dwqr
Drinking Water Quality Regulator for Scotland

DRINKING WATER QUALITY **IN SCOTLAND 2013**

PUBLIC WATER SUPPLY

SAFEGUARDING YOUR DRINKING WATER QUALITY

Published on behalf of the Drinking Water Quality Regulator for Scotland, August 2014.

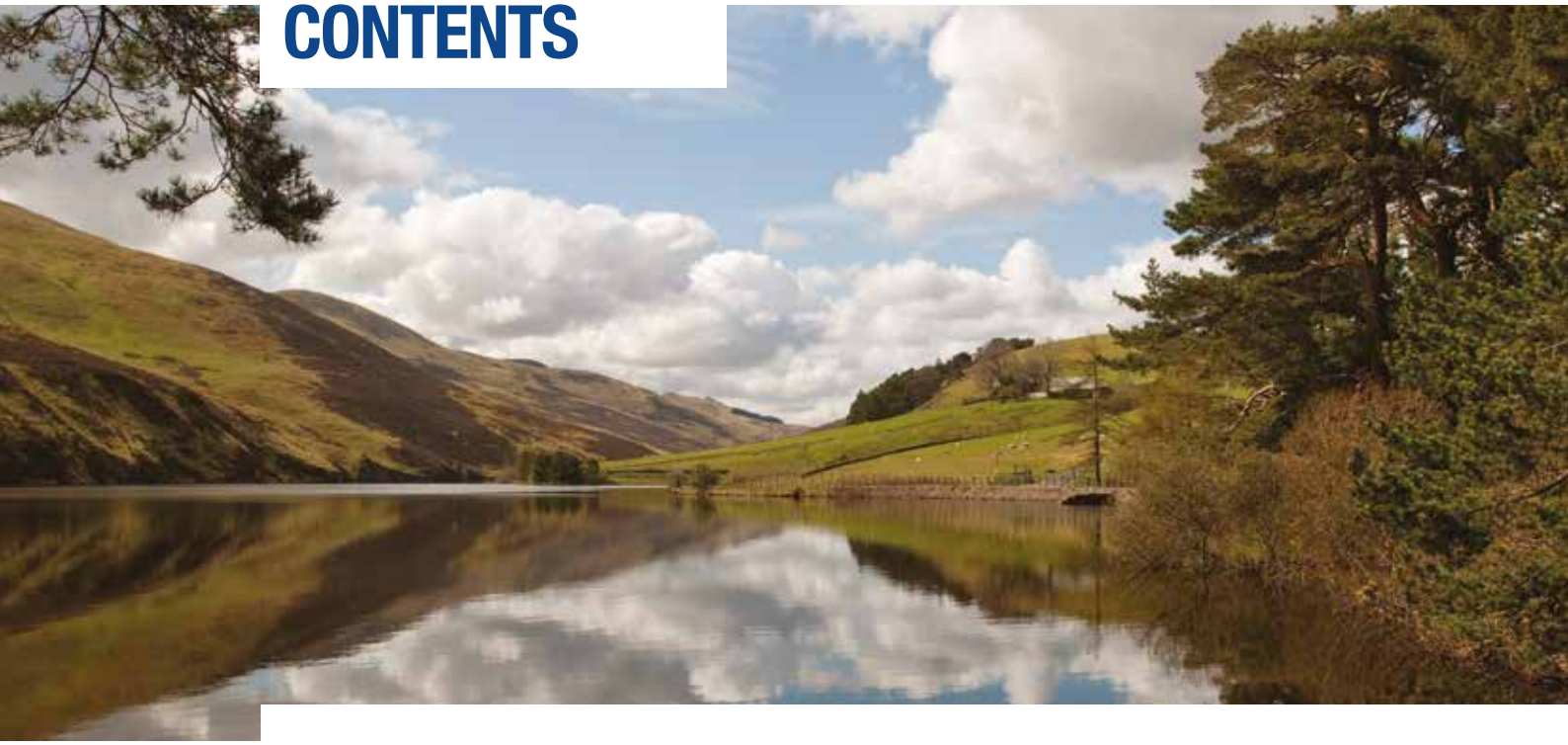
Produced for the Drinking Water Quality Regulator by APS Group Scotland

DPPAS27367 (08/14)

ISBN: 978-1-78412-674-2

Further copies are available from DWQR at **www.DWQR.org.uk** or 0131 244 0190.

CONTENTS



EXECUTIVE SUMMARY

The Drinking Water Quality Regulator for Scotland (DWQR) regulates the quality of water supplied by Scottish Water (the public supply), and has a role to ensure that local authorities are meeting their responsibilities to regulate the quality of private water supplies. The role of DWQR was created by the Water Industry (Scotland) Act 2002 ("the Act"), which gives the Regulator various powers to enter premises as part of an investigation, to obtain information and to take enforcement action. This report fulfils the requirement under the Act that the DWQR publishes a report on the exercise of the Regulator's functions during the previous year. This report relates to the calendar year 2013.

The quality standards that drinking water supplies must meet are set out in regulations and the function of DWQR is to ensure that these regulations are complied with. In Scotland the regulations relating to the quality of water supplied by Scottish Water are the Water Supply (Water Quality) (Scotland) Regulations 2001. Private water supplies have equivalent regulations – the Private Water Supply (Scotland) Regulations 2006 – which are enforced by local authorities. Quality standards in both regulations are derived from the European Drinking Water Directive 98/83/EC.

In Scotland the water supplier, Scottish Water, takes and analyses its own samples to demonstrate that the water supplied complies with regulatory requirements. This is consistent with water industry practice in the rest of the UK. The DWQR checks that this has been done correctly and monitors the results. DWQR also inspects a range of Scottish Water activities that could affect quality and investigates any water quality incidents that are reported.

Drinking water in Scotland comes from a number of sources. All supplies need to be treated before they are of satisfactory quality to be drunk by consumers. The extent and type of treatment required depends on the nature of the supply, its quality and any potential risks to quality that are present. All water in Scotland supplied by Scottish Water is disinfected. This usually involves adding a tightly controlled amount of chlorine to the water in order to make it safe. Summary facts about the public water supply in Scotland are shown below:

197 Loch and Reservoir Sources

177 River Sources

84 Spring and Borehole Sources

47,000km Water Mains

252 Water Treatment Works

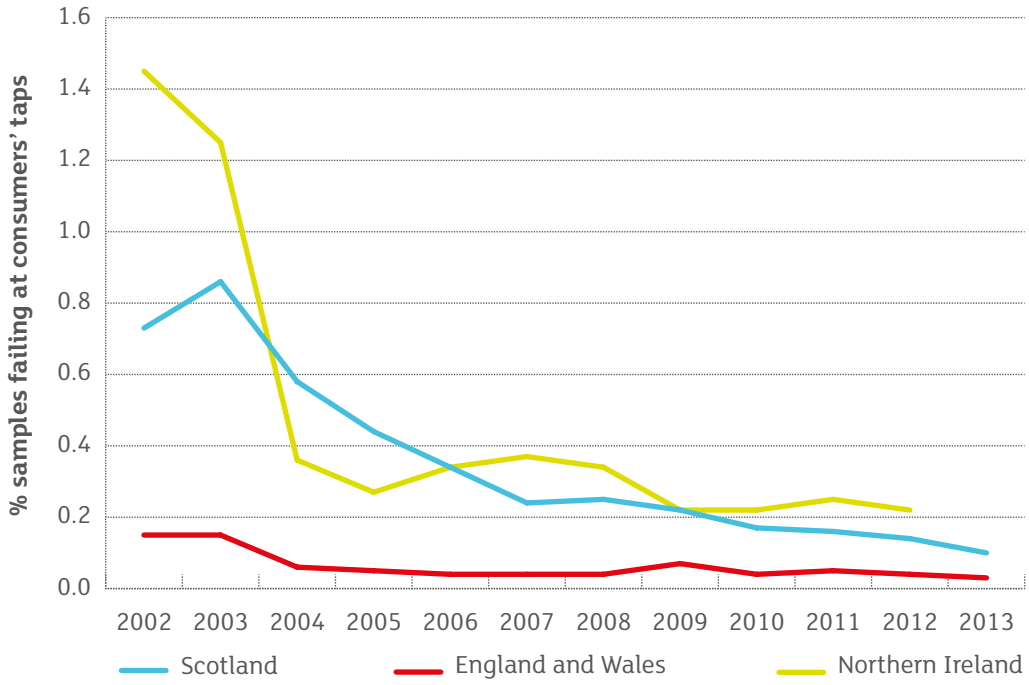
1,001 Storage Points

COMPLIANCE WITH THE STANDARDS – HOW GOOD WAS DRINKING WATER IN 2013?

Scottish Water carried out 330,156 regulatory tests for which there is a numerical standard on Scotland's drinking water in 2013 and many more for operational purposes. Some of these tests were on samples taken from water as it leaves treatment works and storage points. The largest number of samples was collected from randomly selected consumers' taps across the country, and this is where compliance is generally measured as it is the point at which users consume the water.

In 2013, 154,755 tests were carried out on samples collected from consumers taps and 99.89% of these complied with the standards, demonstrating the continued improvement in drinking water quality. The chart shows that compliance in Scotland has improved considerably in the 11 years since Scottish Water was formed. It also shows that there remains more to do before water quality in Scotland consistently achieves the same standard as that in England and Wales.

Relative compliance at consumers' taps in the UK



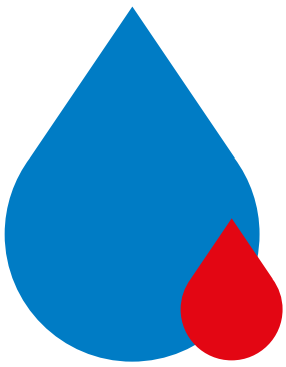
WATER QUALITY AT TREATMENT WORKS

The 252 water treatment works (WTW) around Scotland vary considerably in size, but all are sampled regularly. In 2013, 72,209 tests were carried out on samples collected at treatment works. The main compliance parameters are microbiological – coliforms and *E. coli* – and these provide an important check that disinfection has been effective. In 2013, only 17 samples contained coliforms and one contained *E. coli*. This represents a significant improvement on past years with detections of both parameters around half those in 2012, and represents the best ever microbiological compliance.

Cryptosporidium is a microscopic organism that can cause illness and can be present in untreated water contaminated by faecal material. The treatment process should be able to remove it. Scottish Ministers require Scottish Water to sample supplies and test for *Cryptosporidium* in all supplies at a frequency that depends on risk. Out of 8,300 samples from 252 treatment works in 2013, 118 contained *Cryptosporidium* oocysts. The number of treatment works from which at least one positive sample was taken was 43. Both of these figures are a considerable improvement on 2012, although there is plenty of scope for additional progress.

Water treatment works performed well in 2013, reflecting delivery of investment, improved sampling arrangements and significant efforts by operational staff. DWQR inspections of works have generally shown treatment works to be adequately equipped and well managed. Among site specific issues identified, some common themes emerged, including a need to more comprehensively assess and respond to important risks to water quality, including the need for additional water quality monitoring where a risk has been identified.

Work to fully understand the operation of key parts of the treatment process and the science behind these at some sites is beginning to bear fruit. It is vital that Scottish Water continues this work and challenges long-standing assumptions and operational practices where appropriate. Nowhere is this more apparent than with *Cryptosporidium* and the need to investigate detections and assess plant performance against well-documented industry best practice to ensure the necessary resilience is built into all treatment processes.



72,209 tests at WTW

30 tests failed

WATER QUALITY IN DISTRIBUTION SYSTEMS

The distribution system comprises the network of pipes delivering water to homes and businesses as well as any storage points such as water towers and service reservoirs. Scottish Water has over a thousand storage points and more than 47,000km of water mains and it must ensure that the condition of these does not cause water quality to deteriorate.

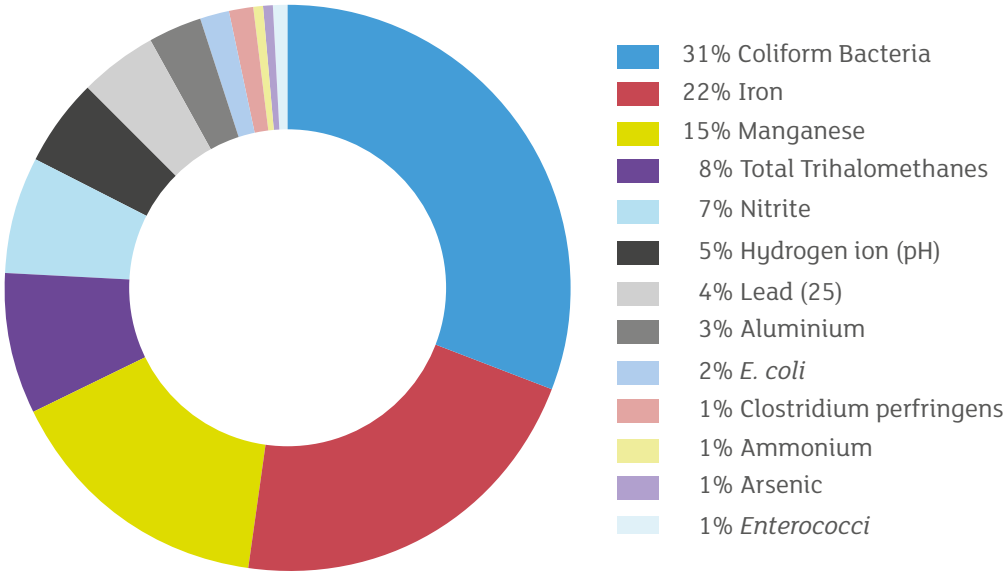
Scottish Water must sample each storage point weekly and test for *E. coli* and coliform bacteria. According to the Regulations, 5% of samples from a storage point may contain coliforms before it is considered to have failed to meet the standard, however, DWQR expects all detections to be investigated. In 2012, 3 samples contained *E. coli* and no storage points failed to meet the regulatory requirement that 95% of samples shall not contain coliforms. This is the first time that this has been achieved. Scottish Water's investigation of failures at storage points has improved over the year and is helping to bring about improvements to the assets and to working practices, although there remains much to do.

Although they are measured at consumer's taps, iron and manganese compliance provides an indication of the condition of the distribution system and any sediment within it. Both substances can cause discoloration that can greatly inconvenience consumers and lead to complaints. In 2013, compliance for iron and manganese remained fairly static compared to previous years. Rawburn supply zone in the Scottish Borders had the poorest iron compliance, while five of the 25 manganese failures occurred in Muirdykes zone where there is a known problem that is the subject of an Undertaking from Scottish Water.

WATER QUALITY AT CONSUMERS' TAPS

Most samples to assess regulatory compliance are taken from consumer taps, and testing takes place for 51 parameters that have numerical standards. Sampling frequencies are determined by the size of the population in the water supply zone. The vast majority of samples that were taken complied fully with regulatory requirements. For microbiology, three samples contained *E. coli*, one more than in 2012. The poorest compliance was for total trihalomethanes (99.14%), iron (99.32%), lead (99.54%) and manganese (99.51%), with all of these except iron an improvement on last year. Trihalomethane (THM) compliance was greatly improved on that of 2012, with extensive work by Scottish Water to reduce the number of failures due to this disinfection by-product producing results. This work must continue to bring THM compliance in Scotland into line with that in the rest of the UK.

Failures at consumers' taps by parameter



The percentages show the proportion of total failures

EVENTS AND INCIDENTS

Very occasionally things go wrong, and Scottish Water is required to tell DWQR about all events that could adversely affect water quality or cause concern to consumers. In 2013, 419 such events were notified to DWQR, a significant reduction on previous years. DWQR considers each event and classifies them. The more serious ones are declared incidents and may require a full report from Scottish Water. DWQR investigates incidents and produces a written assessment, making recommendations where appropriate. Incident assessments are published on the DWQR website. In 2013, 24 events were classified as incidents, representing a sharp drop on 2012. Once again, the number of incidents that were caused by a failure of the disinfection process is too high. Scottish Water has committed to producing disinfection strategies at all of its treatment works. These should consider the effectiveness and resilience of the current disinfection process at each site and identify any risks that need to be addressed via the drinking water safety planning process.

Three significant incidents occurred in 2013:

- **Tomnavoulin WTW, Moray**
  Cryptosporidium was detected in the supply, which has had a history of problems of this nature. It is evident that measures put in place previously to address problems in 2012 at the works have not been completely effective. Scottish Water has replaced membranes, installed additional monitoring and is continuing to investigate the situation. DWQR has visited the site and has been engaged in ongoing dialogue with Scottish Water concerning the resilience offered by the plant and is continuing to seek a prompt, lasting, solution to ensure that consumers in Tomnavoulin have a safe and reliable supply of drinking water.

- **Bradan WTW, Ayrshire**
  Bradan water treatment works suffered a failure of the disinfection process for nearly three hours. Further investigation established that an isolation valve from the standby chlorine drum was in a closed position and the drum appeared empty when it was in fact full. Emergency chlorine dosing to the clear water tank was used until the issue was rectified and prevented any impact on the quality of water supplied to consumers. DWQR visited the site to speak to staff and better understand the circumstances around the incident. Scottish Water has implemented various measures to prevent a recurrence.

- **Storr Forest WTW, Skye**
  Cryptosporidium was detected in large quantities in a sample taken from this basic supply. Further detections continued at lower concentrations through the Autumn until clear samples were eventually obtained in November. Scottish Water took advice from NHS Highland throughout the incident. Storr Forest is vulnerable to changes in raw water quality as there is no filtration process and there has been a history of intermittent *Cryptosporidium* previously in the supply.

  DWQR considers that, although some actions to improve source protection have been taken, the current treatment at the site is inadequate for the risks present and the new membrane plant planned for the supply should be constructed as quickly as possible, with temporary filtration equipment installed at the site to reduce the risk.

AUDIT AND INSPECTION

Audit and Inspection is a key part of DWQR's role and DWQR undertakes a number of inspections across Scotland every year, auditing against regulatory requirements and industry best practice. This enables DWQR to monitor Scottish Water's performance and hear about issues first hand from operational staff as well as comparing practices in different parts of Scotland. Where deficiencies are noted, DWQR makes recommendations, the resolution of which is tracked. Elements of best practice are also noted. In 2013 DWQR undertook the following inspections:

- 7 water treatment works
- 10 treated water storage points
- Scottish Water's complaints procedure
- Scottish Water's procurement processes

The treatment works inspections demonstrated that treatment processes were generally being run effectively by highly competent staff. A number of issues were identified. The more commonly occurring themes included the online monitoring of water quality, SCADA systems, and identification of risk.

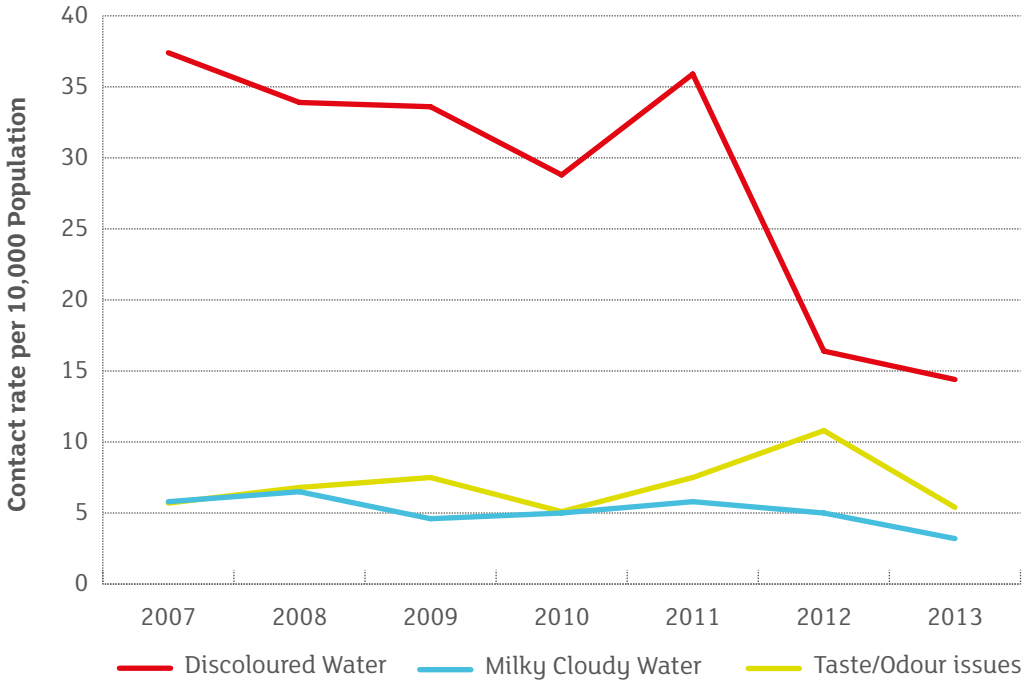
Inspection of storage points around the country highlighted a number of site-specific issues that have been addressed by Scottish Water. The procurement of chemicals and services affecting water quality was audited, with robust processes found to be in place.

52 recommendations were made by DWQR during inspections of WTW.

CONSUMER CONTACTS

Scottish Water had 12,212 consumer contacts relating to water quality equating to a contact rate of 24.4 per 10,000 population. The equivalent contact rate in England and Wales was 19 contacts per 10,000 population. This is a reduction in overall call volumes of 32.3%, when compared to the number of calls during 2012. This is a considerable and welcome trend, which it is to be hoped can be continued. There is a reduction in the numbers in all categories of call but the largest segment continues to be consumers experiencing discoloured water, although this too shows a downward trend. Over 40% of all taste and odour complaints are about chlorine, the level of complaints is 2.2 per 10,000, which is the lowest seen in the past seven years.

Trend in key contact categories – contacts per 10,000 population

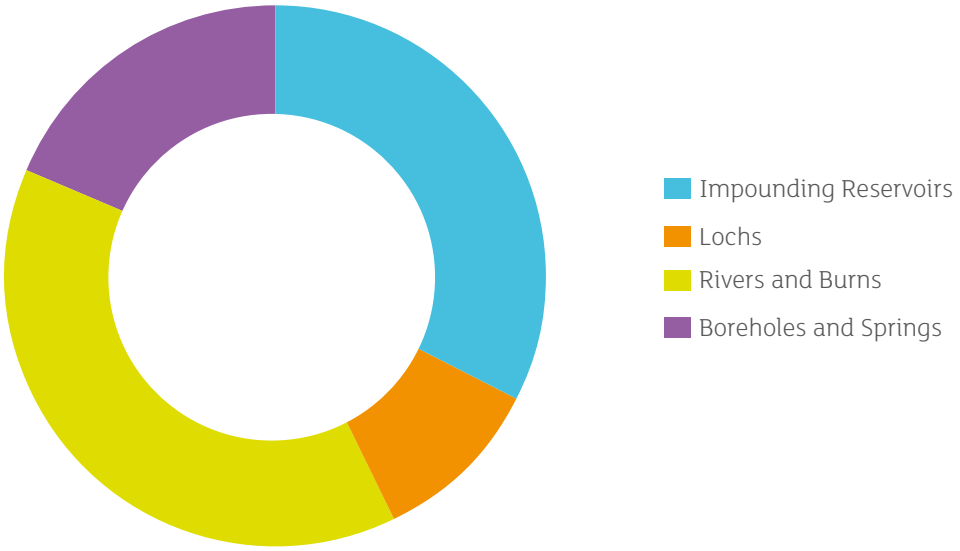


SECTION 1 CATCHMENT

Scotland's water resources used for public water supplies are generally of very high quality. There are four types of sources used for public water supplies, as depicted in **Fig 1.0**. Impounding reservoirs are man-made, formed by the construction of a dam across a river valley. These make up roughly a third of Scotland's water resources. Just over another third comes from taking water directly from rivers and burns. Natural lochs make up a further 11% of total resources with the remainder coming from boreholes and naturally occurring springs.

The groundwater taken from boreholes is generally more consistent in quality and requires less intensive treatment than water taken from a surface water supply. Impounding reservoirs and natural lochs tend to be the next best quality as the process of storing the water in large volumes has the benefit of dampening out the fluctuations in quality of the waters. Water taken from rivers and burns is generally the poorest quality out of the types of sources since it is the most affected by changing weather patterns and land management practices.

Fig. 1.0_ Raw water sources



1.1_ POTENTIAL CONTAMINANTS WITHIN CATCHMENTS

Scottish Water is required to produce Water Safety Plans (WSPs) for all of its water supplies which consider the risks to drinking water quality from source through treatment and distribution to consumers' taps. These plans should take into account any risks presented by the quality of the source water and identify ways to mitigate them.

Water quality can vary considerably between sources but can also vary with time, especially during severe weather.

Scottish Water must therefore ensure that its treatment works are sufficiently robust in order to consistently produce clean, safe drinking water, regardless of the variability in raw water quality encountered at those works. Scottish Water must also routinely sample the water sources it uses for drinking water purposes.

Some substances, such as manganese, are naturally occurring, while others like nitrate and pesticides are present because of land based activity such as agriculture, leisure and forestry. It can be expensive to remove nitrate and pesticides from our drinking water – fortunately these substances are not present in many of Scottish Water's raw water supplies because 374 out of the 458 sources in Scotland (about 82%) are derived from upland catchments where agricultural activity is limited.

It is worth highlighting the large amounts of naturally occurring iron and manganese in some raw waters and the importance of adequate treatment to bring these substances down to acceptable levels. To give an idea of the scale of the issue, approximately 38% of samples taken from sources before treatment have higher than acceptable levels of iron and the equivalent figure for manganese is about 16%.

The greatest risk to public health is associated with the consumption of drinking water that is contaminated with human and animal faecal material. Many raw water sources contain significant levels of bacteria, which serves to demonstrate the importance of adequate treatment, especially disinfection, in order to ensure our water is safe to drink.

Many micro-organisms are naturally present in the environment. Some, such as *E.coli*, are present in large numbers in the gut of all warm-blooded animals, and when detected in water samples indicate that there has been faecal contamination of the supply. Rain washes micro-organisms off the land and into drinking water sources, but well designed, operated and maintained disinfection systems at water treatment works ensure that microbiological contamination is removed.

Cryptosporidium is a microscopic protozoan parasite that can also contaminate water resources. *Cryptosporidium* oocysts can survive in the environment for long periods. A large number of animals, such as cattle, sheep and deer are known to harbour the parasite. The parasite was first discovered to infect humans in 1976, and waterborne transmission was confirmed for the first time in 1984.

The *Cryptosporidium* (Scottish Water) Directions 2003 require Scottish Water to sample some drinking water sources for *Cryptosporidium*. Not all sources are sampled as this depends on the volume of water being supplied and the catchment risk assessment, which take into account such things as density and type of animals on the catchment, agricultural practices and the type of water source. In 2013, all raw water sources sampled for *Cryptosporidium* contained it in at least one sample. Water treatment works are expected to have treatment processes suitable for removing *Cryptosporidium*, and treated water supplies are also monitored for the parasite.

1.2_ CATCHMENT MANAGEMENT

Ultimately, reducing the risk to the public from *Cryptosporidium* and other contaminants in drinking water is as much about reducing the occurrence in the catchment as it is about improving treatment. Improved liaison between Scottish Water and stakeholders such as the Scottish Environment Protection Agency (SEPA), livestock farmers and landowners should result in a more joined-up approach to the protection of drinking water sources in line with the European Union's Water Framework Directive.

In its Final Determination for the strategic review of charges for 2010-2015, the Water Industry Commission for Scotland allowed Scottish Water to invest £3 million per year to identify and operate sustainable land management (SLM) measures in water catchments. Six catchments were identified in 2010 in agreement with DWQR and SEPA. They are as follows:

1. Lochgoin and Craigendunton – source for Amlaird water treatment works (WTW) – supplies North Kilmarnock, Galston and Greenholm.

2. River Ugie – source for Forehill WTW – supplies Peterhead, Cruden Bay, Ellon, St Combs and St Fergus.

3. River Deveron – source for Turriff WTW – supplies Turriff, Fraserburgh, Aberchirder, Cullen and Portsoy.

4. Lintrathen Reservoir – source for Clatto WTW – supplies Dundee, Carse of Gowrie, Monifieth and Carnoustie.

5. Loch Ascog – source for Ascog WTW – supplies Central Rothesay and East Bute.

6. Dumfries Basin Aquifer – source for Cargen and Terregles WTWs – Cargen supplies New Abbey, Carsethorn and Kirkhouse South of Dumfries. Terregles supplies Dumfries.

These catchments were chosen on the basis that there was potential to influence and change current land management practice to mitigate the impact of potentially polluting contaminants (for example colour, pesticides, phosphorous and nitrates) at source, thereby avoiding the costs of installing expensive treatment to take these contaminants out at the water treatment works. In 2011 Scottish Water worked with SEPA, land managers and farmers to better understand what is happening in each of the catchments in order to determine the effectiveness of SLM in reducing the level of purification treatment required in the production of drinking water.

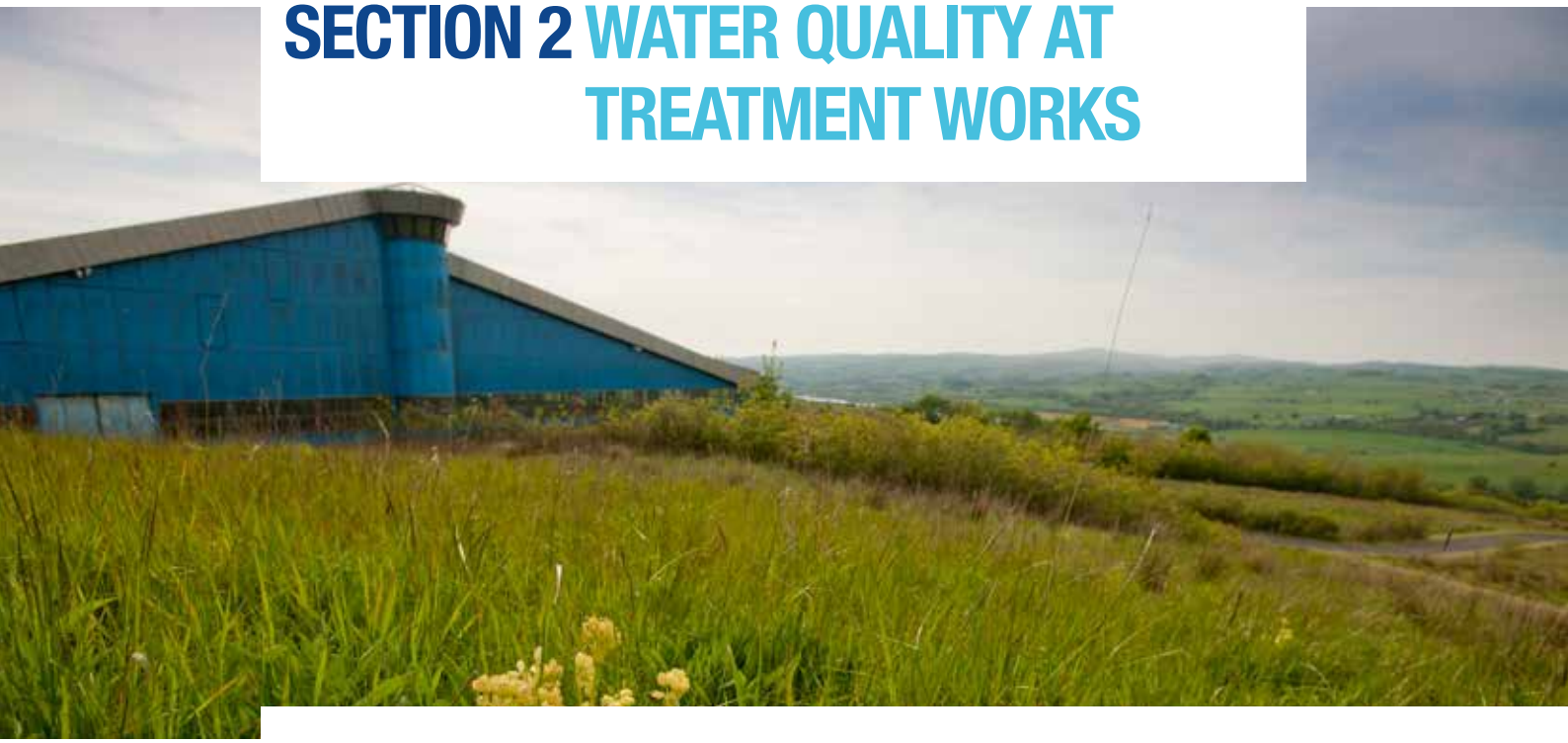
During 2012, Scottish Water implemented a programme of detailed sampling in these catchments to better understand the sources and pathways of diffuse pollution. This provided them with a starting point to measure the success of any measures introduced to improve the quality of the source water.

Scottish Water also developed a Sustainable Land Management Incentive Scheme in 2012 to help land managers finance measures aimed at reducing the level of diffuse pollution, for example from the application of pesticides. There have been some applicants for this scheme, but it is too early to say what impact, if any, these measures will have on water quality.

In 2013, Scottish Water promoted their incentive scheme in all six catchments. This included evening meetings, stands at livestock markets and agricultural shows and visits to farms. In autumn 2013, Scottish Water launched a pesticide support service for the Ugie and Deveron catchments which is a free service for consultants, contractors and land managers to obtain weather and water quality information.

Scottish Water continues to work in close partnership with a number of different agencies, including SEPA, to deliver SLM measures with the aim of ensuring that drinking water sources are protected at the same time as keeping customers' charges as low as possible with the added benefit of improving the environment.

SECTION 2 WATER QUALITY AT TREATMENT WORKS



Scottish Water has 252 water treatment works (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 plants that supply small communities consisting of a few properties. Regardless of size, Scottish Water is expected to ensure that its works are capable of treating the range of raw water quality which may be found in source waters.

Scottish Water uses water safety plans to assess risks to raw water quality and the ability of treatment works to deal with these. Where risks are identified that are not adequately addressed by the current treatment process, Scottish Water should decide how these risks are best managed. This may involve promoting the site for capital investment, or addressing the risks via operational means.

All natural water requires treatment, including disinfection, before it can be considered safe to drink. It is vital that water is thoroughly treated first in order for the disinfection process to be effective. In order to prepare water for disinfection, particulate material needs to be removed along with naturally occurring organic compounds in the water. These include the compounds that cause water to be coloured and can react with chlorine to form trihalomethanes (THMs) and other by-products later in the process. Treatment of surface waters commonly consists of a flocculation stage to collect particulate material together, followed by a clarification stage such as sedimentation or flotation. Water is then filtered to remove any remaining particulate and coagulant material to ensure that water is as clean as possible prior to disinfection with chlorine.

The majority of regulatory analysis takes place on samples collected from consumers' taps, but some important sampling also takes place on water as it leaves each treatment works. The number of samples which need to be collected each year varies depending on the volume of water supplied by the treatment works.

2.1_ MICROBIOLOGICAL QUALITY AT TREATMENT WORKS

Disinfection is used to remove pathogens from the water so that it is safe to drink. Chlorine, or compounds based on chlorine, are an effective means of achieving disinfection and have been used for this purpose in drinking water for over one hundred years. Scottish Water is expected to add sufficient chlorine to kill pathogens and leave a small residual amount to keep the water safe as it travels through distribution pipework to consumers. Although it is normal for consumers to be able to detect a slight taste and smell of chlorine in water from their taps, Scottish Water needs to control chlorine concentrations carefully to ensure that no more is used than necessary.

Coliforms and *E.coli* are two parameters measured in water leaving treatment works in order to verify that disinfection has been successful. Coliforms are a group of bacteria, of which *E.coli* is one species, that are found commonly in the environment. Not all coliforms cause illness, but they are used as indicators that disinfection has not been successful or that water may have become contaminated after treatment. While some detections of coliforms are probably due to issues associated with sampling, such as the condition of the tap, all failures must be fully investigated by Scottish Water and reported to DWQR, the local NHS board and local authority. *E.coli* is detected less frequently than coliforms, however this organism does have the potential to cause illness. It originates from faecal material, indicating the possibility of serious contamination that must be investigated immediately and the risk to consumers assessed.

When investigating sample failures at treatment works, Scottish Water should be considering a number of factors, such as changes in the quality of the incoming raw water, issues or unexpected changes in the treatment process, the circumstances of sampling, including the condition of the sample line and sample tap, and evidence from samples taken downstream in the distribution system. Consideration should be given to taking additional samples, including between stages of the treatment process to establish whether there is a genuine problem and where this might be. Data for on-line monitoring can also yield very useful information on quality around the time of the failure. Last year Scottish Water increased the depth of investigation it undertakes in response to microbiological failures and this has been helpful in understanding and resolving the causes underlying many failures.

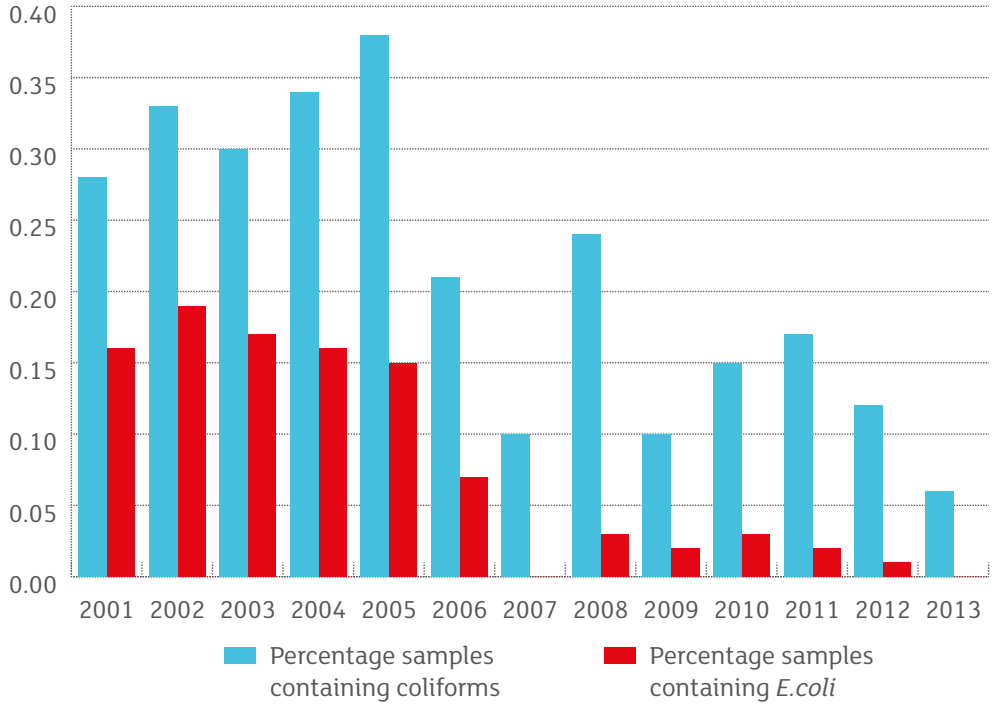
Colony counts are also monitored at water treatment works, although there is no numerical standard for these. They are a useful indicator of microbiological activity, and again provide a measure of the effectiveness of the disinfection process, especially when trended over time.

Table 2.1a_ Summary of microbiological tests at treatment works

COLIFORM BACTERIA	2013	2012	2011	2010	2009	2008
Number of tests	26,888	27,305	28,792	29,097	30,997	31,488
Number containing coliforms	17	33	49	44	30	76
Percentage containing coliforms	0.06	0.12	0.17	0.15	0.1	0.24
E. COLI						
Number of tests	26,888	27,304	28,794	29,097	30,997	31,487
Number containing *E.coli*	1	3	5	8	6	10
Percentage containing *E.coli*	0.00	0.01	0.02	0.03	0.02	0.03

Table 2.1a and **Figure 2.1a** show the microbiological results at treatment works for recent years. Of the 26,888 samples taken, only 17 contained coliforms and 1 contained *E.coli*. This represents a significant improvement on past years with detections of both parameters around half those in 2012. As well as working to improve and optimise treatment processes, Scottish Water has invested heavily in upgraded sampling facilities and it is likely that these factors in combination are behind the improved results.

Fig 2.1a_ Tests failing microbiological standards



Most of the coliform detections involved a single coliform, although one sample, at Storr Forest on Skye (North region) in September, contained 20 coliforms and the only *E. coli* detection of the year at a treatment works. This result was associated with a failure of the disinfection process and was declared an incident and investigated by DWQR, and is described in more detail in section 2.5.

Seven of the samples containing coliforms were from Scottish Water's West region. Only two treatment works produced more than one failing sample during the year – these were Muirdykes in Renfrewshire (West region) and Lomond Hills in Fife (East region). DWQR has requested that Scottish Water confirms the efficacy of the disinfection process at all of its treatment works.

Of the total of 18 microbiological failures, half occurred during the three Summer months of June, July and August. This is not unexpected as increased temperatures support microbiological growth, however this effect is well known and should be anticipated by Scottish Water, with chlorine concentrations closely monitored and adjusted seasonally where necessary.

CLARIFICATION PROCESS AT AFTON WTW, AYRSHIRE

2.2_ CHEMICAL QUALITY AT TREATMENT WORKS

Water is tested for two chemical parameters in samples taken from treatment works. These are summarised in Tables 2.2a and 2.2b. 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. For the second year running, no exceedences of the standard for nitrite were recorded at water treatment works, the culmination of Scottish Water's efforts to actively control the chloramination process.

Table 2.2a_ Summary of nitrite tests on samples taken at water treatment works

NITRITE	2013	2012	2011	2010	2009	2008
Number of tests	2,824	2,790	2,910	2,859	2,993	3,028
Number of tests exceeding standard	0	0	1	3	4	2
Percentage of tests exceeding standard	0.00	0.00	0.03	0.10	0.13	0.07
Number of treatment works not meeting regulatory requirements	0	0	1	2	3	2
% of treatment works not meeting regulatory requirements	0.00	0.00	0.38	0.74	1.06	0.68

Turbidity is a measure of the extent to which particulate matter in the water scatters light – effectively how cloudy the water appears. Turbid waters cannot be properly disinfected, hence a treatment standard of 1 NTU has been set in the Regulations. A robust, well operated treatment process should achieve this stand ard with ease. In 2013 there were 12 exceedences of the standard for turbidity, marginally more than in 2012. It is possible that a number of these are due to the effects of lime dosed for pH correction after disinfection, but Scottish Water needs to ensure that this effect is minimised by good mixing and careful siting of the final water sample tap.

Table 2.2b_ Summary of turbidity tests on samples taken at water treatment works

TURBIDITY	2013	2012	2011	2010	2009	2008
Number of tests	7,298	7,331	7,745	7,855	8,123	8,250
Number of tests exceeding standard	12	10	24	28	26	33
Percentage of tests exceeding standard	0.16	0.14	0.31	0.36	0.32	0.4
Number of treatment works not meeting regulatory requirements	10	8	18	2	20	17
% of treatment works not meeting regulatory requirements	3.97	3.00	6.79	8.49	7.04	5.78

Two treatment works – Clatto in Dundee (East region) and Earlish at Uig on Skye (North region) recorded two turbidity failures during 2013. These were all attributed to unrepresentative samples obtained from the sample point, illustrating the point above.

2.3_ *CRYPTOSPORIDIUM* AT TREATMENT WORKS

Cryptosporidium is a microscopic protozoan parasite that can live in the gut of humans and other animals. There are a number of species of *Cryptosporidium*, and not all are thought to be infectious to humans. All species form bodies known as oocysts which can survive in the environment for long periods. Once ingested, *Cryptosporidium* multiplies rapidly in the gut and oocysts are excreted in very large numbers, completing the life-cycle of the organism. In humans, infection can cause stomach cramps and diarrhoea and, in extreme cases, can be fatal to the immuno-compromised or to the very young or old. Most cases of *Cryptosporidiosis* in the UK are acquired abroad through ingestion of contaminated food or water, or in the UK through swimming or close contact with 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. Standard chlorine disinfection is not generally effective against oocysts, so removal using a physical filter barrier is the best option, however the small size of oocysts means that these must be well optimised. The *Cryptosporidium* (Scottish Water) Directions 2003 define the measures Scottish Water is expected to take to prevent oocysts from contaminating drinking water supplies. Under the Directions, all Scottish Water's treatment works should have at least 12 final water samples taken and tested for *Cryptosporidium* during the year, with the exact sample frequency determined by the risk assessment process.

Table 2.2c_ Summary of sample data for *Cryptosporidium* in final water

CRYPTOSPORIDIUM	2013	*2012*	*2011*	*2010*	*2009*	*2008*
Number of tests	8,300	*8,739*	*8,919*	*9,386*	*10,386*	*11,002*
Number of samples containing *Cryptosporidium* oocysts	118	*217*	*378*	*312*	*409*	*471*
% of samples containing *Cryptosporidium* oocysts	1.42	*2.48*	*4.24*	*3.32*	*3.94*	*4.28*
Number of treatment works sampled for *Cryptosporidium*	252	*267*	*264*	*270*	*281*	*292*
Number of treatment works with one or more samples containing oocysts	43	*77*	*91*	*88*	*93*	*87*
% of treatment works with one or more samples containing oocysts	17.46	*28.84*	*34.47*	*32.59*	*33.1*	*29.79*

Table 2.2c shows the results of tests for *Cryptosporidium* in samples taken at water treatment works in the context of previous years. Out of 8,300 samples from 252 treatment works, 118 contained oocysts. The number of treatment works from which at least one positive sample was taken was 43 in 2013. Both of these figures are a considerable improvement on 2012, but still represent an unacceptably large number of positive samples indicating that there are a number of treatment works where a consistently effective barrier to *Cryptosporidium* does not appear to be in place.

One striking characteristic of the *Cryptosporidium* data in 2013 is that whereas in 2012, 14 treatment works detected oocysts in more than 20% of samples, in 2013 only one site reported this frequency of detection – Storr Forest on Skye. To some extent, this serves to demonstrate the variability of the occurrence of *Cryptosporidium* from one year to the next, but it also undoubtedly reflects an improving picture and the benefits of investment and efforts on optimisation. Many of the treatment works that featured in last year's list of works with greater than 20% of works containing *Cryptosporidium* have been removed from service or had additional treatment installed. Storr Forest treatment works does not have a physical filtration barrier and installation of a membrane treatment process is planned for 2015. As a temporary measure Scottish Water is installing cartridge filters to reduce the risk to public health due to the lack of effective treatment at this site until such a time as the permanent solution is installed.

Fig. 2.2a_ Treatment types at WTW recording at least one *Cryptosporidium* detection

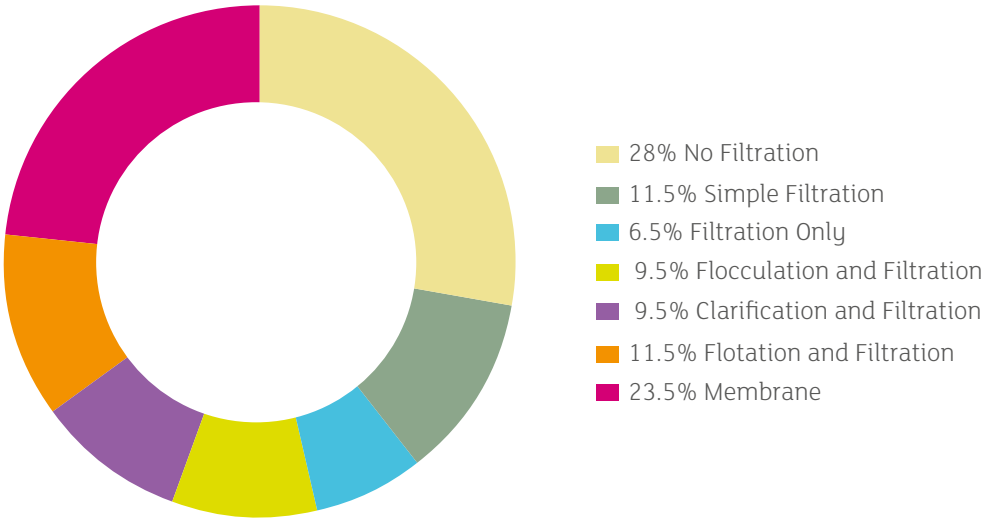
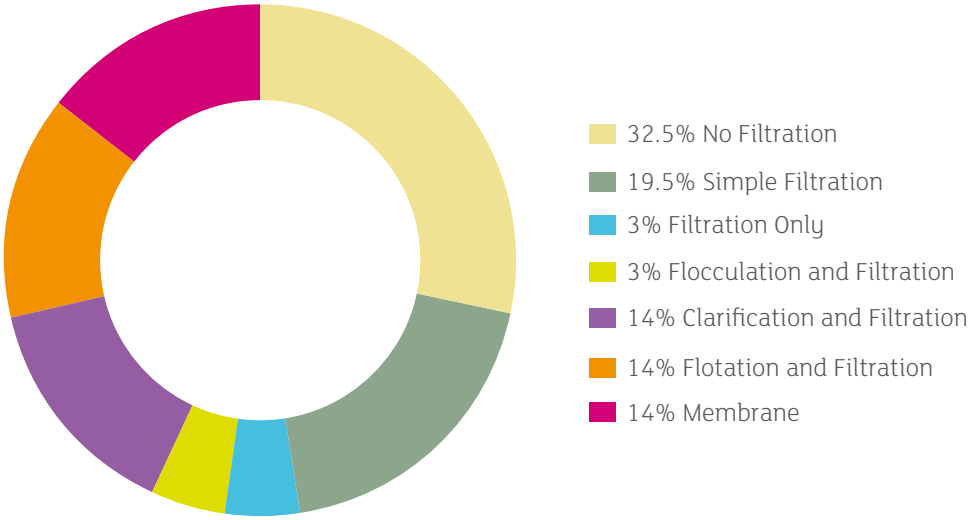


Fig 2.2b_ Treatment types at WTW recording 2 or more *Cryptosporidium* detections



Figures 2.2a and **2.2b** show the breakdown of treatment types at sites where *Cryptosporidium* was detected in 2013. Sites with no filtration or filtration alone could not be expected to provide a robust barrier to *Cryptosporidium*, therefore it is unsurprising that oocysts are being detected at these sites. It is acknowledged that some of these sites will have been replaced or upgraded during the course of the year, but Scottish Water needs to continue to assess whether *Cryptosporidium* risks are being adequately addressed by the other sites and ensure action is taken via the Drinking Water Safety Planning process. It is of some concern that around 50% of sites where oocysts were detected have a robust treatment processs that should effectively prevent oocysts from reaching the final water. This is especially true of membrane filtration which should provide an almost absolute barrier. DWQR is of the opinion that Scottish Water should be doing more to ensure all such sites are operated and maintained correctly in accordance with the reports from the groups of experts chaired by Badenoch and Bouchier, and DWQR has made it clear that all future detections of *Cryptosporidium* should be investigated rigorously making reference to the best practice contained within these documents.

Scottish Water has sought independent advice on the performance of several of its Aberdeenshire treatment works, but DWQR remains concerned that within Scottish Water there is the perception of a degree of inevitability about low levels of *Cryptosporidium* being present in final water under certain conditions. It is imperative that greater importance is attached to sequences of low level *Cryptosporidium* detections and DWQR considers there to be a need for a wider appreciation throughout the organisation of the importance of maintaining treatment elements and processes in an optimal state to address the *Cryptosporidium* risk.

Fig 2.2c_ Number of treatment works recording *Cryptosporidium* over multiple years to 2013

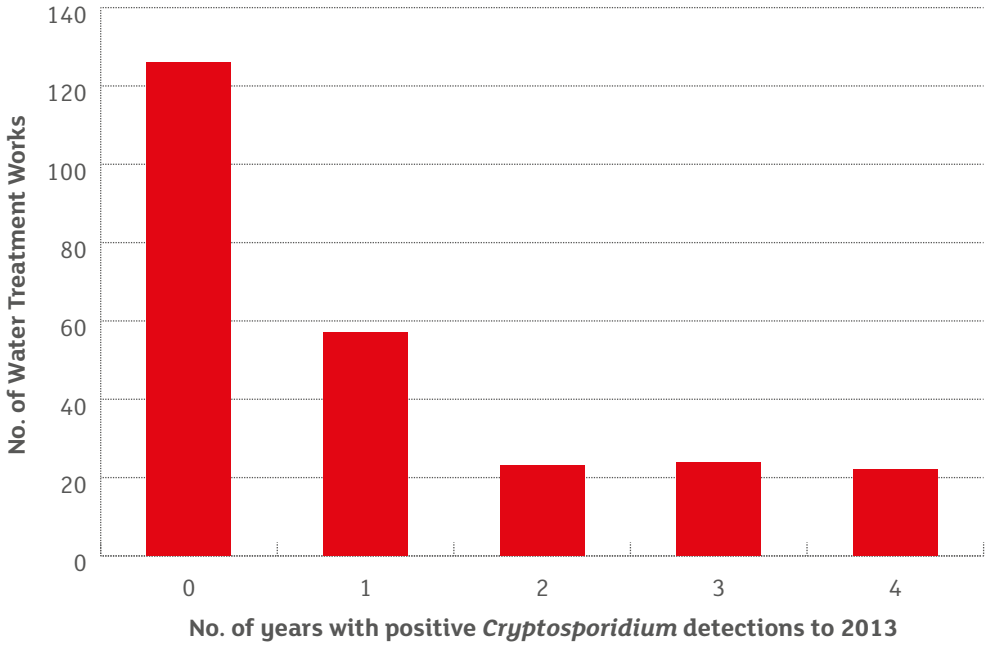


Fig 2.2c shows the number of treatment works which have recorded *Cryptosporidium* multiple times over the past four years. The majority of treatment works have recorded no samples containing oocysts, but a worrying 21 treatment works recorded oocysts in each of the four years. Many of these works have minimal treatment, and this is being addressed by Scottish Water, but a number have more robust treatment processes and should not be persistently recording *Cryptosporidium*. Three large treatment works with a full coagulation and filtration process appear on the list with oocysts in each of the four years: Rosebery in Midlothian and Forehill and Turriff in Aberdeenshire. Equally of concern, Tomnavoulin and Spey Badentinan in Moray and Bunessan on Mull appear, with all these sites having membrane treatment. Scottish Water is working to ensure that existing processes are maintained correctly, and this must bring about an improvement without delay.

2.4_ AUDIT AND INSPECTION AT TREATMENT WORKS

An important part of DWQR's scrutiny role is to audit and inspect activities undertaken by Scottish Water. During an inspection of water treatment works, DWQR looks at all aspects of the treatment process relevant to water quality from raw water intakes to final water storage.

Auditing takes place against the requirements of the Regulations and *Cryptosporidium* Directions, as well as water industry best practice. Where issues are noted these are recorded as recommendations that are tracked and followed up. If common themes are identified, these are progressed centrally with senior Scottish Water staff. Elements of best practice are also highlighted when these are observed. Scottish Water co-operates fully during the technical inspection process.

In 2013, seven water treatment works were inspected, selected on a risk basis using analytical data. **Table 2.4a** shows the inspections that were undertaken during the year and the number of recommendations made.

Table 2.4a_ Technical inspections of water treatment works during 2013

LOCATION	DATE	REASON FOR AUDIT	NO. OF RECOMMENDATIONS
Afton (Ayrshire)	Feb 2013	Risk based	8
Fife Boreholes (Fife / P&K)	Mar 2013	Risk based	9
Glenfarg (Fife)	Mar 2013	Risk based	6
Lochaline (Highland)	Aug 2013	Risk based	6
Glenconvinth (Highland)	Sep 2013	Risk based	3
Fort William (Highland)	Oct 2013	Risk based	9
Daer (S. Lanarkshire)	Nov 2013	Risk based	11

As always, Scottish Water staff operated their plants with a high degree of professionalism and pride and many examples of best practice were noted. As the inspections were risk or incident triggered, particular attention was paid to the deficiency that had triggered the audit, whether this was asset based or procedural. In most cases, DWQR was satisfied that Scottish Water had, or was in the process of, fully investigating the issue and implementing a plan to resolve it. It was disappointing to note that in one instance a recommendation made during a DWQR in audit in 2005 had still not been actioned. DWQR now monitors completion of actions arising from inspections and incidents closely to ensure completion.

A LARGE MEMBRANE TREATMENT WORKS

Most sites visited were maintained and operated to a high standard, but notable common issues that were identified across several treatment works include:

- A lack of adequate monitoring of one or more quality parameters, despite an identified risk being present;
- Inadequate maintenance and calibration of quality monitors;
- Deficiencies in the recording of key quality parameters that could have a bearing on plant operation and resilience;
- Inadequate assessment of and response to important risks to water quality;
- Shortcomings with some site SCADA systems that inhibited the ability of operators to clearly trend water quality parameters, especially turbidity.

Summaries of all inspections undertaken are published on the DWQR website **www.dwqr.org.uk**.

2.5_ EVENTS AND INCIDENTS AT TREATMENT WORKS

Scottish Water is required to tell the DWQR about all events that could affect water quality or cause concern to consumers. This includes all regulatory sample failures that are significant or unexpected and any failure of a treatment process. Each event is reviewed and the most serious classified as incidents. Where further information is required a full report will be requested from Scottish Water. Incidents are fully investigated and a written assessment produced, making recommendations where appropriate. Incident assessments are published on the DWQR website. For the most serious incidents, enforcement action or even prosecution may be considered.

In 2013, 419 events were reported to the DWQR, of which 124 occurred at water treatment works. A new mechanism of reporting implemented by Scottish Water in 2013 makes it difficult to compare this number directly with previous years, but it is likely that this represents a significant reduction, which is welcomed. In 2013, DWQR began a new classification process for events, based on an assessment of risk and the potential impact on public confidence in the water supply. Using this method, the majority of events (274) were classified as not significant by DWQR, with only 22 events assessed as either serious or significant in total, meaning that they were declared incidents. The breakdown of classifications at WTW is shown in the pie chart in **Figure 2.5a**.

Fig 2.5a_ DWQR classification of events at Scottish Water treatment works in 2013

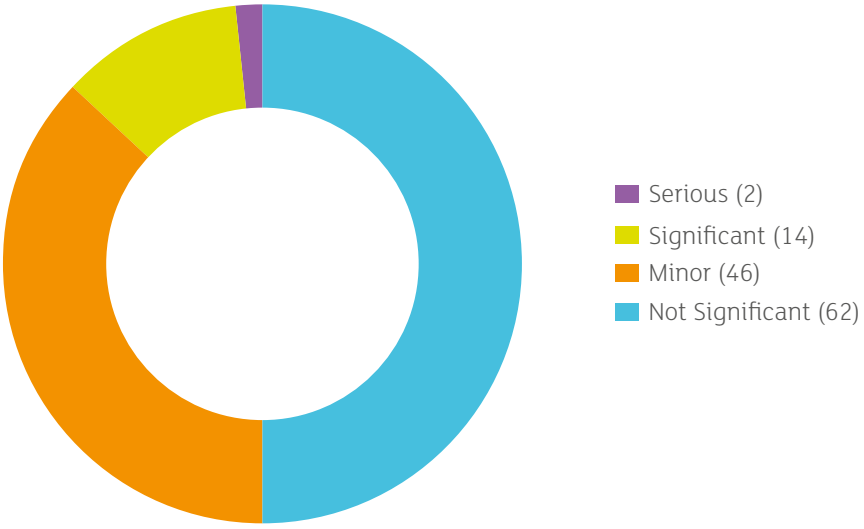
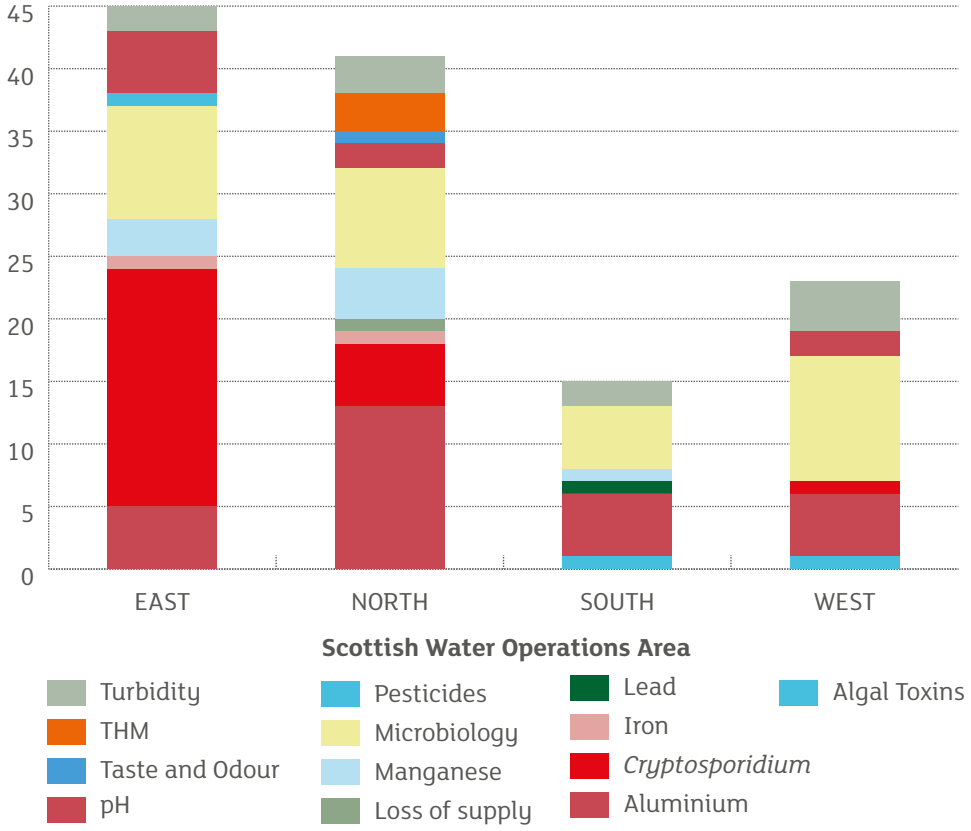


Fig 2.5b_ The nature of events at water treatment works in 2013



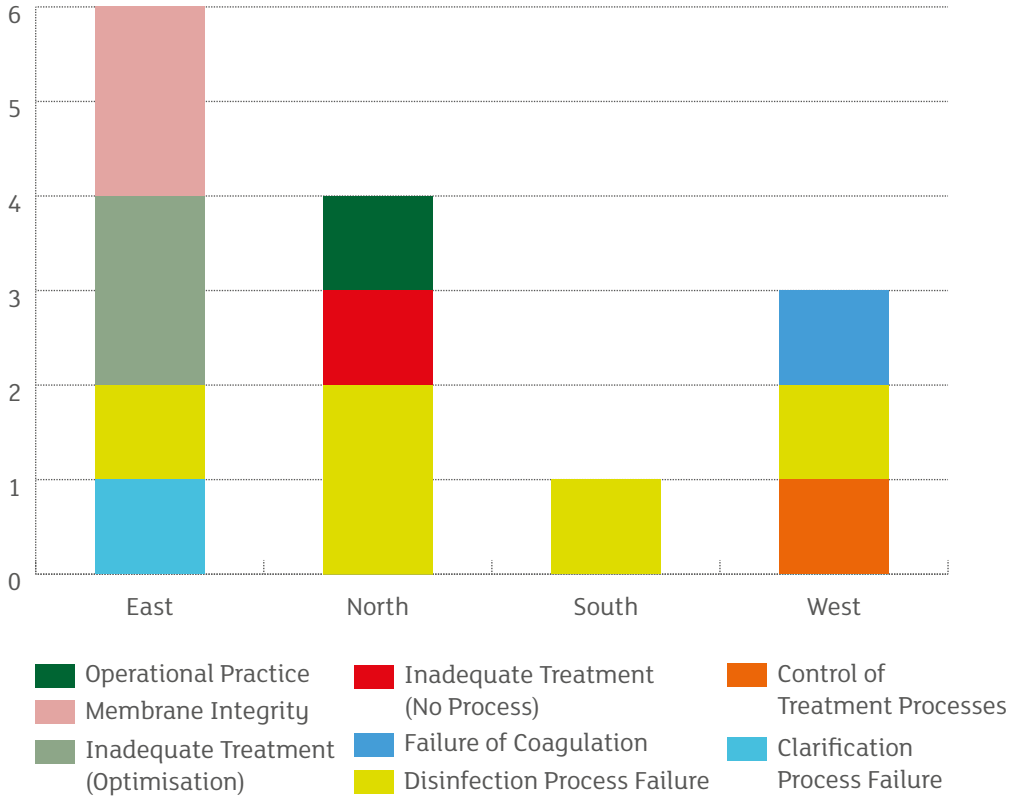
Craighead WTW (Aberdeenshire), Newmore WTW (Highland) and Bayhead WTW (Western Isles) were the treatment works that generated the most events in 2014. The five Craighead events were all for different parameters, reflecting the asset's poor resilience as highlighted in DWQR's inspection report of March 2014. Two of the four Newmore events were due to aluminium, providing evidence that the Actiflo ballasted clarification process there, while usually robust, can be liable to periods of reduced performance and Scottish Water needs to review the resilience of this process. Three of the four events at Bayhead involved ammonium and followed the commissioning of a new chloramination process at the site. DWQR declared these failures, in combination, to be an incident and has published an assessment. **Fig 2.5b** shows the nature of events at water treatment works during the year.

The largest single cause of events was the disinfection process, which generated 24 events at treatment works. Adequate disinfection is absolutely vital to ensuring the safety of drinking water. The number of events caused by failings in this process lends support to the need for DWQR's requirements as set out in Information Letter 2013/3 that Scottish Water produce site specific disinfection strategies for all of its treatment works.

The second most common event cause was "inadequate treatment" – the classification used by DWQR to describe situations where there was either no treatment process at the site which was capable of preventing the event, or where the nature of a process fell short of that needed to provide an adequate response. DWQR expects Scottish Water to use robust methods, including drinking water safety plans, to adequately assess potential risks at treatment works presented by raw water quality or other factors and ensure that the investment process or operational management is used efficiently to mitigate these in a timely manner.

Failures of the coagulation process accounted for 21 events, representing an improvement on previous years but also demonstrating that there is more that Scottish Water can do to ensure all treatment process are resilient and able to cope with changes in raw water quality.

Figure 2.5c_ Nature of incidents at WTW



Annex A lists incidents declared in 2013. Fourteen occurred at treatment works and this accounts for 63% of all incidents. This is indicative of the potential of events occurring at treatment works to affect a large population and have serious implications for water quality. **Fig 2.5c** shows the nature of incidents occurring at treatment works. As last year, most of these involved issues around the disinfection process, highlighting the continued need for Scottish Water to work to fully understand the process and associated risks at each site, seeking opportunities to improve its resilience. Six of the other incidents concerned *Cryptosporidium* detections which were attributed to a number of causes including inadequate treatment and lack of membrane integrity. *Cryptosporidium* has been discussed earlier in this report, and is concerning, especially as many detections are occurring at treatment works that should have a robust process to remove oocysts.

A full list of incidents that occurred at water treatment works during 2013 is provided in Annex A. Several key incidents at treatment works are described in more detail below:

Tomnavoulin WTW, Moray – *Cryptosporidium* and Failure of Membrane Integrity – June 2013

Samples taken by Scottish Water for the purpose of demonstrating the integrity of the membrane treatment process indicated that there may be a problem. Shortly after this, *Cryptosporidium* oocysts were detected in the supply. This followed problems with *Cryptosporidium* at the works the previous year, which had resulted in a boil water notice. Following the problem in 2012 Scottish Water believed that the complete replacement of the membrane unit had resolved any potential issues with the process. The repeat of this problem in 2013 has required further membrane replacement and Scottish Water have been investigating all aspects of the process and catchment in considerable detail in order to provide a lasting solution to the issue and provide confidence in the treatment process. This has involved working closely with the construction engineers and membrane manufacturers, although a definitive cause has not been forthcoming. DWQR has visited the site and has been engaged in ongoing dialogue with Scottish Water concerning the resilience offered by the plant. Although the majority of treated water samples taken for *Cryptosporidium* have not contained oocysts, occasional single detections have continued. DWQR is continuing to seek a prompt, lasting, solution to ensure this water treatment works is sufficiently robust to deal with the significant challenge that the raw water quality presents, and that consumers in Tomnavoulin have a safe and reliable supply of drinking water.

Bradan WTW, Ayrshire – Failure of Disinfection Process – June 2013

Bradan water treatment works suffered a failure of the disinfection process on 19 June 2013 when chlorine dosing at the site failed for nearly three hours. It had appeared that the chlorine gas drum was empty, so emergency chlorine dosing was undertaken at the clear water tank. Further investigation established that an isolation valve from the standby drum was in a closed position and the drum was in fact full. A check was carried out on the chlorine dosing system and the closed valve was opened to restore the disinfection system to normal. Once this was seen to be in order, the emergency dosing to the clear water tank, which prevented any impact on the quality of water supplied to consumers, was stopped.

It was determined that, following maintenance work on the chlorine dosing system, the valve had been left in a closed position and correct procedures to test the system under pressure had not been carried out. Had the step been taken, the closed valve would have been identified. A further proceduralised check to ensure the system was fully operational was also not completed. DWQR visited the site to speak to staff and considers that the two failures of procedures concerning this most important element of water treatment are a serious matter. Scottish Water has implemented various measures to prevent a recurrence.

Storr Forest WTW, Skye – *Cryptosporidium* – September 2013
Cryptosporidium was detected in large quantities in a sample taken from this supply on 21 August 2013. Further detections continued at lower concentrations through the autumn until clear samples were eventually obtained in November. Scottish Water sought advice from NHS Highland throughout the incident.

Storr Forest is currently a very basic treatment works consisting of disinfection of spring water, although investment is planned. It is vulnerable to changes in raw water quality as there is no filtration process and there has been a history of intermittent *Cryptosporidium* previously in the supply. Recently an area of trees around the springs has been felled, and it is possible that this caused some disturbance to the springs or to the local wildlife.

Following the *Cryptosporidium* detections Scottish Water inspected the springs and identified a comprehensive list of actions that will be taken to further improve the source protection and visibility of quality at individual springs. DWQR considers that these actions are helpful, but that the current treatment at the site is inadequate for the risks present and the new membrane plant planned for the supply should be constructed as quickly as possible. Following concern expressed by both Highland Health Board and DWQR, Scottish Water has agreed to install temporary filtration equipment at the site and this should be operational by Summer 2014, greatly reducing the risk. The full treatment plant should be constructed and operational in 2015. DWQR visited the site, including each of the springs, in February 2014.

2.6_ INVESTMENT AT TREATMENT WORKS

Scottish Water has been directed by Scottish Ministers to undertake a number of different projects to improve and protect drinking water quality across Scotland during the period of 1 April 2010 to 31 March 2015. These projects include the establishment of a Water Safety Plan, as promoted by the World Health Organisation, for all public water supplies in Scotland. These plans should consider the risks to drinking water quality from source through treatment and distribution to customers' taps. Scottish Water was directed to complete half of these plans during the previous investment period (2006-2010) with the remainder to be completed in the current period (2010-2015). Scottish Water managed to complete this task early during 2011 allowing the water company since then to concentrate on analysing all of the risks identified in these plans and to make a start on deciding whether or not improvement programmes are required to mitigate these risks in the next investment period beyond 2015. Progress was made with this task during 2012, but it soon became apparent that investment was still required at certain water treatment works to deal with actual non-compliance with some key parameters first before investing to reduce the risks of non-compliances. By the end of 2013, Scottish Water had produced a list of projects for inclusion in the next investment period beyond 2015 which was agreed with DWQR.

SECTION 3 DISTRIBUTION SYSTEMS

The public water supply is carried to consumers through a network of water mains and storage tanks and this is known as the distribution system. Depending on the size and location of communities served and the size of the treatment works, these can be very large systems covering an extensive geographical area or can consist of one or two short lengths of small diameter pipes. The pipeline materials, the condition of the pipes and condition of storage tanks can have a significant effect on the quality of water passing through them. Cast iron mains can corrode and add particles of iron to the water and deposits of iron, manganese or aluminium can accumulate in the system, perhaps from inefficient treatment processes, long since replaced. These deposits can be disturbed by changes in the flow causing discoloured supplies. If the integrity of the distribution system is breached, or re-growth of microbiological organisms occurs, bacterial contamination can be a problem. In practice, such problems are rare, but careful management of the distribution system is required in order to ensure that the quality of the treated drinking water is not allowed to deteriorate on its way to consumers.

3.1_ STORAGE TANKS

Service reservoirs and water towers are located at points in the distribution system to store water, both for hydraulic reasons and to even out the demand for water through the day. If these storage tanks are not maintained they can be prone to inward leakage from contaminated surface water. This needs to be controlled through inspection and maintenance. Scottish Water adopts a risk-based approach to cleaning and refurbishing storage tanks.

Secondary disinfection is installed at some storage tanks, but this should only be used where chlorine residuals diminish because of long distribution networks. In such cases there may be a need to boost disinfection levels to achieve a disinfection residual at the end of the network. It is important that secondary disinfection does not disguise a more fundamental problem with a storage tank or within the water mains.

DWQR inspects a selection of structures each year in order to ensure that they are being maintained and operated in a manner that minimises risk to water quality.

Coliforms and *E.coli* are two parameters measured in samples regularly taken from storage tanks to verify that disinfection is effective within the distribution system and to identify any instances where the water may have become contaminated. Coliforms, of which *E.coli* (faecal coliforms) is one species, are a group of bacteria, that are commonly found in the environment. *E.coli* indicates that contamination by faecal material has occurred. While some detections of coliforms are potentially due to issues associated with sampling, such as the condition of the sample point, all coliform failures must be fully investigated by Scottish Water and reported to DWQR, the local NHS board and local authority.

Summary results for storage tanks in 2013 (**Table 3.1a**) show that there was an all-round improvement in the incidence of bacteriological sample failures. 73 samples failed the coliform standard and five samples contained *E.coli*. These failures were recorded across 69 sites which is a significantly improved position over previous years.

Table 3.1a_ Summary of microbiological tests on storage tanks

COLIFORM BACTERIA	2013	2012	2011	2010	2009	2008
Number of tests	51,523	52,226	51,952	49,877	53,001	55,104
Number containing coliforms	73	109	122	106	137	137
% containing coliforms	0.14	0.21	0.23	0.21	0.26	0.25
E. COLI						
Number of tests	51,591	52,226	51,952	49,877	53,001	55,102
No. containing faecal coliforms	5	7	13	9	12	11
% containing faecal coliforms	0.01	0.01	0.03	0.02	0.02	0.02

Scotland has a large number of storage tanks and Scottish Water has a duty to maintain its assets so that they do not introduce a risk to water quality. Scottish Water adopted a new process for the investigation of failures of microbiological standards this year, seeking to determine and understand the root causes of each event. This has been a valuable tool to Scottish Water in gaining an understanding of issues at failing sites and DWQR welcomes the approach.

All storage tanks met the regulatory requirement that 95% of samples should not contain coliforms and again, this level of performance is an improvement over that in 2012. **Table 3.1b** shows the poorest performing sites in 2013.

Table 3.1b_ Storage tanks failing microbiological standards

STORAGE TANK	LOCATION	% SAMPLES WITH NO COLIFORMS	NO. OF SAMPLES TAKEN
Culburnie	Culburnie	95.83	48
Kirriemuir Hill	Kirriemuir	96.08	51
Stonebyres	Lanark	96.15	52
Ellon Low level	Ellon	96.23	53
Viewlands	Perth	97.30	37

The monitoring requirement for storage tanks is to take weekly samples when they are in service and a 'live' part of the water supply route. A number of sites fell short of recording 52 samples in the year and DWQR is satisfied that this is substantially due to the storage point being withdrawn from supply for a period of time for inspection, cleaning or repair. It is of considerable concern however that seven storage tanks feature in the list of failures in each of the past two years and two of those, Conerock Service Reservoir in Moray and Graemsay Service Reservoir on North Hoy, also failed in 2011. Scottish Water must work harder to understand and resolve the issues at these sites.

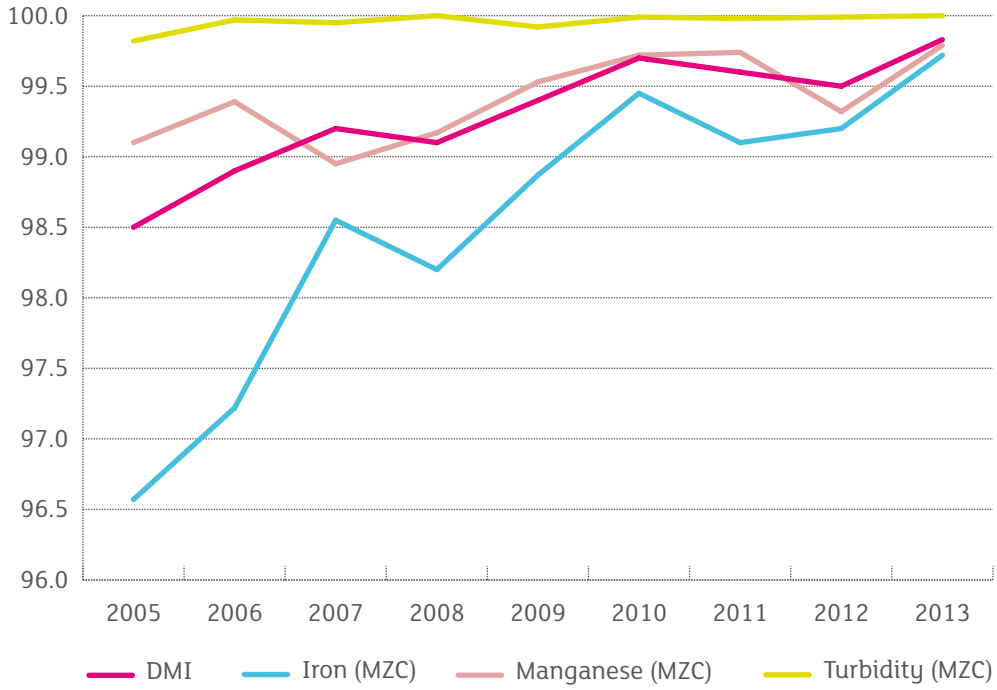
3.2_ WATER MAINS NETWORK

The Distribution Maintenance Index, or DMI, is a measure used to monitor the performance of distribution systems. DMI looks at regulatory sample data for turbidity, iron and manganese at consumer taps since these three parameters best reflect the performance of the distribution system and its tendency to cause discoloured water incidents.

Turbidity is a measure of the cloudiness of the water. Iron and manganese are the two substances most commonly associated with discoloured supplies. Whilst iron in water supplies is commonly associated with the corrosion of cast iron water mains, it may also originate from a water treatment works which is failing to adequately remove naturally occurring iron from the raw water, or adding it as a coagulant. Manganese is a naturally occurring substance found in raw waters in some parts of Scotland. If treatment processes are insufficient to remove it, it passes into the distribution system. Both iron and manganese may be deposited in pipes where low flows enable them to settle out and accumulate. Such deposits may later be disturbed by changing flow patterns causing discoloured supplies. DMI is a measure of the extent to which these substances are accumulating in the distribution system and the effectiveness of the techniques used by Scottish Water to keep the distribution system clean. A full description of DMI, which is derived from the Mean Zonal Compliance for the three parameters, can be found in Annex H.

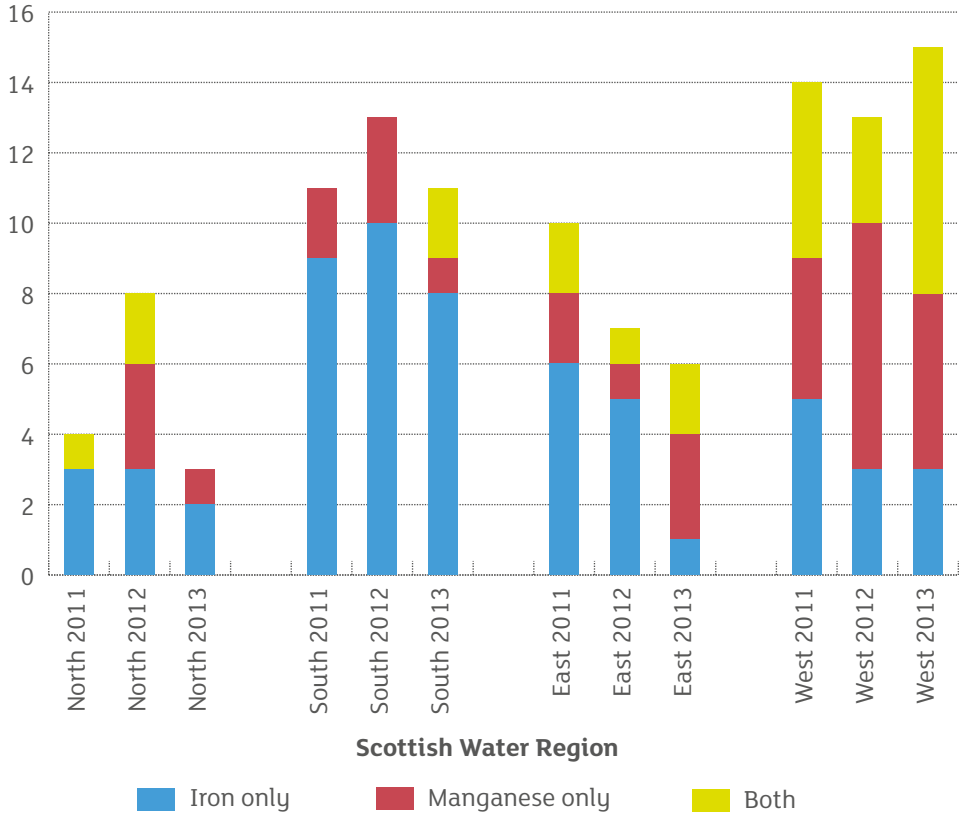
Fig 3.2a shows the DMI trend since its introduction as a measure in 2005, together with the mean zonal compliance of the three index parameters.

Fig. 3.2a_ Distribution maintenance index



The mean DMI for all zones was 99.83%, which is the highest level to be achieved by Scottish Water, since the use of this measure was introduced in 2005. 35 supply zones recorded a failure of an index parameter which is an improvement on the 42 last year. Iron and Manganese are the main contributors to performance and **Fig 3.2b** shows the regional breakdown of the number of zones with iron and manganese failures.

Fig 3.2b_ Regional breakdown of iron and manganese failures



The impact of excessive levels of iron and manganese in the water main network is that consumers receive discoloured water and this is discussed more fully within the Water Quality at Consumers' Taps section of this report. Failures of these parameters may be related to the condition of the water supply network but they may also be caused or exacerbated by operational activity, such as the operation of valves or burst mains, causing flow changes within the water mains.

Three regions show an improved position in 2012 but the highest level of failures, particularly of manganese, continues to be consistent over the past three years in the West region of Scotland. Five of the manganese only failures occurred in the Muirdykes supply zone and four are directly attributable to the presence of naturally occurring manganese in the raw water supply to the treatment works in June and July. DWQR declared the problem an Incident and a summary of the circumstances and findings are in section 4.4.

The notable improvement in the East is reflective of the extensive rehabilitation work undertaken in the Whitehillocks distribution system and it is good to see the positive effects of this significant investment. The poorer manganese performance is less easily attributed as the zones affected are supplied by four different treatment works. Almost half of the failures for iron in the South Region during 2013 occurred in two supply zones, Rawburn in the Borders and Balmore F zone supplying the Broxburn, Kirkliston and Queensferry area.

Compliance in the North improved significantly, again reflecting investment in distribution systems and treatment processes. Only Stornoway supply zone recorded a manganese failure in this region.

3.3_ AUDIT AND INSPECTION OF DISTRIBUTION SYSTEMS

An important part of DWQR's scrutiny role is to audit and inspect activities undertaken by Scottish Water. During an inspection of water supply networks, all aspects of the operation and maintenance of the assets and the management processes governing activity upon the network are reviewed. Auditing takes place against the requirements of the Regulations, Scottish Water's Distribution and Operation Maintenance Strategy (DOMS) as well as water industry best practice. Where issues are noted, these are recorded as recommendations that are tracked and followed up. If common themes are identified, these are progressed centrally with senior Scottish Water staff. Elements of best practice are also highlighted.

In 2013, DWQR investigated a number of incidents occurring on the distribution system and these are discussed in more detail in Section 3.4. The incidents however afforded DWQR the opportunity to closely examine Scottish Water's arrangements for compliance with Regulations, DOMS and industry best practice in relation to management of networks obviating the need, this year, to carry out audits on this area of activity. **Table 3.3a** shows the inspections that were undertaken during the year on the condition and management of storage points. Whilst there were specific recommendations made on each site, indicating scope for further improvements to the condition and operation of these assets, there were no common themes emerging.

Table 3.3a_ Storage point audits

STORAGE POINT	LOCATION	DATE	NO. OF FINDINGS
Tarskavaig	Isle of Skye	Aug 2013	5
Isleornsay	Isle of Skye	Aug 2013	5
Barcaldine	Oban	Aug 2013	5
Oban North Tank	Oban	Aug 2013	0
Boundary Cottage	Oban	Aug 2013	2
Fort George	Highland	Sep 2013	2
Blackstand	Highland	Sep 2013	0
Culburnie	Highland	Sep 2013	1

3.4_ EVENTS AND INCIDENTS IN DISTRIBUTION SYSTEMS

In 2013, 419 events were reported to the DWQR, of which 223 were raised in relation to sample failures or issues in distribution systems. Eight of these events were declared incidents which translates to 36% of all incidents as occurring on water mains or storage points.

Fig 3.4a shows the breakdown of the water quality issues at the root of the events in the distribution systems across the country. It quite clearly illustrates the degree to which microbiological and iron parameters contribute to the overall numbers of events.

Fig 3.4a_ Nature of water quality events

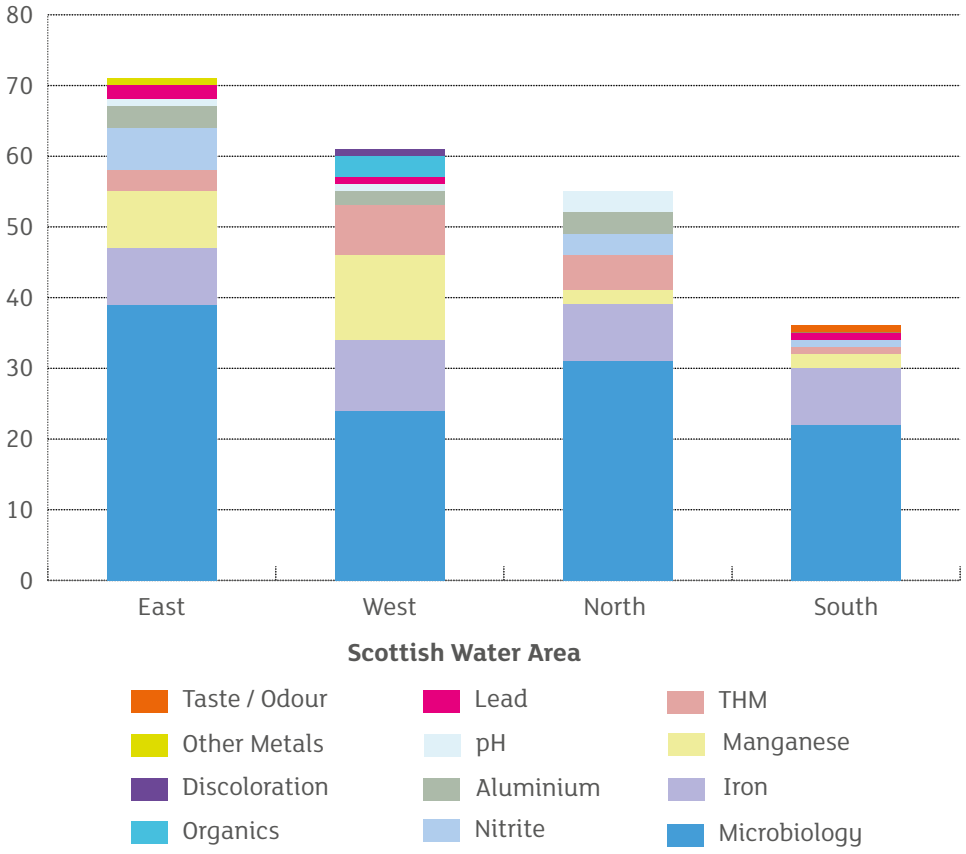


Table 3.4a_ Location of event root cause

FAILURE ELEMENT	NUMBER OF NETWORK EVENTS	% NETWORK EVENTS
Network	87	39.0
Storage Point	50	22.4
Treatment Works	32	14.4
No cause determined	27	12.1
Sampling	24	10.8
Service Pipe	3	1.3
Total	**223**	

Table 3.4a shows the element of the water supply chain to which the root cause of the failure was attributed. The table shows 14.4% are a direct consequence of some treatment issue which has had an impact within distribution. The most common attributable cause however is the condition of the water mains. Sample failures generally arise from the disturbed deposits within the pipes which can be a reflection of the condition of the iron pipeline material but also of accumulations from historical treatment failures or process effectiveness.

Storage points account for the majority (61%) of microbiological failures where the integrity of the tank structure or access cover seals may potentially have allowed the ingress of surface water from rainfall into the stored water area.

Scottish Water has established a larger resource of staff to investigate water quality issues and it is clear that this has resulted in a more focussed examination of the root causes of microbiological failures. In some cases however it has not been possible to attribute a definite root cause to the event. The 12.1% of events, 27 in number, where it has not been possible to attribute the event to a specific element of the distribution system almost entirely concern microbiological failures of samples taken from storage points or consumer taps. A further 17 events, primarily concerning microbiology at storage points, were unable to identify the cause of the failures. These figures represent a significant improvement on the overall proportion of events reported in 2012 where Scottish Water was unable to determine a cause.

DWQR declared eight incidents from events occurring on the distribution system. Five were categorised as serious by DWQR and three as significant. The most common root cause in these were disturbance to flows within the water mains and in three of the four incidents, the disturbance was found to be caused by Scottish Water's own activities. Scottish Water must examine their controls over operation of valves and the necessary flushing activities associated, to minimise water quality issues for consumers.

A description of all incidents is provided in Annex A and summaries of all Incident investigations are published on the DWQR website **www.dwqr.org.uk**

The following are incidents of particular note, requiring significant investigation by DWQR:

Kilmarnock

A consumer complaint of fuel or solvent taste in the water supply was investigated with samples showing the presence of hydrocarbons, manganese, aluminium and pH at levels exceeding the standards. Scottish Water had been carrying out investigations on the water mains in Glasgow Road to determine the potential for removing redundant pipework. An operation to verify the status of a line control valve, which was believed to be in an open position, had in fact opened the valve and caused water from a higher pressure zone to enter into the area for a short period of time. This was sufficient to cause a disturbance and shift of stagnant water lying in what is now understood to have been a dead end in the supply system. DWQR found this to be the root cause of the taste complaints and of the failures of water quality parameters.

DWQR was satisfied that the plans and arrangements for the investigative work were appropriate to the recorded configuration of valves and mains. The presence of aluminium and manganese in samples was consistent with a sudden change in flow conditions within old water mains. These pipes were installed around 100 years ago, with a bitumen lining to protect against corrosion and these can have a tendency to now cause hydrocarbon type tastes, particularly where water has lain dormant for an extended period of time.

DWQR considered Scottish Water's investigation of the possible sources of the high levels of hydrocarbons to have been thorough. DWQR considers it essential that accurate records are kept of the configuration of water mains and fittings to ensure water supply systems can be managed effectively. Scottish Water must put in place firmer guidance for staff testing the status of line valves to ensure all necessary precautions are taken to avoid such consequences. The incident was categorised as serious.

Colinton, Edinburgh
A number of alarms for low inlet flow and low tank level at Firhill New Service Reservoir alerted Scottish Water staff to an issue with the inlet control valve. Following investigations, the inlet control valve was bypassed to prevent a loss of supply to around 20,000 properties in the Colinton area of Edinburgh. The bypassing of this valve resulted in a significant increase in flow, causing disturbance of iron and manganese deposits in the water mains network. This led to a total of 48 consumer contacts complaining about water quality, and samples which were taken as a result of this incident failed for iron, manganese and turbidity. Bottled water was supplied to consumers who complained and flushing of the network was carried out.

While Scottish Water reported the cause of the incident to be the failure of the inlet control valve, DWQR is of the opinion that the root cause of the incident was that the inlet control valve bypass was not opened in a controlled manner, causing a disturbance of sediment in the pipework downstream of the valve. Better control of the valve sequencing and operation and pre-flushing of pipework to bring the bypass into service would have minimised or prevented water quality issues for consumers.

Only one of the two staff who were called on to deal with the incident had appropriate Distribution, Operation and Maintenance (DOMS) training; this is unacceptable. It is critical that only suitably trained staff carry out operational activities on Scottish Water's networks. DWQR considers it important that only suitably trained personnel are used in carrying out work on the public water supply distribution networks. In addition, there was an unacceptable delay by Scottish Water in flushing the affected network. It was not until some 19 hours after a decision was taken to cleanse the system, that the water mains were flushed. During this time there continued to be complaints from consumers. DWQR designated this incident as significant.

3.5_ INVESTMENT IN THE DISTRIBUTION SYSTEM

Scottish Water has been directed by Scottish Ministers to achieve a number of different objectives to improve and protect drinking water quality across Scotland during the period of 1 April 2010 to 31 March 2015.

During 2013, Scottish Water completed the installation of backflow prevention devices on the incoming water mains at a further 13 wastewater treatment works (WWTW) which now only leaves 26 left to do out of the total number of 242. These will protect the public water supply from any contamination that could have been caused in the rare event of a backflow of dirty water from the WWTW as a result of a sudden loss of pressure in the mains water, for example due to a burst pipe.

In 2013, Scottish Water did not carry out any more studies on water supply zones to determine the extent of water mains rehabilitation required to reduce the number of discoloured water events and consumer complaints. However, following studies previously undertaken, Scottish Water carried out rehabilitation works to over 800 km of water main in 33 of its water supply zones to reduce the risk of water quality being degraded by the condition of the distribution system pipework.

SECTION 4 CONSUMERS

4.1_ WATER QUALITY AT CONSUMERS' TAPS

Scottish Water's supply area is divided into 298 water supply zones. Most sampling to assess regulatory compliance takes place at consumers' taps, and testing takes place for 51 parameters. Sampling frequencies are determined by the size of the population in the water supply zone.

In 2013, 151,725 tests were carried out on samples taken at consumers' taps. Of these, 162 failed to meet the standard set out in the Regulations. This means that 99.89% of tests complied with the standards. The equivalent figures for 2012 were 221 failing samples and 99.86% compliance, demonstrating a marked improvement.

In 2013, 88 supply zones had a sample taken that failed to meet one or more of the standards, which is a significant improvement on 2012's figure of 117. Scottish Water's overall figure for Mean Zonal Compliance in 2013 was 99.93%.

Table 4.1a shows the test results of samples taken from randomly selected consumer's taps. Compliance for a number of key parameters is then discussed in more detail.

Table 4.1a_ Summary of all tests on consumer tap samples during 2013

PARAMETER	TOTAL NO. OF SAMPLES	NO. FAILED SAMPLES	NO. ZONES WITH FAILURES	% COMPLIANCE	MEAN ZONE COMPLIANCE
KEY PARAMETERS					
Coliform Bacteria	14,107	50	41	99.65	99.58
E. coli	14,107	3	3	99.98	99.94
Colour	5,164	0	0	100.00	100.00
Turbidity	5,164	0	0	100.00	100.00
Hydrogen ion (pH)	5,164	8	8	99.85	99.36
Aluminium	5,124	5	5	99.90	99.96
Iron	5,123	35	25	99.32	99.72
Manganese	5,123	25	21	99.51	99.79
Lead (25)	1,515	7	7	99.54	99.62
Total Trihalomethanes	1,516	13	9	99.14	99.32
OTHER PARAMETERS					
1,2 Dichloroethane	1,515	0	0	100.00	100.00
Aldrin	1,517	0	0	100.00	100.00
All Other Individual Pesticides	12,922	0	0	100.00	100.00
Ammonium	5,163	1	1	99.98	99.92
Antimony	1,514	0	0	100.00	100.00
Arsenic	1,514	1	1	99.93	99.92
Benzene	1,516	0	0	100.00	100.00
Benzo 3,4 Pyrene	1,514	0	0	100.00	100.00
Boron	1,515	0	0	100.00	100.00
Bromate	1,515	0	0	100.00	100.00
Cadmium	1,514	0	0	100.00	100.00
Chloride	1,515	0	0	100.00	100.00
Chromium	1,513	0	0	100.00	100.00
Clostridium perfringens	5,124	2	2	99.96	99.91
Conductivity	5,164	0	0	100.00	100.00
Copper	1,514	0	0	100.00	100.00
Cyanide	1,515	0	0	100.00	100.00
Dieldrin	1,517	0	0	100.00	100.00
Enterococci	1,515	1	1	99.93	99.92
Fluoride	1,515	0	0	100.00	100.00
Heptachlor	1,517	0	0	100.00	100.00
Heptachlor epoxide	1,517	0	0	100.00	100.00
Mercury	1,514	0	0	100.00	100.00
Nickel	1,514	0	0	100.00	100.00
Nitrate	2,449	0	0	100.00	100.00
Nitrite	2,449	11	7	99.55	99.76
Nitrite/Nitrate formula	2,449	0	0	100.00	100.00
Odour	5,164	0	0	100.00	100.00
PAH - Sum of 4 Substances	1,514	0	0	100.00	100.00
Pesticides - Total Substances	2,663	0	0	100.00	100.00
Selenium	1,514	0	0	100.00	100.00
Sodium	1,515	0	0	100.00	100.00
Sulphate	1,514	0	0	100.00	100.00

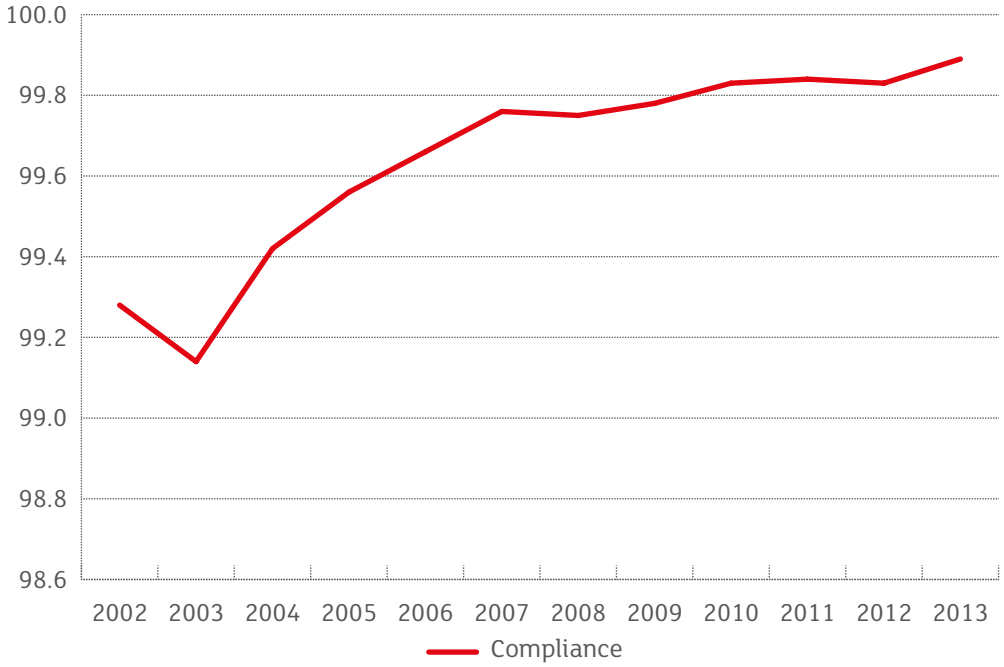
PARAMETER	TOTAL NO. OF SAMPLES	NO. FAILED SAMPLES	NO. ZONES WITH FAILURES	% COMPLIANCE	MEAN ZONE COMPLIANCE
Taste	5,163	0	0	100.00	100.00
Tetrachloroethene/Trichloroethene	1,517	0	0	100.00	100.00
Tetrachloromethane	1,518	0	0	100.00	100.00
Tritium	1,515	0	0	100.00	100.00
SCOTLAND	**151,725**	**162**	**88**	**99.89**	**99.93**

Overall Compliance

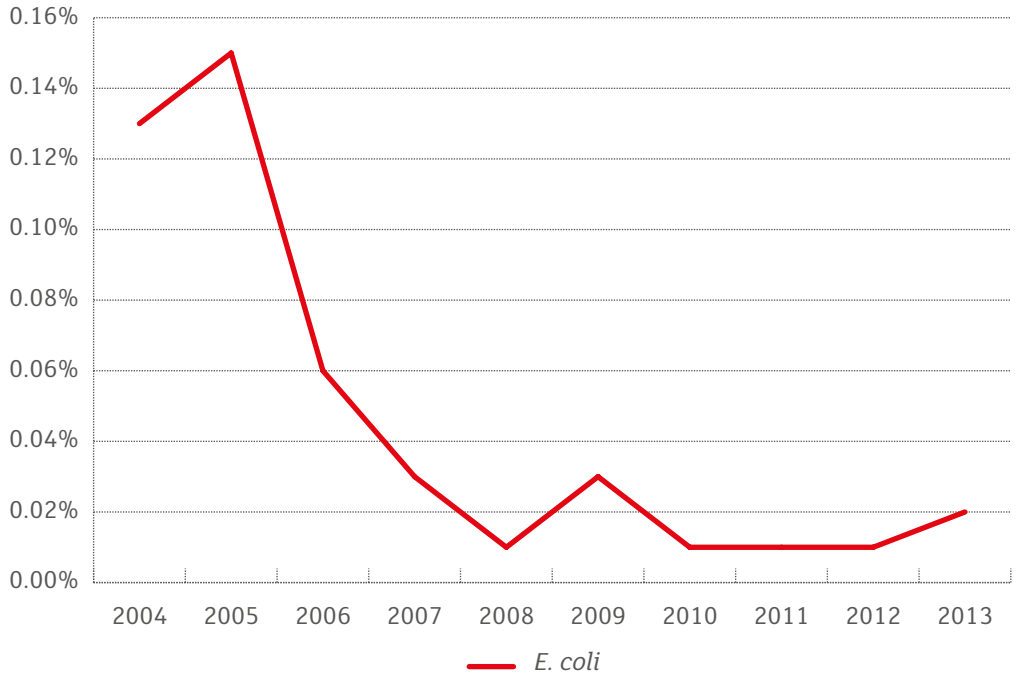
Figure 4.1 shows the overall compliance figure at consumers' taps every year since Scottish Water was created in 2002. The improving trend is clearly seen, with 2013's results suggesting an increase in the pace of improvement.

The graphs and comments on the following pages in this section illustrate the trends of compliance for each key parameter over the past ten years.

Fig 4.1_Percentage compliance at consumers taps (all samples)



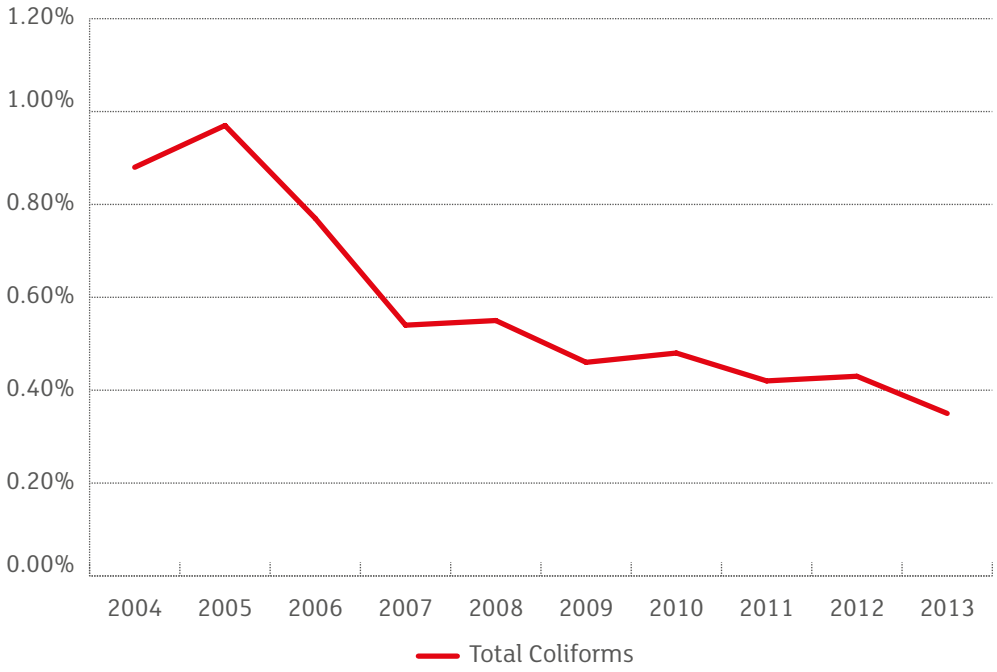
E. Coli – % Failures



E.coli is an extremely important parameter because it is an indicator of faecal contamination and the microbiological safety of the water. Compliance for this parameter is relatively stable with only a few failures occurring each year. Three samples failed last year against two in 2012. These failures represent only 0.02% of tests undertaken for this parameter.

The detection of *E.coli* in a water sample may be an indication that the supply in that area has become contaminated or it may simply relate to the tap from which the sample was taken. Scottish Water must investigate each failure thoroughly to try to determine the cause and respond appropriately.

Total Coliforms – % Failures

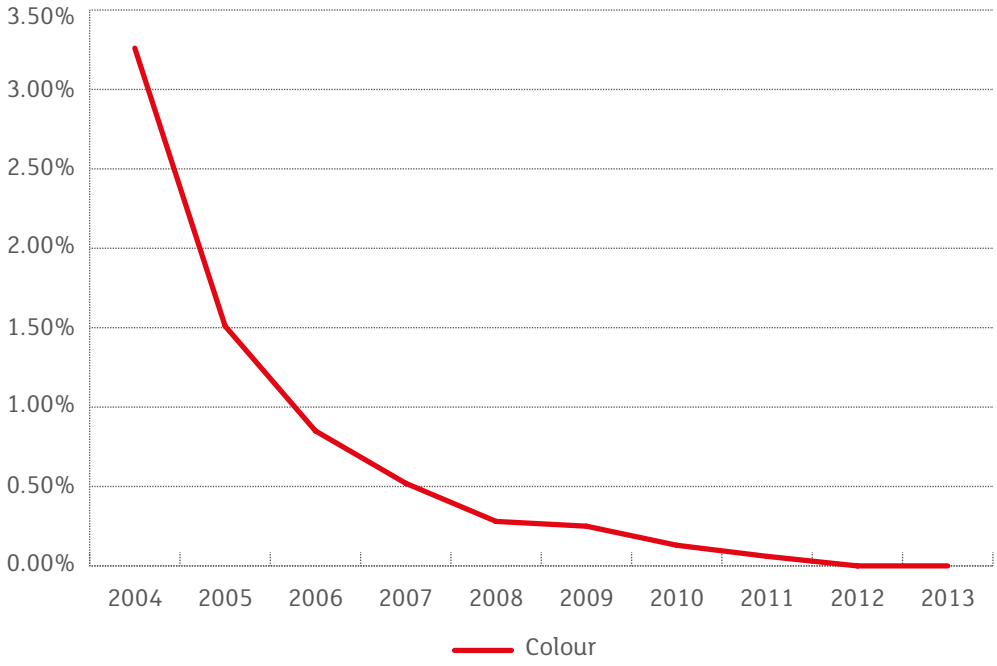


Total coliforms represent the group of bacteria of which *E.coli* is one species. They are common in the environment and do not necessarily indicate faecal contamination, but should not be present in the water supply as they are readily deactivated by chlorine, which is added in controlled amounts to all of Scottish Water's supplies.

Coliforms were detected in 50 samples in 2013, a reduction of 11 from 2012. Scottish Water has significantly increased its efforts in investigating failures at consumers' taps during the past year and this improved understanding of the root causes of microbiological failures may be showing benefits. Similar work on failures at treatment works and storage points is also likely to have resulted in improvements to the quality of water entering consumer's homes.

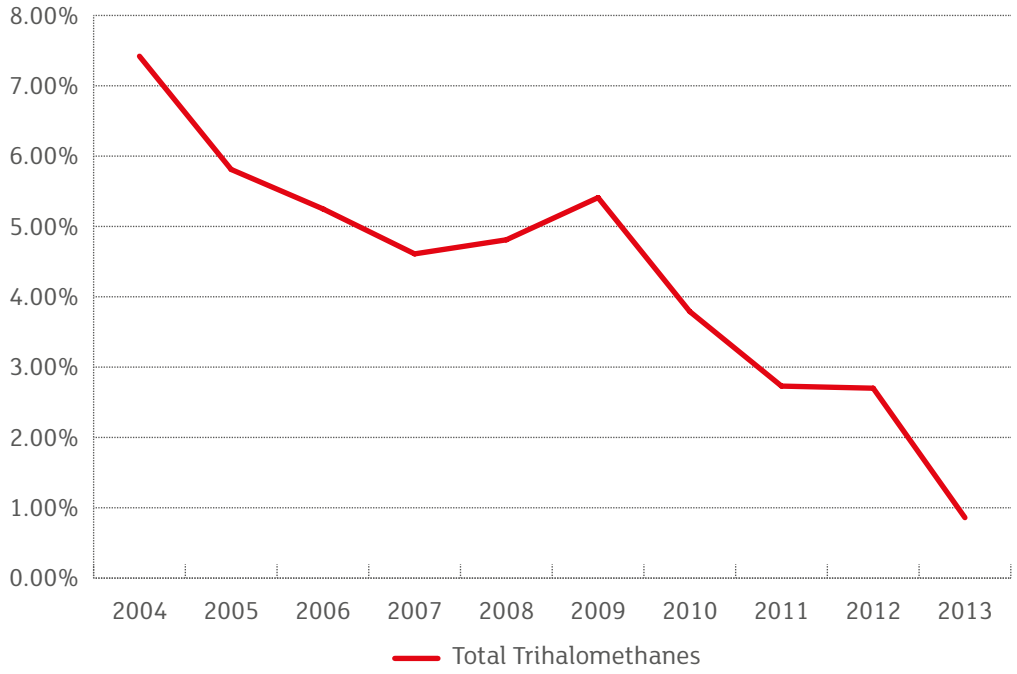
A number of supply zones featured multiple failures during the year. These include Black Esk zone and two zones supplied by Daer WTW in the South, Turriff supply zone in Aberdeenshire, Tullich supply zone in the Oban area and Corsehouse supply zone in Ayrshire. Although this year's data show an improvement, this must continue. Supply zones with multiple failures should receive enhanced attention, which needs to include a full review of disinfection processes at the treatment works and the strategy for maintaining disinfection across the supply zone.

Colour – % Failures



True colour is a measure of the tint to the water due to dissolved or colloidal material. In Scotland many raw waters are naturally highly coloured due to substances derived from peat. Not only is coloured water unsatisfactory to consumers from an aesthetic point of view, but it is also an indication that organic compounds, which can react with chlorine, are likely to be present in the water. Improvements to Scottish Water's treatment processes have resulted there being no failures of the colour standard for the second year running.

Total Trihalomethanes (THMS) – % Failures

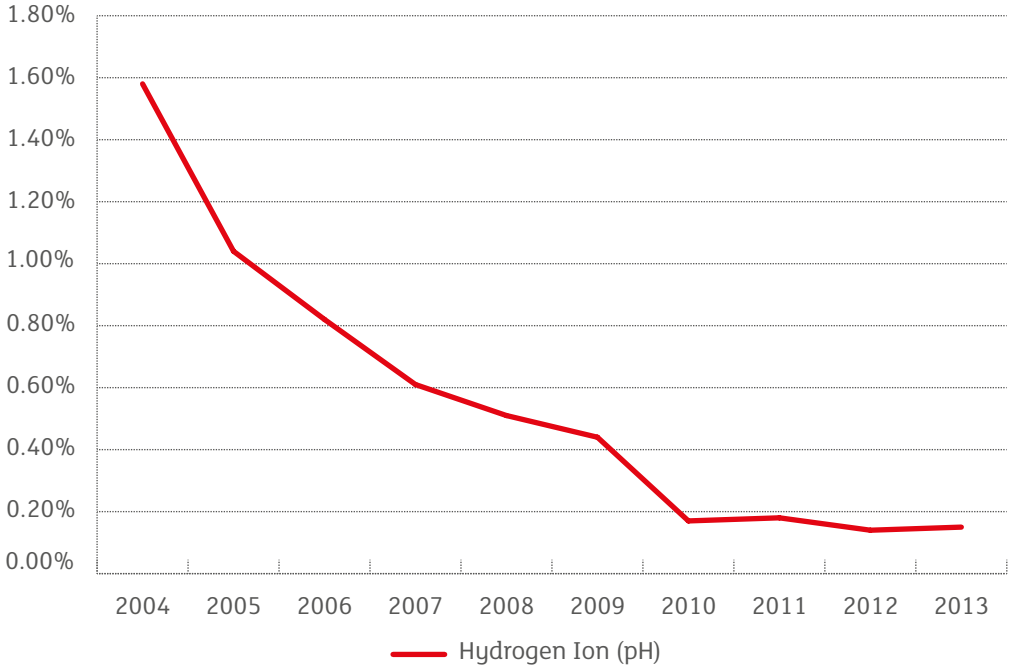


THMs are one group of disinfection by-products that can form when organic substances combine with chlorine. In terms of percentage compliance, they long represented Scottish Water's lowest complying parameter, however DWQR is pleased to report that this is no longer the case. A concerted effort by Scottish Water to understand and reduce the formation of THMs in its water supplies has resulted in a significant reduction in the number of failures, such that Scottish Water's compliance for this parameter has gone from 97.3% in 2012 to 99.14% in 2013. Further improvement can and must be achieved – England and Wales recorded no failures of this standard in 2013.

During 2013, Scottish Water has worked hard to understand the characteristics of its raw waters and their potential to form THMs when chlorinated. A range of techniques have been employed to improve organics removal at treatment works and reduce THM formation in distribution systems. This work is demonstrating a clear benefit and is welcomed.

The only supply zones recording multiple THM failures during the year were two of the zones supplied by Bradan WTW in Ayrshire. This is a large treatment works which does sometimes have performance issues. A great deal of effort has been put in by Scottish Water to ensure that it is optimised as far as possible, but a view must be taken as to whether this will be sufficient to achieve full compliance. If not, provision must be made for the appropriate investment. DWQR has considered enforcement action, and in response Scottish Water has given an Undertaking to Scottish Ministers committing to resolve this issue.

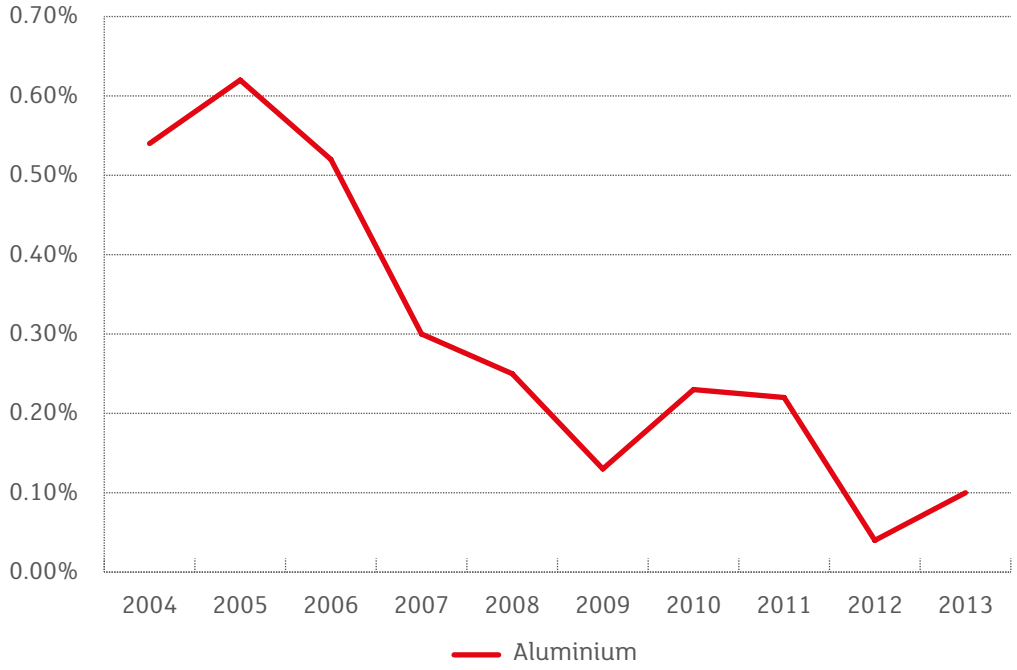
Hydrogen Ion (pH) – % Failures



The pH of a substance is the measure of how many hydrogen ions it contains, with large numbers of hydrogen ions making it more acidic. Most waters in Scotland are naturally soft and have a low pH. Such water can be corrosive to metals used in plumbing, therefore Scottish Water needs to correct this to bring the 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.

Compliance for pH has improved in the last ten years but has now reached a plateau, with eight samples failing to meet requirements in 2013. Scottish Water can improve this compliance figure further by improving control of pH correction dosing at the end of the water treatment process and by managing water residence times and rehabilitating where necessary any water mains containing cement where high pH values are a problem.

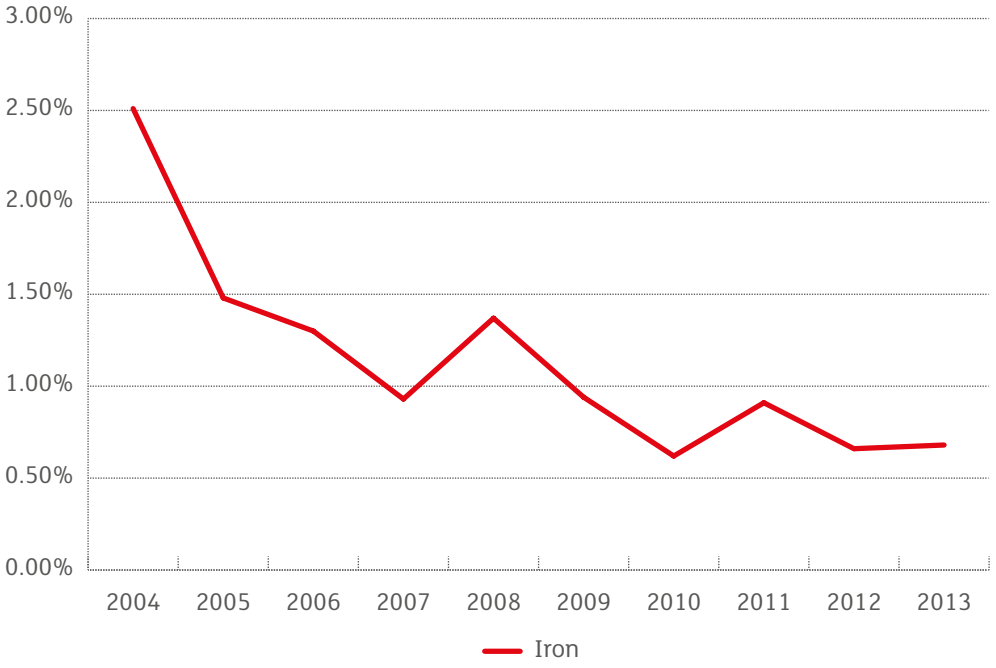
Aluminium – % Failures



Aluminium can be naturally occurring in water. It is also used as a flocculant in some water treatment processes and, if these are not operating efficiently, it can enter the water supply via this route. Generally it is not of significant health concern, but high concentrations can lead to taste complaints and affect dialysis patients.

The number of exceedences of the aluminium standard has reduced significantly since Scottish Water was created in 2002. Only five failures of the standard occurred in 2013, although this is a deterioration on the two recorded in 2012.

Iron – % Failures



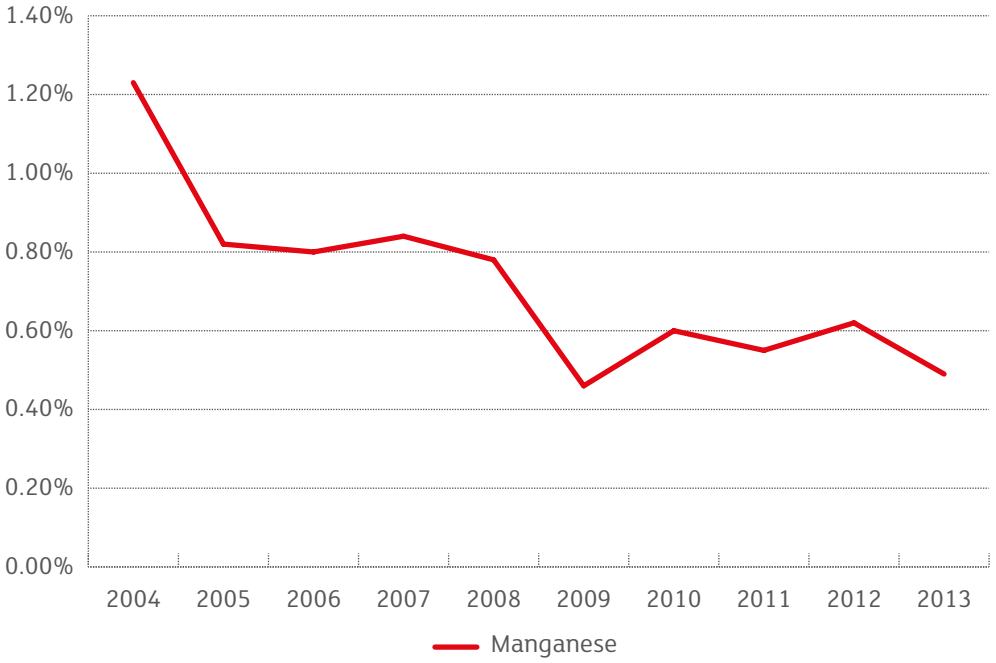
Iron occurs naturally in some water supplies but should be removed by the treatment process. It is used as an alternative flocculant to aluminium at a few treatment works in Scotland. The most common cause of failures of the iron standard at consumer taps is corroding cast iron water mains which can cause sediment to build up in distribution systems. High concentrations of iron can cause discoloured water supplies, greatly inconveniencing consumers.

Scottish Water has embarked on a large programme of renovation of the water mains that cause the most significant water quality issues but the company needs to ensure that quality is managed in the meantime. Compliance with the iron standard has not improved significantly for a number of years, and in the opinion of DWQR, needs to improve. This is also reflected in the number of discoloration complaints received by Scottish Water which is the largest category of water quality complaints.

In addition to the targeted programme of mains rehabilitation, Scottish Water has begun to look at actively monitoring discoloration and proactive systematic flushing of water mains to remove iron sediment. This is welcomed as a positive development, although DWQR is also aware that much of the rest of the UK water industry has been undertaking similar work for a number of years.

Rawburn supply zone in Berwickshire was the area with the poorest compliance in 2013, with four failures of the standard for iron. This zone has been a problem for a number of years, with long lengths of unlined cast iron water main. Work is underway to improve the situation.

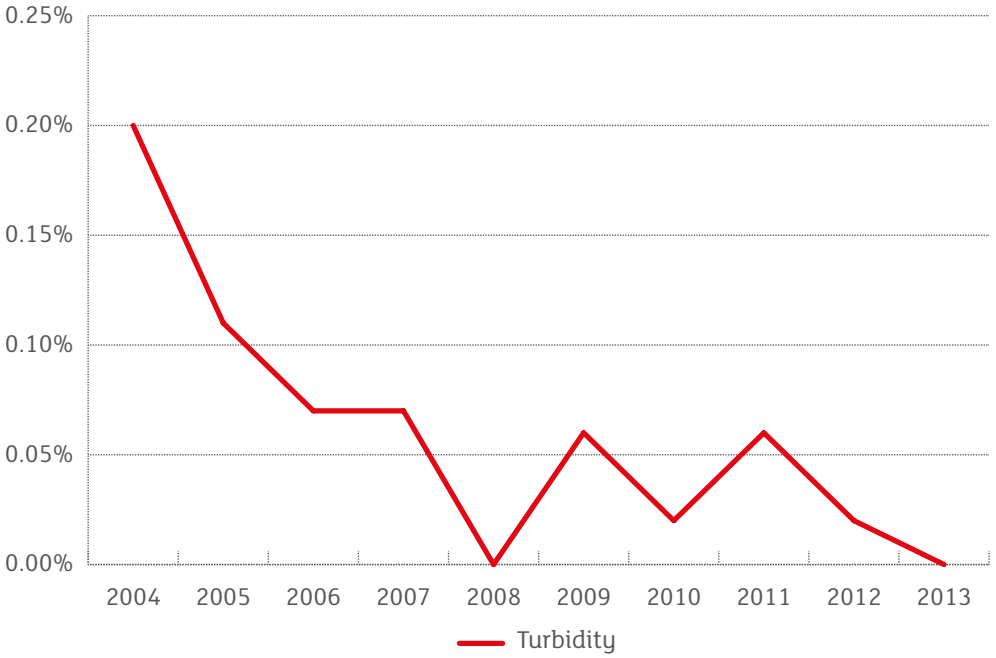
Manganese – % Failures



Manganese occurs naturally in some raw waters, especially in the West of Scotland. If it is not removed effectively by the treatment process it can accumulate as a fine black sediment in distribution system pipework and cause severely discoloured water supplies and great inconvenience for consumers. Overall compliance has not improved significantly for a number of years. This is mainly because issues tend to be localised, and DWQR is keen that Scottish Water monitors manganese concentrations closely and anticipates problems before they develop. Even a relatively low concentration of manganese in the final water of a treatment works can accumulate in pipes and cause problems in distribution pipework.

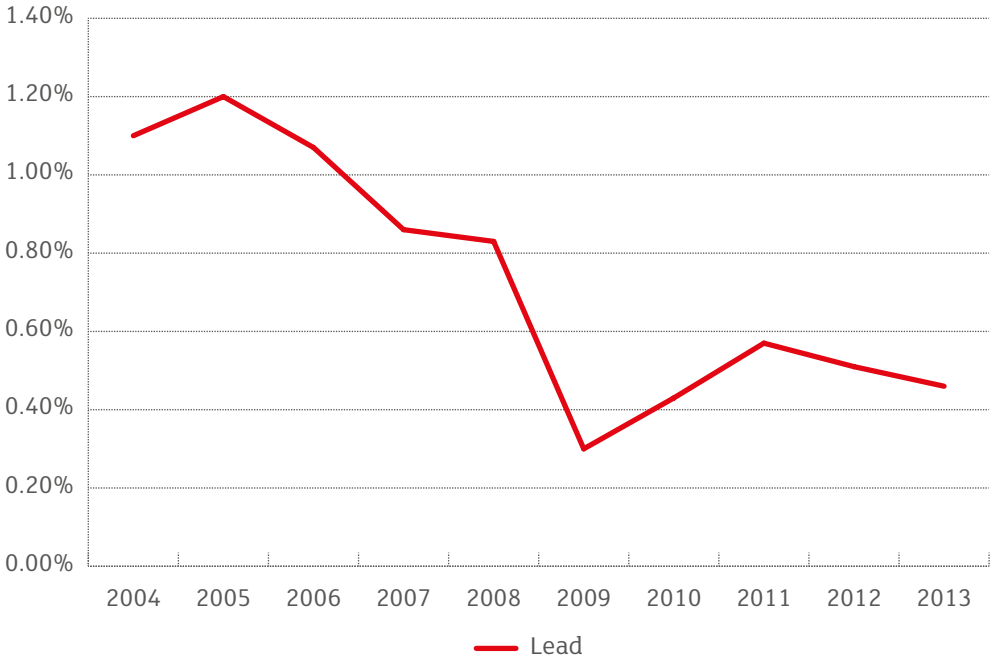
The only water supply that recorded more than one failure in 2013 was Muirdykes in and around Paisley where five failing samples were taken. This known issue is covered by a water quality Undertaking, which is a legally binding commitment given by Scottish Water stating that all work shall be complete by March 2017, although the improvements should be cumulative in the run up to this date.

Turbidity – % Failures



Turbidity is a measure of the tendency of suspended material in the water to scatter light, making it appear cloudy. There can be a number of causes of turbidity failures at consumers' taps. Most are localised issues and related to the condition of the distribution system pipework. No exceedances of the standard for turbidity occurred in 2013.

Lead – % Failures



Lead does not occur naturally in water supplies in significant quantities, but may fail the standard at consumers' taps where lead piping is present in a property. 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 extent to which the water supplied dissolves lead. The standard for lead reduced from 25µg/l to 10µg/l at the end of 2013, which is likely to lead to an increase in failures in 2014. Had the 10µg/l revised standard been in force during the whole of 2013, there would have been a further ten failures of the standard. Scottish Water needs to continue to implement measures to reduce the amount of lead in water supplies and produce a documented strategy for doing so.

Some progress has been made in recent years due to the optimisation of phosphate dosing at water treatment works that prevents the dissolution of lead from pipework, however continued efforts are needed as the standard reduces. In 2013, seven failures of the 25µg/l standard occurred across Scotland. Although no zone recorded multiple failures of the current standard, Lomond Hills borehole supply zone would have recorded two failures of the revised standard.

Recent medical opinion suggests that lead concentrations should be as low as possible, and while most lead pipework is in private ownership, Scottish Water is expected to work with other stakeholders to minimise plumbosolvency, warn property owners of the dangers and encourage replacement of lead piping.

Other Notable Parameters

Among the other parameters, it was gratifying to see a significant improvement in several of these, most notably pesticides, PAH and all of which recorded a number of failures in 2012 but none in 2013. (One Benzo-3,4-pyrene test was recorded with a result of 0.0112µg/l and is classified as a failure by Scottish Water, however DWQR require reporting of results to two decimal places and is recorded as such on the DWQR database, which means the result has not exceeded the 0.01 µg/l standard). The improvement in pesticide compliance is especially pleasing as this is partly the result of work by Scottish Water to improve catchment management measures. Work to install pesticide removal treatment at Forehill WTW serving Peterhead was completed in early 2014 and should complement measures in the River Ugie catchment to reduce and control pesticide usage, ensuring that traces of pesticide do not enter the water supply.

Nitrite

The only non-key parameter which did not show a significant improvement in compliance during the year was nitrite. This forms when nitrifying bacteria act on ammonia that is added to chlorine in a process known as chloramination. If the process is not tightly controlled and nitrifying bacteria are allowed to persist in the distribution system due to high water residence times, failures of these parameters can result.

In 2013 the number of failures for this parameter increased, from six in 2012 to 11 in 2013. Although the area around Aberdeen still produced a few of the failures, the majority, five in total, occurred in Spynie zone which supplies the area around Elgin. This emerging issue serves to demonstrate the speed at which nitrite issues can take hold in distribution systems if it is not properly monitored and controlled.

4.2_ PUBLIC BUILDINGS

The European Drinking Water Directive requires that Member States have regulations to deal with the monitoring of water quality in buildings to which the public have access. In order to fully transpose this requirement into Scottish law, the Water Quality (Scotland) Regulations 2010 (“the 2010 Regulations”) were laid. The measures introduced by the 2010 Regulations are the minimum considered necessary to complete the transposition of the Drinking Water Directive in Scotland.

In 2013, 7590 tests were undertaken on samples collected from public buildings by Scottish Water. Of these, four failed to meet the regulatory standard. Three samples contained low levels of coliforms and one exceeded the standard for *Clostridium perfringens*. DWQR assessed all of these failures as being not significant, with remedial action taken and consumers notified where appropriate.

4.3_ SCOTTISH WATER CONSUMER CONTACTS

When a consumer calls Scottish Water regarding the quality of their water supply, the contact is recorded and classified according to the categories listed in Annex G. **Table 4.3a** shows the number of contacts, by type, that Scottish Water received during 2013.

Table 4.3a_ Consumer contacts received by Scottish Water

CONTACT CATEGORY	NUMBER OF CONTACTS			% CHANGE ON 2012	CONTACT RATE PER 10,000 POPULATION		
	2013	2012	2011		2013	2012	2011
APPEARANCE							
Discoloured Water	7,172	8,279	17,940	-13.4	14.4	16.6	35.9
Aerated (Milky) Water	1,587	2,536	2,897	-37.4	3.2	5.1	5.8
Particles in Water	523	1,190	788	-56.1	1.1	2.4	1.6
Organisms in Water	50	67	53	-25.4	0.1	0.1	0.1
TASTE AND ODOUR							
Chlorine	1,105	1,986	1,458	-44.4	2.2	4.0	2.9
Metallic	539	1,285	1,358	-58.1	1.1	2.6	2.7
Solvent/Fuel Taste/Smell	54	107	42	-49.5	0.1	0.2	0.1
Musty/Earthy	558	1,035	588	-46.1	1.1	2.1	1.2
TCP/Chemical Taste/Smell	457	1,102	283	-58.5	0.9	2.2	0.6
OTHER CONTACT ABOUT WATER QUALITY							
Illness due to Water	167	451	427	-63.0	0.3	0.9	0.9
Other Contact	0	0	73	-	0.0	0.0	0.1
TOTAL CONTACTS ABOUT WATER QUALITY	**12,212**	**18,038**	**25,907**	**-32.3**	**24.4**	**36.1**	**51.9**

Fig 4.3b_ Breakdown of consumer contacts by type

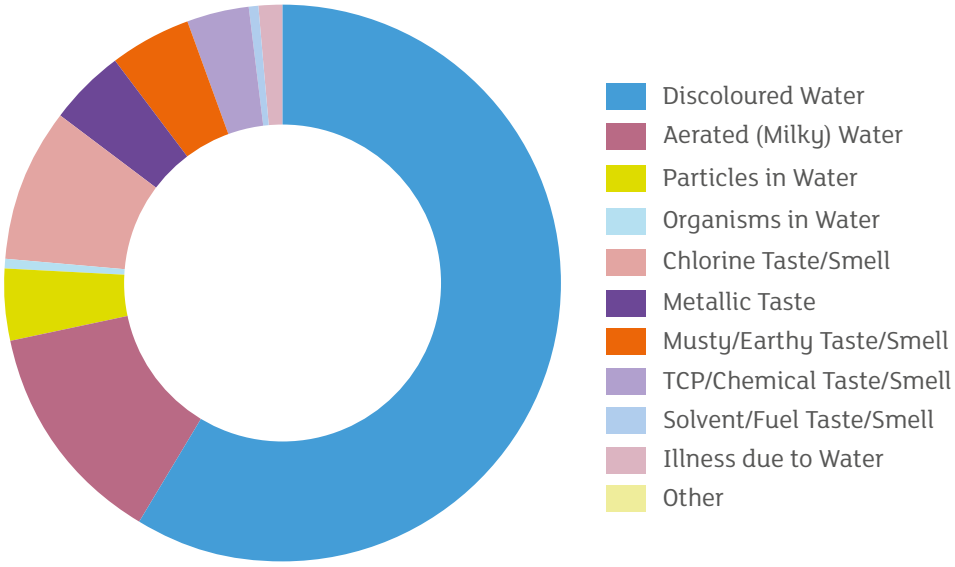
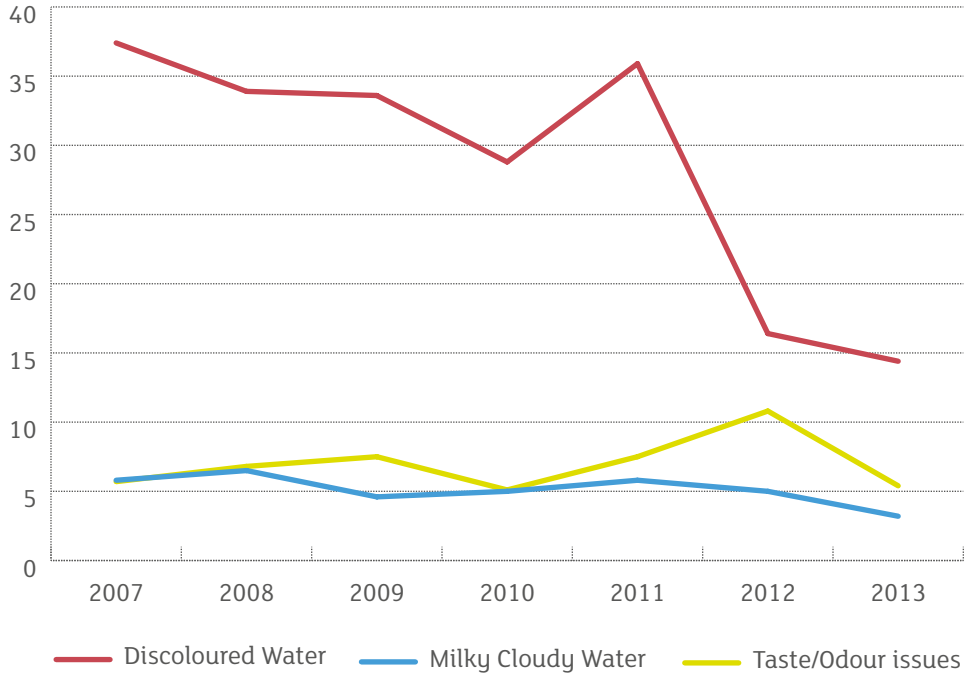


Fig 4.3b shows over 70% of calls were made in response to discoloured water and aerated (or milky) water. These categories are not only a reflection of problems related to the condition of the water supply network but they also are influenced by operational activity causing flow changes within the water mains i.e. operation of valves or burst mains. The diagram also shows the significant proportion (22%) of contacts relating to the taste or smell of the water supply causing concern to consumers.

Whilst it is acknowledged that the proportions of categories will shift as the overall numbers have dropped, **Fig 4.3c** further illustrates the point in terms of the trends in key contact types. The continuing downward trend following the marked reduction in discoloration complaints last year is welcomed and it illustrates the very clear benefits of Scottish Water's investment in the water supply network. It is also good to see the troubling upward trend in Taste and Odour issues appears to have been arrested. This category is back in line with earlier years' experiences and Scottish Water must work harder to address the various causes of taste and ensure satisfactory supplies are provided to consumers.

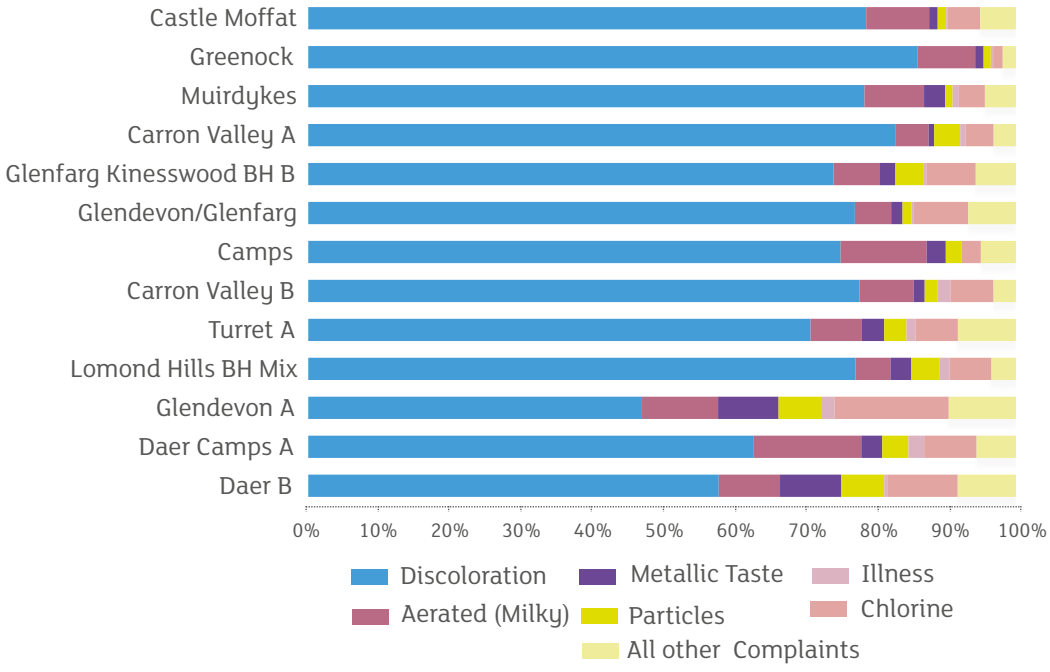
Over 40% of all taste and odour complaints are about chlorine – the level of complaints is 2.2 per 10,000, which is the lowest seen in the past seven years. This is welcomed by DWQR but it is important that Scottish Water continues to review chlorine residuals in water supply systems to ensure these are appropriate and to identify opportunities to reduce the amount of chlorine being added whilst not compromising microbiological safety.

Fig 4.3c_ TREND in key contact categories – contacts per 10,000 population



The overall contact rate for Scotland in 2013 (from **Table 4.3a**) was 24.4 per 10,000. In geographic terms, the areas where most issues were raised by consumers are shown in **Figure 4.3d**. This chart shows the supply zones, ranked by contact rate.

Fig 4.3d_ Water supply zones with most water quality complaints



Castle Moffat Supply Zone, in East Lothian, had almost twice the rate of contacts than the next highest, which was Greenock Zone, generating 125 contacts per 10,000 population. This is an unusual zone to feature in this analysis. The prime reason for consumers calling Scottish Water in this area, 60% of calls, was due to network management issues causing disturbance within the water mains and discoloured supplies. In one instance a failing pressure reducing valve required temporary re-zoning of the area and the consequent valve operations in the network caused discoloration of the supply. In the other, a burst water main, again necessitating rezoning of supplies, caused a similar effect. These illustrate the importance of responsible management of valving operations on supply networks to minimise water quality issues for consumers. Eight of the 13 zones in the graphic featured in the similar illustration last year, with Muirdykes and Carron Valley 'B' zones also in 2011 highlighting the persistent issues there.

A water quality incident at Muirdykes treatment works in June, when manganese passed into the distribution system, led to some 270 of the 570 consumer complaints in the zone. There is a known issue with the capability of the WTW to deal with manganese and Scottish Water has given Scottish Ministers an Undertaking to address the problems. This can be viewed on the DWQR website **http://www.dwqr.org.uk/regulator-activity/undertakings.htm**. The incident clearly illustrates the need for the capital investment in the manganese removal stage currently underway at the works and the benefits to be expected upon its completion.

4.4_ CONSUMER CONTACTS TO DWQR

Scottish Water has a responsibility to investigate water quality complaints and supply issues and DWQR guides 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, then the DWQR carries out an investigation of the issues.

The DWQR is committed to ensuring consumer complaints are properly investigated and has an agreement with the Scottish Public Services Ombudsman (SPSO) on the arrangements and processes required to provide a fair and transparent assessment of water quality complaints.

Table 4.4a_ Consumer contacts received by DWQR

CONTACT CATEGORY	NUMBER OF CONTACTS				
	2013	2012	2011	2010	2009
APPEARANCE					
Discoloured Water	6	8	18	21	11
Aerated (Milky) Water	2	3	2	6	3
Particles in Water	2	2	5	4	3
Organisms in Water	0	0	0	4	0
TASTE AND ODOUR					
Chlorine	5	19	19	5	19
Metallic	2	2	3	1	2
Solvent/Fuel Taste/Smell	0	0	0	0	0
Musty/Earthy	2	0	2	3	5
TCP/Chemical Taste/Smell	1	1	2	6	1
OTHER CONTACT ABOUT WATER QUALITY					
Illness due to Water	2	1	8	6	3
Other Contact	10	10	5	3	21
TOTAL PUBLIC WATER SUPPLY WATER QUALITY CONTACTS	**32**	**46**	**64**	**59**	**68**
Public water supply issues & requests for information	27	42	56	60	75
Private water supply issues	12	7	16	5	-
General Enquiries to DWQR	21	37	17	26	-
TOTAL CONSUMER CONTACTS TO DWQR	**92**	**132**	**153**	**150**	**143**

Table 4.4a shows the various categories of consumer contacts received by the DWQR in 2013. Overall, 92 contacts were received. The overall number of contacts and, within that, the number of consumers with complaints about the public water supply has significantly reduced in recent years. The key factor in the reduction is a clearer guidance to consumers to make use of Scottish Water's formal complaints process to allow the company the opportunity to properly investigate and resolve issues. The fewer numbers however may also be a reflection of improvements seen in water quality and the reduction in contacts received directly by Scottish Water.

DWQR carried out one formal investigation of a complaint against Scottish Water in 2013. A consumer had complained to Scottish Water in June 2012 after experiencing many instances of discoloured water at his home. Scottish Water investigated the circumstances and provided information to him regarding planned improvement works to the water mains within the water supply zone. He was also informed that a flushing programme had been set up for the mains in his street to remove the discoloured water and that samples of the water supply would be taken. DWQR determined that Scottish Water had not carried through with commitments made to the consumer and had provided inaccurate information on planned investment. The DWQR made seven recommendations to Scottish Water in her determination. The full determination is published on the DWQR website **www.dwqr.org.uk**

4.5_ AUDIT AND INSPECTION

In light of the continuing reduction in the number of complaints escalating to DWQR, the annual inspection programme for 2013 again included an inspection of the way in which Scottish Water responds to formal complaints from consumers and an audit of their formal complaints process was carried out in November. The purpose of the audit was to seek demonstration of clear links between complaints, determination of causes, commitment to resolving issues, providing appropriate information and confirmation that remedial actions were taken. It therefore also examined the actions surrounding the initial consumer contact to establish appropriateness of those responses and to understand the basis for escalation to formal complaint.

The DWQR is satisfied that Scottish Water carries out appropriate investigation into formal complaints and takes the necessary steps to resolve consumer issues. The cases show Scottish Water to be adhering to the process and timescales set out in its procedure. Investigations were initiated with appropriate functions and teams to determine background and to identify solutions and timescales. It is clear that frontline staff have a desire to resolve complaints and a high level of attention has been given to ensuring appropriate information is supplied to complainants and that opportunities have been taken to further explain relevant issues and options.

The audit findings are published on the DWQR website.

4.6_ EVENTS AND INCIDENTS

In 2013, 419 events were reported to the DWQR, of which 59 were specifically related to domestic plumbing issues. Consumers can have a direct influence in these cases and failures may reflect the hygienic condition of the kitchen tap when bacteriological samples were taken. The other key issue is the presence of lead piping in the supply route which is the responsibility of the property owner. Of the 59 events, 26 were identified as arising from hygiene issues at the kitchen tap and 22 were caused by failures of the lead standard.

In 2013, one incident was declared due to customer plumbing issues and it arose from improper pipework arrangements within commercial premises allowing backflow into the public water mains.

A description of all water quality incidents is provided in Annex A and summaries of incident investigations are published on the DWQR website.

Paisley

Two consumer contacts reporting a fuel taste were received in March and sampling found there to be a high level of hydrocarbons in the water supply. Investigations determined that the affected consumers were in a localised area and steps were taken to close-off the water mains network supplying the small number of properties and prevent any expansion into the wider distribution system. A ‘Do Not Use’ notice was issued to affected consumers.

The area contained a mix of domestic, commercial and industrial premises and Scottish Water's Industrial Byelaws teams carried out inspections and investigations of the non-domestic premises for indications of backsyphonage of contaminants into the public water supply system. The inspections found one business where a number of Byelaws contraventions were found which provided a high risk of backsyphonage taking place and the water supplies into the premises were isolated until remedial works could be carried out. Levels of hydrocarbons fell significantly in subsequent sampling providing confidence that the source of contamination had been found and isolated. Discussions were then held with the Consultant in Public Health Medicine to remove the restrictions on use of the supply.

Scottish Water submitted a case for prosecution to the Procurator Fiscal relating to the contraventions of the Byelaws. DWQR supports Scottish Water's desire to utilise their enforcement powers in relation to Byelaws contravention and is pleased to note their success in this instance. This incident was categorised as serious by DWQR.

4.7_ INVESTMENT

Scottish Water has been directed by Scottish Ministers to undertake a number of different projects to improve and protect drinking water quality across Scotland during the period of 1 April 2010 to 31 March 2015.

During 2013, Scottish Water completed studies to determine the location and number of lead communication pipes in Scottish Water's ownership and to gain a better understanding of the extent of lead supply pipes on the consumer side. The communication pipe is the name given to that part of the pipe that delivers water from the water main in the road to the property boundary and is connected to what is called the supply pipe which is owned by the property owner and which runs on and into the property itself. These studies should help Scottish Water develop its longer term strategy to ensure that it complies with the standard for lead which reduced from 25 micrograms per litre to 10 micrograms per litre from the end of 2013.

In the short term, during 2013, Scottish Water continued with its present strategy of replacing any lead found in smaller (less than 400 properties) zones and introducing chemical dosing at the treatment works to minimise the uptake of lead in the water in larger zones (greater than 400 properties). In 2013, this accounted for 15 zones where the lead was replaced with plastic pipes and three cases where chemical dosing was introduced at the works. Of the three works which had chemical dosing introduced, DWQR inspected two of them to ensure that they had been properly installed and were operating as intended.

As already referred to in the water treatment section of this report, Scottish Water improved the control of disinfection at seven water treatment works during 2013. This work should improve the consistency of chlorine dosing, making the taste and odour of the water being supplied from these works more acceptable to consumers while ensuring its safe disinfection.

ANNEXES

ANNEX A – SUMMARY OF EVENTS AND INCIDENTS

Scottish Water is required to tell DWQR about events that could affect water quality. DWQR assesses all events and categorises them in consideration of their impact on public confidence in the water supply. There are five categories used with the three most severe declared by DWQR to be incidents.

CATEGORY	NOT SIGNIFICANT	MINOR	SIGNIFICANT	SERIOUS	MAJOR
No. of Events	326	68	14	7	0

The following tables detail the significant and serious events declared as incidents within treatment works and distribution systems.

Water Treatment Works

SITE	DATE OF INCIDENT	CAUSE OF INCIDENT	CATEGORY
Balmore WTW	Jan 13	Failure of Coagulation	Significant
Tomnavoulin WTW	Jun 13	Membrane integrity	Significant
Glendale WTW	Jun 13	Operational Practice	Significant
Bradan WTW	Jun 13	Disinfection Process Failure	Significant
Bradan WTW	Jun 13	Control of Treatment Processes	Significant
Spey Badentinan WTW	Jun 13	Disinfection Process Failure	Significant
Storr Forest WTW	Sep 13	Inadequate Treatment (No Process)	Significant
Storr Forest WTW	Sep 13	Disinfection Process Failure	Significant
Bayhead WTW	Oct 13	Disinfection Process Failure	Significant
Mannofield WTW	Oct 13	Clarification Process Failure	Serious
Forehill WTW	Oct 13	Inadequate Treatment (Optimisation)	Significant
Invercannie WTW	Nov 13	Membrane integrity	Serious
Turriff WTW	Nov 13	Inadequate Treatment (Optimisation)	Significant
Ringford WTW	Dec 13	Disinfection Process Failure	Significant

Distribution Systems

SUPPLY ZONE OR STORAGE RESERVOIR (SR)	LOCATION	DATE OF INCIDENT	CAUSE OF INCIDENT	CATEGORY
Blairlinnans	Paisley	Mar 13	Back-syphonage	Serious
Amlaird	Kilmarnock	Apr 13	Flow Disturbance	Serious
Muirdykes	Paisley	Jun 13	Inadequate Treatment (No Process)	Serious
Glencorse C	Colinton	Jul 13	Flow Disturbance	Significant
Milngavie M1	Maryhill	Jul 13	Flow Disturbance	Serious
Windyfield SR	Rhynie	Jul 13	Sampling	Serious
Bayhead	Western Isles	Nov 13	Flow Disturbance	Significant
Assynt	Beauly	Nov 13	Hygiene Code	Significant

ANNEX B – AUDIT AND INSPECTION

It is a key part of DWQR's role to inspect Scottish Water's activities and assets that could impact upon water quality. When conducting an inspection, DWQR is auditing against the requirements of the 2001 Regulations and water industry best practice. In all cases, the report and recommendations made are passed to Scottish Water for comment before a summary of the audit report is published on the DWQR website. Actions arising from inspection recommendations are tracked to ensure that they are completed satisfactorily. In 2013, DWQR completed the following inspections:

Water Treatment Works

LOCATION	DATE	REASON FOR AUDIT	NO. OF RECOMMENDATIONS
Afton (Ayrshire)	Feb 2013	Risk based	8
Fife Boreholes (Fife / P&K)	Mar 2013	Risk based	9
Glenfarg (Fife)	Mar 2013	Risk based	6
Lochaline (Highland)	Aug 2013	Risk based	6
Glenconvinth (Highland)	Sep 2013	Risk based	3
Fort William (Highland)	Oct 2013	Risk based	9
Daer (S. Lanarkshire)	Nov 2013	Risk based	11

Distribution Systems

LOCATION	DATE	SCOPE OF AUDIT	NO. OF RECOMMENDATIONS
Tarskavaig SR	Aug 2013	Isle of Skye	5
Isleornsay SR	Aug 2013	Isle of Skye	5
Barcaldine SR	Aug 2013	Oban	5
Oban North Tank SR	Aug 2013	Oban	0
Boundary Cottage SR	Aug 2013	Oban	2
Fort George SR	Sep 2013	Highland	2
Blackstand SR	Sep 2013	Highland	0
Culburnie SR	Sep 2013	Highland	1

Consumer Complaints to Scottish Water

LOCATION	SCOPE OF AUDIT	DATE	NO. OF RECOMMENDATIONS
Scottish Water Service Review Team	Consumer complaints about WQ	Nov 2013	3

Procurement Services

LOCATION	SCOPE OF AUDIT	DATE	NO. OF RECOMMENDATIONS
Scottish Water Procurement, Blantyre	Procedures for procuring goods and services which could affect water quality	Mar 2013	0

ANNEX C – UNDERTAKINGS AND ENFORCEMENT NOTICES

Where water supplies do not comply with the required water quality standard, there are a number of mechanisms available to DWQR to ensure that the necessary steps are taken to achieve compliance. These are set out in DWQR's Enforcement Policy, which is published on the DWQR website.

Undertakings

In general, the DWQR will seek to secure compliance with legislation through co-operation, discussion and offering advice. This process of co-operation and discussion may result in Scottish Water giving a legally binding Undertaking to Scottish Ministers under the provision of Section 76E of the Water (Scotland) Act 1980, setting out the steps that Scottish Water will take to secure compliance with the legislation. Such Undertakings provide a visible commitment from Scottish Water that the necessary improvement will be made.

In 2013, there were two ongoing Undertakings. One was to deal with manganese in the water supply from Muirdykes water treatment works which supplies parts of Renfrewshire to the south west of Glasgow. This work is currently scheduled to be complete by March 2017. The other one is to deal with pesticides from Forehill water treatment works in the Peterhead area by March 2014.

In 2013 Scottish Water submitted new Undertakings to Scottish Ministers for:

Bradan water treatment works and supply zones – Manganese and THMs
Amlaird treatment works and supply zones – Iron and THMs
Craignure treatment works – *Cryptosporidium*
Tullich treatment works – *Cryptosporidium* and THMs

Enforcement Notices

When DWQR has evidence that Scottish Water has contravened a drinking water quality duty and the contravention is likely to recur *and* Scottish Water does not appear willing to take 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 2013, there were no active Enforcement Notices.

ANNEX D – SUMMARY OF IMPROVEMENT PROGRAMMES

Investment in Catchments

In its Final Determination for the strategic review of charges for 2010-2015, the Water Industry Commission for Scotland allowed Scottish Water to invest £3 million per year to identify and operate sustainable land management (SLM) measures in five water catchments. Six catchments were actually identified in 2010 in agreement with DWQR and SEPA. Names of the actual catchments chosen can be found in section 1.1 (catchment).

During 2012, Scottish Water implemented a programme of detailed sampling in these catchments to better understand the sources and pathways of diffuse pollution. This provided them with a starting point to measure the success of any measures introduced to improve the quality of the source water.

Scottish Water also developed a Best Practice Incentive Scheme in 2012 to help land managers finance measures aimed at reducing the level of diffuse pollution, for example from the application of pesticides. There have been some applicants for this scheme, but it is too early to say what impact, if any, these measures will have on water quality.

In 2013, Scottish Water promoted their incentive scheme in all six catchments. This included evening meetings, stands at livestock markets and agricultural shows and visits to farms. In autumn 2013, Scottish Water launched a pesticide support service for the Ugie and Deveron catchments which is a free service for consultants, contractors and land managers to obtain weather and water quality information.

Scottish Water continues to work in close partnership with a number of different agencies including SEPA to deliver SLM measures with the aim of ensuring that drinking water sources are protected at the same time as keeping customers' charges as low as possible with the added benefit of improving the environment.

Investment at Treatment Works

Scottish Water has been directed by Scottish Ministers to undertake a number of different projects to improve and protect drinking water quality across Scotland during the period of 1 April 2010 to 31 March 2015. These projects include the establishment of a Water Safety Plan, as promoted by the World Health Organisation, for all public water supplies in Scotland.

Scottish Water managed to complete this task early during 2011 allowing the water company since then to concentrate on analysing all of the risks identified in these plans and to make a start on deciding whether or not improvement programmes are required to mitigate these risks in the next investment period beyond 2015. Progress was made with this task during 2012, but it soon became apparent that investment was still required at certain water treatment works to deal with actual non-compliance with some key parameters first before investing to reduce the risks of non-compliances. By the end of 2013, Scottish Water had produced a list of projects for inclusion in the next investment period beyond 2015 which was agreed with DWQR.

In addition, disinfection control was improved at seven water treatment works during the course of 2013. Works improved included Shieldaig on the north west coast of Scotland which the DWQR inspected to ensure that it had been properly installed and was operating as intended. This investment should improve the consistency of chlorine dosing, making the taste and odour of the water being supplied from these works more acceptable to consumers.

There are a number of water treatment works which have more extensive works planned for investment during the period leading up to 2015. In 2013, 13 treatment works were improved. Most of this work related to the introduction of a treatment barrier to deal with *Cryptosporidium* and included work at Kinlochewe, Raasay (off the Isle of Skye) and Lochcarron. DWQR inspected these sites to ensure that they had been properly installed and were operating as intended. In addition, work was completed to install filters to deal with a manganese problem at Loch Eck which supplies Dunoon and the surrounding area. This work was the subject of an Enforcement Notice issued by the DWQR to Scottish Water. DWQR inspected the works to ensure that they had been properly installed and were operating as intended.

Investment in the Distribution System

Scottish Water has been directed by Scottish Ministers to achieve a number of different objectives to improve and protect drinking water quality across Scotland during the period of 1 April 2010 to 31 March 2015.

During 2013, Scottish Water completed the installation of backflow prevention devices on the incoming water mains at a further 13 wastewater treatment works (WWTW) which now only leaves 26 left to do. These will protect the public water supply from any contamination that could have been caused by the backflow of dirty water from the WWTW as a result of a sudden loss of pressure in the mains water, for example due to a burst pipe.

In 2013, Scottish Water did not carry out any more studies on water supply zones to determine the extent of water mains rehabilitation required to reduce the number of discoloured water events and consumer complaints. However, following studies previously undertaken, Scottish Water carried out water main rehabilitation works in 33 of its water supply zones to reduce the risk of water quality being degraded by the condition of the distribution system pipework.

Investment – Consumers

Scottish Water has been directed by Scottish Ministers to undertake a number of different projects to improve and protect drinking water quality across Scotland during the period of 1 April 2010 to 31 March 2015.

During 2013, Scottish Water completed studies to determine the location and number of lead communication pipes in Scottish Water's ownership and to gain a better understanding of the extent of lead supply pipes on the consumer side. The communication pipe is the name given to that part of the pipe that delivers water from the water main in the road to the property boundary and is connected to what is called the supply pipe which is owned by the property owner and which runs on and into the property itself. These studies should help Scottish Water develop its longer-term strategy to ensure that it complies with the standard for lead which reduced from 25 micrograms per litre to 10 micrograms per litre from the end of 2013.

In the short term, during 2013, Scottish Water continued with its present strategy of replacing any lead found in smaller (less than 400 properties) zones and introducing chemical dosing at the treatment works to minimise the uptake of lead in the water in larger zones (greater than 400 properties). In 2013, this accounted for 15 zones where the lead was replaced with plastic pipes and three cases where chemical dosing was introduced at the works. Of the three works which had chemical dosing introduced, DWQR inspected two of them to ensure that they had been properly installed and were operating as intended.

As already referred to in the water treatment section of this report, Scottish Water improved the control of disinfection at seven water treatment works during 2013. This work should improve the consistency of chlorine dosing, making the taste and odour of the water being supplied from these works more acceptable to consumers while ensuring its safe disinfection.

ANNEX E – THE REGULATORY FRAMEWORK

The regulatory standards for drinking water quality in Scotland largely stem from European Directives. These standards are based on Guidelines values, developed by the World Health Organization, to protect public health.

Our key domestic water quality legislation includes:

The Water (Scotland) Act 1980 (as amended)

- *Scottish Water must supply wholesome water for domestic purposes. It is a criminal offence to supply water unfit for human consumption;*
- *Scottish Ministers must take enforcement action against Scottish Water if it fails in its duty to supply wholesome water (as defined in the relevant regulations) unless the failure is trivial or Scottish Water is complying with a legally binding undertaking to remedy the matter;*
- *local authorities must take appropriate steps to keep themselves informed about the wholesomeness of public water supplies in their area and notify Scottish Water if not satisfied;*
- *local authorities are required to secure improvements to private water supplies if they consider them necessary.*

The Water Supply (Water Quality) (Scotland) Regulations 2001

The 2001 regulations came into force on 25 December 2003, they:

- *transpose the requirements of Council Directive 98/83/EC on the quality of water intended for human consumption into Scottish legislation;*
- *define wholesomeness by setting standards for 40 parameters and a further 11 indicator parameters;*
- *set and define, the supply zone as the basic unit for quality monitoring;*
- *specify sampling requirements for samples taken at taps within zones, at service reservoirs and at WTW; and*
- *require Scottish Water to publish an annual report and keep a public register of water quality in its area.*

The Water Industry (Scotland) Act 2002

- *created the role of Drinking Water Quality Regulator for Scotland (DWQR);*
- *set out responsibility for enforcing the Water Supply (Water Quality) (Scotland) Regulations 2001;*
- *defines DWQR's independent status;*
- *defines DWQR power to obtain information, power of entry or inspection and power of enforcement; and*
- *DWQR also has emergency powers to require a water supplier to carry out works to ensure quality of water supplied is safe for public consumption.*

The Water Quality (Scotland) Regulations 2010

The 2010 Regulations came into force on 20th April 2010, they:

- *further transpose the requirements of Directive 98/83/EC most particularly in respect of water quality failures which are attributable to the domestic distribution system in establishments and premises where water is supplied to the public;*
- *require local authorities to investigate such water quality failures to determine its cause;*
- *instruct remedial action through the service of a notice on the person who owns, or is responsible for, the domestic distribution system;*
- *ensure that affected consumers are notified of any risk to their health;*
- *make a number of technical amendments to the Water Supply (Water Quality) (Scotland) Regulations 2001 and the Private Water Supplies (Scotland) Regulations 2006; and*
- *create a duty to minimise contamination from disinfection by-products and to verify the effectiveness of the disinfection process.*

The *Cryptosporidium* (Scottish Water) Directions 2003

The *Cryptosporidium* (Scottish Water) Directions 2003 came into force on 1 January 2004, they:

- *provide for more widespread testing for* Cryptosporidium *to provide data about background levels in water supplies; and*
- *provision put in place for* Cryptosporidium *sampling at all water treatment works; every supply in Scotland must be tested based on the assessed risk and the flow through the works (at least once a month).*

The Scottish Water (Objectives for 1st April 2010 to 31st March 2015) Directions 2009

In support of the Government's objective for a healthier Scotland, the Scottish Ministers issued Directions to Scottish Water to deliver a number of specified objectives in the period 1st April 2010 to 31st March 2015. In relation to drinking water quality these include:

- *Delivering appropriate treatment solutions to a number of sites to reduce the risk of* Cryptosporidium *from entering the supply system;*
- *commencing a programme of water mains rehabilitation that will reduce the risk of water quality being degraded by the condition of the distribution system when in steady state flow conditions;*
- *delivering the necessary improvements to ensure that water supply zones are protected against conditions that have a probability of a 1 in 40 year return period; and*
- *establishing water safety plans, as promoted by the World Health Organisation, for all public drinking water supplies.*

ANNEX F – INDEX OF INFORMATION LETTERS ISSUED DURING 2013

Information Letter number	Title
Public Supply	
2013/1	The handling of contacts about drinking water quality from non-domestic consumers
2013/2	Authorisation of different standards
2013/3	Requirement and expectations for supply-specific disinfection strategies
Private Supply	
2013/1	Temporary departures

Copies of these letters are available on the DWQR website:
www.dwqr.org.uk

ANNEX G – CATEGORIES OF DRINKING WATER QUALITY CONTACTS

Appearance of the Water

Discoloured Water

Water with a discernable taint or colour caused by suspended or dissolved matter. Two of the most common causes are a yellow taint caused by dissolved organic matter arising from peat in upland sources and more general orange, brown or black discolouration caused by suspended particles of iron (orange/brown) and manganese (black). Iron discolouration may occur through natural iron present in the raw water passing through inadequate treatment or from corrosion of cast iron distribution mains. Manganese is present in some raw waters and may not be removed if treatment is inadequate.

Milky Cloudy Water

Water which has a milky appearance is caused by tiny bubbles of entrained air which dissolve in the water under pressure but come out of solution at the consumers' tap. A number of causes are possible including burst mains, malfunctioning pumps and consumer stop taps that are only partially open. If air is the cause of the milky water, the cloudy appearance will clear in a glass of water from the bottom up.

Particles in Water

Visible particulate matter in water which is otherwise not discoloured. This can be caused by corrosion of iron mains or deposits of sand, grit or other material present in the main being re-suspended following a change in the flow in the main.

Organisms in Water

This category includes complaints of insects or other animals in the water supply. Most complaints arise where an insect has crawled up a tap or is present in the sink. Very occasionally water systems can contain animals which may arise from the raw water, from treatment works or within the water mains themselves. This is extremely rare, however organisms such as midge larvae (*Chironomid*) or water shrimp (*Aesellus*) have occasionally been found in domestic supplies.

Taste or Smell of the Water

Chlorine Taste/Smell

The use of chlorine as a disinfectant ensures the water supply remains safe as it travels through the sometimes extensive water mains system and private pipework to consumers. Chlorine dissipates as it travels through water mains, so levels leaving the treatment works will necessarily be higher than those at the ends of the system and some consumers will experience a higher level than others, depending upon their location. Excess residual chlorine can result in taste and smells but these should dissipate if the water is left to stand in the fridge for a few hours. It will also not be present after boiling. Scottish Water should keep chlorine concentrations under review to limit taste and odour issues with the provision that the safety of the water supply always remains of paramount importance.

Metallic Taste

Metallic tastes may arise from an excess of iron, aluminium or other metal dissolved in the water, although normally there will also be visible discoloration.

Solvent/Fuel Taste/Smell

This is not a common problem and if it arises it should be investigated immediately. Possible causes include spillages of petrol or hydrocarbons that have percolated through the soil and penetrated the plastic water main.

Musty/Earthy Taste/Smell

Musty or Earthy tastes can arise due to naturally occurring compounds present in raw waters that have not been removed by the treatment process. Geosmin is one such compound commonly associated with earthy/musty tastes. Complaints are more common in the summer months when biological activity is highest – algal blooms in raw water sources are common causes of widespread musty tastes.

TCP / Chemical Taste

Sometimes consumers report that their drinking water has an unusual taste. Such tastes can be hard to describe, but a common description is TCP, medicinal or chemical. This can have a number of causes, but a common cause is where the small amount of chlorine added to the water to keep it safe reacts with phenol in plastics and rubbers in household plumbing and appliances to produce harmless compounds that have a very strong taste and smell that persists in cold and boiled drinks. Washing machine and dishwasher hoses, tap washers and kettles have all been shown to cause the problem under certain circumstances. The use of British Standard approved appliances and fittings will prevent the problem.

Other categories

Illness due to Water

Illnesses caused by public drinking water supplies are extremely rare in the UK as the quality of water is so high. Occasionally, consumers have concerns that their water supply is affecting their health in some way, but usually Scottish Water is able to demonstrate that the water is not the cause. DWQR expects Scottish Water to take all such concerns very seriously indeed, to investigate each contact very thoroughly and sample appropriately to demonstrate that the water supplied is wholesome. It is also expected that Scottish Water will provide reassurance to consumers and assist them by providing information on the quality of their water supply that they can discuss with their doctor if appropriate.

Other

Scottish Water receives a small number of contacts that do not easily fit into any other category. These may include other tastes and odours, or issues relating to lead plumbing and fungal growth on bathroom fittings.

ANNEX H – STATISTICAL METHODS USED IN THE REPORT

Water Quality Compliance Data for Local Authority Areas

In order to present drinking water quality data by local authority area in Section 3, it has been necessary to report data for the group of supply zones within that area. Water supply zone boundaries do not fit local authority boundaries exactly, so the data for any supply zone which falls wholly or partly into the local authority area has been included.

This approach means that data from some supply zones is included twice or more in Section 3. For example, the same data for Alnwickhill B supply zone is included in the sections for East Lothian, Midlothian and City of Edinburgh.

Zonal Compliance

Zonal compliance is simply the percentage of samples meeting the PCV for that parameter.

Mean Zonal Compliance

Mean zonal compliance for an area is built up from zonal compliance figures for individual parameters in individual supply zones. DWQR used the Mean Zonal Compliance (MZC) index for the first time in the 2005 report. This is a helpful tool when considering water quality at national, regional and local level as it provides a simple means of summarising drinking water compliance and comparing year-on-year performance.

Overall Compliance

The Overall Compliance for any group of supply zones is the arithmetic mean of the MZCs for every parameter. An Overall Compliance figure for Scotland may be calculated in this way. In 2013, DWQR has used all regulatory parameters that have a numerical standard in this calculation to give a value of 99.93%. If only the 41 parameters in Schedule 1 of the 2001 Regulations that have a numerical standard are used in the calculation, the 2013 value is 99.93%. The full list of parameters may be found in **Table 4.1a** of this report.

Pesticides

All parameters are weighted equally in the calculation but the sheer number of pesticide determinands has the potential to skew the Overall Compliance calculation by placing undue weight on pesticide analysis. For that reason, results for the individual pesticides not specifically mentioned in Schedule 1 of the Regulations have been pooled to produce a single “All Pesticides” parameter. The large number of different pesticides analysed every year, is determined using a risk assessment process to define specific sampling requirements in each supply zone.

Zones with Small Populations

Some of the water supply zones in Scotland are very small, serving populations in single figures. Regulatory sample frequencies are based on population, hence sampling for certain parameters in these zones is infrequent, with perhaps only two samples being taken for each parameter per year. If one of these samples fails, this will adversely affect mean zonal compliance to a much greater extent than a sample failure in a large supply zone. This is unavoidable, and in calculations of regional mean zonal compliance, this effect is compensated for by the large number of these small zones which are present in individual regions such as the North.

Distribution Maintenance Index

The Distribution Maintenance Index (DMI) is the same as the Operational Performance Index (TIM) used in previous DWQR reports. It is used to reflect the performance of the distribution system for a zone or collection of zones, and is simply the arithmetic mean of the MZCs for turbidity, manganese and iron for the zone.

Worked Examples

Zonal Compliance

The zonal compliance for iron for a notional supply zone, Zone 1, is calculated as follows:

	NO. SAMPLES TAKEN FOR IRON	NO. SAMPLES FAILING	ZONAL COMPLIANCE (IRON)
Zone 1	52	2	96.15

Mean Zonal Compliance

In order to calculate the MZC for iron for a group of 10 zones which include Zone 1, the arithmetic mean of all the zonal compliances for iron is taken.

Zone 1	96.15
Zone 2	98.6
Zone 3	100
Zone 4	100
Zone 5	100
Zone 6	100
Zone 7	100
Zone 8	100
Zone 9	100
Zone 10	100
MZC	99.48

Overall Compliance

To calculate overall compliance for the group of 10 zones, the arithmetic mean of the MZC for every parameter is calculated

The DWQR may be contacted either by writing to:

Drinking Water Quality Regulator for Scotland
Area 1D South
Victoria Quay
EDINBURGH
EH6 6QQ

or via our website: **www.DWQR.org.uk**

or telephoning 0131 244 0224

ISBN: 978-1-78412-674-2