

Drinking water 2016

Quarter 2
April – June 2016

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A report by the Chief Inspector of Drinking Water





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Public water supplies for
England and Wales

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Foreword

Drinking Water 2016 Q2 is part of the annual publication of the Chief Inspector of Drinking Water for England and Wales. It is published as a series of quarterly reports which cover public water supplies in England and Wales.

The report sets out to develop a source to tap approach in the supply of water, developing learning points from recent data, events and company strategies. It builds upon the strategic objective of the Drinking Water Inspectorate (DWI) for safe, clean and wholesome drinking water to all consumers at all times.

This report focuses on the wider risk management of catchments and the merits of this to benefit all; the strategic prioritisation of drinking water storage in clean water tanks and reservoirs; developing the understanding of residual risks at treatment works; and long-term collective strategies where only partial mitigation is available to companies in domestic distribution systems.

Finally, during the second quarter of 2016, four new statutory instruments relating to the regulation of public and private water supplies in England and Wales were published and came into force. The change is largely due to the transposition of the Euratom Directive introducing new requirements for water companies and water suppliers to monitor for radioactive substances. The focus is primarily on radon and further information can be found in the Additional information section of this report and the Information Letter, the link of which is below.

<http://www.dwi.gov.uk/stakeholders/information-letters/2016/04-2016.pdf>

Drinking water sources and catchment management

In the Chief Inspector's Report (CIR) 2016 Q1, it was stated that management of catchments used for drinking water is crucial to remove pollutants and prevent them from entering supply. When examining compliance data from tap water samples it is possible to determine the contribution the catchment makes to these numbers for those parameters which are known to originate at the source when not removed by treatment. In Q2, pesticides contributed 5% to failures to meet standards, and raw water deterioration detected as a musty or earthy taste and odour and caused by methylisoborneol (MIB) and/or geosmin contributed 13%. Taken together with failures due to household plumbing, this constitutes 37% of all failures this quarter in the two areas highlighted in CIR 2016 Q1 where mitigation was partial or deferred to treatment.

Catchment management has been reaffirmed by the DWI as a route to reducing water treatment and the inherent costs to water companies as well as for the wider benefit of the environment, wildlife and their habitats. From a forward-looking viewpoint, competition for raw resources, source availability and the connection between raw water quality and treatment needs emphasise the critical activity of managing catchment risks. The continuing drive to reduce risks in catchment will also reduce some of the pressures on sufficiency allowing for more flexible resource management strategies.

The focus for companies should be on wider issues and not just metaldehyde. Other pesticides are not easily removed by treatment such as clopyralid, carbetamide and propyzamide. Nitrate should continue to be monitored and accompanied by catchment control under the Nitrates Directive. Research investment into the origin of MIB and geosmin should be made to understand how the risk from algae develops in certain catchments. Equally, emerging catchment risks such as chromium VI need to be understood.

The Water Industry Act and the water quality regulations place duties on water companies to risk assess the potential impacts on public health, wholesomeness and consumer acceptability. This includes consideration of where tap water quality is threatened by disinfection by-products arising due to raw water quality or where a treatment works is not configured to treat water from all sources it may receive. At all times the company must act to protect their consumers.

Currently there are 31 undertakings in place for various pesticides and 19 of these are due to be completed by 31 March 2020. Of these, 16 undertakings in place across England acknowledge risks from, and have

measures to address, metaldehyde. There has been renewed focus on company efforts to address this pesticide within the last quarter and discussions continue with stakeholders such as Natural England and ministers for England. These undertakings were reissued in September to bring forward the reporting step from March 2018 to March 2017.

The requirements will remain the same with all undertakings containing the following step...*'Provide a report to DWI on the progress to date and outcomes of the catchment measures included in this undertaking, and proposals for any further measures required, to secure or facilitate compliance. Include in this report proposals for demonstration of delivery of the required outcomes in the period to 31 Dec 2019.'*

Table 1: List of catchment management undertakings for metaldehyde/pesticides

Affinity Water	AMP6 North Mymms Water Treatment Works (WTW) metaldehyde
Affinity Water	AMP6 Ardleigh WTW pesticides including metaldehyde
Affinity Water	AMP6 R. Thames WTWs Pesticides including metaldehyde catchment management
Anglian Water	AMP6 Pesticides catchment management
Bristol Water	AMP6 Purton and Littleton catchment management
Dee Valley Water	AMP6 Boughton Herbicides – R. Dee catchment management
Essex and Suffolk Water	AMP6 Catchment management – Southern region
Northumbrian Water	AMP6 Catchment management – Northern region
Sutton and East Surrey Water	AMP6 Bough Beech catchment management
South East Water	AMP6 Catchment management – metaldehyde
Southern Water	Catchment management for pesticides
South Staffordshire Water	AMP6 Seedy Mill and Hampton Loade metaldehyde catchment management
Severn Trent Water	AMP6 Catchment management for metaldehyde 12 sites
Thames Water	AMP6 Catchment management 11 Treatment Works
United Utilities	AMP6 River Dee catchment management
Yorkshire Water	AMP6 metaldehyde catchment management

Water quality at treatment works

During the second quarter of 2016, the Inspectorate has continued assessing the risk assessment reports supplied by companies, has reviewed the investigations of compliance failures at treatment works and has audited the UV disinfection arrangements at 13 sites. The findings from this work are reported below

Review of compliance – microbiological failures at treatment works

During Q2, companies reported five failures (ANG 1, NNE 1, SEW 2, TMS 1) to meet coliform standards in samples taken at treatment works, there were no detections of *E.coli*

Table 2: Q2: 2016 – Microbiological tests
The number of tests performed and the number of tests not meeting the standard

Parameter	Total number of tests	Number of tests not meeting the standard
Water leaving water treatment works		
<i>E.coli</i>	41,084	0
Coliform bacteria	41,081	5

A review of the outcomes of investigations of the cause of the coliform detections indicated that tanks were subject to ingress in two cases. In a further two cases, tank inspections are planned but have not yet been carried out and in the additional case, no cause was found despite a satisfactory investigation.

Water companies are required to notify microbiological failures at treatment works to the Inspectorate as events. The Inspectorate assesses the actions taken by the company to rectify the circumstances. The following account provides an example of a satisfactory response from the company to the event described

Hook works supplies approximately 2,000 people in the Chard area of Devon and is situated on the side of a hill. During extremely heavy rainfall, the site suffered from flooding and ingress into the contact tank through a small, previously unidentified, leak from a chamber above the contact tank. With no further barrier before any contamination reaches consumers' taps, good practice regarding the maintenance of clean water tanks and service reservoirs is well documented. The risk of contamination was compounded by the local farmer who had recently been spreading slurry on nearby fields which drained across the site. The risks associated with slurry in the proximity of service reservoirs were described in the Badenoch Report of the Group of Experts (1990), and more recently seen in the event of 2012

at Severn Trent Water's Broadway reservoir. To minimise these events, companies should seek to develop a strategic plan and prioritise inspections based upon risk. Most recently, Severn Trent Water and Wessex Water have responded to previous service reservoir failures and have put into place evidence-based inspections where the schedule is not solely based upon a rigid rolling programme.

In this case example, the company quickly identified the problem through an unexplained reduction in chlorine concentrations and shut the site down preventing further water contaminated with faecal bacteria from leaving site.

The event was compounded by there being 39 customer properties who were directly fed from this site and whom had no alternative water source. The company liaised with each of these customers to keep them informed of the situation while they used a tanker connected at Hook works to restore supplies.

The ingress into the contact tank was quickly resolved by draining and cleaning the contact tank along with sealing any leaks. The site was returned to supply within 26 hours of the event occurring, although the boil water Notice remained in place for three days while sampling was undertaken to confirm the quality of supplies.

While satisfied with the event handling, the Inspectorate were concerned about a recurrence in site flooding. Site flooding is a risk which requires immediate action since the reality is that structural movement occurs over time and ingress is sometimes a consequence. By allowing a known and controllable risk to remain unmitigated, inaction will inevitably result in contamination which this case illustrates. The company invited the Inspectorate, along with local authority and public health representatives, to visit the site so that it could demonstrate the mitigation measures that had been undertaken since the event occurred; in this case a large 12" collection channel and drainage system had been constructed around the site to divert any flood water away from site processes. The company were also in the process of building a system to enable the 39 direct fed customers to receive water during any future outage via a rearrangement of the network. The Inspectorate does, however, consider an opportunity was missed to proactively minimise the risk before the event occurred and expects the company to consider their strategy going forward.

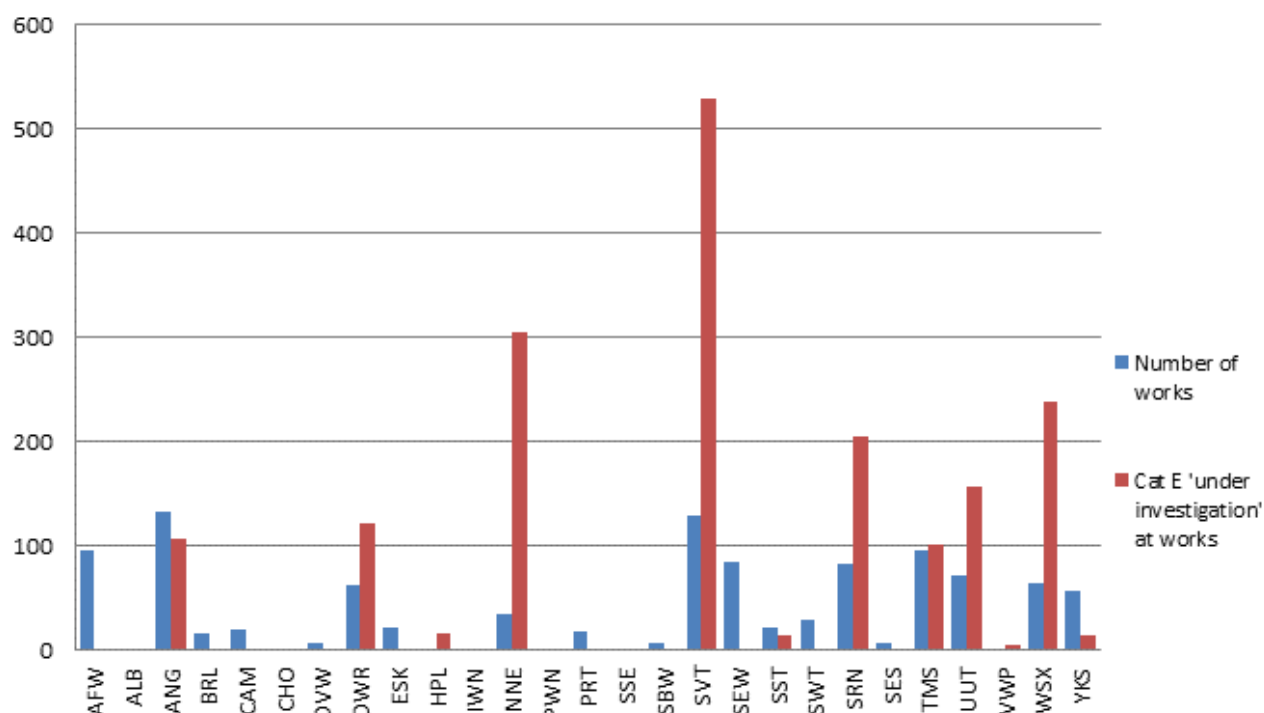
Review of risk assessment reports – treatment works

Since receiving water companies' Regulation 28 report submissions conforming to new data requirements, the Inspectorate has been reviewing companies' risk assessment conclusions. Over 70,000 records have been subject to review, the extent of which was determined using a risk-based approach.

The dataset can be grouped by asset type (abstraction point, water treatment works, service reservoir and zone) and by assessment conclusion (A-H). Having prioritised certain asset type and conclusion combinations, the Inspectorate looked in more detail at individual hazards and their associated mitigation measures.

Taking water treatment works where mitigation measures for particular hazards were 'under investigation' (DWI category E), there were 1,818 hazard mitigation combinations that fell into this category. Figure 3 shows this figure broken down by company and also shows how many works each company had in operation during 2015.

Figure 3 – Numbers of works and numbers of hazards assigned DWI category E 'mitigation under investigation'



In a dynamic and changing environment it is expected for there to be hazards under investigation, since if there were none identified then realistically the risk assessment model may not be effectively identifying and mitigating emerging risks. It is entirely possible to have a simple supply, where risks have been entirely mitigated and ideally this would lead to confidence that an event would be unlikely to occur. As with any models there will be a range of confidence in the assessments, however, reviewing the risk assessments allows identification of companies where there appear to be relatively more risks. One company, Northumbrian Water, sits as a clear outlier with in excess of 30 mitigations under investigation per works.

For Northumbrian Water, there are 304 category E hazards arising at only ten works. On reassessment, 24 were reassigned to category A. A further 112 had identified actions already completed and would subsequently be recategorised; 24 had further actions being planned, 119 were associated with ongoing work and 25 were still being investigated. One works with 23 instances still being investigated may lead to enforcement action. A better estimate therefore is 2.5 category E hazards per works which is comparable with companies of a similar size. Companies must ensure all information is available to facilitate an appropriate assessment.

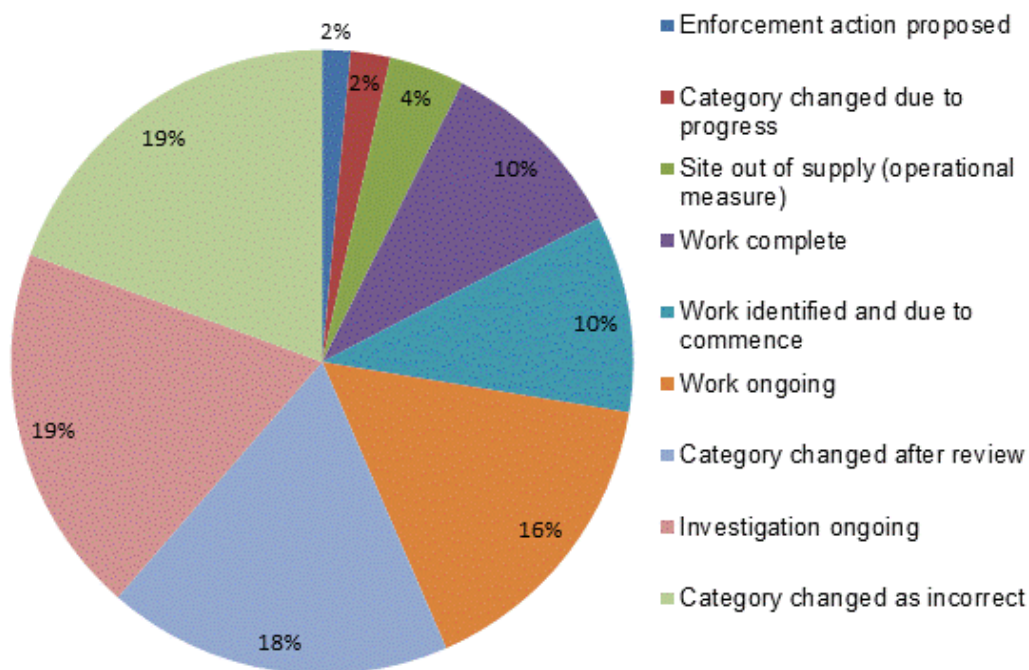
Severn Trent Water has the largest number of instances (528 category E hazards) and this is a rate of about 4.2 per works. For Severn Trent Water, 320 were where the company are keeping a 'watching brief' of levels of a particular hazard (i.e. monitoring with plans to act if there are detections or a detection above a trigger level). The company need to satisfy themselves they are content that the 'watching brief' provides an adequate control point to proactively mitigate a change in risk profile. In this instance, if the hazard was currently adequately controlled, this would be deemed a 'DWI category A' meaning the 'target mitigation is achieved and verified'. A further 73 were reassigned to other categories, 62 were genuinely being reviewed and for the remaining 73, further mitigation measures were either in planning or delivery stages. Many of Severn Trent Water's works are covered by company-wide legal instruments.

Another company approaching four category E risks per works was Wessex Water at 3.7. Companies are encouraged to ensure these values are reflective of the residual risks under investigation, as the maximum for most companies is 2.5 per works. There are several companies that do not have any mitigation measures under investigation at works (AFW, BRL, CAM, CHO DVW, ESK, PRT, SBW and SES). This indicates that these companies have achieved their target residual risk level for all water quality hazards at their works. The Inspectorate is encouraged that these companies have mitigated all their risks at works and would therefore not expect to see any problems associated with flexibility of supply, operation

and maintenance of assets including disinfection or unexpected occurrences of deterioration of the water supply.

Looking to all other companies, a detailed review of each mitigation measure under investigation was carried out. In all cases there was insufficient information included in the existing data submission to carry out a review without requesting further information from the company. Figure 4 describes the recategorisation following the exercise and only 19% remained as 'investigation ongoing'. For future submissions, companies should aim to provide reasonably descriptive information in their data return, better utilising the 'Additional Control Measure Details' and 'Comments' fields (i.e. where a mitigation measure is under investigation, what is the nature of the investigation, and when will it conclude).

Figure 4: Treatment works: Mitigation under investigation – Additional information



Enforcement action may be used when there is evidence of inadequate mitigation measures linked to meeting the requirements of Regulation 26 and the performance of treatment processes such as coagulation. Of the 2% where enforcement action is proposed, (Figure 4), United Utilities have the majority share, which reflects the transformation project embarked upon by the Inspectorate in response to the high risks being carried and realised by the company. This project will look in further detail at actions proposed at United Utilities' sites, with a view to putting legal instruments in place to formalise work. Of the remaining companies identified in this

category, (ANG, TMS, WSX), further details on proposals will be required before enforcement action is considered.

In general, the majority of mitigations under investigation were wrongly categorised, have or will be recategorised due to review or actions being completed, or are still under investigation with actions yet to be confirmed. It is expected that the number wrongly categorised will be greatly reduced after the annual submission. The provision of the outcomes of this exercise is intended to inform senior managers of their relative position within the industry (England and Wales) to determine if their residual risk is within acceptable limits. Companies should take note of the accuracy and reliability of their data and the actions necessary for them to have the most up-to-date information when deciding long-term strategy. The Inspectorate will again review all category E hazards from the annual submission, paying particular attention to those which were 'investigation ongoing' at the end of 2015.

Risk assessment reports as dynamic evolving documents

The risk assessment reports produced and maintained by companies are required to be under continual review and be current and relevant.

The Inspectorate has investigated several events recently where risk reports have referenced site processes which are 'out of service' as being current and effective mitigation.

For example, if a site has a specific set of pressure vessels which have been removed, long term, for maintenance then these do not form part of the effective mitigation for that site and the submitted risk reports should be updated.

As an example, Severn Trent Water's Church Wilne works had a dissolved air floatation (DAF) treatment stage which had been removed from service as the site was on restricted flow rates and thus did not require it to be operational. However, this DAF plant was recorded to form part of the mitigation.

Companies should know the status of their assets and which are in service and this should be fed back to the team responsible for the risk assessments and in turn updated in the data submissions to the Inspectorate.

Some companies have successfully implemented processes for the review of risk assessments and during 2016, there have been a small number of instances when a company's risk assessment review process has

demonstrated good practice and has complimented the Inspectorate's processes for event assessment, risk assessment review and enforcement.

An example of good practice occurred when, on 25 August 2015, South East Water notified the Inspectorate of an event involving detection of *E.coli* at a service reservoir. The company risk assessment report held by the Inspectorate was dated 29 April 2015. It concluded that the control measures (which included an inspection and cleaning programme, operator training, policies and procedures and turnover management) were validated through monitoring and maintenance records and were reported as adequately mitigating bacteriological risks.

In response to the event, the company reviewed this risk assessment and submitted a revised risk assessment report at the beginning of February 2016, the review having taken place on 01 November 2015. The updated reports recognised the increased likelihood arising from the detection of *E.coli*. The company also declared additional control measures to be delivered, which included inspection and cleaning of the reservoir, using the event reference number in the report.

The company demonstrated good practice in the execution of their risk assessment review strategy such that updated risk assessment information was submitted to the DWI as expected and required for the event assessment, risk assessment review, and enforcement action to be completed.

Audits of UV disinfection arrangements

The Inspectorate carried out a series of audits across 13 sites and a selection of companies to understand the status of ultraviolet (UV) operation in the water industry. The audits covered several areas but focused upon the key principles of people, processes, technology fit for purpose and resilience of operation.

At all sites audited, UV was intended by the company to be suitable for the inactivation of *Cryptosporidium* and in all but one case companies were able to demonstrate that their equipment was validated to either USEPA or DVGW methodology. In the single instance where this was not the case, the UV reactor was installed prior to the requirements for validation. In a dynamic and changing risk assessment model, companies must investigate and apply current expectations to any equipment designed to mitigate a risk. Without validation information a company does not have sufficient information to determine efficacy of the control point and cannot then rely upon this as a mitigation or consider it fit for purpose.

Equipment is only as good as the people who operate it, the maintenance which underpins the continuing operation and the information defining working limits. It remains a disappointment that an example was still found where there was some confusion over the target organisms that UV was installed to control. Training is the cornerstone of competency and the responsibility rests with the company to ensure operators are qualified and trained to a minimum standard. Equally, operators will be at a disadvantage if the site operating manual does not contain the manufacturer's instructions. It is not considered acceptable when examples of this are still found and companies should not need reminding.

In the majority of cases maintenance was at a minimum standard, but again companies increase the residual risk where critical equipment is not integrated into a SCADA system to make operational limits clearly visible and facilitate a fast response when limits are exceeded. To avoid the need for reactive action, a robust plan for maintenance should be in place. Again, while this was largely the case there was a mixture of approaches to maintenance. Some companies' maintenance is entirely 'in house', others rely on contractors and some use a combination of both. Despite these arrangements, one case was identified where the lamp life had been exceeded. The process was inadequate and the mitigation no longer in place. Should there have been a coincident contamination event the consequences could have been severe.

When considering resilience of operation, companies have failsafe processes in place to prevent the supply of water where there is inadequate disinfection or contamination following lamp breakages. Many of the failsafe responses relied on a multi-stream approach assuming only one stream at a time would be impacted. If there is a power failure, this assumption may not be valid. When considering power resilience and failsafe, there were a mixture of approaches from very clear auto-shutdown and run to waste (RTW) both before and after UV, with valves backed by an uninterruptable power supply, to no auto-shutdown or RTW post UV. If the site was considered to be a critical site where there is no opportunity to supply by any other means, the company would be considered to have failed to complete an adequate risk assessment.

Finally, monitoring is taken into account in the risk assessment, ensures operational limits are met and helps assess any risks arising from the treatment process itself. There was a mixture of approaches to online monitoring: All companies had turbidity monitoring in place, and some also had monitoring for colour. Many companies monitored UV transmittance (UVT) and in some cases carried out sampling to provide additional confidence above on-line monitoring alone. When considering technology such as UV disinfection, companies had not fully considered disinfection by-products and very few had any additional monitoring for this. The reliance

on compliance monitoring, for the presence of bromide for example, would be too late when aspiring to use a proactive risk model, a consequence experienced by Bristol in 2013.

Water quality at service reservoirs and in distribution

In Q2, two companies reported detection of *E.coli* at service reservoirs (SES 1, TMS 2). In all three cases, investigations identified ingress as a result of defects in the structures. All reservoirs are subject to movement and/or deterioration of the structure to a greater or lesser degree, understanding the extent of which should be part of the company risk assessment strategy. Allowing this assessment to be governed by non-water quality objectives, for example, structural insurance will lead to unmitigated failures. Senior managers should determine what strategic residual risk they are prepared to accept and this in turn should determine the frequency and prioritisation of inspection. The focus on risk should be tracked through success criteria and the dynamic reassessment of residual risk. For example, the Board of Dŵr Cymru Welsh Water considered this and moved to a three-yearly inspection regime, the outcome of which has been a diminishing coliform failure rate over the last three years compared to previous years.

Table 5: Q2: 2016 – Microbiological tests
The number of tests performed and the number of tests not meeting the standard

Parameter	Total number of tests	Number of tests not meeting the standard
Water leaving service reservoirs		
<i>E.coli</i>	51,891	3
Coliform bacteria	51,889	20

Considering distribution, in Q2 the Inspectorate concluded the assessment of an event that arose as a result of poor planning. Unlike residual risk assessment of assets to determine forward strategy as described above, this event demonstrates the merits of risk assessment and mitigation of foreseeable risks ahead of planned work.

An attempt was made to recommission a 14 inch cast iron main which had previously supplied Tilehurst service reservoir with the aim of providing more flexibility in the supply to the town. When the work went ahead, flow reversals in the recommissioned 14 inch main caused mains sediments to

be disturbed and discoloured water was supplied to an estimated maximum population of 30,000 in Reading.

The planning of this exercise was deficient as an appropriate risk assessment was not carried out. The company failed to learn from previous events where poor planning of scheduled work led to widespread discolouration issues. Other events reported to the Inspectorate include: Bexley Hill and Plumstead, Blackhealth, Farringdon, and Witney. In all these events, recommendations and suggestions relating to the completion and correct use of risk assessments were made, to prevent discoloured water and possible breaches of the regulations.

Water quality at consumers' taps

Assessment of compliance

Most samples taken to assess regulatory compliance are taken from consumers' taps, and testing takes place for 51 parameters that have numerical standards. Sampling frequencies are determined by the size of the population in the water supply zone. The vast majority of samples taken complied fully with regulatory requirements. However, in England 36% of reported events and in Wales 20% of reported events in Q2 were attributable to the domestic distribution system. These vary from just simple tap hygiene through to the materials within the property and the arrangements of the plumbing.

From the samples taken to demonstrate compliance with European Union or national standards, there were a total of 110 failures for 15 parameters in Q2 2016.

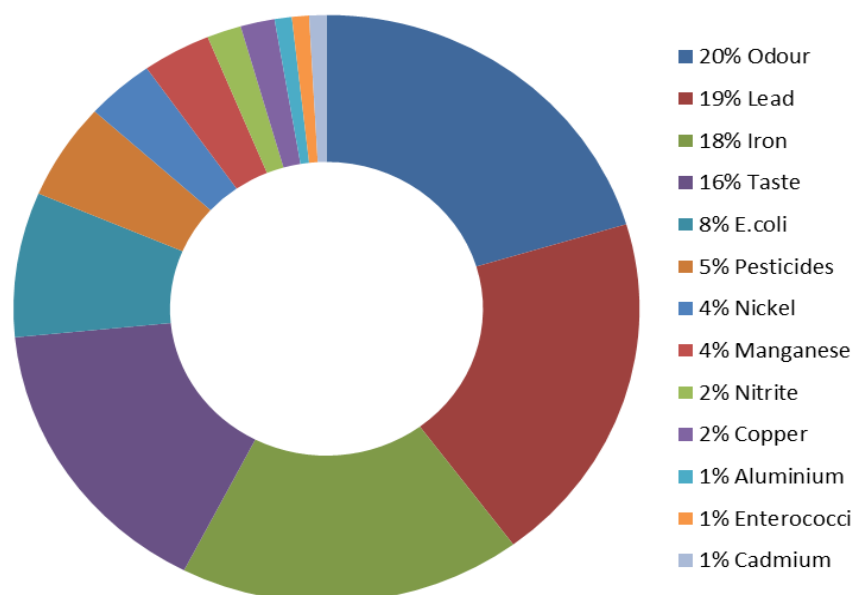
For microbiological parameters, nine samples contained *E.coli* and one contained Enterococci. With regard to chemical parameters, the most prevalent detections were for iron, lead and taste and odour which accounted for 83 failures (75% of the total).

Looking at the 110 failures in more detail, Figure 6 shows the proportion of failures for the 15 parameters.

In Q2 about 50% of compliance failures were due to the domestic system and together with the number of reported events, these constitute a significant challenge for companies who must deliver wholesome water at the tap. The mitigation of these risks should be a long-term strategy based upon two tenets; the availability of materials to the market and an approval mark for those who carry out work on domestic systems underpinned by water company strategy on their fittings activities. I am pleased to note

that 21 companies have embarked upon collective working with the Water Regulations Advisory Scheme (WRAS) to keep water safe in premises.

Figure 6: European and national parameters failing in Q2 2016 – percentage of the 110 failures recorded



In Q2, one company reported a failure of the cadmium standard, a very unusual occurrence. Investigation revealed two errors in the analysis process within the relevant laboratory whereby analytical quality control (AQC) failed for the first analysis of the sample and on reanalysis, an AQC standard was mistakenly analysed in place of the correct sample. Additionally, a system error meant the resulting breach of standard was not flagged to the analyst. The Inspectorate expects the company to document and report the non-conformity to UKAS (the United Kingdom Accreditation Service which accredit laboratories) in addition to ensuring that the lessons learned are documented and shared with relevant staff.

Additional information

Radioactivity waiver changes

During late summer of 2016, following the consultation held in March, the Inspectorate wrote to companies to outline changes to the requirements for the monitoring of radioactivity in water. Waivers may be applied for which cover tritium, gross alpha and gross beta and radon.

Information from catchment risk assessments, operational and compliance monitoring for Indicative dose and tritium, and relevant information from other organisations such as the Environment Agency, Natural Resources Wales, Public Health England and Public Health Wales has been used to evidence suitability for the cessation of monitoring where the risk is low or absent. Applications should include information on whether the source of any radioactivity detected is natural or artificial. Schedule 4 of the 2016 regulations is transposed directly from the Euratom Directive, and provides more detail about the monitoring requirements, radionuclides that should be monitored to verify indicative dose and analytical requirements.

Many companies have started to send reports to the Inspectorate covering treatment works and showing monitoring data gathered over the past two or three years. Information available to the Inspectorate indicates that all public supplies in England and Wales are likely to qualify for an exemption from monitoring under Regulation 6(12). It should be noted that under Regulation 8 there are provisions for sampling for any radioactivity parameter at supply points.

The Inspectorate is in the process of assessing information from companies and where appropriate will issue waivers for works and associated supply zones. These waivers will become effective from 1 January 2017 and expire at the end of 2021. This approach paves the way for changes brought about by the directive which will allow companies to take a risk-based approach and, where evidence can be produced, companies will be able to apply for waivers to permit reduction in sampling for a wide range of parameters.

This also highlights the need for companies to fully adopt a dynamic and integrated approach to water safety plans with the regular update of risk assessments. It is essential that companies assess the need for periodic operational monitoring as failure to be able to quantify risks and show relevant sample data may hinder their ability to apply for waivers or a continuation of a waiver in the future. Any parameter which is due to exceed or has exceeded its value should be reported immediately to the Inspectorate irrespective of a waiver being in place or not.



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