

DRINKING WATER QUALITY IN SCOTLAND 2012

ANNUAL REPORT BY THE DRINKING WATER QUALITY REGULATOR FOR SCOTLAND



SAFEGUARDING YOUR DRINKING WATER QUALITY



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EXECUTIVE SUMMARY



The Drinking Water Quality Regulator for Scotland (DWQR) regulates the quality of water supplied by Scottish Water 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 2012.

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.

THE PUBLIC WATER SUPPLY IN SCOTLAND

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 assets and 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 sources need to be treated before they are of satisfactory quality to be supplied to consumers. The extent and type of treatment required depends on the nature of the source, 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:



238 Loch and Reservoir Sources



198 River Sources



84 Spring and Borehole Sources



47,000km Water Mains



267 Water Treatment Works



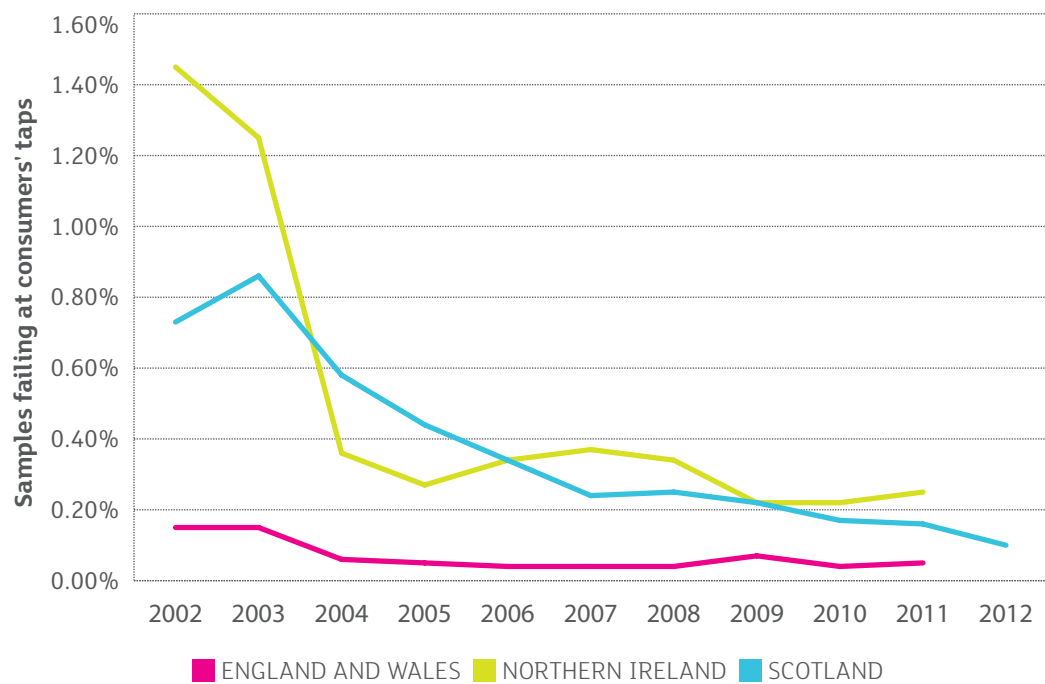
1,015 Storage Points

COMPLIANCE WITH THE STANDARDS – HOW GOOD WAS DRINKING WATER IN 2012?

Scottish Water carried out 322,632 regulatory tests for which there is a numerical standard on Scotland’s drinking water in 2012 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 2012 153,433 tests were carried out on samples collected from consumers taps and 99.86% of these complied with the standards, which is Scottish Waters’ best ever compliance. The chart shows that compliance in Scotland has improved considerably in the 10 years, since Scottish Water was formed. It also shows that there is 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



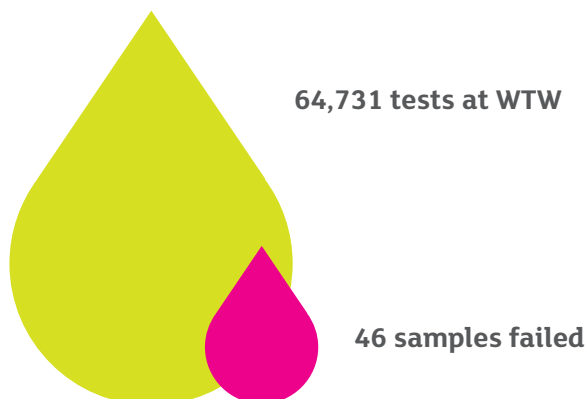
WATER QUALITY AT TREATMENT WORKS

The 267 water treatment works (WTW) around Scotland vary considerably in size, but all are sampled regularly. In 2012, 64,731 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 2012, 0.12% of samples contained coliforms, an improvement on 2011 but a figure that was surpassed in both 2007 and 2009. Only three samples contained *E. coli*, representing 0.01% of samples, which is the best ever 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. In 2012 Scottish Water performed 8,739 tests for *Cryptosporidium* on water leaving treatment works. *Cryptosporidium* oocysts were detected in 217 samples at 77 treatment works. This means that 2.48% of samples contained oocysts, representing a much-awaited significant improvement in performance.

Water treatment works performed well in 2012, 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. Areas for additional focus include improving the resilience of treatment works to deal with changing raw water quality and ensuring that quality monitoring and SCADA systems are sufficient for this purpose. Work to fully understand the operation of key parts of the treatment process at some sites is needed, and this work should culminate in the production of policies and strategies on quality at both corporate and site specific level, resulting in a more consistent approach across Scotland. Work to document and verify the effectiveness of the disinfection process at each site will be a particular focus over the next few years.

As work to shape the next investment period from 2015 to 2021 continues, Scottish Water is using risks to water quality highlighted via the Water Safety Plan (WSP) approach to target investment, as well as dealing with any remaining sources of non-compliance. DWQR believes that this is a very positive step, representing a shift from responding to failures towards acting to prevent them from occurring in the first place.



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, 7 samples contained *E. coli* and one storage point failed to meet the regulatory requirement that 95% of samples shall not contain coliforms. This level of performance is much improved to that of 2011 when five sites failed to meet the requirement. Although this is an improvement on last year, DWQR is of the opinion that the pace of improvement in microbiological compliance at storage points is too slow and more rigorous investigation of failures needs to take place as there were, again, a significant number of investigations carried out in 2012 where no cause was found for failures. DWQR is encouraged that Scottish Water has significantly augmented the internal resource dedicated to the investigation of such issues and increased the pace of reservoir cleaning and inspection.

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 2012, compliance for iron improved against 2011's result, but manganese compliance deteriorated slightly, largely due to failures occurring in parts of Ayrshire served by Bradan WTW.



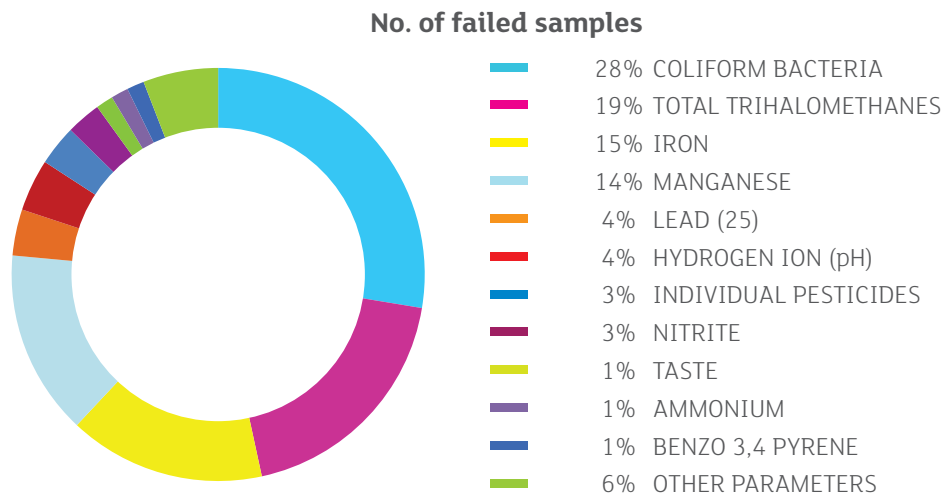
0.62%

of tests failed for manganese

WATER QUALITY AT CONSUMERS' TAPS

Most samples to assess regulatory compliance are taken from consumer taps, and testing takes place for fifty-one parameters. Sampling frequencies are determined by the population in the water supply zone. The vast majority of samples that were taken complied fully with regulatory requirements. For microbiology, only two samples contained *E. coli*, the same as in 2011. The poorest compliance was for total trihalomethanes (97.30%), iron (99.34%), lead (99.49%) and manganese (99.38%). Trihalomethane compliance was similar to 2011, despite ongoing work by Scottish Water to reduce the number of failures due to this by-product of the disinfection process. DWQR takes the view that Scotland can and must achieve the same high level of compliance for this parameter that is seen elsewhere in 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 2012, 709 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 2012, 23 events were classified as incidents, representing a sharp drop on 2011. DWQR remains concerned with the number of incidents that were caused by a failure of the disinfection process. Scottish Water has been asked to look at verification of this process for each water supply, and this work should include resilience and process safeguards.

Three significant incidents occurred in 2012:

- Crianlarich WTW, Stirlingshire
Contamination of a temporary water pipeline at the treatment works resulted in hydrocarbon contamination of the supply and taste and odour complaints. A “Do Not Use” notice was imposed on the supply. The temporary pipeline included a hose supplied by a contractor that had been contaminated during storage. Scottish Water Procurement undertook a review of suppliers in response to the incident.
- Aviemore WTW, Highland
A new water source was commissioned, causing consumers to notice the different characteristics of the supply, resulting in significant press interest. The supply remained safe to drink throughout the incident. DWQR concluded that the new supply complied with Regulatory requirements and that, while Scottish Water had done a good job in communicating the change to the community, it could have acted more swiftly in adjusting chlorine concentrations to take account of the new supply.
- Kirkintilloch, East Dunbartonshire
Scottish Water received taste and odour and discoloration complaints from consumers in a large, new, housing development in Kirkintilloch. Investigations by Scottish Water revealed foam swabs used to clean water mains had been inadvertently left in a main, restricting flow and affecting quality. These had originated from when the new mains were laid by contractors, and DWQR found significant shortcomings in Scottish Water’s control of developers and self-lay contractors providing water mains on new developments.

23

water quality events were
classified as incidents by DWQR

AUDIT AND INSPECTION

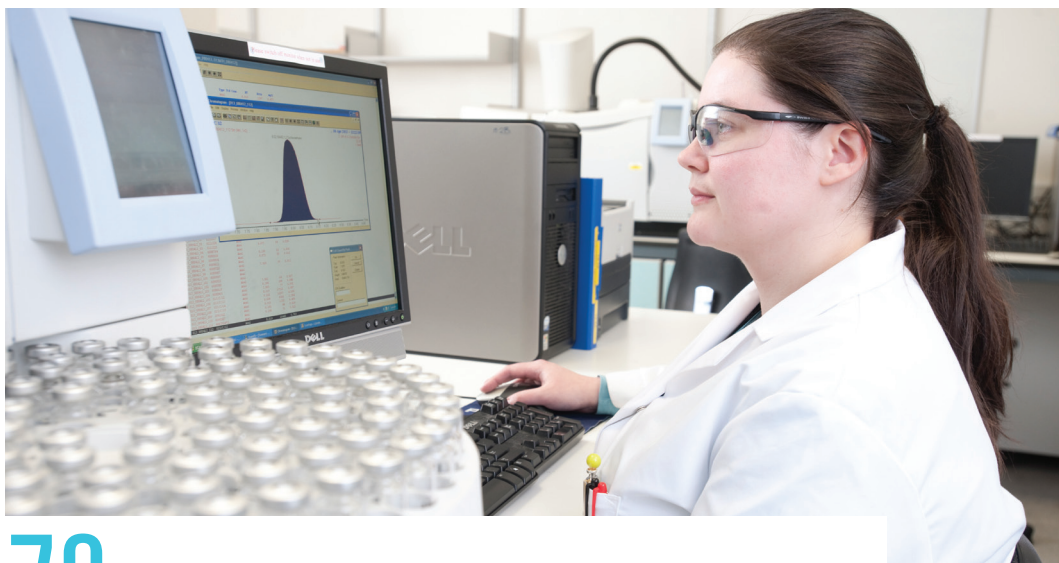
Audit and Inspection is a key part of DWQR's role and DWQR undertakes a number of inspections across Scotland every year, auditing against regulatory requirements and industry best practice. This enables DWQR to monitor Scottish Water's performance and hear about issues first hand from operational staff 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 2012 DWQR undertook the following inspections:

- 9 water treatment works
- 5 distribution systems
- 2 sampling and analysis
- Scottish Water's complaints procedure
- Delivery of recommendations
- Mains rehabilitation investment

The treatment works inspections demonstrated that treatment processes were generally being run effectively by highly competent staff. A number of issues were identified, and more commonly occurring themes included the online monitoring of water quality, operation and maintenance of filters and clarifiers and chemical storage and dosing.

The sampling and analysis audits of Inverness and Edinburgh laboratories showed that Scottish Water Scientific Services staff were operating to a very high standard, a view also held by UKAS when they audited against Drinking Water Testing Specification (DWTS) requirements early in 2013.



70

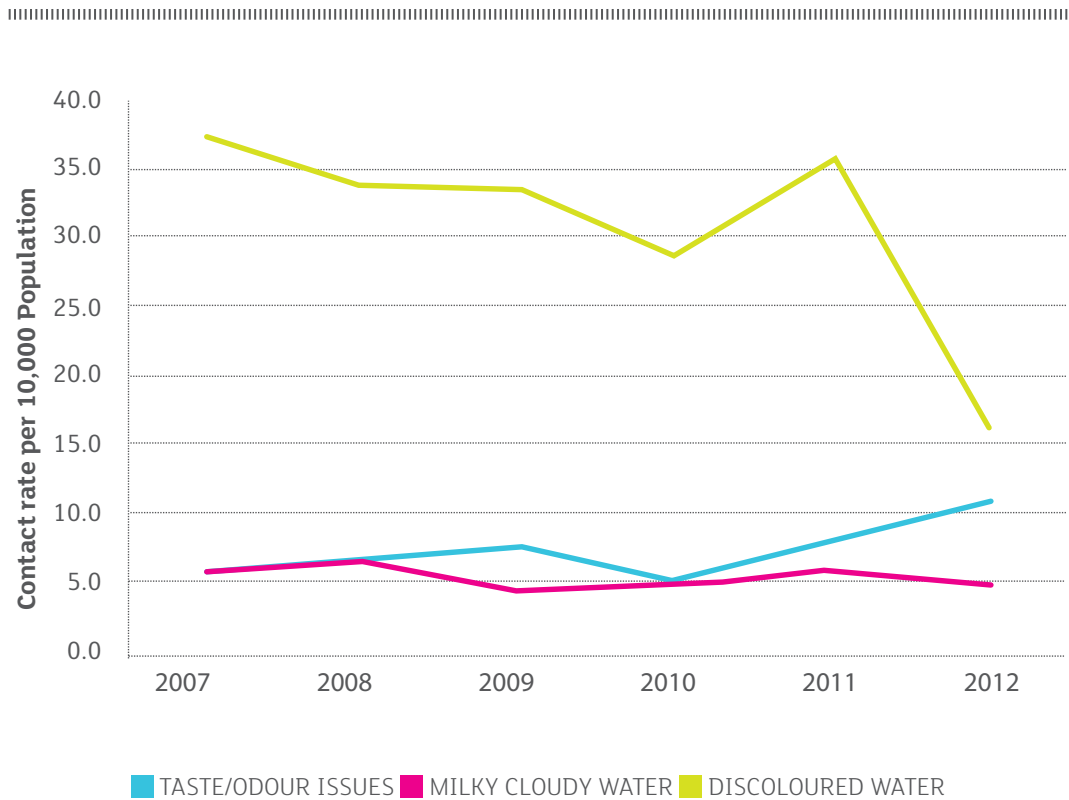
recommendations were made by
DWQR during inspections of WTW

CONSUMER CONTACTS

Scottish Water received 17,776 consumer contacts relating to water quality which was a 31% reduction in the numbers experienced in 2011, although a similar value to that reported in 2010. The significant change was due to decreased numbers of contacts reporting discoloured water although dissatisfaction with chlorine or metallic tastes in the water increased by a lesser amount.

Discoloured supplies remained the largest category of complaints, mainly due to iron sediment arising from cast iron water mains and manganese incompletely removed by treatment processes. Significant work to rehabilitate water mains continued throughout the period and should result in a continued decrease in this figure.

Trends in consumer contacts to Scottish Water about quality



The upward trend in taste and odour contacts is of concern and is primarily related to chlorine tastes and smells. Thorough disinfection of the water supply is vital to public health, but Scottish Water must manage the amount of chlorine added carefully to avoid causing consumers to find the taste unpleasant.

17,776

Contacts to Scottish Water from consumers regarding the quality of their water supply

PRIVATE WATER SUPPLIES

Private water supplies (PWS) are drinking water supplies which are not the responsibility of Scottish Water but of their owners and users. The Private Water Supplies (Scotland) Regulations 2006 (“the 2006 Regulations”) are enforced by local authorities, and the DWQR supervises this enforcement.

The sources of PWS are many and varied, and a large number of householders and businesses depend on them for their drinking water supplies. In 2012 there were 19,916 registered PWS in Scotland which were reported to the DWQR, 2,434 Type A and 17,482 Type B. Type A supplies are those which supply 50 or more people or 10m³ water or more, and any PWS which is used in a commercial or public activity. The Type B classification relates to smaller, domestic supplies. Around 3% of Scotland’s population relies on PWS for their drinking water, but a significant number of others, for example visitors and tourists, will also consume these supplies.

Environmental Health teams from local authorities annually review risk assessments and sample larger ‘Type A’ PWS. In 2012, 89% of Type A PWS had either a completed or reviewed risk assessment. A total of 57,358 tests were carried out on samples taken from PWS, with 91% of tests complying with the standards; 39,006 from Type A supplies (93% compliance) and 18,352 from Type B supplies, which are sampled on a less frequent basis (86% compliance).

Type A supplies are subject to the monitoring requirements of European Directive 98/83/EC, which is reflected in the requirements of the 2006 Regulations. These supplies must be sampled at least annually for microbiological and chemical parameters which are set out in the 2006 Regulations.



DWQR has carried out an assessment of sampling compliance for each local authority for 2012, based on the data returns provided by each authority. It is disappointing to note that, based on the information available, of 31 local authorities in Scotland with PWS in their areas, only two achieved full compliance with their check sampling duties. In 2013, the DWQR will work with local authorities to identify any issues which can be improved with the reporting arrangements; write to all local authorities to provide a copy of their check monitoring sample compliance report, and will offer support with interpretation of the 2006 regulations as required. Policy will also be developed in 2013 to give clarity to local authorities on DWQR's expectations with sampling compliance and an agreed set of performance measures will be developed. It is DWQR's intention to publish local authority sampling compliance data in future annual reports.

The quality of all PWS, particularly microbiological quality, continues to be of concern. Of 2,158 tests on Type A supplies for *E. coli*, which is used as an indicator for faecal contamination, 333 (15%) contained *E. coli* and therefore failed the standard, a similar proportion to 2011. As a comparison, less than 0.01% of public water supplies failed the standard. Coliform bacteria were found in a third of private supplies.

Faecal contamination of drinking water supplies can pose a potential immediate risk to health of anyone drinking the water, including the user, their children and any visitors. Owners and users of PWS are strongly advised to ensure that they follow any advice given by Environmental Health teams on minimising this risk.

It is strongly recommended that where sampling shows that there is *E. coli* in a PWS, or where a risk assessment shows that there is a risk of faecal contamination, the catchment and source of the supply should be protected from animals and animal waste, and from sewage contamination. Additionally, appropriate treatment, including disinfection, should be installed and maintained to protect the health of consumers of the supply from *E. coli* and any other pathogens that may be present in the supply.

It is disappointing to note that a significant number of failures of the *E. coli* standard are continuing to occur at supplies where there is disinfection. In 2012, of 762 failures for *E. coli* standard, 40% of the supplies had disinfection.

15%

Of Type A PWS samples contained *E. coli*

DWQR expects local authorities to continue to work with owners and users of PWS to ensure the health risks from PWS are minimised, and if necessary that local authorities will use the regulatory powers available to them in order to protect public health.

Due to the concerns over the poor compliance with water quality standards, DWQR held a workshop with stakeholders including local authorities and health boards in October 2012 to begin the development of a strategy for improvement.

Non-means tested grants of up to £800 per property to improve PWS are available from local authorities to all who own or use a PWS. In the 2012-13 financial year £1.58 million of grants were awarded for PWS improvements.

1_ PUBLIC WATER SUPPLY



In Scotland 97 per cent of the population receives water from the public water supply, which is provided by Scottish Water. Scottish Water is a publicly owned company, delivering drinking water to 2.4 million households throughout the country. Water must meet the same quality standards regardless of the size of the supply or its location in Scotland.

Water from lochs, rivers, boreholes and springs is cleaned and disinfected at water treatment works before being distributed to consumers via a network of storage points and water mains. In line with best practice guidance from the World Health Organization, a Water Safety Plan approach is used to identify and manage risks to the quality of water supplied by Scottish Water. This approach breaks supplies down into a number of sequential stages, from catchment, through treatment and the distribution system to the consumer's tap. Each stage carries its own issues and risks and this section of the report explores water quality and DWQR activities at each stage during 2012.

1.1_CATCHMENT



Scotland's water resources used for public water supplies are generally of very high quality. There are basically three sources used for public water. 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 with natural lochs providing 14% of resources. Just over another third comes from taking water directly from rivers and burns. The remaining 16% comes from boreholes and naturally occurring springs.

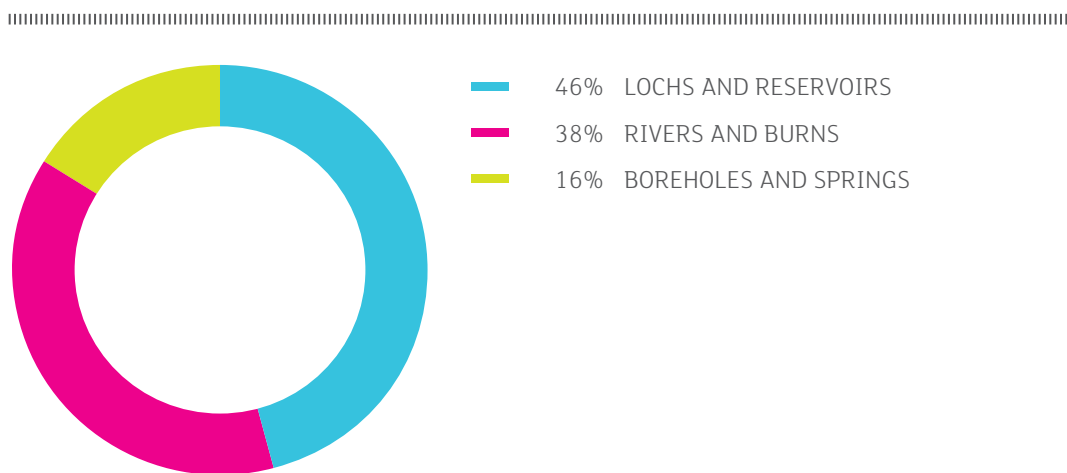
The groundwater taken from boreholes and springs is generally more consistent in quality and requires less intensive treatment than water taken from a surface water supply. Impounding reservoirs and natural lochs tend to be the next best quality as the process of storing the water in large volumes has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

1.1.1_ POTENTIAL CONTAMINANTS WITHIN CATCHMENTS

Scottish Water is required to produce Water Safety Plans (WSPs) for all of its water supplies. These 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. The types of sources are depicted in the chart below.

Source Type Description



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 intended for the abstraction of drinking water.

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 436 out of the 523 sources in Scotland (about 83%) 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 42% 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 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 microorganisms 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 microorganisms off the land and into drinking water resources, 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 *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 score, which take into account such things as density and type of animals on the catchment, agricultural practices and the type of water source. In 2012, 82 out of 267 drinking water sources were sampled for *Cryptosporidium* across Scotland and 26% of these contained *Cryptosporidium* oocysts. Water treatment works are expected to have treatment processes suitable for removing *Cryptosporidium*, and treated water supplies are also monitored for the parasite.

1.1.2_ 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 five 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, nutrients such as phosphorous and nitrates) at source, thereby avoiding the costs of installing expensive treatment to take these contaminant(s) out at the water treatment works. In 2011 Scottish Water worked with SEPA and land managers such as 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 monitoring in these catchments to better understand the sources and pathways of diffuse pollution.

Scottish Water has also developed a Sustainable Land Management Incentive Scheme to help land managers finance measures aimed at reducing the level of diffuse pollution that can be caused by the application of pesticides. There have already been a small number of applicants for this scheme, but it is too early to say what impact, if any, these measures are having on water quality. In addition, Scottish Water is working closely 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.

1.1.3_ EVENTS AND INCIDENTS IN CATCHMENTS

Kilmuir

Work to construct a new treatment works at Kilmuir on Skye required the construction of a new access road. This was to be built across land near to some of the springs supplying raw water to the works. Soon after construction had commenced, deteriorating raw water quality was noted at the works. Although work on the road was quickly stopped, further water quality exceedences occurred for turbidity, aluminium and iron over a number of days. As the existing works had minimal treatment, any impact on raw water also affected the final water supplied to consumers. Elevated *Cryptosporidium* counts were also noted in the supply during April.

Modifications to the spring collection system were made and temporary filtration equipment was installed on site by mid-May. The scope of the project was reviewed and it was decided not to construct a treatment works at Kilmuir, and instead to supply it from an upgraded works nearby. In the interim period, temporary treatment was put in place. Appropriate sampling was undertaken over the period confirming that final water quality was not compliant for a total of five consecutive days.

DWQR is of the opinion that, although some efforts were made to evaluate the risk to the source from the proposed work, these were not adequate. The hydrogeology of the spring system at Kilmuir was not entirely understood when construction commenced on site, and a number of assumptions were made. The investigation work that had taken place beforehand had not revealed any potential impacts on water quality or spring yield, however a full investigation was not done and no accurate drawings were available for the source.

Scottish Water Solutions identified three actions necessary to prevent the occurrence of a similar situation at other shallow groundwater sites. These include the requirement to consult with a hydrogeologist prior to the commencement of work within 50m of any spring or other shallow hydrogeological source.

1.2 WATER QUALITY AT TREATMENT WORKS



Scottish Water has 267 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.

It is vital that water is treated properly to ensure that the disinfection process is 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) 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.

1.2.1_ 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 many 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 and 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. In 2012, following discussion with DWQR, Scottish Water has increased the depth of investigation it undertakes in response to microbiological 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.

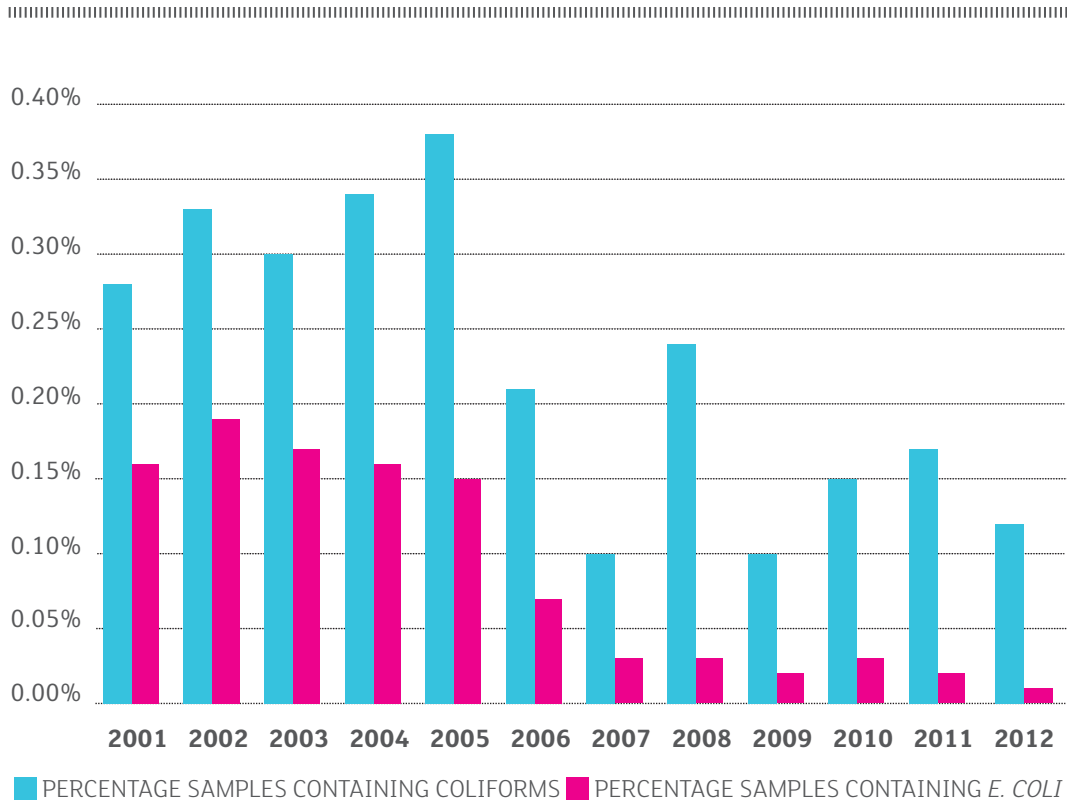
Table 1.2a_Summary of Microbiological tests at WTW

COLIFORM BACTERIA Standard = 0 per 100ml						
	2012	2011	2010	2009	2008	2007
Number of tests	27,305	28,792	29,097	30,997	31,488	32,534
Number containing coliforms	33	49	44	30	76	33
Percentage containing coliforms	0.12	0.17	0.15	0.10	0.24	0.10
E. COLI Standard = 0 per 100ml						
Number of tests	27,304	28,794	29,097	30,997	31,487	32,534
Number containing faecal coliforms	3	5	8	6	10	10
Percentage containing faecal coliforms	0.01	0.02	0.03	0.02	0.03	0.03

Table 1.2a and **Figure 1.2a** show the microbiological results at treatment works for recent years. Of the 27,304 samples taken, only 33 contained coliforms and three contained *E. coli*. This represents an improvement on recent years, and the number of samples containing *E. coli* is the lowest ever recorded in Scotland. Scottish Water has continued to invest in new or improved water treatment works during 2011/12 in addition to improving facilities for taking samples at treatment works, and it is likely that this has had a positive effect.



Fig. 1.2a



During 2012 Glendevon WTW recorded three coliform failures, and Glenfarg WTW recorded two. Both of these works supply parts of Fife. Glenfarg WTW was inspected by DWQR early in 2013. It is likely that there is no single cause of these failures. The matter has been discussed with Scottish Water and a number of actions will be taken. The *E. coli* detections occurred at Balmore, Perth (Gowans Terrace) and Muirdykes WTW. In all three cases, Scottish Water was quickly able to establish that there was not a general problem with the supply and that chlorine residuals were adequate. At Balmore, changes were made to the sampling arrangements in response to the failure.

1.2.2_ CHEMICAL QUALITY AT TREATMENT WORKS

Water is tested for two chemical parameters in samples taken from treatment works. These are summarised in **Tables 1.2b** and **1.2c**. 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 first time ever, no exceedences of the standard for nitrite were recorded at water treatment works.

Table 1.2b_ Summary of nitrite tests at WTW

NITRITE Indicator Standard = 0.1mg/l at WTW	2012	2011	2010	2009	2008	2007
Number of tests	2790	2,910	2,859	2,993	3,028	3,182
Number of tests exceeding standard	0	1	3	4	2	3
Percentage of tests exceeding standard	0	0.03	0.1	0.13	0.07	0.09
Number of treatment works not meeting regulatory requirements	0	1	2	3	2	2
Percentage of treatment works not meeting regulatory requirements	0	0.38	0.74	1.06	0.68	0.65

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 standard with ease. In 2012 there were 10 exceedences of the standard for turbidity, less than half the 2011 number but still more than is acceptable. Daer WTW and Fort William WTW both recorded two failures each. Both have been attributed to sampling issues and resolved.

Table 1.2c_ Summary of turbidity tests at WTW

TURBIDITY Indicator Standard = 1 NTU AT WTW	2012	2011	2010	2009	2008	2007
Number of tests	7331	7,745	7,855	8,123	8,250	8,514
Number of tests exceeding standard	10	24	28	26	33	71
Percentage of tests exceeding standard	0.14	0.31	0.36	0.32	0.4	0.83
Number of treatment works not meeting regulatory requirements	8	18	20	20	17	39
Percentage of treatment works not meeting regulatory requirements	3.00	6.79	8.49	7.04	5.78	12.70



1.2.3_ *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 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 1.2d_Summary of *Cryptosporidium* tests at WTW

CRYPTOSPORIDIUM	2012	2011	2010	2009	2008	2007
Number of tests	8,739	8,919	9,386	10,386	11,002	11,393
Number of samples containing <i>Cryptosporidium</i> oocysts	217	378	312	409	471	927
Percentage of samples containing <i>Cryptosporidium</i> oocysts	2.48	4.24	3.32	3.94	4.28	8.14
Number of treatment works sampled for <i>Cryptosporidium</i>	267	264	270	281	292	300
Number of treatment works with one or more samples containing oocysts	77	91	88	93	87	138
Percentage of treatment works with one or more samples containing oocysts	28.84	34.47	32.59	33.10	29.79	46.00

Table 1.2d shows the results of tests for *Cryptosporidium* in samples taken at water treatment works in the context of previous years. Out of 8,739 samples from 267 treatment works, 217 contained oocysts. The number of treatment works from which at least one positive sample was taken was 77 in 2012. This is a considerable improvement, and the percentage of samples with a positive *Cryptosporidium* result is less than a third of that reported in 2007. This improvement is welcomed, but DWQR believes that all of Scottish Water's treatment works should be equipped and optimised to remove oocysts and the detection of oocysts at 29% of treatment works is far from acceptable. Scottish Water has been funded to ensure all treatment works are able to effectively remove oocysts and remaining improvements should be delivered within the current five year investment period. It is apparent that a number of treatment works that have processes that should be capable of oocyst removal are still recording positive samples, suggesting that greater focus may be needed on maintenance and optimisation in accordance with water industry best practice.

Table 1.2 e_ WTW with more than 20% of Samples Containing Oocysts

TREATMENT WORKS	SAMPLES TAKEN	SAMPLES CONTAINING OOCYSTS	% CONTAINING OOCYSTS	TREATMENT DURING 2012	OUTCOME
Shieldaig WTW	5	5	100.00	Disinfection Only	New WTW
Craignure WTW	12	10	83.33	Simple Filtration	Alternative supply planned
Strollamus WTW	51	32	62.75	Simple Filtration	Alternative supply planned
Achmore WTW	16	10	62.50	Simple Filtration	Alternative supply (Kyle)
Lochaline WTW	12	6	50.00	Simple Filtration	Work planned
Kinlochewe WTW	13	6	46.15	Simple Filtration	New WTW
Arnisdale WTW	12	4	33.33	Simple Filtration	New WTW planned
Glenfinnan WTW	9	3	33.33	Simple Filtration	Alternative supply planned
Maaruig WTW	10	3	30.00	Simple Filtration	Alternative supply planned
Gairloch WTW	7	2	28.57	Disinfection Only	New WTW (Poolewe)
Invermoriston WTW	12	3	25.00	Simple Filtration	New WTW planned
Kilmuir WTW	8	2	25.00	Simple Filtration	Alternative supply planned
Southdean Mill WTW	12	3	25.00	Simple Filtration	Alternative supply planned
Tarskavaig WTW	12	3	25.00	Simple Filtration	Alternative supply (Teangue)

In 2012, many supplies that regularly contained oocysts were either replaced with a new, robust, works or replaced by a supply from a neighbouring area that is compliant. Kinlochewe, Gairloch, Shieldaig, Elphin and Achmore have all benefitted from such investment. Work is still awaited at a number of other sites in order to ensure they offer a robust barrier to *Cryptosporidium*.

Cryptosporidium was also detected at a number of treatment works with apparently robust treatment in 2012. These include some works with membrane treatment, which should provide an absolute barrier to *Cryptosporidium*. In particular, two large membrane sites – Badentinan on Speyside and Invercannie, serving Aberdeen, had multiple detections. Scottish Water has identified a need for improved maintenance of membranes and is implementing this across Scotland – it is vital that all detections at membrane sites are fully investigated and addressed. DWQR requires Scottish Water to routinely monitor membrane integrity, and understand and act upon the results.

Some treatment works having more conventional multistage flocculation and filtration processes also recorded multiple samples containing oocysts in 2012. These works should act as an effective barrier, but breakthrough is possible if they are not operated optimally. Turriff and Forehill, both in Aberdeenshire, and Rosebery and Castle Moffat, both in the Lothians, are large works that all detected oocysts on more than one occasion in 2012. There is extensive and established guidance available to the water industry regarding this, and it is vital that Scottish Water follows this thoroughly and consistently at all its works.



OLD WTW AT KINLOCHEWE, NOW REPLACED BY MODERN MEMBRANE WORKS

1.2.4_ 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 catchment 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 2012 nine water treatment works were inspected. The majority of these were selected on a risk basis using analytical data, but one was in direct response to a water quality incident. **Table 1.2f** shows the inspections that were undertaken during the year.

Table 1.2f_ Inspections at WTW

LOCATION	DATE	REASON FOR AUDIT	NO. OF RECOMMENDATIONS
Amlaird (Ayrshire)	January 2012	Risk based	12
Bradán (Ayrshire)	January 2012	Risk based	12
Muirdykes (Renfrewshire)	February 2012	Risk based	8
Rawburn (Borders)	February 2012	Risk based	3
Invercannie (Aberdeenshire)	March 2012	Risk based	6
Mannofield (Aberdeenshire)	March 2012	Risk based	6
Turriff (Aberdeenshire)	April 2012	Risk based	10
Rosebery (Midlothian)	November 2012	Risk based	9
Calder Hoy (Caithness)	December 2012	Incident Investigation	4

Scottish Water staff operated their plants with a high degree of professionalism 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.

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

- The need for adequate water quality monitoring instrumentation and to ensure this is properly maintained and calibrated;
- A lack of clearly evidenced and documented disinfection contact time at some sites and a site specific disinfection policy;
- A benefit in enhanced focus on optimisation of filter performance for quality issues;
- 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.

1.2.5_ EVENTS AND INCIDENTS AT TREATMENT WORKS

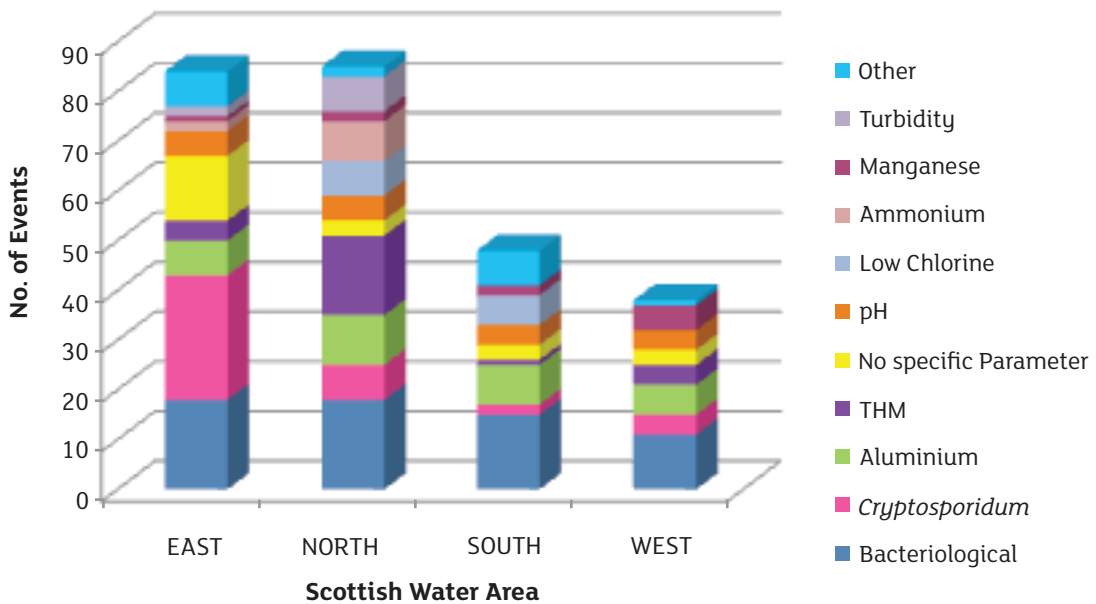
Scottish Water is required to tell the DWQR about all events that could affect water quality or cause concern to consumers. This includes all regulatory sample failures that are significant or unexpected and any failure of a treatment process. Each event is reviewed and the most serious classified as 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 prosecution may be considered.

In 2012, 709 events were reported to the DWQR, of which 248 related to water treatment works. This represents a reduction of nearly 200 in the total number of events and much of this reduction, 178 events, comes from treatment. If sustained over coming years, this is a positive development as it suggests the resilience of Scottish Water's treatment assets is improving and mechanisms to alert operational staff to issues are becoming more effective.

Bradán WTW in Ayrshire and Craighead WTW serving Huntly in Aberdeenshire recorded the largest number of events in 2012 with seven each. DWQR inspected Bradán WTW in 2012, making 12 recommendations.

Treatment works at Marchbank (Lothian), Glenlatterach (Moray), Glenfarg and Glendevon (both Fife) all generated 6 events each. Three of the events at Glenfarg concerned microbiological failures, and DWQR inspected this site in early 2013.

Fig. 1.2b_Causes of Events in Scottish Water’s Operational Areas



Overall, 24% of Scottish Water’s events at treatment works related to bacteriological issues, such as coliform detections in the final water. These events were fairly evenly distributed across Scottish Water’s operational areas. Out of 62 bacteriological events, almost half had no definite cause attributed to them. This is unacceptable, and Scottish Water must do more to comprehensively investigate failures and events in order to identify the cause. The company has recently put together a team responsible for this activity, so a significant improvement in the quality of investigations is anticipated.

The next largest category of events is *Cryptosporidium*, with 15% of the total figure. As can be seen from the graph, the majority of these occurred in Scottish Water's East region, which stretches from Fife to Aberdeenshire and includes Orkney and Shetland. A number of these failures relate to large treatment works which have treatment process which should provide a robust barrier to *Cryptosporidium*. Some also relate to much smaller works with minimal treatment. Investment should be underway at these sites to provide a reliable barrier process.

THM events primarily occurred in the North area, where some treatment works are still not capable of removing the organic THM precursor compounds from the highly coloured source waters.

Table 1.2f_ Causes of events at WTW

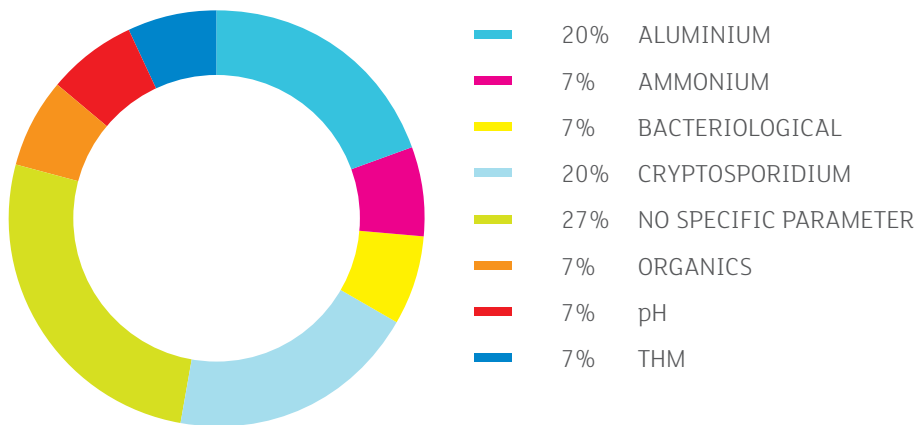
EVENT CAUSE	NUMBER OF TREATMENT EVENTS	% OF TREATMENT EVENTS
Inadequate Treatment	70	28
No Cause or Outcome	46	19
Failure of Coagulation	32	13
Disinfection Process Failure	15	13
Power Failure	14	6
Final Water pH Control	11	6
Sample Point or Line	18	4
Other	5	7
Catchment	5	2
SCADA/PLC/Telemetry	5	2
TOTAL	248	

Table 1.2f shows the causes that were attributed to the events at WTW reported in 2012. The most common cause remains "inadequate treatment" as in 2011, accounting for almost 30% of events. This relates to situations where, in the Regulator's opinion, the treatment works does not have appropriate processes to satisfactorily treat the incoming raw water or where the processes are appropriate but are not treating water effectively to the standard required. As in 2011, *Cryptosporidium* detections accounted for the largest number of these events, but some also related to manganese and THMs.

The "No Cause or Outcome" category represents the next largest, and as discussed previously, DWQR expects Scottish Water to actively reduce this in future years.

The number of events caused by failure of the coagulation and disinfection processes has reduced since last year, suggesting that these processes are being better managed and safeguards working more effectively – but as ever there remains room for further improvement.

Fig. 1.2c_ Nature of Incidents at WTW



Annex A lists incidents declared in 2012. Fifteen occurred at treatment works and this accounts for 65% 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 1.2c** shows the nature of incidents occurring at treatment works. It can be seen that the largest single category of incident related to no specific parameter. Most of these involved issues around the disinfection process at treatment works where no actual failure occurred, although clearly there was the potential for serious consequences for quality. In the 2011 report, DWQR raised grave concerns over the increasing number of incidents which occurred due to a failure of the disinfection process. Scottish Water has responded positively to this concern and during 2012 a reduction in this type of incident is noted. However, the number of disinfection failure incidents continues to be of concern and Scottish Water has been requested to look at verification of this process for each water supply, including assessment of resilience and process safeguards.

The next largest categories concern aluminium and *Cryptosporidium* with three incidents each. The number of incidents has more than halved since last year, suggesting an improved control of the coagulation process.

A full list of incidents that occurred at water treatment works during 2012 is provided in Annex A. Two key incidents at treatment works are described in more detail below:

65% of Scottish Water's incidents occurred at water treatment works

Crianlarich WTW, Stirlingshire, February 2012

On 26 February 2012, at 18:54 hrs, Scottish Water received a telephone call from a consumer reporting a chemical smell from their drinking water supply. Initial checks with local staff and at the treatment works did not identify any cause for concern with the supply and the odour of the water was described as being musty. Late the following day, two further calls were received from consumers concerned with taste and odour in their water supply and one of these described as being similar to a paraffin odour. Thorough investigation of the issue was instigated on 28 February during which a fuel type odour was detected in the raw water inlet chamber at the water treatment works. An inspection of the intake found no obvious evidence of contamination and the supply from the works was closed off. Water was delivered to the clear water storage tank by tankers from 11:30hrs on 28 February to enable a thorough investigation of the catchment and treatment works and also to allow the system to be flushed with clean water. A restriction on use of the supply was issued to consumers and remained in effect until Scottish Water were able to verify that the supply was again safe to use.

Prior to this event, Scottish Water had identified problems with the efficiency of submersible pumps which transferred water from the raw water inlet chamber to the membrane treatment plant. A temporary arrangement using a diesel pump was put in place to enable the first of the new submersible pumps to be fitted on 24 February. It was suspected that there may have been a problem during the works to install the pump or that the pump itself introduced contamination. Checks showed however that this was not the case and there was no issue with the temporary pumping arrangements. In order to carry out more intensive checks on the area it was decided to move the temporary diesel pump and in doing so, it became evident that a section of pipe forming the water suction pipeline had a defect and the pipe wall was suspected to be contaminated with diesel. This was removed from the site and later examined. The chamber, pipelines and membrane treatment plant were thoroughly cleaned and following verification of clear water samples the restrictions on use were lifted on Saturday 3 March.

DWQR investigated this incident and visited the site. Scottish Water identified nine actions, and DWQR identified an additional one. DWQR also audited Scottish Water's procurement department in early 2013, including the approach taken to ensuring suppliers were storing temporary equipment in a manner which prevented contamination. DWQR was satisfied that Scottish Water had fully addressed the relevant issues.



Penwhapple WTW, Ayrshire, March 2012

A failure of the control system for the return of supernatant liquor to the inlet of the works allowed the pumps to draw up sludge from the lower levels of the filter wash water settling tanks. This in turn overloaded the Dissolved Air Flotation clarifier units causing the loss of the flocculation blanket and carry over onto the filters. The problem occurred outwith normal working hours in the early hours of 27 March with a system alarm alerting control room staff to the problem. A standby Treatment Operator attended the site but failed to identify the problem. The normal site operator arrived on site and realised the process had still not recovered. The problem was escalated to team leaders and with Turbidity in excess of 3 NTU and Aluminium at 600µg/l at around midday on 28 March, the works was shut down until controlled steps could be taken to reset the processes and systems. Cleaning of filters and a section of the clear water tank allowed a staged reintroduction of the plant and full production to be restored.

DWQR considers there to have been a failure to ensure adequate training of staff in the understanding and effective operation of the works. A failure to ensure that key water quality monitoring equipment is in serviceable use is also unacceptable. The effectiveness of the aluminium monitors had been an issue for some nine months and DWQR considers the priority given to repair or replacement of the faulty control instrumentation to be inappropriate, leading to an unacceptable level of operating risk. Scottish Water has identified a number of actions from this incident.



1.2.6_ 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 has been made with this task during 2012, but it became apparent that investment is 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.

In addition, disinfection control was improved at 13 water treatment works during the course of 2012. Works improved include Achmore, Braemar and Tyndrum. This 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 2012, the treatment works at Glassford just north of Strathaven was closed and the area previously supplied by that works is now served by Camps and Daer water treatment works. The water treatment works at Aboyne in Aberdeenshire was also closed with the area previously supplied by that works now being served by Glendye water treatment works.

Of special note during 2012 was the commissioning of the new treatment works at Glencorse, just outside Edinburgh. This long-awaited modern works replaced the aging works at Fairmilehead and Alnwickhill which previously served the city and provides Scotland's capital with drinking water of first class quality. Scottish Water took great care to minimise disruption to consumers during the complex commissioning phase and it is a tribute to this hard work that the change went almost unnoticed by the majority of consumers in Edinburgh.

1.3 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. 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.

1.3.1_ 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. 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. Scottish Water adopts a risk-based approach to cleaning and refurbishing storage tanks. 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 many detections of coliforms may be 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 2012 (**Table 1.3a**) show that there was an all-round improvement in the incidence of bacteriological sample failures. 109 samples failed the coliform standard and seven samples contained *E. coli*. These failures were recorded across 100 sites and although this is better than the number last year, it is still a poorer position than 2010 where 97 sites were affected. It is of considerable concern that 14 storage tanks feature in the list of failures in each of the past two years. Scottish Water must work harder to understand and resolve the issues at these sites.

Table 1.3a Summary of microbiological tests on storage tanks

COLIFORM BACTERIA Standard = 0 per 100ml	2012	2011	2010	2009	2008	2007
Number of tests	52,226	51,952	49,877	53,001	55,104	56,277
Number containing coliforms	109	122	106	137	137	127
Percentage containing coliforms	0.21	0.23	0.21	0.26	0.25	0.23
<i>E. COLI</i> Standard = 0 per 100ml						
Number of tests	52,226	51,952	49,877	53,001	55,102	56,277
Number containing <i>E. coli</i>	7	13	9	12	11	16
Percentage containing <i>E. coli</i>	0.01	0.03	0.02	0.02	0.02	0.03

One storage tank failed to meet the regulatory requirement that 95% of samples shall not contain coliforms, this was at Pathhead in Midlothian. This level of performance is much improved to that of 2011 when five sites failed to meet the requirement. **Table 1.3b** shows the poorest performing sites in 2012. The monitoring requirement for storage tanks is to take weekly samples whilst they remain 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 or, as in the case of Pathhead, Macduff Low, and Westfield, Aberdeenshire being isolated from the network and decommissioned.

Table 1.3b_Storage tanks failing microbiological standards

STORAGE TANK	LOCATION	% SAMPLES WITH NO COLIFORMS	NO. OF SAMPLES TAKEN
Pathhead	Pathhead	93.8	16
Tayvallich	Tayvallich	95.7	47
Macduff Low	Macduff	96.6	29
Westfield	Auchleven	96.8	31

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 investigates each detection and takes action where necessary and it has improved the process by which it prioritises the cleaning of these assets.



RISKS OF INGRESS THROUGH ROOT INVASION OF ROOF CONSTRUCTION JOINTS AND PROTECTIVE MEMBRANES

The slow pace of improvement in microbiological compliance is very disappointing and more rigorous investigation needs to take place. There were again, a significant number of investigations carried out in 2012 where no cause has been found for failures. DWQR is however encouraged that Scottish Water has significantly augmented the internal resource dedicated to the investigation of such issues and looks forward to a substantial improvement in the resolution of microbiological failures at storage tanks.

1.3.2_ WATER MAINS NETWORK

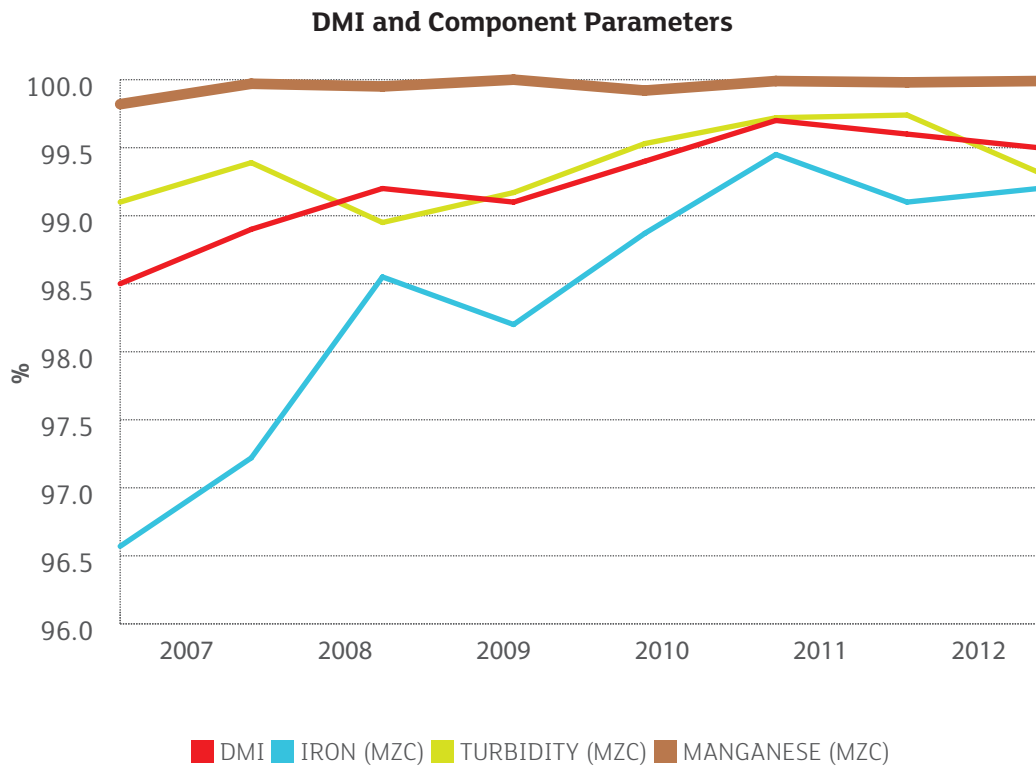
The Distribution Maintenance Index, or DMI, is a measure used to monitor the performance of distribution systems. DMI looks at regulatory sample data for turbidity, iron and manganese at consumer taps since these three parameters best reflect the performance of the distribution system and its tendency 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 1.3a shows the DMI trend since its introduction as a measure in 2005, together with the mean zonal compliance of the three index parameters.

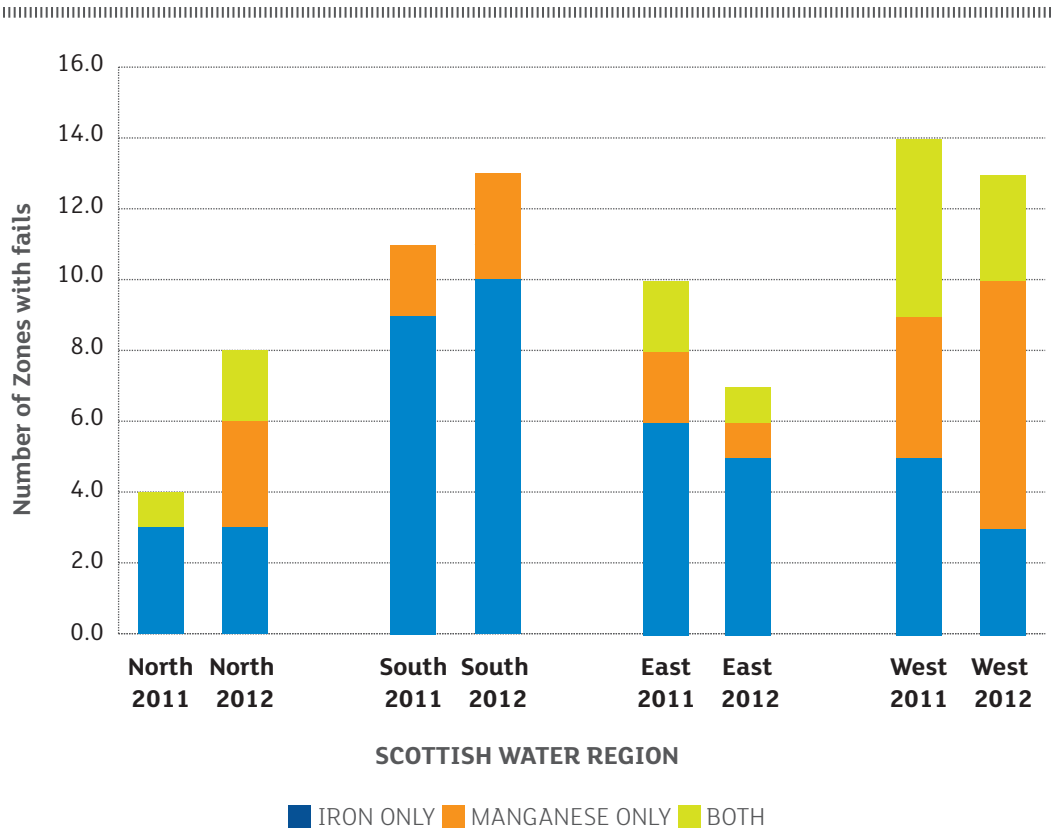
The mean DMI for all zones was 99.50% which, for the second year running, is slightly poorer than the previous report.

Fig. 1.3a_Distribution Maintenance Index



The mean DMI for all zones was 99.50%, which for the second year running, is slightly poorer than the previous report. 42 supply zones recorded a failure of an index parameter which is one more than in 2011. Iron and Manganese are the main contributors to performance and **Fig 1.3b** shows the regional breakdown of the number of zones with iron and manganese failures.

Fig. 1.3b_ 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 by operational activity causing flow changes within the water mains, i.e. operation of valves or burst mains.

Fig 1.3a on the previous page shows an improving situation over the past few years but, perhaps surprisingly, with the ongoing investment into improvement of the network, the loss of ground in 2011 and 2012 is of concern. Whilst there has been a positive shift in the Iron failures in the East and West, the key difference from last year is an increase in the manganese failures in all regions except the East.

It is particularly noteworthy that a third of the failures for manganese during 2012 occurred in the supply zones served by Bradan WTW in Ayrshire, despite the treatment works having a manganese removal process and extensive rehabilitation work having been undertaken in the distribution system. DWQR is disappointed with the poor performance here and Scottish Water must ensure measures are put in place to prevent it continuing to have an adverse impact on consumers.

1.3.3_ 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 by DWQR. If common themes are identified, these are progressed centrally with senior Scottish Water staff. Elements of best practice are also highlighted when these are spotted.

In 2012, a number of inspections on Scottish Water's networks and on the activities of maintenance teams and contractors carrying out investment works on the water mains were carried out. The investment activities were selected to cover rehabilitation works being carried out by different contractors across the country. **Table 1.3c** shows the inspections that were undertaken during the year.



PREPARING THE SPRAY HEAD ON A MAINS RELINING TOOL

Table 1.3c_ Inspections of distribution systems

LOCATION	DATE	SCOPE OF AUDIT	NO. OF FINDINGS
Carron Valley B	August 2012	Leakage works	2
Glasgow City	August 2012	Rehab works	2
Carron Valley B	August 2012	Full Networks	14
Edinburgh City	September 2012	Maintenance works	0
East Calder	September 2012	Maintenance works	1
East Calder	September 2012	Rehab works	4

The full distribution system audit within the Carron Valley B supply zone showed Scottish Water's management of water quality and operations to be, in the main, very good. Within this audit, a number of storage tanks were visited. The common themes emerging were that sample point and sample lines were less than adequately arranged or provisioned to ensure any risks from bacteriological contamination of a sample were minimised or that the sample being taken was representative of the water held in storage. Weed, scrub and sapling growth on tank roofs and embankments were also noted and these present a risk to the integrity of roofs and walls and their ability to withstand ingress of surface water. These issues are potential contributing factors in the general theme of poor performance in microbiological failures at service reservoirs.

The lack of hygienic storage of materials and equipment in temporary compounds, site containers and vehicles was the common issue across contractors working on investment activity on the water mains networks.

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

1.3.4_ EVENTS AND INCIDENTS IN DISTRIBUTION SYSTEMS

In 2012 a total of 709 events were reported to the DWQR, of which 449 related to networks. Six of these events were declared incidents which translates to 26% of all incidents as occurring on water mains or storage tanks.

Fig 1.3c 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. 1.3c

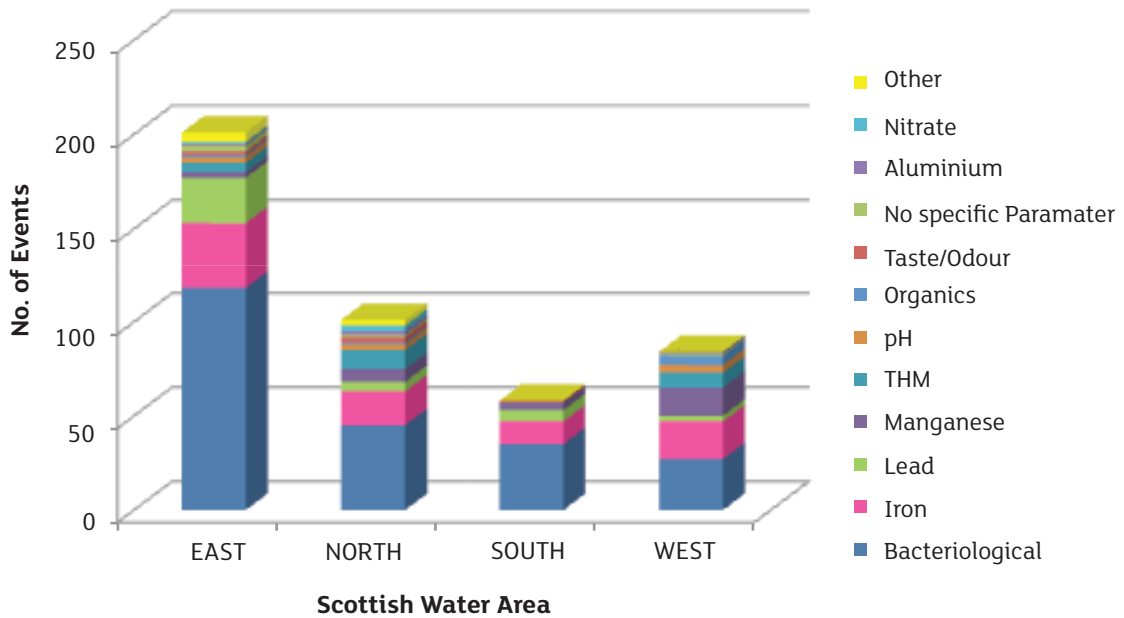


Table 1.3d shows the causes that were attributed to the networks related events which were reported to an outcome in 2012. A relatively small proportion of events (6.8%) are a direct consequence of some treatment issue which has had an impact within distribution. The most common attributable cause however 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.

Table 1.3d_Causes of distribution system events

CAUSE	NUMBER OF NETWORK EVENTS	% OF NETWORK EVENTS
No Cause or Outcome	150	33.8
Mains condition	129	29.1
Domestic Plumbing	52	11.7
Treatment Issues	30	6.8
Low Chlorine	30	6.8
Sample point or line	17	3.8
Ingress	14	3.2
Sampling or Laboratory error	5	1.1
Other	16	3.6
TOTAL	444	

For 150 events, however, it has not been possible to attribute a cause. Some 89% of events in this category are due to a bacteriological failure taken from storage tanks or consumer's taps and this, disappointingly, is a similar level of indeterminate cause to last year. They are very often in relation to low level parameter failures and follow-up sampling at the same point or neighbouring properties do not fail. Again it is possible that the condition of the water mains, the deposits within them and their local configuration may lie at the root of the failures, or they may be related to the condition of the tap or the sampling process itself, but this has not been proven. Scottish Water has established a larger resource of staff to investigate water quality issues and it is hoped that this resource will drive down the level of events with un-attributable causes.

The water supply zone with the largest number of events is again Whitehillocks in Angus where the condition of the water mains and un-attributable bacteriological failures comprise 9 of the 12 events. Scottish Water has substantially completed extensive rehabilitation works on the water supply mains throughout the zone and this should significantly reduce the level of failures, and the impact of discoloured water on consumers in 2013.

The six incidents assessed as serious events and sample failures in distribution, are attributed to the condition of the water mains or to low chlorine. The quality issues they exposed ranged across microbiological, polyaromatic hydrocarbons (PAH) and Lead parameters.

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:

Clashbuie Service Reservoir

The incident affected consumers supplied from the service reservoir at Clashbuie in Highland Region and saw repeated failures of microbiological standards over a number of days in September 2012. Following discussions with the NHS Highland Health Board, a boil water notice was delivered to the properties supplied by the reservoir affecting approximately 96 consumers in total. The notice remained in place for six days.

The service reservoir was drained and cleaned, but a series of burst mains in the area delayed completion of this. Efforts were also made to increase chlorine residuals, and secondary chlorine dosing was re-instated at Clashbuie. Scottish Water had historically added additional chlorine at this service reservoir in order to boost concentrations during the Summer months. Following the installation of more efficient disinfection equipment at Calder Hoy WTW earlier in the year however, this practice was discontinued. Chlorine concentrations had held up well through the Summer, but had dropped off in the few weeks prior to the first failure. It is likely that nitrifying bacteria took hold within the distribution system as chlorine residuals dropped off. Sample evidence suggests that coliform contamination was limited to Clashbuie Service Reservoir and the area it supplied, so it is possible that minor contamination entered the system and chlorine residuals were insufficient to neutralise it.

Following a number of sets of clear samples from the storage tank and within the supply area, the boil notice was lifted. The disinfection approach at Calder Hoy WTW was also changed, with the ratio of disinfection chemicals adjusted. DWQR audited Calder works in December 2012, partly in response to this incident and four recommendations were made.

This incident serves to demonstrate the importance of a comprehensive understanding of all aspects of disinfection across a water supply system. In this incident, less than optimal disinfection conditions at the treatment works are likely to have combined with local circumstances to produce a situation that, while subsequently shown not to have directly threatened public health on this occasion, certainly served to inconvenience consumers.

DWQR has made one recommendation in response to this incident.

Kirkintilloch

During the evening of 22 August 2012, Scottish Water began to receive complaints from consumers in Kirkintilloch, of discoloration, taste and odour in the water supply. The calls centred on a large, new housing development in the town where works had been carried out earlier in the day to transfer the development from one water supply system onto another. Consumers had variously described the water as being cloudy, stagnant or having a methane or sewage type smell and there was concern around the possibility of some form of contamination having entered the supply. The supply was shut off until the full extent of the problem could be assessed and to enable consumers to be warned that they should only use the water supply for sanitation purposes.

Operations staff undertook a controlled flushing of the system and a staged re-introduction of supply to the area, carrying out sampling at a range of addresses at different points in the development and surrounding streets. During this work, flows through the water mains unaccountably stopped and investigation of the problem revealed a foam swab to be stuck in the pipeline. This was removed by excavation of the main. One further swab was recovered at a separate point in the supply system during the operation. The presence of the swabs in the pipelines provided explanation to the complaints of stagnant water in that the transfer of the area onto a different supply system was likely to have moved a plug of stagnant water from an unused part of the mains system into consumers supply pipes. Further flushing was carried out and additional disinfection was provided locally into the system. Once clear water samples had been confirmed across the area, all-clear notices were issued to consumers.

DWQR considered the root cause of this incident to be the presence of foam swabs in the water mains system. Swabs are used in the commissioning and testing of new water mains to ensure any debris that may have accumulated in the construction phase is removed. It is a serious breach of hygiene standards and installation procedures for swabs to be permitted to remain in a pipeline. It demonstrates that the mains have not been properly cleansed before being introduced into supply and their presence provides a harbour of future water quality and operational issues, the consequences of which are clearly demonstrated here.

DWQR found there to have been significant shortcomings in Scottish Water's control of developers and self-lay contractors providing water mains. They were unable to demonstrate sufficient record of inspections or audit over the essential main laying activity and hygiene arrangements of the organisations operating on this development but also across the breadth of the development sector. Scottish Water needs to ensure the rigour applied in other functions of the Company to ensuring water quality is brought to bear.

1.3.5_ INVESTMENT IN THE DISTRIBUTION SYSTEM

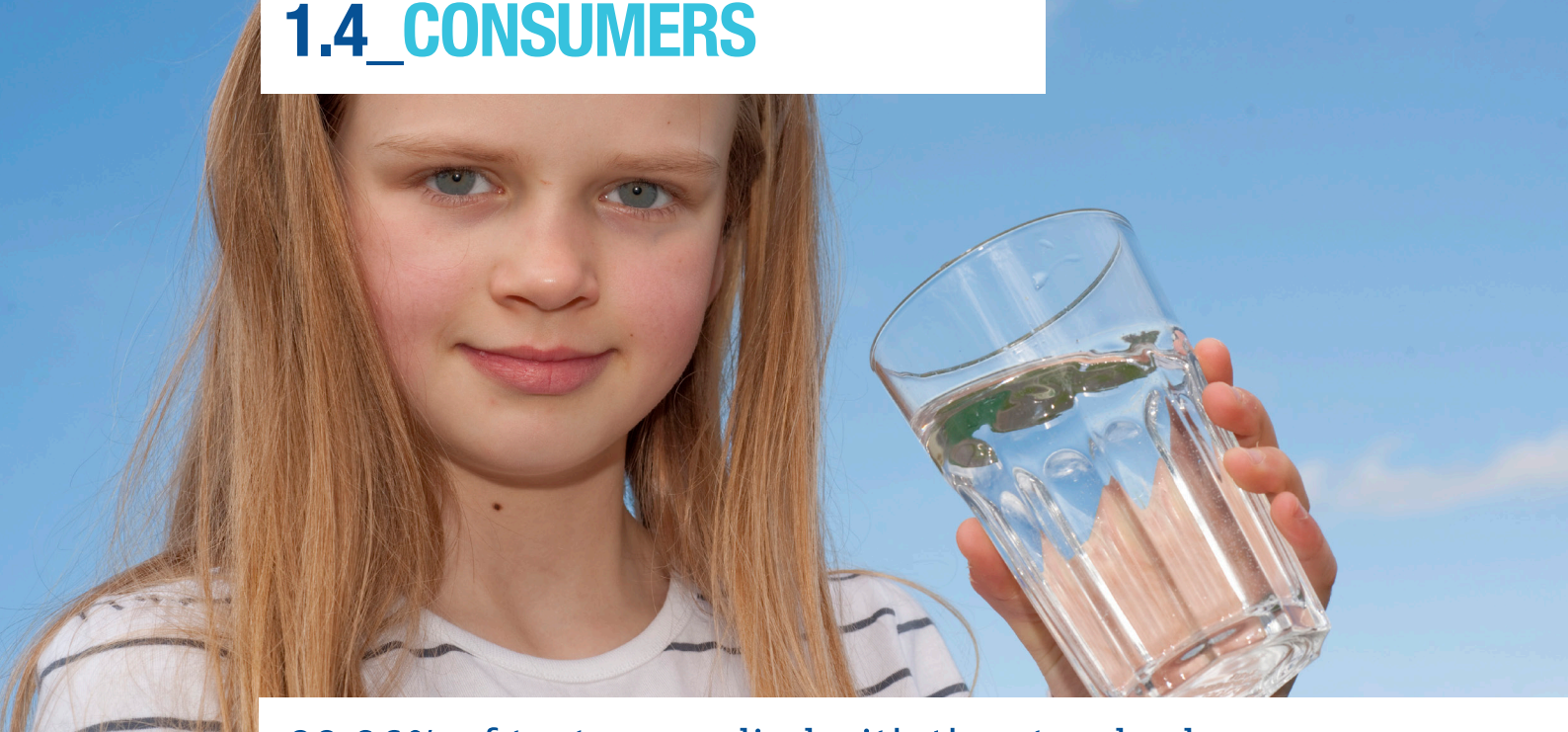
Scottish Water has been directed by Scottish Ministers to achieve a number of different objectives to improve and protect drinking water quality across Scotland during the period of 1 April 2010 to 31 March 2015.

During 2012, Scottish Water completed the construction of the remaining six (out of the total of 14) emergency tanker fill points at strategic positions within distribution systems throughout Scotland. If the piped supply fails or becomes contaminated for any reason, these facilities will assist Scottish Water in complying with their duty to supply at least 10 litres of alternative water per head of population each day during such an emergency.

Also during 2012, Scottish Water completed the installation of backflow prevention devices on the incoming water mains at 128 wastewater treatment works (WWTW). 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.

Finally, during 2012, Scottish Water carried out studies on 16 water supply zones to determine the extent of water mains rehabilitation required to reduce the number of discoloured water events and consumer complaints. In addition, following studies previously undertaken, Scottish water carried out water main rehabilitation works in 91 of its water supply zones to reduce the risk of water quality being degraded by the condition of the distribution system pipework.

1.4_CONSUMERS



99.86% of tests complied with the standards

1.4.1_ WATER QUALITY AT CONSUMERS' TAPS

Scottish Water's supply area is divided into 310 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 2012, 153,433 tests were carried out on samples taken at consumers' taps. Of these, 221 failed to meet the standard set out in the Regulations. This means that 99.86% of tests complied with the standards.

In 2012, 117 supply zones had a sample taken that failed to meet one or more of the standards, which is actually a larger number of zones than in 2011 even though the total number of failing samples is lower. Scottish Water's overall figure for Mean Zonal Compliance in 2012 was 99.83%.

Table 1.4a 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 1.4a Summary of all tests on consumer tap samples during 2012

PARAMETER	TOTAL NO. OF SAMPLES	NO. OF FAILED SAMPLES	NO. OF ZONES WITH FAILURES	% COMPLIANCE
KEY PARAMETERS				
Coliform Bacteria	14,215	61	44	99.57
<i>E. coli</i>	14,214	2	2	99.99
Colour	5,159	0	0	100.00
Turbidity	5,160	1	1	99.98
Hydrogen ion (pH)	5,160	9	7	99.83
Aluminium	5,096	2	2	99.96
Iron	5,123	34	27	99.34
Manganese	5,123	32	21	99.38
Lead (25)	1,556	8	8	99.49
Total Trihalomethanes	1,554	42	29	97.30
OTHER PARAMETERS				
1,2 Dichloroethane	1,553	0	0	100.00
Aldrin	1,554	0	0	100.00
All Other Individual Pesticides	12,796	7	2	99.95
Ammonium	5,159	3	3	99.94
Antimony	1,554	0	0	100.00
Arsenic	1,554	0	0	100.00
Benzene	1,553	0	0	100.00
Benzo 3,4 Pyrene	1,556	3	3	99.81
Boron	1,556	0	0	100.00
Bromate	1,556	0	0	100.00
Cadmium	1,554	0	0	100.00
Chloride	1,556	0	0	100.00
Chromium	1,554	0	0	100.00
<i>Clostridium perfringens</i>	5,126	2	2	99.96
Conductivity	5,159	0	0	100.00
Copper	1,556	2	2	99.87

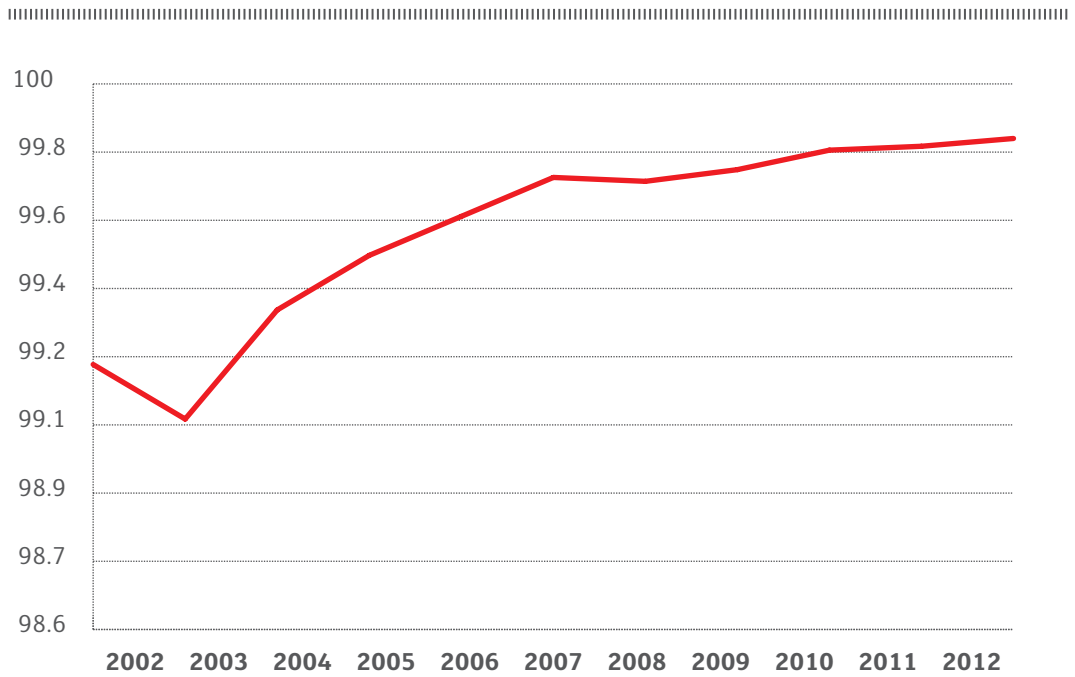
Table 1.4a Cont.

PARAMETER	TOTAL NO. OF SAMPLES	NO. OF FAILED SAMPLES	NO. OF ZONES WITH FAILURES	% COMPLIANCE
Cyanide	1,556	0	0	100.00
Dieldrin	1,554	0	0	100.00
<i>Enterococci</i>	1,556	0	0	100.00
Fluoride	1,556	2	2	99.87
Heptachlor	1,554	0	0	100.00
Heptachlor epoxide	1,554	0	0	100.00
Mercury	1,554	0	0	100.00
Nickel	1,554	0	0	100.00
Nitrate	2,470	0	0	100.00
Nitrite	2,470	6	3	99.76
Nitrite/Nitrate formula	2,470	0	0	100.00
Odour	5160	0	0	100.00
PAH – Sum of 4 Substances	1,556	2	2	99.87
Pesticides – Total Substances	2,661	0	0	100.00
Selenium	1,554	0	0	100.00
Simazine	471	0	0	100.00
Sodium	1,556	0	0	100.00
Sulphate	1,556	0	0	100.00
Taste	5,153	3	3	99.94
Tetrachloroethene/Trichloroethene	1,553	0	0	100.00
Tetrachloromethane	1,553	0	0	100.00
Tritium	1,556	0	0	100.00
SCOTLAND	153,433	221	117	99.86

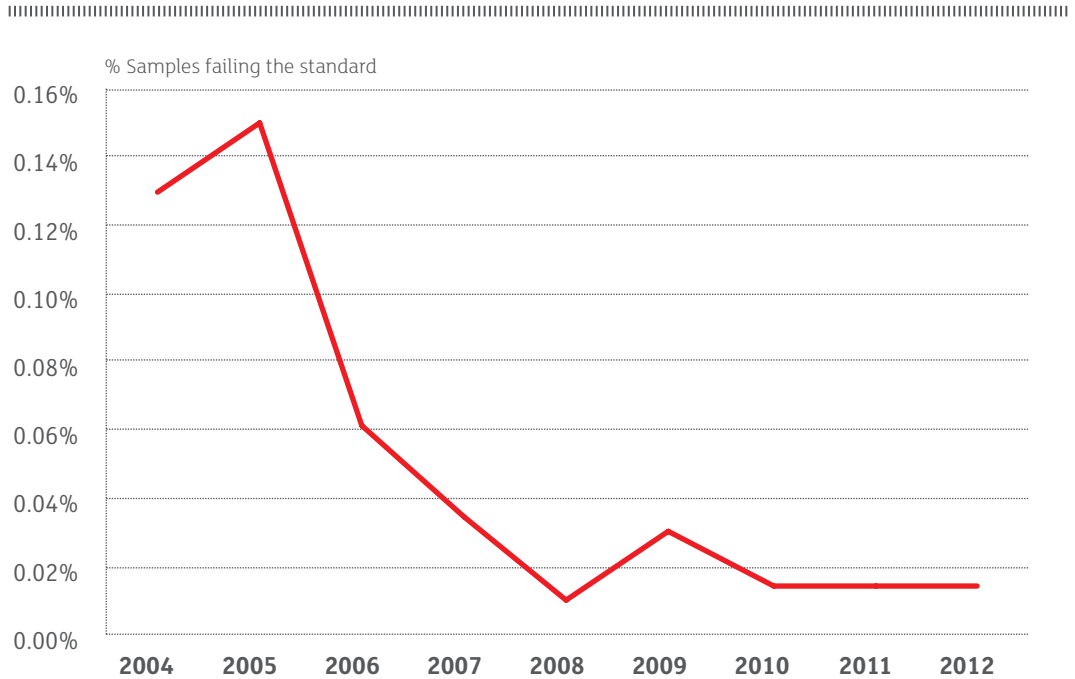
OVERALL COMPLIANCE

The graph shows the overall compliance figure at consumers taps every year since Scottish Water was created in 2002. The improving trend is clearly seen, although the rate of improvement has levelled off considerably in recent years.

Percentage Compliance at Consumers' Taps (all samples)



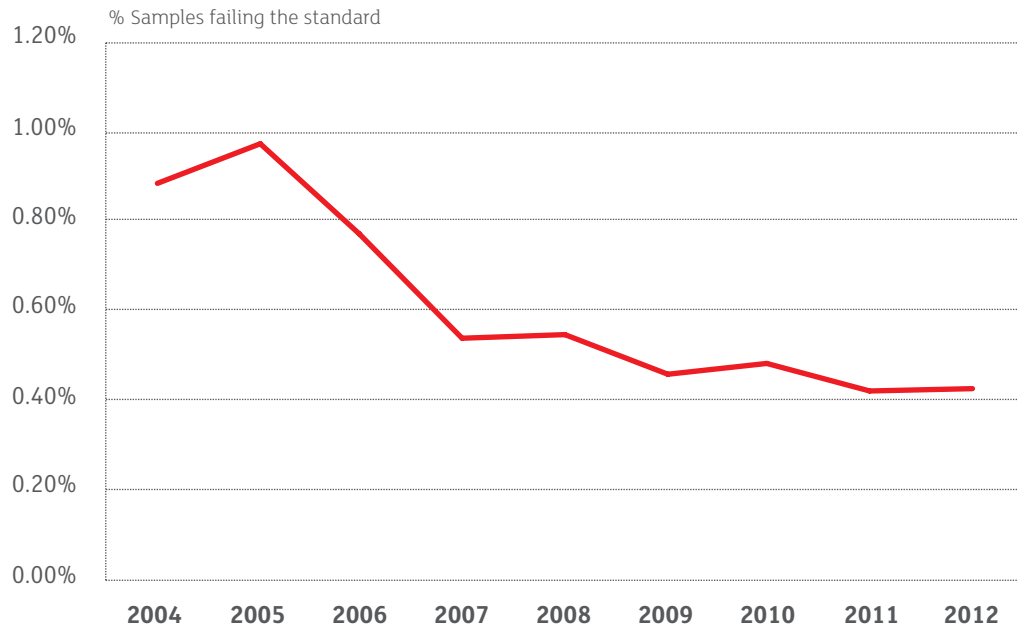
E. coli



E. coli is an extremely important parameter because it is an indicator of faecal contamination and the microbiological safety of the water. In 2012, compliance was the same as in the two preceding years, with two samples containing *E. coli*. These failures represent only 0.01% 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.

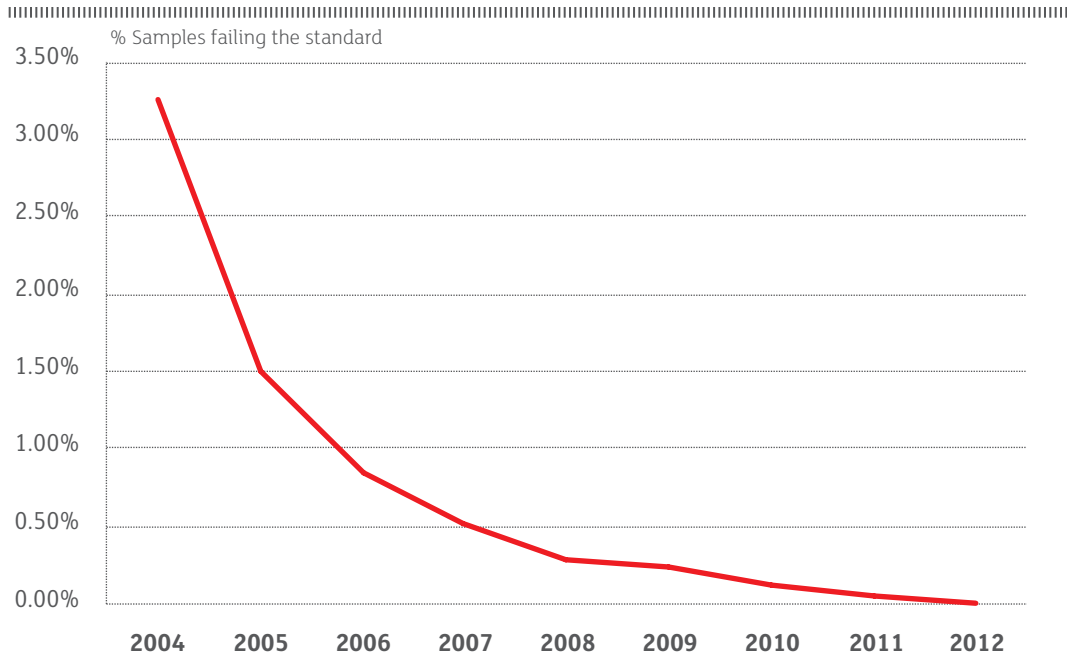
Percentage Total Coliform Failures



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.

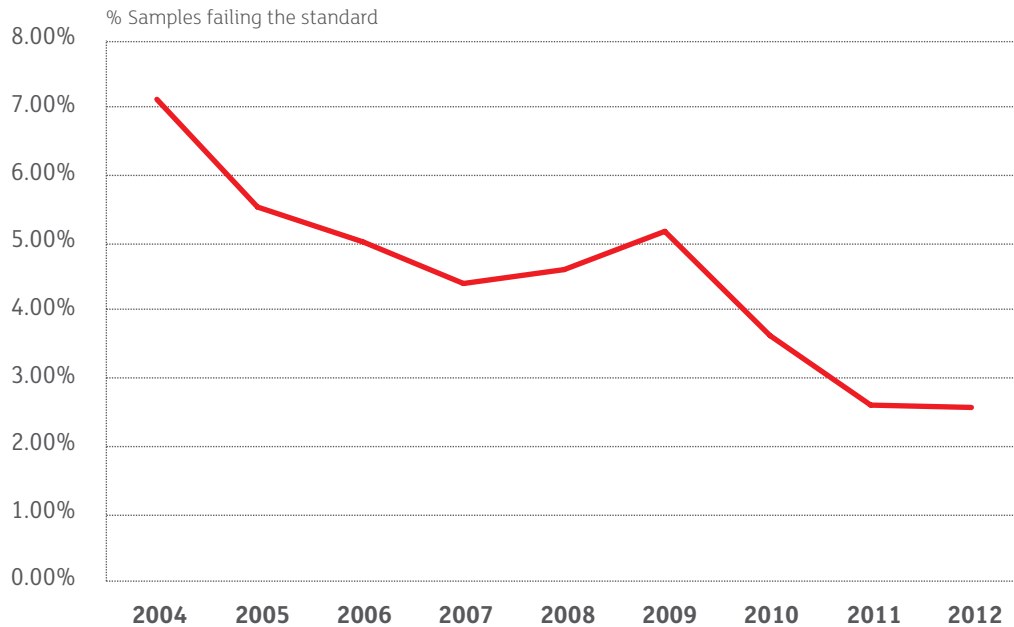
Coliforms were detected in 61 samples in 2012, a similar figure to 2011. The DWQR believes that there is scope to reduce this figure further. DWQR has reviewed chlorine concentrations before, during and after all microbiological failures at taps during 2012 and there is no clear evidence of lower chlorine residuals being the direct cause of the failure, except possibly in a minority of cases. While disinfection with chlorine is an important tool in ensuring the microbiological safety of the water, it is clear that simply increasing chlorine residuals will not in most cases resolve microbiological exceedences and the answer may lie elsewhere, including the treatment works' performance and storage points' integrity. Scottish Water has increased its efforts in investigating failures at consumers' taps during the past year and this improved understanding of the root causes of microbiological failures needs to result in proactive action to reduce the number of samples containing coliforms, especially in those supply zones where there are multiple failures.

Percentage 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 in the catchment. Not only is coloured water unsatisfactory to consumers from an aesthetic point of view, but it is also an indication of organic compounds that can react with chlorine are likely to be present in the water. Improvements to Scottish Water's treatment processes have resulted in there being no failures of the colour standard in 2012, which is to be applauded. However THM failures are still occurring which suggests that although the regulatory standard for colour is being met, there is still work to do in ensuring improved organics removal at some treatment works.

Percentage Total Trihalomethane (THM) Failures



THMs are one group of disinfection by-products that can form when organic substances combine with chlorine. In terms of percentage compliance, they easily represent Scottish Water’s lowest complying parameter, with 2.7% of samples taken failing to meet the standard, which is made up of a total of four different substances. Failures occurred in 29 zones, two more than last year, and, as last year, these were predominately in the North and West.

The lack of an improvement in THM compliance is extremely disappointing, especially in light of the additional efforts made by Scottish Water to achieve improvements in this respect. A number of treatment works with THM issues, such as Gairloch, Achmore and Shieldaig, were replaced during 2012 making the lack of progress all the more surprising.

Analysis of the data by DWQR shows that the pattern of THM failures in 2012 changed compared with previous years. Eighteen of the 29 supplies recording failures in 2012 did not fail in 2011 – a particularly concerning trend. Whereas most exceedences previously occurred at treatment works with little in the way of treatment capable of removing the precursor compounds that form THMs, many of these sites have now been improved or replaced. Now, many failures are occurring where the treatment processes present at the site should, in theory at least, be able to treat the water to a standard needed to avoid THM formation.

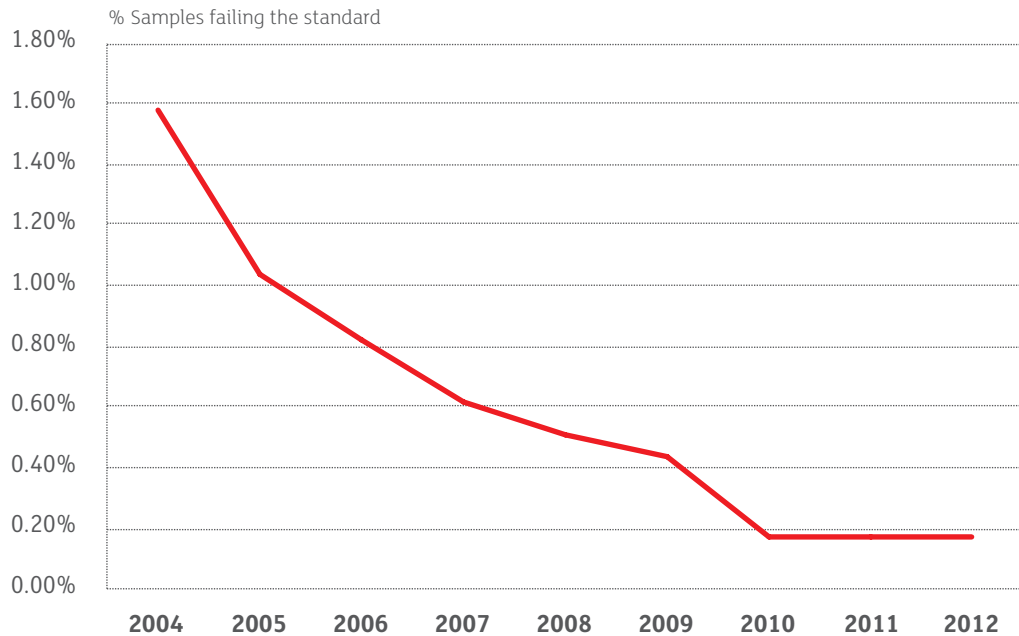
For example, 16 out of the 29 supplies that produced a THM failure in 2012 had a treatment process that included a flocculation stage. Notably, some large treatment works in the West of Scotland are failing, including Bradan and Amlaird, both serving Ayrshire, which recorded three failures each. This is a worrying trend, as the scale of these works means that large populations are supplied with water containing THMs, and the rate of sampling is correspondingly higher meaning they have a greater impact on Scotland's overall compliance. Both of these supplies will be the subject of formal action by DWQR in 2013. The supply zone around Oban in Argyll, supplied from Tullich WTW, also recorded three failures. This works has a comparatively unusual treatment process comprising ozone gas and granular activated carbon filters, and THM concentrations marginally exceeding the standard for much of the year. Investment is underway to construct a new treatment works to supply the area during this financial regulatory period which ends in 2015.

Seven out of the 29 failing supplies had membrane treatment. This process is used extensively in Scotland because of its ability to remove organic compounds and *Cryptosporidium*. None of these supplies should be producing water that fails the THM standard, and these failures suggest that the integrity of the nanofiltration membranes has been breached. To put this another way, Scottish Water has failed to monitor and replace membrane modules before they deteriorate to an extent that they allow organic material to pass through. Scottish Water acknowledges this and has implemented processes to ensure timely intervention takes place.

DWQR's position on THMs is that the 100 µg/l standard will soon have been in place for 10 years and that full compliance can and must be achieved in Scotland, just as it has been elsewhere in the UK. In fact, the EU Drinking Water Directive requires disinfection by-products to be as low as possible and therefore Scottish Water's efforts must not stop at achieving the standard. The trend in 2012 towards failures due to a lack of plant maintenance, both at larger works and nanofiltration membrane sites, is worrying and DWQR has received assurances from Scottish Water that the situation has been rectified. One contributory factor at some sites may be a change in the quality of raw water, meaning that a once adequate treatment process is now unable to cope. The extent of this issue has yet to be fully quantified, but Scottish Water must gain an intimate understanding of the quality of water it has to treat and design, build and optimise treatment processes accordingly.

DWQR has discussed THM compliance with Scottish Water on a number of occasions and heard of the efforts the company is making across multiple areas to drive compliance with the standard up. These initiatives seem appropriate and it is vital they are adequately resourced and reviewed until they bear fruit. It is likely that legally binding commitments instigated by DWQR will also play a part in achieving compliance at certain sites.

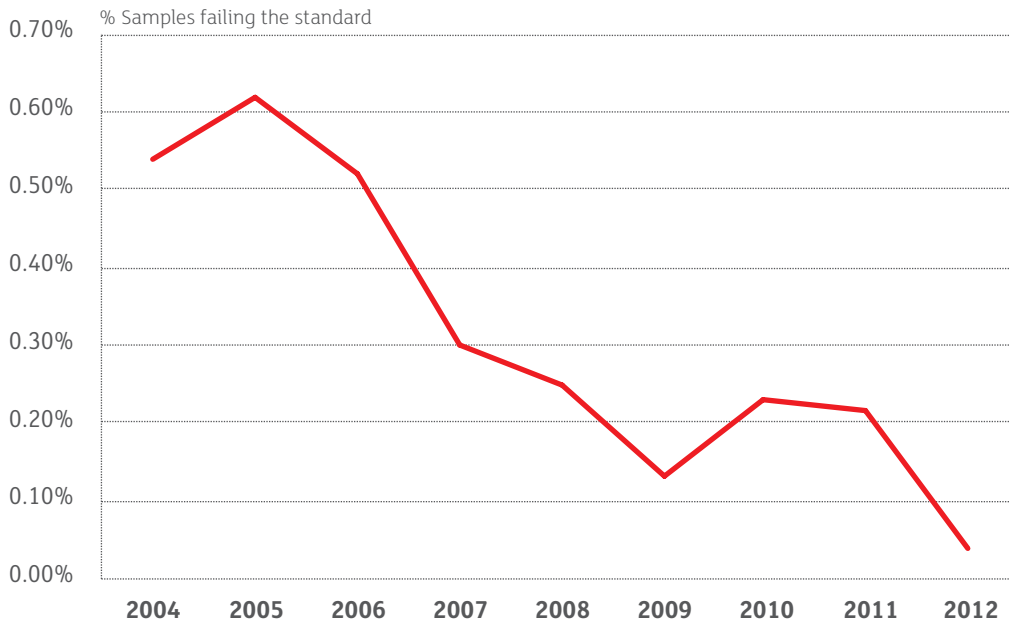
Hydrogen Ion (pH)



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 consistently improved year on year, and only 9 samples failed to meet requirements in 2012. 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.

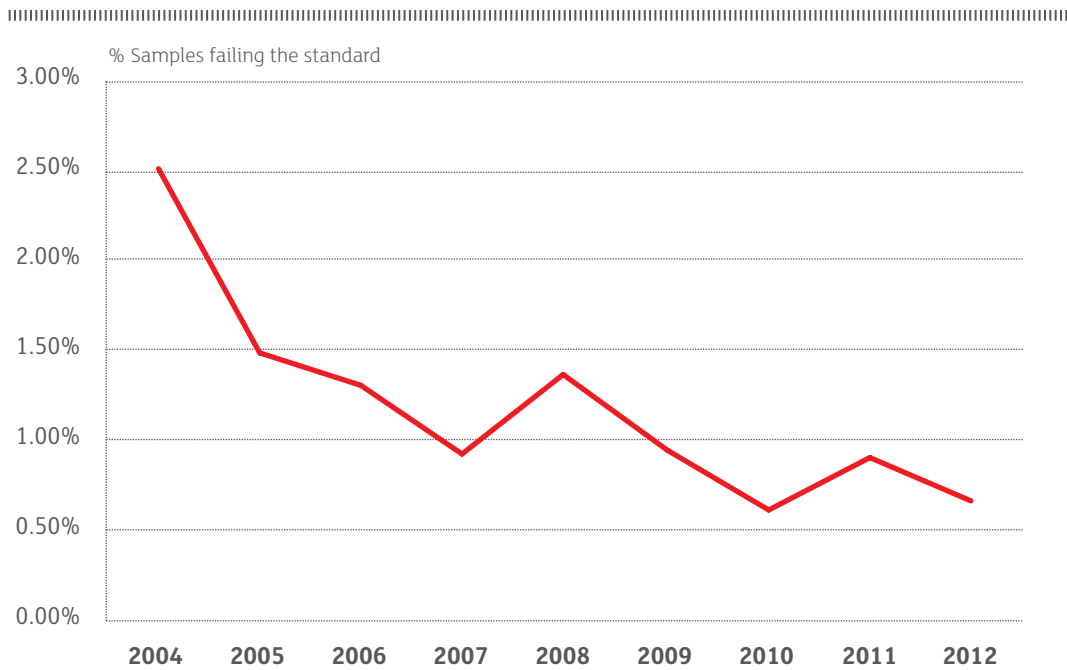
Percentage Aluminium Failures



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 and is now the lowest ever. This matches a reduction in the number of water quality events reported to DWQR where Scottish Water had lost control of the coagulation process, resulting in elevated aluminium concentrations leaving the treatment works. This improvement is welcomed and, it is hoped, will continue.

Percentage Iron Failures



Iron occurs naturally in some water supplies but should be removed by the treatment process. It is used as an alternative coagulant 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. 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 causing the most significant water quality issues but needs to ensure that quality is managed in the meantime. Compliance with the iron standard has not improved significantly for a number of years. This is mirrored in the number of discolouration complaints received by Scottish Water which also needs to improve.

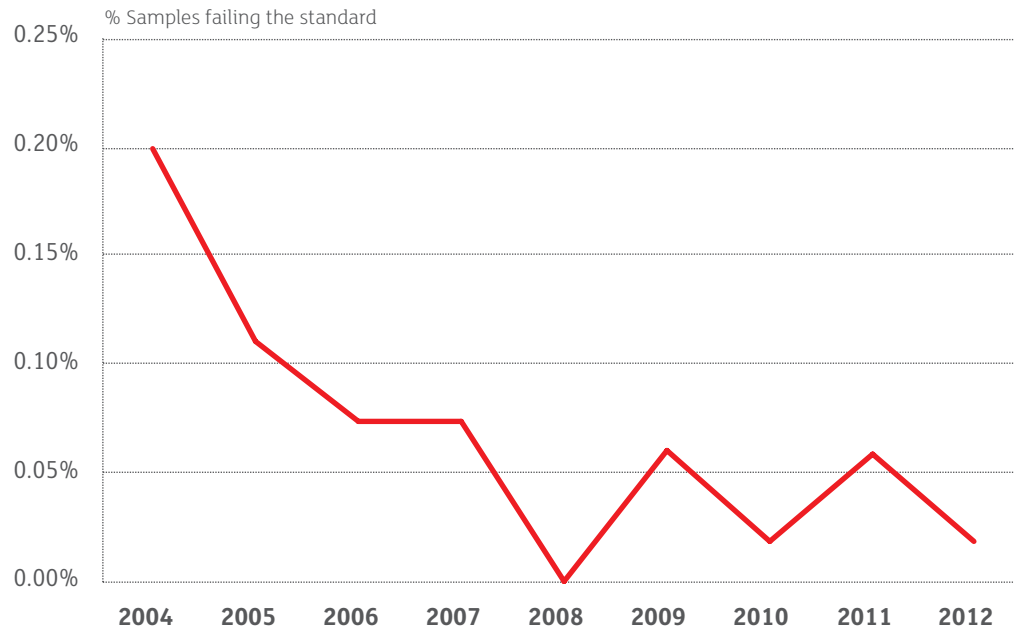
Percentage Manganese Failures



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 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 unfortunately, as Scottish Water has resolved a problem in one area a different one has emerged in another location. An issue with manganese in the Dunoon area of Argyll has been resolved, and work is under way to control and remedy another in the Paisley area. It was disappointing to note that 10 of the 32 failures during 2012 occurred in the supply zones served by Bradan WTW in Ayrshire, in spite of the treatment works having a manganese removal process and extensive rehabilitation work having been undertaken by Scottish Water in the Bradan distribution system. Scottish Water must now do everything it can to manage this emerging problem and prevent it having an adverse impact on consumers.

It is clear that greater attention must be paid to the monitoring of manganese both entering and leaving water treatment works, as even a relatively low concentration of manganese in the final water can accumulate and cause problems in distribution pipework. Scottish Water must do more to anticipate and resolve such problems before they develop to have an impact on compliance and consumers.

Percentage 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. Only one exceedence from 5160 samples occurred in 2012.

Percentage 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 will reduce from 25µg/l to 10µg/l at the end of 2013, and 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 2012, eight failures of the 25µg/l standard occurred across Scotland. Five of these were in zones where phosphate is not added to supplies. Had the 10µg/l revised standard been in force, there would have been 31 failures in total. Although no zone recorded multiple failures of the current standard, Penwhirn zone in Dumfries and Galloway would have recorded three failures of the revised standard. Phosphate dosing has only recently commenced at Penwhirn WTW.

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 risks to health and encourage replacement of lead piping.

OTHER NOTABLE PARAMETERS

Ammonium and Nitrite

These two parameters are related, and occur 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, failures of these parameters can result.

In 2012 the number of failures for both these parameters reduced, following a concerted effort by Scottish Water to deal with known issues, however the fact that failures still occur shows that a strategy is required to manage disinfection across all supply systems.

Pesticides

The standard for individual pesticides is set with a large margin of safety, consequently a failure does not usually imply a risk to health, however Scottish Water is expected to meet the standard.

Seven exceedences occurred in 2012, in the two Forehill supply zones serving the Peterhead area in the North East, where a number of different pesticides were detected in small quantities. These substances entered the River Ugie from the intensive agricultural activity in the catchment, and there is currently no treatment process at Forehill WTW to remove them. To date attempts have been made to achieve a reduction in the amount of pesticide entering the river through good farming practice, using initiatives under Scottish Water's Sustainable Land Management programme however it is now evident that a treatment process will also be required and plans to design and construct this are well under way. The standard for total pesticides was not exceeded.

1.4.2_ 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 relation to water quality failures in public buildings, the 2010 Regulations place a general duty on **local authorities** to:

- immediately investigate a water quality failure arising from the domestic distribution system in a public building to determine its cause and to report their findings to the Scottish Ministers (in practice the Drinking Water Quality Regulator for Scotland);
- ensure that remedial action is taken as soon as possible to restore water quality and that priority is given to enforcement action having had regard amongst other things to the potential danger to human health;
- in relation to water constituting a risk to human health to prohibit, restrict the use of, or take such other action as is necessary to protect human health; and
- inform affected consumers promptly and give them the necessary advice in relation to any risk to their health (in practice ‘health’ advice is likely to be given following advice from the local NHS Board Consultant in Public Health Medicine (“CPHM”).

The 2010 Regulations also require local authorities to serve a notice of improvement under section 76FB of the 1980 Act on the person responsible for the domestic distribution system (“the responsible person”) to ensure that remedial action is taken to restore a wholesome supply of water.

In 2012, 7153 tests were undertaken on samples collected from public buildings by Scottish Water. Of these, 20 failed to meet the regulatory standard. Of these, five samples contained low levels of coliforms, four exceeded the standard for iron and three for manganese. All failures were trivial in nature, with remedial action taken and consumers notified.

1.4.3_ 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 1.4b** shows the number of contacts, by type, that Scottish Water received during 2012.

Table 1.4b_ Consumer contacts received by Scottish Water

CONTACT CATEGORY	NUMBER OF CONTACTS			% CHANGE ON 2011	CONTACT RATE PER 10,000 POPULATION		
	2012	2011	2010		2012	2011	2010
APPEARANCE							
Discoloured Water	8,174	17,940	14,349	-54.4	17,940	35.9	28.8
Aerated (Milky) Water	2,509	2,897	2,466	-13.4	17,940	5.8	4.9
Particles in Water	1,170	788	742	48.5	17,940	1.6	1.5
Organisms in Water	68	53	55	28.3	17,940	0.1	0.1
TASTE AND ODOUR							
Chlorine	1,935	1,458	1,261	30.3	17,940	2.9	2.5
Metallic	1,277	1,358	418	-6.0	17,940	2.7	0.8
Solvent/Fuel Taste/Smell	103	42	43	145.2	17,940	0.1	0.1
Musty/Earthy	1,014	588	618	72.4	17,940	1.2	1.2
TCP/Chemical Taste/Smell	1,087	283	247	284.1	17,940	0.6	0.5
OTHER CONTACT ABOUT WATER QUALITY							
Illness due to Water	439	427	242	2.8	17,940	0.9	0.5
Other Contact	0	73	54	100.0	17,940	0.1	0.1
TOTAL CONTACTS ABOUT WATER QUALITY	17,776	25,907	20,495	-31.4	35.6	51.9	41.1

There was a reduction in overall call volumes of 31%

Scottish Water had 17,776 consumer contacts relating to water quality equating to a contact rate of 35.6 per 10,000 population. This is a reduction in overall call volumes of 31%, when compared to the number of calls during 2011. This is a considerable and welcome change but it is in part, a reflection of the large increase experienced in 2011. There is a significant downward shift in the numbers of consumers experiencing discoloured water but the taste categories have shown an increase.

Scottish Water has examined its systems for logging and tracking consumer contacts and has reported there to be an element of duplication in contact numbers with their contact recording system registering outgoing calls to investigate situations with consumers. DWQR expects that during 2013, the actual number of incoming contacts from consumers will be clear and provide a more accurate comparison with other regions in the UK.

Fig. 1.4b_ Breakdown of consumer contacts by type

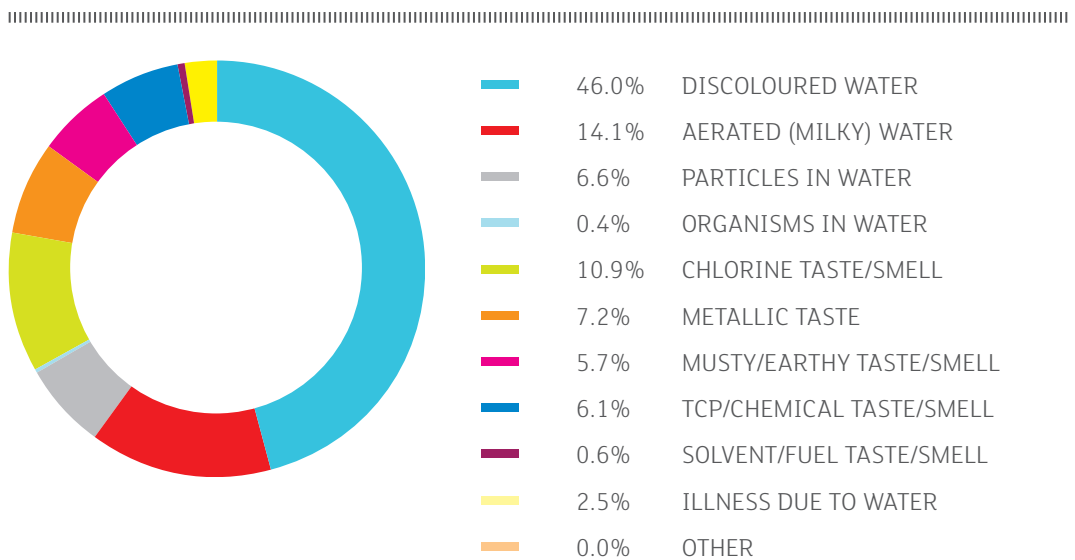
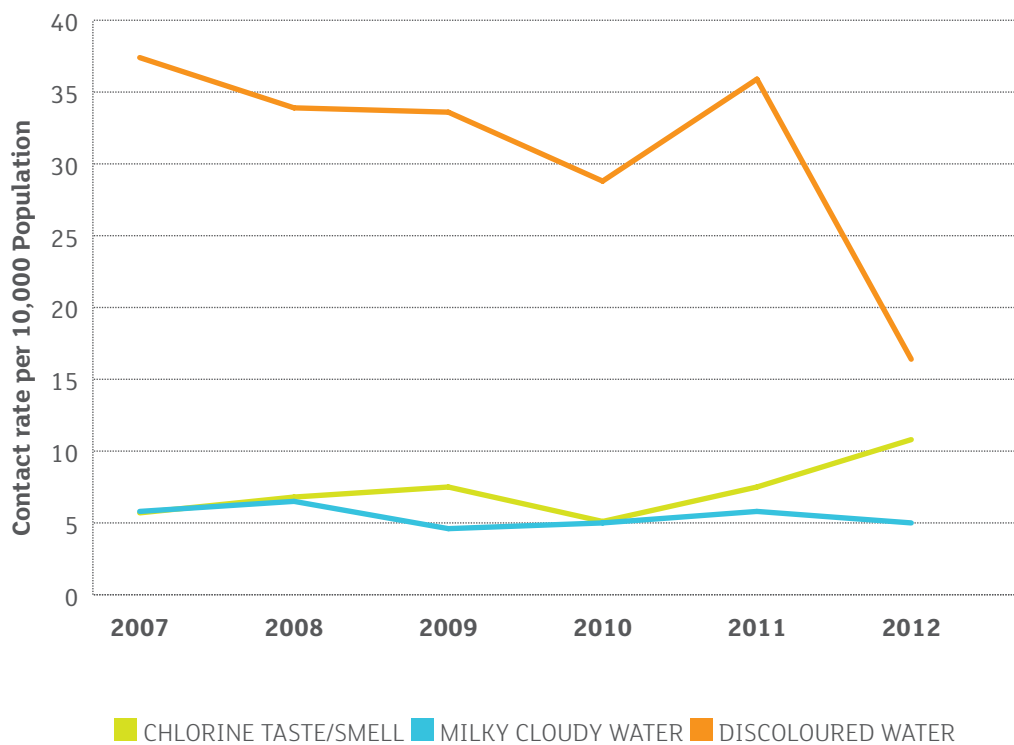


Fig 1.4b shows just over 60% of calls were made in response to discoloured water and aerated (or milky) water. These categories are not only a reflection of problems related to the condition of the water supply network but they also are influenced by operational activity causing flow changes within the water mains i.e. operation of valves or burst mains. The diagram also shows the significant proportion (30%) 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 1.4c** further illustrates the point in terms of the trends in key contact types. The very marked reduction in discolouration complaints is welcomed and it illustrates the very clear benefits of Scottish Water’s investments in improvement to the water supply networks. Taste and odour issues are however showing a troubling upward trend and the various causes of taste must be addressed to ensure satisfactory supplies are provided to consumers.

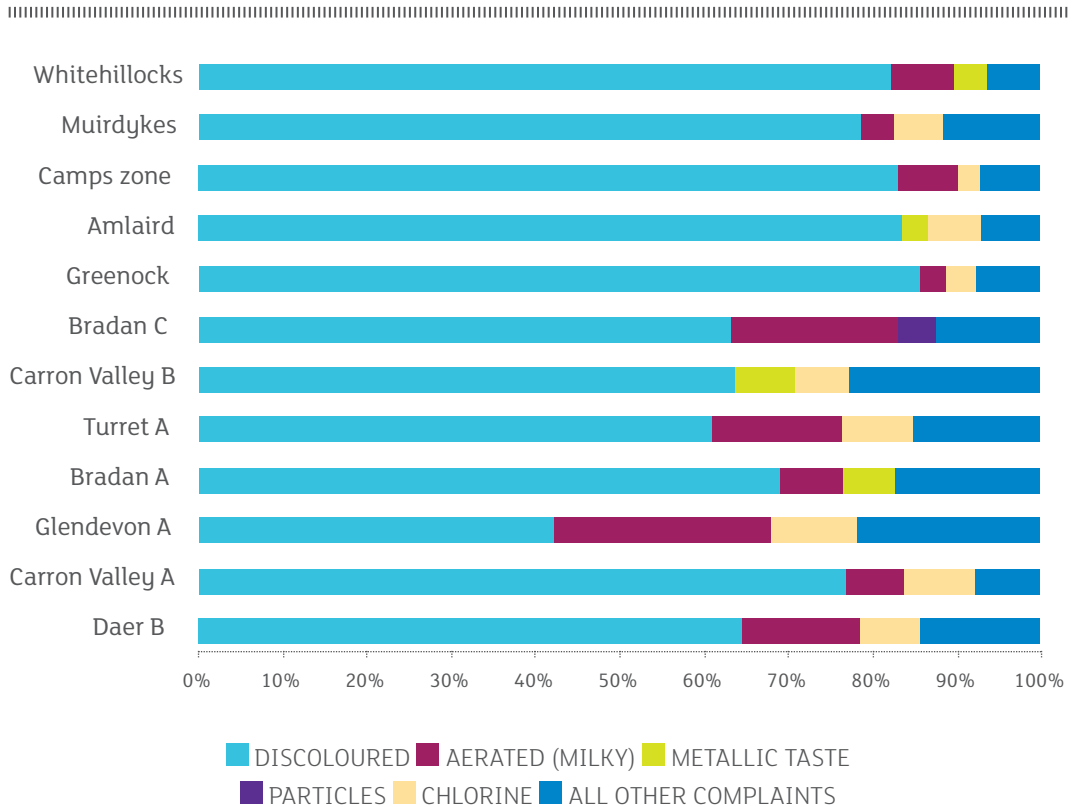
With regard to the primary cause of concern in this category, chlorine, it is possible the cleaner supply systems are allowing chlorine to persist longer and travel further along the distribution network and consequently is more noticeable to consumers. It is important that Scottish Water continues to 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. 1.4c_ Trend in key contact categories



The overall contact rate for Scotland in 2012 (from **Table 1.4b**) was 35.6 per 10,000. In geographic terms, the areas where most issues were raised by consumers are shown in **Figure 1.4d**.

Fig. 1.4d_ Water Supply zones with most water quality complaints



This chart shows the supply zones, ranked by contact rate. Whitehillocks had twice the rate of contacts compared to the second highest, which was Muirdykes zone, and generated 263 contacts per 10,000 population. The numbers in Whitehillocks are driven by the level of discolouration and aerated water complaints. Many of these will have been generated by the investment activity in the zone and DWQR expects that the issues will now be resolved with the conclusion of the works. Muirdykes, Carron Valley 'B' and Bradán 'A' zones feature again this year in the list of zones highlighting the persistent issues there.

Bradan

There are three supply zones fed from Bradan treatment works. Two feature in the graphic, **Fig 1.4d** and the third, Bradan B, falls just outside the worst performing zones. Combined, the three zones account for 998 complaints and over two-thirds of these were in relation to discoloured water. Many of these complaints would be stimulated by disturbance of manganese deposits in the water mains and they reflect the high level of failures of regulatory samples for this parameter in 2012. In spite of the treatment works having a manganese removal process and extensive rehabilitation work having been undertaken by Scottish Water in the Bradan supply areas, this is a deteriorating problem and Scottish Water must address the issues in the works and the distribution system to improve the quality of water for consumers.

1.4.4_ 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 entered into 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 1.4c shows the various categories of consumer contacts received by the DWQR in 2012. Overall, 132 contacts were received. The overall number of contacts and, within that, the number of consumers with complaints about the public water supply are fewer than 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.

Scottish Water has in the course of the year, established a clearer focus on the resolution of formal complaints and their Service Review Team has a clear remit to investigate these and identify resolution actions. It is also its role to investigate issues where consumers feel compelled to make repeated contacts. DWQR is encouraged by the approach and looks forward to a reduction in the numbers of contacts and formal complaints registered.

Table 1.4c_Consumer contacts received by DWQR

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



AUDIT OF SCOTTISH WATER'S COMPLAINTS PROCESS

1.4.5_ AUDIT AND INSPECTION

In light of the change in the number of complaints escalating to DWQR, the annual inspection programme for 2012 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. It is clear that frontline staff have a desire to resolve complaints but in some cases, the effectiveness of that effort is diminished as responsibility for arranging the completion of actions lies with other functions and teams within Scottish Water. This failure to maintain ownership of complaint resolution has been highlighted in previous Annual Reports and DWQR will be monitoring to see that effective processes are put in place to ensure a focus is retained on the timely resolution of consumer issues as responsibility for taking action is transferred between responsible teams in the Company.

The audit findings are published on the DWQR website www.dwqr.org.uk.

1.4.6_ EVENTS AND INCIDENTS

In 2012, 709 events were reported to the DWQR, of which 52 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 52 events, 17 were in relation to microbiological parameters and 29 were caused by failures of the lead standard.

In 2012, two other incidents were declared due to domestic plumbing issues. In one case, microbiological failures of samples taken from a property in Hurlford in Ayrshire following repair works on the water mains were likely caused by the hygienic condition of the kitchen tap. In the other, at an address in Aberdeen, failures of samples drawn from the kitchen tap stemmed from the improper installation of a washing machine causing backflow from the appliance and allowing dirty water to contaminate the property's supply.

The DWQR also declared an incident due to significant consumer concern about a change in the water supply at Aviemore.

Aviemore

Scottish Water constructed a new water supply to serve the Badenoch and Strathspey area in the central Highlands. This supply, situated near Aviemore, replaced an old, basic water supply drawn from Loch Einich, high in the Cairngorms that did not meet a number of regulatory quality standards and was increasingly unable to satisfy demand due to growth in the area.

The new supply abstracts water from boreholes near Aviemore and treats it on site by filtering the water through membranes. The level of chlorine in the supply leaving the treatment works was initially quite similar to the old Black Park source, but the higher quality water meant that chlorine concentrations did not decrease as the water travelled through the distribution system, as had been the case with the old supply.

Consumers soon noticed the change in water quality, both in terms of an increase in chlorine reaching their homes and changes in other quality parameters, such as hardness (even though this was still comparatively soft water), caused by the different source. The Company received 131 complaints from consumers between February and June, 82 of which were chlorine-related taste complaints.

DWQR investigated and concluded that the incident was caused by consumers' reactions to a change in the source of their water supply from an upland surface water to a groundwater with very different aesthetic properties. Also the superior quality of the new supply meant that chlorine added at the treatment works persisted through the distribution system for a much greater time than it had in the old supply. Even though Scottish Water progressively reduced the amount of chlorine in the water over the Spring, it is likely that the majority of consumers in the area were still experiencing higher chlorine residuals than those to which they had been accustomed on the old supply. Confidence in the supply was eroded and people became concerned that the supply was unsafe or was making them ill. Once this happened, any reassurances from Scottish Water and NHS Highland had only minimal effect.

DWQR's conclusion was that at no time was the new Aviemore supply unfit for human consumption or non-compliant with the standards set out in the water quality regulations. In fact, the new supply has brought an improvement in quality and a significant reduction in the risk of non-compliance. Notwithstanding this, it is important that consumers trust their water supply and consider its quality to be aesthetically acceptable.

Scottish Water has identified the need to review and learn from its experience in Aviemore and this is to be welcomed, as changes to water supplies for operational reasons will always be necessary and it is important that these are managed as effectively as possible.

1.4.7_ INVESTMENT

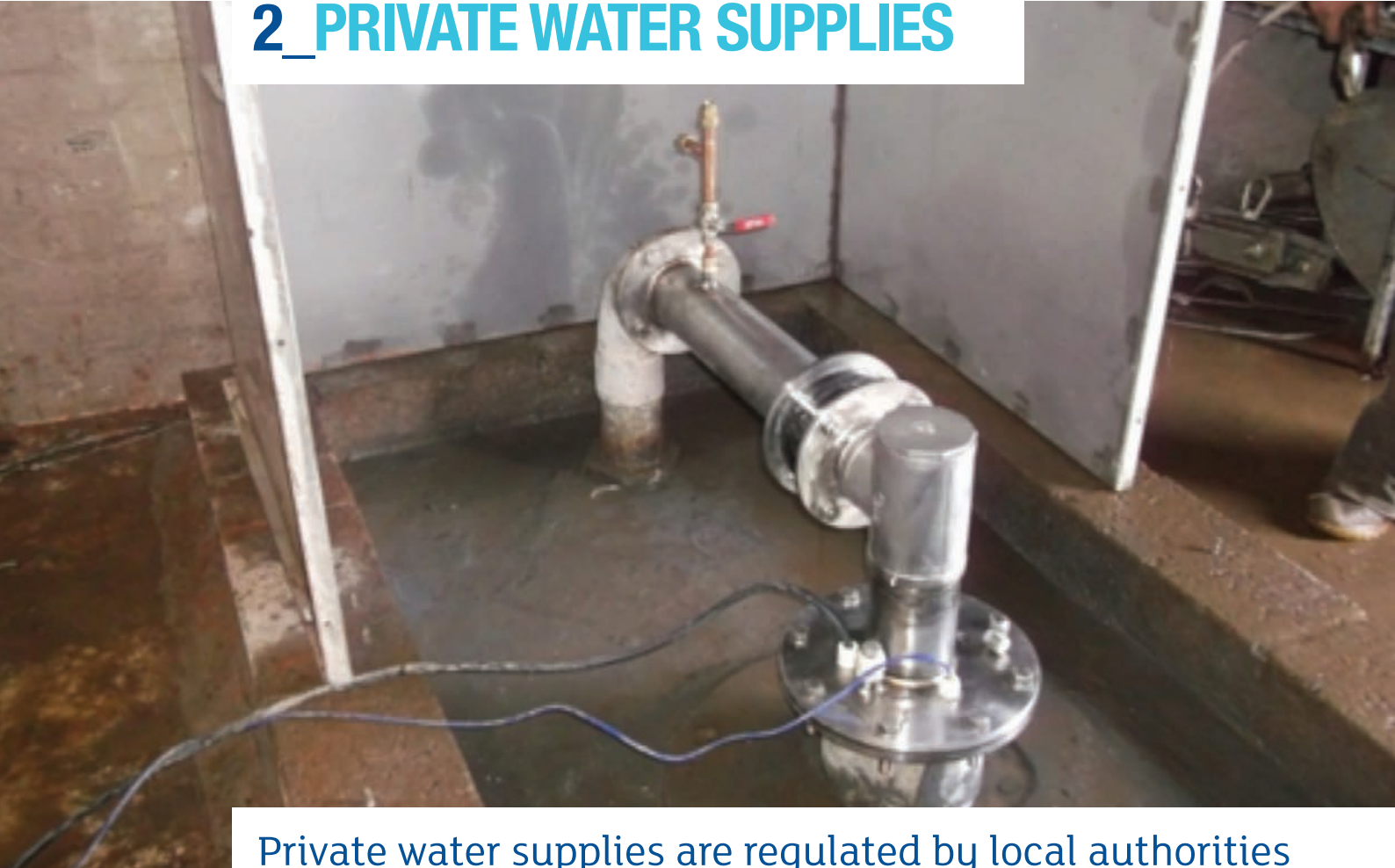
Scottish Water has been directed by Scottish Ministers to undertake a number of different projects to improve and protect drinking water quality across Scotland during the period of 1 April 2010 to 31 March 2015.

During 2012, Scottish Water continued to undertake 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 will reduce from its current level of 25 micrograms per litre at present to 10 micrograms per litre from the end of 2013.

In the short term, during 2012, Scottish Water investigated 27 water supply zones for the presence of lead communication pipes. Where there was no lead present, no action was taken. Where lead communication pipes were found, these pipes will be replaced with plastic pipes in most cases, and consumers will be advised to replace their supply pipes, but in one case chemical dosing was introduced at the treatment works to minimise the uptake of lead in the water.

As already referred to in the water treatment section of this report, Scottish Water improved the control of disinfection at 13 water treatment works during 2012. 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.

2_PRIVATE WATER SUPPLIES



Private water supplies are regulated by local authorities and are the responsibility of their owners and users.

Private water supplies (PWS) are drinking water supplies that are not provided by Scottish Water as part of their core function but are the responsibility of their owners and users. The Private Water Supplies (Scotland) Regulations 2006 (the 2006 Regulations) require local authorities to classify PWS as either Type A or Type B supplies.

Type A PWS are those which supply 50 or more people, provide 10 or more cubic metres a day, or regardless of the number of people served or the volume supplied, are supplied as part of a commercial or public activity. Type B PWS are all other domestic PWS.

2.1_ REGISTERS OF PWS

Table 2.1a_ PWS by Local Authority Area

LOCAL AUTHORITY AREA	NUMBER OF TYPE A SUPPLIES	NUMBER OF TYPE B SUPPLIES	TOTAL NUMBER OF SUPPLIES
Aberdeen City	12	100	112
Aberdeenshire	223	7,453	7,676
Angus	42	359	401
Argyll and Bute	437	1,411	1,848
City of Edinburgh	2	12	14
Clackmannanshire	5	22	27
Comhairle nan Eilean Siar	20	35	55
Dumfries and Galloway	170	1,197	1,367
Dundee City	0	1	1
East Ayrshire	14	176	190
East Dunbartonshire	1	15	16
East Lothian	10	37	47
East Renfrewshire	11	3	14
Falkirk	1	8	9
Fife	34	294	328
Glasgow City		No PWS	
Highland	719	1,619	2,338
Inverclyde	8	52	60
Midlothian	4	65	69
Moray	96	695	791
North Ayrshire	22	261	283
North Lanarkshire	0	15	15
Orkney	34	201	235
Perth and Kinross	274	1,202	1,476
Renfrewshire	6	4	10
Scottish Borders	157	1,263	1,420
Shetland	1	69	70
South Ayrshire	26	205	231
South Lanarkshire	34	283	317
Stirling	59	365	424
West Dunbartonshire	4	15	19
West Lothian	8	45	53
SCOTLAND	2,434	17,482	19,916

In 2012 there were 19,916 registered PWS in Scotland which were reported to the DWQR, 2,434 Type A and 17,482 Type B.

Owners and users of PWS are responsible for their drinking water supplies. The 2006 regulations place a duty on local authorities, in practice Environmental Health teams, to enforce PWS legislation. Local authorities are required to provide DWQR with an annual data return for PWS in their areas. In 2012 all local authorities with PWS in their areas provided their data on or before 31 March.

The Water Industry (Scotland) Act 2002 (“the 2002 Act”) places a duty on the DWQR to supervise the enforcement of the drinking water quality duties that local authorities have responsibility to enforce.

2.2_ RISK ASSESSMENTS

Local authorities are required by the 2006 regulations to complete risk assessments for all Type A supplies and to review these risk assessments annually. Additionally, local authorities must provide advice and assistance on risk assessments to those responsible for Type B supplies on request. In 2012, 89% of Type A PWS had either a completed or reviewed risk assessment.

Table 2.2a_ Risk assessments completed on Type A supplies from 2010-12

	NUMBER OF TYPE A SUPPLIES	RISK ASSESSMENTS OR REVIEWS COMPLETED	RISK ASSESSMENTS OR REVIEWS COMPLETED (%)
2012	2,434	2,166	89
2011	2,318	2,209	95
2010	2,209	2,066	94

Table 2.2b_ Type A Risk Assessments by Local Authority Area

LOCAL AUTHORITY AREA	NUMBER OF TYPE A SUPPLIES	RISK ASSESSMENTS OR REVIEWS COMPLETED	RISK ASSESSMENTS OR REVIEWS COMPLETED (%)
Aberdeen City	12	0	0
Aberdeenshire	223	212	95
Angus	42	42	100
Argyll and Bute	437	385	88
City of Edinburgh	2	1	50
Clackmannanshire	5	5	100
Comhairle nan Eilan Siar	20	17	85
Dumfries and Galloway	170	163	96
Dundee City	0	0	-
East Ayrshire	14	14	100
East Dunbartonshire	1	1	100
East Lothian	10	7	70
East Renfrewshire	11	10	91
Falkirk	1	1	100
Fife	34	34	100
Glasgow City		No PWS	
Highland	719	703	98
Inverclyde	8	8	100
Midlothian	4	4	100
Moray	96	90	94
North Ayrshire	22	21	95
North Lanarkshire	0	0	-
Orkney	34	31	91
Perth and Kinross	274	274	100
Renfrewshire	6	6	100
Scottish Borders	157	10	6
Shetland	1	1	100
South Ayrshire	26	25	96
South Lanarkshire	34	31	91
Stirling	59	58	98
West Dunbartonshire	4	4	100
West Lothian	8	8	100
SCOTLAND	2,434	2,166	89

Generally local authorities performed well in completing their risk assessments, with 13 reporting that they had completed all required risk assessments or reviews. Apart from Scottish Borders and Argyll and Bute Councils, all local authorities with large numbers of PWS performed well in completing their risk assessments.

Of particular concern in 2012 was the very low number of risk assessments and reviews completed in the Scottish Borders Council area (SBC). Staff changes and management reviews within SBC had highlighted deficiencies in the way that its risk assessment process had been previously undertaken, and as a result SBC made the decision to completely review its PWS regulation process. DWQR attended two risk assessment site visits with SBC and also carried out an audit of all of SBC's PWS enforcement duties in early 2013. DWQR also requested and received a strategy for improvement from SBC and has agreed a programme of quarterly supervisory meetings with SBC in 2013 to ensure that the improvements continue and are maintained. It should be noted that significant improvements have been made to the quality of SBC's risk assessments and other duties, and management processes relating to all of SBC's PWS duties are being developed and implemented. A further audit has been agreed for early 2014.

Also of concern was that Aberdeen City Council carried out no risk assessments or risk assessment reviews of Type A PWS in its area in 2012.

2.3_ LOCAL AUTHORITY WATER QUALITY SAMPLING DUTIES

Local authorities are required by the 2006 regulations to sample each Type A supply in their area at least once a year. Supplies producing up to 100 cubic meters must have at least one sample taken, supplies which produce between 100 and 1000 cubic meters of water a day will require four samples to be taken each year (unless they qualify for reduced sampling frequency), and supplies of more than 1000 cubic meters a day are required to be sampled more – the exact sampling frequency depends on the volume of water supplied.

Type B supplies must be sampled by local authorities within 28 days of being requested by the owner or user of the supply.

In 2012 a total of 57,358 tests were carried out on PWS, 39,006 from Type A supplies and 18,352 from Type B supplies.

The 2006 regulations require “check monitoring” for all Type A supplies. This is a standard suite of samples from Schedule 2, Table A of the regulations and the purpose of this monitoring is to provide information on the microbiological and organoleptic quality as well as information on the effectiveness of water treatment. Check parameters are ammonium, Coliform bacteria, colony counts, colour, conductivity, *E. coli*, hydrogen ion (pH), odour, taste and turbidity. Samples should be taken for aluminium and iron where these metals are used as flocculants during water treatment, *Clostridium perfringens* must be monitored where the water originates from or is influenced by surface water, and nitrite must be monitored if chloramination is used as a disinfectant. The Scottish Government issued Information Letter 1/2011 in February 2011 giving guidance to local authorities on the requirements for data reporting and sampling requirements. This letter can be found at

<http://www.dwqr.org.uk/technical/information-letters/privatesupplies.htm>.

DWQR has carried out an assessment of sampling compliance with check monitoring requirements for each local authority for 2012, based on the data returns provided by each authority. It is disappointing to note that, based on the information available, of 31 local authorities in Scotland with PWS in their areas, only two achieved full compliance with their check sampling duties. In 2013, the DWQR will work with local authorities to identify any issues which can be improved with the reporting arrangements; write to all local authorities to provide a copy of their check monitoring sample compliance report, and will offer support with interpretation of the 2006 regulations as required. Policy will also be developed in 2013 to give clarity to local authorities on DWQR’s expectations with sampling compliance and an agreed set of performance measures will be developed. It is DWQR’s intention to publish local authority sampling compliance data in future annual reports.

Further analysis of sampling compliance data shows a shortfall in the number of samples which should have been taken for *E. coli*. This is concerning given the health risks that untreated; poorly treated and poorly maintained private water supplies can pose, and emphasises the need for guidance on sampling duties; to ensure that the current reporting systems provide accurate and robust information to support the introduction of a performance measure for sampling compliance. Notwithstanding this, sampling is indicative and users of private water supplies also require to take more responsibility for ensuring that their private water supplies are maintained and improved where necessary.

“Audit” monitoring must also be carried out for all Type A supplies, and the range of parameters to be sampled can be reduced depending on the outcome of the risk assessment of supplies and also from the results of previous monitoring. The 2006 regulations require local authorities to review any decisions made on reduction of audit monitoring at least once in every five years, and DWQR shall be surveying local authorities in 2013 to determine compliance with this requirement.

2.4_ WATER QUALITY OF PWS IN SCOTLAND

Type A supplies are subject to the monitoring requirements of European Directive 98/83/EC, which is reflected in the requirements of the 2006 Regulations. These supplies must be sampled at least annually for microbiological and chemical parameters which are set out in the 2006 Regulations.

The 2006 Regulations require Type B monitoring to be carried out at the request of owners or users of the supplies, against a smaller suite of national parameters.



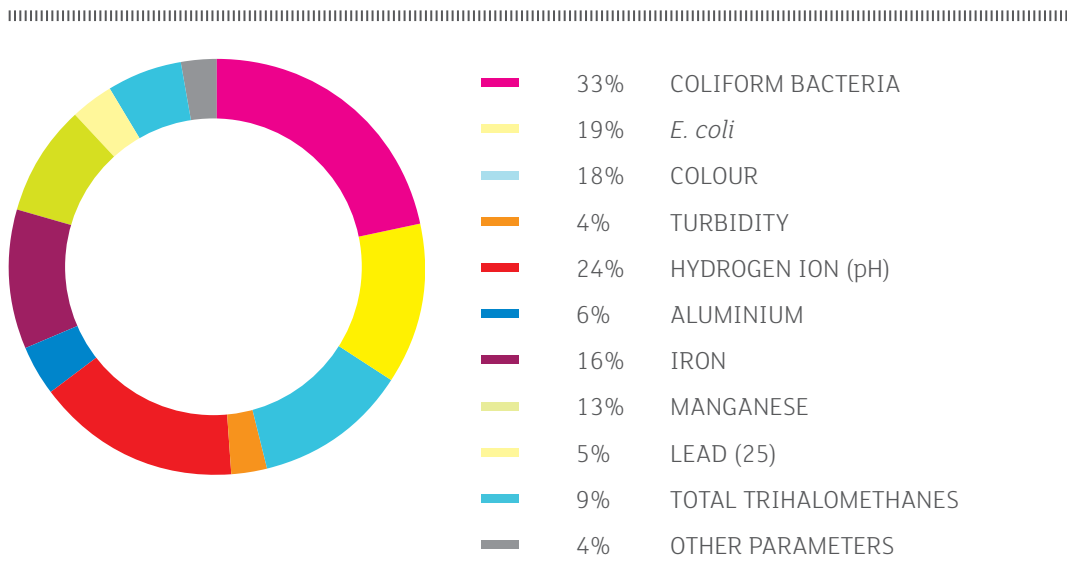
LABORATORY ANALYSIS OF DRINKING WATER SAMPLES

Table 2.4a shows a summary of the overall compliance of Type A and Type B samples across Scotland.

Table 2.4a Summary of Compliance of Type A Regulatory PWS Samples and Type B Samples

PARAMETER NAME	NUMBER OF TYPE A TESTS	NUMBER OF TYPE A FAILS	COMPLIANCE (%)
Coliform Bacteria	3,943	1,315	67
<i>E. coli</i>	3,955	762	81
Colour	2,171	382	82
Turbidity	3,270	132	96
Hydrogen ion (pH)	3,568	856	76
Aluminium	660	38	94
Iron	1,708	265	84
Manganese	1,550	198	87
Lead (25)	2,169	102	95
Total Trihalomethanes	46	4	91
Other Parameters	34,318	1,225	96
ALL PARAMETERS	57,358	5,279	91

Fig. 2.4a Proportion of Failing Parameters on PWS in Scotland



Compliance with the Coliform bacteria standard was lowest with 73% of Type A and 59% of Type B supplies complying with the standard. Coliform bacteria are a wide range of micro-organisms, and do not necessarily indicate that there is a risk to health. They can however indicate the absence or lack of effectiveness of disinfection systems and poor integrity of treated water supplies.

Table 2.4b_ Summary of Compliance of Type A Regulatory Samples

PARAMETER NAME	NUMBER OF TYPE A TESTS	NUMBER OF TYPE A FAILS	COMPLIANCE (%)
Coliform Bacteria	2,167	585	73
<i>E. coli</i>	2,158	333	85
Colour	1,932	324	83
Turbidity	2,054	53	97
Hydrogen ion (pH)	2,064	442	79
Aluminium	543	15	97
Iron	909	128	86
Manganese	796	79	90
Lead (25)	1,011	43	96
Total Trihalomethanes	41	4	90
Other Parameters	25,331	682	97
ALL PARAMETERS	39,006	2,688	93

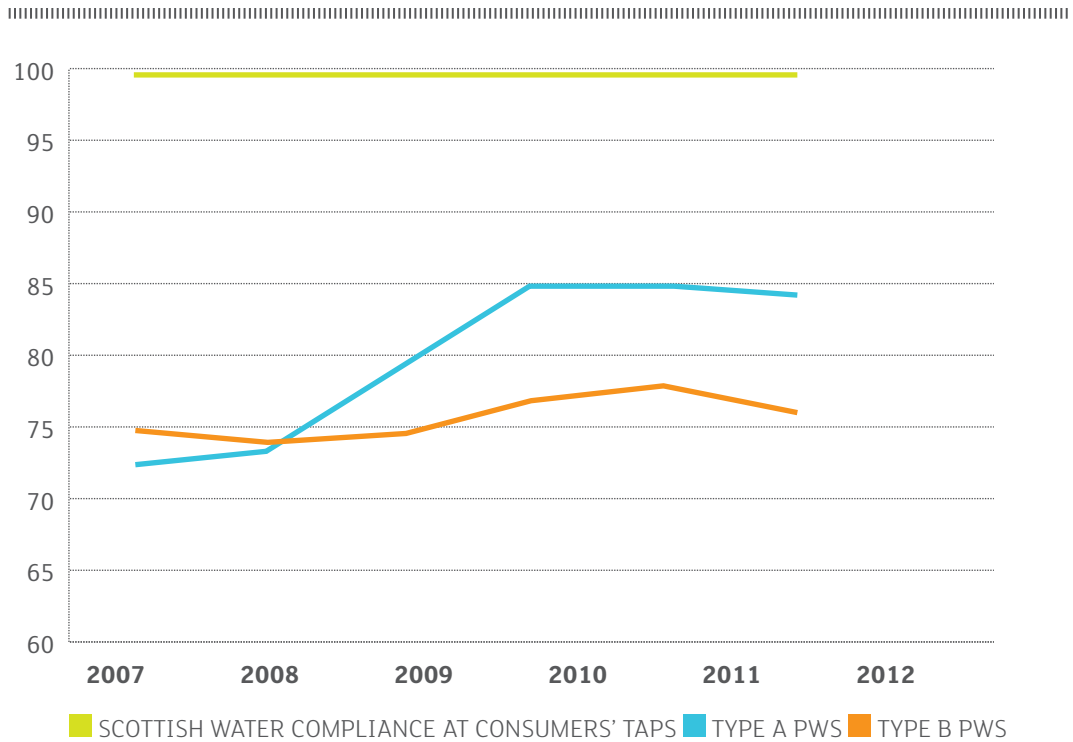
Table 2.4c_ Summary of Compliance of Type B Samples

PARAMETER NAME	NUMBER OF TYPE B TESTS	NUMBER OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	1,776	730	59
<i>E. coli</i>	1,797	429	76
Colour	239	58	76
Turbidity	1,216	79	94
Hydrogen ion (pH)	1,504	414	72
Aluminium	117	23	80
Iron	799	137	83
Manganese	754	119	84
Lead (25)	1,158	59	95
Total Trihalomethanes	5	0	100
Other Parameters	8,987	543	94
ALL PARAMETERS	18,352	2,591	86

The quality of many PWS in Scotland continues to be of concern, particularly the microbiological quality. In 2012, 15% of Type A supplies and almost a quarter (24%) of Type B supplies failed the *E. coli* standard. *E. coli* is present in high numbers in human and animal faeces, and when detected in drinking water is an indicator that the supply has been contaminated. Disappointingly, there were slightly more failures in 2012 when compared with 2011, when 15% of Type A and 22% of samples showed the presence of *E. coli*.

Figure 2.4b shows *E. coli* compliance from 2007-2012 for Type A and Type B PWS and for comparison, the overall compliance from consumer tap samples from Scottish Water’s supplies.

Fig. 2.4b_ Comparison of *E. coli* compliance for Type A, Type B and Scottish Water consumer tap samples from 2007 – 2012



It is disappointing to note that a significant number of failures of the *E. coli* standard are continuing to occur at supplies where there is disinfection. In 2012, of 762 failures of this *E. coli* standard, 305 samples, or 40%, of the supplies had disinfection.

It is strongly recommended that where sampling shows that there is *E. coli* in a PWS, or where a risk assessment shows that there is a risk of faecal contamination, the catchment and source of the supply should be protected from animals and animal waste, and from sewage contamination. Additionally, appropriate treatment, including disinfection, should be installed and maintained to protect the health of consumers of the supply from *E. coli* and any other pathogens that may be present in the supply.

DWQR expects local authorities to continue to work with owners and users of PWS to ensure the health risks from PWS are minimised, and if necessary that local authorities will use the regulatory powers available to them in order to protect public health.

The health risks posed by the presence of *E. coli*, particularly the verotoxigenic, or VTEC, strains of *E. coli*, such as *E. coli* O157, are well known. The Scottish Government recognises these risks and has re-convened an action group which has drafted a comprehensive set of recommendations covering all exposure routes. It is expected that during 2013 this action plan will be approved by Ministers and work will commence on implementation. Private water supplies are included in this report and a number of recommendations will apply; DWQR will be working with the Scottish Government and local authorities to develop programmes of work in this area.

17% of Type A and 24% of Type B supplies failed the colour standard in 2012. Colour is generally caused by naturally occurring organic matter that is derived from the catchment of surface water supplies, but can also be caused by the metals iron and manganese. Elevated levels of organic colour in drinking water supplies can be aesthetically unacceptable to consumers, but it can also pose issues for drinking water disinfection systems. Where chlorine is used as a disinfectant, the presence of colour can lead to the formation of Trihalomethanes (THMs), and in 2012 10% of samples tested for THMs failed the standard, all of which were for Type A supplies. Colour can also interfere with ultraviolet (UV) disinfection as the colour absorbs the UV light. In 2012, the DWQR, Aberdeenshire, Dumfries and Galloway, Argyll and Bute, Highland, Moray, Perth and Kinross and Angus Councils and Scottish Water developed a research proposal to investigate and define the interferences of raw water contaminants, including colour, on the effectiveness of UV disinfection. Research funding from the Scottish Government and from Scottish Water was awarded to fund the project which will begin in June 2013.

Manganese in drinking water supplies is naturally occurring and comes from the water supply catchment. Iron can also be naturally occurring, and elevated levels of manganese and iron are often found together. Iron can also be derived from rusting cast iron pipes. Elevated levels of iron and manganese cause discolouration of water and also staining of laundry and sanitary ware. Both can also interfere with UV disinfection process, either from coating glass sleeves on UV tubes or through particulate material shielding micro-organisms from the UV light. The impact of iron and manganese on UV will also be studied as part of the research project discussed earlier.

Compliance with the hydrogen ion, or pH, standard was poor in 2012. More than a fifth (21%) of Type A and more than a quarter (28%) of Type B supplies failed the pH standard in 2012. While naturally occurring pH failures are unlikely to present a risk to health, it is the corrosion of plumbing materials such as copper which are of concern. In 2012, compliance with the copper standard was disappointing, with 26% of samples taken for copper failing the standard (25% of Type A and 30% of Type B samples). Of the 936 samples taken for copper, 242, or 26% of these samples also failed pH standards.

5% of samples (4% Type A and 5% of Type B samples) taken for lead failed the current lead standard of 25µg/l. At the end of 2013 the lead standard will be tightened to 10µg/l across Europe, and based on the figures for 2012, the number of failures will almost double to 9%. **It is recommended that all lead pipes and tanks on drinking water supplies are replaced.**

Arsenic in drinking water is generally naturally occurring and tends to be found in groundwater. There were a small number of PWS which failed the standard for arsenic in 2012; out of 582 samples taken, nine (2%) failed the standard. There were six failures from 482 samples from Type A supplies (1%) and three failures from 100 samples from Type B supplies (3%).

2.5_ GRANTS

Local authorities continued to promote and administer the grants system for improvements to PWS on behalf of Scottish Minister in 2012. Non means tested grants of up to £800 per property are available for all PWS. Owners and users of PWS should contact their local authority's Environmental Health department for advice and details of how to apply for a grant.

In the 2012-13 financial year £1.58m of grants were awarded for PWS improvements. It is critical that when improvements to a supply are made, the improvements are adequately operated, maintained and managed.

An example of where grant funding has been awarded and good management of the supply is demonstrated is Mackies in Aberdeenshire. The business consists of a 1600 acre dairy farm, an ice cream production facility and an ice production plant. In total there are seven business units and 23 domestic properties. Originally only the water supply serving the ice cream room and ice production plant had water treatment, but the entire water supply system was significantly improved in 2012 by the company to give treatment for all parts of the supply. In addition to the investment spent by the company, the business was awarded grants for improvement by Aberdeenshire Council following their risk assessment. The supply was assessed and then improvements were made across the water supply system from the source through to drinking water taps, with work being completed on the protection and management of sources, improved storage tanks and replacement of pipework. Additional raw water sources were brought into supply and suitable treatment was installed on all of the supply. Crucially, a Water Safety Plan was developed by Mackies to identify and control risks to the water supply, and this along with monthly maintenance checks and daily in house monitoring of the supplies help ensure the PWS remains safe for both commercial and domestic use.

2.6_ MANAGEMENT OF PWS AND THE USE OF WATER SAFETY PLANS

The DWQR and many local authorities continued to promote the use of Water Safety Plans (WSP) for PWS in 2012. WSP are management plans which include the risk assessment and risk management of drinking water supplies. They are promoted by the World Health Organisation as the most effective method of consistently managing drinking water supplies. All of Scottish Water's drinking water supplies have WSP, and **it is strongly recommended that owners and users of private water supplies have WSP to help manage their drinking water supplies.**

A WSP should consist of:

- **Risk assessment.** Local authorities carry out risk assessments for Type A supplies and will also provide assistance for the development of risk assessments for Type B supplies. Information on risk assessments can also be found at www.privatewatersupplies.org.uk.
- **Controls for risks.** These will depend on the individual supply. They can be very simple, for example if drinking water supply is at risk from faecal contamination because farm animals can access the source of the supply, then the control could be that a fence is needed to keep the animals away. Another control could be the installation of water treatment, for example the installation of disinfection. **Controls for risks identified through a local authority risk assessment may be eligible for financial assistance from the non-means tested grants system available from local authorities.** The controls need to be monitored to ensure their on-going effectiveness – using the examples given above, this would be regular checking to ensure that the fence is intact and keeping animals away from the supply, or regular checks that the disinfection system is operating properly.

- **Management Plans to describe how the drinking water supply system is operated and maintained, including instructions for what to do if something goes wrong.** This can be a simple diary system containing:
 - reminders and instructions for routine operational and maintenance tasks such as checking the source of the supply or checking and changing UV bulbs that are used for disinfection
 - instructions for how any water treatment processes work and contact details of the manufacturers
 - procedures for what to do if there is a problem with the supply and contact details of who can provide advice and assistance.

DWQR continued to be actively involved in the World Health Organization's International Small Community Water Supply Management Network in 2012, and attended a meeting of the Network in Zaragoza in Spain. The Network was formed to promote improvements to small community supplies, particularly in rural areas and to promote the use of WSP. There was also a joint meeting held between the Network and RegNet, WHO's international regulators' group.

2.7_ PWS WORKSHOP

In October 2012, the DWQR hosted a workshop on PWS for the different agencies involved in PWS, including local authorities' Environmental Health representatives, the Scottish Government, and the National Health Service. There were a number of presentations given by stakeholders and then the DWQR launched the first draft of a PWS Strategy for discussion. Feedback of the event from delegates was very positive and as a result a second workshop, which will focus on compliance and enforcement issues, has been arranged for October 2013.

2.8_ PWS QUERIES AND COMPLAINTS

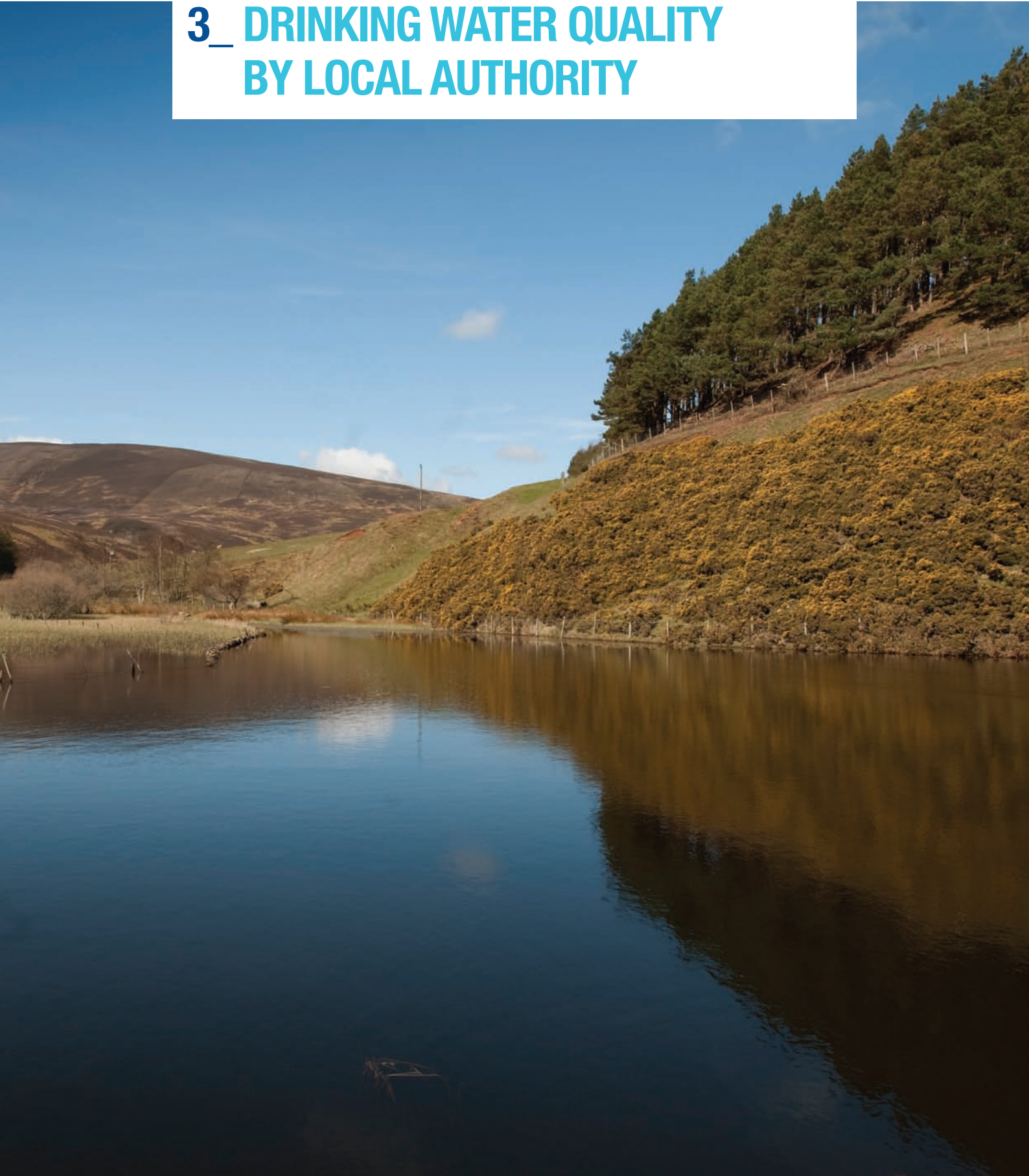
If owners or users have any queries about their PWS they should contact their local authority for advice. There is also a website at www.privatewatersupplies.gov.uk.

Any complaints about a local authority's PWS duties should be directed to the relevant local authority and if the complaint is not satisfactorily resolved, the local authority's formal complaints process should be followed. Following this, if it is thought that the complaint has not been dealt with satisfactorily, the DWQR can be contacted for advice.

2.9_ FURTHER INFORMATION

Further information and advice on PWS and also the grants scheme can be obtained from Environmental Health teams at local authorities and also at www.privatewatersupplies.gov.uk












3_ DRINKING WATER QUALITY BY LOCAL AUTHORITY



Aberdeen City



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	768	9	1.17	4	98.83
<i>E. coli</i>	768	0	0.00	0	100.00
Colour	272	0	0.00	0	100.00
Turbidity	272	0	0.00	0	100.00
Hydrogen ion (pH)	272	1	0.37	1	99.63
Aluminium	271	0	0.00	0	100.00
Iron	272	0	0.00	0	100.00
Manganese	272	0	0.00	0	100.00
Lead (25)	52	0	0.00	0	100.00
Total Trihalomethanes	52	0	0.00	0	100.00
Other Parameters	4964	2	0.04	1	99.96
ALL PARAMETERS	8235	12	0.15	5	99.85

Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	2	0	0.00	100.00	10	2	20.00	80.00
<i>E. coli</i>	2	0	0.00	100.00	10	0	0.00	100.00
Colour	2	0	0.00	100.00	10	0	0.00	100.00
Turbidity	2	0	0.00	100.00	10	0	0.00	100.00
Hydrogen ion (pH)	2	1	50.00	50.00	10	2	20.00	80.00
Aluminium	0	0	-	-	0	0	-	-
Iron	2	0	0.00	100.00	10	2	20.00	80.00
Manganese	2	0	0.00	100.00	10	0	0.00	100.00
Lead (25)	2	0	0.00	100.00	10	0	0.00	100.00
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	18	2	11.11	88.89	85	10	11.76	88.24
ALL PARAMETERS	34	3	8.82	91.18	165	16	9.70	90.30

Aberdeenshire



KEY TO LOCAL AUTHORITY MAPS:

- Motorway
- Primary route
- A class road
- B class road
- Minor roads
- ~ Rivers
- ☪ Lochs
- Foreshore
- Urban areas
- National Parks
- ☪ Scottish Water supply areas

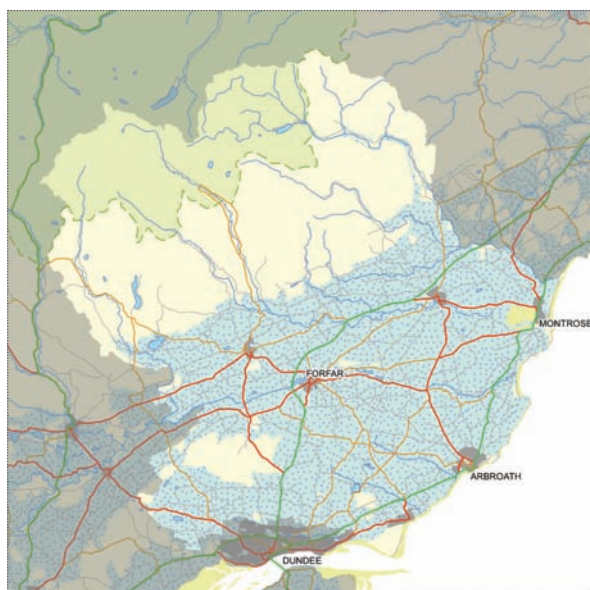
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	1564	12	0.77	6	99.23
<i>E. coli</i>	1564	0	0.00	0	100.00
Colour	546	0	0.00	0	100.00
Turbidity	546	0	0.00	0	100.00
Hydrogen ion (pH)	546	1	0.18	1	99.82
Aluminium	545	0	0.00	0	100.00
Iron	546	7	1.28	4	98.72
Manganese	546	1	0.18	1	99.82
Lead (25)	129	1	0.78	1	99.22
Total Trihalomethanes	129	0	0.00	0	100.00
Other Parameters	10424	10	0.10	3	99.90
ALL PARAMETERS	17085	32	0.19	12	99.81












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	202	46	22.77	77.23	680	235	34.56	65.44
<i>E. coli</i>	202	12	5.94	94.06	699	90	12.88	87.12
Colour	173	5	2.89	97.11	26	0	0.00	100.00
Turbidity	197	1	0.51	99.49	450	21	4.67	95.33
Hydrogen ion (pH)	201	47	23.38	76.62	665	205	30.83	69.17
Aluminium	2	0	0.00	100.00	17	12	70.59	29.41
Iron	198	6	3.03	96.97	474	36	7.59	92.41
Manganese	196	13	6.63	93.37	481	65	13.51	86.49
Lead (25)	198	7	3.54	96.46	473	11	2.33	97.67
Total Trihalomethanes	1	0	0.00	100.00	0	0	-	-
Other Parameters	3453	202	5.85	94.15	2838	183	6.45	93.55
ALL PARAMETERS	5023	339	6.75	93.25	6803	858	12.61	87.39

Angus



KEY TO LOCAL AUTHORITY MAPS:

	Motorway		Rivers
	Primary route		Lochs
	A class road		Foreshore
	B class road		Urban areas
	Minor roads		National Parks
	Scottish Water supply areas		

Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	912	2	0.22	2	99.78
<i>E. coli</i>	912	0	0.00	0	100.00
Colour	304	0	0.00	0	100.00
Turbidity	304	0	0.00	0	100.00
Hydrogen ion (pH)	304	0	0.00	0	100.00
Aluminium	304	0	0.00	0	100.00
Iron	304	6	1.97	3	98.03
Manganese	304	1	0.33	1	99.67
Lead (25)	40	0	0.00	0	100.00
Total Trihalomethanes	40	0	0.00	0	100.00
Other Parameters	3762	0	0.00	0	100.00
ALL PARAMETERS	7490	9	0.12	3	99.88












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	41	12	29.27	70.73	0	0	-	-
<i>E. coli</i>	41	6	14.63	85.37	0	0	-	-
Colour	31	3	9.68	90.32	0	0	-	-
Turbidity	38	0	0.00	100.00	0	0	-	-
Hydrogen ion (pH)	39	11	28.21	71.79	0	0	-	-
Aluminium	0	0	-	-	0	0	-	-
Iron	4	0	0.00	100.00	0	0	-	-
Manganese	3	0	0.00	100.00	0	0	-	-
Lead (25)	7	0	0.00	100.00	0	0	-	-
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	428	8	1.87	98.13	0	0	-	-
ALL PARAMETERS	632	40	6.33	93.67	0	0	-	-

Argyll and Bute



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

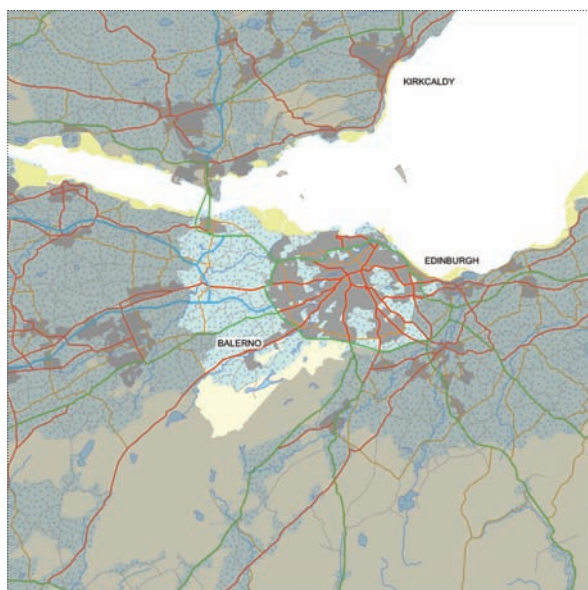
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	615	2	0.33	2	99.67
<i>E. coli</i>	615	0	0.00	0	100.00
Colour	250	0	0.00	0	100.00
Turbidity	250	0	0.00	0	100.00
Hydrogen ion (pH)	250	0	0.00	0	100.00
Aluminium	247	0	0.00	0	100.00
Iron	249	2	0.80	2	99.20
Manganese	249	3	1.20	3	98.80
Lead (25)	155	1	0.65	1	99.35
Total Trihalomethanes	155	8	5.16	6	94.84
Other Parameters	6881	0	0.00	0	100.00
ALL PARAMETERS	9916	16	0.16	10	99.84












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	376	139	36.97	63.03	145	55	37.93	62.07
<i>E. coli</i>	380	96	25.26	74.74	148	42	28.38	71.62
Colour	345	75	21.74	78.26	31	10	32.26	67.74
Turbidity	365	13	3.56	96.44	129	7	5.43	94.57
Hydrogen ion (pH)	365	67	18.36	81.64	152	30	19.74	80.26
Aluminium	318	11	3.46	96.54	37	3	8.11	91.89
Iron	338	67	19.82	80.18	95	29	30.53	69.47
Manganese	337	34	10.09	89.91	93	11	11.83	88.17
Lead (25)	348	13	3.74	96.26	141	12	8.51	91.49
Total Trihalomethanes	9	2	22.22	77.78	1	0	0.00	100.00
Other Parameters	7213	166	2.30	97.70	1228	59	4.80	95.20
ALL PARAMETERS	10394	683	6.57	93.43	2200	258	11.73	88.27

City of Edinburgh



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

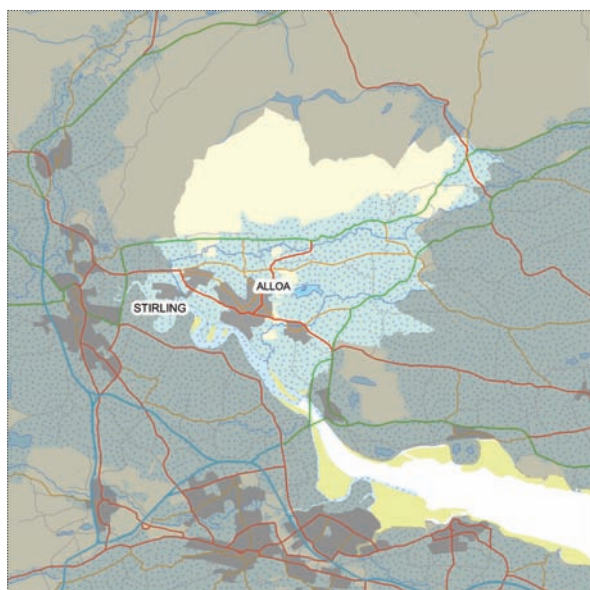
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	1826	1	0.05	1	99.95
<i>E. coli</i>	1826	0	0.00	0	100.00
Colour	648	0	0.00	0	100.00
Turbidity	648	0	0.00	0	100.00
Hydrogen ion (pH)	648	0	0.00	0	100.00
Aluminium	641	0	0.00	0	100.00
Iron	648	5	0.77	4	99.23
Manganese	648	0	0.00	0	100.00
Lead (25)	88	0	0.00	0	100.00
Total Trihalomethanes	88	0	0.00	0	100.00
Other Parameters	8796	0	0.00	0	100.00
ALL PARAMETERS	16505	6	0.04	5	99.96












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	1	1	100.00	0.00	3	2	66.67	33.33
<i>E. coli</i>	1	0	0.00	100.00	3	0	0.00	100.00
Colour	1	0	0.00	100.00	0	0	-	-
Turbidity	1	0	0.00	100.00	2	0	0.00	100.00
Hydrogen ion (pH)	1	0	0.00	100.00	2	0	0.00	100.00
Aluminium	1	0	0.00	100.00	0	0	-	-
Iron	1	0	0.00	100.00	0	0	-	-
Manganese	0	0	-	-	0	0	-	-
Lead (25)	0	0	-	-	2	0	0.00	100.00
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	7	0	0.00	100.00	17	0	0.00	100.00
ALL PARAMETERS	14	1	7.14	92.86	29	2	6.90	93.10

Clackmannanshire



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	552	1	0.18	1	99.82
<i>E. coli</i>	552	0	0.00	0	100.00
Colour	180	0	0.00	0	100.00
Turbidity	180	0	0.00	0	100.00
Hydrogen ion (pH)	180	0	0.00	0	100.00
Aluminium	180	0	0.00	0	100.00
Iron	180	0	0.00	0	100.00
Manganese	180	0	0.00	0	100.00
Lead (25)	24	0	0.00	0	100.00
Total Trihalomethanes	24	0	0.00	0	100.00
Other Parameters	1938	0	0.00	0	100.00
ALL PARAMETERS	4170	1	0.02	1	99.98












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	4	2	50.00	50.00	2	1	50.00	50.00
<i>E. coli</i>	4	2	50.00	50.00	2	1	50.00	50.00
Colour	4	0	0.00	100.00	0	0	-	-
Turbidity	4	1	25.00	75.00	0	0	-	-
Hydrogen ion (pH)	4	1	25.00	75.00	0	0	-	-
Aluminium	0	0	-	-	0	0	-	-
Iron	2	1	50.00	50.00	0	0	-	-
Manganese	2	1	50.00	50.00	0	0	-	-
Lead (25)	0	0	-	-	0	0	-	-
Total Trihalomethanes	3	1	33.33	66.67	0	0	-	-
Other Parameters	136	9	6.62	93.38	2	1	50.00	50.00
ALL PARAMETERS	163	18	11.04	88.96	6	3	50.00	50.00

Comhairle nan Eilean Siar



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

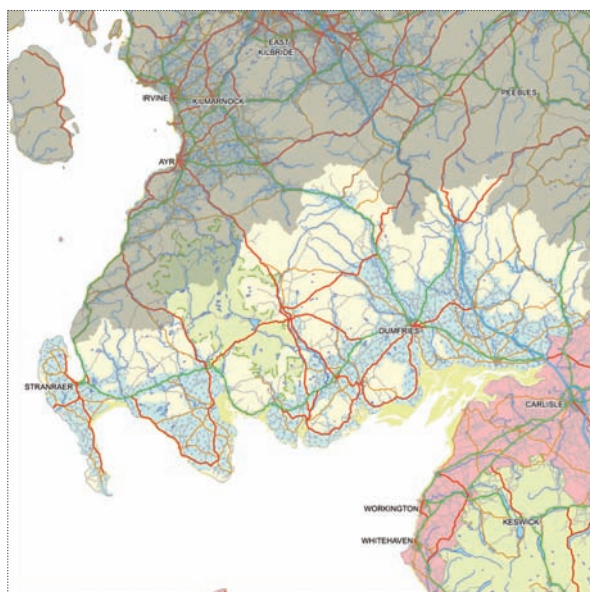
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	208	0	0.00	0	100.00
<i>E. coli</i>	208	0	0.00	0	100.00
Colour	86	0	0.00	0	100.00
Turbidity	86	0	0.00	0	100.00
Hydrogen ion (pH)	86	0	0.00	0	100.00
Aluminium	86	0	0.00	0	100.00
Iron	86	0	0.00	0	100.00
Manganese	86	3	3.49	3	96.51
Lead (25)	63	0	0.00	0	100.00
Total Trihalomethanes	63	6	9.52	4	90.48
Other Parameters	2851	1	0.04	1	99.96
ALL PARAMETERS	3909	10	0.26	8	99.74

Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	6	2	33.33	66.67	1	1	100.00	0.00
<i>E. coli</i>	6	0	0.00	100.00	1	1	100.00	0.00
Colour	2	1	50.00	50.00	0	0	-	-
Turbidity	6	0	0.00	100.00	1	0	0.00	100.00
Hydrogen ion (pH)	6	5	83.33	16.67	1	1	100.00	0.00
Aluminium	1	0	0.00	100.00	0	0	-	-
Iron	6	2	33.33	66.67	1	1	100.00	0.00
Manganese	6	1	16.67	83.33	1	0	0.00	100.00
Lead (25)	6	3	50.00	50.00	0	0	-	-
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	37	4	10.81	89.19	5	0	0.00	100.00
ALL PARAMETERS	82	18	21.95	78.05	11	4	36.36	63.64

Dumfries and Galloway



KEY TO LOCAL AUTHORITY MAPS:

- Motorway
- Primary route
- A class road
- B class road
- Minor roads
- ⋯ Scottish Water supply areas
- ~ Rivers
- ⬮ Lochs
- ⬮ Foreshore
- ⊕ Urban areas
- ⬮ National Parks

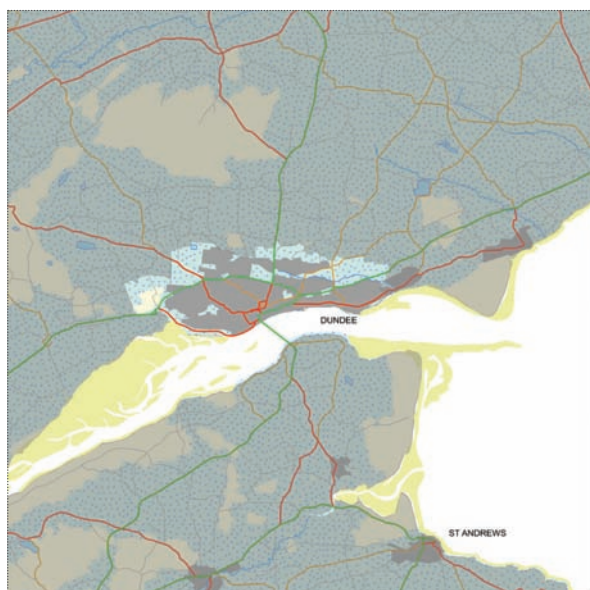
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	772	1	0.13	1	99.87
<i>E. coli</i>	772	0	0.00	0	100.00
Colour	290	0	0.00	0	100.00
Turbidity	290	0	0.00	0	100.00
Hydrogen ion (pH)	290	0	0.00	0	100.00
Aluminium	289	1	0.35	1	99.65
Iron	290	5	1.72	4	98.28
Manganese	290	1	0.34	1	99.66
Lead (25)	105	2	1.90	2	98.10
Total Trihalomethanes	104	2	1.92	2	98.08
Other Parameters	5303	0	0.00	0	100.00
ALL PARAMETERS	8795	12	0.14	7	99.86












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	205	57	27.80	72.20	167	89	53.29	46.71
<i>E. coli</i>	194	37	19.07	80.93	167	59	35.33	64.67
Colour	164	9	5.49	94.51	10	1	10.00	90.00
Turbidity	160	2	1.25	98.75	86	5	5.81	94.19
Hydrogen ion (pH)	148	41	27.70	72.30	84	31	36.90	63.10
Aluminium	18	1	5.56	94.44	4	2	50.00	50.00
Iron	42	9	21.43	78.57	10	4	40.00	60.00
Manganese	24	7	29.17	70.83	6	1	16.67	83.33
Lead (25)	80	5	6.25	93.75	93	10	10.75	89.25
Total Trihalomethanes	4	0	0.00	100.00	1	0	0.00	100.00
Other Parameters	1607	34	2.12	97.88	860	45	5.23	94.77
ALL PARAMETERS	2646	202	7.63	92.37	1488	247	16.60	83.40

Dundee City



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

Quality of Public Water Supplies

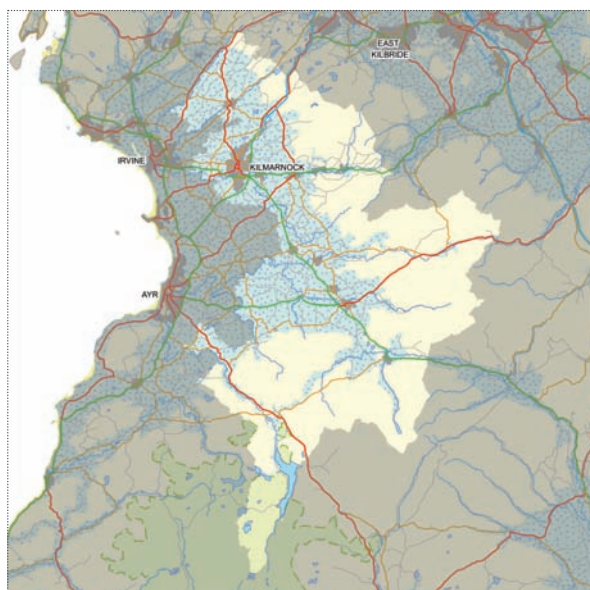
PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	444	1	0.23	1	99.77
<i>E. coli</i>	444	0	0.00	0	100.00
Colour	152	0	0.00	0	100.00
Turbidity	152	0	0.00	0	100.00
Hydrogen ion (pH)	152	0	0.00	0	100.00
Aluminium	152	0	0.00	0	100.00
Iron	152	1	0.66	1	99.34
Manganese	152	0	0.00	0	100.00
Lead (25)	16	0	0.00	0	100.00
Total Trihalomethanes	16	0	0.00	0	100.00
Other Parameters	1659	0	0.00	0	100.00
ALL PARAMETERS	3491	2	0.06	1	99.94

Quality of Private Water Supplies












PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria								
<i>E. coli</i>								
Colour								
Turbidity								
Hydrogen ion (pH)								
Aluminium								
Iron								
Manganese								
Lead (25)								
Total Trihalomethanes								
Other Parameters								
ALL PARAMETERS								

Dundee City Council did not take any samples during 2012

East Ayrshire



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

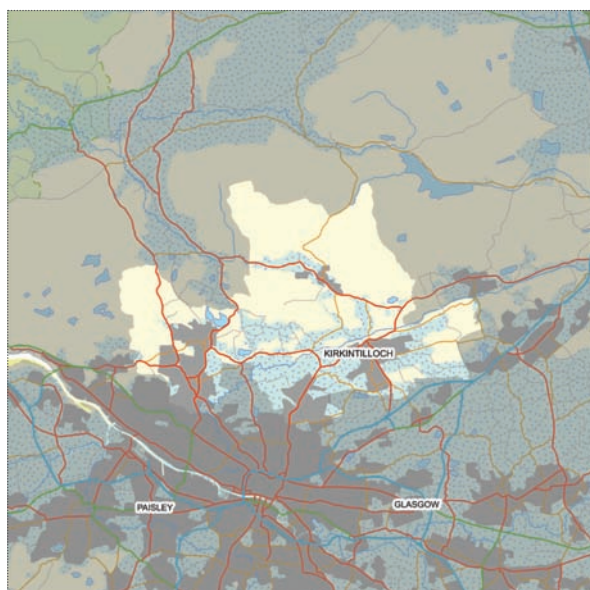
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	1177	8	0.68	6	99.32
<i>E. coli</i>	1177	0	0.00	0	100.00
Colour	412	0	0.00	0	100.00
Turbidity	412	0	0.00	0	100.00
Hydrogen ion (pH)	412	0	0.00	0	100.00
Aluminium	412	1	0.24	1	99.76
Iron	412	3	0.73	3	99.27
Manganese	412	11	2.67	4	97.33
Lead (25)	80	0	0.00	0	100.00
Total Trihalomethanes	80	11	13.75	6	86.25
Other Parameters	5259	2	0.04	1	99.96
ALL PARAMETERS	10245	36	0.35	9	99.65

Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	7	3	42.86	57.14	103	59	57.28	42.72
<i>E. coli</i>	7	3	42.86	57.14	103	39	37.86	62.14
Colour	1	1	100.00	0.00	2	0	0.00	100.00
Turbidity	9	1	11.11	88.89	81	11	13.58	86.42
Hydrogen ion (pH)	7	0	0.00	100.00	81	12	14.81	85.19
Aluminium	2	0	0.00	100.00	35	3	8.57	91.43
Iron	1	1	100.00	0.00	36	16	44.44	55.56
Manganese	1	1	100.00	0.00	36	12	33.33	66.67
Lead (25)	0	0	-	-	0	0	-	-
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	52	1	1.92	98.08	444	36	8.11	91.89
ALL PARAMETERS	87	11	12.64	87.36	921	188	20.41	79.59

East Dunbartonshire



KEY TO LOCAL AUTHORITY MAPS:

- Motorway
- Primary route
- A class road
- B class road
- Minor roads
- ~ Rivers
- ⬮ Lochs
- ⬮ Foreshore
- ⬮ Urban areas
- ⬮ National Parks
- ⬮ Scottish Water supply areas

Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	1572	6	0.38	4	99.62
<i>E. coli</i>	1571	1	0.06	1	99.94
Colour	528	0	0.00	0	100.00
Turbidity	528	1	0.19	1	99.81
Hydrogen ion (pH)	528	0	0.00	0	100.00
Aluminium	522	0	0.00	0	100.00
Iron	528	3	0.57	2	99.43
Manganese	528	1	0.19	1	99.81
Lead (25)	96	0	0.00	0	100.00
Total Trihalomethanes	96	1	1.04	1	98.96
Other Parameters	6773	0	0.00	0	100.00
ALL PARAMETERS	13270	13	0.10	5	99.90












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	1	0	0.00	100.00	17	11	64.71	35.29
<i>E. coli</i>	1	0	0.00	100.00	17	5	29.41	70.59
Colour	1	0	0.00	100.00	0	0	-	-
Turbidity	1	0	0.00	100.00	12	3	25.00	75.00
Hydrogen ion (pH)	1	0	0.00	100.00	12	2	16.67	83.33
Aluminium	0	0	-	-	0	0	-	-
Iron	1	0	0.00	100.00	9	4	44.44	55.56
Manganese	1	0	0.00	100.00	7	3	42.86	57.14
Lead (25)	1	0	0.00	100.00	12	2	16.67	83.33
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	22	0	0.00	100.00	57	5	8.77	91.23
ALL PARAMETERS	30	0	0.00	100.00	143	35	24.48	75.52

East Lothian



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

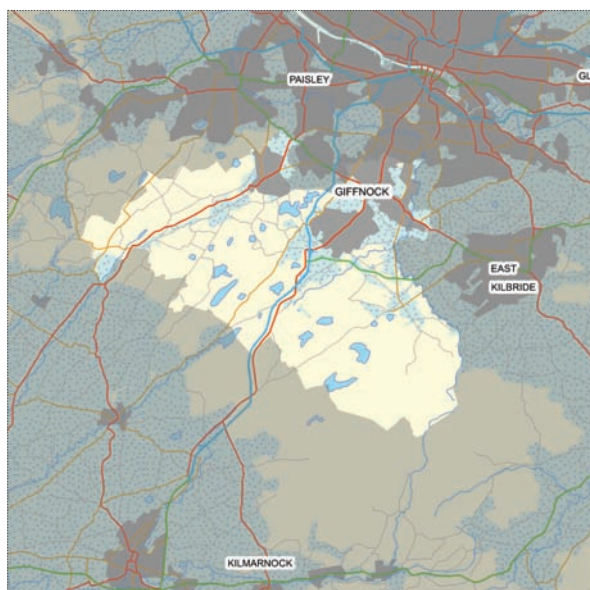
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	600	1	0.17	1	99.83
<i>E. coli</i>	600	0	0.00	0	100.00
Colour	240	0	0.00	0	100.00
Turbidity	240	0	0.00	0	100.00
Hydrogen ion (pH)	240	0	0.00	0	100.00
Aluminium	238	0	0.00	0	100.00
Iron	240	1	0.42	1	99.58
Manganese	240	1	0.42	1	99.58
Lead (25)	44	0	0.00	0	100.00
Total Trihalomethanes	44	0	0.00	0	100.00
Other Parameters	3577	0	0.00	0	100.00
ALL PARAMETERS	6303	3	0.05	2	99.95












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	7	1	14.29	85.71	11	2	18.18	81.82
<i>E. coli</i>	7	0	0.00	100.00	11	2	18.18	81.82
Colour	1	0	0.00	100.00	0	0	-	-
Turbidity	7	0	0.00	100.00	2	0	0.00	100.00
Hydrogen ion (pH)	7	0	0.00	100.00	2	1	50.00	50.00
Aluminium	5	0	0.00	100.00	1	0	0.00	100.00
Iron	5	0	0.00	100.00	1	0	0.00	100.00
Manganese	5	0	0.00	100.00	1	0	0.00	100.00
Lead (25)	8	1	12.50	87.50	6	0	0.00	100.00
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	148	1	0.68	99.32	68	1	1.47	98.53
ALL PARAMETERS	200	3	1.50	98.50	103	6	5.83	94.17

East Renfrewshire



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

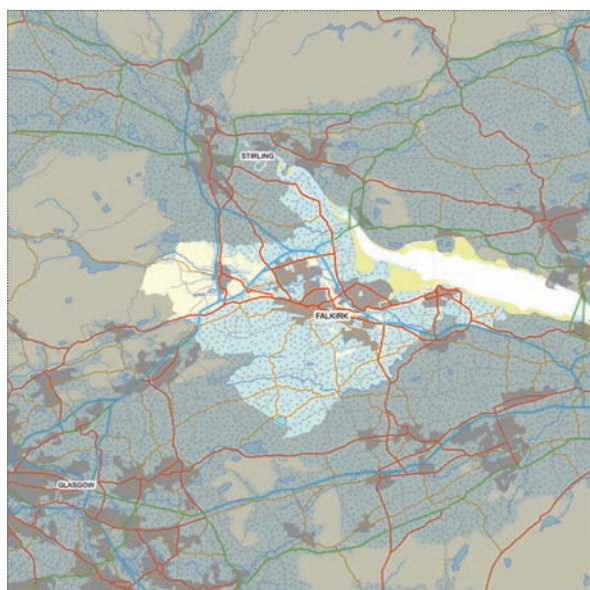
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	841	3	0.36	3	99.64
<i>E. coli</i>	841	0	0.00	0	100.00
Colour	296	0	0.00	0	100.00
Turbidity	296	0	0.00	0	100.00
Hydrogen ion (pH)	296	0	0.00	0	100.00
Aluminium	296	0	0.00	0	100.00
Iron	296	0	0.00	0	100.00
Manganese	296	2	0.68	1	99.32
Lead (25)	88	0	0.00	0	100.00
Total Trihalomethanes	88	0	0.00	0	100.00
Other Parameters	5058	0	0.00	0	100.00
ALL PARAMETERS	8692	5	0.06	4	99.94












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	3	2	66.67	33.33	11	6	54.55	45.45
<i>E. coli</i>	3	0	0.00	100.00	11	5	45.45	54.55
Colour	2	0	0.00	100.00	8	0	0.00	100.00
Turbidity	2	0	0.00	100.00	10	1	10.00	90.00
Hydrogen ion (pH)	3	0	0.00	100.00	11	3	27.27	72.73
Aluminium	0	0	-	-	0	0	-	-
Iron	0	0	-	-	0	0	-	-
Manganese	0	0	-	-	0	0	-	-
Lead (25)	0	0	-	-	2	0	0.00	100.00
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	9	0	0.00	100.00	37	3	8.11	91.89
ALL PARAMETERS	22	2	9.09	90.91	90	18	20.00	80.00

Falkirk



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

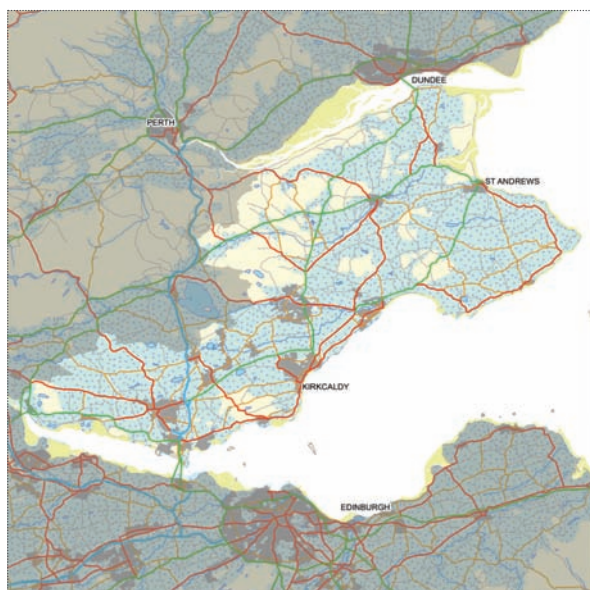
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	1228	5	0.41	3	99.59
<i>E. coli</i>	1227	0	0.00	0	100.00
Colour	410	0	0.00	0	100.00
Turbidity	410	0	0.00	0	100.00
Hydrogen ion (pH)	410	0	0.00	0	100.00
Aluminium	409	0	0.00	0	100.00
Iron	410	3	0.73	2	99.27
Manganese	410	2	0.49	2	99.51
Lead (25)	73	0	0.00	0	100.00
Total Trihalomethanes	73	0	0.00	0	100.00
Other Parameters	5321	0	0.00	0	100.00
ALL PARAMETERS	10381	10	0.10	4	99.90












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	1	0	0.00	100.00	0	0	-	-
<i>E. coli</i>	1	0	0.00	100.00	0	0	-	-
Colour	1	0	0.00	100.00	0	0	-	-
Turbidity	1	0	0.00	100.00	0	0	-	-
Hydrogen ion (pH)	1	0	0.00	100.00	0	0	-	-
Aluminium	0	0	-	-	0	0	-	-
Iron	0	0	-	-	0	0	-	-
Manganese	1	0	0.00	100.00	0	0	-	-
Lead (25)	0	0	-	-	0	0	-	-
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	4	0	0.00	100.00	0	0	-	-
ALL PARAMETERS	10	0	0.00	100.00	0	0	-	-

Fife



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

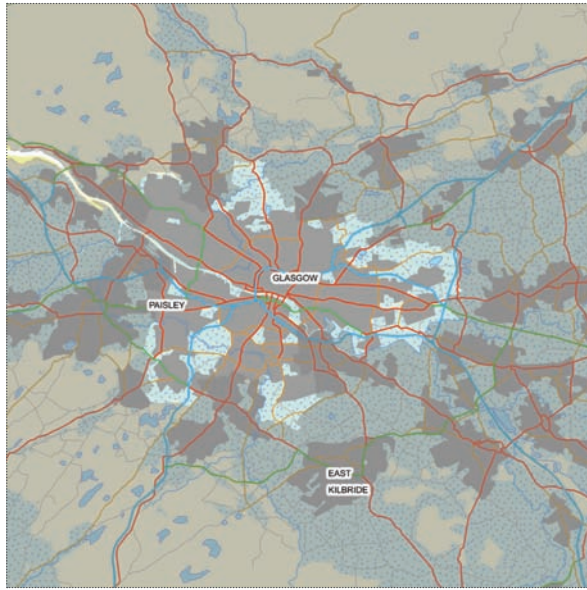
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	904	7	0.77	4	99.23
<i>E. coli</i>	904	0	0.00	0	100.00
Colour	322	0	0.00	0	100.00
Turbidity	322	0	0.00	0	100.00
Hydrogen ion (pH)	322	0	0.00	0	100.00
Aluminium	321	0	0.00	0	100.00
Iron	322	0	0.00	0	100.00
Manganese	322	0	0.00	0	100.00
Lead (25)	61	0	0.00	0	100.00
Total Trihalomethanes	61	0	0.00	0	100.00
Other Parameters	4609	0	0.00	0	100.00
ALL PARAMETERS	8470	7	0.08	4	99.92

Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	33	2	6.06	93.94	26	10	38.46	61.54
<i>E. coli</i>	33	2	6.06	93.94	26	5	19.23	80.77
Colour	24	1	4.17	95.83	2	0	0.00	100.00
Turbidity	31	0	0.00	100.00	23	2	8.70	91.30
Hydrogen ion (pH)	33	2	6.06	93.94	23	3	13.04	86.96
Aluminium	25	0	0.00	100.00	2	0	0.00	100.00
Iron	25	2	8.00	92.00	3	1	33.33	66.67
Manganese	6	1	16.67	83.33	1	0	0.00	100.00
Lead (25)	10	0	0.00	100.00	22	2	9.09	90.91
Total Trihalomethanes	5	0	0.00	100.00	0	0	-	-
Other Parameters	618	2	0.32	99.68	123	8	6.50	93.50
ALL PARAMETERS	843	12	1.42	98.58	251	31	12.35	87.65

Glasgow City



KEY TO LOCAL AUTHORITY MAPS:

- Motorway
- Primary route
- A class road
- B class road
- Minor roads
- Rivers
- Lochs
- Foreshore
- Urban areas
- National Parks
- Scottish Water supply areas

Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	2737	5	0.18	4	99.82
<i>E. coli</i>	2737	1	0.04	1	99.96
Colour	932	0	0.00	0	100.00
Turbidity	932	0	0.00	0	100.00
Hydrogen ion (pH)	932	0	0.00	0	100.00
Aluminium	925	0	0.00	0	100.00
Iron	931	0	0.00	0	100.00
Manganese	931	8	0.86	4	99.14
Lead (25)	172	0	0.00	0	100.00
Total Trihalomethanes	172	2	1.16	1	98.84
Other Parameters	11989	1	0.01	1	99.99
ALL PARAMETERS	23390	17	0.07	8	99.93

Quality of Private Water Supplies












PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria								
<i>E. coli</i>								
Colour								
Turbidity								
Hydrogen ion (pH)								
Aluminium								
Iron								
Manganese								
Lead (25)								
Total Trihalomethanes								
Other Parameters								
ALL PARAMETERS								

Glasgow City Council do not have any Private Water Supplies

Highland



KEY TO LOCAL AUTHORITY MAPS:

	Motorway		Rivers
	Primary route		Lochs
	A class road		Foreshore
	B class road		Urban areas
	Minor roads		National Parks
	Scottish Water supply areas		

Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	1136	7	0.62	6	99.38
<i>E. coli</i>	1136	1	0.09	1	99.91
Colour	429	0	0.00	0	100.00
Turbidity	430	0	0.00	0	100.00
Hydrogen ion (pH)	430	5	1.16	4	98.84
Aluminium	426	0	0.00	0	100.00
Iron	428	4	0.93	4	99.07
Manganese	428	1	0.23	1	99.77
Lead (25)	283	1	0.35	1	99.65
Total Trihalomethanes	281	6	2.14	6	97.86
Other Parameters	13114	12	0.09	8	99.91
ALL PARAMETERS	18521	37	0.20	27	99.80












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	635	170	26.77	73.23	104	58	55.77	44.23
<i>E. coli</i>	634	81	12.78	87.22	102	32	31.37	68.63
Colour	616	164	26.62	73.38	87	38	43.68	56.32
Turbidity	618	9	1.46	98.54	82	6	7.32	92.68
Hydrogen ion (pH)	622	136	21.86	78.14	86	23	26.74	73.26
Aluminium	0	0	-	-	0	0	-	-
Iron	66	19	28.79	71.21	38	19	50.00	50.00
Manganese	56	14	25.00	75.00	34	8	23.53	76.47
Lead (25)	47	6	12.77	87.23	63	2	3.17	96.83
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	5118	98	1.91	98.09	1006	37	3.68	96.32
ALL PARAMETERS	8412	697	8.29	91.71	1602	223	13.92	86.08

Inverclyde



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

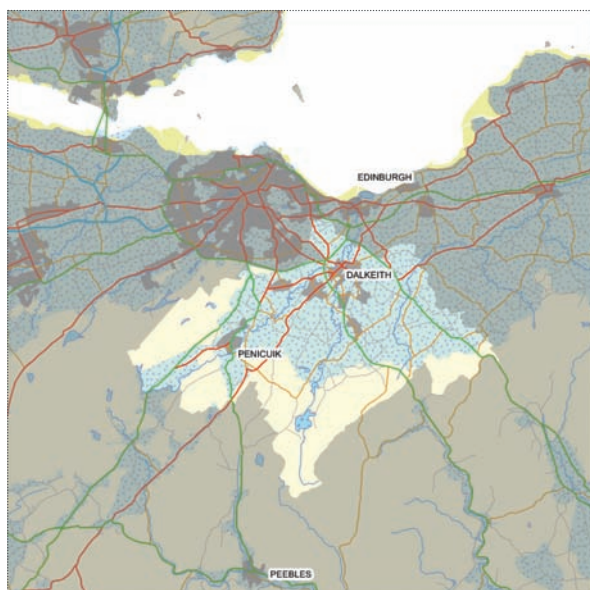
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	408	3	0.74	2	99.26
<i>E. coli</i>	408	0	0.00	0	100.00
Colour	140	0	0.00	0	100.00
Turbidity	140	0	0.00	0	100.00
Hydrogen ion (pH)	140	2	1.43	1	98.57
Aluminium	138	0	0.00	0	100.00
Iron	140	1	0.71	1	99.29
Manganese	140	0	0.00	0	100.00
Lead (25)	32	1	3.13	1	96.88
Total Trihalomethanes	32	0	0.00	0	100.00
Other Parameters	2078	2	0.10	1	99.90
ALL PARAMETERS	3796	9	0.24	3	99.76












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	8	1	12.50	87.50	0	0	-	-
<i>E. coli</i>	8	1	12.50	87.50	0	0	-	-
Colour	8	0	0.00	100.00	0	0	-	-
Turbidity	8	0	0.00	100.00	0	0	-	-
Hydrogen ion (pH)	8	1	12.50	87.50	0	0	-	-
Aluminium	4	0	0.00	100.00	0	0	-	-
Iron	4	0	0.00	100.00	0	0	-	-
Manganese	4	0	0.00	100.00	0	0	-	-
Lead (25)	4	0	0.00	100.00	0	0	-	-
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	128	4	3.13	96.88	0	0	-	-
ALL PARAMETERS	184	7	3.80	96.20	0	0	-	-

Midlothian



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

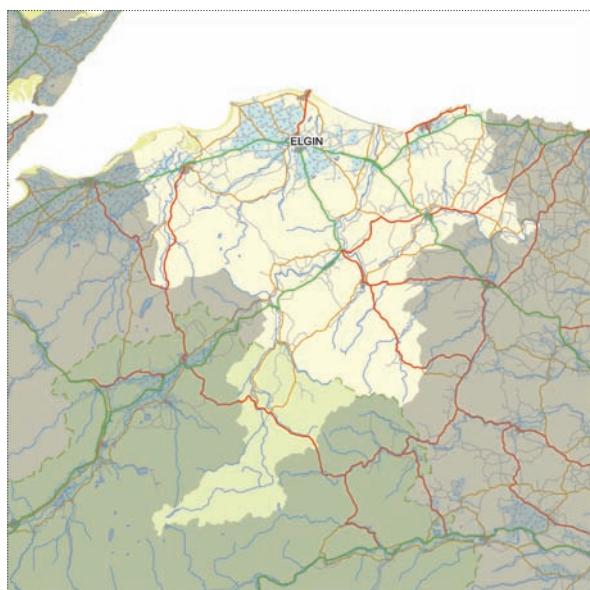
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	721	2	0.28	2	99.72
<i>E. coli</i>	721	0	0.00	0	100.00
Colour	276	0	0.00	0	100.00
Turbidity	276	0	0.00	0	100.00
Hydrogen ion (pH)	276	0	0.00	0	100.00
Aluminium	272	0	0.00	0	100.00
Iron	276	1	0.36	1	99.64
Manganese	276	1	0.36	1	99.64
Lead (25)	40	0	0.00	0	100.00
Total Trihalomethanes	40	0	0.00	0	100.00
Other Parameters	3790	0	0.00	0	100.00
ALL PARAMETERS	6964	4	0.06	3	99.94












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	4	0	0.00	100.00	12	9	75.00	25.00
<i>E. coli</i>	4	0	0.00	100.00	12	5	41.67	58.33
Colour	4	1	25.00	75.00	1	0	0.00	100.00
Turbidity	4	0	0.00	100.00	12	0	0.00	100.00
Hydrogen ion (pH)	4	0	0.00	100.00	12	3	25.00	75.00
Aluminium	4	0	0.00	100.00	1	0	0.00	100.00
Iron	4	1	25.00	75.00	1	0	0.00	100.00
Manganese	0	0	-	-	0	0	-	-
Lead (25)	1	0	0.00	100.00	11	0	0.00	100.00
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	32	0	0.00	100.00	86	4	4.65	95.35
ALL PARAMETERS	61	2	3.28	96.72	148	21	14.19	85.81

Moray



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	384	2	0.52	1	99.48
<i>E. coli</i>	384	1	0.26	1	99.74
Colour	136	0	0.00	0	100.00
Turbidity	136	0	0.00	0	100.00
Hydrogen ion (pH)	136	0	0.00	0	100.00
Aluminium	119	0	0.00	0	100.00
Iron	120	0	0.00	0	100.00
Manganese	120	0	0.00	0	100.00
Lead (25)	44	1	2.27	1	97.73
Total Trihalomethanes	44	0	0.00	0	100.00
Other Parameters	2812	3	0.11	1	99.89
ALL PARAMETERS	4435	7	0.16	2	99.84












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	90	23	25.56	74.44	64	10	15.63	84.38
<i>E. coli</i>	90	8	8.89	91.11	64	8	12.50	87.50
Colour	88	3	3.41	96.59	1	0	0.00	100.00
Turbidity	90	17	18.89	81.11	51	3	5.88	94.12
Hydrogen ion (pH)	90	45	50.00	50.00	79	47	59.49	40.51
Aluminium	88	2	2.27	97.73	0	0	-	-
Iron	90	2	2.22	97.78	55	5	9.09	90.91
Manganese	83	1	1.20	98.80	58	10	17.24	82.76
Lead (25)	84	2	2.38	97.62	49	0	0.00	100.00
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	1031	33	3.20	96.80	220	8	3.64	96.36
ALL PARAMETERS	1824	136	7.46	92.54	641	91	14.20	85.80

North Ayrshire



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

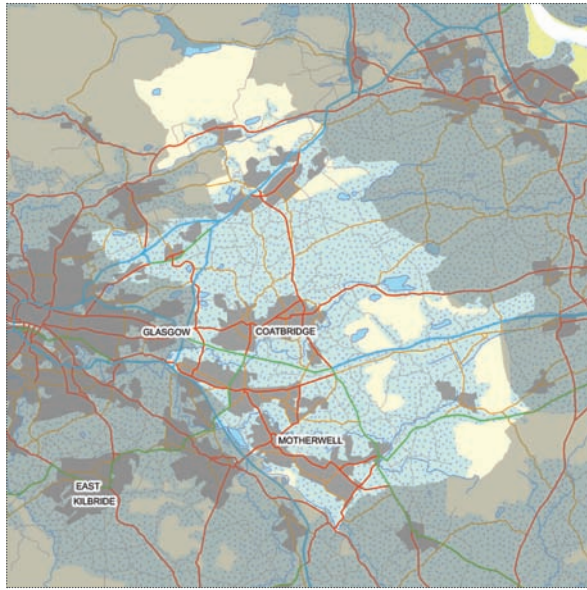
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	685	6	0.88	3	99.12
<i>E. coli</i>	685	0	0.00	0	100.00
Colour	224	0	0.00	0	100.00
Turbidity	224	0	0.00	0	100.00
Hydrogen ion (pH)	224	2	0.89	1	99.11
Aluminium	224	0	0.00	0	100.00
Iron	224	3	1.34	3	98.66
Manganese	224	3	1.34	2	98.66
Lead (25)	52	0	0.00	0	100.00
Total Trihalomethanes	52	6	11.54	3	88.46
Other Parameters	3182	2	0.06	1	99.94
ALL PARAMETERS	6000	22	0.37	4	99.63

Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	20	5	25.00	75.00	12	8	66.67	33.33
<i>E. coli</i>	20	4	20.00	80.00	12	7	58.33	41.67
Colour	14	0	0.00	100.00	3	1	33.33	66.67
Turbidity	20	1	5.00	95.00	6	2	33.33	66.67
Hydrogen ion (pH)	20	1	5.00	95.00	7	3	42.86	57.14
Aluminium	1	0	0.00	100.00	8	0	0.00	100.00
Iron	4	0	0.00	100.00	8	8	100.00	0.00
Manganese	1	0	0.00	100.00	8	8	100.00	0.00
Lead (25)	7	0	0.00	100.00	12	4	33.33	66.67
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	172	1	0.58	99.42	99	8	8.08	91.92
ALL PARAMETERS	279	12	4.30	95.70	175	49	28.00	72.00

North Lanarkshire



KEY TO LOCAL AUTHORITY MAPS:

- Motorway
- Primary route
- A class road
- B class road
- Minor roads
- Scottish Water supply areas
- Rivers
- Lochs
- Foreshore
- Urban areas
- National Parks

Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	2316	10	0.43	8	99.57
<i>E. coli</i>	2315	0	0.00	0	100.00
Colour	784	0	0.00	0	100.00
Turbidity	784	0	0.00	0	100.00
Hydrogen ion (pH)	784	0	0.00	0	100.00
Aluminium	779	0	0.00	0	100.00
Iron	784	5	0.64	3	99.36
Manganese	784	3	0.38	3	99.62
Lead (25)	120	0	0.00	0	100.00
Total Trihalomethanes	120	0	0.00	0	100.00
Other Parameters	9541	1	0.01	1	99.99
ALL PARAMETERS	19111	19	0.10	11	99.90

Quality of Private Water Supplies












PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria								
<i>E. coli</i>								
Colour								
Turbidity								
Hydrogen ion (pH)								
Aluminium								
Iron								
Manganese								
Lead (25)								
Total Trihalomethanes								
Other Parameters								
ALL PARAMETERS								

North Lanarkshire did not take any samples during 2012.

Orkney



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

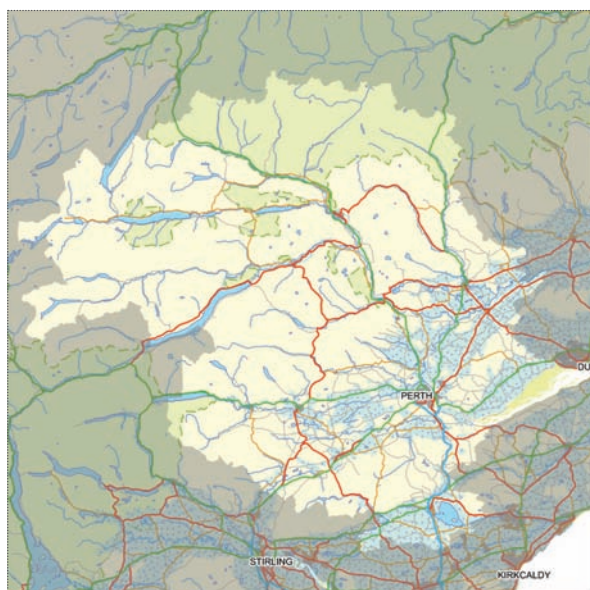
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	136	0	0.00	0	100.00
<i>E. coli</i>	136	0	0.00	0	100.00
Colour	60	0	0.00	0	100.00
Turbidity	60	0	0.00	0	100.00
Hydrogen ion (pH)	60	0	0.00	0	100.00
Aluminium	60	0	0.00	0	100.00
Iron	60	1	1.67	1	98.33
Manganese	60	1	1.67	1	98.33
Lead (25)	40	1	2.50	1	97.50
Total Trihalomethanes	40	3	7.50	2	92.50
Other Parameters	1846	1	0.05	1	99.95
ALL PARAMETERS	2558	7	0.27	5	99.73












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	31	12	38.71	61.29	39	19	48.72	51.28
<i>E. coli</i>	31	2	6.45	93.55	39	9	23.08	76.92
Colour	23	2	8.70	91.30	1	0	0.00	100.00
Turbidity	31	0	0.00	100.00	30	1	3.33	96.67
Hydrogen ion (pH)	31	1	3.23	96.77	30	0	0.00	100.00
Aluminium	13	0	0.00	100.00	1	0	0.00	100.00
Iron	12	1	8.33	91.67	1	0	0.00	100.00
Manganese	0	0	-	-	0	0	-	-
Lead (25)	3	0	0.00	100.00	29	0	0.00	100.00
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	216	4	1.85	98.15	191	11	5.76	94.24
ALL PARAMETERS	391	22	5.63	94.37	361	40	11.08	88.92

Perth and Kinross



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

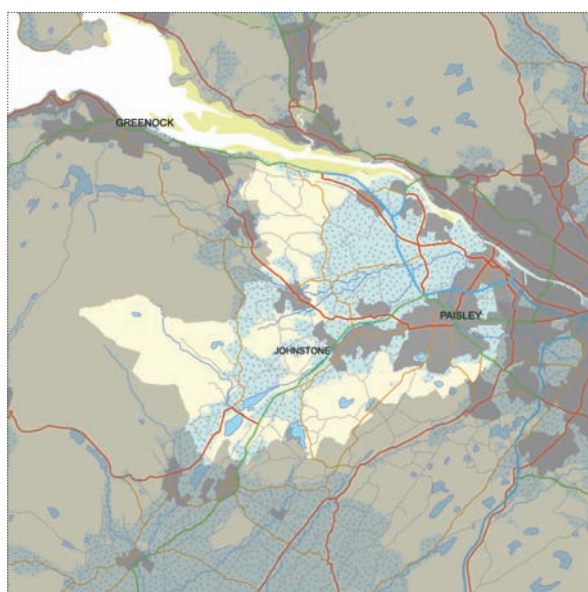
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	1452	6	0.41	6	99.59
<i>E. coli</i>	1452	0	0.00	0	100.00
Colour	496	0	0.00	0	100.00
Turbidity	496	0	0.00	0	100.00
Hydrogen ion (pH)	496	0	0.00	0	100.00
Aluminium	496	0	0.00	0	100.00
Iron	496	2	0.40	2	99.60
Manganese	496	0	0.00	0	100.00
Lead (25)	96	0	0.00	0	100.00
Total Trihalomethanes	97	0	0.00	0	100.00
Other Parameters	6905	1	0.01	1	99.99
ALL PARAMETERS	12978	9	0.07	6	99.93












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	263	50	19.01	80.99	184	77	41.85	58.15
<i>E. coli</i>	263	39	14.83	85.17	184	65	35.33	64.67
Colour	251	40	15.94	84.06	6	0	0.00	100.00
Turbidity	252	6	2.38	97.62	80	6	7.50	92.50
Hydrogen ion (pH)	253	61	24.11	75.89	85	20	23.53	76.47
Aluminium	16	1	6.25	93.75	7	3	42.86	57.14
Iron	30	12	40.00	60.00	15	4	26.67	73.33
Manganese	20	3	15.00	85.00	12	0	0.00	100.00
Lead (25)	27	3	11.11	88.89	88	8	9.09	90.91
Total Trihalomethanes	13	1	7.69	92.31	3	0	0.00	100.00
Other Parameters	2395	58	2.42	97.58	546	62	11.36	88.64
ALL PARAMETERS	3783	274	7.24	92.76	1210	245	20.25	79.75

Renfrewshire



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

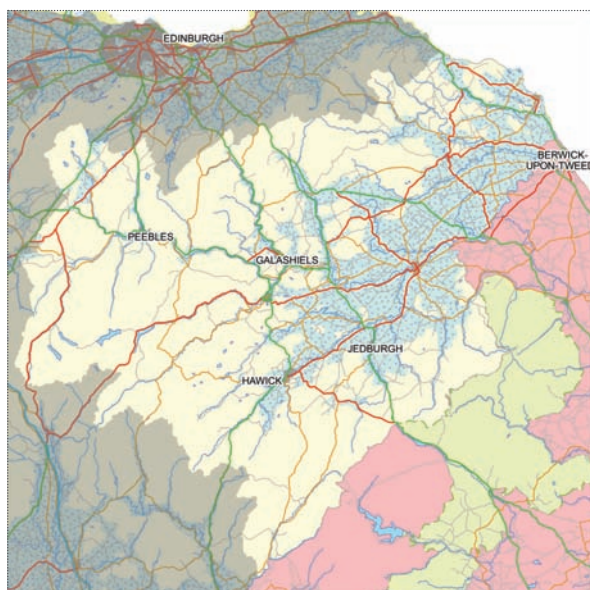
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	1260	6	0.48	5	99.52
<i>E. coli</i>	1260	1	0.08	1	99.92
Colour	440	0	0.00	0	100.00
Turbidity	440	0	0.00	0	100.00
Hydrogen ion (pH)	440	0	0.00	0	100.00
Aluminium	435	0	0.00	0	100.00
Iron	439	0	0.00	0	100.00
Manganese	439	5	1.14	2	98.86
Lead (25)	80	1	1.25	1	98.75
Total Trihalomethanes	80	1	1.25	1	98.75
Other Parameters	5539	2	0.04	2	99.96
ALL PARAMETERS	10852	16	0.15	7	99.85

Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	9	1	11.11	88.89	3	2	66.67	33.33
<i>E. coli</i>	9	0	0.00	100.00	3	1	33.33	66.67
Colour	2	1	50.00	50.00	0	0	-	-
Turbidity	2	0	0.00	100.00	4	0	0.00	100.00
Hydrogen ion (pH)	9	2	22.22	77.78	4	0	0.00	100.00
Aluminium	9	0	0.00	100.00	0	0	-	-
Iron	9	0	0.00	100.00	0	0	-	-
Manganese	9	0	0.00	100.00	0	0	-	-
Lead (25)	0	0	-	-	0	0	-	-
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	190	0	0.00	100.00	15	1	6.67	93.33
ALL PARAMETERS	248	4	1.61	98.39	29	4	13.79	86.21

Scottish Borders



KEY TO LOCAL AUTHORITY MAPS:

	Motorway		Rivers
	Primary route		Lochs
	A class road		Foreshore
	B class road		Urban areas
	Minor roads		National Parks
	Scottish Water supply areas		

Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	680	3	0.44	2	99.56
<i>E. coli</i>	680	0	0.00	0	100.00
Colour	272	0	0.00	0	100.00
Turbidity	272	0	0.00	0	100.00
Hydrogen ion (pH)	272	0	0.00	0	100.00
Aluminium	253	0	0.00	0	100.00
Iron	255	2	0.78	1	99.22
Manganese	255	0	0.00	0	100.00
Lead (25)	90	0	0.00	0	100.00
Total Trihalomethanes	90	0	0.00	0	100.00
Other Parameters	5245	0	0.00	0	100.00
ALL PARAMETERS	8364	5	0.06	3	99.94












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	117	25	21.37	78.63	108	44	40.74	59.26
<i>E. coli</i>	116	18	15.52	84.48	109	35	32.11	67.89
Colour	103	6	5.83	94.17	12	1	8.33	91.67
Turbidity	110	1	0.91	99.09	82	8	9.76	90.24
Hydrogen ion (pH)	110	7	6.36	93.64	83	13	15.66	84.34
Aluminium	5	0	0.00	100.00	0	0	-	-
Iron	5	0	0.00	100.00	1	1	100.00	0.00
Manganese	5	0	0.00	100.00	1	1	100.00	0.00
Lead (25)	114	0	0.00	100.00	86	7	8.14	91.86
Total Trihalomethanes	6	0	0.00	100.00	0	0	-	-
Other Parameters	981	21	2.14	97.86	615	30	4.88	95.12
ALL PARAMETERS	1672	78	4.67	95.33	1097	140	12.76	87.24

Shetland



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	116	1	0.86	1	99.14
<i>E. coli</i>	116	0	0.00	0	100.00
Colour	58	0	0.00	0	100.00
Turbidity	58	0	0.00	0	100.00
Hydrogen ion (pH)	58	0	0.00	0	100.00
Aluminium	58	1	1.72	1	98.28
Iron	58	0	0.00	0	100.00
Manganese	58	0	0.00	0	100.00
Lead (25)	33	0	0.00	0	100.00
Total Trihalomethanes	33	4	12.12	2	87.88
Other Parameters	1520	1	0.07	1	99.93
ALL PARAMETERS	2166	7	0.32	4	99.68











Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	1	1	100.00	0.00	1	1	100.00	0.00
<i>E. coli</i>	1	1	100.00	0.00	1	0	0.00	100.00
Colour	0	0	-	-	0	0	-	-
Turbidity	0	0	-	-	0	0	-	-
Hydrogen ion (pH)	0	0	-	-	0	0	-	-
Aluminium	0	0	-	-	0	0	-	-
Iron	0	0	-	-	0	0	-	-
Manganese	0	0	-	-	0	0	-	-
Lead (25)	0	0	-	-	0	0	-	-
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	3	1	33.33	66.67	3	0	0.00	100.00
ALL PARAMETERS	5	3	60.00	40.00	5	1	20.00	80.00

South Ayrshire



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

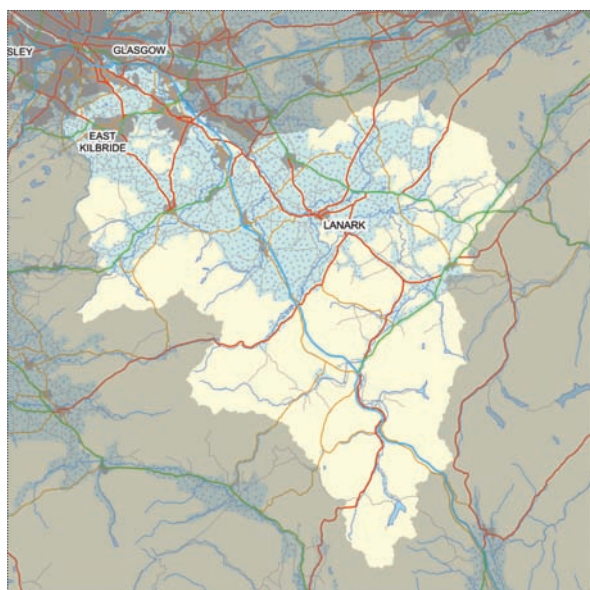
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	672	5	0.74	3	99.26
<i>E. coli</i>	672	0	0.00	0	100.00
Colour	228	0	0.00	0	100.00
Turbidity	228	0	0.00	0	100.00
Hydrogen ion (pH)	228	0	0.00	0	100.00
Aluminium	227	1	0.44	1	99.56
Iron	228	2	0.88	2	99.12
Manganese	228	10	4.39	3	95.61
Lead (25)	40	0	0.00	0	100.00
Total Trihalomethanes	40	7	17.50	4	82.50
Other Parameters	2678	2	0.07	1	99.93
ALL PARAMETERS	5469	27	0.49	5	99.51












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	23	7	30.43	69.57	13	4	30.77	69.23
<i>E. coli</i>	23	5	21.74	78.26	13	4	30.77	69.23
Colour	11	2	18.18	81.82	1	0	0.00	100.00
Turbidity	23	0	0.00	100.00	12	2	16.67	83.33
Hydrogen ion (pH)	23	6	26.09	73.91	12	1	8.33	91.67
Aluminium	11	0	0.00	100.00	1	0	0.00	100.00
Iron	11	1	9.09	90.91	1	0	0.00	100.00
Manganese	11	2	18.18	81.82	1	0	0.00	100.00
Lead (25)	0	0	-	-	0	0	-	-
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	288	11	3.82	96.18	57	3	5.26	94.74
ALL PARAMETERS	424	34	8.02	91.98	111	14	12.61	87.39

South Lanarkshire



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	2125	5	0.24	5	99.76
<i>E. coli</i>	2125	0	0.00	0	100.00
Colour	716	0	0.00	0	100.00
Turbidity	716	0	0.00	0	100.00
Hydrogen ion (pH)	716	0	0.00	0	100.00
Aluminium	713	0	0.00	0	100.00
Iron	716	1	0.14	1	99.86
Manganese	716	3	0.42	2	99.58
Lead (25)	128	0	0.00	0	100.00
Total Trihalomethanes	128	0	0.00	0	100.00
Other Parameters	9118	1	0.01	1	99.99
ALL PARAMETERS	17917	10	0.06	8	99.94












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	24	9	37.50	62.50	15	6	40.00	60.00
<i>E. coli</i>	24	4	16.67	83.33	15	4	26.67	73.33
Colour	11	0	0.00	100.00	0	0	-	-
Turbidity	24	0	0.00	100.00	11	1	9.09	90.91
Hydrogen ion (pH)	24	5	20.83	79.17	19	8	42.11	57.89
Aluminium	11	0	0.00	100.00	0	0	-	-
Iron	12	0	0.00	100.00	0	0	-	-
Manganese	12	1	8.33	91.67	1	0	0.00	100.00
Lead (25)	24	0	0.00	100.00	17	0	0.00	100.00
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	482	7	1.45	98.55	131	11	8.40	91.60
ALL PARAMETERS	648	26	4.01	95.99	209	30	14.35	85.65

Stirling



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

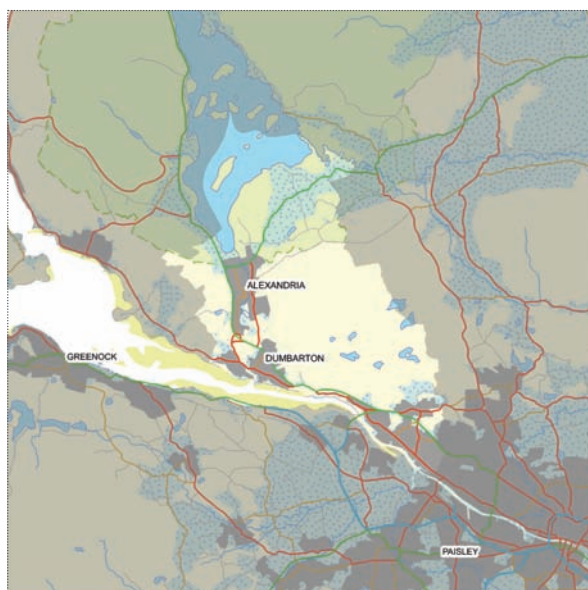
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	915	3	0.33	1	99.67
<i>E. coli</i>	914	0	0.00	0	100.00
Colour	310	0	0.00	0	100.00
Turbidity	310	1	0.32	1	99.68
Hydrogen ion (pH)	310	1	0.32	1	99.68
Aluminium	308	0	0.00	0	100.00
Iron	310	3	0.97	2	99.03
Manganese	310	1	0.32	1	99.68
Lead (25)	89	0	0.00	0	100.00
Total Trihalomethanes	89	1	1.12	1	98.88
Other Parameters	4973	0	0.00	0	100.00
ALL PARAMETERS	8838	10	0.11	3	99.89












Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	42	8	19.05	80.95	40	19	47.50	52.50
<i>E. coli</i>	42	7	16.67	83.33	40	10	25.00	75.00
Colour	41	10	24.39	75.61	38	7	18.42	81.58
Turbidity	39	1	2.56	97.44	38	0	0.00	100.00
Hydrogen ion (pH)	42	2	4.76	95.24	39	6	15.38	84.62
Aluminium	0	0	-	-	0	0	-	-
Iron	28	4	14.29	85.71	37	7	18.92	81.08
Manganese	2	0	0.00	100.00	0	0	-	-
Lead (25)	31	3	9.68	90.32	37	1	2.70	97.30
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	326	10	3.07	96.93	220	17	7.73	92.27
ALL PARAMETERS	593	45	7.59	92.41	489	67	13.70	86.30

West Dunbartonshire



KEY TO LOCAL AUTHORITY MAPS:

 Motorway	 Rivers
 Primary route	 Lochs
 A class road	 Foreshore
 B class road	 Urban areas
 Minor roads	 National Parks
 Scottish Water supply areas	

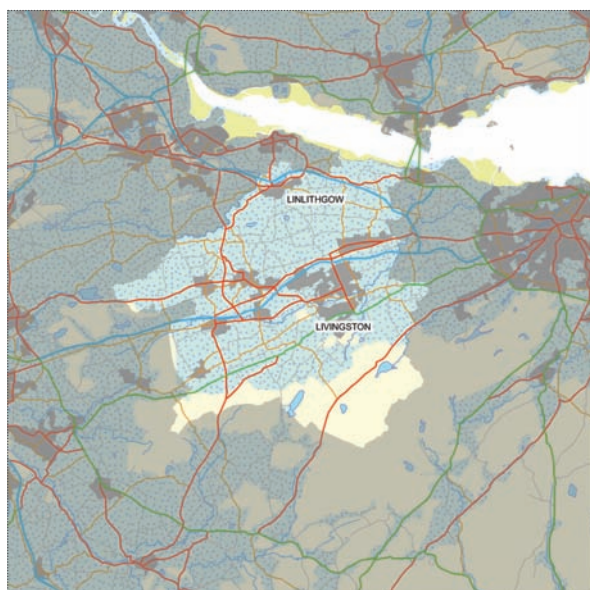
Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	1127	5	0.44	3	99.56
<i>E. coli</i>	1126	1	0.09	1	99.91
Colour	372	0	0.00	0	100.00
Turbidity	372	1	0.27	1	99.73
Hydrogen ion (pH)	372	0	0.00	0	100.00
Aluminium	368	0	0.00	0	100.00
Iron	371	3	0.81	2	99.19
Manganese	371	2	0.54	2	99.46
Lead (25)	72	0	0.00	0	100.00
Total Trihalomethanes	72	3	4.17	2	95.83
Other Parameters	4900	2	0.04	1	99.96
ALL PARAMETERS	9523	17	0.18	6	99.82

Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	3	0	0.00	100.00	3	0	0.00	100.00
<i>E. coli</i>	3	0	0.00	100.00	3	0	0.00	100.00
Colour	0	0	-	-	0	0	-	-
Turbidity	1	0	0.00	100.00	0	0	-	-
Hydrogen ion (pH)	2	0	0.00	100.00	3	0	0.00	100.00
Aluminium	1	0	0.00	100.00	3	0	0.00	100.00
Iron	1	0	0.00	100.00	3	0	0.00	100.00
Manganese	1	0	0.00	100.00	3	0	0.00	100.00
Lead (25)	1	0	0.00	100.00	3	0	0.00	100.00
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	19	1	5.26	94.74	28	0	0.00	100.00
ALL PARAMETERS	32	1	3.13	96.88	49	0	0.00	100.00

West Lothian



KEY TO LOCAL AUTHORITY MAPS:

- Motorway
- Primary route
- A class road
- B class road
- Minor roads
- ~ Rivers
- ◊ Lochs
- ◊ Foreshore
- + Urban areas
- ◊ National Parks
- ◊ Scottish Water supply areas

Quality of Public Water Supplies

PARAMETER NAME	TOTAL NO. SAMPLES	NO. OF FAILED SAMPLES	FAILURES %	NO. OF ZONES WITH FAILURES	COMPLIANCE (%)
Coliform Bacteria	1680	6	0.36	4	99.64
<i>E. coli</i>	1679	0	0.00	0	100.00
Colour	560	0	0.00	0	100.00
Turbidity	560	0	0.00	0	100.00
Hydrogen ion (pH)	560	0	0.00	0	100.00
Aluminium	558	0	0.00	0	100.00
Iron	560	6	1.07	4	98.93
Manganese	560	2	0.36	2	99.64
Lead (25)	88	0	0.00	0	100.00
Total Trihalomethanes	88	0	0.00	0	100.00
Other Parameters	7061	0	0.00	0	100.00
ALL PARAMETERS	13954	14	0.10	7	99.90

Quality of Private Water Supplies

PARAMETER NAME	NO. OF TYPE A TESTS	NO. OF TYPE A FAILS	% OF TYPE A FAILS	COMPLIANCE (%)	NO. OF TYPE B TESTS	NO. OF TYPE B FAILS	% OF TYPE B FAILS	COMPLIANCE (%)
Coliform Bacteria	8	6	75.00	25.00	2	0	0.00	100.00
<i>E. coli</i>	8	5	62.50	37.50	2	0	0.00	100.00
Colour	8	0	0.00	100.00	0	0	-	-
Turbidity	8	0	0.00	100.00	2	0	0.00	100.00
Hydrogen ion (pH)	8	0	0.00	100.00	2	0	0.00	100.00
Aluminium	8	0	0.00	100.00	0	0	-	-
Iron	8	0	0.00	100.00	0	0	-	-
Manganese	8	0	0.00	100.00	0	0	-	-
Lead (25)	8	0	0.00	100.00	2	0	0.00	100.00
Total Trihalomethanes	0	0	-	-	0	0	-	-
Other Parameters	198	4	2.02	97.98	6	0	0.00	100.00
ALL PARAMETERS	270	15	5.56	94.44	16	0	0.00	100.00

ANNEXES

ANNEX A – SUMMARY OF EVENTS AND INCIDENTS

Scottish Water is required to tell DWQR about events that could affect water quality. DWQR looks at all events and classifies the most serious as incidents. All incidents are assessed by DWQR and, where appropriate, investigated further. The following tables detail the incidents declared in relation to distribution systems and treatment works events.



Distribution Systems

SUPPLY ZONE OR STORAGE RESERVOIR (SR)	LOCATION	DATE OF INCIDENT	CAUSE OF INCIDENT
Stornoway	Western Isles	Jan-12	Mains Condition
Blackpark	Aviemore	Mar-12	Significant Consumer Concern
Mannofield East	Aberdeen	Jun-12	Domestic Plumbing
Afton	Kilmarnock	Aug-12	Domestic Plumbing
Balmore A	Kirkintilloch	Aug-12	Mains Condition
Clashbuie Tubeg (SR)	Tongue	Sep-12	Low Chlorine
Glenlatterach	Forres	Sep-12	Mains Condition
Muirdykes	Paisley	Oct-12	Mains Condition
Tullich	Oban	Oct-12	Disinfection Process Failure

Water Treatment Works

SITE	DATE OF INCIDENT	CAUSE OF INCIDENT
Acharacle WTW	Feb-12	Disinfection Process Failure
Pateshill WTW	Feb-12	Failure of Coagulation
Kilmuir WTW	Feb-12	Catchment
Crianlarich WTW	Feb-12	Ingress
Picketlaw WTW	Mar-12	Disinfection Process Failure
Newcastleton WTW	Mar-12	Disinfection Process Failure
Penwhapple WTW	Mar-12	Failure of Coagulation
Tomnavoulin WTW	May-12	Inadequate Treatment
Marchbank WTW	Jun-12	Failure of Coagulation
Windyfield WTW	Jun-12	Disinfection Process Failure
Glenconvinth WTW	Jul-12	Disinfection Process Failure
Kinnesswood WTW	Aug-12	Ingress
Tullich WTW	Dec-12	Inadequate Treatment
Afton WTW	Dec-12	Failure of Coagulation

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 2012, DWQR completed the following inspections:

Water Treatment Works

LOCATION	DATE	REASON FOR AUDIT	NUMBER OF RECOMMENDATIONS
Bradán (Ayrshire)	Jan 2012	Risk based	12
Amlaird (Ayrshire)	Jan 2012	Risk based	12
Rawburn (Scottish Borders)	Feb 2012	Risk based	3
Muirdykes (Renfrewshire)	Feb 2012	Risk based	8
Mannofield (Aberdeen)	Mar 2012	Risk based	6
Invercarnie (Aberdeen)	Mar 2012	Risk based	6
Turriff (Aberdeenshire)	Apr 2012	Risk based	10
Rosebery (Lothian)	Nov 2012	Risk based	9
Calder Hoy (Caithness)	Dec 2012	Response to Incident	4

Distribution Systems

LOCATION	DATE	SCOPE OF AUDIT	NUMBER OF RECOMMENDATIONS
Falkirk (Contractor)	Aug 2012	Rehab works	2
Glasgow (SW)	Aug 2012	Rehab works	6
Carron Valley B Zone	Aug 2012	Full Distribution System	14
East Calder (SW & Contractor)	Sept 2012	Rehab works x2	4 & 1
Edinburgh (SW)	Sept 2012	Mains Repair	2

Consumer Complaints to Scottish Water

LOCATION	DATE	SCOPE OF AUDIT	NUMBER OF RECOMMENDATIONS
Scottish Water Contact Centre	Nov 2012	Consumer complaints about WQ	5

Sampling and Analysis

LOCATION	DATE	SCOPE OF AUDIT	NUMBER OF RECOMMENDATIONS
Inverness Laboratory	Sept 2012	Method Witnessing and Vertical audits – Whole of Lab	3
Edinburgh Laboratory	Nov 2012	Method Witnessing and Vertical audits – Whole of Lab	1

Scottish Water Response to Recommendations

LOCATION	DATE	SCOPE OF AUDIT	NUMBER OF RECOMMENDATIONS
SW Offices	Nov 2012	SW response to delivery of actions arising from DWQR recommendations	15

Scottish Water Water Mains Rehabilitation Programme

LOCATION	DATE	SCOPE OF AUDIT	NUMBER OF RECOMMENDATIONS
SW Offices	Nov & Dec 2012	Sign off of investment schemes to rehabilitate water mains	3

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 2012, there were two active 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.

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 2012, there was one active Enforcement Notice. This was to deal with manganese in the water supply from the Lock Eck water treatment works which supplies Dunoon and the surrounding area. The work required by the Enforcement Notice was completed by the end of 2012.

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. They are as follows:

1. Lochgoin and Craighendunton – 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, nutrients such as phosphorous and nitrates) at source, thereby avoiding the costs of installing expensive treatment to take these contaminants out at the water treatment works.

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

Scottish Water has also developed a Best Practice Incentive Scheme to help land managers finance measures aimed at reducing the level of diffuse pollution such as can be caused by the application of pesticides. There have already been a small number of applicants for this scheme, but it is too early to say what impact, if any, these measures are having on water quality. In addition, Scottish Water is working closely 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. 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 has been made with this task during 2012, but it became apparent that investment is 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.

In addition, disinfection control was improved at 13 water treatment works during the course of 2012. Works improved include Achmore, Braemar and Tyndrum. This 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 2012, the treatment works at Glassford just north of Strathaven was closed and the area previously supplied by that works is now served by Camps and Daer water treatment works. The water treatment works at Aboyne in Aberdeenshire was also closed with the area previously supplied by that works now being served by Glendye water treatment works. In addition, the supplies for Cullivoe in Shetland, Kilberry in Argyll and on the Isle of Tiree were improved.

However, the most outstanding achievement during the early part of 2012 was the completion of a new treatment works for Edinburgh. DWQR has taken a close interest in the development of this project from its inception to completion and would congratulate Scottish Water on the successful commissioning of this major works which allowed the closure of the existing works at both Alnwickhill and Fairmilehead.

Investment in the Distribution System

During 2012, Scottish Water completed the construction of the remaining six (out of the total of 14) emergency tanker fill points at strategic positions within distribution systems throughout Scotland. If the piped supply fails or becomes contaminated for any reason, these facilities will assist Scottish Water in complying with their duty to supply at least 10 litres of alternative water per head of population each day during such an emergency.

Also during 2012, Scottish Water completed the installation of backflow prevention devices on the incoming water mains at 128 wastewater treatment works (WWTW). 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.

Scottish Water also carried out studies during 2012 on 16 water supply zones to determine the extent of water mains rehabilitation required to reduce the number of discoloured water events and consumer complaints. In addition, following studies previously undertaken, Scottish water carried out water main rehabilitation works in 91 of its water supply zones to reduce the risk of water quality being degraded by the condition of the distribution system pipework.

Scottish Water continued to undertake studies during 2012 to determine the location and number of lead communication pipes in Scottish Water's ownership. 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 will reduce from its current level of 25 micrograms per litre at present to 10 micrograms per litre from the end of 2013.

In the short term, during 2012, Scottish Water investigated 27 water supply zones for the presence of lead communication pipes. Where there was no lead present, no action was taken. Where lead was found, these pipes were replaced with plastic pipes in most cases, but in one case chemical dosing was introduced at the treatment works to minimise the uptake of lead in the water.

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 Organisation, 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 may 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; and*
- *local authorities are required to secure improvements to private water supplies as appropriate.*

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 post 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 Private Water Supplies (Scotland) Regulations 2006

- *The 2006 Regulations came into force on 3 July 2006, they;*
- *define wholesomeness in accordance with the EC Drinking Water Directive 98/83/EC;*
- *require local authorities to classify private supplies according to size and use;*
- *require local authorities to monitor, risk assess and report on private supplies in their area according to classification and risk; and*
- *provide advice to private supply owners and ensure improvements are carried out.*

The Private Water Supplies (Grants) (Scotland) Regulations 2006

- *The Regulations provide for grants to be paid to eligible persons to enable them to improve their private water supply; and*
- *are administered by local authorities and provides for non-means tested grants of up to £800 per property.*

The Water Quality (Scotland) Regulations 2010

- *The 2010 Regulations came into force on 20 April 2010.*
- *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.*
- *The 2010 Regulations also make a number of technical amendments to the Water Supply (Water Quality) (Scotland) Regulations 2001 and the Private Water Supplies (Scotland) Regulations 2006 to:*
- *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;*
- *provide for more widespread testing for Cryptosporidium to provide data about background levels in water supplies;*
- *provision put in place for Cryptosporidium risk assessment and 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 1 April 2010 to 31 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 1 April 2010 to 31 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 Organization, for all public drinking water supplies.*

ANNEX F – INDEX OF INFORMATION LETTERS ISSUED DURING 2012**Information****Letter number****Title****Public Supply**

01/2012	Consumer Complaint Information Requirements
02/2012	Reference not used
03/2012	Matters to be notified to DWQR and Scottish Ministers via the Event Reporting Process
04/2012	Mechanism for Reporting Drinking Water Quality events to DWQR

Private Supply

01/2012	Guidance on confirmation of typing of <i>E. coli</i> isolates from private water supply monitoring
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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 consumer's 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 discolouration.

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. All drinking water quality regulators in the UK are now reporting Mean Zonal Compliance figures using the same methodology, so it should therefore be possible to make comparisons using this index across the UK.

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 2012, DWQR has used all regulatory parameters that have a numerical standard in this calculation to give a value of 99.86%. If only the 40 parameters in Schedule 1 of the 2001 Regulations that have a numerical standard are used in the calculation, the 2012 value is 99.87%. The full list of parameters may be found in **Table 1.4a** of this report.

Pesticides

All parameters are weighted equally in the calculation but the sheer number of pesticide determinants 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 West.

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.

