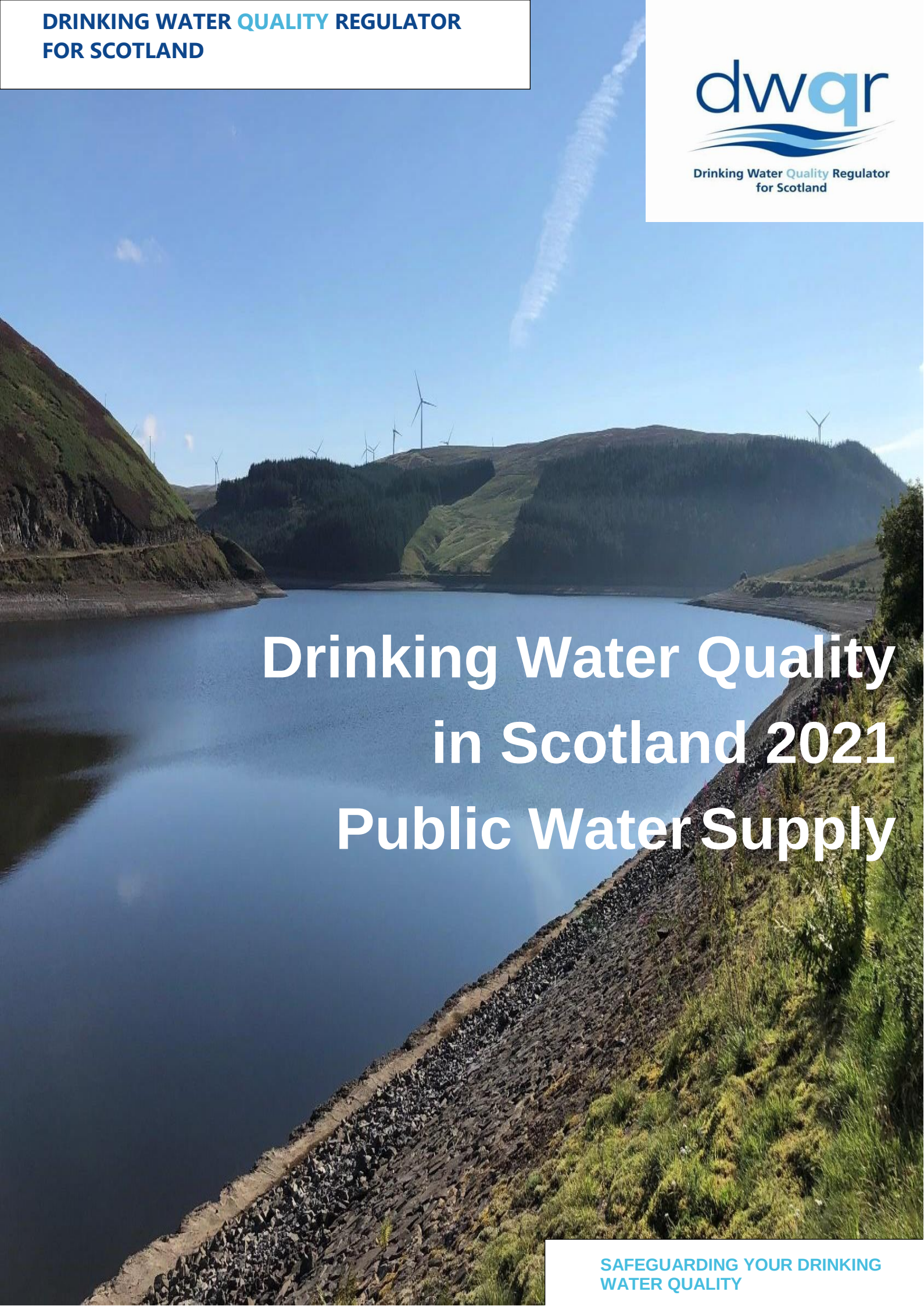
DRINKING WATER QUALITY REGULATOR FOR SCOTLAND

dwqr
Drinking Water Quality Regulator for Scotland



Drinking Water Quality in Scotland 2021

Public Water Supply

SAFEGUARDING YOUR DRINKING WATER QUALITY

Content

i. FOREWORD

This is the twentieth report from the Drinking Water Quality Regulator for Scotland (DWQR). It provides a summary of the quality of Scotland's public water supplies for 2021, as well as describing my work during the calendar year 2021, in scrutinising the quality of drinking water provided by Scottish Water.

I wanted to take the opportunity to reflect on the improvements in drinking water quality over the past 20 years since Scottish Water was formed from the previous three regional water authorities. During that time there has been significant investment in improving drinking water quality by upgrading, replacing and repairing ageing water treatment works, storage tanks and water pipes. Compliance with standards has improved from 99.28% in 2002 to 99.92% in 2021. This may sound very marginal, but the number of failures of standards has decreased substantially at customers taps from over 1000 in 2002 to 110 in 2021. Very significant improvements in compliance have also been delivered at water treatment works.

Scottish Water's customers now receive very high quality drinking water which they can use with confidence for all their drinking, cooking and hygiene needs. Particularly notable improvements are visible in compliance at treatment works and service reservoirs in this year's data, reflecting significant efforts by Scottish Water. In spite of this, there is no room for complacency, Scotland's climate is changing, impacting on the water environment. Higher temperatures and changing rainfall patterns are altering the quality and quantity of water in catchment reservoirs and patterns of usage of water by consumers is changing. Risks to water quality include algae, metals such as manganese, increases in colour and turbidity. To maintain the high quality of drinking water supplies it is essential to have a robust assessment of catchment risks and implement mitigation plans.

An example of the impact changes in the catchment can have on drinking water quality occurred in 2021. Very dry weather was experienced in early spring and summer which caused some of the catchment reservoirs to be at the lowest levels seen in 160 years. This impacted on the quality of the water in some reservoirs, and customers in Lanarkshire and some other parts of Scotland experienced discoloured water intermittently for some weeks. The discolouration was caused by high levels of manganese in the supply. This was very concerning for customers who did not wish to use or drink the water from their tap because of its appearance. Scottish Water provided bottled water as an alternative to those customers affected and are developing plans for improvements to the supply.

Over the next 20 years Scottish Water will need to address the challenges of our changing climate, putting in place strategies and investing in the resilience of its assets, so that customers can continue to enjoy their drinking water and have confidence in its quality.

Sue Petch

Drinking Water Quality Regulator for Scotland

ii. EXECUTIVE SUMMARY

In Scotland the public water supply is provided by Scottish Water. All other supplies are known as private water supplies, managed by owners and/or users. The Drinking Water Quality Regulator for Scotland (DWQR) regulates the quality of water supplied by Scottish Water, ensuring that drinking water supplies meet the requirements of the Public Water Supplies (Scotland) Regulations 2014 ("the Regulations"). This report describes the quality of the public supply provided by Scottish Water and the regulatory actions that DWQR has undertaken in 2021. DWQR publishes a separate report on private water supplies which you can view on our website at https://dwqr.scot/information/annual-report/.

Scottish Water takes and analyses its own samples to demonstrate that the water supplied complies with regulatory requirements. Samples are taken from drinking water as it leaves water treatment works (WTWs), service reservoirs (also referred to as storage points) and from randomly selected consumers taps. This sampling and analysis is independently accredited by UKAS and this approach is consistent with water industry practice in the rest of the UK. DWQR assesses Scottish Water's monitoring programme and results. When the pandemic began, DWQR worked closely with Scottish Water to ensure continuity of sampling and analysis. This meant that water quality could be verified in a way that did not compromise the safety of consumers in their homes, while also protecting sampling staff; for example, when sampling from consumers' taps was not possible for part of the year, samples were taken from Scottish Water's service reservoirs (SRs).

In 2021, Scottish Water carried out a total of 290,849 regulatory tests on Scotland's drinking water for which there is a standard, and many more for operational reasons such as following a burst main. Of the 136,455 tests taken to represent water at consumers taps 99.92% complied with the standards. In 2021 Scottish Water met its regulatory commitments regarding water sampling, and the data contained in this report shows a continued high level of compliance with standards. A further 59,746 tests were carried out on water supplied from treatment works, and all but 24 of these tests met the required standards, an improvement on the previous year's performance. 94,648 tests were also taken from service reservoirs, where treated water is stored. Compliance here was significantly improved on 2020.

As well as reporting water quality test results Scottish Water also reports the numbers of contacts received from consumers about the quality of their drinking water. There were 23,770 such contacts during 2021. Of these, 17,887 related to discoloured water, a large increase on 2020. This was primarily due to an incident in Lanarkshire in central Scotland, where exceptionally low reservoir levels caused manganese to enter the treatment works, discolouring supplies. DWQR also carries out formal complaint investigations if consumers are not satisfied with Scottish Water's own investigation; there were no such investigations in 2021.

Very occasionally things go wrong, and Scottish Water is required to tell DWQR about all events that could affect water quality or cause consumer concerns. The number of water quality events reported in 2021 was 855. Events of a more serious nature are categorised as water quality incidents, and in 2021, 31 events were declared to be incidents and were investigated by DWQR. There were a number of causes of water quality incidents, with significant loss of control of the water treatment process by far the largest category. Section 3 of this report gives more details on some of the incidents that we investigated during 2021.

Audit and inspection is a key part of DWQR's role and we inspect a range of Scottish Water's activities and assets that could affect the quality of drinking water every year, auditing against regulatory requirements and industry best practice. Sites are selected for inspection using a risk based process that takes into account sample failures and water quality events and incidents. We had to partly amend our approach to auditing during the pandemic, although as the situation eased we were able to return to site. During 2021, four incident investigation visits took place and 11 water treatment works were audited. Focused audits looking at particular topics were also undertaken, such as scrutinising Scottish Water's approach to controlling manganese and algal blooms. Further information on our audit and inspection work is given in Section 4 of this report.

Image 1 Sample tap at South Uist

Image 2 Borehole at Yarrowfeus

2021 in review
Public Water Supplies in Scotland

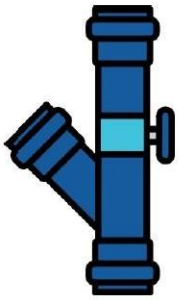
228 Water Treatment Works

960 Water Storage Tanks

278 Water Supply Zones

Drinking water sources

There are 30,400 miles of drinking water distribution pipes in Scotland



We assessed:

290,849 tests were taken by Scottish Water

136,455 tests were taken at consumers' taps

99.92% of tests to represent consumers' taps passed

We reviewed 855 drinking water related events

We declared 31 incidents

20th ANNIVERSARY OF THE DRINKING WATER QUALITY REGULATOR

With this being the twentieth report from the DWQR it is important that we look back and reflect on the progress that has been made in ensuring that the quality of Scotland's drinking water is of the highest standard. In 2002 the Water Industry (Scotland) Act 2002 came into force. The Act created Scottish Water from three regional water authorities. It also created the Water Industry Commissioner for Scotland (the economic regulator) and the DWQR. Over those 20 years Scottish Water has transformed as a business, meeting tough challenges set by the economic regulator for issues such as efficiency and leakage. There have also been significant improvements in drinking water quality following substantial investment in drinking water assets.

In 2021, 99.92% of tests taken from consumers' taps met the standards set out in Scottish legislation, an extremely high rate of compliance with only 110 tests failing, compared to the 99.28% compliance in 2002 (1,076 failures). At that time the quality of drinking water provided in England and Wales had a significantly higher rate of compliance at 99.85%, and Scottish water faced a great challenge to make improvements to its ageing assets, many of which needed significant upgrade to treatment processes. This improved compliance is more noteworthy when consideration is given to those standards which have been tightened over the last twenty years such as lead (reduced from 50µg/l in 2002 to 10µg/l by 2013) and trihalomethanes (reduced from an average of 100µg/l over 3 months to 100µg/l by 2008). Despite the tightening of regulatory standards, lead and trihalomethanes compliance have improved over the last 20 years from 99.71% and 82.9% to 99.73% and 99.86% respectively.

One of the other most noticeable improvements in regulatory compliance can been seen in the number of failures for coliform bacteria and faecal coliforms (*E. coli*) standards at water treatment works (WTW) and service reservoirs (SR) with up to 97% reduction in sample failures over the last 20 years, as shown in Figure 1 and Table 1.

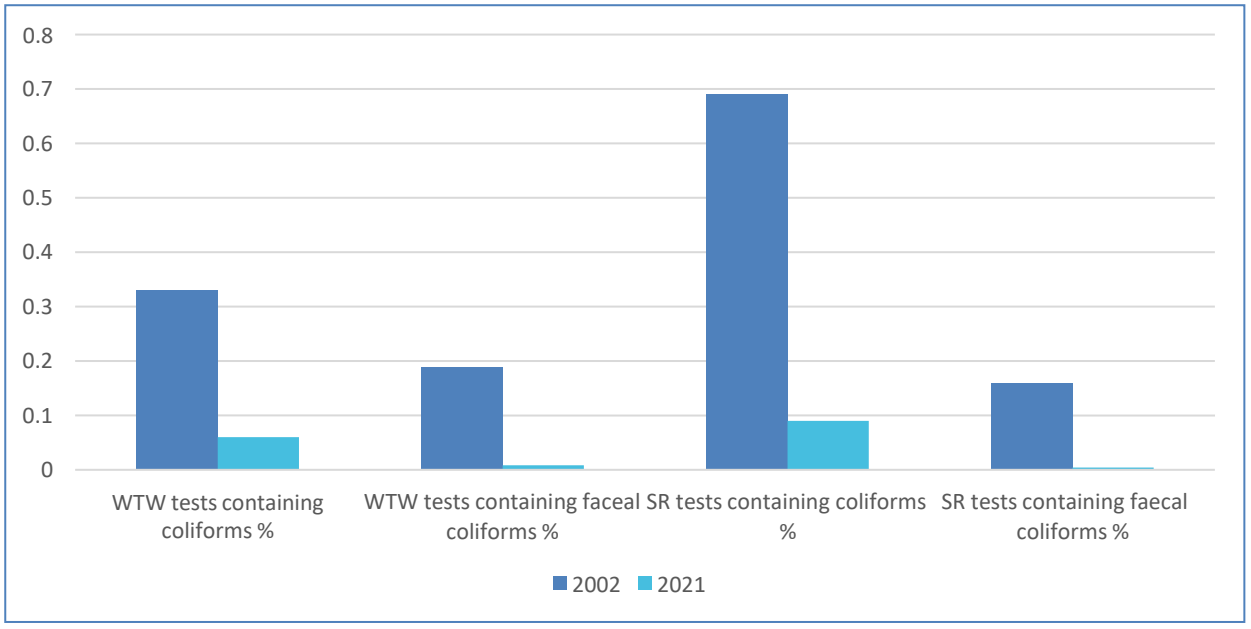


Figure 1 % of samples that tested positive for coliforms

Table 1 Percentage reduction in microbiological test results between 2002 to 2021

Asset and Parameter	Percentage Reduction in failures
WTW tests containing coliforms	82%
WTW tests containing faecal coliforms	96%
SR tests containing coliforms	87%
SR tests containing faecal coliforms	98%

Coliforms and *E. coli* are both indicators that disinfection has not been effective in killing potentially harmful bacteria, or that the water supply may have become contaminated, most commonly due to ingress or a breach in the integrity of the water supply.

Over the last twenty years, Scottish Water has undertaken considerable work to reduce the number of WTWs and SRs that are in supply and to refurbish those that are still in use. The 2002 annual report highlighted that 82% of microbiological failures at SRs were in the smallest tanks with a capacity of <2 Million litres (Ml), whilst 78% of microbiological failures at WTWs were at the smallest works with <3Ml/d output.

These continued downward trends in the number of water quality failures is credit to the ongoing work by Scottish Water and DWQR in assessing and understanding the root cause of water quality events so that appropriate actions can be taken to improve resilience in the water supply.

An area of continued focus going forward will be the management of manganese, in particular with challenges such as climate change, altering demand patterns and the existing capability of treatment assets. This continues to be an area where compliance still needs to improve. Scottish Water must meet these challenges by planning ahead and investing appropriately.

2.0 PUBLIC DRINKING WATER SUPPLIES IN SCOTLAND 2021

2.1 Water Treatment Works

Scottish Water has 228 WTW that treat water to ensure that it is safe to drink and complies with the standards set out in the Regulations. Treatment works in Scotland range from large supplies serving whole cities to very small works that supply small communities consisting of only a few properties. Regardless of their size, DWQR expects Scottish Water to ensure that its WTW are capable of treating a range of raw water qualities found in water sources.

Overall 59,746 microbiological and chemical tests were undertaken on samples collected at treatment works, and of these, 24 (0.04%) failed to meet the required standards.

2.1.1 Microbiological Quality at Water Treatment Works

Coliform bacteria and *E. coli* are two parameters that are measured in water leaving treatment works to check that disinfection of the supply has been successful. Coliforms are groups of bacteria widely found in the environment, and *E. coli* is an indicator of faecal contamination. Their presence shows that the disinfection process may not have been effective at killing potentially harmful bacteria. The standard for both coliform bacteria and *E. coli* is zero, and all sample failures must be fully investigated by Scottish Water and reported to DWQR, the local NHS board and the relevant local authority.

When investigating sample failures at treatment works, Scottish Water considers a number of potential contributory factors, such as changes in the quality of the incoming raw water, issues with treatment processes, sampling conditions, and evidence from samples at the treatment works and in the distribution system. Sampling can help to establish whether there is a genuine problem and what this is. Data from on-line monitoring and manual testing of water at the treatment works for other parameters can also yield useful information.

Samples taken at water treatment works continued to show that supplies in Scotland were of a very high microbiological standard in 2021. Of the 24,849 samples taken, two, or 0.008%, failed the *E. coli* standard, and sixteen samples, 0.06%, failed the standard for coliform bacteria. The performance trend in compliance with these standards is shown in Figure 2 below. One sample failure occurred at Glenfarg WTW in Perth and Kinross in July 2021, when 46 Coliform bacteria and 4 *E. coli* were detected in 100ml water. This was a very unusual detection, and despite investigations by Scottish Water, no clear cause for the sample failure could be found, though the disinfection contact tank is inadequately sized and improvements to this are planned within this investment period. Subsequent investigative samples were found to be clear of both coliform bacteria and *E. Coli.* The other *E. Coli* failure occurred at Inverness WTW in June 2021, where a sample failed with two coliform bacteria and one *E. Coli* detected in a 100 mL sample. Again, despite investigations, no cause for the sample failures could be found, and no further sample failures occurred following resampling of the supply.

Two water treatment works had more than one failure of the coliform bacteria standard in 2021, Kettleton WTW in Dumfries and Galloway and Roberton WTW in the Borders. At Kettleton WTW, the cause of one of the failing samples, from July 2021, could not be determined, but another in August may have been caused by a short deterioration of raw water quality following a plant shutdown for routine maintenance of a chemical dosing static mixture. At Roberton WTW in the Scottish Borders, a sample in May 2021 contained a single coliform bacteria which was attributed to the cleanliness of the sample point and a further single coliform bacteria sample failure in July 2021 was attributed to high flows through the treatment works, higher than usual temperatures and storage tanks being overdue for cleaning.

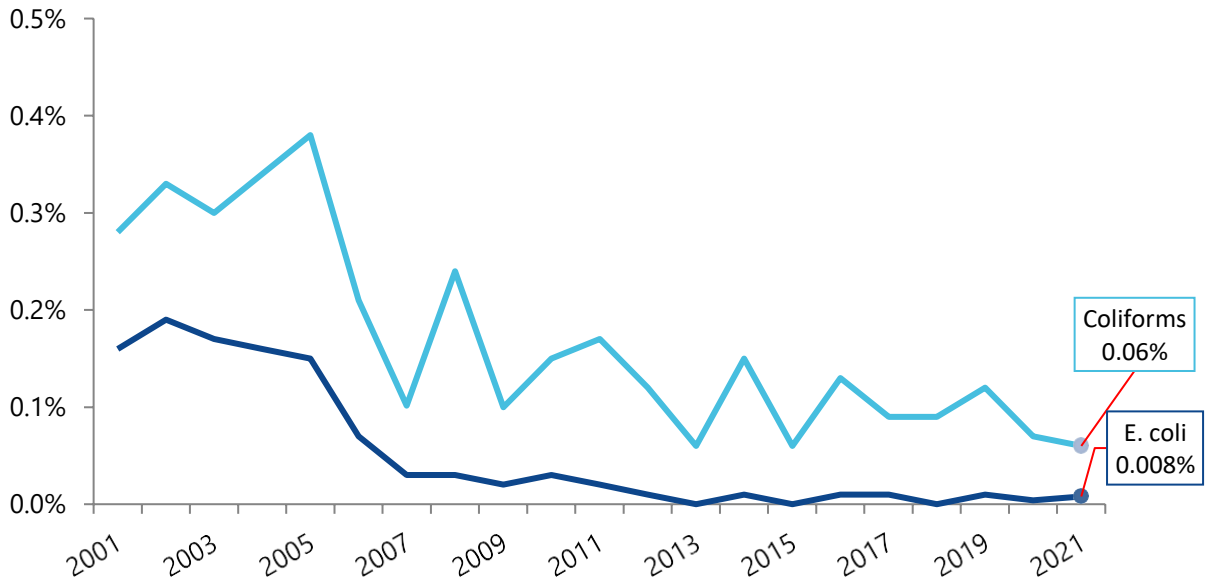


Figure 2 Microbiology Failure Rate at Water Treatment Works

2.1.2 *Cryptosporidium* at Water Treatment Works

Cryptosporidium are microscopic protozoan parasites that can live in the gut of humans and warm blooded animals. *Cryptosporidium.* oocysts can enter a water supply if faecal material is washed into the source (raw) water and oocysts are not removed by the treatment process. *Cryptosporidium* oocysts are not killed by chlorine at the levels used in water treatment, and water treatment processes need to be optimized and well monitored in order to ensure they are physically removed. Scottish Water tests water supplies for *Cryptosporidium* to verify that these processes are removing oocysts. Ultra Violet (UV) light can be effective at inactivating oocysts, and Scottish Water uses this process at a small number of sites where physical removal of oocysts by the original treatment process is not consistently achieved.

There was a significant reduction in the number of samples containing *Cryptosporidium* oocysts in 2021 when compared with 2020, down from 46 to 25, despite an increase in the number of samples taken. Table 2 below shows the comparative performance from 2017 to 2021. Additionally, 60% of these samples had been irradiated with UV to inactivate oocysts and minimize risk to health; while Turriff WTW had the greatest number of *Cryptosporidium*. detections, the presence of the UV system, installed in November 2018, will have inactivated oocysts present in the supply. Mannofield WTW had the highest

number of *Cryptosporidium* detections in a supply without UV treatment. Two of the three detections were reported as having been caused by the treatment work's inability to respond to changes in raw water quality, and a third was attributed to issues with the filter backwash system. Investment is underway at Mannofield to improve the mixing of coagulation chemicals and filter performance. Hopes WTW in East Lothian had three detections of *Cryptosporidium*, with one caused by infiltration of surface water into a storage tank and another by the treatment work's ineffective response to changing raw water quality. UV treatment was installed in October 2021 to minimise the risk from *Cryptosporidium*. Rosebery WTW in Midlothian had two detections of *Cryptosporidium following* issues with the PLC controlling the site, which in one case left the site with no chemical dosing for around four hours. This was investigated by DWQR and a site visit was made and the underlying issue has since been rectified.

Table 2 *Cryptosporidium* Detections at Water Treatment Works

Cryptosporidium	**2021**	**2020**	**2019**	**2018**	**2017**
No. of tests	5,810	5,213	9,101	8,764	9,087
No. of samples containing *Cryptosporidium* oocysts	25	46	38	35	44
% of samples containing *Cryptosporidium* oocysts	0.43	0.88	0.42	0.40	0.48
No. of samples containing *Cryptosporidium* oocysts treated with UV	15	38	30		
% of samples containing *Cryptosporidium* oocysts treated with UV	60	83	79		
No. of WTW sampled for *Cryptosporidium*	224	229	230	238	234
No. of WTW with one or more samples containing oocysts	8	5	11	23	20
% of WTW with one or more samples containing oocysts	3.57	2.18	4.78	9.66	8.55

2.1.3 Chemical Quality at Water Treatment Works

The Regulations require that water is tested for two chemical parameters, turbidity and nitrite, in samples taken from treatment works. Nitrite is a compound of nitrogen that can occur in supplies where ammonia is added to chlorine in a process called chloramination. This process needs to be tightly managed and the presence of nitrite in significant quantities can indicate that it is not controlled as it should be. There were no exceedances of the nitrite standard at treatment works during 2021.

Turbidity is a measure of the extent to which particulate matter in the water scatters light – effectively how cloudy the water appears. There is a risk that turbid waters cannot be properly disinfected, hence a treatment standard of 1.0 nephelometic turbidity units (NTU) has been set in the Regulations.

Image 3 Untreated and treated water

There were six turbidity tests that failed regulatory standards in 2021. In December at Black Esk WTW in Dumfries and Galloway, there were two exceedances of the turbidity standard, both of which were likely to have been caused by the disturbance of deposits of lime added for pH correction of the supply. At Turriff WTW, two exceedances were again caused by lime sediment being disturbed.

Table 3 Summary of Turbidity Tests on Samples Taken at Water Treatment Works

Turbidity	2021	2020	2019	2018	2017
Number of tests	6,854	7,139	7,026	6,859	7,060
Number of tests exceeding standard	6	5	8	9	10
Percentage of tests exceeding standard	0.09%	0.07%	0.11%	0.13%	0.14%
No. of WTW not meeting regulatory requirements	4	3	6	9	9
% of WTW not meeting regulatory requirements	1.75	1.28	2.56	3.78	3.78

Table 4 Turbidity Failures at Water Treatment Works

Site	Parameter	No. of failures
Turriff WTW	Turbidity	2
Black Esk WTW	Turbidity	2
Fort Augustus WTW	Turbidity	1
Daer WTW	Turbidity	1

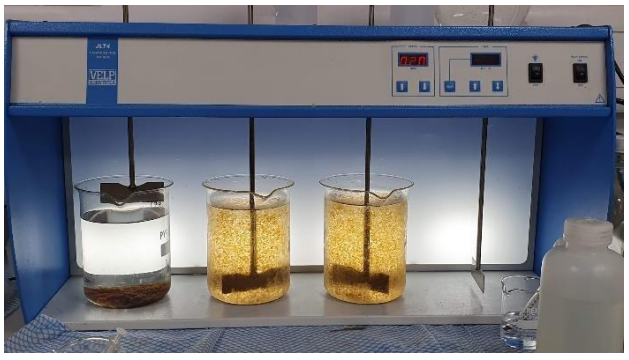


Image 4 Floc test at Auchneel Water Treatment Works

2.2 Service Reservoirs

Service reservoirs (also referred to as storage points) are located at points in the distribution system to store water for hydraulic reasons to meet the demand for water from consumers throughout the day. If service reservoirs are not maintained they can be prone to inward leakage from contaminated surface water. We inspect a selection of structures each year in order to ensure that they are being maintained and operated in a manner that minimises risk of contamination.

Compliance with microbiological standards at service reservoirs in 2021 has improved significantly as Figure 3 below shows. It is likely that this has been as a result of the investment that Scottish Water has made in tackling the back log of repairs needed to improve the integrity of its storage tanks. From 47,324 samples, 44 (0.09%) of samples did not comply with the Coliform bacteria standard.

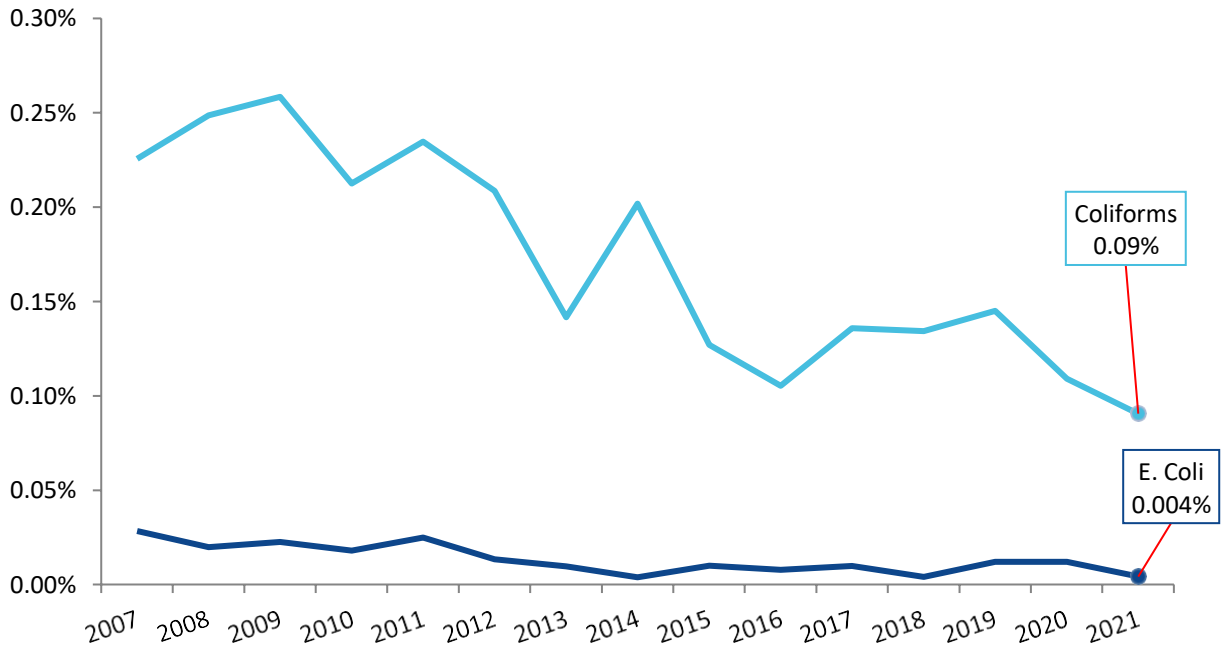


Figure 3 Microbiology Failure Rate at Service Reservoirs

Two samples from two service reservoirs, 0.004% of samples, failed the *E. coli* standard – Castlemilk SR and Deuchney SR. Areas of ingress into the Castlemilk tank were identified by Scottish Water and the tank was bypassed until remedial work could be carried out. The *E. coli* detection from the other service reservoir, Deuchney SR, had further laboratory investigations which indicated that the microorganism detected was unlikely to be *E. coli*, but was characterised as *Klebsiella oxytoga*. This microorganism is relatively sensitive to disinfection and should not have been present in the supply, but was unlikely to have presented a risk to health.

Three service reservoirs had two samples each in 2021 which failed the Coliform bacteria standard. Spynie SR detections were due to the poor condition of the tank. Isleorsnay SR was also found to have areas of ingress, and a temporary protective cover was placed over the roof of the tank until a more permanent solution was found. At Ayton SR, nitrification of the system was found to have led to low chlorine levels and elevated bacterial counts.

2.3 Water Quality at Consumers' Taps

Scottish Water's supply area is divided into 278 water supply zones serving up to 100,000 people. Water is tested for 70 substances known as parameters, with sampling frequencies determined by the size of the population in the water supply zone. As with 2020, due to the Covid-19 pandemic, it was agreed that the usual approach of sampling at randomly selected consumers' properties was not appropriate and some zonal sampling took place at Scottish Water's storage points. As restrictions lifted later in the year, some sampling took place at Scottish Water and DWQR staff volunteers' properties, before normal sampling at randomly selected consumer taps was reinstated at the end of June, although this was briefly suspended at the end of 2021 due to the emergence of the *Omicron* Covid-19 variant.

DWQR met regularly with Scottish Water during 2021 to discuss the impact of Covid-19 on sampling and other operational matters. As in 2020, changes to island flight times and other logistical issues with the transportation of samples made it difficult at times for Scottish Water to get samples to the laboratory within specified time limits. Through these regular meetings, DWQR was able to ensure that everything possible was being done to minimise disruption to the sampling programme, with the verification of the safety of drinking water being a priority.

This necessary change in sampling approach means that, although the correct numbers of samples have been taken from supply zones, the circumstances around their collection is different. Sampling at storage points means the quality of water, and consequently the data from the sampling, will be slightly altered. For example, sampling at fixed points means that the usual variation in taps and distribution system locations does not occur. This can affect parameters such as iron, microbiology and metals, such as lead and nickel where domestic plumbing can greatly affect the quality of water after it has entered properties. Consequently, in reviewing the 2021 data, DWQR will avoid drawing significant conclusions from year-on-year trends.

In 2021, 136,455 tests were carried out on samples taken to represent water quality at consumers' taps, although as discussed above the samples were not always taken from consumers' taps. Of these, 110 failed to meet the standard set out in the Regulations. This means that 99.92% of tests on samples intended to represent water at consumers' taps complied with the standards. The equivalent figures for 2020 were 73 failing samples and 99.95% compliance. Fifty seven supply zones had samples that failed to meet one or more of the standards, compared with 52 in 2020. The equivalent figure for 2019 was 66 zones.

Table 5 below shows the failing test results of samples taken to represent water at consumers' taps. Compliance for a number of key parameters is then discussed in more detail. The number of samples taken for each parameter that Scottish Water is required to test for is shown in the Performance Tables which accompany this report and can be found on our website. In addition to these regulatory samples, Scottish Water also takes samples for further investigation where the consumer reports an issue. This continued throughout the pandemic, with Scottish Water working to ensure issues were properly investigated while minimising the need to enter consumers' properties.

Table 5 Summary of Failing Tests on Regulatory Samples From Consumers' Taps in 2021

Parameter	Total No. of Tests	No. Failed Tests	No. Zones with Failures	% Compliance in 2021
Bacteria				
Coliform Bacteria	14,764	25	21	99.83
E. coli	14,764	2	2	99.99
Enterococci	1,443	2	2	99.86
Clostridium perfringens	5,224	3	3	99.94
Metals **				
Aluminium	5,222	2	2	99.96
Iron	5,222	22	11	99.58
Lead	1,463	4	4	99.73
Manganese	5,222	33	18	99.37
Nickel	1,459	11	10	99.25
Other key parameters				
Colour	5,256	0	0	100.00
Hydrogen ion (pH)	5,256	2	2	99.96
Nitrite	2,834	1	1	99.96
Odour	5,256	0	0	100.00
Taste	5,253	0	0	100.00
Total Trihalomethanes	1,467	2	1	99.86
Turbidity	5,256	0	0	100.00
Total others	51,049	1	1	99.99
Scotland total (incl. other parameters)	**136,455**	**110**	**57***	**99.92%**

* A supply zone can fail for more than one parameter. This means that the total number of zones that failed for at least one parameter is less than the sum of the 'No. Zones with failures' column

**not all parameters are shown here. You can see the full list in the Supporting Information Table 19

2.3.1 Microbiological Quality at Consumers' Taps

Coliform Bacteria

Coliforms were detected in 25 samples in 2021, with four zones reporting two failures.

When coliform failures occur, Scottish Water takes further samples from the premises and also from neighbour's taps to determine if there is a local property issue or a wider supply system concern. Scottish Water notifies the consumer of the findings and provides the appropriate advice in each case. During the early part of 2021, it was harder for Scottish Water to collect samples from consumers' premises, however failures were still investigated thoroughly.

E. coli

E. coli is an extremely important parameter because it is an indicator of faecal contamination and the microbiological safety of the water. The detection of *E. coli* in a water sample may be an indication that either the supply in that area or the tap from which the sample was taken has become contaminated. Some *E.coli* can cause illness. Scottish Water must investigate each failure thoroughly to try to determine the cause and respond appropriately.

Compliance for this parameter is relatively stable with only a few failures occurring each year. Two samples failed singly in separate zones in 2021.

Enterococci

Enterococci is also used as indicator of faecal contamination and the microbiological safety of the water. The numbers of *Enterococci* found in human faeces are generally an order of magnitude lower than *E. coli*, but they tend to survive for longer in the water environment and are more resistant to chlorination than *E. coli*.

Compliance for this parameter is relatively stable with only a few failures occurring each year. Two samples failed singly in separate zones in 2021.

Clostridium perfringens

Clostridium perfringens is a secondary indicator of faecal pollution. *Clostridium sp.* spores can survive in water much longer than organisms of the coliform group and will resist disinfection by chlorine. Their presence in disinfected waters may indicate deficiencies in treatment. In distribution systems and at consumer taps, they can be an indicator of some historic contamination having occurred.

Three samples contained *Clostridium* in 2021.

2.3.2 Chemical Quality at Consumers' Taps

Iron

Iron occurs naturally in some water supplies but should be predominantly removed by the treatment process. Iron compounds such as ferric sulphate are used as alternative flocculants to the more common aluminum based coagulants at a few treatment works in Scotland. The most common cause of failures of the iron standard at consumers' taps is corroding cast iron water mains, which can cause sediment to build up in distribution systems. High concentrations of iron can cause discoloured water supplies, greatly inconveniencing consumers.

In 2021 Scottish Water continued with a programme of renovation and cleaning of the water mains in the areas that caused the most significant water quality issues to help reduce the number of complaints about discoloured water.

Iron compliance in 2021 was similar to 2020, with 22 tests failing to meet the standard, maintaining the previous year's improved performance. As many samples during 2020 and 2021 were collected at Scottish Water's storage points rather than consumers' taps due to Covid-19 restrictions, these samples should have been less vulnerable to local disturbances in water mains and an improvement would be expected. It remains to be seen whether this can be maintained in 2022.

Manganese

Manganese occurs naturally in some raw waters, especially in the West of Scotland. If it is not removed effectively by treatment processes it can accumulate as fine black sediment in distribution system pipework and cause severely discoloured water supplies. Even a relatively low concentration of manganese in the water from the treatment works can build up in distribution pipework and lead to significant consumer complaints... Thirty-three Regulatory samples failed the manganese standard, compared with 15 in 2020 and 10 in 2019. This increase is almost exclusively due to an incident in the late Summer in Lanarkshire, when fourteen failures were from samples from zones supplied by Daer WTW. Areas receiving their water supply from Daer and Camps reservoirs experienced a prolonged period of intermittently discoloured water due to high levels of manganese, which lead to 6,781 complaints from consumers. The manganese originated from the catchment reservoirs, which had dropped to unprecedentedly low levels. Without a dedicated treatment process to remove manganese at the treatment works, it passed through to the distribution system and to consumer's properties. Further details of the incident are included in Section 3 of this report.

Lead

Lead is a toxic metal that can accumulate in the body. In Scotland, lead does not occur naturally in significant concentrations in our water supplies. The problem arises when drinking water comes into contact with lead supply pipes, lead tanks, lead solder joints on copper pipes, or inferior quality brass fittings and taps, particularly when water is in contact with the materials for longer periods of time (e.g. overnight/weekends/holiday periods). This can result in high lead levels in the drinking water supply. Although the majority of lead piping is privately owned and therefore outside Scottish Water's direct control, the company does have a responsibility under the Regulations to minimise the risk from dissolved lead and does this by adding controlled amounts of orthophosphoric acid to some supplies to minimize lead solubility.

In 2021, four lead failures were detected in regulatory samples taken from consumers' taps. In 2021 due to the Covid-19 pandemic consumer tap sampling was only used for part of the year so this number of failures is unrepresentative of the presence of lead pipes either owned by Scottish Water or within consumers' properties.

Total Trihalomethanes (THMs)

THMs are a group of disinfection by-products that can form when naturally occurring organic substances in water from reservoirs combines with chlorine added to disinfect the water. As Scotland's upland waters are naturally rich in these organic compounds, management of THM formation can present a challenge for Scottish Water. Scottish Water has devoted much effort to reducing the formation of THM in its water supplies and has made significant progress on this issue in the past 20 years.

Two exceedances of the THM standard occurred in 2021, both from Camphill water supply zone that serves parts of Ayrshire. Scottish Water investigated and found that organic material in the water had increased beyond the capability of the works to remove it. Ways of improving Camphill's performance further are being explored by Scottish Water.

Nitrite

Nitrite forms when nitrifying bacteria react with ammonia that is added to chlorinated water in a process known as chloramination. If the process is not carefully controlled and nitrifying bacteria are allowed to persist in the distribution system, nitrite can build up and cause failures of the nitrite standard. This can be aggravated by long residence time of water in pipes, for example due to the length of the system and/or the amount of water being used by consumers; this can be a particular issue in warmer weather. There was a single failure of this parameter in 2021 from Rawburn in the Scottish Borders.

Nickel

Nickel is not found in high concentrations in Scotland's waters. Nickel is, however, used for many different applications but mainly in the production of stainless steel and other metal products Its presence in drinking water generally arises from contact with plumbing fittings, such as nickel or chromium-plated taps or certain types of kettles.

Eleven nickel failures occurred in 2021, a further deterioration on 2020's poor results. The high proportion of samples collected from Scottish Water's own taps at service reservoirs rather than at consumers' properties due to the pandemic indicated that Scottish Water needed to replace some of its sample taps at its service reservoirs,

Taste and Odour

There were no failures of the standard for taste and odour in 2021, this is the same as reported for 2020.

Turbidity

Turbidity in water is caused by suspended particles or colloidal matter that obstructs light transmission through it, making it appear cloudy. The standard is primarily an aesthetic one, but high turbidities need to be investigated. There were no failures of the turbidity standard at consumers' taps in 2021.

Hydrogen Ion (pH)

The pH of water is the measure of how acidic or alkaline it is. Most waters in Scotland are naturally soft and have a low pH. Such water can be corrosive to metals used in plumbing, so Scottish Water adjusts pH into the required range. High pH values can sometimes occur where water is in prolonged contact with some water mains containing cement; waters with a very high pH can have a taste that some consumers find unpleasant. Two samples failed the standards for pH in 2021. These were in two supply zones in the Glasgow area, but were due to local conditions in the water main and were not related.

2.4 Consumer Contacts

2.4.1 Consumer contacts to Scottish Water

When a consumer calls Scottish Water regarding the quality of their water supply, the contact is recorded and classified according to the nature of the issue. Scottish Water received 23,770 consumer contacts relating to water quality in 2021, equating to a contact rate of 44 per 10,000 population served. In 2020, there were 18,142 and the overall contact rate was 34 per 10,000. This has been a worrying increase of 31% on 2020 with the increase predominantly being driven by complaints about the colour of the water.

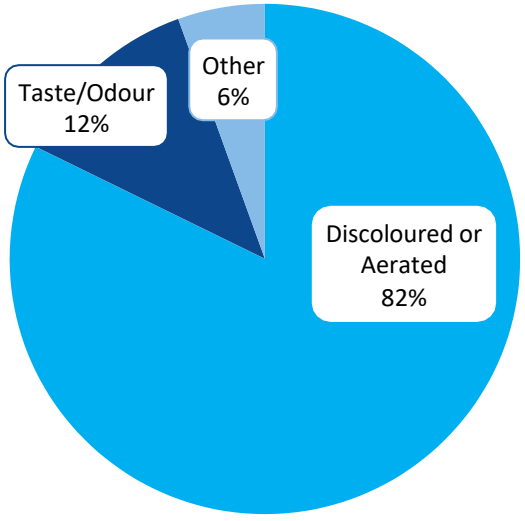


Figure 4 Breakdown of Water Quality Consumer Contacts by Type

Figure 4 shows 82% of calls were received in response to discoloured water and aerated (or milky) water. an increase of 1% compared to 2020. 12% of the consumer calls were related to taste and odour. This includes complaints about water that has an earthy, chlorinated, metallic, fuel or chemical taste or smell. This is down 2% from last year. Other reasons for consumer contacts include concerns about illness and particles or organisms in the water.

In 2019 Scottish Water introduced a new consumer contact management system which is better able to record contact information and also includes contact by social media. Given the change of system it is not possible to carry out meaningful assessment of trends over at present, however the rise in contacts about discoloured water is of great concern. This increase in discolouration complaints came as the result of increased manganese in some supplies. 2021 was a particularly dry Summer and as a result, Scottish Water's source (raw) water reservoirs in some areas were at very low levels. This caused an increase in the concentration of manganese in source waters, due to water being drawn out of the reservoirs at a lower level of the reservoir, where manganese can be in higher concentrations and more difficult to remove in water treatment processes, resulting in discoloured water.

In geographic terms, the areas where most issues were raised by consumers are shown in Figure 5. There are fifteen zones where more than 300 contacts were received. The chart shows the supply zones ranked by contact rate with most being received from consumers in the Daer/Camps A zone. Daer/ Camps area made up 79% of the total consumer complains last year, with discolouration making up 79% of these complaints. Water quality incidents related to manganese in the source water at Daer WTW and Camps WTW caused significant consumer concern, which are discussed in Section 3. It is worth noting though that Daer A and Daer Camps A zones also had the highest number of contacts in 2020. Scottish Water has given DWQR a Letter of Commitment for improvements at Daer and a Letter of Commitment for a pan Scotland manganese strategy. In addition to the areas also mentioned there were water quality incidents due to manganese in Burncrooks zone, Glendevon A zone, Muirhead and Black Esk.

Image 5 Camps Reservoir in summer 2021 showing low water levels

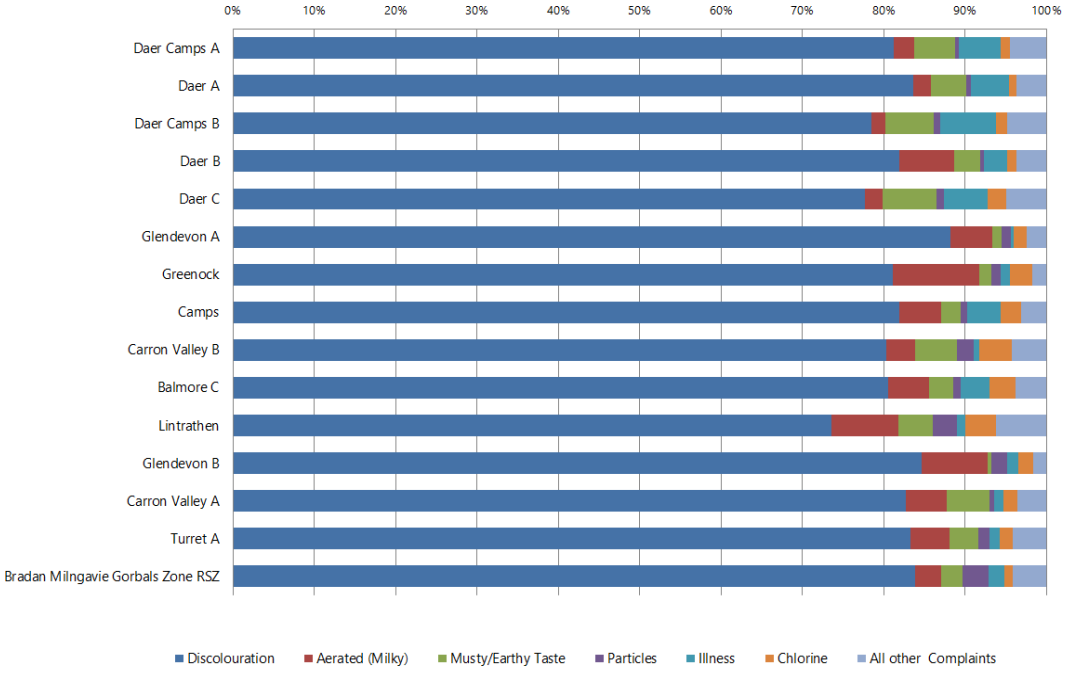


Figure 5 Water Supply Zones with the most consumer contacts in 2021

In 2021 there were 30 zones that had more than 200 contacts, which is increased from 27 from the previous year. In 2020, there were nine zones contained in the comparable chart were those with 200 contacts or more

Image 6 Daer Reservoir in summer 2021 showing low water levels

2.4.2 Consumer Contacts to DWQR

Scottish Water has a responsibility to investigate water quality complaints and supply issues. We guide consumers to report any concerns to Scottish Water in the first instance to enable their investigation and resolution. Where consumers are dissatisfied with Scottish Water's response and have pursued and completed a formal complaint with Scottish Water, DWQR can carry out an investigation of the issues.

As well as dealing with formal complaints about Scottish Water, DWQR receives contacts from consumers and other organisations about water quality matters. We can offer impartial advice and assistance in many cases and a summary of these is shown below in Table 6.

The table shows that the main complaints that the DWQR received last year related to discolouration of drinking water. This has increased significantly from last year. Thirteen of the complaints received by DWQR last year were in relation to the water quality in the Daer Camps zone.

Contact Category	Number of Contacts				
	2021	2020	2019	2018	2017
Appearance					
Discoloured Water	15	5	4	2	4
Aerated (Milky) Water	0	0	0	0	0
Particles in Water	0	1	1	1	2
Organisms in Water	0	2	0	1	1
Taste and Odour					
Chlorine	2	11	5	2	5
Metallic	0	1	0	0	0
Solvent/Fuel	0	0	0	0	0
Musty/Earthy	1	0	2	0	1
TCP/Chemical	1	0	2	0	0
Other contact about Water Quality					
Illness due to Water	2	5	3	2	5
Other Contact	7	5	17	21	7
Total Public Water Supply Water Quality contacts	**28**	**30**	**34**	**29**	**25**
Public water supply requests for information	5	10	6	3	35
Private water supply issues	50	66	64	96	59
General Enquiries to DWQR	24	25	19	15	5
Total Consumer Contacts to DWQR	**107**	**131**	**123**	**143**	**124**

Table 6 Consumer Contacts Received by DWQR in 2021

Last year the DWQR did not carry out any formal investigations. However, the incidents declared for discoloration and manganese at Daer and Camps WTW were investigated by DWQR as part of our incident assessment process - see Section 3 Events and Incidents for more detailed summary of the investigation.

3. WATER QUALITY EVENTS AND INCIDENTS

Scottish Water is required to tell DWQR about all events that have affected or could affect water quality or cause concern to consumers. This includes all regulatory sample failures; operational sample failures that are significant or unexpected; any failure of a treatment process; significant numbers of consumer contacts; and issues which attract significant media interest.

Each event is reviewed and classified into one of five categories: not significant, minor, significant, serious or major. Those events categorised into one of the latter three categories are classed as incidents requiring further detailed investigation by DWQR. Where further information is required, a full report may be requested from Scottish Water. It should be noted that where a full report is not requested, this does not suggest in any way that the incident is less serious.

Incidents are fully investigated by DWQR Drinking Water Specialists who produce a written assessment and make recommendations where appropriate. As part of the investigation, DWQR staff often visit Scottish Water sites to talk to Scottish Water employees and examine equipment failures. A short summary of the incident assessment is published on the DWQR website. For the most serious incidents, enforcement action or referral to the Procurator Fiscal for prosecution are considered and can be taken. In 2021, one incident resulted in enforcement action being taken. Further to the enforcement notice, there were three Letters of Commitment provided by Scottish Water to DWQR. A Letter of Commitment sets out the steps that Scottish Water plans to take to resolve a problem.

There were 855 events reported to DWQR during 2021, the majority of which were not significant. Table 7 shows the numbers of events and the Scottish Water operating areas where they occurred. A summary of incidents is available on the DWQR website https://dwqr.scot/regulator-activity/water-quality-incidents/

Table 7 Drinking Water Quality Events and Incidents in 2021

	Not Significant	Minor	Significant	Serious	Major
EAST	191	55	9	1	0
NORTH	77	19	5	0	0
SOUTH	165	92	8	1	2
WEST	206	19	3	2	0
SCOTLAND	**639**	**185**	**25**	**4**	**2**

Thirty-one of these events were classified by DWQR as incidents, which is two more than were declared in 2020. The reasons why events were classified as incidents in 2021 are illustrated in the chart in Figure 6.

Twelve incidents were declared due to a significant loss of control of treatment process with a further 7 incidents causing significant customer concern or media interest. Some of the customer concerns relate to discoloured water, milky/white water or taste and odours. In certain cases, planned interventions within the water mains network cause these issues and in others, it arises from the need to manage supplies due to issues with the distribution network such as burst water mains.

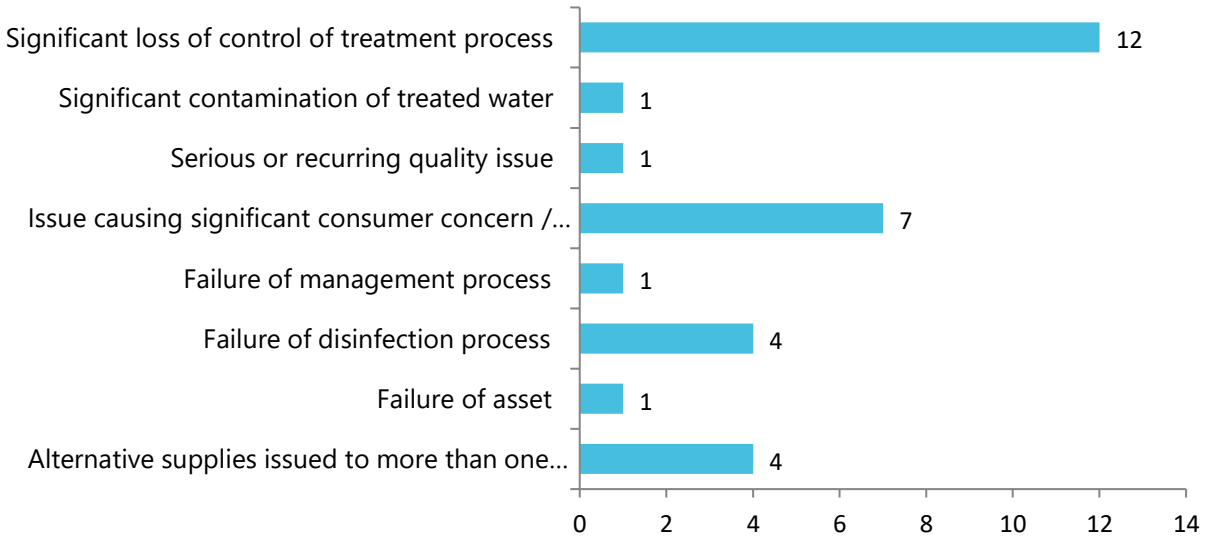


Figure 6 Reasons for Declaration of an Incident in 2021

DWQR is especially concerned about the number of incidents where a causal factor was failure of part of a treatment works. This was found to be either the cause or a compounding factor in sixteen incidents. A further five incidents found that water treatment works either had inadequate or no process within their design to deal with specific hazards in the source water, particularly in managing changes to the raw water quality.

Each Incident Assessment can be viewed on the DWQR website at https://dwqr.scot/regulator-activity/water-quality-incidents/2021-incidents/ . A number of these are worth highlighting in this report as they illustrate significant consumer issues or present important learning points for Scottish Water. These are set out below.

Camps Water Treatment Works (WTW) – August to October 2021

During August to October 2021, elevated levels of manganese were experienced in the water leaving Camps WTW affecting a population of 329,347. The increased manganese levels were caused by exceptionally low water levels in Camps reservoir following the driest April to September period in 160 years.

In response to the elevated levels of manganese, Scottish Water recommissioned a manganese removal stage at Camps WTW, undertook extensive sampling throughout the distribution network, provided information to consumers about the issue and distributed bottled water.

While DWQR accepted that the quality of the raw water supply deteriorated quickly, DWQR's investigation found that Camps WTW had a manganese removal stage on-site which was not operational, and it took Scottish Water 12 days to recommission this removal stage, after which, the levels of manganese in the treated water dropped significantly. It is of concern to DWQR that despite there being previous knowledge of manganese in the raw water, manganese was not routinely monitored in the raw water or in the treated water leaving the WTW, but only in regulatory samples at consumers' taps. This most likely caused a delay in Scottish Water becoming aware of the issue and taking action to prevent manganese entering the distribution system to consumers.

Scottish Water identified six actions from this incident, and DWQR made three further recommendations. DWQR also requested, and has received, a Letter of Commitment from Scottish Water outlining how the company will manage manganese both in the short and longer terms.

Daer WTW – August to October 2021

Similarly to the incident at Camps WTW, during August to October 2021, elevated levels of manganese were experienced in the water leaving Daer WTW. The manganese was caused by exceptionally low water levels in Daer reservoir following the driest April to September in 160 years in the catchment area.

There were 12,856 customer contacts reported within Daer, Camps and Daer/Camps operational areas between 1st August and 4th October 2021

DWQR's investigation found that Daer WTW had no manganese removal stage as manganese had not been identified as a risk in the raw water supply by Scottish Water. Following consumer complaints, it was realised that elevated manganese concentrations were passing though the works and into supply. It took Scottish Water five days from the initial increase in manganese concentrations to recognise the issue as being due the treatment works rather than being related to the distribution system, as manganese was not routinely sampled at the treatment works.

Once the cause was identified, there was little that Scottish Water could immediately do to resolve the situation other than responding to consumer concerns about discolouration. Work commenced to install temporary manganese removal at the treatment works, but it took several weeks for this to be fully effective. It was also noted that the additional chlorine used in the efforts to install a temporary manganese removal stage led to a number of exceedances of the trihalomethane (THM) standard.

It was early October before the manganese leaving the treatment works fell significantly to below 20µg/l, although it should be noted that this is still a significant quantity of manganese entering the distribution system.

DWQR was critical that Scottish Water should have realised early on that this was likely to be prolonged situation and should have planned a frank and supportive communication strategy that remained consistent throughout the incident. Improvements have been identified, with Scottish Water highlighting fourteen actions from this incident, whilst DWQR made three further recommendations. DWQR also requested, and has received, a Letter of Commitment from Scottish Water outlining how the company will manage manganese in Daer supply both in the short and longer terms.

Image 7 Daer Water Treatment Works

Lock Eck – August to December 2021

In August 2021, Scottish Water received multiple calls from a small geographical area near Dunoon reporting discoloration and black particles in the water. On 25th August, Scottish Water took samples from one of the properties, which subsequently failed a number of microbiological standards, with Coliform bacteria present at a concentration of 300 CFU/100ml, *E. coli* at 10 CFU/100ml, and Enterococci at 3 CFU/100ml. The plate counts were significantly elevated at 296 CFU/100ml and 58 CFU/100ml at 22 and 37°C. A significant quantity of 'non coliforms' were also reported from the sample. The property was issued a Boil Notice whilst further sampling and investigations were carried out to restore a wholesome supply of water. Following further sampling, a total of 23 properties were issued Boil Notices between 26th August and 1st September.

A fire hydrant was installed on the water main on the 28th August and flushing was carried out from the 28th August until the 1st September, by which time further sampling showed that the supply complied with microbiological standards and the Boil Notice was lifted. As background chlorine residuals remained low, flushing was reinstated on 3rd September and continued until 21st December.

Scottish Water undertook an investigation into the root cause of the failure and found that the main had twice been repaired, on the 8th and 10th August, and initially Scottish Water assumed that ingress had occurred at this point in the network However, this was not the case, and unbeknown to Scottish Water, there was a small leak in a nearby pipe which, when found, was immediately repaired. Hydraulic modelling showed that the area around this leak would have become depressurised during the mains repair operations on the 8th and 10th August, and ingress into the pipe could have occurred.

The supply network was reconfigured by Scottish Water, with a new water main being laid to service the affected properties from a different part of the distribution system. This main was brought into service on the 13th December 2021 and the branch main that had been leaking was abandoned.

As part of DWQR's assessment, site visits were carried out to the area, recordings of customer calls were reviewed, Scottish Water staff were interviewed and statements taken. Four of the consumers affected were interviewed, with statements taken from two of them. DWQR's investigation highlighted a number of concerns including the sampling response following the burst main repair and the microbiological failure, the time taken to respond to the consumer contacts, the handling of consumer contacts by Scottish Water's call Centre, a lack of cooperation to DWQR's request for information from Scottish Water's Framework Contractor, the time taken to investigate and identify the source of the contamination and that Scottish Water did not appear to have considered disinfecting the contaminated main rather than simply flushing it.

Scottish Water identified eight actions from this incident, whilst DWQR made fourteen further recommendations. An enforcement notice has been issued which requires improvements in Scottish Water's processes and procedures for the management of its distribution network. https://dwqr.scot/media/ksublvly/innellan-en-17-june-2022.pdf

Glendevon A – November 2021

In November 2021, two unrelated events occurred in the same Water Supply Zone (WSZ), each causing loss of supply and water quality issues for consumers. As the management of the two events was connected and the consequence for consumers similar, they were treated as one incident.

On 4th November, a leak on an 18" water main deteriorated significantly causing loss of supply or pressure affecting approximately 12,546 customers. As the leak worsened, flow through the pipe increased and pressure decreased, leading to a rise in customer contacts about discoloured water. The burst main was isolated at 23:00 on 4th November and repairs were completed at 22:30 on 5th November. Throughout this time, Scottish Water deployed a fleet of tankers to inject water at key points within the distribution system in an attempt to maintain water supplies.

A second event at Redcraigs Service Reservoir was also unfolding in the afternoon of the 4th November, where reports of no water were being taken by the Consumer Contact Centre. Investigations here showed that there was no inlet flow to the tank which had caused it to drain down. This tank is formed of two cells and only one was fully operational due to a faulty inlet flange in the other awaiting maintenance attention. The full flow was opened up into this section to replenish the tank and the drained-down water mains leading from the site to the wider distribution network.

In both aspects of this event, the sudden restoration in flow of water through the network caused disturbance of deposits in the water mains and consequently reports of discoloured water to be made by consumers. In both cases, the occurrence of the problems, their isolation for repair, restoration of water flow and introduction of tankered water supplies into water mains, caused a significant number of consumer complaints between the 4th and 10th November. In all, over the course of the events and the

following days, a total of 1,355 contacts were received by Scottish Water, of which 624 related to discoloured water or taste and odour issues.

Sampling showed there to be failures of standards for aluminum, iron and manganese. One also failed the microbiological standard for total coliforms. Subsequent resampling over the following days showed water quality to have been restored in all the affected areas by 12th November.

DWQR expressed concern at the management of the tankering operations. Direct injection of water into mains brings a risk of contamination, but records were not kept of the exact location of the direct injects into the system during this incident, meaning that thorough investigation of any contamination or mains disturbance would not have been possible.

Scottish Water identified six action from this incident, and DWQR made no additional recommendations.

Rosebery WTW – November – December 2021

Rosebery WTW, near Gorebridge, had three incidents within the space of 3 weeks in 2021.

The first incident involved the standby operator being called out to a rapid gravity filter (RGF) alarm. On attending they found that the Programmable Logic Control (PLC) was in fault and water had continued to flow through the treatment works and into distribution with no treatment or disinfection dosing for four hours. The operator successfully restarted the plant by resetting the PLC, washing the filters and adding an emergency dose of disinfectant into tanks at the treatment works before restarting the works. Reactive sampling detected *Cryptosporidium* in the water leaving the treatment works and one failure of the manganese standard in the distribution system.

The second incident occurred a week later when the standby operator was called out for a standby generator failure. This time the raw water inlet valves had closed effectively, but chlorine dosing had failed. The operator returned the site to mains power and carried out the relevant work onsite before restarting the works. A further *Cryptosporidium* failure was detected from this event.

The third incident occurred the following week when the standby operator was called out to another RGF plant failure. It was discovered that again the PLC was in fault and the WTW inlet valves were open with no chemical dosing for approximately three and a half hours. The operator cleared the PLC fault and went through the correct procedures for restarting the works. On this occasion all reactive sampling was compliant.

The DWQR found that the first alarm received during this event was missed and this contributed to a delay in an operator attending site but accepts that the Intelligent Control Centre experienced an unprecedented number of alarms at the time due to Storm Arwen.

Scottish Water made a commitment to six actions, and DWQR made a further two recommendations.

4. AUDIT AND INSPECTION

4.1 Water Treatment Works and Service Reservoirs

An important part of DWQR's scrutiny role is to audit and inspect activities undertaken by Scottish Water. We can choose to inspect any aspect of Scottish Water's activities that could affect water quality. Inspections commonly undertaken include WTW, storage points, distribution system activities, response to consumer water quality issues and analytical services. We audit against the requirements of the Regulations, as well as water industry best practice. We also audit the completion of investment projects.

The inspection process provides a number of benefits:

- It enables DWQR to verify that Scottish Water is complying with regulatory requirements at sites across Scotland;
- It allows DWQR to see new initiatives and areas of best practice;
- It is an opportunity for DWQR staff to meet site-based Scottish Water staff and discuss water quality issues with them;
- It raises awareness of DWQR and the regulations amongst Scottish Water staff;
- It enables verification of the delivery of investment work;
- It enables DWQR to build an awareness of common trends, risks or deficiencies across Scotland and use these to inform future policy and guidance.

We select sites for inspection using a risk based process that takes into account sample failures and water quality events and incidents. DWQR may also choose to inspect sites randomly or directly following incidents. Other types of inspection may be undertaken in response to a particular issue or concern.

To make sure we are consistent all our inspectors use standard inspection templates and the audit process is subject to an ISO accredited procedure. DWQR also participates in benchmarking audits with other regulators in the UK and beyond to drive consistency and to spread best practice.

Where issues are noted during an inspection these are recorded as recommendations that are tracked and followed up. Where common themes are identified, these are progressed centrally with senior Scottish Water staff. Elements of best practice are also highlighted. Scottish Water has an opportunity to comment on draft inspection reports and co-operates fully during the technical inspection process.

Once an inspection report has been finalised the completed report is sent to Scottish Water and a summary placed on the DWQR website. You can view the DWQR audit and inspections reports on our website at https://dwqr.scot/regulator-activity/audit-and-inspection/

Our audit activities during 2021 continued to be affected by the pandemic. Due to restrictions and the need to protect essential services, it was not possible to visit as many Scottish Water sites as we would in a normal year. Instead, we found other ways of auditing, using video calls and written evidence to undertake our scrutiny activities.

4.1.1 Water Treatment Works

During 2021 eleven technical audits were carried out at WTW. Our findings included the need to increase manganese sampling in both the raw water and across treatment so that staff can understand if treatment is effective at manganese removal and the review of emergency action levels (EALs) to ensure staff can react promptly to fluctuating levels at the WTWs.

Three visits were undertaken to see the effectiveness of treatment put in place to control algae at the reservoirs following incidents involving taste and odour complaints from the breakdown products of algae in previous years. These were observed to be working well with no taste and odour problems noted at these sites since the interventions were made.

In addition to full audits, we also made eight visits to treatment works to assist our investigations into events and incidents to interview staff and increase understanding of the situation. These are also recorded in Table 8.

Image 8 Bubble curtain at Gladhouse Reservoir

Image 9 Stoneybridge Reservoir

Table 8 DWQR Site Visits for Audits and Event and Incident Investigation in 2021

Site	Date	Reason for Audit	No of recommendations
Manse Street, Galashiels	May	Risk based	5
Yarrowfeus, Scottish Borders	May	Risk based	1
Afton, Ayrshire	June	Risk based	6
Carron Valley, Falkirk	June	Algal control	1
Eela, Shetland	July	Risk based	7
Gladhouse reservoir, Midlothian	July	Algal control	0
Watch Water, Scottish Borders	July	Algal control	0
Tighnabruich, Argyll	July	Manganese management	7
Daer and Camps, Lanarkshire	August, September, October	Incident investigation	n/a
Stoneybridge, Western Isles	September	Risk based	8
Balmichael, Arran	September	Risk based	5
Lochranza, Arran	September	Risk based	4
Auchneel, Dumfries and Galloway	November	Risk based	3
Penwhirn, Stranraer	November	Risk based	4
Mannofield, Aberdeen	November	Incident investigation	n/a
Invercannie, Banchory	November	Incident investigation	n/a
Loch Eck, Dunoon	November	Incident investigation	n/a

4.1.2 Distribution Systems

We audited eight distribution systems and service reservoirs (SRs) in 2021. Our findings included recommendations for training and more comprehensive use of impact assessment forms (IAFs) when assessing issues in distribution.

Table 9 Distribution System Audits in 2021

Site	Date	Reason for audit	No. of recommendations
Crail, Fife	July	Tankering	7
Elsrickle, South Lanarkshire	July	Network rehabilitation	1
Haddington, East Lothian	July	Mains repair	1
Eela, Shetland	July	Risk based	2
South Uist	September	Network rehabilitation	0
Arran	September	Risk based	2
Eriskay SR, Western Isles	September	Risk based	0
Fineview SR, Dumfries and Galloway	November	Risk based	0

Image 10 Water Storage tank at Eriskay Distribution Service Reservoir

4.2 Services and Benchmarking

Services

Due to the pandemic we carried out a number of remote audits using video messaging and examination of records and data. This works well for the audits of services which are more desk-based and look at procedures rather than physical equipment and processes. During 2021 we carried out four audits of Scottish Water's services and procedures.

The consumer contact audit was carried out to follow up on the similar 2018 audit at which time Scottish Water was about to implement new consumer contact recording and reporting systems. This audit examines calls made by consumers to the contact centre and the response from call centre staff and all relate to water quality concerns. It was clear from the reports and data provided that the new systems provide a significant step forward in the recording of consumer contacts. Consumers now use a number of channels, including social media, to report their concerns and that Scottish Water respond to all of these channels in a similar manner. In most cases selected for audit Scottish Water demonstrated a high degree of consistency of reporting consumer contacts in relation to water quality events and the overall extracts of data from the contacts database.

Table 11 Audit of Services

Service	Date	No. of recommendations
Consumer Contacts	April	4
Pesticide Risk assessment	May	0
Intelligent Control Centre	January and March	5
WTW actions follow up	January	0

Benchmarking

DWQR retains close contact with the other water quality regulators in the UK and Europe to share knowledge, learning and best practice. These are excellent benchmarking opportunities: both to ensure DWQR inspectors are auditing to a high standard; and to make sure Scottish Water's standards for operations and procedures are of the same quality (or better) than other water providers. There were no opportunities for benchmarking audits during 2021. However, it is intended that these shall be continued in future and DWQR has extended the invitation to colleagues in England and Northern Ireland to accompany DWQR on benchmarking opportunities in Scotland.

5. NETWORK INFRASTRUCTURE SECURITY DIRECTIVE

The Network Information Systems (NIS) Directive was introduced to improve the levels of cyber security and resilience of essential services across the EU. It provided the basis of NIS Regulations that were introduced in 2018. These regulations provide legal measures to protect essential services by improving the security of the network and information systems that support the delivery of these services. In line with the NIS Regulations, Scottish Water is identified as an 'Operator of Essential Services' as it supplies water to more than 200,000 people. The DWQR is identified as the relevant Competent Authority in Scotland.

The National Cyber Security Centre are the technical authority supporting both Operators of Essential Services and their competent authorities with cyber security advice and guidance. Further information is available at: NIS introduction - NCSC.GOV.UK.

In 2021, Scottish Water submitted its assessment of compliance with the Regulations using the Cyber Assessment Framework (CAF) to the DWQR. Following further discussion of the CAF an improvement plan was submitted by Scottish Water to DWQR and this forms the basis of ongoing discussion and monitoring of progress.

Image 11 Control panel at Manse Street Water Treatment Works

6. ANNEXES

Annex A

6.1 Information Letters issued during 2021

One information letter was issued by DWQR in 2021. It may be viewed on the DWQR website.

DWQR Information letter 01 – 2021 The Augmentation of Drinking Water Supplies by Tanker

https://dwqr.scot/media/auihxe2t/dwqr-information-letter-01-2021-the-augmentation-of-drinking-water-supplies-by-tanker-19-august-2021.pdf

Annex B

6.2 Current Letters of Commitment and Enforcement Notices

When DWQR has evidence that Scottish Water has contravened a drinking water quality duty, the contravention is likely to recur, and Scottish Water is not taking timely steps to rectify the situation, DWQR may serve an Enforcement Notice on Scottish Water under Section 10 of the Water Industry (Scotland) Act 2002. Such an Enforcement Notice must set out specific actions to be taken by Scottish Water within specified timescales. Failure to complete such actions by the due date is a criminal offence under Section 12 (5) of the Act.

In 2021, there were five active Enforcement Notices. Two of these were issued during 2021, one of which related to the Network and Information Systems Directive and has not been listed below due to operational sensitivities:

Table 11 Current Enforcement Notices and their completion date

Location	Compliance Date	Description
Turriff WTW	30/06/22	Filter refurbishment / SCADA replacement
Bonnycraig WTW	20/12/22	Installation of *Cryptosporidium Spp.* removal process
Scotland wide	30/09/23	Improved corporate risk assessment process
Afton	31/12/21	Improvements to management, monitoring and control

Enforcement Notices are published on the DWQR website which you can view here:
https://dwqr.scot/regulator-activity/enforcement/

Letters of Commitment are issued by Scottish Water to DWQR and provide a commitment to undertake specific actions. If the terms of a letter of commitment are not complied with, DWQR may choose to initiate enforcement action. Seven letters of commitment were active during 2021 and beyond in respect of:

- **Black Esk WTW**
- **Daer WTW**
- **Carron Valley WTW**
- **Glenfarg WTW**
- **Turiff WTW**
- **Herricks WTW**
- **Manganese Strategy**

Letters of Commitment are published on the DWQR website which you can view here: https://dwqr.scot/regulator-activity/letters-of-commitment/

Image 12 The view of Whiteadder Reservoir

6.3 Abbreviations and Glossary

BH Borehole

Bq/l Becquerels per litre, a measure of radioactivity

CAF Cyber Assessment Framework

CWT Clear Water Tank

DCMS Department for Digital, Culture, Media and Sport

DOMS Distribution Operation and Maintenance Strategy

DWSP Drinking Water Safety Plan

DWQR Drinking Water Quality Regulator for Scotland

EAL Emergency Action Levels

IAF Impact assessment Form

ISO International Standards Organisation

mg/l milligrammes per litre

NCSC National Cyber Security Centre

NHS National Health Service

NIS Network Infrastructure Security

NRV Non-Return Valve

NSO Network Service Operator

NTU Nephelometric Turbidity Unit

PAC Powdered Activated Carbon

PCV Prescribed Concentration or Value

PHT Scottish Water's Public Health Team

PLC Programmable Logic Controller

RSZ Regulated Supply Zone

SCADA Supervisory Control and Data Acquisition

SEPA Scottish Environment Protection Agency

SR Service Reservoir

THM Trihalomethanes

TL Team Leader

TOMS Treatment Operation and Maintenance Strategy

TWS Treated Water Storage

µg/l micrograms per litre

UV Ultraviolet Light

WTW Water Treatment Works

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