Scottish Water
Trusted to serve Scotland

Sustainability report 2019

Doing the right thing for Scotland

Our vital role

Our services support the daily lives of 2.54 million households and 152,000 business premises. We are proud of the service we provide:

- **delivering 1.46 billion litres of clear, fresh drinking water and;**
- **removing 996 million litres of waste water which we treat, recover resources from and return safely to the environment.**

Over the six year period from 2015-21 £3.9 billion will be invested in managing our assets and further improvements to drinking water quality, protecting the environment and contributing to the Scottish economy. In 2018/19, the fourth year of the regulatory programme, we invested £660 million.

Our average household charge is £46 lower per year than in England and Wales.

Customer charges go towards maintaining and improving:

30,311
miles of water pipes

33,059
miles of sewer pipes

239
water treatment works

1,827
waste water treatment works

Contents

Icon key

The 3 icons shown below represent the **Environment**, **Society** and the **Economy**. We have used the dark blue icons throughout this report to help you quickly identify the areas our activities have a positive impact.

Environment **Society** **Economy**

Foreword

"Net zero is clearly a big challenge, but a massive opportunity too and we're up for it. I want to make sure Scottish Water is playing a positive part in the future of this country and our planet."

Douglas Millican, Chief Executive

Welcome to our eighth annual sustainability report. During 2019 we saw an unprecedented focus on climate change.

Scottish Water has been taking action to mitigate our greenhouse gas emissions and to adapt to the impacts of climate change on our services for around a decade. As a major public body providing vital water and waste water services throughout the whole country, we are absolutely committed to doing all we can to reduce the impact we have on the environment.

The 2019 Programme for Government focused on the Climate Emergency and the commitment for Scotland to achieve net zero emissions by 2045. Scottish Water's success in improving our energy efficiency and increasing our renewable energy generation was recognised within that.

We have committed to going further than the targets already laid down. We are going to accelerate our efforts and turn Scottish Water into a net zero emissions business by 2040, five years ahead of the 2045 target. And once we achieve that, we want to go beyond, to go further in ensuring all of our activities have an overall positive impact on the planet. This will have a transformative impact on everything we do.

In this sustainability report, we take a look at some of the actions we have been taking to cut our emissions, and some of the ideas that will help us on our journey to net zero.

As part of our response to the Climate Emergency, future reports will focus on monitoring progress on our climate change commitments.

UN Sustainable Development Goals supported by Scottish Water

Responding to the climate emergency – ending our contribution to global heating

Global heating, driven by greenhouse gas emissions, is impacting the climate and environment on which we depend.

The effects of climate change are apparent across the water cycle, with increases in the frequency and intensity of both dry weather and rainfall events[1]. In Scotland, reports suggest there may be a modest overall increase in rainfall, but that the frequency and intensity of weather events may increase, and there may be a reduction in rainfall in eastern areas compared with western parts of Scotland[2].

The UK Climate Change Committee has concluded that, using existing technologies, the UK has the ability to get to 'net zero'[3] greenhouse gas emissions by 2050, and that Scotland should do so by 2045[4].

In April 2019 the Scottish Government declared a climate emergency and committed Scotland to achieving net zero greenhouse gas emissions by 2045.

Scottish Water's commitment, as set out in the 2019 Programme for Government[5], is to achieve net zero emissions across all operational and capital investment activities by 2040.

Emissions mitigation strategy – the net zero challenge

Our service – water collection, treatment and distribution to customers, and the collection, pumping and treatment of waste water – require significant infrastructure and energy. Consequently, we are one of Scotland's larger users of electricity, with a demand of some 570GWh of electricity per annum (including services run on our behalf by PFI companies).

We have been measuring and managing our operational greenhouse gas emissions since 2006/07. Since 2006/07, our emissions have fallen by 41% to 272,000 tonnes of carbon dioxide equivalent (CO_2e) in 2018/19.

Reductions in earlier years were achieved through measures such as energy efficiency, leakage management and renewable power generation. More recently the 'greening' of the electricity grid has benefited our footprint, and details of our operational carbon footprint can be found on pages 5-7.

Each year we invest significantly in our asset base, and our capital programme is a significant source of emissions. We have a major role in working with our supply chain and delivery partners to transform greenhouse gas emissions in our capital investment (see pages 12-13 on capital emissions).

Net zero emissions is a major challenge that Scottish Water will embrace, both in our day-to-day service provision and in our capital investment. We are developing a net zero route map, which will require significant efforts around energy efficiency, renewable power and the transformation of our assets in the coming years. It will demand close working, across the business and with our wider supply chain, to bring innovation for emissions reductions into capital investment and to identify opportunities to avoid the emissions associated with the products we use.

We also need to find ways to 'lock up' greenhouse gases in our landholdings, be this through peatland restoration, woodland creation, or other approaches still to be developed, to help balance those emissions that cannot today be eliminated. We are also exploring the potential to become a 'carbon sink' for Scotland, which may be a key lever in Scotland meeting net zero. We will finalise our net zero route map for publication during 2020.

Trialling sniffer dogs for leakage detection

Sustaining our service – adapting to a changing climate

Our services help to support a sustainable society through the provision of high quality drinking water, collecting and safely recycling society's waste waters to the environment and supporting the economic development of Scotland. We must ensure that we are able to continue to provide these services in a changing climate – we must adapt.

Our climate change adaptation approach focuses on understanding the challenges presented by climate change and identifying steps to ensure our services are resilient in a changing climate. We have undertaken a number of projects looking at specific risks associated with climate change and the way this may impact on assets and services.

We have taken a lead for the UK water industry in developing programmes of research that inform adaptation approaches and provide tools to support complex technical areas, such as water resource planning and drainage network modelling.

We are currently evaluating, with the wider water industry, how the latest climate change models need to be integrated into our tools and guidance. We will continue to use these to manage our assets and services in the coming decades.

Renewable solar electricity generation at Clatto Water Treatment Works

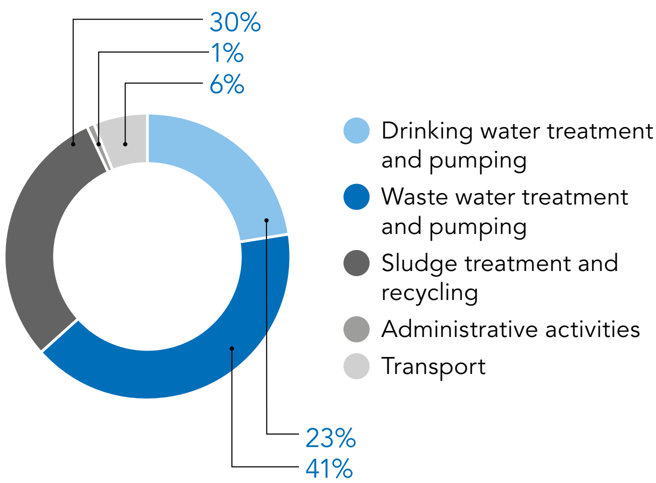
Operational greenhouse gas emissions 2018/19

This is our 13th annual operational carbon footprint report. It covers the greenhouse gas (GHG) emissions associated with delivering water and waste water services to customers across Scotland. It is externally verified in accordance with ISO 14064-3, a process that provides assurance that our reporting is relevant, complete, consistent, accurate and transparent[6].

Our operational carbon footprint (CFP) for 2018/19 was 272,000 tCO_2e (tonnes of carbon dioxide equivalent)[7,8]. This is a decrease of 40,000 tCO_2e, or nearly 13%, compared to 2017/18[9]. Since we started reporting in 2006/07, our CFP has fallen by 41%.

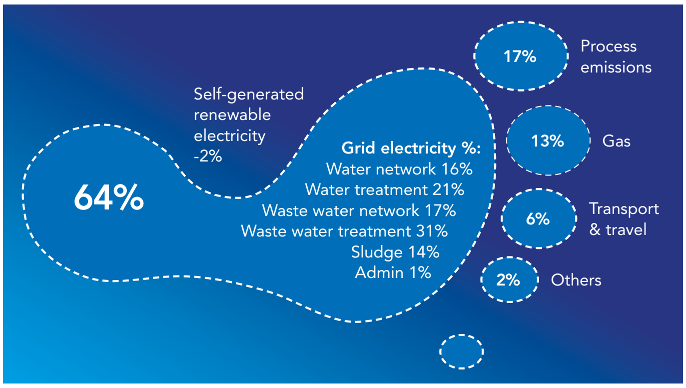
The chart below shows our CFP broken down by the types of **activities** that deliver our services. It shows that the majority of our emissions, 71% of the total, are produced through the pumping, treatment and recycling of waste water and sludge. Our emissions relating to transport make up only 6% of our CFP, despite operating a large fleet across a wide geographical area.

GHG emissions by activity 2018/19



Another way to look at the CFP is to examine the **sources** of emissions, as shown in the foot diagram in the adjacent column. We can see that grid electricity is by far the largest contributor at 64% (this is down from 69% in 2017/18). This percentage will continue to decrease over time, as the proportion of grid electricity from renewable sources increases. Process emissions (GHGs such as methane and nitrous oxide formed from organic matter breakdown), and natural gas use also make significant contributions at 17% and 13% respectively.

GHG emissions by source 2018/19



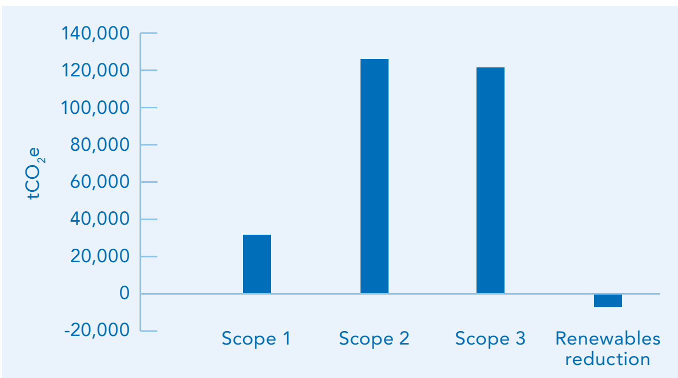
The UK Department for Environment, Food & Rural Affairs (Defra) advises reporting GHG emissions in terms of **'Scope'**:

- Scope 1 – Direct emissions: onsite combustion of fossil fuels; process emissions; and emissions from vehicles owned or leased by Scottish Water.
- Scope 2 – Indirect emissions: use of grid electricity.
- Scope 3 – Indirect emissions: business travel by public transport and private vehicles; outsourced activities including sites run by PFI companies[10].

We show our emissions by scope in the chart below. This confirms that most emissions are from our own use of grid electricity. It also shows high Scope 3 emissions. This is largely due to energy use at many of the largest waste water treatment works, which are PFI-operated.

Both setting the boundary for Scope 3 (deciding what to include) and getting information from the supply chain for the included elements, are not simple. Our boundary is set in line with the guidance used within the UK water industry (which is aligned to Defra guidance) and is reviewed regularly with the rest of the sector.

GHG emissions by scope 2018/19



Carbon intensity of water and waste water services

The carbon intensity of our services is the amount of greenhouse gases emitted to treat and supply a litre of water, or collect and treat a litre of waste water. They make it easier to see the underlying trend of emissions.

Our water service is amongst the lowest carbon intensity in the UK. This is mainly due to more opportunity to use gravity to supply our customers (rather than pumping).

The carbon intensity of our waste water service is around the UK average. The metric takes account of the 'flow to full treatment' (i.e. it includes much of the rainwater that enters our sewers) and is a more accurate reflection of the carbon intensity of pumping and treatment than calculations using only foul discharges to the sewer.

Customers who know how much water they use and waste water they produce, can use the carbon intensity figures in the table below to calculate the CFP associated with their water and waste water use (CO_2e in grams per litre (g/l) or tonnes per megalitre (t/Ml))[11,12].

Customer footprinting

Emissions Sources	CO_2e emissions (g/l or t/Ml)
Drinking water services – includes abstraction, pumping and treatment of drinking water supply	0.11
Waste water services – includes pumping and treatment of waste water and transport and treatment of sludges	0.23

Changes to the Carbon Accounting Workbook v13

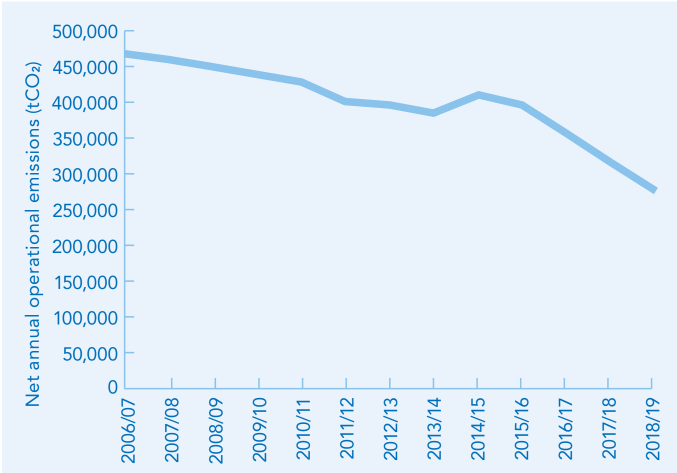
The Carbon Accounting Workbook (CAW) is updated annually to take account of changes to emissions factors (EFs) and reporting guidelines. For version 13 of the CAW, the change in the grid electricity EF (grid EF) had the most significant impact. The grid EF represents average annual EFs (in $kgCO_2$e per kWh) for electricity in the UK national grid. It changes year to year as the fuel mix (coal, gas, nuclear, renewables etc.) used in power stations changes. The grid EF decreased by over 17% between 2017/18 and 2018/19, directly contributing to our fall in greenhouse gas emissions.

Changes to our carbon footprint

Across the first eight years we reported our CFP (2006/07 to 2013/14) we saw a consistent downward trend in our emissions, leading to an overall reduction of over 18%. The majority of this reduction (almost 15%) was attributable to Scottish Water activities such as leakage reduction, investment in energy efficiency and renewable generation. The remaining 3% was due to changes in the grid EF.

Due to a 13% increase in the grid EF in 2014/15 there was a partial reversal of this downward trend. From 2015/16 onwards the grid EFs have decreased, with the most recent (2017/18 to 2018/19) being nearly 17%. Overall since 2006/07 our carbon footprint has fallen by 41%.

Carbon footprint trend



Differences in carbon footprint compared to 2017/18CFP

Our carbon footprint fell by nearly 13% compared with 2017/18. It is important to understand whether changes between years are genuine or caused by a change in the accounting methodology. When we analyse changes between years, we split them into three categories. More than one category can impact on emissions from the same activity. The three categories we use are:

- 'Genuine' – real changes in CO_2e emissions (i.e. from operational changes).
- 'Baseline' – changes in emissions factors, the inclusion of previously unavailable data or the exclusion of previously available data sources. These changes may mask genuine increases and decreases.
- 'Reallocation' – moving emissions from one part of the CFP to another (affecting the relative size of the divisions in the GHG emissions by activity diagram on page 5, but not the total CFP).

Although we saw an overall decrease of around 40,000 tCO_2e in 2018/19, this was the net effect of increases and decreases in different sections of our footprint; the main ones being:

- Grid electricity (decrease)
- Renewable electricity (increase)
- Process emissions (increase)
- Onsite fuels (decrease)
- Natural gas (increase)

Grid electricity

Overall our electricity use increased slightly (0.7% compared to 2017/18. The most significant contributor to this was increased pumping of drinking water due to extended dry weather in 2018/19.

Despite this, we saw a decrease of over 42,000 tCO_2e in the emissions relating to our grid electricity use. Grid electricity emissions now make up 64% of our carbon footprint, down from 69% in 2017/18. This reduction is due to the decrease in the grid EF discussed on page 6, so would be classed as a baseline change.

Renewable electricity

Scottish Water generates renewable electricity at a number of its sites. The electricity produced is either used on site or exported to the grid. When we generate and use on site 'REGO[13] accredited' electricity, there are no associated emissions to add to our CFP. If the REGO accredited electricity is exported, we have an emissions saving (equivalent to the grid EF). Where the renewable electricity generated and used on site is not REGO accredited, emissions are added to our CFP as if we were using grid electricity.

In 2018/19 the emissions saving (subtracted from our carbon footprint) due to the export of REGO accredited renewable electricity was over 5,000 tCO_2e, a reduced saving compared to the previous year. This is due to a combination of the decrease in the grid EF (a baseline change) and a 5% decrease in the amount of REGO accredited electricity exported (a genuine change).

Process emissions

Process emissions arise from the secondary treatment of waste water and the management of sludge. We saw process emissions rise by over 2% in 2018/19. This was due to an increase in the population served by secondary treatment and an increase in raw sludge produced.

Onsite fuels

Fuels such as gas oil, kerosene and propane are largely used for heating on our sites. We saw a decrease of nearly 2,000 tCO2e (about 33%) in the emissions for the use of these types of fuels in 2018/19. The warm summer and mild winter of 2018/19 will have influenced this decrease.

Natural gas

Emissions relating to the use of natural gas increased by over 1,200 tCO_2e (almost 4%). This is due to a genuine increase in the amount of natural gas used for sludge treatment.

Verification

Once completed, our CFP was externally verified by a consultancy experienced in GHG inventories, who stated: "Scottish Water's 2018/19 Carbon Footprint is materially correct and a fair representation of the organisation's footprint, based upon the data available, and has been calculated in accordance with the relevant UKWIR [UK Water Industry Research] methodology. As such, it can be published with a reasonable degree of confidence."

Conclusion

2018/19 saw our lowest ever CFP and the largest percentage drop in emissions since we started reporting our CFP over a decade ago.

Our CFP is now 41% lower than it was in 2006/07. Over that time we have seen genuine reductions due to operational efficiency, leakage reduction and renewable power generation; but the main contributor has been reductions in grid emissions factors.

Renewable energy in Scottish Water

Our use of grid electricity comprises almost two thirds of our annual carbon footprint. Reducing electricity consumption is a significant contributor to reduce our emissions, and we continue to seek ways to reduce demand and improve efficiency. But water is heavy. Where we cannot use gravity, it requires energy to be pumped across large parts of Scotland; and we rely on energy intense processes to produce high quality drinking water and to protect our environment.

We have developed a renewable power generation programme across our assets and estate, which helps us to reduce the emissions from our services and contribute to Scotland's renewable generation targets. Some of our assets and land are ideally suited for the generation of renewable electricity through hydro, wind and solar power, as well as combined heat and power from organic wastes.

This helps us support emissions reduction, by using electricity in two ways:

1. Reducing the greenhouse gas intensity of the electricity grid

The UK's electricity is generated from multiple sites across the country and distributed via the National Grid to wherever it is needed. Greenhouse gas emissions associated with grid electricity vary depending on which fuels are used to generate electricity at any given time. Fossil fuels (gas, oil and coal) have high emissions, whilst renewables (wind, hydro and solar) have low or no emissions.

The more renewables that 'feed' the grid, the lower the greenhouse gas intensity of grid electricity. Where we have no electricity demand from our own assets, we can partner with energy companies to generate renewable electricity on our land to supply the National Grid.

Through our renewables programme, we now host three large scale wind farms and a hydro generation plant. Together, they have a design capacity of 832 GWh/year. We continue to work with generating companies to progress new renewable opportunities: at Lower Glendevon reservoir we have a lease agreed for a hydro plant, and a wind farm in the Daer water resource catchment is now in development.

Clyde windfarm extension, near Clatto reservoir

2. We generate renewable energy for use on our own sites

Where we have both the opportunity to generate energy and a demand from our assets and services, we invest to install and operate renewable generation ourselves. This displaces grid electricity used by Scottish Water, which has a dual benefit: it directly reduces our carbon footprint, and it provides benefit to our customers in reducing the cost of service. Since 2013, Scottish Water and Scottish Water Horizons have trebled the amount of renewable capacity on our sites to more than 63 GWh/year.

Previously, we focussed mainly on electricity from hydro schemes and combined heat and power (CHP) utilising the biogas produced at some waste water assets. We have diversified this portfolio with the advent of new technologies and, at March 2019, it consisted of:

- 34 hydro turbines (located across 26 sites),
- 17 sites installed with small scale wind turbines (65 turbines in total),
- 39 photovoltaic solar schemes,
- 1 solar thermal plant,
- 3 CHP plants, and
- 3 biomass boilers.

We have continued to develop a number of schemes through 2019 and more than 70 of our water and waste water treatment works are either fully or partly self-sufficient in their electricity requirements. This is helping make our service more sustainable by reducing our use of grid electricity and lowering operating costs.

For example, at Stornoway Waste Water Treatment Works we installed 15 small wind turbines on the land around the works. They now generate 35% of the site's electricity consumption (equivalent to 83 households), and export electricity to the grid when the demand from the treatment works drops.

Future ambitions

The Programme for Government, published by the Scottish Government in September 2019, challenges us to build on the good progress we have made. Within it we have committed to increase the amount of renewable generation across our estate (either produced by us, or hosted on our sites) to over 1,300 GWh per annum, three times our current electricity demand.

Wind turbines at Stornaway Waste Water Treatment Works

Low-carbon heat in Scottish Water

In Scotland, the way we heat our buildings and homes comprises 50% of the total energy consumed across society[14]. The Scottish Government has made a commitment to decarbonise heat sources, and is supporting projects that demonstrate innovative, low-carbon ways of generating heat.

Scottish Water Horizons has been leading the roll out of ground-breaking ‘heat from waste water’ technology. The first project of its kind in the UK was commissioned at Borders College, Galashiels in 2015, and to date it has saved the college 223 tonnes of carbon dioxide equivalent (tCO_2e) by exploiting the renewable heat value of waste water.

One of our most recent projects is the Stirling District Heat Network. Working in collaboration with Stirling Council, and with support from the Scottish Government’s Low Carbon Infrastructure Transition Programme, the £6m project is providing low-carbon heat to a number of the Council’s customers, including St Modan’s High School, The Robertson Trust offices and conference centre and the head offices of the Water Industry Commission for Scotland and Zero Waste Scotland.

The project uses heat from waste water technology alongside a combined heat and power (CHP) engine to generate low emissions energy – the first time these two technologies have been used together in this way in the UK. The CHP engine is powered by mains gas and provides the majority of the electricity demand from the waste water treatment works (WWTW), as well as providing the electricity required to power the heat pumps. Biogas boilers provide heat to the sludge digester at the WWTW. Heat generated by the CHP and heat from waste water technology, along with any excess heat from the biogas boilers, is stored ready to be distributed throughout the heat network as required.

First Minister Nicola Sturgeon visited the project in August, commending it as a example of the how Scotland's innovative policies are being implemented to address the climate crisis, and a great demonstration of working collaboratively to make a real difference.

The scheme is projected to save Stirling Council around 380 tCO_2e per year.

In Campbeltown, Argyll and Bute, the Aqualibrium library and leisure centre will also benefit from a heat from waste water system, providing low-carbon heat to the complex from our nearby Kinloch Park waste water pumping station.

The £1.3m project, which also received Scottish Government funding from the Low Carbon Infrastructure Transition Programme, will meet around 95% of the centre’s heating requirements and save 144 tCO_2e per year.

We are actively looking for heat from waste water opportunities, with a number of potential projects already in development. In addition to the benefit to Scotland’s greenhouse gas emissions, we hope this will play a key role in meeting Scotland’s renewable heat targets and addressing social issues such as fuel poverty.

Alan Scott, Finance Director, Scottish Water, and Scott Farmer, Head of Stirling Council, with First Minister Nicola Sturgeon on her visit to Stirling heat from waste water plant

Energy efficiency in our waste water treatment

As shown in our operational carbon footprint report, electricity is currently the dominant source of our carbon footprint, and waste water treatment is the most carbon-intense part of our service. Therefore, focusing on the emissions associated with this activity has potential for big reductions in greenhouse gases.

Since 2010 we have delivered a programme of energy saving initiatives at our waste water treatment works. The cumulative savings to 2018/19 were 26 GWh of electricity and over 10,000 tonnes of carbon dioxide equivalent (tCO_2e). We aim to deliver a further 8 GWh efficiencies by 2021, and to further expand this programme in our next investment programme (2021-27). Initiatives include:

- replacement of pumps and aeration equipment with more energy efficient models,
- process improvements through real-time control systems, and
- heating and lighting improvements.

Real Time Control for waste water treatment

Real Time Control (RTC) is an operating philosophy that can be used to improve the energy efficiency and process control of the waste water aeration processes. In waste water that is treated with biological processes that rely on us adding air, up to 60% of the total energy consumption occurs during the aeration phase. Reducing energy consumption during aeration can therefore yield large energy savings.

Shieldhall Waste Water Treatment Works

With RTC, the amount of air delivered to treatment is optimised by using a network of measurement probes and modelling, linked to variable speed drives on the aeration blowers. This delivers only what is required for treating the characteristics of the waste water at that time, avoiding excessive aeration and saving energy.

We are already seeing a number of benefits from this, including:

- Reduced greenhouse gas emissions – RTC typically saves 20-30% of the electricity used in the aeration process. Where there is electricity use there are greenhouse gas emissions, so there are obvious savings here.
- Financial savings – A reduction in our electricity use means we save on operational costs.
- Improved treatment stability and compliance – because the system is taking measurements constantly, it can react rapidly to any peak loading and maintain compliance.
- Asset life and maintenance costs – because the aeration pumps are not operating constantly at high speed, wear and tear on the motors is reduced, along with maintenance costs, downtime and repair costs.

The recently completed RTC installation at one of Scotland's largest waste water treatment works at Shieldhall in Glasgow has delivered great results. The first year of RTC operation at the site yielded 2.2 GWh of annual efficiencies, with £240,000 savings on energy costs and almost 850 tCO_2e reduction.

RTC systems have also been installed at waste water treatment works at Laighpark, Philipshill, Erskine, Perth and Hamilton; and we plan to invest significantly in rolling this out at other sites.

Estimating and understanding our baseline capital emissions

Our operational carbon footprint, reported annually since 2006/07, covers emissions associated with the delivery of water and waste water services, it does not include emissions from capital investment, and although our capital programme is delivered through our supply chain partners, we recognise we have a big role in managing these emissions and are working with them to understand and reduce these emissions. As we develop a better understanding of the sources of emissions within our capital projects, we will be able to manage these emissions more effectively.

A baseline provides a starting point against which to measure change and against which we can set targets. In planning for our SR21 investment period (2021-27), we need to be able to assess the baseline greenhouse gas emissions of individual projects and of our capital programme as a whole. Having a reliable baseline enables us to understand the major sources of emissions across the materials and activities that we deploy. This enables us to focus our efforts most effectively, and to inform our journey to net zero.

We are working closely with our delivery partners to ensure that as many projects as possible receive reliable emissions assessment. This is done using our Capital Carbon Accounting Tool (you can read more about CCAT in last year's Sustainability Report). We will gain more detailed emissions data as we continue to apply CCAT between now and the start of SR21, increasing the confidence we have in our emissions baseline.

Our delivery partner ESD recently completed a CCAT for a water abstraction pipeline at Loch Ness. In the initial design, the CCAT indicated embodied carbon emissions for this part of the project of 8 tonnes of carbon dioxide equivalent (tCO_2e). Having investigated low-carbon solutions, the final design indicates emissions of just 1 tCO_2e. This project is part of a much larger programme of work for the new Loch Ness Regional WTW scheme.

A large tunnelling project that has recently been completed in Paisley runs for almost a mile beneath the streets of Paisley and will help reduce sewer flooding and improve the environment of White Cart Water. The CCAT for this project estimates that building the tunnel and its associated shafts resulted in the emission of 1,800 tCO_2e.

Construction of the intake pipe for Loch Ness Water Treatment Works

Good emissions data are available for most elements, such as pipelines, concrete tanks, excavations, tunnelling etc. But for many mechanical or electrical items, such as the pumps, screens and switchboards that we routinely use within capital projects, reliable emissions data are not readily available. We are developing estimates of the embodied emissions associated with such equipment. In the longer term, our work with the supply chain will allow us to quantify this more reliably.

Our supply chain will have a big role to play and, over the past year, we have begun the process of working with our suppliers to address the data gaps. We have engaged directly with several key suppliers, developed an Embodied Carbon Calculator (to help suppliers estimate emissions where they do not already have this information). This topic was a key feature in our 2019 Supply Chain Conference.

Reducing the global heating impact of our capital programme will rely on more than just good data – it will require behavioural and technical changes as well. Developing a good understanding of our current emissions is a vital stage on our journey to net zero.

Motor Control Centre (switchboard) at a large waste water treatment works

A circular economy approach to rehabilitating pipelines

At Uddingston, near Glasgow, 200 metres of sewer, which included two pipe bridges across North Calder Water, required repair and refurbishment to reduce the risk of pollution and to maintain service. In a first for the UK, Scottish Water deployed an innovative approach to the repair and refurbishment of the sewer structure, by wrapping it in a carbon fibre and epoxy coating.

This technique helps to strengthen the original structure and negates the need to replace the whole length of a pipe. It is suitable for use on sewer pipes that run overland, and on pipe bridges (pipe structures that span obstacles).

It involves brush-blasting the original pipe in an enclosed environment. A layer of fibreglass is added to create a separation layer from the pipe. The carbon fibre is then applied to provide strength. The technique is expected to extend the lifespan for the pipe by 60 years.

Compared with traditional repairs, carbon fibre wrapping retains the value of the original structure and material, reducing waste, cost and the time to complete the work. It also enables work to be delivered in remote areas where accessibility for traditional replacements can be more problematic.

A major environmental benefit is that the waste water continues to flow through the pipe whilst the repair work is undertaken, meaning that temporary pipelines and additional pumping is avoided. Additionally, there is less site traffic, meaning disruption in the area is reduced.

The calculation of carbon emissions for this process is in development in order to estimate potential savings. The emissions associated with 200 metres of new steel pipe are in the region of 95 tCO_2e. When deployed as business as usual, we would expect the emissions associated with pipe wrapping techniques to be significantly lower.

The technology originates in the United States and Scottish Water, along with delivery partner aBV, worked with the supplier to train staff and to develop the method to suit UK standards, weather and sites.

This technique is expected to contribute to carbon savings by retaining the value of the existing materials and reducing the time and resource on site. Having learned from this project and built the expertise in Scottish Water, we will be seeking more opportunities to deploy this innovative approach in the future.

Encapsulation tent for pipe wrapping at Uddingston

One of the completed pipe bridges at Uddingston

Low-carbon approaches to meeting Scotland's population growth

A key challenge for Scottish Water is supporting the growth of our communities in a sustainable way. As population increases, we need to provide more capacity to manage the water and wastewater demands of the community. For waste water, conventionally this might mean building new structures and processes to provide that capacity. This has implications for our emissions through investment in concrete, steel and other materials, but also adds cost and time to the provision of capacity.

Our engineers are using their experience to challenge conventional approaches and find lower cost, lower carbon opportunities. Embracing the "making things last" ethos of the circular economy[15] we are seeking innovative ways to maximise performance and capacity within existing treatment works – whilst minimising building requirements.

Ellon WWTW, on the River Ythan in Aberdeenshire, required an improvement in treatment quality to meet new environmental standards and population growth. A conventional solution would be to build additional capacity at the treatment works, adding new tanks and energy-intense treatment processes. However, the site was constrained due to lack of space, so a conventional upgrade was not feasible.

Instead, we are introducing an innovative approach that intensifies the effectiveness of existing processes. Integrated Fixed Film Activated Sludge (IFAS) involves adding new plastic media (substrate on which waste water-treating bacteria can grow) within the existing treatment system. This increases the concentration of bacteria in the treatment stage, improves treatment, and means that we do not need to build new treatment stages, avoiding emissions.

Deploying the IFAS approach at Ellon allowed the existing treatment works to achieve the necessary standards, and accommodate future growth, without significant building works. The energy use of the IFAS solution is similar to that of a conventional treatment works, and the main saving at the site was in the avoidance of embodied emissions from building a new works.

We are continuing to seek opportunities to improve performance to meet new demands within the fabric of our existing assets. We expect new technologies to play a key role in helping us reduce the embodied emissions associated with investment.

Ellon Waste Water Treatment Works showing the aeration lanes where IFAS will be deployed

Waste water treatment works of the future

Our assets will last for many decades, serving both current and future generations. It requires significant planning and investment to maintain and enhance our services; both to improve our resilience, and to meet the needs of customers, society and the environment.

Since the inception of Scottish Water in 2002, we have invested over £1.7 billion in our waste water infrastructure and treatment works to protect and enhance the environment. This has provided a significant benefit to customers and to the chemical and ecological quality of Scotland's water bodies. Waste water discharges are no longer the most significant pressure on the water quality of Scotland's rivers, lochs and groundwaters[16].

A consequence of this investment has been the introduction of many schemes that require pumping to move waste water longer distances. In many rural areas we have moved away from local treatment in favour of centralised systems, with associated energy demands. With the need to meet more stringent standards, treatment has become increasingly energy intense – through more aeration (to help the bacteria grow and break down waste water), and additional treatment stages in some areas such as ultraviolet disinfection or nutrient removal processes.

One way in which we are seeking to be more sustainable is to move away from energy intensive aerobic systems. Anaerobic treatment processes are used elsewhere in the world, however to date there have been few examples in the UK. Such approaches are anticipated to provide a range of benefits, including:

- Financial savings through reduced energy use.
- Reduced greenhouse gas impacts by capturing biogas for beneficial use.
- Energy generation.
- Reduced volumes of sludge needing to be transported and treated.
- Production of by-products that have local value as fertiliser and biomass.
- Reduced energy and materials use by using nature-based treatment systems.
- Higher treatment levels, with aesthetic and biodiversity benefits.

Vision for urban waste water treatment

Our vision for the future of waste water treatment is as recovery centres to generate power and resource from society's waste waters, reducing emissions, contributing to the circular economy and delivering value for customers.

Recognising that it will take many years to transition our vast asset base, Scottish Water has been investigating the potential for anaerobic waste water systems in a joint-funded project with the UK water companies and Cranfield University. The output of this piece of work is a design standard for a novel type of treatment works for three different population sizes (2,000, 10,000 and 100,000 population equivalent).

To build confidence in this technology we are developing a pilot scale trial and, if successful, we will install the technology at an existing treatment works to demonstrate at full scale. This will help us to understand how we will transition our asset base to support energy and resource recovery.

Alongside this piece of work there are further areas to be explored, including methane extraction from waste water and effective use of biogas at small scale.

Vision for rural waste water treatment

We aim to retain and treat waste water locally, using sustainable methods that will minimise emissions and sludge production, and recover value where possible.

Rural waste water treatment, both in private and public systems, has typically utilised septic tanks. These provide a relatively basic level of treatment, but are unlikely to achieve the levels of performance that may be required to comply with future water quality standards. In addition, they directly emit greenhouse gases and require regular removal of the sludge, which then has to be transported to treatment at a waste water treatment works.

We are progressing an alternative design for an anaerobic pond and constructed wetland system. This has the potential to transform both our own rural asset base and private waste water provision.

We are also a partner in INNOQUA – an EU-funded project looking for an alternative to septic tanks – involving 20 partners from 11 countries located all over the world. Here we are integrating different technologies into a single modular system for waste water treatment, based on the purifying capacity of organisms such as earthworms and water fleas. INNOQUA aims to provide an ecological waste water treatment system for rural areas and communities, for sustainable homebuilders and for developing countries worldwide.

Removing sludge from a septic tank

INNOQUA pilot plant at Littlemill Waste Water Treatment Works

Low emissions approach to surface water management

The advent of climate change and the potential for more intense rainfall events is one of the key challenges to our urban landscape in the future. With the further challenge of helping support development, the need to find ways to sustainably manage surface water run-off is growing.

Effective collaboration between Glasgow City Council, Scottish Canals and Scottish Water developed an innovative solution to move surface water safely from north Glasgow in a low-emissions way, reducing flood risk impact now and into the future, and enabling massive regeneration.

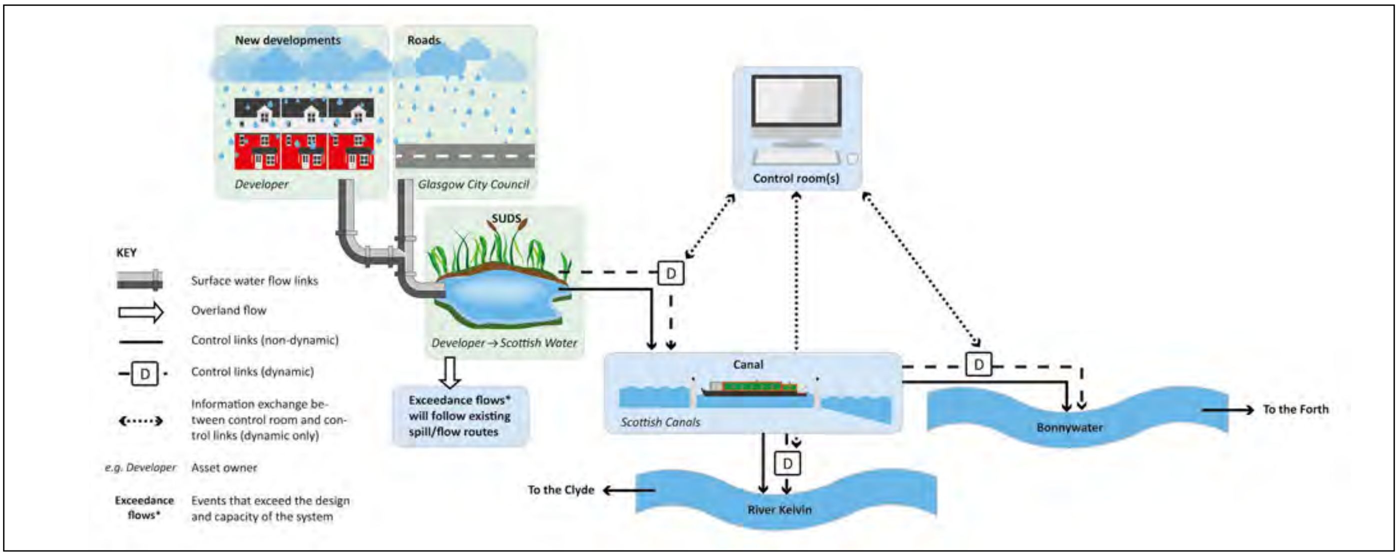
In the first scheme of its kind in Europe, the North Glasgow Integrated Water Management System uses sensor and predictive weather technology to provide early warning of wet weather. Advanced warning of heavy rainfall will automatically trigger a lowering of the canal water level to create capacity for surface water run-off.

Before periods of heavy rain, canal water will be moved safely, using gravity, through a network of newly created urban spaces such as sustainable urban drainage ponds and channels. These absorb and manage the water in a controlled way. This approach provides 55,000 cubic metres (equivalent to 22 Olympic swimming pools) of extra capacity in the canal for floodwater.

A conventional approach to removing this volume of surface water would have been to build a tunnel. The estimated emissions of the tunnelling approach would have been over 3,500 tonnes of carbon dioxide equivalent, coupled with the further operational emissions associated with pumping the storm water through the conventional drainage system. The innovative smart canal approach has therefore avoided substantial emissions.

110 hectares across the north of the city are now suitable for investment, regeneration and development, allowing more than 3,000 new homes to be built.

Whilst this approach benefits from existing canal and drainage infrastructure, partnership working between Scottish Water, Local Authorities and others is key to helping us to sustainably manage the impact of climate change on the sewer network, and we are working with local authorities across Scotland to deliver better outcomes.



A representation of the operational nodes within the North Glasgow Integrated Water Management System
Credit: CREW - Centre of Expertise for Waters

Carbon and peatland restoration

Peatland covers more than 20% of Scotland's land area, which equates to around 1.8 million hectares and is 60% of the UK's total peatland[17]. In terms of global habitat, Scotland boasts 15% of the world's blanket bog (peatland can be blanket bog, raised bog or lowland bog).

Peatland delivers three important ecosystem services:

- Water – the majority of Scotland's public drinking water supplies start in peatland, and globally peatland holds around 10% of the world's freshwater[18].
- Carbon sequestration – Scotland's peatland holds an estimated 1,620 million tonnes of carbon dioxide equivalent (tCO_2e)[19].
- Biodiversity – peatland's share of the estimated social and economic value of biodiversity in Scotland is £23 billion per year[20].

Studies suggest that 80% of Scotland's peatland is degraded, either through natural means or through modification such as artificial drainage[21]. Where drinking water sources are fed from degraded peatland, this can lead to declining water quality and more treatment required to comply with drinking water quality standards.

For the past two years, we have been working together with researchers from the UK Centre for Ecology & Hydrology to develop a tool to estimate future water quality change[22]. This will be very important for planning future peatland restoration and carbon sequestration in catchments.

Peatland restoration can improve the quality of the water used for drinking water, as well as providing a wide range of other ecosystem services.

We have been collaborating with the Peatland Action Group, Scottish Natural Heritage and land managers/owners to restore peatland in our drinking water catchments. To date, we have funded or co-funded the restoration of 190 hectares across two locations. In addition, we have supported the restoration of a further 250 hectares with in-kind contributions (such as water quality monitoring and site inspections).

A further 55 hectares is under active restoration, with a further estimated 1,500 hectares identified for restoration in multiple locations. This figure may change as we assess more catchments for peatland condition.

One of the projects delivered under this collaboration was Sandy Loch in Shetland, which you can read more about in our 2017 Sustainability Report. A more recent example is Loch Orasaigh for North Lochs WTW on the Isle of Lewis, pictured below, covering 11 hectares.

Once peatland has been restored to a healthy growing status, it can sequester between 0.7 and 2.8 additional tCO_2e per hectare per year[23], which is broadly similar to that of typical temperate woodland found in Scotland. Therefore, Scottish Water has funded or co-funded additional sequestration of between 133 and 532 additional tCO_2e per year.

The emissions sequestered through this work are not formally accounted for in our carbon footprint because we do not own the land. However, it has been restored to Peatland Code standards and therefore will contribute to Scottish national targets.

Loch Orasaigh before restoration

Loch Orasaigh after restoration

Natural capital metrics

Trends are based on four years' data (from the start of our current regulatory period, 2015/16). We will develop our metrics in future years.

Operational carbon footprint

Our operational carbon footprint is a measure of the greenhouse gases we emit in the day-to-day running of our business to provide water and waste water services. Our 2018/19 operational carbon footprint is examined in detail on pages 5-7. We work to reduce the greenhouse gases we emit, both in our operations and in our capital programme; therefore a downward trend is positive. The emissions associated with our capital programme do not form part of our operational carbon footprint.

Operational carbon footprint (tCO_2e/yr)

Carbon intensity ratio

Carbon intensity ratios show our greenhouse gas emissions per megalitre of water or waste water treated. They are useful metrics because, for example, if Scotland experiences a very wet year and we therefore have to treat a larger volume of waste water, the carbon footprint associated with waste water may increase; the waste water metric ‘normalises’ this to make it easier to see the underlying trend of emissions. We work to reduce the greenhouse gases we emit; therefore downward trends are positive.

Carbon intensity ratio drinking water (tCO_2e/ML)

Carbon intensity ratio waste water (tCO_2e/ML)

Sludge disposed/recycled

We produce waste water sludge as a natural by-product of the biological waste water treatment process. We treat it to specified standards and then recycle it, either as fertiliser to land or as fuel for energy recovery. Sludge that doesn’t meet the required standards is used for land restoration. We strive to reduce the amount of sludge we produce overall; therefore a downward trend is positive.

Recycled

Disposed

Pollution incidents

An Environmental Pollution Incident (EPI) can occur as a result of something going wrong at one of our assets. Most often, these occur as a result of the waste water network spilling waste water to the environment. We have been working hard to reduce the overall number of EPIs we cause, and to reduce the severity of those we are responsible for; therefore downward trends are positive.

Category 1

Category 2

Category 3

Biodiversity

Due to the large number of assets we operate, we interact with many different environments. Some are specifically designated for features that give them natural heritage value, such as Sites of Special Scientific Interest (SSSIs). This metric illustrates the condition of features at sites where Scottish Water has an influence on that condition. We aim to help achieve favourable conditions; therefore an upward or stable trend is positive. For more information on actions Scottish Water is taking on biodiversity, please see our Biodiversity Report, published every three years as part of our Sustainability Report – most recently in 2017.

Percentage of SSSI features assessed as favourable

Social capital metrics

Trends are based on four years' data (from the start of our current regulatory period, 2015/16). We will develop our metrics in future years.

Unplanned interruptions to supply

Interruptions to the supply of drinking water happen rarely, but can happen for many reasons. For example, if a pipe bursts, some customers may experience an interruption to their water supply; in extremely cold weather, pipes serving customers' properties may freeze; conversely, in very hot dry weather, soils can dry out leading to pipes breaking. Interruptions to supply are measured in two categories: greater than 12 hours and greater than 6 hours. We aim to provide a constant supply of high quality drinking water to all our customers; therefore downward trends are positive.

>12 hrs

>6 hrs

Restrictions on water use/water consumption

If water sources are particularly low due to prolonged dry weather, we may need to restrict how customers use water in order to ensure enough supplies to go around. The more water customers demand, the more we must abstract from the environment, and the less there is for other uses such as agriculture and wildlife. We work to reduce our waste of water by, for example, finding and fixing leaks from our water network.

The water consumption trend reflects consumption by customers. We work to provide a constant supply of high quality drinking water to all our customers; and we aim to reduce the demand for water (for example through our water efficiency campaign); therefore downward trends are positive.

Restrictions on water use

Water consumption (litres per household per day)

Number of properties at risk of internal flooding

The last thing we want to do is flood a customer's property with waste water. Due to more hard surfaces, plus increasingly extreme weather events, sometimes our waste water network cannot cope with the increased volumes of surface water entering the system. They can become overloaded at times of heavy rainfall, flooding waste water into streets and properties. In April 2015 there were 302 properties identified as at highest risk from flooding from the waste water network. We expect to resolve 85% of these by March 2021 (>95% by March 2022) and have already resolved 151. However, additional properties can be identified as at risk as we investigate new flooding issues. In 2018/19, the total number at highest risk has decreased. Obviously we want to minimise the number of properties at risk; so a downward trend is positive.

Number of properties at risk of internal flooding

Endnotes

1 https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/about

2 https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Scotland-National-Summary.pdf

3 Net zero means aiming to reduce emissions as far as possible and balancing continued emissions with genuine additional greenhouse gas reductions, for example in creating new woodland.

4 Committee on Climate Change, Net Zero: The UK's contribution to stopping global warming, May 2019.

5 https://www.gov.scot/publications/protecting-scotlands-future-governments-programme-scotland-2019-20/

6 In keeping with all UK water companies, we use the Carbon Accounting Workbook developed by UK Water Industry Research. This was originally developed in partnership with the Carbon Trust and is updated annually to reflect the latest emissions factors, accounting rules and guidance from the Department for Environment, Food & Rural Affairs and the Department for Business, Energy & Industrial Strategy.

7 This value is rounded to the nearest thousand tonnes.

8 Our CFP includes waste sent to landfill, which is excluded by water companies in England and Wales. For comparison purposes our 'water industry comparable' CFP is 271, 000 tCO_2e.

9 Due to some data used in our 2017/18 CFP calculations being wrongly categorised, our CFP was over reported by 3,000 tCO_2e. Our 2017/18 CFP should have been reported as 312,000 tCO_2e, not 315,000 tCO_2e.

10 Some of our waste water treatment works are run on our behalf by Private Finance Initiative (PFI) companies. The emissions from these sites are included in our CFP as Scope 3.

11 Figures include emissions associated with administration, transport and waste to landfill; i.e. our whole operational footprint shared between water and waste water. They are indicative and based on the best available information. They will change over time and customers should ensure they use the latest figures if calculating emissions associated with their water and waste water services.

12 Water industry comparison: as with the overall CFP, the UK water industry carbon intensity ratios exclude waste to landfill. Our 'water industry comparable' carbon intensity figures are:
Water = 0.9, Waste water = 0.22.

13 Renewable Energy Guarantees of Origin

14 Annual Compendium of Scottish Energy Statistics 2019

15 https://www.gov.scot/publications/making-things-last-circular-economy-strategy-scotland/

16 Audit Scotland 2010

17 UKCCC 2011

18 Labadz et al. 2010

19 Smith et al. 2009

20 The UK National Ecosystem Assessment (2011)

21 IUCN UK Commission of Inquiry on Peatlands (2011)

22 https://www.ceh.ac.uk/our-science/projects/freedom

23 Artz et al. 2011

The water industry in Scotland

The water industry in Scotland is regulated. This model provides assurance that Scottish Water meets the interests of our customers, protects the quality of drinking water and the environment, and is accountable for our performance.

The water industry in Scotland is regulated as shown in the diagram below.

The Scottish Parliament
Holds Scottish Water and Scottish Ministers to account and regularly calls executives to its committees to give progress updates.

The Scottish Government
Scottish Ministers set the objectives for Scottish Water and appoint the Chair and Non-executive Members.

Scottish Water
Responsible for providing water and waste water services to household customers and wholesale Licensed Providers. Delivers the investment priorities of Scottish Ministers within the funding allowed by the Water Industry Commission for Scotland.

Water Industry Commission for Scotland (WICS)
Economic regulator. Sets charges and reports on costs and performance.

Drinking Water Quality Regulator (DWQR)
Responsible for protecting public health by ensuring compliance with drinking water quality regulations.

Scottish Environment Protection Agency (SEPA)
Responsible for environmental protection and improvement.

Scottish Public Services Ombudsman (SPSO)
Responsible for investigating complaints about public services in Scotland, including Scottish Water, once the services' complaints procedure has been completed and sharing lessons from complaints to improve the delivery of public services.

Citizens Advice Scotland (CAS)
Represents the interests of consumers within Scotland's water industry.

Customer Forum
Responsible for ensuring that customers have a clear voice in the business planning and price setting processes and at the heart of key decisions that affect the services Scottish Water customers pay for.

Other regulators
Like other companies and utilities, Scottish Water is also regulated by a variety of other bodies such as the Health and Safety Executive (HSE), Environmental Health Officers and the Scottish Road Works Commissioner.

For more information on Scottish Water and our services visit **www.scottishwater.co.uk** or contact our Customer Helpline on **0800 0778778***.

* We record all calls for quality and training purposes.