

Drinking water 2021

Quarter 4 October – December 2021

A report by the Chief Inspector of Drinking Water



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Drinking water 2021

Public water supplies for
England and Wales

Quarter 4

October – December 2021

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Water quality compliance

Microbiological failures at treatment works

There was a single failure to meet the *E. coli* standard at one treatment works in this quarter (SRN), and 17 breaches of the total coliform standard over the same period (SWB 3, TMS 3, ANH 2, DWR 2, NES 2, UUT 2, BRL, SRN and YKS).

Table 1: Q4 2021 – Microbiological failures at water treatment works

Parameter	Total Number of tests	Number of tests not meeting the standard
<i>E. coli</i>	47,074	1
Coliform bacteria	47,074	17

E. coli and coliform bacteria were detected at Southern Water’s Burham works in November. Coliform bacteria were detected at South West and Bournemouth Water’s Alderney works in October and Tottiford works in November. Bristol Water detected coliform bacteria at the Stowey works in December. All of the breaches occurred at works where a legal instrument is in place.

Southern Water’s Burham works

The condition of an asset is critical in maintaining the quality of drinking water. This site has previously detected coliforms in 2018 and 2019 and remains a site of regulatory attention. Whilst the company undertook a thorough investigation and the cause was not definitively identified, the structural integrity of the site remains a concern with potential point of ingress. Companies should always take a water quality first approach when considering asset health, ensuring mitigations are prioritised to secure a safe supply. This site is subject to enforcement action.

Thames Water’s Ladymead (Dapdune) and Swinford works

Enforcement action was initiated following a coliform breach at Thames Water’s Ladymead (Dapdune) works in November, where the company are unable to remove the contact tank from supply to allow for internal inspection and potential repair. Similarly, enforcement action was initiated following a coliform breach at Thames Water’s Swinford works in December.

Microbiological ingress via the granular activated carbon (GAC) contactors and combined with an overdue inspection on a contact tank compartment prompted the need for further action. Ingress through water treatment processes has been previously identified on Thames Water sites and a recommendation was made for the company to review its internal and external inspection programmes to avoid deteriorations, which allow such contamination. It also came to light that the GAC had not been regenerated in line with company policy and a recommendation was made to rectify this, with consideration of further enforcement if there is evidence of significant non-compliance with the policy. The inability to remove a contact tank, failure to inspect tanks and failure to regenerate the GAC in the planned time are all ongoing and known risks which a company should strategically plan, to keep water safe. This is a water quality first approach and the minimum standard.

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Anglian Water Clay Lane and Wing

In quarter four 2021, Anglian Water saw two coliform failures at treatment works. Whilst a coliform detection at Clay Lane treatment works was assessed as satisfactory investigation no cause identified, the coliform detection at Wing treatment works in December 2021 resulted in recommendations. During investigations it was found that GAC media was seeding the contact tank which may have caused shielding in the disinfection process. A substantial quantity of GAC media was removed from the contact tank. In addition, the Inspectorate found that although annual maintenance checks on GAC adsorber media depth were part of the company's procedures there was no evidence that depth checks had been undertaken at the works. As this action is a critical control point, the Inspectorate recommended that the company review the frequency for checking filter media depths and the process by which these are electronically recorded and monitored. In addition to this the Inspectorate found deficiencies with the method for checking GAC adsorber backwash checks. Companies are reminded to regularly monitor media depth and have a robust recording system in place that allows for performance assessment and monitoring media loss. In addition, backwash checks should include logging air scour pattern and overall condition of GAC adsorbers. Anglian Water were given a second recommendation to ensure that the process for checking backwash performance includes condition checks and is appropriately recorded with any issues being escalated for investigation.

Northumbrian Essex and Suffolk Water Gunnerton and Hanningfield

Northumbrian Water had two coliform breaches in quarter four 2021. The Inspectorate concluded that the first detection, at Gunnerton works, was unlikely to recur and that the company had carried out a robust investigation into the cause of the breach. The second failure at Hanningfield works where 2 coliforms/100 mL were detected was assessed as covered by legal instrument. The treated water tank at Hanningfield works is overdue inspection and covered by notice NES 2020-00011. The company committed to carrying out the tank inspection by May 2022. The site is currently under enhanced monitoring as part of the notice. There were concerns regarding the overflow on the outfall of the treated water tank as this was found to be fixed in the open position. The company undertook work to clear the ditch and upgrade the outfall protection. Companies are reminded to complete regular check on outfall and overflow pipework as these can present a risk for tank contamination. Tanks that are overdue inspection present a high risk to treated water where points of ingress may go unidentified. Following audits in 2021 companies with tanks overdue inspection have been served regulation 28(4) notices to ensure that inspections are completed and cleaning schedules maintained.

United Utilities Sutton Hall and Ashworth Moor

United Utilities had two coliform breaches in quarter four 2021 at Sutton Hall Number 1 works and Ashworth Moor works. Both failures were assessed and investigations into the treatment processes did not identify any issues, with both works operating satisfactorily prior to and on the day of the infringements. In both instances the root cause was found to be ingress into the works contact tanks, identified upon inspection. Both tanks were within the 10-year inspection frequency and following remedial work to address the points of ingress, the company collected satisfactory samples and returned the tanks to service. Companies are reminded that tank risk assessments should be kept under continuous review as part of regulation 27(3). A suggestion was given to the company that the risk assessments determining the inspection frequency of the site tanks are kept

under continuous review, and that works evaluate any appropriate changes based upon the risks presented on site.

Dŵr Cymru Welsh Water's Felindre and Cantref treatment works

There were two microbiological failures at treatment works in Wales. These were single coliform failures at Dŵr Cymru Welsh Water's Felindre and Cantref treatment works in October.

Felindre treatment works

In October 2021 there was a single coliform breach at Dŵr Cymru Welsh Water's Felindre treatment works. There was an earlier single coliform failure at this works in October 2019, where the company's investigation did not initially find a cause. Ingress was later found in one of the contact tanks, however the company was not able to remove it from supply to complete repair work.

Following the coliform breach in October 2021, external inspections identified ingress in both contact tanks and the final water tank at the works plus a detached membrane, ingress around the hatches, peeling of overbanding and treated water in the drains. Since the company are currently unable to remove any of these three tanks from supply, the risk posed by these tanks is ongoing and has been for at least the two years since the previous failure and investigation findings. This is arguably an unacceptable ongoing risk which the company have chosen to bear whilst knowing that ingress was a root cause. It is questionable therefore if this is a 'water quality first' approach given that the assets have been in the company possession for over 30 years and a strategic plan should have worked towards avoiding any sites being unable to be removed from service.

Although both contact tanks were inspected via remotely operated vehicles (ROV) in previous years, neither contact tank had been drained and internally inspected since construction in 1972 and 2000. The final water tanks were internally inspected in 2019 (North) and 2020 (South). Both contact tanks have now been inspected via ROV following the failure and ingress found. Notably, these inspections found staining and possible ingress of eight of the hatches in one contact tank. The company has put measures in place to make some repairs where possible (without removing the tanks from supply) and a temporary membrane has been installed over the contact and final water tanks. The company are in the process of installing a bypass to enable it to isolate these tanks after 54 years.

Two recommendations were given to the company following this breach; one to review the risk assessment for frequency of mitigation measures on a risk-based approach. Due to volume output and the knowledge that these tanks cannot currently be bypassed, they may have benefitted from increased frequency inspections to identify issues before they cause a failure. Since the ingress which has been found to date has been via external inspection, the Inspectorate has concluded that this breach was preventable. A second recommendation was given to the company to provide a contingency plan in the event of failures in the meantime, whilst repair work is ongoing.

Cantref treatment works

Following an earlier operational failure at Cantref treatment works in August 2020, the company's investigation found multiple points of ingress through the treatment works and in the contact tank. Intrusive refurbishment works were carried out, with some of the significant defects addressed,

however, several other defects raised were left un-resolved. During the inspection following the failure in October 2021, numerous key defects were identified, including ingress of water from the first stage discharge tank into the contact tank, in the same place as repaired previously.



Figure 1 Leak through soffit slab into inlet gallery Cantref treatment works



Figure 2 Ingress from interstage filter tank into inlet Cantref treatment works gallery



Figure 3 and Figure 4 Phosphoric acid dosing location – not fully airtight and light passing through into tank Cantref treatment works

The company took swift action in removing the works from supply the same day as the failure was reported, thus removing the risk to consumers. The site remains offline until repair work has been completed. Cantref treatment works is due to be replaced by the new Merthyr/Cwm Taff treatment works which is due to be completed by 2030. For assets which are due to be replaced, it is important that these assets should not have their maintenance and repair deprioritised and companies are therefore reminded that assets should continue to be adequately maintained until such time they are removed from supply and decommissioned.

Due to the issues identified surrounding the contact tank, Cantref treatment works has been included in the notice DWR 2021-00002 Service Reservoir and Treated Water Tanks. For Cantref treatment works, the notice will ensure enhanced monitoring, once it is brought back into supply.

For the remaining four breaches, the assessing Inspectors considered the investigations satisfactory with no cause found or that they were unlikely to recur.

Turbidity failures at treatment works

Of the seven turbidity breaches at treatment works in this quarter (TMS 2, ANH, BRL, SEW, SVT and UUT), there were three where the assessing Inspector considered no further action after a satisfactory investigation or deemed the breaches unlikely to recur.

South East Water's Shellbrook works

Turbidity was detected in the final water at South East Water's Shellbrook works in November. The company was not able to conclusively identify the source of the turbidity but following investigative sampling believe the cause may have been related to insufficient flushing of the copper sample line. As the company did not fully investigate the cause of where the particulate matter may have originated from in the sample line, the Inspectorate recommended that they review the root cause, including works optimisation, to confirm the works process was not the cause of the turbidity.

Thames Water Orpington works

The Inspectorate recommended that Thames Water investigates the condition of the outlet main at Orpington works after elevated iron and turbidity were found on the final water in October. Similar issues had occurred in 2018, 2019 and 2020.

Anglian Waters Baylham works

A 2.53 NTU turbidity break at Anglian Waters Baylham works in October 2021 was thought to be caused by a pump change over. The method used to conduct pump change overs is controlled to minimise hydraulic shock on the system. A suggestion was made that to support the controlled pump change over, quantitative data is used to inform the risk with manual turbidity sampling conducted at the time of the changeover. During the investigation it was identified that the dirty wash water tank is situated above the contact tank and the filters are situated above the balance tank at Baylham works, a design that perhaps might not be considered acceptable by current standards if thinking about water quality first rather than the site footprint. In view of these findings, the Inspectorate suggested that the company review the frequency of inspection of both these tanks since the last inspections were conducted in 2017 and some internal issues were found.

This turbidity breach was a repeat, with the previous failure in February 2020 also being linked to pump changes overs. Due to the repeat nature of this exceedance the Inspectorate was unable to

conclude that the turbidity breach was unlikely to recur and therefore a recommendation was given that the company complete a thorough and detailed investigation of the high lift pump manifold and pump changeover methodology on site. Water companies are reminded that invasive actions on treatment process such as pump change overs should be adequately risk assessed with action plans put in place to monitor and control the level of risk as the operations are taking place.

United Utilities Godley works

In October 2021 UUT had a 3.64 NTU turbidity failure at Godley works. This resulted in the Inspectorate given recommendations. The root cause of the exceedance was found to be valving operations on the contact tank. Both the inlet and outlet valves of the tank were operated sequentially to conduct routine key valve checks. The company was unable to verify that disinfection in the contact tank was not compromised by the operation of the inlet valve and the Inspectorate saw no evidence to show that sediments in the contact tank were absent at the time of the failure. A suggestion was given to the company stating that there is a risk of final water rising above 1 NTU on tanks that require key valve operations, steps should be taken to contain any water above 1 NTU. During investigations it was found that the final water turbidity monitors were not within calibration. Instruments that are not correctly calibrated will give incorrect measurements that cannot support an accurate assessment of risk. A recommendation was given that all water quality instruments are calibrated as per the manufacturers guidance to ensure that they are functioning correctly and representative of the sampled water. Water companies should actively track when recalibrations are required to avoid instances such as this occurring.

Radiological failures at supply points

Gross alpha was detected four times and radon detected twice at supply points on the Isles of Scilly during quarter four. The parameters have been included on the island wide notices which cover the improvements South West and Bournemouth Water are undertaking on the Isles to bring the water supply systems up to regulatory drinking water quality standards. The notices ensure suitable mitigation for the radiological parameters are included to protect the health of residents and visitors to the islands.

Water quality at service reservoirs and in distribution

E. coli was detected at three service reservoirs (DWR, TMS and YKS) in quarter four, and 16 samples contained coliform organisms, (DWR 2, SWB 2, TMS 2, YKS 2, AFW, ANH, BRL, HDC, SRN SVT, UUT and WSX).

Table 2: Q4 2021 – Microbiological failures at service reservoirs

Parameter	Total Number of tests	Number of tests not meeting the standard
<i>E. coli</i>	51,952	3
Coliform bacteria	51,952	16

Dŵr Cymru Welsh Water's Fitzroy service reservoir and Pengarddu service reservoir

In October 2021, a single *E. coli* failure was reported from Dŵr Cymru Welsh Water's Fitzroy service reservoir. The company removed the reservoir from supply on the afternoon the initial coliform was reported (prior to the confirmation of *E. coli*) and the Inspectorate welcomes this fast response to safeguard drinking water supplies.

The service reservoir was drained down and an internal inspection carried out. This identified leaks along the entire roof and wall joint, thought to be the cause of the failure. Other issues were also highlighted, such as two abandoned inlet mains requiring cutting and capping. The reservoir was last internally inspected in March 2016.



Figure 5 Defective bitumen joint
Fitzroy service reservoir

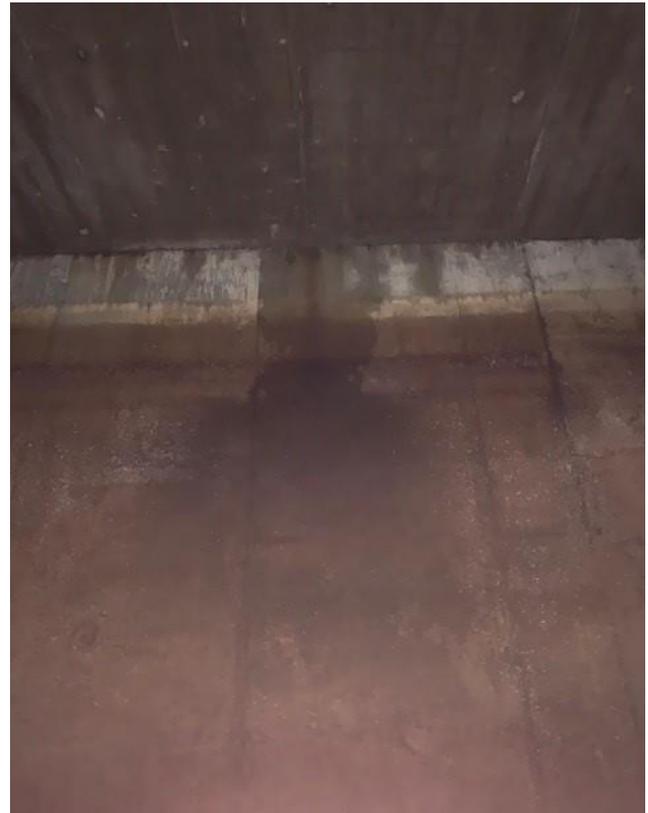


Figure 6 Defective bitumen joint
Fitzroy service reservoir

All resamples collected for the investigation were satisfactory, there were two coliform compliance failures in distribution downstream from this reservoir in the preceding days. One of these breaches was found to be related to tap hygiene, however, in the case of the second failure there was no definitive cause found for the breach. There is no evidence that this second failure was linked, however, excepting these two zonal failures, there have been no other microbiological compliance failures in this zone since 2013. Companies should be reminded that where ingress into a reservoir is considered a potential cause of a failure, related sample failures may not be limited to the same type of bacteria.

In December 2021, a sample from Dŵr Cymru Welsh Water's Pengarddu service reservoir was reported to contain a single coliform bacteria. All resamples were found to be satisfactory. The company had carried out an inspection by a remotely operated vehicle (ROV) in November 2021, then again following the failure, which identified several potential causes including debris on the

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floor, which in some areas was up to 10 cm, and potential dead legs of pipework. An ROV clean was carried out following the latest inspection, removing the risk of the sediment build up, causing any further issues.

The company have been unable to remove this tank from supply due to network constraints and is building a new reservoir on site under the notice DWR 2018-00002. Once the new reservoir is in supply, the company will remove this reservoir from supply for a full internal inspection.

Hafren Dyfrdwy's Welshpool Yr Allt service reservoir

10 coliforms were detected at Hafren Dyfrdwy's Welshpool Yr Allt service reservoir in November 2021. Both cells were last internally inspected in 2015. The company attempted to remove the service reservoir from supply, however the bypass was found to be inoperable. Following work to resolve this, the reservoir was removed from supply in January 2022, nearly 10 weeks after the failure was reported. The company were given a suggestion in an audit report in December 2021, to include operability checks for critical valves which may prevent recurrences of this in the future. The internal inspection highlighted a broken washout pipe, which is a potential point of ingress, overgrown vegetation reaching the tank, making it difficult to fully inspect the asset from the outside, and a point of ingress through the roof hatches, from which daylight could be seen from the inside. This is a good example of why critical valves should be checked for operability and companies should ensure that wherever possible, service reservoirs and tanks can be removed from supply when required.



Figure 7 Entry hatch (closed) showing daylight visible through gaps
Welshpool Yr Allt service reservoir

This asset is due for replacement in AMP7 and is another example of an asset which has failed whilst awaiting renewal.

Thames Water's Darnicle Hill service reservoir and Pewley service reservoir

The Inspectorate welcomed Thames Water's decision to promptly remove Darnicle Hill service reservoir from supply, following the detection of *E. coli* in October. An internal inspection identified biofilm growth within the tank, but the company were unable to ascertain its nature. The Inspectorate suggested that the company consult more widely with experts in other organisations to complete its investigations.

The Inspectorate recommended that Thames Water ensure remedial work is appropriately prioritised following a coliform breach at Pewley service reservoir in October. The company had identified ingress risks including poorly sealed hatch covers prior to the detection, but these had not been rectified and represent a missed opportunity to prevent contamination of the service reservoir.

Wessex Water's Donhead service reservoir

After a detection of a single coliform bacteria at the Wessex Water's Donhead service reservoir, the company's investigation identified the species of coliform was one that could be found within slugs or soil. Slugs had been observed in the sample kiosk and to help prevent a recurrence the company fitted a cover in an open hole to prevent insect/mollusc access and contamination of the sample point. The company undertakes six monthly sample tap inspections and the Inspectorate recommended that the criteria is reviewed to include drain cap/covers are in place to help prevent a future breach of regulation 16 at other sample points.

Southern Water Deal Low Level service reservoir

Southern Water recently made improvements to their sample tap and kiosk inspection procedures (see Audit section) and following a detection of coliform bacteria at the Deal Low Level service reservoir in October, and whilst no cause could be found, the Inspectorate suggested to assess whether the enhancements have improved reporting.

Water companies are reminded to ensure that their sample tap/kiosk inspections consider all potential points of contamination to help ensure samples are representative of the water being supplied and are designed in a way that any deterioration in the condition indicating improvements are required can be quickly identified and actioned.

Severn Trent Water Derwent Village HI (Fairholmes) service reservoir

The Inspectorate had already served a notice on Severn Trent Water to complete enabling work to allow Derwent Village HI (Fairholmes) service reservoir to be removed from supply before a coliform detection in October. The reservoir had increased monitoring due to the risk and was eventually removed from supply in January 2022 following a bypass allowing booster pumps to supply the area whilst an inspection was completed.

Yorkshire Water Grassington Number 2 service reservoir

Recommendations were given to Yorkshire Water following an *E. coli* breach at Grassington Number 2 service reservoir in October 2021. The company operates a secondary chlorination unit at Grassington Number 2 CRE which doses to a set point of 0.4 – 0.6 mg/L residual chlorine. The unit is not connected to the company's telemetry system, therefore remote visibility and control of the chlorine dosing is absent. Upon investigation it was found that the company has submitted a regulation 28(1) risk assessment for the over or underdosing of chlorine at Grassington Number 2

service reservoir as a category A risk which appears for the downstream Skipton/Craven 2015 zone risk assessment. The risk assessment includes online monitoring and SCADA systems as part of the risk controls. This risk assessment was not an accurate account of the monitoring controls on the secondary chlorination unit and therefore a recommendation was given requiring the company to update the risk assessment to reflect the current risk at this asset and any other company assets where secondary chlorination is carried out. An additional recommendation was also given that the company reviews any mitigation in place to avoid overdosing chlorine at this asset, including the requirement for offsite visibility and the use of appropriate alarms.

Companies are reminded to keep their regulation 27 risk assessments and corresponding regulation 28(1) submissions up to date and accurate. In previous years the Inspectorate has investigated events linked to secondary chlorination units and it is therefore unacceptable to not have telemetry and therefore visibility and control of these systems.

Water quality at consumers' taps

E. coli at consumers' taps

There were three detections of *E. coli* at consumers' taps in the last quarter of 2021 (ANH, NES, SVT). In each case, the Inspectorate was satisfied that the issues had been addressed and the failures were unlikely to recur.

Coliform bacteria at consumers' taps

Coliform bacteria were detected seven times in samples collected from consumers' taps in the fourth quarter (SRN, SVT, TMS, UUT 3, YKS)

Iron

South East Water detected iron in excess of the standard in a sample collected from the Greywell supply zone. The sample was collected from a business park which houses a small number of industrial units and businesses. In response to the failure, the company instigated a flushing programme to remove the build-up of accumulated deposits from within the distribution system. As flushing is a temporary measure to address the risk of build-up of deposits and does not address the root cause of the source of the iron, the Inspectorate recommended that the company undertakes a validation exercise to confirm the flushing programme's effectiveness and, if necessary, identifies if any further work which may be needed to ensure the root cause is resolved as a longer term strategy. Taking this approach ensures water being supplied is wholesome.

In quarter four Northumbrian Water had five iron exceedances. Many of these were assessed as covered by legal instrument as work being undertaken in notice NES 2018-00003 will prevent future breaches occurring once the noticed measures are delivered. Enforcement was considered for an iron exceedance of 350 µg/L in the Marsden Cleadon and South Shields zone in November 2021 and a recommendation issued. The company had previously identified the local distribution network associated with this breach as an area of persistent elevated iron, linked to the condition of an unlined cast iron main. This issue was identified following a compliance failure in March 2020. A commitment was made to the Inspectorate with work due to start in April 2021 to replace the main. During this repeat occurrence the Inspectorate found that the mains work had been put on hold

and not completed as planned. A recommendation was made requiring the company to provide monthly updates on the main replacement with further enforcement considered should the work show delays. Where companies identify localised sources of persistent discolouration such as unlined cast iron mains replacement works should be undertaken swiftly to restore wholesome supplies to those properties affected. Where necessary the Inspectorate will put in place enforcement notices for small schemes such as this if repeat failures are not dealt with appropriately and promptly to ensure a water quality first approach is taken.

United Utilities had two iron failures in November 2021 with both instances being caused by transient resuspension of historic mains deposits from within the local networks. Both zones are covered by the company's legal instrument UUT 2020-00005 which is delivering improvements to United Utilities discolouration risk in zones across the company's network.

Yorkshire Water had four iron exceedances in quarter four 2021. The sample failing in the Holmfirth and Emley 2019 zone contained an iron concentration of 246 µg/L. Investigatory resamples taken from the original and neighbouring properties remained elevated. Network flushing had been taking place in the DMA prior to the regulatory sample being collected and the root cause put forward by the company was suggested to be a result of resuspended sediment in the network. However, a water quality first strategy might question why the sediment is there in the first place because unnecessary ongoing flushing could be reduced as an ongoing resource. The company is subject to a regulation 28(4) notice for consumer acceptability associated with discolouration (YKS 2019-00001) and therefore the breach was covered by this legal instrument. Companies are reminded that if network flushing is taking place every effort should be made to limit the impact on consumers, use of turbidity monitors and manual samples to quantify risks and night flushing to limit impacts to consumer acceptability and water use is encouraged as good practice.

Enforcement action is being considered following repeated breaches of the iron standard in Severn Trent water's Higham supply zone beginning in December 2021. The failing property is at the end of a cul de sac, and short term flushing measures to remove mains sediments have so far proved unreliable in rectifying the issue. As a short term control measure the company installed filters at the affected property boundaries. Further information on the long term solution is awaited before the Inspectorate completes its assessment.

In 2021, there were four regulatory exceedances of the iron standard, in Severn Trent Water's Alvaston supply zone. Whilst the company had instigated an investigation across the entire supply zone, the Inspectorate could not conclude that the iron failures were unlikely to recur and consequently, enforcement action was initiated to prevent further breaches of regulation 4.

Lead

Lead was detected from a consumer tap in the Wessex Water Heytsbury supply zone in October. The company ceased phosphate dosing in this zone in January 2020 following a review of data which showed there was no discernible concentrations of lead for over two years. Modelling data identified up to 42 properties which were at risk of lead, with some but not all, which had service pipe replacements prior to the cessation of the phosphate dosing. The Inspectorate recommended that the company reviewed its risk assessments for the cessation of phosphate dosing to ensure public health risks are identified and includes appropriate verification steps to ensure stopping of plumbosolvency measures will not cause a detriment to the quality of the water supplied. The

Inspectorate made further enquiries as to the risk posed to the other consumers who may have a lead service pipe still in place.

A sample taken from Northumbrian Water's Low Service to City Centre zone in Newcastle-upon-Tyne failed for both lead (20 µg/L) and nickel (230 µg/L). Investigations at the property revealed a lead communication pipe which was replaced. The nickel failure was investigated with a water fittings inspection which concluded that the most likely source of the nickel was from the kitchen mixer tap which is over 20 years old and in poor condition. The consumer was advised to flush the water from the tap before use in the short term and given a recommendation to replace the tap. The Inspectorate concluded that the nickel detection was property specific whilst the lead detection was caused by the public distribution system (communication pipe). The lead breach was closed as covered by legal instrument as the company's lead strategy notice (NNE 3279) supports the reduction of lead exposure risks to consumers. The Nickel exceedance was closed as unlikely to recur. Companies are encouraged to continue assessing their networks for high-risk lead areas and pursue localised campaigns to remove company-owned lead pipes whilst continuing to raise awareness across the customer base about the risks of lead to health.

Manganese

United Utilities exceedances are described below under aluminium (Bamford East zone).

Aluminium

On the 17 December United Utilities had four PCV breaches in the Bamford East zone. Two aluminium breaches were recorded (447 µg/L and 359 µg/L) and two manganese breaches (77.7 µg/L 74.2 µg/L). The cause of the infringements were associated with the failure of a valve operated as part of a planned activity on the network during the hours preceding the sample being taken. The valve failure caused increased flow velocities within the network and a resuspension of historic deposits on the morning of 17 December 2021. Network personnel identified the fault quickly and arranged for the valve to be replaced. The company have in place a discolouration notice with which improvements to the volume of historical mains deposits which lead to occurrences of discolouration are being undertaken. The four breaches were assessed as covered by legal instrument. Companies are reminded to maintain efforts to remove historical mains deposition and limit further seeding of networks from treatment works and along trunk mains.

Nickel

A sample collected from a café on a campsite in Wessex Water's Portland zone failed for nickel in December. Prior to the sample being taken, the supply to the café had little turnover as it had been closed for a period of time. The company reported the cause for the nickel was low turnover/stagnant water, however this did not identify where the nickel may be originating from. Flushing advice was provided to the café owner and the Inspectorate recommended that the company follows up the investigation to determine whether any further action should be taken, including under Section 75, of the Water Industry Act if necessary. A further recommendation was made to the company to review its sampling procedure which had allowed a deviation from the standard sampling process which was put in place during the pandemic.

One NES Nickel failure is associated with the lead breach and described above.

Sodium

The Inspectorate recommended that Severn Trent Water takes steps to ensure that regulatory samples are representative of the water supplied to properties following a high sodium result in Bromsberrow supply zone in November. The consumer had identified that there was a softener at the property, but despite this disclosure the sampler made no checks to see if the sampled tap was a direct mains fed supply.

Taste and Odour

A fruity odour was detected from a sample collected from a business premises staff kitchen in the Southern Water's Ashley zone. The repeat sampling included in-situ testing which detected a chlorinous odour from the premises and a strong chlorinous odour was also detected from the supplying treatment works. The company has received a number of chlorine related consumer contacts from this supply zone so the Inspectorate recommended that further work should be done to investigate whether there is a wider issue with odour in the water being supplied in this zone.

The sampler detected a strong cooking oil odour in Severn Trent Water's Atherstone supply zone in November. The company reported this strong odour as the cause of the taste and odour subsequently detected. To comply with regulation 16, the Inspectorate recommended that the company consider the environment that the sample is taken in when considering if the location is suitable to collect a regulatory sample.

Similarly, a recommendation was made for Thames Water to reconsider its sampling procedures following a sweet taste to a sample from its Reading East supply zone in December. The cause was later found on a water fittings inspection to be due to a softener at the premises. No indication of a softener was given by the consumer. It remains incumbent upon water companies, not the consumer, to ensure that samples taken for regulatory purposes are compliant with regulation 16. Simple hardness test strips could be used to easily identify a softened supply.

Trihalomethanes

In October 2021 Yorkshire Water reported a result of 106.17 µg/L for Trihalomethanes (total by calculation) for the Idle/Pudsey 2004 zone. This result was associated with a taste and odour event in Bradford (2021/8294) which is still under investigation by the Inspectorate. An increase in organic compounds in the raw water supply to Chellow Heights works followed by chlorination is the likely cause of this Trihalomethane exceedance. Chellow Heights works which holds a notice for risks associated with disinfection by-products, Trihalomethanes and halo acetic acids (YKS 2018-00005) and therefore the breach assessment was covered by the legal instrument.

Turbidity

On 18 November Northumbrian Water had a PCV failure for turbidity at 4.5 NTU in the Gunnerton zone. The sample also failed for ammonium (1.3 mg/L). Resampling was initiated on 19 November and continued to the 23 November with further sampling undertaken on 29 November and 8 December. All resamples were satisfactory for turbidity. The zone is directly supplied from Gunnerton works, with no water storage between the works and the zone. Water is pumped via Warden pumping station. The company reviewed the treatment process at Gunnerton works, and no issues were highlighted which could have contributed to the failure. Turbidity results from the final sample point at Gunnerton works over the previous 12 months were all satisfactory. An

investigation into network activity identified a burst on the inlet main, to a Warden pumping station which was caused by joint movement in the main. In terms of ingress contamination likelihood from the burst, this was identified to be low, supported by bacteriologically satisfactory sample results from the repaired main. No consumer contacts were received in relation to the exceedance. The company concluded that this was the likely cause of the breach, and given that this was likely to have disturbed historic mains sediment the Inspectorate agreed with this assessment. The company completed flushing activities in the area and the breach was assessed as unlikely to recur.

Taste and Odour (ANH 13, NES 4, UUT 6)

In quarter four 2021 Anglian Water reported 13 taste and odour exceedances which was substantial compared to other water companies. Repeat failures were seen in the Braintree and Bocking zone, Halstead Rural zone and Hadleigh zone. For the Braintree and Bocking zone a total of eight regulatory breaches for odour have been recorded since 2017 with 69 consumer contacts for taste and odour from the zone across 2020 and 2021. The majority of the breaches share the same odour descriptor of 'musty'. The company's investigations have not been able to conclusively identify a root cause for the exceedances. Due to the quantity of taste and odour failures reported by the company, enforcement is being initiated to deal with the continuing deviation from a wholesome water supply.

Of the six taste and odour breaches UUT reported in quarter four 2021, four breaches received recommendations due to deficiencies in regulation 18 investigations. The company concluded that no root cause could be found for the failures in the Barrowford zone, however the company did not complete a water fittings inspection at the property to investigate internal plumbing issues and did not supplement the investigation with second mains fed tap samples. Similarly a failure in the Stalybridge zone was unable to find the root cause with no resamples being collected from inside the property due to the owner refusing entry. The company made no attempt to collect a sample from the property boundary. A recommendation was made that the company puts in place procedures to ensure that investigations include actions to support the elimination of potential causes within the consumer property and/or the network distribution system to support root cause identification and mitigate against further breaches of the regulations. Companies should endeavour to find the root cause of any failure and conduct thorough investigations to support root cause identification, this includes completing water fittings inspections and boundary sampling to assess whether the public distribution network may be contributing to the failure.

Events case studies

In December 2021, Dŵr Cymru Welsh Water received a request from the local authority for assistance in investigating the supply arrangements for a farmhouse and buildings in Nant-y-moel, near Bridgend. Following a confirmed report of illness at the property, the council had previously been advised that the property was supplied by a private spring supply and samples collected by the local authority confirmed the presence of *E. coli*, coliforms and enterococci in the drinking water supply. The residents were advised to boil the water and following this, the water company were contacted by the local authority. Extensive investigations and water fittings inspections were carried out by Dŵr Cymru Welsh Water, and it was established that the residential property was in fact supplied by a mains supply and the outbuildings on the farm were supplied by the private spring.

The company reviewed the billing arrangements for the property and identified that the property was incorrectly marked as changed from a mains supply to a private supply in 2017, following advice from the owner. Although chlorine checks had been completed at the time, this had confirmed the presence of the private supply only and not the absence of the mains connection. This event highlights the importance of confirming the source of the incoming supply into the property when removing it from the billing system.

Affinity Water - Elevated Turbidity at Batchworth works

In December 2020, Affinity Water carried out some flow trials to increase the output from Batchworth works, a groundwater site located in Rickmansworth. Elevated turbidity passed through the works and entered supply.

Water is abstracted from three on-site boreholes, there is no filtration stage and disinfection is achieved via UV irradiation and super-chlorination prior to water passing into a break tank and then into a pressurised contact tank. At the time of the event, a run to waste facility was only available on the individual boreholes.

The flow trials were undertaken to address reduced output from other sites that was anticipated by the High Speed 2 (HS2) railway project. The company planned to increase flow from Batchworth works in a stepped approach. The first stage to increase abstraction to 25MI/d took place between November and early December 2020 and had been successfully achieved.

The second stage to increase abstraction to 26.4 MI/d initially took place between 14 to 16 December 2020 with several instances of elevated turbidity being observed on 14 and 15 December. On 15 December this led to failsafe turbidity shutdowns occurring on two boreholes, which were subsequently left out of operation. The works was restarted using the remaining borehole 3 at a lower rate than the trial conditions and no further turbidity issues were seen for the rest of the day. The elevated turbidity occurrences were not upwardly reported to supervisory or water quality staff at this stage.

Attempts to operate the site using all three boreholes on the morning of 16 December led to a series of water quality shutdowns on elevated turbidity with attempts to restart unsuccessful on each borehole with the exception of borehole 3, which ran for approximately 30 minutes before an additional pump started automatically and caused the turbidity to rise again. Attempts were made to run individual boreholes to waste which reduced turbidity in the individual boreholes, however, water with elevated turbidity had passed beyond the run to waste points and into the contact tank. There was no run to waste facility downstream of the contact tank. During an attempt to restart on the afternoon of 16 December 2020, the final turbidity monitor (downstream of the contact tank) was reading greater than 2 NTU. A routine compliance sample was collected at this time which returned a turbidity of 4.7 NTU.

In order to avoid further shutdowns, the works was restarted at normal licenced flow rates and the alarms were over-ridden on the final turbidity monitor. With the final water turbidity shutdown overridden improperly disinfected water entered supply for approximately 45 minutes of water >1 NTU entered the contact tank, which equates to approximately one million litres of water.

After the event the company identified the root cause as chalk that had been disturbed during the flow trial. The company also concluded that there was some confusion about the accountability for

the flow trial; the appropriate escalation path was not followed; no downstream run to waste facility was available and the risk of turbid water entering the contact tank was not considered. 28 additional treatment works that do not have appropriate run to waste facilities were also identified.

The Inspectorate's investigation concluded that the staff involved in the trial had all been experienced but had not followed the company's own escalation procedures and overrides were not operated in accordance with company policy. As is often the case in events such as this, the documented risk assessment was poor, the risk of elevated turbidity reaching the contact tank had not been considered and no contingencies had been considered. The plan had not been communicated to all site staff. Operatives had chosen not to escalate through the line management route as the supervisory staff were relatively new in post.

The decision to override the turbidity monitors and allow the improperly treated water into supply was consciously made. The company's disinfection policies and procedures did not meet the guidance laid out by the Inspectorate to comply with regulation 26.

Our investigations identified that Batchworth works had previously been successfully removed from operation for extended periods without the risk of loss of supply when there was sufficient supply available from other works in the area. However, two alternative sources were out of supply and there was a restriction on output at a third works, which meant that alternative supplies were not available to allow Batchworth works to be removed from supply. This contingency measure was not considered within the risk assessment. Had this contingency been available the event may have been avoidable.

The company took timely action to install a run to waste facility at the works outlet and this was a factor in the Inspectorate's decision to issue a Warning Letter to the company following this event.

All companies are reminded of the requirement to appropriately risk assess non routine activities throughout its operational area, but particularly at water treatment works to ensure that the risks to water quality are appropriately considered and mitigated prior to starting work. Human factors account for a significant proportion of the causes of water quality events and companies should consider carefully the appropriate control measures to ensure that policies and procedures are followed, including random checks on compliance with policies and procedures before an event occurs.

Southern Water Cooks Castle Service Reservoir Ingress

In October 2021 a planned ROV inspection of Cooks Castle service reservoir identified a number of defects in the wall joints and roof including a feature or a construction joint which had moved, extending some 4m in height and 2cm in width in a wall. The wall had been constructed in the service reservoir in 2016 following the structural failure of the cell due to a landslip. The site is covered by the service reservoir's legal instrument and under the terms of the notice the company submitted an action plan to the Inspectorate which detailed the short, medium and long-term actions that are required to facilitate the removal of the asset and provide ongoing mitigation measures.

The company event report identified issues with perimeter fence and sample line not being up to company standards so recommendations were issued to address these deficiencies. The company

investigations also identified that the site is still at ongoing risk from ground movement and is proposing short, medium and long-term actions to enable removal of the asset and implement a permanent solution. The Inspectorate will be issuing a regulation 28(4) notice to cover the delivery of this work.

Northumbrian, Essex and Suffolk - Mosswood Works Treatment Failure October 2021 (2021-8303)

On 13 October 2021 a communications outstation at Mosswood works, which controls chemical dosing at the raw water inlet, developed a fault. There was no impact upon water treatment or water quality, and the issue was remotely investigated. The issue was given a next working day priority for on-site investigation.

On 14 October, the outstation began to fail intermittently, and a technician was sent to investigate. However, the outstation failed later on the same day consequently affecting coagulation, the outcome of which was a rise in turbidity above 1 NTU for around two hours and 25 minutes.

The company received 83 calls from consumers; 52 of which related to discolouration or concern about water quality. A large proportion of these discolouration calls were linked to a concurrent burst in Washington and South Shields caused by rezoning activities.

In taking a water safety and quality first approach the company prepared for the possibility of issuing boil water advice to consumers downstream of the works. Boil notices were printed, and bottled water reserves were assessed. However, a continuous *Cryptosporidium* sample was found to be clear on 15 October. In liaison with the United Kingdom Health Security Agency (UKHSA) a boil water notice was not put into place. The company are commended on being ready to act in the public interest.

The Inspectorate carried out a technical event audit in response to this event and six recommendations were consequently raised. A recommendation was raised for the company to review its risk assessment criteria for events such as this, to ensure the requirements of the site-specific disinfection policy are fully considered, particularly where treatment processes are not fully optimised or not working properly. Water companies must always consider the integrity of treatment processes during events such as this and determine whether multiple barriers designed to remove risk to wholesomeness have been compromised. Taking this approach reduces the risk of a serious incident occurring securing public health, the public interest and business risk.

Extensive sampling undertaken by the company, across the network, at the works, downstream service reservoirs and consumer properties. All samples returned satisfactory results for microbiology and *Cryptosporidium*. Six samples breached the PCV for iron, with a maximum result of 310 µg/L. The high levels of iron were present in the raw water and in the samples of water leaving the works, indicating the treatment process had failed.

The event was ultimately caused by a telemetry outstation failing, which caused a loss of communications between the dosing systems and the site Supervisory Control and Data Acquisition (SCADA) system. This meant that the site staff did not have visibility of the works during the outage, requiring the site to be put into manual dosing. The outstation that failed had been flagged as a risk in 2019. The outstations are well beyond their recommended working asset life of 20 years, with some at 40 years old. The reason given for the company not replacing the outstations was that spare parts were readily available when outstations fail and that other projects have taken priority

Drinking water 2021

in asset planning. Where a critical risk has been identified, it is not acceptable for it to remain unmitigated for over two years particularly where replacement was due 20 years before. The fact that other projects were of a higher priority is concerning because this suggests higher risks elsewhere even within a 20-year window. It is a false economy not to replace assets which are beyond their life and do not meet modern standards. This was a near miss which could have cost the company and their consumers dearly.

Mosswood is undergoing major investment in new assets and is covered by two legal instruments for this upgrade work. The company is installing new holding tanks, new UV, new power supplies (both mains incomer supplies and backup generators), new dosing equipment and better resilience measures (including a run to waste facility). These are ongoing projects that were in flight prior to this event. Additional works to replace the telemetry outstation began in quarter one 2022.

Yorkshire Water - Elvington Village Boil Water Notice October 2021 (2021- 8305)

A compliance sample was taken from the kitchen tap at the company's Elvington Water Treatment Works (WTW) on 14 October 2021 as part of the regulatory sampling for the York East 2019 Water Supply Zone (WSZ). The sample was reported as containing 56 coliforms per 100 mL. The domestic supply back to Elvington works is supplied by Elvington works via Siwards How Water Tower (WTR), the last consumer properties before the supply returns to Elvington works are in Derwent Close.

Where a significant failure is detected, it is of the highest priority to carry out an investigation including resamples as soon as possible to protect public health, this is a water quality first approach. It is therefore disappointing to note that the resamples were not considered a priority, the first of which were taken on 16 October and samples from the works were not even analysed because they arrived at the laboratory at the weekend and the laboratory had not been told. This meant that when coliforms were detected again, the health protection advice in the form of a boil water notice was issued to the affected DMA at 18:30 on 18 October 2021 with bottled water delivered to affected consumers.

A Closed Circuit Television (CCTV) survey of the cast iron main in Derwent Close identified a displaced joint connection meaning that there is likely to have been ingress causing contamination at this point. Analysis of the company's flow and pressure data showed regular flow increases in the affected DMA which was thought to be causing short-lived depressurisation.

The company completed chlorination of the Derwent Close distribution main to 50 mg/L and the receipt of two sets of microbiologically satisfactory sample results the health protection advice was rescinded. However, the company only completed planned work to replace the main in January 2022 choosing daily large volume sampling from the kitchen tap at Elvington works as mitigation until the main was replaced to monitor the risk of contamination from the displaced joint. This means that for over three months a residual risk remained and was considered acceptable by the company.

Northumbrian, Essex and Suffolk – Whickham Service Reservoir *E. coli* Detection November 2021 (2021-8327)

On 19 October 2021, due to increased network demands in North Tyneside, Northumbrian Water decided to supply Whickham Service Reservoir (SR) with water from Mosswood works via the

Paddy's Bridge Electronic Control Valve (EOV) on the Derwent Link Main. Due to an error which misinterpreted the operating position of a valve, water did not in fact feed Whickham service reservoir but actually by-passed it leaving the water in the service reservoir to stagnate for three weeks. Consequently, when a routine sample was taken this failed for *E. coli*.

Following the exceedance, Whickham service reservoir was inspected in December 2021. The inspection identified ingress from the overbanding adhesive at the joints in all three tanks and further investigations led to the over-banding entirely debonding from the wall in the East tank.

Companies are reminded that network configurations when carrying out such work must be fully assessed to include valve status to ensure water quality is protected.

Audits

Northumbrian Essex and Suffolk Water Drinking Water Safety Plans

In quarter four 2021 a technical audit of risk assessment methodology and risk assessments of Rochester works, Layer works, and Honey Hill works was complete for Northumbrian Water. The desktop audit was part of the Inspectorate's programme of Drinking Water Safety Plan (DWSP) audits which aimed to improve understanding of how companies are reporting risks differently and to establish a more consistent reporting across all companies. The audit focussed on the DWSP methodology, identification of risks and control measures, categorisation of risks for regulation 28 reporting and the company's risk register.

The company's risk assessments are split across six stages: Catchment, Abstraction, Treatment, Service reservoirs, Distribution and Customer properties. The company's water safety plan exists within a database system known as Maximo which contains the risks associated with each asset in the NES water production and supply system.

During the audit of Layer works, there was a clear risk of microbiological and turbidity failure due to the condition of the slow sand filter floors. This was not properly reflected in the DWSPs. It was therefore recommended that the company ensures its internal trigger levels for operational samples are properly accounted for within its DWSP, investment system and regulation 28 report and that the issue with the condition of slow sand filter floors at Layer works is reported as an appropriate DWI risk category reflecting the status of progress with the refurbishment work. Companies should ensure that if a risk is reported on its investment system, it should be reported as the appropriate DWI risk category and additional control measures are investigated and implemented.

Regarding the current condition of the filters at Layer works, there are only three hazardous events associated with the slow sand filter stages in the company's DWSP system, which are "Birds roosting on slow sand filters", "Rotting weed on slow sand filter" and "Secondary filter breakthrough". There was no further mention of a hazardous event reflecting filter failure due to the current condition of the underdrains, which is a potential breach of regulation 27. The Inspectorate recommended that the company reviews its hazardous event list for Layer works and associated risk scores to reflect the current state of the site assets. Companies are reminded to keep lists of hazardous events dynamic and ensure that these are updated when new risks present.

Portsmouth Water Drinking Water Safety Plan audit

Portsmouth Water has legal instrument in place which covers updates to the drinking water safety plan methodology. In quarter four the Inspectorate audited the company methodology and a number of suggestions and recommendations were raised to ensure that the regulation 27 and 28 reporting processes are improved to ensure that risks to drinking water quality are appropriately identified and recorded. The audit was deemed unsatisfactory with recommendations raised for the various stages in the DWSP process including catchment, abstraction and treatment, storage and distribution. A recommendation was also raised for the company to review the risk assessments at a defined frequency after a deficiency was found with how the risk assessment recorded a risk associated with failing the nitrate standard and to improve the identification and recording of risks associated with backflow from commercial premises and from lead communication/supply pipes.

The audit identified that the majority of the risk assessment process is undertaken only based on sample results, with the hazardous event stream being used for proactive risk assessment based on asset information. These two risk assessment methods are separate and there is not a risk assessment which combines risk information from both sources. The dominant risk assessment method, via individual parameter assessments (IPAs) uses only sample results for risk assessment, in contravention of the World Health Organization approach to DWSPs to ensure they are a proactive way to protect water quality.

Companies are reminded that it is important that all sources of information, not just sample results, are used to determine a risk score and DWI category.

Treated Water Tanks and Service Reservoir Audits

In the fourth quarter, the Inspectorate completed a series of audits of service reservoirs and treated water tanks. Information Letter 01/2021 required companies to provide information on service reservoirs, contact tanks and treated water storage tanks and this informed the audit programme alongside consideration of microbiological failures and other sites of higher risk.

Severn Trent Water Tanks and Service Reservoir Audits

Inaccuracies were identified with the data provided by Severn Trent Water at both Budby and Far Baulker works, with individual compartments not reported as required by the Information Letter and this led to a recommendation to update the data return with a separate line for every cell or compartment at a site whether they are hydraulically linked or not.

Budby works could not be removed from supply following a microbiological failure in August as Severn Trent Water were unable to maintain supplies from alternative sources. The company is installing a new UV reactor disinfection scheme, which is welcomed and shall reduce the risk of a microbiological breach at the works, however, it is of concern that the company have as yet failed to identify any solutions that ensure Budby works could be removed from supply should the need arise in future. This shall be taken into consideration in the event of further failures. The company had identified ingress through level probes on the compartment it had managed to isolate following the microbiological failures, but at the time of the audit had not taken precautionary action to address ingress that may be occurring on those tanks that remained in supply. But subsequently,

took steps to address ingress risks around access hatches and the level probes (See Figure 8 and Figure 9).



Figure 8 and Figure 9 Precautionary ingress prevention measures at Budby works

There were no tests to ensure that the site would fail-safe on elevated turbidity at Budby works and the Inspectorate recommended that appropriate tests were instituted as per chlorine.

Severn Trent Water's contingency plans for removing Misk Hill service reservoir from supply referenced assets that had been abandoned in August 2020, the company subsequently updated the document. The company had been unable to remove Misk Hill service reservoir from supply due to a prolonged outage from a downstream reservoir, but it was not apparent that this change in water quality risk had been appropriately considered. A recommendation was made to amend the company's procedures. An enforcement notice has since been issued to address all service reservoirs and tanks that have not been internally inspected within the last 10 years.

Thames Water Tanks and Service Reservoir Audits

The audit team were unable to establish the frequency of access hatch inspections at Thames Water's sites with documented inconsistencies requiring weekly, monthly or quarterly inspections, however, no records could be located to confirm which, if any, had been checked. A recommendation was made to implement and record a suitable inspection regime. Good practice was observed related to hatch cleaning. See Figure 10.



Figure 10: Hatch cleaning at Thames Water

The company currently has service reservoirs that are outside the company's maximum 10-year inspection frequency. The company also has a series of service reservoirs that cannot be readily isolated from supply on a reactive basis (without causing significant consumer impacts). The list of service reservoirs requiring enabling work to complete isolation is based on reservoirs with internal inspections overdue or due in the next year. These reservoirs present a risk to maintaining a wholesome supply. Recommendations were made for the company to establish an urgent programme of work to bring its service reservoirs in line with its inspection programme; to develop/implement contingency plans where reservoirs cannot be reactively isolated; and to investigate its service reservoir asset base to understand if enabling work is required at all sites to allow them to be isolated. An enforcement notice has since been issued to address all service reservoirs and tanks that have not been internally inspected within the last 10 years.

At Brasenose service reservoir there were some uncertainties around the site drawings and main location. The Inspectorate recommended the company confirms the actual situation with regard to mains and valves on the site. Inspectors observed security issues at one site that have been taken up with the company. The company withheld information relevant to access hatches in contravention of the requirements of section 86(3) of the Water Industry Act and the Inspectorate recommended that the company provides all such information as the Inspectorate may reasonably require.

A recommendation for the company to introduce a suitable policy for air valve inspection and maintenance using a risk-based approach was made with a suggestion that the company takes heed of guidance laid out in the Principles of Water Supply Hygiene including paragraphs 8.1 and 8.3 along with Technical Guidance Note 2. Both air valves observed at the audit were heavily corroded externally. As shown in Figure 11 and Figure 12.



Figure 11 and Figure 12 Corroded air valves at Thames Water service reservoirs

The Inspectorate welcomed that all the risks identified at this audit were all captured and visible to the assessing Inspectors in the company's regulation 28 reports.

Affinity Water Tanks and Service Reservoir Audits

Similar to the Thames Water audit, Affinity Water had no policy for air valves inspections and an identical recommendation for the company to introduce a suitable policy for air valve inspection and maintenance using a risk-based approach was made. At Amersham service reservoir, the company explained that, in theory, it would be able to support the distribution system if it was

necessary to remove the site from supply, but this had not been tested or captured as part of any resilience strategy and or formal contingency arrangement. The company has since modelled scenarios and are using the outputs to develop contingency plans for resilience. The Inspectorate welcomed that the company has committed to update on progress of these plans. But also recommended that these plans are extended to include all other sites with a similar resilience risk; and that the risk assessments for the sites are updated accordingly.

The sampling facilities for Amersham service reservoir (Figure 13) do not comply with several aspects of the company's own policy document. There is no sink, no anti-splash plate behind the tap and sampling is likely to be impeded by the barrier rail in close proximity to the tap. There is insufficient space between the tap outlet nozzle and the small drainage funnel for adequate collection of samples, an arrangement considered wholly unsatisfactory for the purpose of regulatory sampling. A recommendation that these facilities are brought up to the company standard was made. Another recommendation was made for the company to review the sampling arrangements at all sites to ensure that that they are in line with the company's own standard.



Figure 13 Amersham sampling point

Yorkshire Water Tanks and Service Reservoir Audit

In October 2021 the Inspectorate completed an unsatisfactory technical audit of tanks and service reservoirs (SRs) at Yorkshire Water including Oldfield works, Sladen Valley works, Graincliffe works and Horton Bank service reservoir. The audit was part of the Inspectorate's quarterly audits on the theme of treated water storage tanks and was based on the information relating to tank inspections provided by the company in May 2021 in response to Information Letter 01/2021. The audit locations were selected from the list of treated water storage tanks which had not been inspected within the last 10 years. The company's risk prioritisation inspection programme was also audited.

Deficiencies in the company's operation of treated water storage were observed during this audit which presented a risk to treated water quality and to the company's compliance with regulation 4 at the Oldfield and Sladen Valley works. In response to the audit findings the Inspectorate is taking enforcement action in relation to the operation, maintenance and protection of treated water structures.

At Oldfield works overflow and wash out arrangements for the clean water tanks were inspected. At the time of the audit, none of the washout, outlets or overflows from either compartment were protected from vermin or from ingress of surface water (Figure 14). It was not able to be confirmed during the audit which pipework in the chamber shown in Figure 14 was from which tank or

whether the pipework was potentially from other parts of the treatment or the sludge process. The company have since confirmed which overflows and washouts enter the chamber and which pipework is the outlet of the chamber to the soakaway. The company have now also installed 400 µm mesh protection to prevent vermin entry. Companies are reminded that outlet and washout chambers can present a risk to water quality if pipework is not adequately protected.



Figure 14 Outlet chamber at Yorkshire Water's Oldfield works.

At the time of the audit there was no vermin protection, this has since been installed.

Oldfield treatment works has a public right of way through the site. As part of notice YKS 2019-00003 a new treatment process is being built to the East of the current works to replace existing assets. The perimeter of the new works will exclude the area of the public right of way. The Inspectorate suggested that the company maintains appropriate signage for users of the public footpath and upholds current security measures until the new works is built and the right of way no longer enters the operational site. Companies should uphold strict security measures if public rights of way enable the public access to sites. Where possible permission to re-route footpaths should be sought from the local authority. Signage should always be installed to clearly mark the footpath.

During the audit it was noted that a number of hatches were missing foam around the seals. To ensure that the requirements of regulation 4 for wholesomeness are maintained, a recommendation was given that the company reviews the hatches on both clean water tanks and ensures that foam present on the hatches meets the company standard/procedure during all future inspections. It is important that water companies uphold their own asset standards and ensure that all relevant personnel are briefed on the prescribed requirements.

The company had introduced risks from vermin access to the treatment process at Oldfield by passing electricity cables through holes in the roof structure. This appeared to be a long-term arrangement. Due to the risk to water quality and compliance with regulation 4, it was recommended that the company either make appropriate arrangements to supply power to the point of use within the building or seal up the point of entry to prevent contamination. Consideration should always be given for points of animal ingress on site buildings that house partially treated or treated water. Individuals completing installation work such as electricians should be briefed prior to starting work to ensure that actions to install new kit do not introduce risks to water quality.

The regulatory sample point at Oldfield works was in a poor state, far below expected industry standards (Figure 15). Since the audit the company have committed to installing new tun dishes and sampling housings with improvements being made to the regulatory sample point building. The Inspectorate suggested that that the company implement a checklist for sample points which covers the surroundings of regulatory sample points to ensure they are clean, tidy, and well lit. The Inspectorate expects all companies to be working towards dedicated, clean sample kiosks for all regulatory compliance points. Adequate space and provisions to aid sampling and suitable sample tap drainage should be installed. The Inspectorate does not expect to see regulatory sample points in the condition shown in Figure 15 and therefore companies should complete upgrades where necessary.



Figure 15 Surroundings of regulatory sample tap at Yorkshire Water’s Oldfield works that are below the expected industry standard

At Sladen Valley works redundant pipework was found between contact tank number one and clear water tank number two. In addition, the outlet main next to the connection for the regulatory sample point had two lengths of redundant pipework attached. Redundant pipework presents a risk to regulation 4 should there be a low-pressure event or water treatment works shutdown. A single isolation valve was identified on pipework however if this were to fail a deterioration in water quality is likely. Therefore, the Inspectorate suggested that, as a short-term mitigation, the valve on this pipework be locked off and labelled appropriately to identify the risk present. The regulation 28(4) notice the company received in response to the unsatisfactory audit includes measures to address redundant pipework associated with tanks to remove the risk.

Horton Bank service reservoir showed evidence of seepage and ingress into the chambers. The ingress points appeared to be from previous repairs. There was no evidence that these defects had been identified on the proactive inspections by network teams. The company said at the time of the audit that the water on the hatch upstands was condensation. However, condensation does not present the same pattern/distribution on the concrete upstands as observed on the day of the audit (see Figure 16). The Inspectorate recommended that the integrity of the repairs on Horton Bank service reservoir were checked with flood testing and that any ingress was rectified to maintain the standards for wholesomeness.



Figure 16 Evidence of repairs and seepage at Yorkshire Water's Horton Bank service reservoir

The roof of Horton Bank service reservoir was very boggy, and no roof drainage system could be seen at the time of the audit. The Inspectorate suggested that the company assess the presence and effectiveness of the roof drainage system and take action to address any defects. Companies should have proactive network teams that complete regular checks on roof drainage and where issues arise action logs can be raised to track progress and rectify the issues.

Bristol Water Tanks and Service Reservoir Audit

In October, the Inspectorate completed a technical audit of Bristol Water's Montpelier 2, Blackdown and Hawksbury Upton service reservoirs. The Inspectorate selected Montpelier 2 for audit as the reservoir has not been physically internally inspected within the last 10 years; as recommended as industry best practice, by the Principles of Water Supply Hygiene, Technical Guidance Note 9. Montpelier 2 is the company's only service reservoir that has not been physically internally inspected within the last 10 years. Blackdown service reservoir was selected for audit following concerns around the risk of ingress from a stream running adjacent to the reservoir that has eroded the embankment, exposing the reservoir walls. The Inspectorate also chose to inspect Hawksbury Upton service reservoir based on the company's regulation 28(1) report for Hawksbury Upton that was categorised as a DWI risk category D citing risk of contamination due to surface water ingress into the reservoir from embankment slippage exposing part of the concrete structure and membrane.

For the risks associated at Blackdown service reservoir, it was noted that surface water ingress from the stream was unlikely due to the surrounding topography. In addition, the company has provided an Action Plan to the Inspectorate, which details interim mitigations measures in place and the company has confirmed that to further mitigate the risk of ingress from the stream, the embankment at Blackdown service reservoir will be reinstated. The Inspectorate was also satisfied that the slippage of the embankment at Hawksbury Upton 1 service reservoir does not pose any structural or water quality risks.

The audit however was deemed unsatisfactory, primarily due to the risks identified at the company Montpelier 2 reservoir. The structure was constructed in 1921 and does not have a waterproof roof membrane and was last inspected in November 2010 where some minor issues were identified and

remedied. The company confirmed that Montpelier 2 can be bypassed but the company have not yet removed the reservoir from supply due to concerns over the risks associated with changing mains pressures that could potentially cause bursts and subsequent loss of supply. The company have undertaken trials to remove Montpelier 2 from supply for inspection but due to the concerns identified within the network the reservoir fell outside of the 10 year inspection frequency.

The company conducted an ROV survey in August 2020 which identified a leak between the seal on the access hatch and upstand. Internally, the survey identified where concrete render had come off the wall in places and silt near the reservoir outlet and evidence of snail activity or similar (Figures 17 and 18).



Figure 17 and Figure 18 Render coming off walls and evidence of snail or similar activity from August 2020 ROV survey

On the day of the audit, it was observed the grass on the roof was long, evidence of animal activity and discarded tin cans and balls from the neighbouring residential area were found. A mesh which protected the overflow pipe had also become dislodged.

Due to the potential issues with invertebrates and the degradation of the construction materials within the reservoir and that the company had not yet removed the reservoir from supply for inspection/repairs the Inspectorate issued an enforcement notice to cover these works and the audit was deemed unsatisfactory. Suggestions and a recommendation were raised to cover the other issues identified onsite.

Wessex Water Tanks and Service Reservoir Audit

Wessex Water submitted information detailing six service reservoirs which were outside of their 10-year inspection frequency following publication of the Inspectorate's Information letter 01/2021. The company completed inspections of three of the structures during quarter 4 and the Inspectorate audited the three remaining sites, Corfe Hills, Ulwell and Whiteway service reservoirs.

Ulwell service reservoir had previously been internally inspected in February 2009. On the day of the audit, the company had bypassed Ulwell and it had been drained, inspected and repairs were being undertaken including application of a regulation 31 approved surface sealant product. Due to the restricted access up to the service reservoir via a steep set of steps and limited vehicular access, the company transported the larger equipment required to facilitate the remedial works by helicopter. On the day of the audit the Inspectorate undertook the opportunity to enter the structure to observe the repairs. The company was also undertaking improvement works to the site drainage and removal of two potential dead legs connected to the outlet pipework.

Whiteway service reservoir was previously inspected in March 2010. The company had completed enabling works to allow the tank to be removed from supply including increasing the capacity of an upstream service reservoir and completion of a trial bypass and the internal inspection was planned for completion in January 2022.

Corfe Hills service reservoir was previously inspected and cleaned in 2010. Due to the complex nature of bypassing Corfe Hills service reservoir, the company was progressing an optioneering study to remove the service reservoir from supply, with the inspection scheduled for quarter 1 2022. Documentation provided for the site during the audit did not align with differences noted between the site and water quality schematics so a suggestion was made to update these schematics so they are both accurate. A recommendation was also issued to the company to review the regulation 28 report for Whiteways service reservoir, as the risk had been set to a DWI category A (target risk mitigation achieved, verified and maintained) on completion of the enabling works, however this does not constitute this risk being mitigated until such time it has been inspected and confirmed as in sound structural condition. Otherwise, due to the advanced plans the company had in place to inspect the remaining structure and findings on site, the audit was deemed generally satisfactory.

Southern Water Tanks and Service Reservoir Audit

Southern Water have a legal instrument in place (SRN3923) to cover water quality risks associated with reservoirs and tanks which are outside of the 10-year inspection frequency. The notice forms part of the company's transformation programme and has a phased approach to enable the inspections and identified improvement works up to 2026 and move the company onto a risk-based inspection programme with a maximum frequency of five-years. The company's data submission following publication of Information Letter 01/2021 detailed 36 structures which are outside of the 10-year inspection frequency. The technical audit completed in October 2021 included visits to four service reservoirs and a review of progress against the legal instrument.

The audit was deemed unsatisfactory and found short comings in progress against the notice with deficiencies identified with the audit strategy, submission of milestone reports, delays in completing quarterly site visits and how the samples were being taken before, during and after completing ROV surveys. The company has also experienced issues with a previously appointed grounds maintenance contractor, with issues sited with the contract reportedly underestimated as well as the size of the estate. Only 33 of 172 sites had received the required number of scheduled summer visits. This was witnessed on the day of the audit with three of the four sites visited showing signs of poor ground maintenance. Following the audit, the company have carried out a review of the grounds maintenance and are recovering their position with all sites to have at least one cut by end of December and a further cut over winter.

On the day of the audit, the Inspectorate visited Patcham Mid, Goldstone 1 and 2 and Broadwater service reservoirs. Issues with perimeter fencing and animal activity were identified at Patcham Mid and the sample kiosk was found to be in a poor condition, with cobwebs seen in the kiosk (Figure 19). This was in contrast to Goldstone and Broadwater where more modern and hygienic facilities were observed. The company has a scoring process whereby samplers record the condition of the kiosk during sampling visits and the company committed to reviewing and improving this process due to the obvious deficiencies with this scoring process identified on the day of the audit. A

recommendation was also issued due to risks associated with using vehicles on tops of treated water tanks and risks to assets as evidence of tyre tracks on the roof Goldstone 2 service reservoir and damage to cables from grass cutting was seen.



Figure 19 Sample tap facilities Patcham Mid service reservoir

Further recommendations were issued to the company to review the sample line flush calculations and to review the calculation for turnover for Broadwater service reservoir.

Isles of Scilly (South West and Bournemouth Water) Tanks and Service Reservoir Audit

In November the Inspectorate audited Telegraph service reservoir which is located in St Mary's on the Isles of Scilly. In addition to Telegraph service reservoir, inspectors also audited Vane Hill and Tommy's treatment works. The inspectors also visited the desalination plant which feeds Porthellick treatment works and the company laboratory at Porthellick.

All service reservoirs on the Isles of Scilly have been drained and inspected since South West and Bournemouth Water adopted the water services on the isles, with Telegraph service reservoir being the last site requiring an inspection at the time of the audit. When the Inspectors audited the site the company had commenced work onsite with reservoir number two out of supply having been cleaned, inspected and remedial measures completed including a point of ingress on the structure's roof.

Recommendations were issued to the company to improve turbidity measurements to ensure compliance with regulation 26(2)b at Vane Hill works and to assess the risks associated with disinfection by-product formation as a large container of sodium hypochlorite was seen at this site. As sodium hypochlorite can break down to form chlorate and is affected by storage conditions, this recommendation was extended across all sites where large volumes of chemicals are held. Sampling facilities were noted not to be up to company mainland standard and the improvement of these will be included as a measure in the island wide notices.

Drinking water 2021

Currently, the Isles of Scilly sampling programme is based on a logistics schedule, including flights to transport sample bottles back to the company laboratories on the mainland and a recommendation was made to build in the element of randomness into the sampling programme. The company is currently seeking UKAS and DWTS accreditation for the microbiological laboratory on St Mary's and the Inspectorate made a recommendation that South West and Bournemouth water make sufficient resource available to obtain the accreditation by the dates proposed. The Inspectorate acknowledged that the company have delivered improvements to the general operation, maintenance, and inspection of the water assets on the islands and a suggestion was made to expand on the improvements already made by undertaking routine inspections and includes general housekeeping activities.

Whilst the audit was deemed unsatisfactory due to the current water supply systems not being at a standard to meet the requirements of the Regulations, the Inspectorate noted the considerable progress the company has made to improve the water supply facilities in the short and medium term when the longer term solution to replace the treatment facilities is being delivered.

The Isles of Scilly pose a unique set of challenges to the company and the Inspectorate will be monitoring progress of the delivery of the works which have been captured under the island wide legal instruments.

Wales Service Reservoir Audit

The information return in May 2021 provided the Inspectorate with a national view of the state of inspections of service reservoirs and treated water tanks within the industry. This information informed the quarter four audit program for Wales. Two audits were completed in Wales in October 2021, one each for HDC and DWR, with a focus on service reservoirs.

The Dŵr Cymru Welsh Water audit involved site visits to two service reservoirs; Genfforddisaf and Llanstephan, which are located north of Brecon in South Wales. Constructed in 1966 (Genfforddisaf) and 1936 (Llanstephan), these reservoirs were chosen for audit since neither had been drained down and internally inspected since 2008. The company has been proactive by carrying out remotely operated vehicle inspections, with the last inspection completed in June 2021 for Genfforddisaf and December 2020 for Llanstephan. External inspections are carried out annually, and both tanks were inspected in June 2021. Although a full picture of the risk to water quality posed by these tanks cannot be known without a full drain down and internal inspection, it is encouraging that the company has used available options with regular frequency, to understand this risk as much as possible.

Audit Findings

For both single cell tanks; the Inspectors found these in fair condition, with comments regarding maintenance of hatch sealant and one recommendation was given regarding a possible ingress route into an outer hatch via cable ducting.



Figure 20 Unsealed cable ducting in exterior hatch at Llanstephan service reservoir



Figure 21 Sealed cable ducting in Llanstephan service reservoir (different hatch to Figure 20) post audit

Flap valves were in place and in good condition at both assets.



Figure 22 Flap valve at Llanstephan Service Reservoir



Figure 23 Genforddisaf sample tap

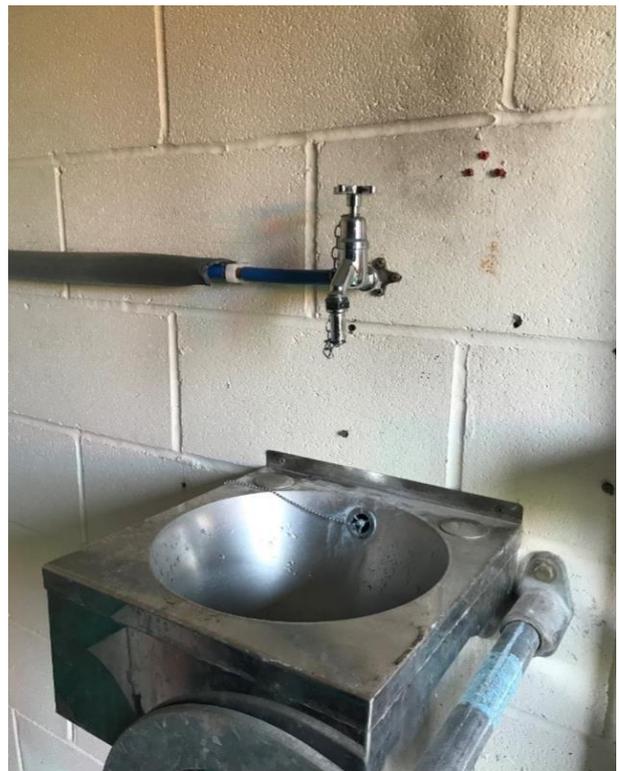


Figure 24 Llanstephan sample tap

The company employ manual chlorine dosing, which is implemented company wide, where chlorine residuals are found to have dropped below the minimum target value. The company received a recommendation to review the practice and consider other options for chlorine residual control.

The outcome of this audit was unsatisfactory; however, this was primarily because of the elapsed time since last inspection for both service reservoirs, and because neither tank was able to be removed from supply in an emergency without there being significant impact on the network. The company had site specific contingency plans for these assets, including details of locations for tanker supply into the reservoir (or network downstream) and rezoning arrangements. Suggestions were given to include additional details of escalation measures and sampling locations in case the assets were required to be removed from supply (which would require support from alternative supplies), and particularly for sites such as these, which are classed as higher risk since they have not been recently inspected, additional readiness checks are introduced, such as operability of critical valves and ensuring correct spares, such as pumps are available.

Enforcement action regarding tanks which have not been inspected for over 10 years is currently being initiated with the company. Further detail will be included in the annual Chief Inspector's Report.

Two service reservoirs were visited during the Hafren Dyfrdwy audit in October, Cinders and New Hall. Constructed in 1979 (Cinders) and 1978 (New Hall), these tanks were chosen for audit because the time since last drain down and inspection had been over 10 years. Cinders service reservoir was last inspected in 2000 and New Hall in 1995. Remotely operated vehicle inspections were last completed in 2010 for both assets and therefore the risk to water quality from these tanks is considered unknown. Although external inspections were last completed in September 2017 (Cinders) and June 2019 (New Hall), the company carries out external checks on a regular basis. For example, hatch checks are completed every six months.

Audit Findings

The service reservoirs visited were found to be in a good condition, with comments given surround the condition of the hatch sealant (as with Dŵr Cymru Welsh Water), which was found to be cracking in one of the hatches checked.

The company Operators carry a 'fat box' with them when they carry out routine checks enabling them to remedy any minor issues at the time, for example, missing signage or renewing sealant. This proactive approach is welcomed by the Inspectorate and assures a quick response.

The company has comprehensive procedures to remove these assets from supply in an emergency. A similar suggestion (to Dŵr Cymru Welsh Water) was given to the company to introduce additional readiness checks such as ensuring operability of critical valves and having correct spares available, in particular, for assets such as these which have unknown risk quantities or are at higher risk. The company have confirmed that spares are available should they be required in an emergency.

New Hall service reservoir has an intelligent membrane installed, which, when checked by an external contractor, can indicate the condition of the membrane and the potential for ingress.

This was last checked in 2015 and remedial work completed following this. The company received a recommendation to review the frequency of these checks, which would be particularly useful for sites where the membrane integrity and therefore internal condition is otherwise unknown. The company have since confirmed they are in the process of replacing all Intelligent membranes with non-Intelligent membranes in 2022.



Figure 25 'fat box'

Flap valves were in place and in good condition at both assets.

Of the sampling facilities, tappings were visible and in a suitable location with the taps in good condition. New Hall facilities did not conform to the company standard, with blue plastic pipework and no drainage except to the ground. The company is working to address this with a companywide replacement programme to include facilities which currently do not comply.

The outcome of this audit was unsatisfactory; however, similar to Dŵr Cymru Welsh Water, this was primarily because of the elapsed time since last inspection for both service reservoirs, and because neither tank was able to be removed from supply in an emergency without there being significant impact on the network. Enforcement action regarding tanks which have not been inspected for over 10 years has since taken place, with a notice issued in March 2022. Further detail will be included in the annual Chief Inspector's Report.

Lead strategy audit

In December 2021 Intention to audit letters were sent out to the industry for an assessment of company lead strategies. The audit was predominantly desktop based with a programme of site visits for companies showing elevated levels of risk associated with Phosphate dosing. The focus of the audit was on the assurance of public health protection in response to lead failures and an assessment of the proactive strategy taken by the company with regards to lead. This included a review of actions taken in response to failures such as water fittings inspections, communication pipe checks and replacement programmes, consumer advice and action trigger levels for investigations or event notifications. The audit also included an assessment of plumbosolvency control at water treatment works. A selection of risk reports identified within company regulation 28(1) submissions were also evaluated as part of the audit. The audit had five specific areas of focus associated with lead strategies.

- A. Water Quality Investigation
- B. Water Fittings Inspections
- C. Communication Pipe Checks and Replacement
- D. Consumer Advice
- E. Plumbosolvency Control at Treatment Works

The intention to audit letters were received by water companies in December 2021 and the data submission was received in January 2022 with selected site visits following in February and March 2022. Further information on audit outcomes will be included in the quarter one 2022 report.

Recommendations (Wales)

In quarter four companies in Wales received 27 recommendations (DWR 20, HDC 7).

Hafren Dyfrdwy

Five recommendations were given for events and two for audits. One recommendation was given following the tankering audit, completed in August 2021, regarding the storage of chemicals, in particular the sodium hypochlorite used to disinfect the tankers. The company responded to say there were appropriate procedures in place, however, in this case they were not followed. Companies are reminded to ensure frequent checks are in place to provide reassurance that procedures are followed. A second recommendation for audits was given following the service reservoir audits in October 2021, which has been detailed above.

The company received four recommendations following an event which took place in July 2021, at Pendas treatment works. This has been detailed in quarter three 2021.

A further recommendation was given regarding an event where lead exceedances were reported at several properties on a shared supply, detailed in the events section above.

Dŵr Cymru Welsh Water

Dŵr Cymru Welsh Water received 20 recommendations in quarter four; two for the service reservoirs audit, detailed above, one for an event and 17 for compliance.

Following a burst main in Penarth in September, affecting a population of 16,000, the company received a recommendation to include laboratory taste and odour parameters in the incident samples.

In quarter four, the company has received a significant number of recommendations relating to compliance, primarily due to breaches from service reservoirs and treatment works. Further detail on service reservoirs and tanks included in the annual report.

Enforcement

During the fourth quarter of 2021, the following thirteen new legal instruments were served on companies, all regulation 28(4) notices relating to risk assessment.

- Affinity Water (1)
- South West and Bournemouth Water Isles of Scilly (5)
- Portsmouth Water (1)
- Severn Trent Water (2)
- South West and Bournemouth Water (3)
- Thames Water (1)

Drinking water 2021

The populations figures given are those provided by companies for the connected zones in each case.

Affinity Water

A notice was served against Affinity Water following an event that affected their customers in Hitchin. The original event was caused by silage being left in a field and leaching within immediate proximity to an abstraction borehole. It became apparent that disinfection could not be verified due to the location of chlorine monitors and blending arrangements. A regulation 28(4) notice was served, requiring the company to investigate its treatment process before installing and commissioning suitable systems to enable verification of disinfection to meet the requirements of regulation 26(2). A population of 41,860 is supplied in the downstream zones. The notice is due for completion by 31 January 2024.

South West and Bournemouth Water Isles of Scilly

The four regulation 20(4) notices served on South West Water (Isles of Scilly) during quarter two for Tommys works, Plump works, Middletown works, and Porthellick works and the regulation 28(4) notice for Highertown works were replaced in quarter four with five regulation 28(4) notices. The Inspectorate formalised the proposed water quality improvements on the Isles of Scilly into whole island notices, one for each inhabited island. Each regulation 28(4) notice covers the water quality improvements being undertaken on each island to secure water quality of the recently adopted supplies on the islands. The St Martins Island and St Agnes Island notices cover a population of 60 each. Bryher Island notice covers a population of 84 and Tresco Island notice covers a population of 182. A population of 1,723 is covered by the St Marys Island notice.

Portsmouth Water

As previously reported in the 2020 Chief Inspector's report, Portsmouth Water has been working collaboratively with the Inspectorate to bring about necessary improvements to address identified deficiencies. These improvements have been encapsulated through a package of regulation 28(4) notices described as the company's 'change programme'. In many ways this programme has the same essence of a transformation programme, just on a smaller scale (in terms of company-wide deficiencies). The core focus of all transforming type programmes to-date has related to company culture and training. This was true for Portsmouth Water with deficiencies identified in the management of training, continued professional development (upskilling), procedures, documentation, disinfection and treatment. Necessary measures to deal with these deficiencies have been formalised in the Portsmouth Water Management and Training regulation 28(4) notice, which was served in quarter four. This is an extensive notice, capturing a significant package of work for the company to level-up to required industry standards and beyond. The company's commitment, at all levels, is once again commended. The Inspectorate will continue to monitor and support the company's progress towards betterment, which will result in improvements for all Portsmouth Water consumers.

Severn Trent Water

A notice was served on Severn Trent Water for improvements to Bamford treatment works, which will benefit up to 2,274,589 consumers. The notice followed two events during 2020 and a third in

2021 in which unwholesome water was supplied from the treatment works. The notice formalises a programme of works being undertaken by the company to install a new failsafe system, a run to waste facility and construct a third contact tank.

Following a consumer complaint to the Inspectorate, a new notice was served on Severn Trent Water for improvements in the Ruddington supply area, which should benefit the 93,663 population supplied. The complainant had experienced persistent discolouration of their supply, without satisfactory resolution from complaints to the company. Sampling identified elevated Iron levels (up to 661µg/l) and the investigation identified a wider issue with cast iron mains within the area. Under the notice, the company shall deliver a long-term solution to improve supplies in the area, whilst maintaining short term mitigations (such as filters at consumer properties) in the meantime.

South West and Bournemouth Water

As part of the company's transformation programme, a regulation 28(4) notice was served on South West Water Ltd to improve the company's shortcomings in scientific investigations. Previous events, audits and recommendations raised against the company relate to online monitors and the verification of parameters. In particular, pH and turbidity at water treatment works. Past audits have also recognised a deficiency with onsite analysis and the ability to verify monitor readings using portable instruments. The notice should deliver water quality improvements for the whole population served by the company.

The third notice of the company's transformation programme was also served during quarter four. A number of recommendations have been raised against the company since 2014, relating to the maintenance and operation of treatment processes. More recently, shortcomings have been noted in audits and event assessments, which indicated there were shortcomings in relation to the company's maintenance and resilience at water treatment works. These result in a reactive approach to issues that arise. Therefore, a regulation 28(4) notice was served on South West and Bournemouth Water requiring the company to undertake hazard reviews at all water treatment works in the company's supply area, to facilitate a more proactive approach to identifying maintenance and resilience issues at sites. This notice will deliver water quality improvements for the whole population served by the company.

South West Water Ltd applied successfully through the Green Economic Recovery fund to install new raw and treated water mains between Prewley works and Northcombe works. A notice has been in place at Prewley works for the PR19 proposal to install manganese filters at the site. Following the publication of the Green Economic Recovery Final decisions, the company were invited to submit a change application detailing the change in technical solution to the Inspectorate. Given the drinking water quality and supply resilience improvements this programme of work will deliver for future generations, the Inspectorate accepted the change in technical solution and replaced the existing Prewley notice with a new notice that will improve water quality and resilience of supplies for a population of 390,556.

Thames Water

A regulation 28(4) notice was served on Thames Water following repeat detections of the pesticide bentazone above the drinking water standard, at Clatford works, which serves 3,341 consumers. The levels observed are not considered to present a danger to human health but do make the water

unwholesome and in breach of the Regulations. The notice has been served to formalise the company response to address the risk.

Research

SARS-CoV-2 Drinking Water Risks: Literature Review

This review concluded that the risk of transmission of SARS–CoV–2 through drinking water is unlikely and the public health risk of SARS–CoV–2 in drinking water is low and does not pose a risk to public health.

Use of the Polymerase Chain Reaction for the Analysis and Enumeration of *Cryptosporidium* Oocysts in Drinking Water

In October 2021 the research contract assessing the use of polymerase chain reaction (PCR) and enumeration of *Cryptosporidium* oocysts in drinking water concluded.

The protozoan parasite *Cryptosporidium* presents one of the main waterborne public health risks due to its resistance to standard disinfection and ability to cause large-scale outbreaks. The standard method, currently used in the water industry in the UK, for detection and enumeration of *Cryptosporidium* is based on high volume filtration, elution of oocysts from the filter, concentration by centrifugation, retrieval by immune-magnetic separation (IMS), and detection and enumeration using a microscope following immunofluorescence staining. This method is time consuming, expensive, has low specificity, with a number of other contaminants ending up on the microscope slide, and has multiple opportunities for loss of oocysts. Molecular methods such as PCR are more open, amenable to streamlining through automation, improving workflow and standardising procedures. This project investigated whether there is sufficient DNA for detection and enumeration using the PCR for the analysis and enumeration of *Cryptosporidium* oocysts in drinking water.

Literature reviews in April 2020 revealed that PCR was an emerging technology in the water industry for microbial detection and enumeration. For parasite detection, technologies based on PCR are not currently used routinely in the water industry and there are no published standard methods. For *Cryptosporidium*, the focus has been on using PCR for genotyping which is mostly outsourced to specialist laboratories.

Perceptions of the use of PCR within the UK water industry were explored through surveys to the water testing laboratories and water supply companies between May and August 2020. They indicated that although PCR was not being widely used, this technology might be considered if clear operational and scientific advantages over the current microscopy based standard method were demonstrated.

For the purposes of this feasibility study, quantitative real-time PCR (qPCR) was explored for the detection and enumeration of *Cryptosporidium* in drinking water. Examination of the impact of pre-analytical processes, the incorporation of internal amplification control DNA in the PCR mix, and whether genomic, plasmid or synthetic DNA provided the most suitable reference material for the generation of calibration curves was undertaken. Although the qPCR indicated reduced reliability of quantification at very low numbers of oocysts, qPCR was sufficiently robust to proceed with a

comparison with the standard method by testing 10L tap water spiked with 10 and 100 oocysts in a Phase one trial.

Detection (positive/negative) by qPCR was reliable at both low and high numbers of oocysts. For samples spiked with 100 oocysts there was no statistically significant difference in median oocyst counts between the two methods. However, for samples spiked with 10 oocysts the median number detected by qPCR was significantly less than by the standard method. Additionally, the variance was greater by qPCR than the standard method, and considerably lower or higher counts could be generated.

The qPCR provided mostly practical advantages over the standard method including a faster time to result, reduced consumables costs, easier interpretation of results, as well as providing material (amplicons) ready for genotyping.

This work indicated some potential limitations with the use of PCR-based methods for enumeration, the recovery efficiency of oocysts from tap water was inherently variable. Quantification by PCR is dependent on the amount of DNA recovered from the sample, which may be improved by revising upstream sample processing to reduce losses and variability, improve the measurement of uncertainty and provide a more robust and reliable approach.

This project demonstrated that a qPCR can be developed for the detection and, to some extent, enumeration of *Cryptosporidium* oocysts in drinking water. Although, the qPCR method is not at a point where recommendations can be made to the industry about its adoption. There is potential for use of PCR-based methods in *Cryptosporidium* analysis, if improvements in sample preparation and the technology for enumeration are explored.

