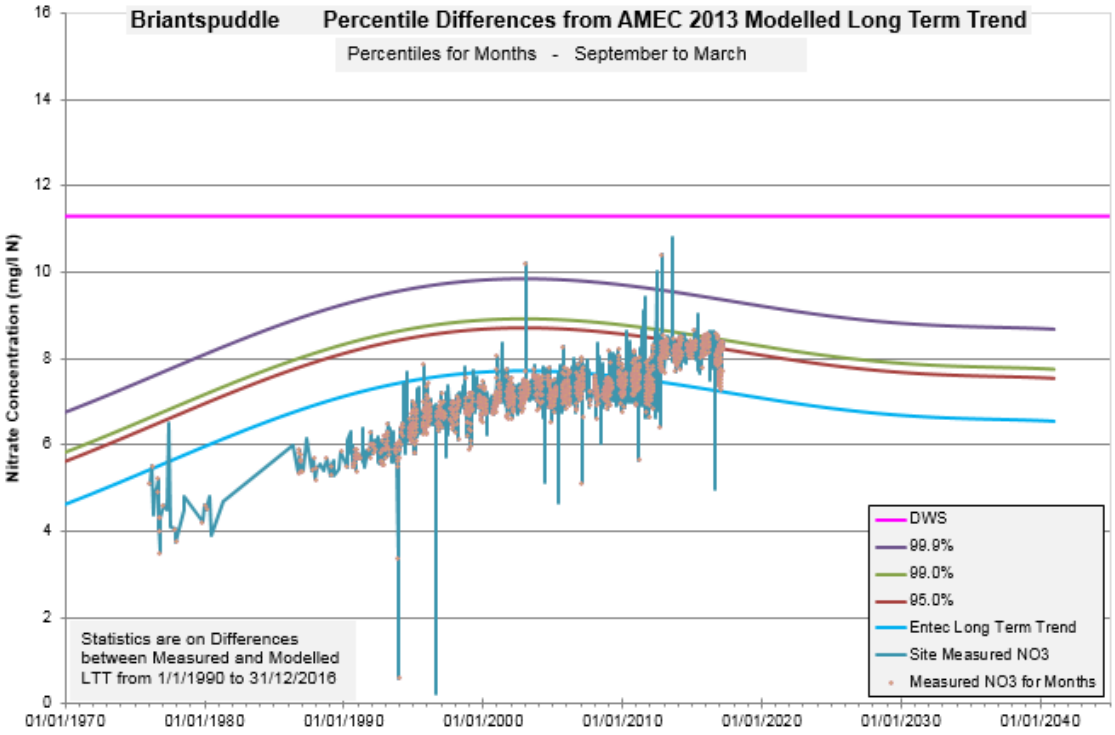


Figure 5-3: Briantspuddle observed and modelled winter



Note: Concentration of y axis is mgN/l. The standard of 50 mgNO_3/l is equivalent to approximately 11.3 mgN/l.

In total, we have recommended six additional sites for catchment management in AMP7 (Table 5-2). As detailed above, Briantspuddle and Cherhill will be subject to catchment management and were included in the Water Industry National Environmental Programme (WINEP). The four additional sources proposed for catchment management are sites where

nitrates have already exceeded the water quality standards and where either treatment, blending or source substitution is employed to maintain compliance. These are Black Lane, Divers Bridge, Goodshill, Litton Cheney and Shepherds Shore.

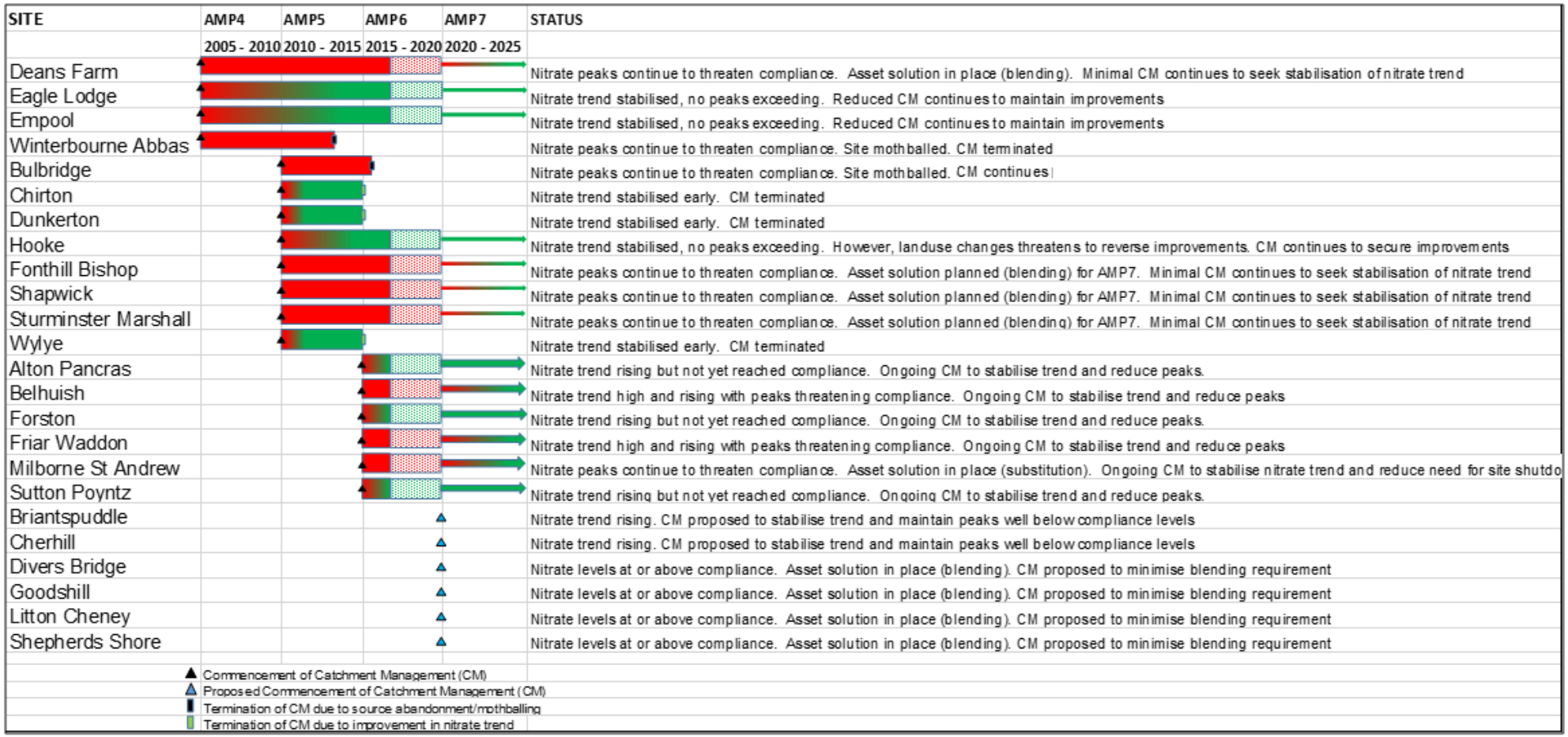
Proposed nitrate strategy

Our nitrate strategy for AMP7 is summarised in table 5-2.

Table 5-2: AMP7 nitrate strategy

Source	Parameter	Proposal
Briantspuddle, Cherhill, Divers Bridge, Goodshill, Litton Cheney, Shepherds Shore	Nitrate	First time catchment management schemes in AMP7 supported by the EA through WINEP
Sturminster Marshall/Shapwick and Fonthill Bishop Deans Farm	Nitrate	Alternative asset solution required – refer to section 6 below Blending solution already in place Lower level background catchment management will continue
Alton Pancras, Belhuish, Bulbridge, Eagle Lodge, Empool, Forston, Friar Waddon, Hooke, Milbourne St Andrew, Sutton Poyntz	Nitrate	Continue with catchment management
Chirton, Dunkerton, Wylye	Nitrate	Catchment management terminated due to an improvement in nitrate trends
Winterbourne Abbas	Nitrate	Catchment management terminated due to source abandonment/ mothballing

Figure 5-4: Summary of status of nitrate catchment management at groundwater sources



SITE	AMP4	AMP5	AMP6	AMP7	STATUS
	2005 - 2010	2010 - 2015	2015 - 2020	2020 - 2025	
Deans Farm					Nitrate peaks continue to threaten compliance. Asset solution in place (blending). Minimal CM continues to seek stabilisation of nitrate trend
Eagle Lodge					Nitrate trend stabilised, no peaks exceeding. Reduced CM continues to maintain improvements
Empool					Nitrate trend stabilised, no peaks exceeding. Reduced CM continues to maintain improvements
Winterbourne Abbas					Nitrate peaks continue to threaten compliance. Site mothballed. CM terminated
Bulbridge					Nitrate peaks continue to threaten compliance. Site mothballed. CM continues
Chirton					Nitrate trend stabilised early. CM terminated
Dunkerton					Nitrate trend stabilised early. CM terminated
Hooke					Nitrate trend stabilised, no peaks exceeding. However, landuse changes threatens to reverse improvements. CM continues to secure improvements
Fonthill Bishop					Nitrate peaks continue to threaten compliance. Asset solution planned (blending) for AMP7. Minimal CM continues to seek stabilisation of nitrate trend
Shapwick					Nitrate peaks continue to threaten compliance. Asset solution planned (blending) for AMP7. Minimal CM continues to seek stabilisation of nitrate trend
Sturminster Marshall					Nitrate peaks continue to threaten compliance. Asset solution planned (blending) for AMP7. Minimal CM continues to seek stabilisation of nitrate trend
Wylye					Nitrate trend stabilised early. CM terminated
Alton Pancras					Nitrate trend rising but not yet reached compliance. Ongoing CM to stabilise trend and reduce peaks.
Belhuish					Nitrate trend high and rising with peaks threatening compliance. Ongoing CM to stabilise trend and reduce peaks
Forston					Nitrate trend rising but not yet reached compliance. Ongoing CM to stabilise trend and reduce peaks.
Friar Waddon					Nitrate trend high and rising with peaks threatening compliance. Ongoing CM to stabilise trend and reduce peaks
Milborne St Andrew					Nitrate peaks continue to threaten compliance. Asset solution in place (substitution). Ongoing CM to stabilise nitrate trend and reduce need for site shutdo
Sutton Poyntz					Nitrate trend rising but not yet reached compliance. Ongoing CM to stabilise trend and reduce peaks.
Briantspuddle					Nitrate trend rising. CM proposed to stabilise trend and maintain peaks well below compliance levels
Cherhill					Nitrate trend rising. CM proposed to stabilise trend and maintain peaks well below compliance levels
Divers Bridge					Nitrate levels at or above compliance. Asset solution in place (blending). CM proposed to minimise blending requirement
Goodshill					Nitrate levels at or above compliance. Asset solution in place (blending). CM proposed to minimise blending requirement
Litton Cheney					Nitrate levels at or above compliance. Asset solution in place (blending). CM proposed to minimise blending requirement
Shepherds Shore					Nitrate levels at or above compliance. Asset solution in place (blending). CM proposed to minimise blending requirement

5.1.4 Radioactivity

Radioactivity in drinking water can originate from many different radionuclides which may be present in natural and manmade sources.

We carry out risk assessments for the three specific radioactivity parameters identified in the Water Supply (Water Quality) Regulations: total indicative dose (gross alpha and gross beta), Radon and Tritium. Initial risk assessments are carried out for all new sources and reviewed periodically for existing sources as part of the DWSP process.

Our initial risk assessment for radioactivity begins in the catchment, with any known sources of natural e.g. hydrogeological catchment, or manmade radionuclides e.g. landfill sites identified. We do this in collaboration with other relevant authorities who are interested in radioactivity such as local authorities and the Environment Agency (EA), who may possess more detailed information. A sampling programme is then undertaken to confirm if any sources are affected by radioactivity and if so, to what extent.

Where risk assessments and supporting data show that there is low or no risk from radioactivity at a source we apply to the Inspectorate for a waiver to reduce monitoring. When granted, one operational sample is then collected per year to provide ongoing verification of the risk assessment.

For sources that do not have a waiver, verification is provided through statutory and any operational sampling undertaken. Where there is no waiver in place up to eight statutory samples a year are taken (as specified in the regulations). Any breaches of the gross alpha and gross beta screening levels are investigated and the information used to inform ongoing risk assessment.

Our sampling programme supports the ongoing review process, demonstrating consistent and continued low levels of radiation.

Assessing the likelihood of very rare events that have not previously affected Wessex Water presents a challenge. The likelihood of a public health risk or a breach of the prescribed concentration value (PCV) is assessed to be very low. After completing risk assessments for each WTW to date there has been no need to introduce additional control measures for radiation. Ongoing operational monitoring and knowledge from across the industry and relevant authorities will continue to be used to review our position.

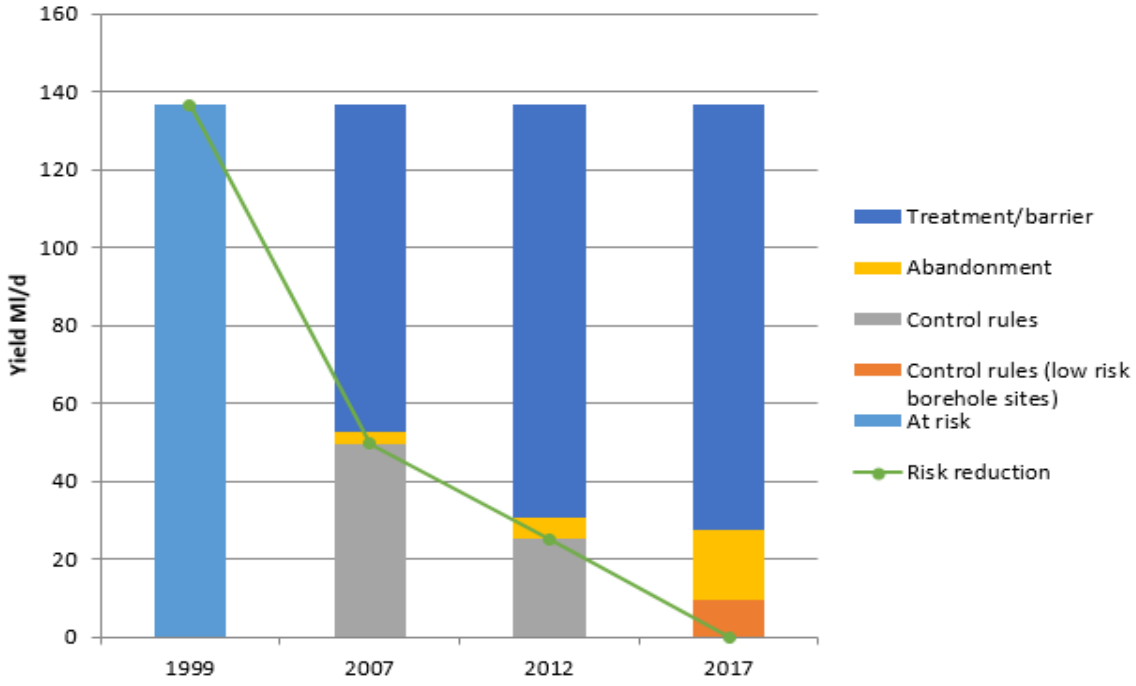
Few samples breach the screening levels and none of our treatment works have a total indicative dose above 0.1mSv. This supports the conclusion that long-term investment in radioactivity is not necessary.

5.1.5 Cryptosporidium

During AMP 6, UV treatment has been installed at our ✂ and ✂ water treatment works so we now have UV treatment in place at 11 water treatment works. A further four sites have membrane plants. We have also abandoned 18 small spring sources to permanently remove the *Cryptosporidium* risk. The diagram below shows how the risk has been

substantially reduced since the original risk assessments in 1999 (Figure 5-5). The control rules specify conditions for auto-shutdown at the sites, triggers for enhanced monitoring and provide assistance for decision making about returning a source to supply. We will continue to review the risk and treatment requirements on a site by site basis through our DWSP process.

Figure 5-5: Risk reduction for Cryptosporidium 'at risk' sites – since 1999



The *Cryptosporidium* risk assessments as a whole were last reviewed in 2014.

We currently have Regulation 28 notices in place for *Cryptosporidium* control at Brixton Deverill WTW, Hooke WTW and Shapwick source. The closure reports for Brixton Deverill and Shapwick were submitted in November 2017. The UV plant at Hooke WTW has been completed and commissioned into supply and the closure report is due for submission in autumn 2018.

We recently carried out a review of treatment requirements at our Ashford works as requested by the Inspectorate and concluded that treatment for *Cryptosporidium* is not currently necessary.

Ongoing collaboration between operational and catchment management teams is fundamental for assessing and reducing risks within the catchment. Catchment management is cheaper and more sustainable than installing barrier or ultra-violet treatment. For sites with *Cryptosporidium* treatment in place, catchment management remains an important control measure for preventing further deterioration of the raw water quality.

5.1.6 Other enduring or emerging risks

Geosmin and 2-Methyl isoborneol

Geosmin and 2-Methyl isoborneol (MIB) are compounds that can cause taste and odour and are most commonly produced by blooms of cyanobacteria (blue-green algae). Risk assessment for occurrence is based on historic data, local knowledge and routine qualitative and quantitative monitoring in raw, treated and distribution water. The risk in the treated water is dependent on the adequacy and effective operation of steps in the treatment process to control, eliminate or reduce the concentration of these compounds.

Destratification air line systems are installed in five of our impounding raw water reservoirs (✂) and are usually run between May and October to artificially mix the water column and control algal growth. Durleigh reservoir currently has a ResMix trial in place (further detail in Section 5.2). All reservoirs (✂) also have temperature probes installed.

All of our surface water treatment works have dissolved air flotation (DAF) and granular activated carbon (GAC) processes installed to manage the risk. Our ongoing programme of investment and maintenance at the water treatment works enables us to continue manage the risk of Geosmin and MIB.

Chromium

We follow the Inspectorate's guidance with regard to Chromium, and keep up to date with research regarding chromium VI. We continue to monitor the risk and review data for chromium through our programme of compliance sampling. Our assessment shows that chromium is not a risk. In a number of water quality zones we also carry out additional quality assurance sampling.

Pharmaceuticals

It is generally understood that pharmaceutical risks primarily affect surface water sources subject to upstream influence from sewage discharge. 72% of our water is from groundwater sources and our largest surface water sources (✂) are upland reservoirs and so therefore there is a low risk of pharmaceuticals contamination.

Whilst still low, we assess the risk will be highest at our surface water sites, with upstream augmentation from rivers. We will mitigate this risk through actively reviewing our sample programme, maintaining resilience to enable the source to be isolated from supply, and keeping up to date with industry research and developments.

Pesticides

New pesticides present a risk to future water quality if not treatable by processes currently in place at our works. We will mitigate this risk through actively reviewing our sample programme, periodically assessing our strategy, participating in industry studies and keeping up to date with industry developments. Reviews and amendments to the analytical suite of

samples are based on acquisition and evaluation of pesticide usage data and experiences across the industry.

5.2 Water Treatment

We will continue to proactively maintain our water treatment works using the latest technology and innovation where appropriate in order to maintain excellent quality drinking water. A programme of risk based proactive asset refurbishment and replacement is in place. Our long term objectives and the performance commitments over the next five years and beyond will be delivered through planned investment and operational activities.

Our asset management framework, which includes asset strategies and asset management plans, provides business-as-usual asset management processes aimed at ensuring our strategic objectives are achieved. Within these investment programmes individual capital projects are organised into enhancement or maintenance sub-programmes delivered by our in house Engineering & Construction team, with risk based minor works and infrastructure expenditure devolved to Operations. The operational budgets are managed at a divisional level with regional sharing of knowledge, good practice and experience

We aim to strike the optimal balance between maximising performance, long term asset stewardship and managing risk, subject to affordability constraints. We therefore use a mix of asset renewal and refurbishment strategies depending upon the asset type and criticality of the asset.

Our business as usual asset management framework and the findings from bottom up assessments and life cycle analysis have been used to formulate a long term investment programme for our key sites (Table 5-3 and 5-4). These are refurbished or renewed as part of a long-term proactive strategic programme. The strategic maintenance plans are informed by risks recorded in our Drinking Water Safety Plan (DWSP) system.

For some assets such as boreholes and service reservoirs we undertake proactive cyclical maintenance inspections which lead to asset maintenance and refurbishment programmes. For other non-critical assets we use a run to fail model which results in a set of reactive capital maintenance tasks. The result is the delivery of a resilient supply service to customers in a cost efficient manner whilst maintaining an appropriate level of risk.

Table 5-3: Surface water works strategic maintenance plan (of strategic/largest sites)

Table 5-4: Groundwater works strategic maintenance plan (of strategic/largest sites)

We aim to ensure that every water treatment works has a documented ‘run to waste’ procedure to ensure water can be disposed of to waste in the event of a water quality shutdown. These documents are available both digitally and on site.

A major site rebuild scheme is currently underway at our water treatment works to address deterioration of source water quality. Installation of new UV plant within the existing

process at ✂ was successfully completed and commissioned in March 2017. The site rebuild which will include a new Dissolved Air Flotation (DAF) plant, new Rapid Gravity Filters (RGF), additional GAC adsorbers and sludge treatment is programmed for completion in 2021.

In conjunction with the rebuild, we have trialled an innovative method of reservoir mixing at ✂ – the ResMix 'Source Management System'. The trial has led to consistent dissolved oxygen (DO) levels at varying depths of the reservoir. The impact is anticipated to be an improvement in raw water quality entering ✂ water treatment works with reduced soluble manganese.

An investigative PR19 study for Fulwood Water Treatment works has been carried out and it has been concluded that the planned strategic maintenance work can be deferred for a further five years without excessive risk. However, some components of the work will be addressed through minor schemes in addition to routine capital maintenance. We will proactively monitor the taste and odour of the water to ensure any issues are addressed, should this become a problem.

Following consultation with the wider industry and the Inspectorate, we have recently updated our disinfection policy to include strategies for achieving primary disinfection using ultraviolet radiation. This will first be implemented in the upcoming disinfection scheme at ✂ treatment works.

Work is also underway to reduce undesirable chlorine concentrations in treated water through optimisation of treatment works and booster stations. Chlorine is dosed to a desired set point based on the disinfection category and required contact time. Monitors are routinely calibrated and maintained to ensure the systems are dosing correctly and accurately.

5.3 Water Distribution

5.3.1 Customer contacts

In accordance with our drinking water quality outcome *we will continue to reduce customers' concerns about the appearance, taste and odour of their water through a combination of targeted rehabilitation of water mains and improved availability of information for customers*

We have achieved a 50% reduction in contacts related to appearance over the past ten year.

Our future targets will be based on cost benefit analysis using costumers' willingness to pay data from the ongoing PR19 customer research. We expect that the target for 2025 to be at least a further 10% - 20% reduction.

5.3.2 Mains replacement

We have 11,800 km of water mains in our network and we currently replace around 50 km per year. Prioritisation of mains replacement is based on known burst history, customer

contacts, leakage and water quality issues. Work is prioritised on an annual basis and then reprioritised as when new risk issues come to light.

Through this programme we are replacing significant lengths of Asbestos Cement pipes laid in the 1950s and 1960, PVC mains laid in the 1960s and 1970s and ductile iron main laid in the 1970s.

5.3.3 Conditioning/aggressiveness

Aggressive treated water affects the network and can result in an increased number of water quality complaints.

Mindful of the need to manage water quality related customer contacts we have reviewed the corrosion indices for a range of our sources to inform the development of our future water quality strategy.

We have undertaken a detailed corrosion control study focusing on water quality modelling of five surface water and five groundwater fed water treatment works followed by three water quality zones. Modelling concluded that groundwater supplies were considered non-aggressive and well-conditioned when entering the distribution system. However, the surface water sites exhibited corrosive properties to varying degrees (Figure 5-6).

Figure 5-6: RTW (Rothberg, Tamburini and Winsor) Water chemistry model outcomes for water corrosivity (i.e. mineral dissolving properties)

Maundown and Fulwood treated water was assessed to be corrosive across the most indices. The report recommended a two-phase approach for Maundown WTW:

- Phase 1 should target LSI compliance followed by network performance re-assessment
- Phase 2, if deemed necessary, would enhance alkalinity levels in final water to further optimise network performance.

When making a decision about whether to proceed with the conditioning scheme, the cost of installing the new plant and ongoing operational costs need to be compared with the cost of mains rehabilitation and replacement. We have an ongoing mains rehabilitation programme which also has the advantage of reducing the risk of bursts, however the conditioning scheme has the potential to reduce corrosion across the whole network.

We are therefore developing plans for the installation of a carbon dioxide/lime dosing plant to treat the soft water, reduce on-going corrosion in the networks and enable the water to be distributed more widely without generating customer complaints. An outline design and costing process has been carried out for both Maundown and Fulwood water treatment works. Following this, our current proposals are to first trial the scheme at Fulwood in order to test technology and effectiveness of the plant ahead of starting work at our largest water treatment works, Maundown.

5.3.4 Mains flushing

We have regular mains flushing programme and flush around 600 km per year (approximately 25% of trunk mains). Mains are flushed primarily in areas at risk of discolouration or high levels of iron where flushing is known to be an effective strategy.

In addition to flushing we also condition trunk mains by exercising mains flows up to their hydraulic capacity to prevent discoloured water issues, using a PODDS approach.

5.3.5 Polycyclic Aromatic Hydrocarbons (PAH)

We are aware of the presence of Polycyclic Aromatic Hydrocarbons (PAH) in our supply network. The source of the PAH in our network is understood to be a combination of deterioration and low turnover associated with cast iron mains at the end of the network. This risk is currently mitigated through prioritisation within the main replacement programme, planned flushing and highlighting high-risk zones in the DWSP system.

5.4 Lead

Lead is a significant compliance issue and we currently have a Regulation 28 notice (WSX3272) for our ongoing lead strategy. We have an exemplary lead pipe replacement strategy and will continue to be ambitious over the next 25 years.

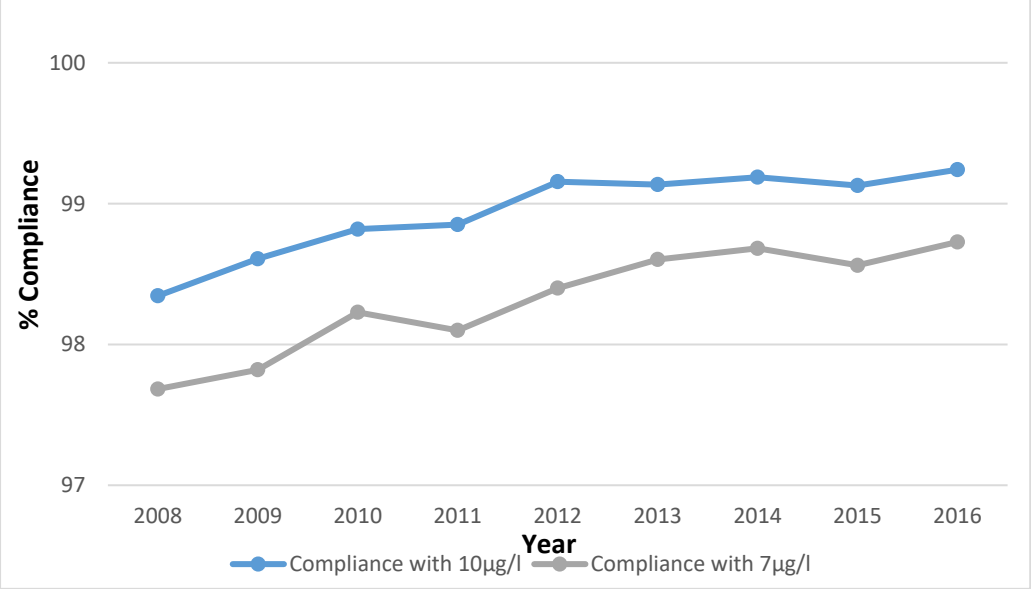
5.4.1 Current Strategy

If following a lead exceedance above our internal trigger level, the investigation confirms our communication pipe is metallic then the pipe is replaced. In addition, if following a lead exceedance the investigation confirms that the customer's supply pipe is also metallic, then we replace the customer's supply pipe up to at least the wall of the property, with the customer's agreement and subject to not incurring excessive cost. It is also our policy to replace brass bodied meters with plastic bodied meters. We replace lead, galvanised iron or copper company communication pipes identified as part of mains replacement or metering projects.

We have a very positive take up from eligible customers of free lead pipe replacement. Over the past 10 years we have replaced approximately 500 lead pipes (200 quality, 300 maintenance) per year.

ln 2017 we changed our internal trigger for investigations from 3 μg/l to 7 μg/ in order to facilitate a more strategic planned small scheme approach to lead pipe replacement, which will be more cost effective and enable targeted pipe replacement. Our internal trigger exceeds the requirements outlined by the Inspectorate. Compliance with the internal trigger concentration and external standards continues to improve, as shown in Figure 5-7: Lead compliance with internal and external standards (all routine samples).

Figure 5-7: Lead compliance with internal and external standards (all routine samples)



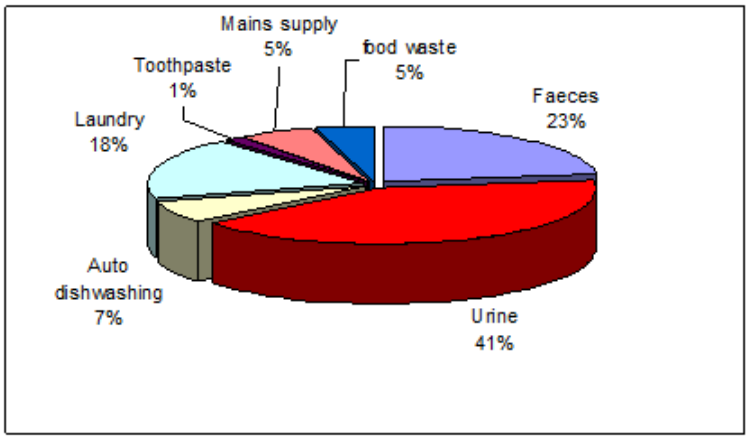
5.4.2 Phosphorous removal

Phosphate dosing is a process that reduces the dissolution of lead by safely coating the inside of metallic pipes. We currently dose around 300 tonnes of phosphoric acid products per year across 27 water quality zones. Figure 5-9 shows the areas within our region that are currently dosed for plumbo-solvency control.

In addition to the chemical costs, phosphate dosing is not the most sustainable solution from an environmental perspective because it often has to be removed from waste water. The AMP7 Water Industry National Environmental Programme (WINEP) has an increased focus on phosphorus removal from rivers and other water bodies related to discharges from sewage treatment works. Figure 5- identifies the location of these existing, confirmed and indicative sites.

An UKWIR report was commissioned in 2009 to understand the sources of phosphorus in sewage influent. At that time 5% was attributed, as a national average, to drinking water supplies, as shown in Figure 5.8. Though it should be noted that we do expect the relative proportion from mains supply to increase due to the banning of phosphorus from laundry and dishwasher detergent, in December 2017 and December 2018 respectively. As such, in dosing phosphoric acid into our distribution network it can be seen that our water treatment works activities are a contributing factor – albeit a small factor – to the deterioration in quality of our rivers.

Figure 5-8: Phosphorus proportions in sewage influent



Our prioritisation of where to focus our lead pipe replacement programme is principally related to drinking water sample data. As part of a more proactive approach we will also investigate targeting areas where phosphorus removal at sewage works is in place or identified through the WINEP, so that we can improve the environment whilst maintaining the highest levels of drinking water quality.

5.4.3 Future strategy

Our long-term ambition is to replace (or reline) all lead pipes (communication and supply pipes) by 2045. This will require us to change our strategy and significantly increase to our activity. As an indication, in order to achieve the long-term objectives we are proposing an ambitious target that is a more than three times our current replacement rate. Our new strategy will include an annual review of DMAs to identify areas for proactive wholesale replacement of services.

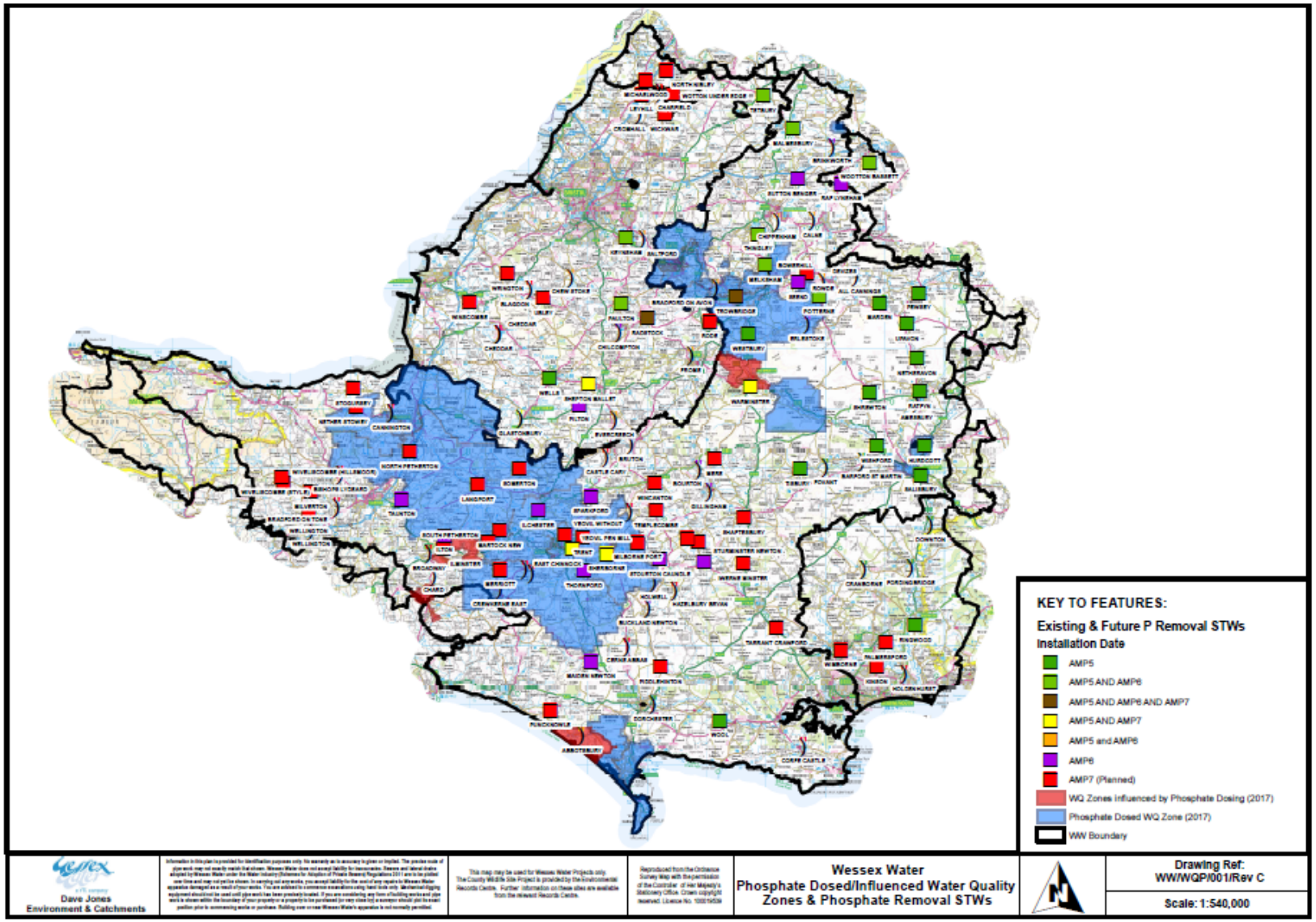
This will also provide an opportunity to form part of a customer focused campaign on plumbing issues. Where practicable we will remove all lead at least up to point of entry into the property and maximise synergies with metering and leakage programmes.

This increased rate of pipe replacement will form part of a holistic strategy where we will promote co-operative partnership working for the benefit of our consumers. In the meantime a twin track approach of lead pipe replacement in conjunction with phosphate dosing will continue. We plan to extend phosphate dosing by seven additional plants in a strive to improve compliance and protect public health. Lead pipe replacement will ultimately result in a reduced need for phosphate dosing and the ability to turn it off completely in some zones. This will have both financial and environmental benefits.

We maintain a risk based approach and are particularly focussing on schools and vulnerable communities. A programme of investigations has taken place to address lead in schools in Bath & North East Somerset. This has been an important project for protecting the health of children in our region. We have set ourselves the ambitious target to be the first water company to roll this project out to check all educational establishments across our region and declare them lead free.

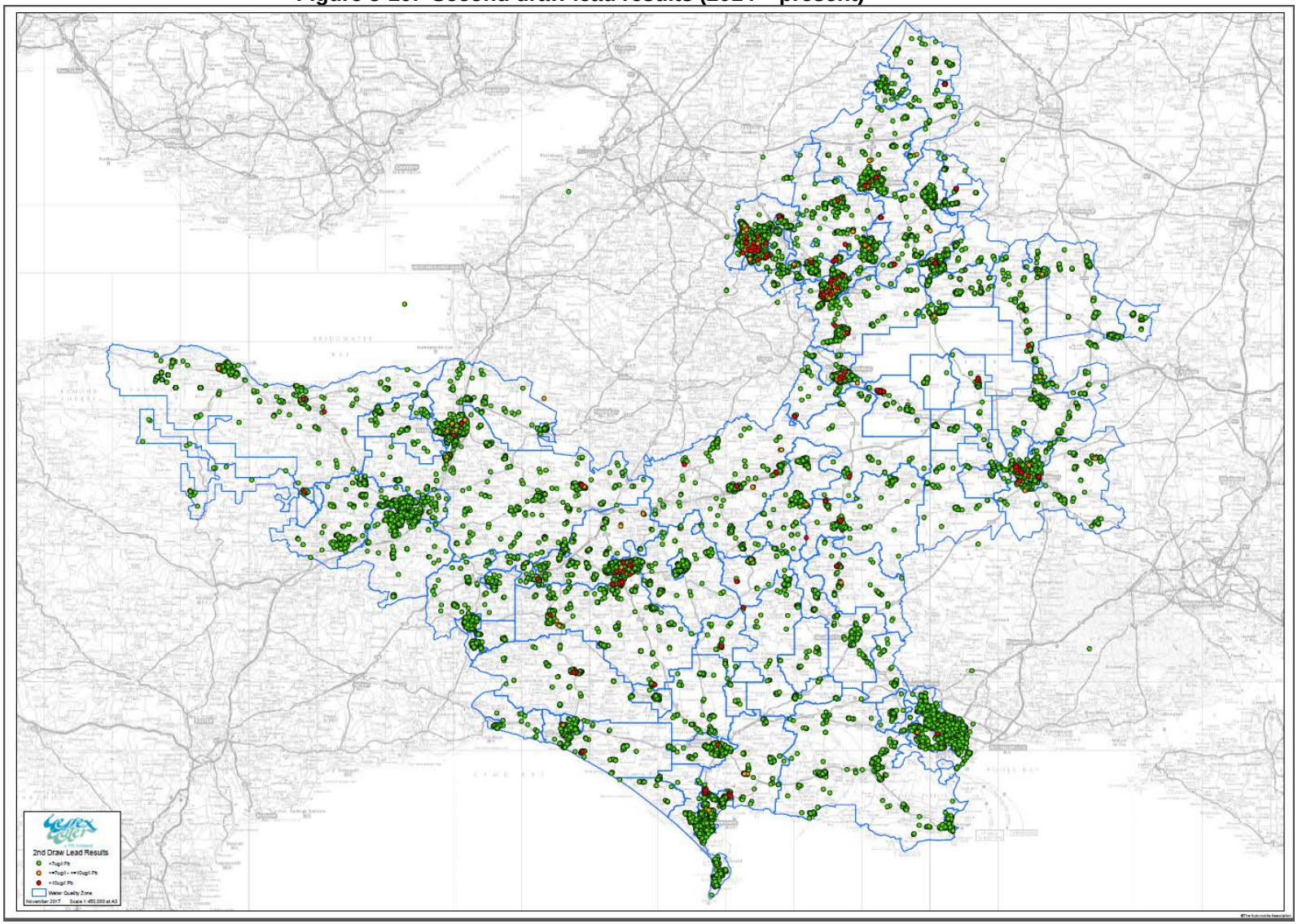
We have, and will, continue to participate in industry studies

Figure 5-9: Phosphate dosed/influenced water quality zones & phosphate removal at sewage treatment works



Phosphate dosing zones are shown in blue and zones influenced by phosphate dosing are shown in red.

Figure 5-10: Second draw lead results (2014 – present)



5.5 Other point of use considerations

As part of our consumer plumbing strategy, we will continue to raise awareness of approved products to avoid failures and taste and odour issues. We are participants of the WRAS Point of Sale Working Group, who are forming an action plan with the ultimate aim to prevent retailers from selling products without stating whether they are approved or not. The ultimate outcome will be to provide consumers with necessary information about a product so they can make an informed decision about its suitability.

In addition to providing high quality advice channels through our website we are developing a series of property specific guidance publications for household and non-household customers educating about common water quality incidents such as oil permeation of supply pipes and blue water back siphonage.

We have set ourselves the ambitious target to be the first water company to check all educational establishments for lead and are currently rolling out our project that was piloted in the Bath & North East Somerset (B&NES) area across the whole Wessex supply region. As part of our public building strategy, we will continue to focus on sensitive users and vulnerable groups, such as major food manufacturers and schools, to ensure they have a lead free supply of drinking water.

Furthermore, we will look to improve our processes for recording and plotting locations of private water supplies and rain-water harvesting systems.

5.6 Concessionary or raw water supplies

At the end of 2015 a property previously thought to be a private supply was identified as being connected to one of our raw water mains and notified to the Inspectorate as an event. The subsequent discussion led to guidance from the DWI that we should reassess all of our untreated water mains and transfer connected properties to either a treated water supply or to the property owners as a private supply.

The Drinking Water Inspectorate requires Wessex Water to have in place a programme of ensuring water that does meet Regulation 4 Water Supply (Water Quality) Regulations 2000 (as amended) is supplied to all properties (for human consumption). We have therefore been undertaking an investigation to identify properties with a historic formal or informal agreement that may be connected to a Wessex Water owned raw water main.

As well as ensuring we are supplying wholesome water to customers, this ongoing project has been an important data verification exercise to ensure our billing records and GIS are correct. This means that in the future we will be in the position to better inform customers in the occurrence of a water quality event. We have also identified hundreds of private water supplies.

5.7 Our long term investment strategy

Long term planning is vital to ensure risks are adequately managed, the most cost beneficial solutions are adopted and that we continue to provide high quality drinking water.

Our strategic maintenance plans cover a wide range of measures as referenced throughout the report.

An overview of our future long-term strategy investment strategy is shown in Figure 5-11. We confirm that we will provide a more detailed commentary on the long term pressures and our investment plans in May 2018, in order that intergenerational issues can be articulated as requested by the Inspectorate.

Figure 5-11: Our long-term investment strategy

6. Schemes requiring support from the DWI

Completed annexes setting out the information requested in the DWI's information letter are provided separately, along with supporting appendices and up to date Regulation 28 risk assessments (as listed in Appendix B).

The following sections provide an overview of the schemes identified for DWI support through the price review process.

6.1 Raw water deterioration – nitrates

6.1.1 Methodology

Nitrate trending

A multifaceted approach has taken place to identify sites at future risk of nitrate exceedances, including detailed nitrate trending work, sample data review and assessment of existing risk scores in the DWSP system.

The nitrate trends have been analysed using a linear regression technique initially. Sites that exhibit a rising trend and are not currently under catchment management were subject to more detailed modelling that looks at the "peaks" and "shoulders" of the trends. The detailed modelling seeks to assess the influence of hydrogeology, ground water levels and historical nitrate leaching. We have engaged specialist consultants to undertake this work and their summary report is referenced in the attached annexes.

Drinking water safety plans

Following the nitrate trending work and an internal challenge/review the nitrate risk scores in the DWSP system were amended based on the DWSP methodology. Within the DWSP methodology nitrates have a fixed consequence score of 3. The likelihood scoring is then based on modelling and sample data results along with the methodology matrix (Table 6-1).

Table 6-1: Nitrate risk matrix extract from the DWSP methodology

	Trend slope	Breaches possible	Predictions for 2025		Likelihood Score
			99.9 %ile mg NO_3/L (mg N/L)	Average mg NO3/L	
Stable, shallow or downward trend, breaches not expected within 25 years, low - moderate average and peak levels by 2035. Catchment and aquifer adequately understood and protected.	Stable, shallow or down	**Not before 2035**	**< 40 (9)**	**Low - Moderate (< 27)**	**1**
Rising but shallow upward trend, no breaches in the past but low to moderate average / moderate to high peak levels. Catchment and aquifer factors understood.	Shallow rising	**Before 2035**	**> or = 46 (10.5)**	**Low - Moderate (13 - 35)**	**2**
Rising trend with seasonal peaks that may be erratic, moderate average levels possibly with high peaks but no breaches predicted before 2030	Erratic seasonal, rising	**Before 2030**	**> or = 44 (10)**	**Moderate (22 - 40)**	**3**
Rising trend, seasonal peaks already approaching limit with moderate to high average levels and breaches predicted for 2025	Rising trend	**Before 2025**	**> or = 50 (11.3)**	**Moderate - High (> 30)**	**4**
Breaches now or in the past and likely before 2020. Marked upward trend, consistently high or significant seasonal peaks	High and rising	**Before 2020**	**>50 (11.3)**	**Moderate - High (> 30)**	**5**

The scores are reviewed as part of our internal governance at the internal risk group meeting.

Appraisal of options

For each site the following options have been evaluated from a technical, operational and economic perspective:

- catchment management
- source abandonment
- asset solutions of
    - treatment
    - substitution of source from the integrated grid
    - blending

Apart for small sources with very low yields, abandonment is not a viable option as it would reduce local and regional resilience and have a detrimental impact on our supply-demand balance position. Shutting down a site and substituting its output with water from another source is only viable where nitrate exceedances are of very short duration and in the winter when demand is lower. Where exceedances are of longer duration and extend into summer, substitution is effectively the same as abandonment, which would cause resilience and sufficiency risks by causing large parts of the water quality zone to be fed by a single source.

Therefore the primary options for consideration are catchment management and the asset solutions of treatment and blending.

6.1.2 Sturminster Marshall/Shapwick – Nitrates

Drinking water quality driver/hazard

Raw water deterioration – nitrates

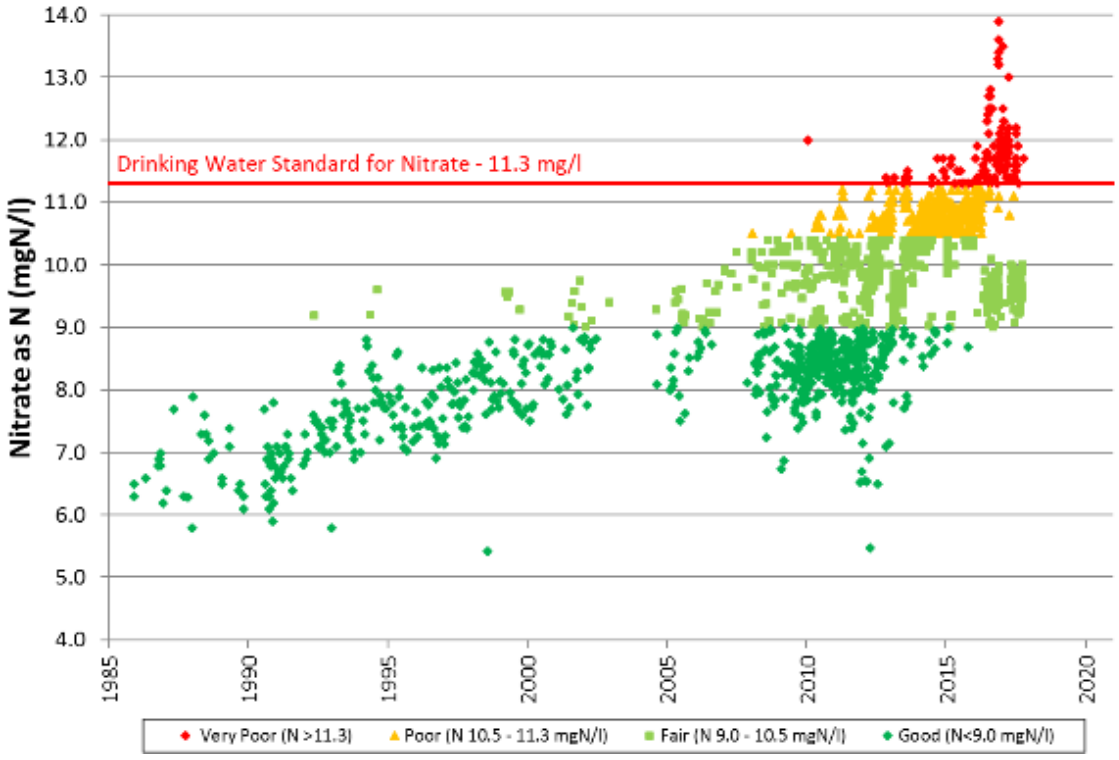
Background

✂.

As explained in section 5.1.3 above, despite ten years of catchment management Sturminster Marshall and Shapwick sources are not responding to catchment management. Raw water nitrate concentrations are continuing to rise and have breached the regulatory standard (refer to Figures 6-1 and 6-2 below).

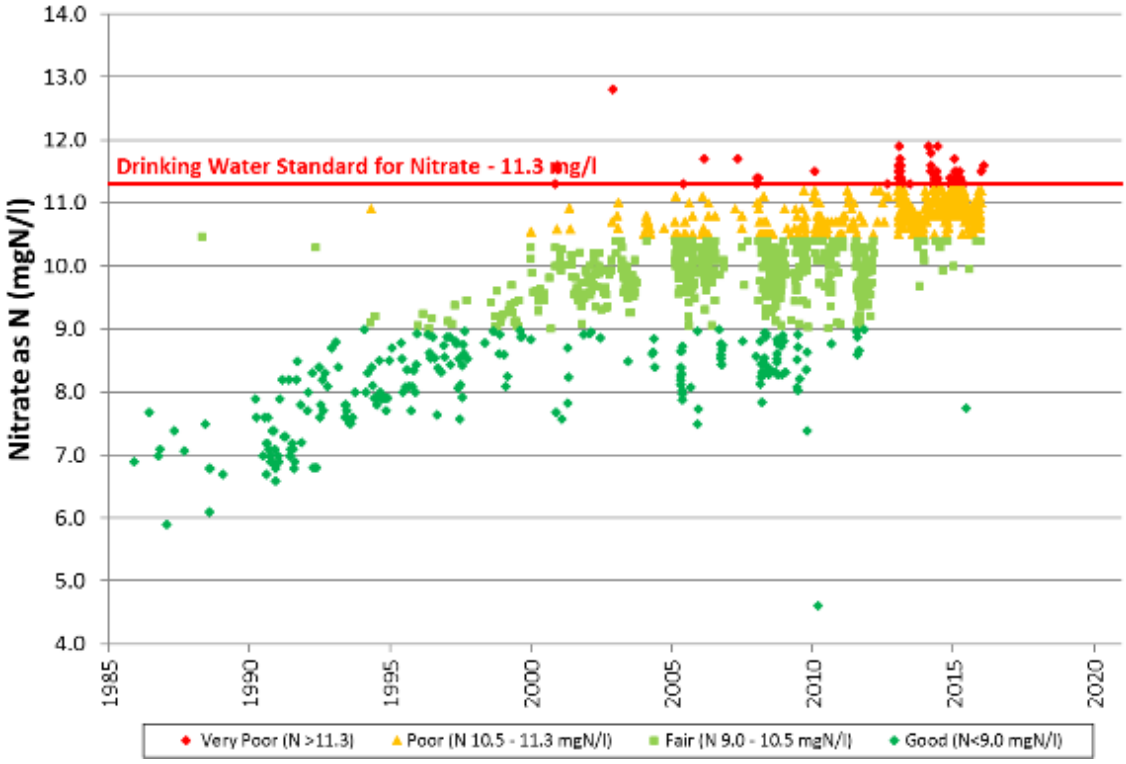
Nitrates are currently managed through blending between the boreholes to maintain compliance. However, as this depends on one borehole at Sturminster Marshall being 2 – 2.5 mgN/l lower than the other boreholes it is considered that this approach is not sustainable given the rising trends.

Figure 6-1: Sturminster Marshall historical nitrate trend



Note: Concentration of y axis is mgN/l. The standard of 50 mgNO_3/l is equivalent to approximately 11.3 mgN/l.

Figure 6-2: Shapwick historical nitrate trend



Note: Concentration of y axis is mgN/l. The standard of 50 mgNO_3/l is equivalent to approximately 11.3 mgN/l.

Options

The principal options that have been considered are:

Option	Description	Cost
Enhanced catchment management	At these sites the current voluntary catchment management practices have not been sufficient to arrest the rising trend in nitrate concentrations. Alternative more radical catchment measures would involve compulsory reversion of arable land to grassland. The farmers would be compensated for the loss of profit between arable crops and grass plus a margin. The main problem with this approach is that, given our extensive work in this catchment already, there is no certainty that this approach would be successful. Furthermore the discussions to date indicate that it would be very challenging to secure cooperation from farmers in a timely manner and that cooperation is not guaranteed.	Not viable due to uncertainty of outcome and timescales

Option	Description	Cost
Blending	This option would involve blending facilities at Sturminster Marshall to enable blending of low nitrate water from ✂with the source water. Water resources modelling has demonstrated that the blending arrangement would not have a significant impact on yields. The sources involved are not subject to any sustainability reductions. There are no sustainability concerns about abstraction from these sources.	Capex £2 – 2.5m plus opex of circa £100k per year
Treatment	This would involve construction of an ion-exchange nitrate removal plant at Sturminster Marshall. Substantial new infrastructure would be required to dispose of the waste stream from the plant.	Capex £12 – 15m with operating costs of up to £500k per year

Based on our assessment of the options the most cost beneficial and sustainable option to ensuring compliance is blending.

Proposed solution

Blending asset solution.

Supporting evidence

Further details are provided in Annex 1, and the supporting documents on nitrate trending and options analysis.

6.1.3 Fonthill Bishop - Nitrates

Drinking water quality driver/hazard

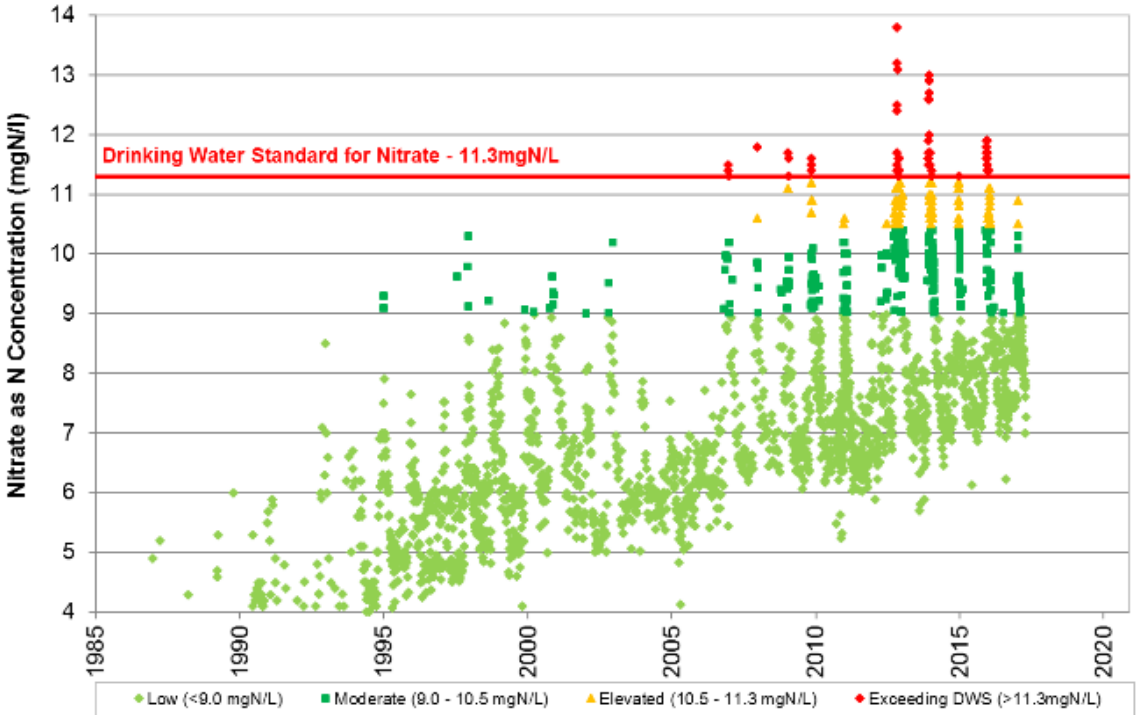
Raw water deterioration – nitrates

Background

✂

✂ Despite prolonged voluntary catchment management, the nitrate concentration are continuing to rise (Figure 6-3 below) and therefore a permanent solution is required.

Figure 6-3: Fonthill Bishop historic sample results



Note: Concentration of y axis is mgN/l. The standard of 50 mgNO_3/l is equivalent to approximately 11.3 mgN/l.

Options

The principal options that have been considered are:

Option	Description	Cost
Enhanced catchment management	At this site the current voluntary catchment management practices have not been sufficient to arrest the rising trend in nitrate concentrations. Alternative more radical catchment measures would involve compulsory reversion of arable land to grassland. The farmers would be compensated for the loss of profit between arable crops and grass plus a margin. The main problem with this approach is that, given our extensive work in this catchment already, there is no certainty that this approach would be successful. Furthermore the discussions to date indicate that it would be very challenging to secure cooperation from farmers in a timely manner and that cooperation is not guaranteed.	Not viable due to uncertainty of outcome and timescales
Blending	This option would involve a pipeline from Fonthill Bishop to ✂ with blending facilities at ✂ service	Capex £7 – 8m with opex of £50k per year

Option	Description	Cost
	reservoir to enable blending with low nitrate water from ✂. Water resources modelling has demonstrated that the blending arrangement would not have a significant impact on yields. Fonthill has already been subject to a sustainability reduction, which is allowed for in our WRMP.	
Treatment	This would involve construction of an ion-exchange nitrate removal plant at ✂. Disposal of the waste stream from the plant would be by tankering.	Capex £12 – 15m with operating costs of up to £500k per year

Based on our assessment of the options the most cost beneficial and sustainable option to ensuring compliance is blending.

Proposed solution

Blending asset solution.

Supporting evidence

Further details are provided in Annex 2, and the supporting documents on nitrate trending and options analysis.

6.2 Lead

Drinking water quality driver/hazard

Lead.

Background

As mentioned in section 5.4.3 our long term ambition is to replace (or reline) all lead pipes (communication and supply pipes) by 2045. This will require us to change our strategy and to significantly increase to our activity.

A twin track approach of phosphate dosing and lead pipe replacement will continue. Our strategy will comprise:

- continuation of lead pipe replacement, following a sample exceedance above a trigger concentration of 7 µg/l and confirmation of a metallic pipe from an investigation
- continuation of our policy of free replacement of the customer service pipe at least up to the wall of the property, subject to agreement and avoidance of excessive cost
- continuation of phosphate dosing with modifications where required

- proactive lead pipe replacement, based on an annual review of DMAs to identify areas for proactive replacement
- replacement of brass bodied meters with plastic bodied meters
- maximise synergies with metering and leakage programmes
- a risk based approach with particular focus on schools and vulnerable communities
- a check of all educational establishments for lead
- a watching brief on changes to the strategy in the light of the potential change in the lead standard to 5 µg/l.

Options

The overall twin track approach of phosphate dosing and lead pipe replacement will continue in accordance with DWI guidelines.

The main options for consideration relate to the extent and pace of lead pipe replacement:

Option	Description	Cost
Minimum	The minimum scope of work would be to replace the communication pipe only following a sample exceedance. This would be a deterioration in the service we currently offer and would not maximise the public health benefit. It is also likely to result in a deterioration of compliance (which is untenable given the drive to achieve 100% compliance or a CRI score of zero). A drawback of this approach could be that there would be pressure to increase the extent of phosphate dosing, with sustainability and environmental implications.	<£1m excluding potential increase on phosphate dosing
Sample driven replacement only	Replacement of the company's communication pipe and free replacement of the customer's supply pipe up to the wall of the property, based on samples exceeding a trigger for investigation. This is the approach that we adopted up to 2017.	£2 – 3m (totex)
Enhanced approach – sample driven plus proactive replacement	Replacement of the company's communication pipe and free replacement of the customer's supply pipe up to the wall of the property, based on samples exceeding a trigger for investigation. Proactive replacement based on prioritisation of DMAs to target replacement / relining of all lead pipe by 2045. The benefit of this approach is that it will enable the phased withdrawal of phosphate dosing over the medium to long term.	£8 – 10m (totex)
Wholesale pipe replacement	Wholesale replacement of all lead communication pipes over a much short timescale. This has the potential to be very disruptive and would not allow the programme to be phased maximising the public health benefit.	>£50m

Based on a balance of the public health benefit, cost and deliverability, the preferred option is an enhanced programme of lead pipe replacement.

Proposed solution

Enhanced lead pipe replacement including partnership working.

Supporting evidence

Further details are provided in Annex 3, and the supporting documents on our lead strategy.

7. Appendix A – DWI Notices

A list of the current notices is given in the table below.

Table A-1: Progress with current Regulatory notices

Ref	Asset	Notice	Parameter	Implement solution by	Sign off date	Comments
WSX2765	Durleigh	Section 19	Metaldehyde	31/03/14	30/04/15	Completion report submitted
WSX3419	Brixton Deverill	Regulation 28	Cryptosporidium	31/03/15	30/11/17	Completion report submitted
WSX3421	Shapwick	Regulation 28	Cryptosporidium	31/03/15	30/11/17	Completion report submitted
WSX3396	Boyne Hollow WTW	Regulation 28	Cryptosporidium	30/06/15	31/08/15	Notice revoked
WSX3398	Milborne Wick WTW	Regulation 28	Cryptosporidium	30/06/15	31/08/15	Notice revoked
WSX3399	Winterbourne Abbas WTW	Regulation 28	Cryptosporidium	30/06/15	31/08/15	Notice revoked
WSX3397	Corscombe WTW	Regulation 28	Cryptosporidium	30/09/15	30/11/15	Notice revoked
WSX3400	Bradley Head WTW	Regulation 28	Cryptosporidium	31/03/16	30/06/16	Notice revoked
WSX3401	Calstone WTW	Regulation 28	Cryptosporidium	31/03/16	30/06/16	Notice revoked
WSX3402	Wellhead WTW	Regulation 28	Cryptosporidium	31/03/16	30/06/16	Notice revoked
WSX3403	Okeford WTW	Regulation 28	Cryptosporidium	31/03/16	30/06/16	Notice revoked
WSX3404	Pitcombe WTW	Regulation 28	Cryptosporidium	31/03/16	30/06/16	Notice revoked
WSX3405	West Lulworth	Regulation 28	Cryptosporidium	31/03/16	30/06/16	Notice revoked
WSX3271	Hooke	Regulation 28	Cryptosporidium	30/09/17	31/10/18	Completion of construction report submitted
WSX3471	Arn Hill	Regulation 28	Turbidity	31/05/17	30/06/18	Completion of construction report submitted
WSX3490	Friar Waddon	Regulation 28	Turbidity	31/07/17	31/07/18	Completion of construction report submitted
WSX3273	Porlock	Regulation 28	Turbidity	31/12/17	31/01/19	Ongoing
WSX3486	Codford	Regulation 28	Turbidity	31/12/17	31/01/19	Ongoing
WSX3489	Burton Road	Regulation 28	Turbidity	30/03/18	30/04/19	Ongoing
WSX3488	Deans Farm	Regulation 28	Turbidity	30/03/18	30/04/19	Ongoing
WSX3492	Litton Cheney	Regulation 28	Turbidity	30/06/18	31/07/19	Ongoing
WSX3487	Compton Durville	Regulation 28	Turbidity	31/09/18	31/10/19	Ongoing

Ref	Asset	Notice	Parameter	Implement solution by	Sign off date	Comments
WSX3482	Alton Pancras	Regulation 28	Turbidity	31/12/18	31/01/20	Ongoing
WSX3491	Lacock	Regulation 28	Turbidity	31/12/18	31/01/20	Ongoing
WSX3493	Mere	Regulation 28	Turbidity	31/12/18	31/01/20	Ongoing
WSX3709	Bourton	Regulation 28	Turbidity	31/12/19	31/01/21	Ongoing
WSX3495	Sutton Poyntz	Regulation 28	Turbidity	31/12/19	31/01/21	Ongoing
WSX3485	Chitterne	Regulation 28	Turbidity	31/03/20	30/04/21	Ongoing
WSX 3494	Pole Rue	Regulation 28	Turbidity	31/03/20	30/04/21	Ongoing
WSX3496	Washpool	Regulation 28	Turbidity	31/03/20	30/04/21	Ongoing
WSX3272	Lead Strategy	Regulation 28	Lead	31/03/20	31/07/20	Ongoing
WSX2892	Nitrate/ Grid	Section 19	Nitrate	31/03/18	30/04/19	Ongoing

8. Appendix B - List of annexes and supporting documents

Ref	Title
	Nitrates
Annex 1	Sturminster Marshall - Nitrates
Annex 2	Fonthill Bishop – Nitrates
	Report: PR19 Catchment interventions for nitrates
	Regulation 28 risk assessment – Sturminster Marshall
	Regulation 28 risk assessment – Fonthill Bishop
	Lead
Annex 3	Lead, including PR19 lead strategy