Scottish Water
Always serving Scotland

Always Serving Scotland
Business Plan 2015 to 2021
Appendices

March 2014
www.scottishwater.co.uk

Appendix 1: About Scottish Water

Our vital role

Scottish Water is always serving Scotland, providing vital services which are essential to daily life.

We provide clean, safe and high quality drinking water to 2.4 million households and 159,000 business premises across Scotland. Every day we provide 1.3 billion litres of clear, fresh drinking water and take away 840 million litres of waste water, which we treat before returning to the environment.

We capture rainwater in reservoirs and take water from rivers or lochs which we then treat to ensure the water is clear and fresh. We distribute this high quality treated water through an extensive network of pipes and storage tanks to meet our customers' essential household needs when they turn on their taps for drinking, cooking, bathing and washing, for business process requirements and recreational uses such as car washing and watering the garden.

We collect the waste water and surface water from customers' homes and business premises along with some of the surface water run off from paved areas, roofs and roads, taking this away and treating it so that we can safely return it to rivers or the sea.

In providing these services we operate, maintain and invest in treatment works, pipelines and other assets that will last for many decades, serving both current and future generations.

We continue to deliver excellent value for our customers.

We are delivering one of the largest investment programmes in the UK water industry during 2010 to 2015. This at a time when our average household charge remains the lowest in Great Britain. In 2013/14, the average household charge in Scotland is £54 lower per year than the average household charge in England and Wales. The quality of our drinking water is at an all-time high and our investment is delivering the benefits Scotland needs.

Customers' charges go towards maintaining and improving:

29,910 miles of water pipes	**252** water treatment works
1,865 waste water treatment works	**31,064** miles of sewer pipes

Our Vision

Scottish Water's vision is to be Scotland's most valued and trusted business, one that we can all be proud of. This is supported through our vision pillars as set out below:

Serving

Ensuring the customer is at the heart of our business. Always delivering a positive customer experience is a key priority and everything we do links to improving the service and the value we provide to our customers.

Responsible

Always doing the right thing for Scotland. Our investment supports the Scottish economy, benefits our customers, visitors and local communities the length and breadth of Scotland and helps protect public health and the environment.

Committed

Ensuring we have the right people, trained, proud to work for Scottish Water and committed to improving the service for our customers across Scotland.
The health and safety of our people, the contractors who work for us and our customers is built into everything we do.
Ensuring we are a Scottish business that people respect.

Leading

As we work to become a low carbon business we will ensure that we will be innovative in delivering service and value for our customers, while tackling climate change and taking action to protect the environment for today's customers and future generations.

Growing

Delivering the investment to help ensure our customers continue to enjoy clear, fresh drinking water from their taps and protect our environment. We will also help communities across Scotland grow and prosper and ensure that we look at innovative and creative ways to improve service and value for our customers.

Strong

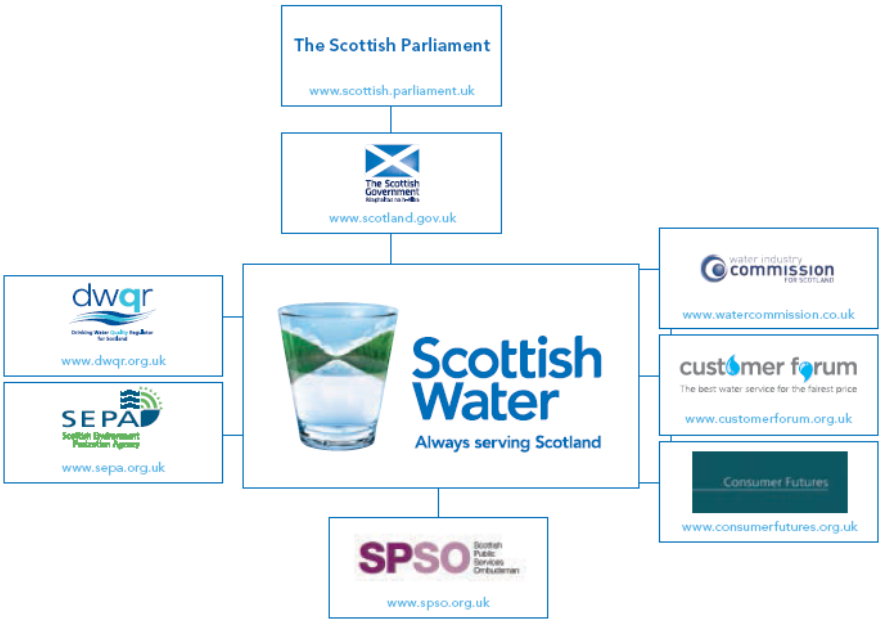
We will maintain our financial strength, continue to explore innovative ways to help deliver the best value for money for our customers and protect Scottish Water for a sustainable future.

How the water industry is run in Scotland

Scottish Water is a public sector body, classified as a public corporation, and is answerable to Scottish Ministers.

The water industry in Scotland is regulated as shown in Figure 1.1.

Figure 1.1: How the water industry is regulated in Scotland



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

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 Ministers within the financing allowed by the Water Industry Commission for Scotland.

Water Industry Commission for Scotland
Economic regulator; sets charges and reports on costs and performance.

Drinking Water Quality Regulator
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
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.

Consumer Futures (formally Consumer Focus Scotland)
Responsible for representing the views and interests of Scottish Water customers and is a statutory consultee for matters relating to the Scottish water industry.

Customer Forum
Ensures that the customer's voice is at the heart of the price setting process and key decisions that affect the services Scottish Water customers pay for.

Other Regulators
Like other utilities, Scottish Water is also regulated by the Health and Safety Executive (HSE) and the Scottish Road Works Commissioner.

Our statutory obligations

Extensive legislation governs the quality of the products that we supply and the impact of our activities on the environment. We work with the Scottish Government, the Drinking Water Quality Regulator for Scotland (DWQR) and the Scottish Environment Protection Agency (SEPA) to understand the implications of legislation for Scotland and on how we provide our services.

Scottish Water was constituted under the Water Industry (Scotland) Act 2002.

Drinking Water

Our duties to provide a wholesome supply of water sufficient for domestic purposes are set out in the Water (Scotland) Act 1980. We also have an obligation to connect customers, at reasonable cost. In addition to the 1980 Act, key legislation for drinking water can be found in:

- 98/83/EC Drinking Water Directive
- The Water Supply (Water Quality) (Scotland) Regulations 2001
- The Cryptosporidium (Scottish Water) Directions 2003
- The Water Quality (Scotland) Regulations 2010

The independent Drinking Water Quality Regulator (DWQR), appointed by Scottish Ministers under the Water Industry (Scotland) 2002 Act, has the duty to ensure that Scottish Water complies with the legislation to provide wholesome drinking water. DWQR has powers of enforcement to obtain information from Scottish Water and to enter and inspect Scottish Water premises such as water treatment works.

Waste water and the environment

Our duties to drain, treat and deal effectively with domestic sewage, surface water and trade effluent are set out in the Sewerage (Scotland) Act 1968. We also have an obligation to provide customer connections, at reasonable cost.

The main drivers for improvement in environmental water quality have been, and continue to be, European Directives that have subsequently been transposed into Scots law. The main European Directives are

- The Urban Wastewater Treatment Directive (UWWTD)
- The Water Framework Directive
- The revised Bathing Waters Directive
- The Waste Framework, Industrial Emissions and Contaminated Land Directives
- The Shellfish Directive
- The Priority Substances Directive

The Scottish Environment Protection Agency (SEPA), constituted under the Environment Act 1995, authorises all Scottish Water's water abstraction from the environment and discharges back to the environment. SEPA has powers to obtain information from Scottish Water, enter land and /or inspect premises owned and operated by Scottish Water, and to take enforcement action where necessary.

Quality and Standards

Quality and Standards is the Scottish Government's planning process by which the improvements required in the water industry in Scotland are set. The improvements are expressed as Ministers' Objectives, or Ministerial Directions, and cover improvements such as:

- Drinking water quality
- The environment
- Customer service
- Mitigate and adapt to climate change

The planning process is assisted by industry stakeholders such as the Scottish Environment Protection Agency, the Drinking Water Quality Regulator, Consumer Futures, and Scottish Water, as well as a public consultation on the improvements proposed.

Quality and Standards 3, the current plan, covers a nine year horizon from 2006 to 2015. Quality and Standards 4 will cover a twelve year period 2015 to 2027 and two regulatory periods. It is acknowledged that planning over a longer horizon enables us to plan investment more effectively and efficiently.

We have based our plan on the draft of the Ministerial Directions as at September 2013, as set out in Appendix 3. Ministers' Objectives for each regulatory period are detailed by a legally binding direction on Scottish Water, which require us to deliver a specific set of outcomes during 2015 to 2021 period and to plan and prepare for the period 2021 to 2027. The Ministerial Directions for each regulatory period are underpinned by a list of locations at which improvements are required. This is known as the "Technical Expression" and is agreed prior to each regulatory period between Scottish Water and its regulators. This is one of the key documents which informs the Strategic Review of Charges and therefore the charges that customers must pay.

Ministers have set up a specific group, the Output Monitoring Group (OMG), to ensure that Ministers' Objectives are delivered. The OMG brings together all major stakeholders in the Scottish water industry including the Scottish Government, Scottish Water, Water Industry Commission for Scotland, Drinking Water Quality Regulator, Scottish Environment Protection Agency and Consumer Futures (Scotland). This group is chaired by the Scottish Government and operates to its protocol and remit.

Appendix 2: Innovation in delivering services

In summary:

- Ongoing innovation is critical to meeting customers' expectations for service and price in the future and achieving our vision to be Scotland's most valued and trusted business, one we can all be proud of.
- Innovation has been instrumental in delivering the high service levels and low charges that customers are benefiting from today. Our plan for 2015 to 2021 builds on our innovation track record to sustain and improve services further and keep charges as low as possible.
- We have embraced the Water Industry Commission for Scotland's innovative proposal to involve customers more in the price setting process through the formation of the Customer Forum.
- Our customer research programme included many innovative ways of engaging with customers from on-line panels to telephone interview and hosted group discussions. We also piloted the use of online preference surveys that could be used in the future to test how customers' views are changing over time.
- We welcome the ability to embrace further innovative investment solutions in our plan through the introduction of the rolling investment review process.
- We have an ambitious research and innovation programme which is based around staff and supply chain engagement.
- We are always open to new ideas and welcome the formation of the Innovation Panel, which will expand our thinking on innovation opportunities. We fully expect new opportunities will arise during the period of this plan that are not covered in this Appendix.
- In our Strategic Projections we identify a number of longer term areas for innovation that could lead to a step change in the cost of services or the way we deliver services.

Scottish Water recognises that innovation is a key enabler for delivering sustainable high quality affordable services for our customers. We have a track record of innovation across all aspects of our business and want to do more to drive and support research and innovation activities across research bodies, stakeholders and our wider supply chain to support achievement of our longer term strategies set out in our Strategic Projections.

This Appendix focuses on the activities of our regulated business and summarises our track record for embracing innovative approaches, the innovation in preparing our business plan for 2015 to 2021 and our plans to use innovative approaches to deliver service improvements and improve efficiency for customers. It describes the approach we are taking to prioritising research activities, fostering an innovation culture across our people and suppliers.

Our approach to Innovation

There are many definitions of innovation. We view innovation as "the implementation of new ideas in order to deliver improved services and increase value for our customers now and in the future."

We believe that innovation supports the improvement of services to customers, and reduces the costs of service delivery. It will also build our reputation as a leading service provider both here in the UK and internationally, and will strengthen our resilience to adapt to long-term challenges and opportunities, such as:

- a changing and unpredictable climate and the need for adaptation to reduce risk and increase resilience;
- change in population and demographics;

- economic uncertainty and affordability issues;
- rising environmental standards; and
- changing energy demands and the need to reduce greenhouse gas emissions.

Innovation has always been a key element in the delivery of services in Scottish Water with the development of operational processes to improve service and reduce costs, and the introduction of new technology to address increasing quality standards in water and waste water.

Innovation – examples of our track record

Some examples of the range of innovations that we have made to deliver leading service levels and keep charges amongst the lowest in the UK are;

Reducing recurring flooding due to blockages

Our focus on improving customer satisfaction has led to significant innovations in the waste water service area delivering higher customer service and improved efficiency. We attend around 2,700 blockages a month, some of which can result in flooding of customers' properties, and 30% of these recur within 12 months. A reactive response clears the issue but doesn't always resolve the root cause, due to a lack of visibility of recurrence information. Our staff developed new systems and processes that would identify recurrent issues in both the Contact Centre and to the response team. New CCTV equipment was provided to response teams to allow root causes to be pinpointed and addressed. This has reduced the costs of service failure and increased customer satisfaction.

De-Ragger

Blocked waste water pumps, due to the accumulation of rags (wipes, sanitary products) and fats, oils and grease, result in increased maintenance activity, inefficient operation and in extreme circumstances localised flooding. We have worked with a local supplier to develop a low cost pump control system that identifies when pumps are starting to rag. The control system then runs the pump in reverse to clear the blockage and then runs the pump at full flow to flush the system. This system has been installed at a number of sites across Scottish Water resulting in reduced attendance to clear blockages and reduced energy consumption as the pump runs more effectively without material build up on the pump impellers. We are exploring opportunities with the supplier to introduce a variation on this across other sites.

Flooding response

We are putting sensors in our sewers to allow us to proactively respond to our sewers filling up. The sensors give early warning allowing our operational response teams to go out and remove any blockages or put in place temporary measures that will reduce or avoid flooding impacts on our customers or pollution to the water environment.

Sustainable Urban Drainage Systems (SUDS)

SUDS have been a requirement for new development in Scotland since around 2006. This means that as far practicable the majority of surface water from new developments is taken to retention ponds and soak-aways rather than into our sewers. This sustainable approach reduces the demand on the sewer system at times of storms and we are looking into the potential for retrofitting SUDS to reduce the hydraulic pressure on our sewers and pumping costs.

Drinking Water Safety Planning

We recognised, along with DWQR, that our approach to achieving compliance with drinking water quality standards will never achieve 100% compliance, as we will always be faced with new causes of non-compliance unless we manage risks to drinking water quality. Over the past 6 years we have developed drinking water safety plans for all public drinking water supplies in Scotland. These plans allow us to identify risks to the reliability of drinking water quality and, from this, identify mitigations that should prevent future non-compliance. The drinking water safety plans have been used to inform our 2015 to 2021 investment plan, enabling us to move to a more proactive, planned and preventative approach to ensuring reliable high quality drinking water for our customers.

Sustaining high quality drinking water

Our operators are always looking to predict where problems may arise and to prevent disruption of services to our customers. We are utilising new on-line monitors on our water treatment works to allow us to more effectively optimise treatment and prevent the creation of THMs (a by-product of the disinfection process). The new THM monitors allow for on-site analysis to be completed within 1 hour as opposed to the 10 days it used to take. This enables operational teams to optimise treatment

effectively in almost real time ensuring that supplies to customers are of the highest quality. We will look for further opportunities to exploit this technology across our water treatment sites

Sustainable land management (SLM)

The Scottish Water SLM approach, which is underpinned by a unique Incentive Scheme aims to address a range of pressures on drinking water quality across a diverse range of catchments. The catchments vary from relatively small in size with only a few land owners (e.g. Lintrathen, Loch Ascog), to much large catchments such as the Deveron which has over 1,000 land owners. Some catchments also require a more integrated approach. For example, at Lochgoin / Craigendunton the requirements of different land operators (such as Whitelee wind farm and the local land owner) need to be balanced with drinking water quality.

It has been encouraging to see the uptake to the scheme increase since its launch in April 2012 and activities move into all of the priority catchment areas. It will take time, however, to see the benefits to drinking water quality. Unlike point source pollution, diffuse pollution can take many years before improvements are realised.

We have undertaken extensive work in the River Ugie catchment to identify the cause of pesticides and implement action plans to reduce these through working with SEPA and landowners. Whilst, we do not believe we can eradicate all pesticides in the catchment we expect SLM to reduce pesticide levels resulting in significant reductions to treatment costs associated with the removal of pesticides at our Forehill WTW.

Variable WwTW licence conditions

We have been working with SEPA to identify innovative ways to operate our waste water treatment works to continue to protect the environment in a more sustainable way. At two sites we are piloting varying discharge quality to suit environmental conditions. There is potential that this could be rolled out across up to 50 sites reducing chemical and power use and be able to adapt to climate change in times of low flow in the environment.

Sustainable waste water treatment

At two sites we are piloting the switching of flows from secondary treatment to wetland/reed bed areas to understand the extent to which these passive treatment technologies can achieve the environmental objectives in a more sustainable way.

Aeration for trihalomethane removal

The use of air stripping for volatile organic removal is a known technology but not applied for removing trihalomethanes (THMs) from potable water in the UK. A project was initiated after one of our process scientists raised an idea in the Innovation Pool. Following modelling and test experiments a pilot was tested at an operational water treatment works and showed great potential. We now have 32 aeration systems installed on our highest risk THM assets. The outcome of this project is a low cost solution giving 20-40% reduction in concentration of THMs and a reduction in the number of regulatory failures.

Reducing duration of interruptions to supply

To deliver leading levels of service to our customers our primary focus has shifted from repairing burst pipes to maintaining supplies for customers even when the main has burst. This has resulted in some new approaches being deployed in Scottish Water. These include:

- Using overland connections to bypass the burst and keep the majority of customers in supply;
- Deployment of new tools to significantly reduce repair times;
- Development and deployment of standardised maintaining supplies response trailers with the appropriate equipment;
- Use of special fittings that allow the burst in the main to be repaired quicker without turning off supplies; and
- Use of a Smart Actuator that allows failed valves to be made operational again.

Flow cytometry

Flow cytometry is emerging as a rapid and quantitative method for routine monitoring of drinking water. We have been developing the technique with Cranfield University to support investigations into full-scale treatment and distribution systems. The tool offers significant benefit over existing plate counts and we have used it for investigating the root cause of microbiological failures and to better understand the risk

of ingress in our service reservoirs, allowing better targeting of investment, leading to reductions in the number of water quality failures[1].

Leakage detection and prevention

We are continually assessing and deploying new techniques to better locate potential leaks in our networks, allowing early intervention before supplies are interrupted and speed up the repair process. We use non-destructive testing devices in live mains to allow the integrity of the pipe walls to be inspected and pipes repaired before services are interrupted or leaks begin.

Water Restoration Park

We are working with a Scottish SME to assess and understand the opportunities for treating effluent for non-potable uses, meaning the effluent can be reused for other applications. The project is funded by the Technology Strategy Board and allows Biomatrix and Scottish Water to further develop on-site waste water treatment system, which combines the latest developments in ecological engineering with traditional treatment processes.

DIFGEN

The Difgen is a pump that when run in reverse can act as a turbine. This allows us to use the existing water distribution network for renewable energy. The technology has been transferred from the oil and gas industry and the first unit was installed in Scottish Water earlier this year. The energy produced is around 600 MWh per annum, which is enough to power 150 homes. A further 4 sites have been developed as part of the wider hydro generation programme. The scale of the Difgen opportunity is being explored across the 3,500 pressure reducing valves (PRVs) currently installed across our water networks. Realisation of the potential is dependent on local operational conditions and ease of local grid connection.

Intelligent Control Centre

Our Intelligent Control Centre uses technology to allow us to sustain high quality services, by pulling together information to identify potential problems and take action before they affect service to our customers, through our leading use of information systems. The planned development of further intelligent controls during 2015 to 2021 will support our aims of moving to an ever more planned approach to both operation and operational maintenance, and allowing greater remote control of assets.

Price Promise

In 2010 we introduced a price promise to customers to clearly signal that they are at the heart of all aspects of our business. At the heart of our price promise is the principle that customers should not pay for a service that they do not receive under normal operating circumstances. This offering went well beyond our guaranteed standards payments and we will enhance this promise in the 2015 to 2021 period.

Agile working

Our vision for Agile Working means "empowering our people to work where, how and when they choose; to maximise their productivity and deliver the greatest value to Scottish Water's customers".

Our People Strategy highlights the need for Scottish Water to develop adaptive capacity, agility and resilience to cope with the ever changing pace and scale of change in our business environment. Agile Working is an important step towards these goals.

Technology is changing faster than ever before. As an organisation with progressive ideas and leadership we recognise the important role new communications platforms and tools can play in delivering a successful future.

Our employees are increasingly becoming more technically savvy – confident in the use of Internet based technologies like knowledge management, web meetings, collaboration tools and social networking. We are introducing new office designs and layouts including Team Zones, Touch Down Zones and Hot Desks.

This is not just about reducing costs – it's also, and importantly, about adopting work styles that promote conversations, help employees to get to know each other and encourage cross-organisational cooperation and innovation.

[1] Nocker *et al.,* (2013). Microbiological tap water profile of a medium-sized building and effect of water stagnation. Environmental Technology. *In press.*

Innovation in our supply chain to reduce capital costs

There are a number of examples of where our supply chain has been innovative to deliver capital projects, including:

- On-site manufacture of the raw water supply main at Glencorse WTW resulted in significant cost savings, a reduction of 1 million lorry miles and reduced traffic disruption for the local community.
- Installation of a novel piano weir at Black Esk Reservoir in Dumfries and Galloway allowed for increased capacity to improve resilience of supplies at lower cost. A 'piano key weir' allows a long overflow weir to be constructed in a small space. This innovation allowed the same volume of water to be stored safely whilst reducing the height the dam was raised by 800mm, saving an estimated £0.5 million.
- We are productising standard equipment such as control panels, kiosks, water booster stations, waste water pumping stations and chemical dosing. This has identified significant savings in both time and design costs. A standard product catalogue has been introduced.
- We are working with our construction partners on off-site fabrication versus on-site construction; for certain schemes this could lead to significant reductions in construction time, carbon and costs. We have taken this opportunity in our water treatment membrane plant programme in 2010 to 2015.

Innovativion in preparing the 2015 to 2021 business plan

Our customers have told us very clearly that we must not compromise existing service levels in the delivery of our plans for 2015-21. Customers therefore trust the reliability of service from Scottish Water, and this sets an important context for our innovation approach.

In preparing this plan, and in our normal business activities, we encourage our people to seek out ever better ways of doing things, provided that this does not create unreasonable risks to the delivery of customers' service expectations. Innovations in processes, business models, technologies, and ways of working are all centred on delivering better outcomes for customers, or the environment, and/or doing this at lower cost than previous approaches. Innovation is not primarily about employing experimental technology, it is primarily about a cultural mindset that continually encourages people to be curious and wrestle with better ways of doing things. Our historic experience suggests that, generally, the most effective innovations are the simple and frequent evolutions of business practices, arising from encouraging our highly engaged people to be creative and flexible, rather than employing unproven new technology.

In preparing our Business Plan for 2015 to 2021 we have embraced new ways of working that have put customers at the heart of the planning process and ensured robust evidence underpins the requirements of our plan. In an investment planning context, where we are seeking to improve service, we can take more risks with the innovation outcome as we are not risking existing service levels. This has lead us to adopt a variety of new approaches, which are sometimes smart adaptations of existing technologies, knowing that we can use the IR18 process to deal with any innovations that are not fully successful.

Understanding customers priorities through extensive research

Our extensive Customer Engagement Programme along with wider Scottish Water customer intelligence supports understanding of the relative importance and value that customers attach to different elements of service, as well as expectations on developments in standards of customer service. The outcomes of this were used to support our business plan and discussions with the Customer Forum regarding priorities for service improvement in the 2015 to 2021 period.

The Customer Engagement Programme was commissioned in 2010 as a stand alone programme of customer research. Its objective was to deliver the information required to understand household and business priorities for service improvement. The programme included many innovative ways of engaging with customers from on-line panels to telephone interview and hosted group discussions. We also piloted the use of online preference surveys that could be used more frequently in the future to test how customers' views are changing over time.

Discussing and balancing priorities with the Customer Forum

We have embraced the Water Industry Commission for Scotland's innovative proposal to involve customers in the price setting process through the formation of the Customer Forum and found the insights of the Forum very informative in developing our business plan. We value the additional complementary research that the Customer Forum undertook which has given a deeper understanding of customers' views in relation to the balance between charges and service improvement levels.

Preparing service improvement reports for discussion with the Customer Forum has allowed us to explore in greater detail the reasons behind the things we do and challenge whether there are better ways to achieve the same, or better, outcomes. Our discussions with the Forum around the balance of priorities for investment in the 2015 to 2021 period was also very insightful and has helped to shape our business plan.

Strategic projections

In October 2012, we published our views of the challenges and opportunities facing the water industry and our strategies for providing services over the next two to three decades. We consulted on these over the period November 2012 to February 2013, and used the feedback to inform our business plan.

Informing requirements through studies

When preparing our 2010-15 business plan we identified that we required more evidence to understand why investment was needed by us, and time to consider the range of appropriate solutions to deliver necessary improvements. Therefore in our 2010 to 2015 plan we included studies to investigate improvements that may be required to protect and enhance the environment and understand the cause of drinking water quality non-compliance issues in networks. These studies have informed the investment that is included in our business plan, and our independent auditor, Black and Veatch, commented – "In summary, the key to the definition of an appropriate programme of projects for 'Improving the Water Environment' is to have an effective working relationship with the other stakeholders, in particular the environmental regulator, SEPA. Our overall conclusion is that Scottish Water has achieved such a relationship with SEPA (and other parties, where required) and that this has allowed an appropriate mix of projects and investigations to be defined which will effectively meet Scottish Water's obligations without expending resources on sub-optimal schemes before the needs are fully understood. There is much from this approach which could be learnt by other water companies."

Assessing capital efficiency opportunities

Regulatory practice in the UK has been to use Cost Base (an idealised set of projects) to assess the relative efficiency of companies and the opportunities for improvement. As much as Cost Base gave a comparative view of relative efficiency of water companies in the UK, it is no longer useful to assess efficiency as it is not updated in England and Wales. It is also problematic to use in isolation due to the process of costing idealised projects. Most significantly, the "Infrastructure Cost Review" published by HM Treasury / Infrastructure UK in December 2010, prompted us to look at our costs in a different way, seeking to understand our performance in total costs incurred against other water companies and other asset intensive industries where data was available.

In early 2011 we embarked on a project to understand the real opportunities for efficiency that we can deliver for our customers in the actual projects we build. We established our 'Frontier efficiency' project to take a long hard look at our practices and behaviours that influence costs. While we have tracked our cost base position, we were conscious of the limitations of cost base assessments. We have looked in depth at our costs of asset delivery and have analysed our processes and each component of cost in detail. We have done this with the support of recognised leading companies in cost management and capital delivery. From this we have identified where our costs are efficient and where we have opportunities to improve our cost to deliver.

Understanding asset deterioration and the impact on service

Our industry leading asset management models have been developed by our in-house teams in partnership with Edinburgh and Glasgow Universities and used to model the deterioration of our assets and their impact on service. These models have allowed us to optimise our interventions and costs, for example in water mains maintenance running scenarios on service levels and costs to understand sensitivity of cost to a chosen service levels, allowing us to reduce our 2015 to 2021 plan by £9 million a year.

Innovative approaches to improving services in the 2015 to 2021 plan

The WICS' methodology for the 2015 to 2021 price review 'Innovation and Choice' enables Scottish Water to consider novel and innovative approaches to delivering service. Throughout this business plan we have identified where innovative approaches could be used to address quality and service issues. This is a positive step forward to allow us to consider alternative approaches that may not guarantee outcomes, but could offer significant savings if successful.

Understanding customers' expectations

We will continue to engage customers to understand their needs and priorities for service and expect the role of customer representation in the business planning and price control process to further develop.

Studies and investigations

Our plan continues with the approach to joint studies and investigations to inform future investment requirements. In this plan we have extended studies beyond the statutory space to include gaining a greater understanding of the resilience to sewer flooding our customers have, understand actual water pressure provided and understand water supply resilience to extreme events. These investigations will continue our transition to a more planned and preventative approach to meeting our customers' expectations.

Rolling Investment Review process (IR18)

As part of the methodology for the 2015 to 2021 price control, we have agreed changes to the planning process with the Water Industry Commission, Quality and Standards stakeholders and Customer Forum that will encourage greater flexibility in the process. Under this approach, investment plans will be updated on a 'rolling' basis at 3 yearly intervals, allowing a more stable investment profile to be developed, with the prospect of continuous investment. This effectively removes the need for our investment plan to be fully specified for the full duration of the next regulatory control period and avoids 'locking in' solutions too early and constraining potential innovative solutions.

This approach is intended to bring benefits for customers by providing greater flexibility in meeting existing and emerging priorities, a better environment for adopting innovative approaches, a more efficient (smoother) delivery profile between regulatory periods, and facilitating longer term strategic solutions. It will also allow opportunity to address changes to priorities that emerge in the 2015 to 2021 period due to new legislation or a changing water environment and for customers to be represented in decisions regarding the next rolling update.

The remainder of the innovation in our plan falls into three broad categories:

- Delivering outcomes through others,
- Improving service and efficiency, and
- Research and innovation programme.

Delivering outcomes through others

In our strategic projections we identified that as we look forward we will depend more on collaborative action with customers, landowners, developers and other agencies to deliver outcomes in a more sustainable way. Examples of these in our plan are;

Sustainable land management

We have identified 23 catchments where rising organic levels, cryptosporidium or pesticide use could pose a risk to future drinking water quality. We will extend our sustainable land management initiative to these areas and where catchments are identified as suitable we will deliver non-asset based solutions. We have included an allowance in our business plan to begin these activities and will review where to progress these as part of the IR18 investment review.

Customer awareness campaign

Investigation on the causes of sewer flooding showed that customers' sanitary products, debris and fat, oils and grease were the cause of over 80% of the incidents we reacted to. We continue to develop capital and operational solutions to sewer flooding and are proposing an innovative customer awareness programme that will target local and national campaigns to reduce sewer misuse. The outcome of this approach is uncertain since it depends upon us being able to successfully influence customer behaviour. If the campaign is successful, further extensions could be considered under the rolling enhancement programme.

Innovation – Surface water action plans

We have agreed with SEPA that, rather than providing treatment to achieve an end of pipe standard for surface water outfalls from 15 industrial estates, we will develop surface water action plans. This is a collaborative approach, working with SEPA and traders to achieve a better outcome by preventing contaminants entering the surface water system. This approach builds on our experiences in 2010 to 2015 where working with local authorities, traders and SEPA has demonstrated that it is likely to achieve a more sustainable outcome than building large scale retention ponds that are often extremely difficult to locate and expensive to build.

Water efficiency trial

In the 2010 to 2015 period we commenced a water efficiency trial to understand the effectiveness of a variety of water efficiency devices and financial incentives to inform our strategy for managing water

demand. We have included in our plan for increasing awareness and providing water saving packs and advice to household customers about benefitting from the efficient use of water in the home.

Influencing development and building standards
Working closely with local authorities and developers we believe there is an opportunity to encourage development in locations where there is existing surplus capacity in our assets and encouraging through building standards more sustainable development with grey water reuse and water efficient buildings.

Improving service and efficiency of delivery

We have identified a number of innovative approaches in our plan that will support meeting customers' expectations for improved services and low charges. These build on the previous innovations set out in this document which we will continue to evolve and exploit across our activities.

Reservoir mixing to reduce manganese
The conventional solution to elevated manganese levels in raw water is to install a manganese removal filter in the water treatment works. Here we will install reservoir-mixing technology into our 4 of our reservoirs to reduce the level of manganese entering our water treatment works. The technology uses a slow rotating impeller to skim a layer of water from the surface of the reservoir and then push it down to the bottom, this reduces stratification and oxidises soluble manganese. If successful this will negate the need for a manganese removal stage.

Mains cleaning and flushing to reduce iron and manganese
We are proposing a significant mains flushing programme to reduce the impact of discolouration on customers and reduce iron and manganese levels in drinking water. We have been working with University of Sheffield to develop a proactive discolouration response strategy (Prediction of Discolouration in Distribution Systems - PODDS). This approach utilises the output of a predictive tool to ensure that the mains condition does not reach a critical point that results in discolouration under stressed conditions (e.g. following a burst). Following an initial mains flushing programme in targeted zones we would look to deploy the PODDS strategy. The innovation challenge is how we automate this process so that optimal mains conditioning regimes are employed to minimise customer disruption from discolouration. We will pilot the approach in 2 test areas.

Condition monitoring
To sustain high service levels we need to move even more to the planned and predictive maintenance of our assets. In support of this we are introducing condition monitoring technology, widely used in manufacturing and petro-chemical industries, to reduce the number of unscheduled plant shutdowns that can affect service to customers. We expect that condition based monitoring and intervention will also, in the longer term, reduce the costs of routine maintenance of our assets by reducing the number of visits and manual inspections.

Organics characterisation to manage THM
We have identified 6 treatment works where improvements are needed to ensure water quality compliance for trihalomethanes. We will continue to investigate the root cause of the failures using organic characterisation tools and pilot test alternative solutions that are being developed as part of our existing research programme.

Outfall relocations to avoid expensive treatment upgrades
Daldowie and Dalmarnock waste water treatment works discharge into the Lower River Clyde which is designated as a sensitive area under the UWWTD. To comply with the Directive, phosphorus levels in the discharges require to be reduced and, traditionally, we would achieve this by enhancing the treatment process by adding chemical dosing plant and filtration equipment. This would result in a large increase in operational costs associated with the use of around 4 tonnes per day of ferric sulphate and sodium hydroxide and would significantly increase sludge production and treatment costs.

Our innovative approach to delivering compliance with both the UWWTD and WFD is to transfer these discharges out of the sensitive area and further down the River Clyde where Estuary standards rather than freshwater standards can be met. This saves in excess of £100 million in the whole life cost of the UWWTD traditional solution and reduces the carbon dioxide emissions when compared against an improved treatment option. In addition, this solution avoids the need to deliver further asset improvements that would be necessary to meet reduced ammonia, dissolved oxygen and soluble reactive phosphorus levels required for compliance with the Water Framework Directive.

Managing bathing beach compliance
Following discussions with SEPA and the Customer Forum we plan to inspect those beaches where our storm overflows operate without adequate screening. If debris is evident, we will deploy monitors within

the overflows that will confirm when these overflows operate to allow notification to beach users and beach cleaning activities to be undertaken.

Private water supplies
We are supporting DWQR and the Scottish Government on ways to improve the quality of private drinking water supplies through our research into sustainable rural communities.

Reducing duration and/or number of short term interruptions to water supply
We will improve our speed of response to potential or actual short term interruptions to water supplies through further real time network monitoring to identify issues early and take action to restore or maintain supplies. We are also looking for further opportunities to control pressures within our network to reduce the likelihood of bursts.

Megget raw water main
Investigations have revealed that the single raw water main that provides water to Marchbank WTW, which serves parts of Edinburgh, is nearing the end of its life. We cannot allow this main to fail and need to intervene before supplies are lost. The traditional approach would be to duplicate this main along its 70km length. However, we have considered this matter from a service outcome perspective and identified a much lower cost solution that has the added benefit of providing additional resilience to the Edinburg water supply system. Instead of duplicating the main, we will install a treated water link main between the Glencorse and Marchbank WTWs. This will cost about a third of the duplication of the raw water main.

Resilience of rural and island water supplies
We have included in our plan the purchase of a mobile water treatment works that can be used as a back-up should any of our small rural water treatment works fail unexpectedly.

WwTW ammonia removal pilot
We plan to pilot test innovative ammonia removal processes at an operational waste water treatment works with a view to deploying the solution on sites we have planned for improvement in 2021 to 2027.

Renewable energy - Advanced anaerobic digestion
Seven out of the ten water and sewerage companies in England and Wales have installed advanced anaerobic digestion (AAD) of sludge at some of their waste water treatment works. However, Scottish Water has not yet taken this route, partly because some 80% of Scottish Water's sludge output is processed at those waste water treatment works operated under PFI contracts and partly because energy prices have not justified the investment. Two of our PFI sites already use sludge as a fuel for energy generation. We plan to start adopting this approach for our directly managed sludge operations, initially via a pilot works. This is a strategic initiative critical to determining the least cost sludge management strategy and is particularly urgent for Glasgow with the Daldowie PFI contract (dealing with around 50% of our sludge) expiring in 2026. The quantity of sludge is reduced via this process and the quality much improved making it easier to recycle to agriculture, thus significantly reducing risk through loss of land bank and tighter recycling standards.

Further innovation opportunities beyond the 2015 to 2021 plan

In our Strategic Projections we identify a number of longer term areas for innovation that could lead to a step change in the cost of services or way we deliver services. These include, leak free water mains to, low cost desalination technology, zero waste extracting value from recycling, heat recovery from sewers, specific water supplies for drinking and other purposes, greater local storage of grey water and reuse in the home, hydrogen fuel cells and localised treatment where appropriate rather than universal service.

Within our plan are investigations that may lead to innovation beyond 2021. Examples are:

Surface water separation - Water of Leith relief sewer
When investigating the tunnel relief sewer strategic solution for the Water of Leith we will consider its potential, in the longer term, to form the spine of a separate surface water drainage system to convey separated surface water from the urban area to the coast. It is likely the sewer will be formed as a combined sewer overflow, but as redevelopment and surface water separation happens over time the storm overflows will be blocked off forming a surface water sewer.

Lead free networks
We have undertaken surveys to understand the number of lead communication pipes we have in our water network. We identified a potential invest to save opportunity that if we remove lead pipes we could then switch off chemical dosing that currently controls lead levels in drinking water supplies and avoid future costs of replacing dosing equipment. We are aware of emerging views that to protect public

health it may be desirable to move to lead free networks in the longer term. We will work with DWQR and the Scottish Government to look at ways to progress this opportunity taking into account concerns about addressing customers' plumbing.

National sludge strategy
In light of some of our PFI contracts expiring from 2021 onwards we are reviewing our strategy to set direction for the 2020 to 2040 period. We will be seeking to exploit opportunities to extract maximum value from waste.

Storm water wetland
In the Daldowie catchment in Glasgow we are investigating the use of a storm water wetland to both manage storm overflows and provide wetland treatment in place of traditional storage, or increased sewer capacity. This investigation will confirm the scope and scale of improvement works that we expect to be undertaken in the next investment period.

Oxygenation of River Clyde
Through detailed estuary modelling, we have demonstrated that further improvements at Shieldhall and Dalmuir waste water treatment works are unlikely to result in a sustainable improvement to the water quality of the inner Clyde estuary and that impacts such as heavier than usual rainfall have a larger bearing on the predicted classification of this water body. The modelling demonstrated that the WFD objectives could only be reliably achieved during years with average or lower than average summer rainfall by the introduction of additional oxygen to the water body. We have undertaken further investigative work and a pilot plant demonstration project which has confirmed the practical application of this approach and allowed definition of a concept design and identification of costs.

Tidal weir flushing the Clyde estuary
When undertaking the Glasgow Strategic Study we collaborated with experts from Heriot Watt University to develop an understanding of how the hydrodynamics of the river system could be used to contribute to improving the water quality of the inner Clyde Estuary. We investigated how we might use the tidal weir as a reservoir to help flush the estuary during dry weather and the level at which the Shieldhall waste water treatment works outfall pipe discharges into the estuary to determine if the ebb tide could be used more effectively to disperse pollutants.

Iron and manganese in distribution networks
We are undertaking research looking at the causes of iron and manganese non-compliance in distribution to better understand how operational activities may contribute to the disturbance of material deposited in the mains and how we can introduce automated cleaning to prevent discolouration at customers' taps.

Asset rationalistaion
We have identified eight water treatment works rationalisations that we will undertake as part of our drinking water quality programme. We do not plan to invest in any other identified rationalisation opportunities due to the extended payback periods as agreed with the Customer Forum but will keep these under review.

Research and innovation programme

Our research and innovation programme has been historically opportunity led where we assessed the opportunities that are presented to us, ranging from scientific research from universities to technology and service development from our supply chain and delivery partners (see examples listed below as innovation highlights). We have worked extensively with other water companies and universities in the UK and Europe to increase the leverage of our own budget, build capacity in the university sector and work on single voice issues of benefit to the wider water sector. We will continue to look for collaboration opportunities as it provide us opportunities for influencing the research community, access to facilities and also access to funds from the research councils and the EU.

In 2010 we formed a research and innovation team to lead our research and innovation programmes, tasked with:

- developing innovative approaches to service delivery and customer engagement;
- seeking innovative opportunities to deliver capital investment more efficiently;
- levering benefits through collaboration with outside bodies on shared work/research programmes.

We have been developing the internal capability and the external networks with other water utilities, research providers and our supply chain.

Research and Innovation themes

We recently refocused our research and innovation programme to support our three strategic objectives and projects are tested to see if they contribute or lead to us achieving the measures identified below.

We have included in our plan £6.8 million of investment in research and innovation that could reduce costs of future services or improve services. These are over and above our normal water industry innovation collaborations and were discussed and supported by the Customer Forum and cover the following areas:

Exemplary compliance – drive higher levels of compliance with drinking water and environmental standards

New technologies that reduce the economic level of leakage – we wish to stimulate academic work looking at the use of nanotechnology, or other means, to create self healing pipes that would reduce leakage significantly and interruptions to supply**.**

Value recovery from waste water streams – maximising the opportunity for recovery of energy, nutrients and other materials from waste water streams to reduce the cost of treatment and support zero waste objectives.[2]

Automation and real time control - maximising the opportunity for real time control and automation of our assets linking to the development of our Intelligent Control Centre.

Sustainable rural communities – exploring alternative treatment options and delivery models to provide rural communities with integrated water, waste and energy services.

Alongside financing projects in these initiatives we will actively pursue single voice issues such as leakage, sewer flooding and carbon though the UK Water Industry Research (UKWIR) programme. UKWIR conduct common issue, generally short term, research on behalf of the industry and we will leverage our £270,000 per annum contribution to access a programme of £4 million worth of research projects. We will maintain the relevance of the projects by having steering group representation on over 50% of the projects in the programme.

We will continue to support PhD and EngD projects that support our strategic aims. We forecast that this will amount to £250,000 per annum based on current activity levels.

We have allocated £0.75 million of our plan specifically for leakage reduction research projects as during our customer research our customers expressed dissatisfaction with the level of visible leakage and the time taken to resolve it. The concept of an economic level of leakage was difficult for customers to understand and they perceive this to be waste of a valuable resource. We will initiate a programme of activity with both the supply chain and research partners to determine the most cost effective means of preventing, predicting and resolving leakage.

As part of our work on a National Substance Strategy we will also work with SEPA to undertake research to identify innovative approaches to controlling priority substances at source instead of through treatment processes.

We will deliver the research and innovation programme by seeking out the most appropriate partners with relevant expertise in the areas of interest. Where appropriate we will establish strategic partnerships where value can be driven through a portfolio approach. It is envisaged that one-off projects will also be required to support rapid evaluation of new technologies, particularly where there is an opportunity for adoption in the short term.

Aligning research with customer priorities

To align research and development with customer priorities we have two research and innovation groups covering the water service and waste water service to identify needs and consider proposals to address these. Research financing is allocated when it is aligned with the three principles we believe are key to a successful research and innovation programme, these being:

[2] UK CDC Report – "*We believe that the introduction of leading-edge technology – particularly on the waste water side is central to achieving both improved water quality and sewerage clean up with lower carbon footprints".*

- a clear line of sight between customer priorities, our vision, our strategic projections and what the proposals will deliver.
- benefits are identified at the initiation of any project and tracked throughout.
- there is a clear implementation route for any project outcome.

The research and innovation groups are tasked with the identification of benefits and are the conduit to successful implementation. This approach provides a coherent linkage between the objectives of the research and innovation programme and the objectives of the business.

We believe a successful programme will also provide staff development activities and generate opportunities to publish outputs allowing Scottish Water to become recognised for our research activity, enhancing our reputation.

We currently support around 30 research and innovation projects with a range of partners. The projects are a mixture of operational, tactical and strategic activities and the total programme value is around £13 million of which Scottish Water contributes around £700,000. Examples of these are:

- We are partnering research at Universities of Strathclyde and Glasgow on asset deterioration modelling that applies statistical analytical methods to improve the predictions of asset condition and allow more targeted capital maintenance.
- We are currently sponsoring 11 engineering doctorate (EngD) projects as part of the STREAM Industrial Doctorate Centre looking at topics such as sustainable land management, phosphorus removal, THM control and asset deterioration modelling.
- Partnering with University of Glasgow on Clean Water for All, an EPSRC funded programme that will develop and explore sustainable technologies for water and waste water treatment. This will support the development of our Sustainable Rural Communities programme.
- We are a pilot community for the EU funded project TRansitions to the Urban Water Services of Tomorrow (TRUST). The project looks at the sustainability of water services and how it may be improved with tools such as water demand management, alternative water sources, waste water and stormwater management and water-energy nexus. As a side benefit of this project we are working closely with partners from Nordic countries on treatment of organic rich water sources.
- We are a partner in the EU funded partnership project - Urban Water. The project is focussed on systems and services to allow the efficient management of water resources and is looking at real-time communication of consumption data and new data management technologies with real-time predictive capability, demand forecasting and consumption pattern interpretation.

We aim to stimulate interest in the supply chain and to assess and accelerate novel and emerging technologies for first use in Scottish Water. We will work with the newly formed Scottish Enterprise funded *Water Innovation Service* to identify opportunities and to accelerate testing and evaluation of products and services.

Specific activities we will undertake are:

- set-up a test facility at either a redundant or operational site to facilitate pilot testing of new water and waste water technologies.
- provide access to our laboratory service to support testing and evaluation.
- identify Scottish Water technical expertise that can be offered to support and challenge innovation offerings from the market.
- identify how Scottish Water would use the service to build effective partnerships to influence and secure funding from external sources e.g. EU Horizon 2020 to support Scottish wide research and innovation efforts.

Innovation culture

In this Appendix we have described our approach to research and innovation projects but our approach to innovation is one that is much broader than research alone.

Overall leadership and governance for the innovation sits with a leadership group with cross-functional senior management representation. This group takes strategic decisions on current priorities, identifies future needs and emerging issues, increasing the innovation capacity across Scottish Water, and looks at:

- how we create space and time for innovation as part of what we do;
- having the systems and processes developed and working effectively to support innovation and effectively manage associated risk;
- having the appropriate tools, techniques and metrics in place to drive innovation.

For the 2015 to 2021 period we plan to roll out innovation training for all staff based on an innovation toolkit. We will work with external suppliers and internal training staff to design and undertake the training.

We will also continue to use our online idea and collaboration tool - *The Innovation Pool* - which allows staff to identify ideas for consideration across all aspects of Scottish Water activity. The tool encourages peer-to-peer engagement at the idea development stage and allows visibility of progress of ideas through the various stages of development. We will also support research projects looking at innovation culture.

An important element of creating the right environment for innovation is celebrating successes of those who innovate. Our annual Vision awards give us the opportunity to recognise the innovations of our staff that have led to better outcomes for customers. Innovation is also a focus in our twice yearly Scottish Water wide leadership events.

Innovation Panel

The Innovation Panel was established in July 2013 as an agreed initiative between Scottish Water and the Water Industry Commission for Scotland to, among other things:

- review and discuss the innovative approaches identified by Scottish Water in its business plan for 2015 to 2021.
- assess and discuss with Scottish Water the extent of further opportunities for innovative approaches within the 2015 to 2021 programme.
- assist Scottish Water with working with other stakeholders to develop these further opportunities.

Presenting evidence to the Customer Forum is seen as an important aspect of the Panel's work and it is expected to conclude its work in November 2014. The Panel is chaired by Dr Jerry Bryan, who is independent from Scottish Water and the Water Industry Commission.

In December 2013, the Panel provided some early conclusions that Scottish Water is likely to be significantly better innovators than other UK water companies but recognised that this is a low target to beat and the potential is much greater. It also concluded that Scottish Water is doing very well but the future potential is much greater and the Panel's task is to assist Scottish Water to ensure that its innovation processes deliver.

WATER INDUSTRY

DRAFT OBJECTIVES FOR THE PERIOD 1 APRIL 2015 - 31 MARCH 2027

The overall purpose of these Objectives is to ensure that the focus of water and sewerage services is on creating a more successful country, with opportunities for all of Scotland to flourish, through increasing sustainable economic growth.

1. A Wealthier and Fairer Scotland

To deliver better and more efficient public services that enhance our quality of life, support sustainable economic growth and assure those that fund and rely on them that their public services are responsive, provide value for money and are continually improving, Scottish Water shall in respect of:

1.1 ASSET MAINTENANCE

Ensure that assets are maintained so that there is no overall deterioration in performance from that required to be achieved by 31 March 2015[1].

1.2 SERVICE STANDARDS OBJECTIVES

Build on the improvements made to date and continue to improve services to customers including those measures[2] agreed with the Customer Forum.

1.3 RURAL COMMUNITIES OBJECTIVE

To support delivery against the Government's priorities in rural communities, in particular with a view to improving water and sewerage provision in rural areas, Scottish Water shall:

a) Assist the Drinking Water Quality Regulator and SEPA with the assessment of the sustainable and cost effective options to address public health risks, limitations to sustainable economic growth and customer willingness to connect to public services associated with private water supplies and sewerage provision.

b) In light of the studies undertaken at a), connect communities to appropriate public water and/or waste water services as approved by Ministers.

1.4 STRATEGIC CAPACITY FOR NEW DEVELOPMENT OBJECTIVES-

(a) Identify and make provision to service demand for new 'strategic' capacity to meet all new housing development and the domestic requirements of commercial and industrial customers for the period 1 April 2015 to 31 March 2027. In doing so, Scottish Water shall take account of extant development plans and their associated action programmes, the General Register Office for Scotland's population projections[3] and the SEPA/Scottish Water Memorandum of Understanding on the Impact of Proposed Development on the Public System[4].

(b) Prioritise the delivery of that part of the investment specified under 1.3(a) in accordance with:

- the spatial priorities identified in the National Planning Framework,
- development priorities identified by local authorities in their Structure Plans/Strategic Development Plans; and
- associated action programmes and Local Plans/ Local Development Plans and Local Housing Strategies.

---

[1] http://www.scotland.gov.uk/Resource/Doc/917/0088613.pdf
[2] Measures include internal sewer flooding, interruptions to supply, malodour, external sewer flooding, drinking water discolouration, taste and odour of drinking water supplies, customer satisfaction etc
[3] Projected Population of Scotland (2008-based), published by GROS 21st October 2009
[4] http://www.sepa.org.uk/pdf/policies/mou_sepa_scottishwater.pdf

In addition, so as to minimise the likelihood of redundant assets, Scottish Water shall act in a manner so as to ensure that such 'strategic assets' are delivered in support of committed development. This shall be ascertained in accordance with the developer confirming, as a minimum, the following:

(i) Land ownership or control;

(ii) The development is supported by the local plan and/or has full planning permission;

(iii) The time remaining on the current planning permission;

(iv) That plans are in place to mitigate any network constraints that will be created by the development through a minute of agreement with Scottish Water; and

(v) Reasonable proposals in terms of annual build rate within the approved development.

1.5 EFFICIENT PUBLIC SERVICES

To support a Wealthier and Fairer Scotland, Scottish Water is required to identify and deliver longer term investments which will reduce the future costs of service delivery. In particular, Scottish Water shall work with other stakeholders to identify and pursue opportunities available to achieve more innovative and sustainable means of delivering services.

2. A Healthier Scotland

To support the delivery of the Scottish Government's Healthier strategic objective, Scottish Water shall contribute to improvements that help people to sustain and improve their health. In particular, it shall in respect of:

2.1 DRINKING WATER QUALITY

(a) Ensure full compliance (where there are still non-compliances) with the Drinking Water Directive 98/83/EC, the Water Supply (Water Quality) (Scotland) Regulations 2001 and the Cryptosporidium (Scottish Water) Directions 2003; and

(b) Reduce the risk of non-compliance with the Drinking Water Directive 98/83/EC, the Water Supply (Water Quality) (Scotland) Regulations 2001 and the Cryptosporidium (Scottish Water) Directions 2003, by improving the resilience to risks as identified in its Drinking Water Safety Plans.

3. A Greener Scotland

To support the delivery of the Scottish Government's Greener strategic objective, Scottish Water shall contribute to improvements to Scotland's natural and built environment and the sustainable use and enjoyment of it. In particular it shall as regards:

3.1 ENVIRONMENTAL WATER QUALITY

(a) To support compliance with the Water Framework, Marine Strategy Framework, revised Bathing Waters Directive and Urban Wastewater Treatment Directives:

(i) reduce the impact of its discharges, abstractions and impoundments so as to contribute to the achievement of the environmental objectives for water bodies and protected areas in line with the measures identified in the River Basin Management Plans and from monitoring and study of bathing waters.

(ii) undertake strategic studies to understand future investment requirements for discharges and abstractions identified as potentially contributing to the failure of environmental water quality objectives in line with the requirements of the River Basin Management Plans and revised bathing water directive.

(iii) work with SEPA and licensed providers to undertake catchment management and customer education to reduce the impact of Priority Substances being disposed of via the sewer and drainage system. In addition they shall undertake research which may assist in identifying the effective treatment of substances that catchment management may not be successful in reducing to acceptable levels.

(iv) improve intermittent discharges identified through modelling and agreed with SEPA, as downgrading the aesthetic or environmental condition of water bodies to support compliance with the Urban Wastewater Treatment Directive.

(v) in partnership with other stakeholders, Scottish Water shall take steps to reduce the impact of its discharges on sewage-related litter in the marine environment.

3.2 NATURE

To support the achievement of the Scottish Government targets for the proportion of natural features in favourable condition, work with Scottish Natural Heritage to identify and undertake management activities at identified sites that will contribute to achievement of the National Indicator 'Improve the condition of protected nature sites'.

3.3 WASTE

Manage the environmental risk associated with sludge historically stored at wastewater and water treatment sites as agreed with SEPA.

3.4 CLIMATE CHANGE ADAPTATION

Improve Scotland's resilience to climate change by continuing to invest in modelling the likely impact of climate change on its assets, and where appropriate, investing to manage risks arising from climate change impacts.

3.5 CLIMATE CHANGE MITIGATION

Contribute towards Scotland meeting its climate change obligations of achieving greenhouse gas emissions reductions in Scotland of 42 per cent by 2020 and by 80 per cent by 2050, by taking all necessary steps to fulfil its duties and obligations required of it as set out in the Climate Change (Scotland) Act 2009. In particular Scottish Water shall:

(a) work with relevant stakeholders to assess, pilot, and where appropriate, implement measures needed over the 2015-2027 period to reduce its direct greenhouse gas emissions and energy usage;

(b) ensure that all investments made as a consequence of these Directions take into account the associated carbon impact; and

(c) invest to reduce its demand for Scotland's resources (water and electricity from the national grid) where it is cost effective to do so.

4. A Safer and Stronger Scotland

To support the Scottish Government's Safer and Stronger strategic objective, Scottish Water will assist local communities to flourish, becoming stronger, safer places to live, offering improved opportunities and a better quality of life. In particular it shall as regards:

4.1 FLOOD MANAGEMENT

Take all necessary steps to fulfil its duties and obligations required for the period 2015-2027 as set out in the Flood Risk Management Act. In particular, Scottish Water shall:

(a) Assess flood risk from sewerage systems and update the latest assessment as required.

(b) Through its participation in the Metropolitan Glasgow Strategic Drainage Partnership and working collaboratively with their partners continue to deliver its agreed share of the improvements that will reduce the risk of flooding in Greater Glasgow;

(c) In partnership with responsible authorities, undertake studies to inform investment requirements in future regulatory periods as agreed with the Scottish Advisory and Implementation Forum for Flooding (SAIFF); and

(d) In partnership with responsible Authorities, commence its agreed share of the investment requirements arising from the flood studies as agreed with the Scottish Advisory and Implementation Forum for Flooding (SAIFF);

(e) Take action to protect its own assets where they lie within an area vulnerable to flooding.

(f) Take action to ensure reservoirs are monitored, inspected and maintained in accordance with the Reservoirs Act 2011 to ensure their structural integrity.

4.2 SECURITY OF SUPPLY

(a) Provide an appropriate level of physical security to Security Service standards agreed with the Scottish Government;

(b) Provide the necessary improvements to provide a level of service in water supply zones, such that these zones are adequately protected against the risk of water shortages; and

(c) Maintain a sufficient supply of water in all water supply zones that reflects the most cost effective operating regime, and takes account of the opportunities for demand management including leakage control and water efficiency measures.

Appendix 4: Maintaining current service levels

- Our asset maintenance will sustain the service risk profile forecast in 2014/15 and ensure continued compliance with statutory requirements, as requested by customers and set out in the Ministers' draft objectives.
- Our plan has been developed using our asset risk models (22%), asset stewardship models (47%), and detailed activity assessments (31%).
- Taking account of our ongoing efficiency improvement we forecast asset maintenance costs will rise from £272 million in 2012/13 to £285 million in 2021, and will average £280 million (2012/13 prices) between 2015 and 2021.
- We forecast asset maintenance activity and investment will continue to rise for the next 10 years, principally due to the extensive investment made on new and enhanced assets over the last 20 years, improving customer service and statutory compliance.

Sustaining high service

This Appendix sets out our assessment of the asset maintenance costs that are required to sustain the high service levels, and associated risk profile, that we will be delivering in 2014/15. In this appendix all investment figures are provided in 2012/13 prices unless otherwise stated.

Ministers' draft objectives

Scottish Ministers' draft objectives for 2015 to 2027 set out that Scottish Water shall in respect of:

1.1 ASSET MAINTENANCE

(a) Ensure that assets are maintained so that there is no overall deterioration in performance from that required to be achieved by 31 March 2015.

Sustaining service

Sustaining service is ensuring the level of service enjoyed by customers and the environment in 2014/15 continues and includes, but is not limited to:

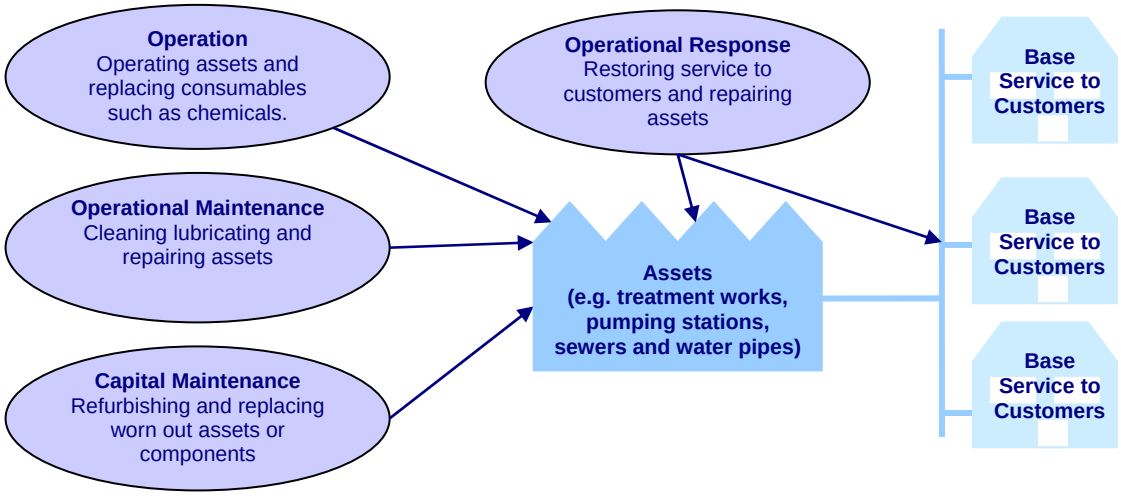
- Sustaining drinking water quality,
- Sustaining water availability and pressure,
- Sustaining waste water collection,
- Sustaining waste water compliance,
- Sustaining customer satisfaction.

In addition it covers maintaining the achieved level of compliance with all statutory requirements including but not limited to:

- Health and Safety legislation,
- The water quality standards,
- Our discharge licences,
- Our Fleet Operators Licence,
- The Reservoirs Act,
- Data Protection Act.

Our service to customers is principally delivered through the effective operation and maintenance of the assets such as water treatment works (WTW), wastewater treatment works (WwTW), water mains and sewers. The effective operation of these systems requires the right balance between operational activity, operational maintenance, operational response and asset maintenance as shown in Figure 4.1.

Figure 4.1: Activities to sustain services to customers



Principles of our asset maintenance plan

Through research our customers have told us that they:

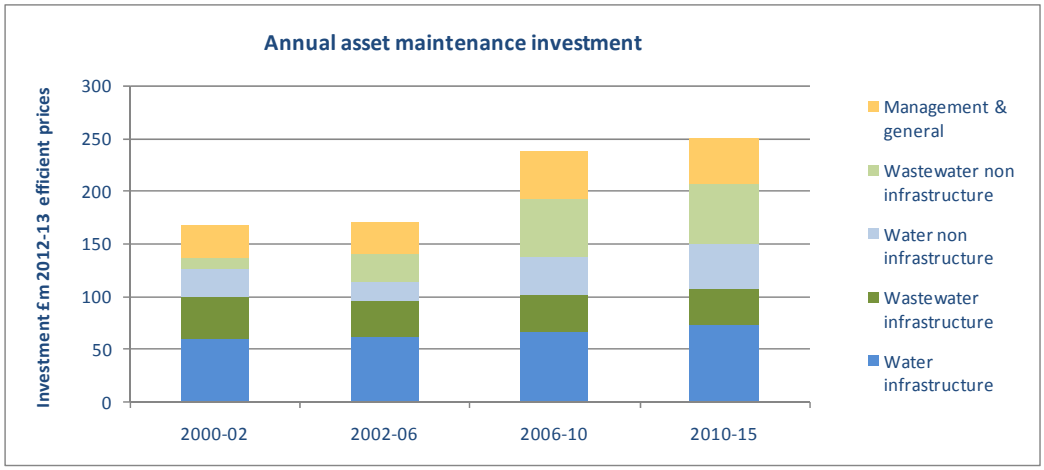
- Do not want to see a reduction in any areas of service;
- Believe that maintaining drinking water quality was the highest priority, before making service improvements;
- Expect Scottish Water to maintain the standards of the water environment; and
- Spontaneously identified that we should be replacing our Victorian sewers and water mains.

Our plan is set out to sustain the levels of service, and associated risk profile, forecast at 2015 and ensure continued compliance with statutory requirements, as requested by customers and set out in the Ministers' draft objectives.

Historic investment levels

Historic demand for asset maintenance investment, adjusted for efficiency improvements made over time, is set out in Figure 4.2. This shows that underlying activity level has been rising over time.

Figure 4.2: Asset maintenance investment 2000 to 2015



Asset maintenance

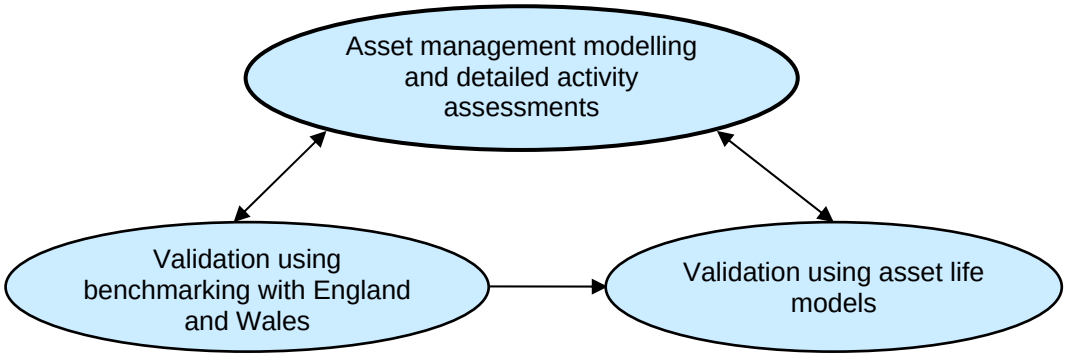
Effective asset maintenance is an essential foundation for delivering high quality services to customers.

Scottish Water manages over £58 billion of assets to provide customers' water and wastewater services. Around £10 billion of these assets are treatment works and pumping stations, about 50% of which have been built in the last 20 years.

Assessing asset maintenance demand

To assess our required capital maintenance investment for 2015 to 2021 we have used asset management modelling techniques and detailed activity assessments. We have validated the output from these models and assessments with the predicted demand from simple asset life models and trends from England and Wales as shown in Figure 4.3.

Figure 4.3: Approach to assessing and validating asset maintenance requirements

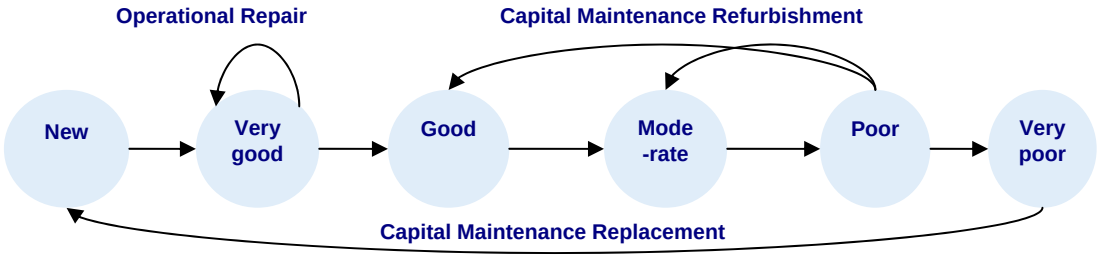


Key to assessing both long and short term requirements has been our asset management models which our in-house teams have developed in partnership with Edinburgh and Strathclyde Universities. They are based on two statistical modelling techniques and have been peer reviewed by an independent expert from Nottingham University and by Black and Veatch. The two approaches are:

- **Asset Risk Models,** which use our past asset failure information to estimate the reliability of our assets, and the impact a failure will have on customers and costs. They then optimise both operational and asset maintenance activities to identify the lowest cost way of delivering a desired level of service at a chosen probability of outcome. These models are complex and require large data sets to develop them; however they provide the best results.

- **Asset Stewardship Models,** which forecast the transition of assets through various states of decay (condition) and the intervention we would undertake at each stage (do nothing, repair, refurbish or replace) as shown in Figure 4.4. This approach can be used where we have limited data. Again it allows us to take account of operational interventions such as repairs.

Figure 4.4: Deterioration of asset condition over time and impact of interventions



In addition to the modelling approaches we use detailed asset inspection data or demand trends to assess future requirements in areas such as fleet, dams and reservoirs where we have not established models or do not think modelling is necessary.

Forecast asset maintenance investment 2015 to 2021

Our asset maintenance investment demand is rising and is forecast to do so over the next ten years. This asset maintenance investment will sustain the significant improvements we have made to customer service and statutory compliance over the last 11 years resulting from the extensive enhancement investment made over the past 20 years.

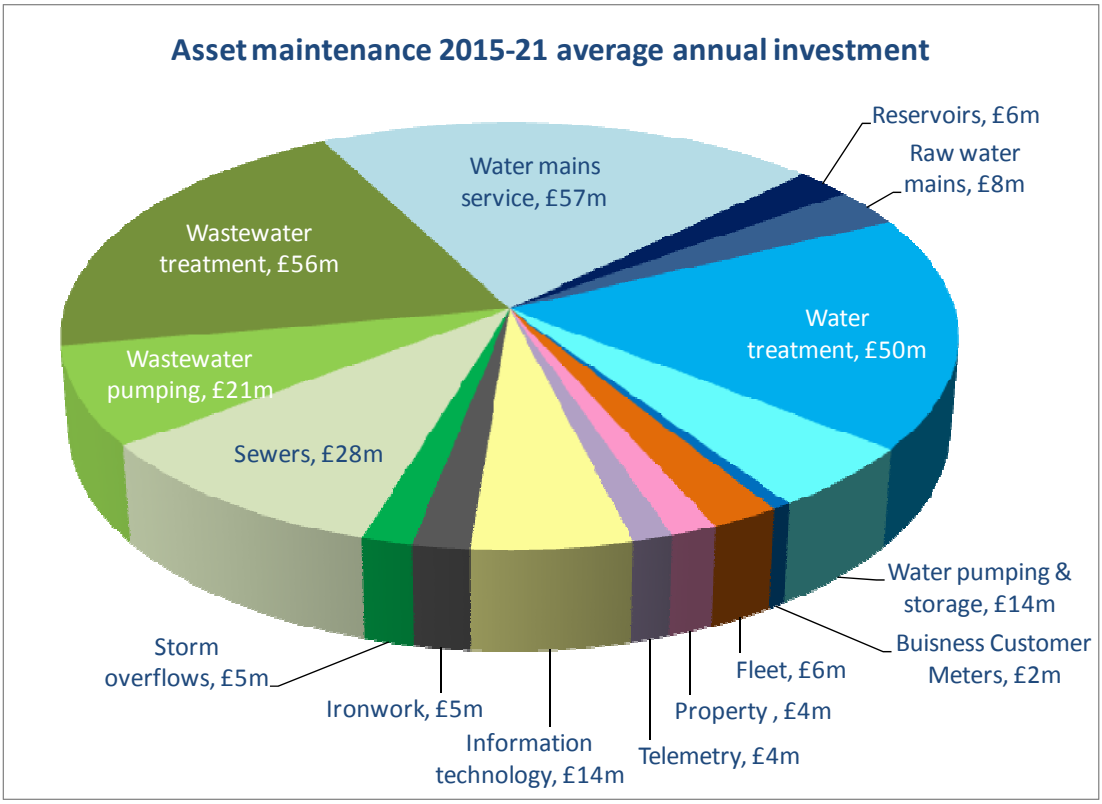
Our assessment indicates asset maintenance demand will increase from £272 million per year in 2012/13 to £285 million per year in 2020/21, an average of £280 million per year over the 2015 to 2021 period as shown in Figure 4.5. This is an average increase of over 10% from the investment level in 2010 to 2015. Our assessment of asset maintenance requirements has been independently reviewed by Black and Veatch who commented.

'Three techniques have been used to define components of Base investment needs. These are Asset Risk Modelling (ARM) …. Asset Stewardship Modelling (ASM)…. and Demand Assessments. ARM and ASM are good tools and their use in the Business Plan investment projections puts SW at or near the leading edge among UK water undertakers.

The modelling method used has been chosen to match the quality and coverage of the asset data available for each asset-type. SW is gradually improving the quality and coverage of asset data, and plans to move more asset types to ARM in future. As SW's sensitivity checks have shown, large data sets are less sensitive to individual errors in asset data than small data sets, since individual discrepancies will be evened out over a larger data set.

A break down of our 2015 to 2021 plan can be seen in Figure 4.5.

Figure 4.5: Proposed asset maintenance investment 2015 to 2021 by asset group



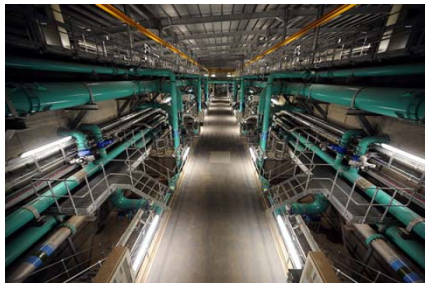
Changes in asset maintenance activity

Our plan proposes a rise in asset maintenance activity due to demand associated with:

- An **increasing asset base** populated with shorter life assets created over the last 20 years to meet higher quality and service standards.
- Maintaining **higher levels of service** expected at 2014/15.

Increasing asset base

To deliver improved drinking water quality, environmental quality and service levels between we have created around £10 billion of new above ground assets (primarily treatment works and pumping stations) in the last 20 years.



To meet the ever tightening drinking water and environmental quality standards we have had to invest in higher technology assets, for example changing from basic treatment with tanks and filters to advanced filtration systems as at the new Glencorse water treatment works (right). These new technologies are reliant on mechanical and electrical equipment which has a shorter operating life than the concrete or stone tanks of the past. As such, £3 billion of the new assets created has an accounting life of 25 years or less. As a result, our asset stewardship models demonstrate a rising demand for maintenance related to wastewater treatment works and pumping stations (constructed to comply with the urban wastewater treatment directive) and water treatment works, boreholes and pumping stations (constructed to comply with the Drinking Water Directive).

To validate our asset stewardship models we have modelled the impact that the increasing asset base has on capital maintenance demand using a simple asset replacement model. This sets a fixed life for each asset depending on what it is; computer software may be 3 years, mechanical equipment such as

pumps and screens 20 years and structures such as filters 60 years. The model then assumes that once the asset has life expired it is replaced with a new asset costing the same as a modern equivalent.

The simple asset life model shows that demand for asset maintenance, due to assets created under enhancement programmes from 1990 to 2015, is rising and is significantly higher than that forecast by our advanced asset stewardship models which take account of the variety of refurbishment and repair interventions in our plan.

The output from our simple asset life model is very similar to an asset life model developed by the water industry research body UKWIR using data from all UK companies.

Asset stewardship models

Our innovative asset stewardship models are based on the condition of our assets and our experience of the time it takes for an asset to reach a state requiring intervention. Implicit in the models is the asset lifetime which is measured by the time it takes for assets to travel through each condition state and reach the state requiring full replacement. As can be seen from the charts below our assessed stewardship model lifetimes are typically longer than the simple asset life models (see figures below). Asset lifetimes are extended due to the inclusion of repeated repair and refurbishment activities from the time that the asset is installed through to the time that the asset undergoes full replacement.

Figure 4.6: Comparison of modelled and accounting lives of water assets

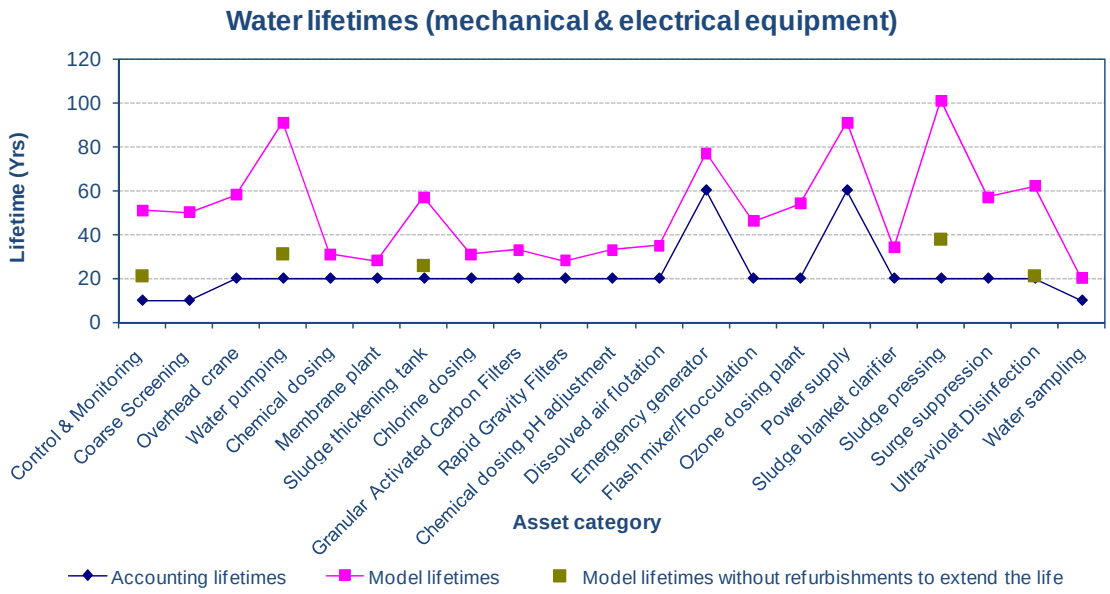
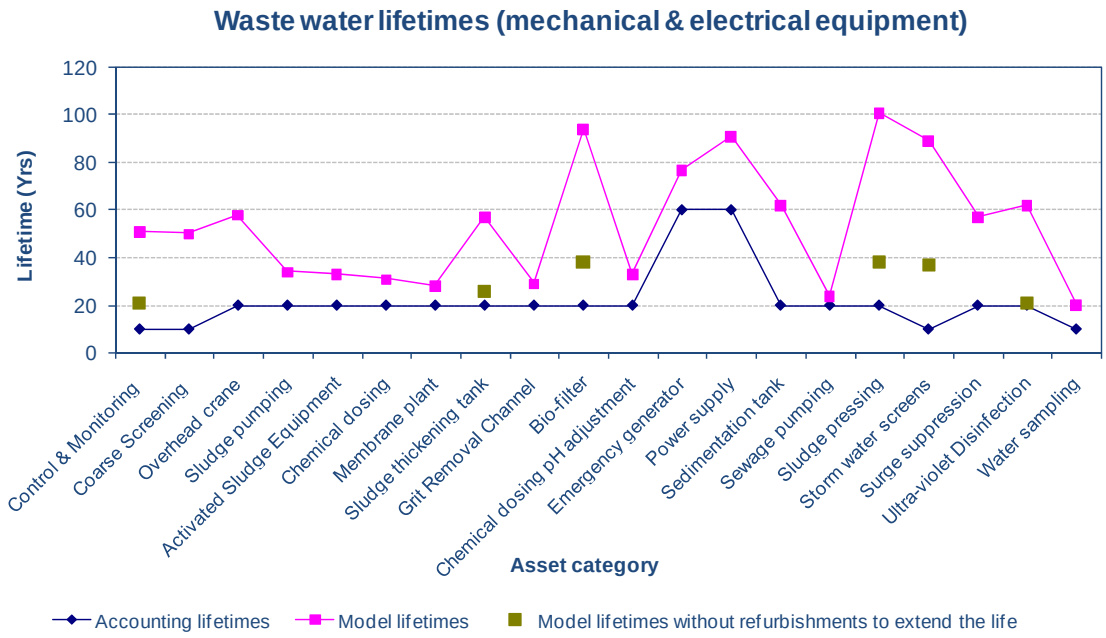


Figure 4.7: Comparison of modelled and accounting lives of wastewater assets



Our asset stewardship models are based on a comprehensive condition assessment of our assets undertaken in 2007. We are currently undertaking a sample survey of these to further validate the accuracy of the predictions from our models. This modelling technique reduces the significant cost of ongoing asset condition surveys and will allow us to develop targeted survey programmes integrated with day to day operations.

From our stewardship model we anticipate that the rise in demand will peak around 2030 as future enhancement investment is expected to be lower in value and have a greater infrastructure element which will lead to the creation of long life assets (greater than 60 years) such as sewers with a lower immediate asset maintenance demand.

Sustaining higher service levels

To sustain the higher service levels expected in 2014/15 will require us to increase maintenance activities in certain areas.

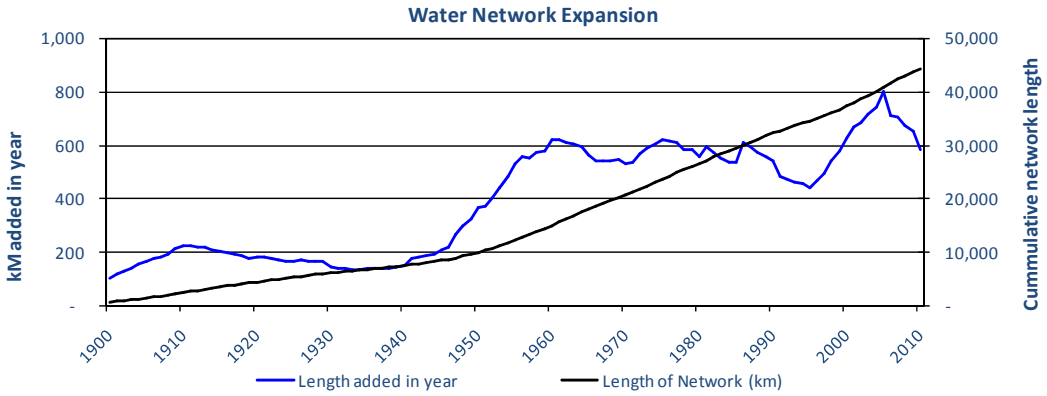
Drinking water quality

In 2009 water quality compliance was 99.78%; by 2014/15 we anticipate this will be around 99.88% as a consequence of the asset enhancements made in the 2010 to 2015 period. This forecast improvement in drinking water quality reflects a forecast 45% reduction in failed water quality tests. To sustain the increased levels of water quality performance requires the risk of asset failure to be held at a significantly reduced level.

Interruptions to supply

In 2009/10 a total of 28,875 customers experienced an unplanned interruption to supply lasting more than 6 hours; by 2014/15 we expect this to be between 11,000 and 15,000. To sustain this improved level of service we estimate we will have to invest on average £9 million per year more than would be needed to sustain 2009/10 service levels. The increased activity is a reflection of the long term deterioration of the water mains (which increase the chance of any one pipe bursting) and the rate of expansion in the network since 1950 (Figure 4.8) which increases the length of pipe that could burst. These two factors combine to create an upward pressure on demand for maintenance to sustain a certain level of service.

Figure 4.8: Rate of expansion of the water network



Environmental quality compliance

In 2009 there were 9 waste water treatment works not consistently complying with the discharge licence. By 2014/15 we expect all works to be consistently compliant. To sustain this level of compliance requires the risks of asset failure across all of our wastewater treatment works to be maintained at significantly reduced levels. This and the previous increase in the asset base to meet tighter discharge standards required by recent legislation combine to increase demand for asset maintenance.

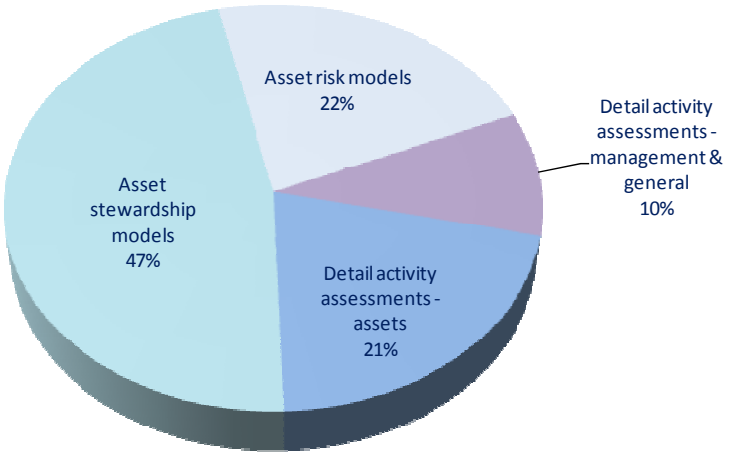
Supplementary information regarding assessment of asset maintenance demand

To assess our required capital maintenance investment from 2015 to 2021 we have used three main approaches;

- Asset Risk Modelling
- Asset Stewardship Modelling; and
- Detailed activity assessments.

Using these we have been able to assess the future capital maintenance demand for all assets. The relative split of each method by value of forecast investment is shown in Figure 4.9.

Figure 4.9: Methods used to develop plan by value

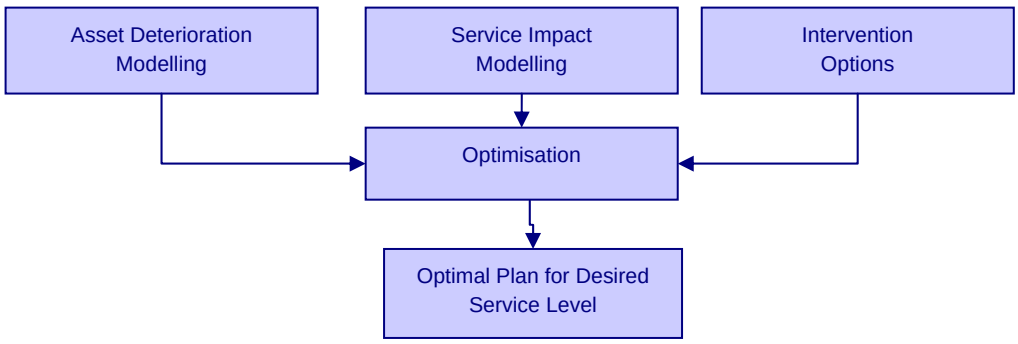


Key to assessing both long and short term requirements has been our asset management models which cover 69% of our proposed investment (by value). These have been developed in house by our analytics team in partnership with Edinburgh and Strathclyde Universities. They are based on two statistical modelling techniques and have been peer reviewed by an independent expert from Nottingham University and Black and Veatch.

Asset Risk Modelling

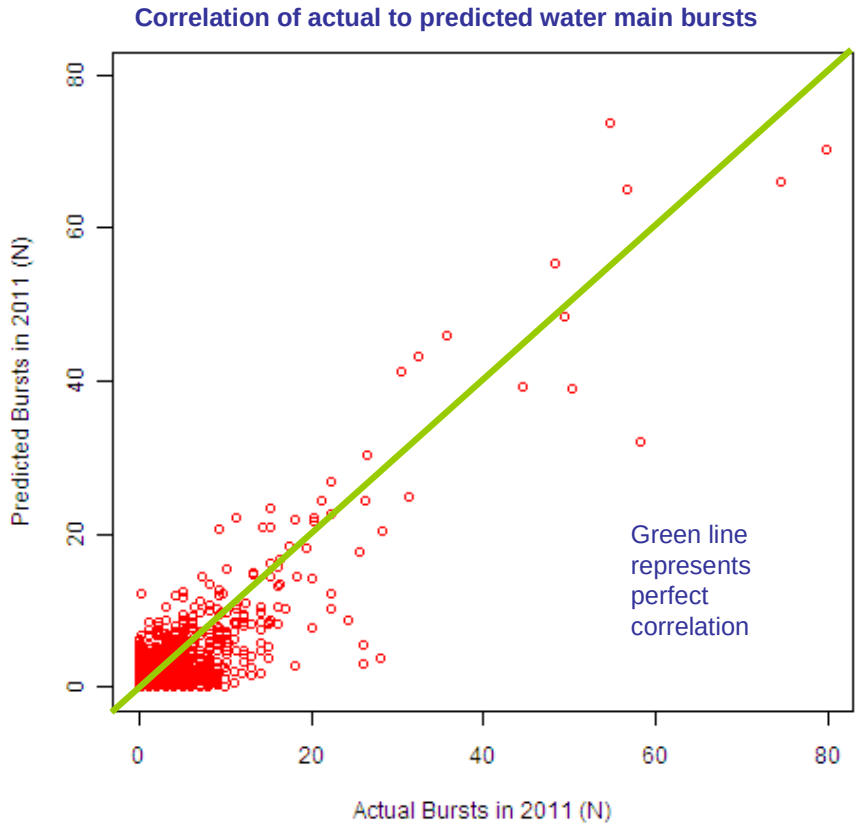
Our Asset Risk Models are based on three key inputs shown in Figure 4.10.

Figure 4.10: Asset risk modelling approach



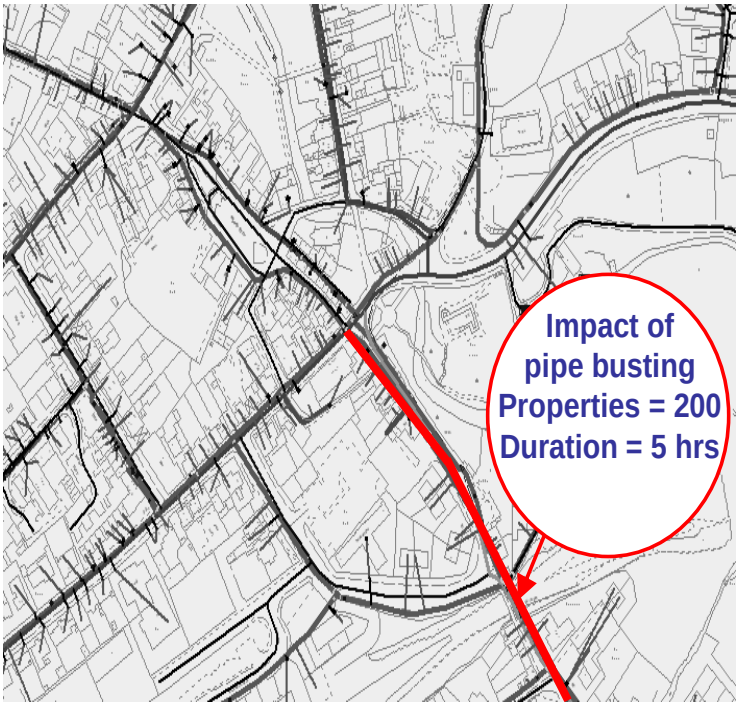
Asset deterioration model – this uses our historic failure data to develop a statistically robust estimate of the reliability of our assets over time. These models are built to take account of the specific circumstances that our assets operate under. A good example of this is our model for water mains, where the model takes account of differences in soil type and pressure. This is important because different soil types can corrode iron pipes at different rates and high pressure can lead to more bursts. These factors can be combined with others (such as age) to provide good predictions of future bursts. Figure 4.11 shows the alignment between modelled bursts for cohorts of pipes (groups of pipes with similar characteristics e.g. material type, diameter, age) and actual water main bursts for the same cohorts of pipes.

Figure 4.11: Alignment between modelled to actual water main bursts



Service impact models – this assesses the impact an asset failing will have on customers. For example if a large water main bursts it will affect a lot more customers than a small local main and may take longer to repair. However if the area served by the large main can be fed from an alternative supply the impact will be less than one that does not have an alternative supply. We have determined for all our water mains the number of customers that would be affected by an interruption to supply and recorded this on our GIS for operational planning and asset maintenance purposes as shown in Figure 4.12. This information has been linked into our service impact models which when combined with our asset deterioration models identifies the future service forecast.

Figure 4.12: Determining the service impact of a water mains burst



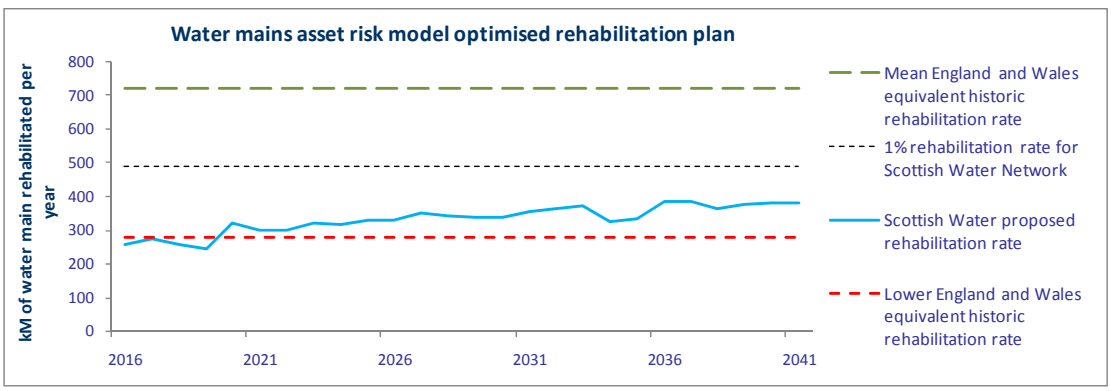
Intervention options model – this holds all of the potential interventions, their costs and the benefits they will have on service. For the water mains example this would include burst repairs and mains renewal.

These models are then combined in an optimiser which models our asset base (for water mains 238,000 groups of pipes) and develops the lowest cost plan for delivery of a selected service level (at a set probability of achieving that in any one year).

Asset Risk Modelling Process

The optimiser generates a recommended asset management plan. For the water mains example, this plan indicates the level of mains rehabilitation and burst repair activity that should be targeted each year to meet the selected service level. Figure 4.13 below shows the mains rehabilitation rate required over time under a scenario to maintain service at 2014/15 service levels compared to the English and Welsh companies replacement rates.

Figure 4.13: Asset risk modelling output for interruptions to supply scenario



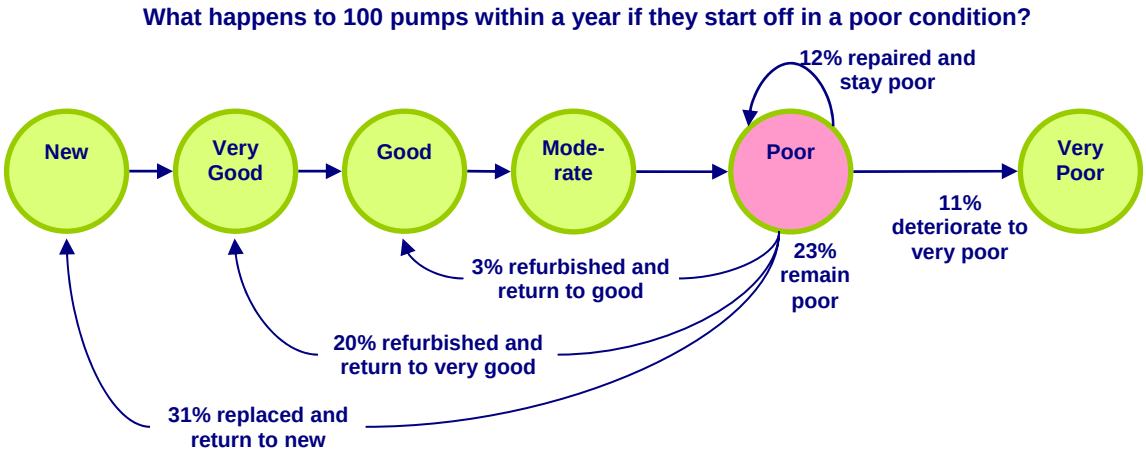
Asset Stewardship Modelling

Asset stewardship modelling assesses:

1. The rate at which assets deteriorate between six different condition states, from 'New' to 'Very Poor'.
2. Interventions we could make at each condition state, and the improvement in condition they would have.

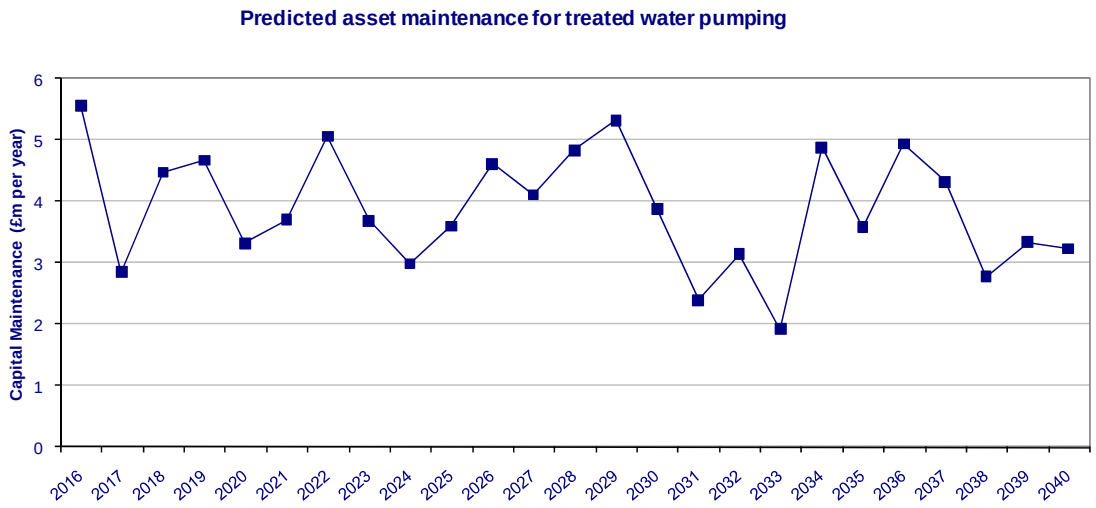
The rates of deterioration, types of intervention and benefits of the intervention have been derived for 38 principal asset groups through structured interviews with our asset management and operational staff. The output from these interviews has been compared with similar work undertaken by companies in England and Wales. The information collected has then been used to create 'transition matrices' which are applied to each of the asset condition states as shown in Figure 4.14.

Figure 4.14: Deterioration of asset condition and impact of interventions



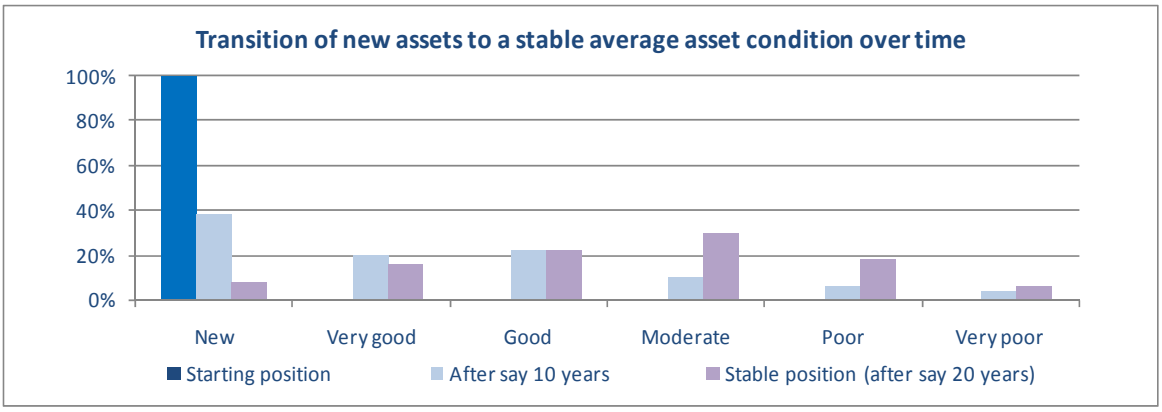
The models have been applied to all the assets in our inventory using the asset condition grade established through survey in 2007 as the starting point. The analysis has been run over 25 years and the demand for 2015 to 2021 determined. The investment demand has then been established based on either the replacement value of the asset or a percentage thereof for repair or refurbishment activity. An example of the output derived from the model is shown in Figure 4.15.

Figure 4.15: Asset stewardship modelling for water pumping station



A feature of the models is that over time they move the average condition of the asset base to an optimised position, aligned with the deterioration and intervention matrix. In some asset groups this improves the overall asset condition, for others it deteriorates. The reason for this is the starting position may be too good or too poor relative to the optimised position over time. This is shown graphically in Figure 4.16 where 100 new assets are created, over time the average asset condition will reduce as they are spread over the condition grades until, at a point in time, a stable position is achieved as determined by the inputs from the asset deterioration and intervention matrix.

Figure 4.16: Change in average asset condition to a stable asset condition profile



Detailed activity assessments

Detailed activity assessments have been used where modelling techniques were not appropriate. For each of these areas below a detailed activity assessment of future demand has been developed considering current activity levels and changes identified through surveys, inspections and demand trends:

- Impounding reservoirs which are subject to yearly inspections.
- Raw water intakes, mains and aqueducts that have been subject to inspections.
- Network modelling (computer models of water mains and sewers) which have specific update requirements to ensure they remain fit for purpose.
- Leakage infrastructure (meters, data loggers, pressure management equipment) which has been assessed as part of our leakage management plans.
- Wastewater outfalls which we have limited condition information about as they are located in the sea.
- Ironwork (manholes and Toby covers) where demand is driven from Local Authority inspection reports and customer complaints.
- Information Technology which is subject to specific system refreshes to ensure security and integrity of the systems.
- Fleet (vans and vehicles) which are assessed based on the lowest whole life cost of ownership.
- Telemetry systems which are based on inspections by our technicians and equipment obsolescence (inability to repair or maintain due to lack of spare parts).

Appendix 5: Improving drinking water quality

In summary:

- Ministers' draft objectives require us to address all known areas of non-compliance with statutory drinking water quality standards.
- Following engagement with the Customer Forum and the DWQR, our plan also includes actions to address identified risks to future drinking water quality compliance that are beyond those currently required by the statutory obligations.
- We have only committed to investment solutions in this plan once all available options have been studied.
- We propose to incur expenditure of £340.1 million in the 2015 to 2021 period improving and protecting drinking water quality.
    - £177.9 million is for confirmed solutions to address statutory improvement requirements for supplies serving 1.4 million customers;
    - £98.9 million of improvements to improve the reliability of drinking water quality across Scotland for up to 3 million customers;
    - an IR18 allowance of £42 million to address non-compliance issues that we are investigating to confirm solutions to in the early years of our plan;
    - an IR18 allowance of £21.3 million for further actions to reduce risks of future non-compliance in supplies serving around 1 million customers that we are still investigating.
- Our plan will reduce but not remove the risk of future non-compliance.

Scottish Water customers are receiving the highest ever level of drinking water quality thanks to significant investment. But we need to do more to meet our statutory obligations and customers' expectations.

This appendix sets out our planned improvements for providing our customers with a safe and reliable supply of drinking water. In this appendix all investment figures are provided in 2012/13 prices unless otherwise stated.

Ministers' draft objectives

Scottish Ministers' draft objectives for 2015 to 2027 set out that Scottish Water shall in respect of:

2.1 Drinking Water Quality

(a) Ensure full compliance (where there are still non-compliances) with the Drinking Water Directive 98/83/EC, the Water Supply (Water Quality)(Scotland) Regulations 2001 and the Cryptosporidium (Scottish Water) Directions 2003; and

(b) Reduce the risk of non compliance with the Drinking Water Directive 98/83/EC, the Water Supply (Water Quality) (Scotland) Regulations 2001 and the Cryptosporidium (Scottish Water) Directions 2003, by improving the resilience to risks as identified in its Drinking Water Safety Plans;

1.3 Rural Communities Objective

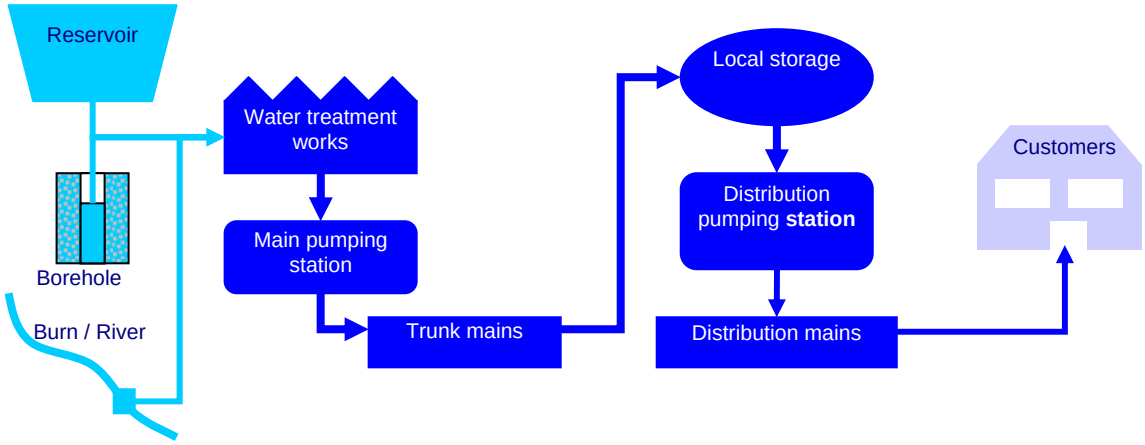
(a) Assist the Drinking Water Quality Regulator and SEPA with the assessment of the sustainable and cost effective options to address the public health risks, limitations to sustainable economic growth and customer willingness to connect to public water and sewerage services associated with community private water supplies and sewerage provision.

(b) In light of studies undertaken at a), connect to appropriate public water and/or wastewater services as approved by Ministers.

Drinking water supply

To provide water supplies to customers we abstract water from lochs, reservoirs and boreholes and burns. We treat these source waters to remove impurities to provide safe drinking water. We then distribute this high quality treated water through an extensive network of pipes, pumping stations and storage tanks for customers to use for drinking, cleaning, recreation, gardening, or in business processes (Figure 5.1).

Figure 5.1: Water supply system



High quality drinking water is essential to life, and without it our health can be impacted. Scottish Water has a duty to ensure the water it supplies is wholesome, as set out in legislative standards laid down by the European Union and Scottish Parliament.

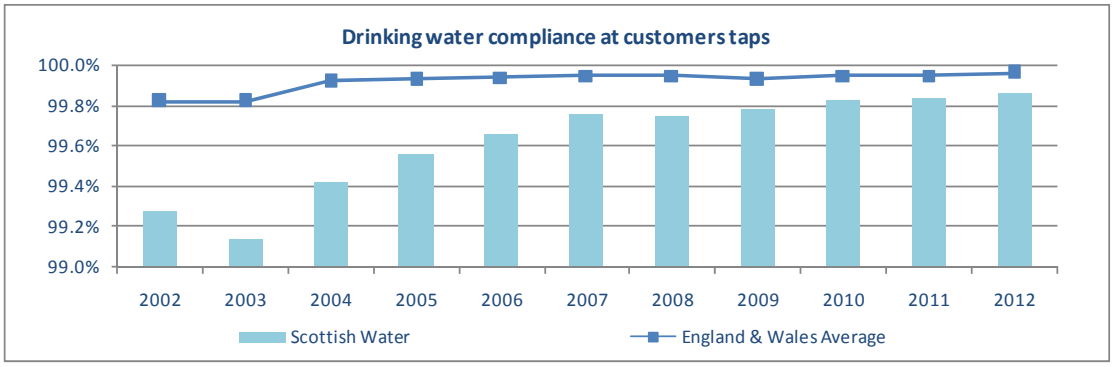
The independent Drinking Water Quality Regulator for Scotland (DWQR) has a statutory responsibility for monitoring and enforcing action to ensure drinking water complies with all of these standards.

Our customer research has shown that having high quality drinking water is a top priority for customers. Most of our customers trust that their water supply is always safe to drink from the tap as they have never experienced a problem and rightly expect this to always be the case.

Drinking water quality performance

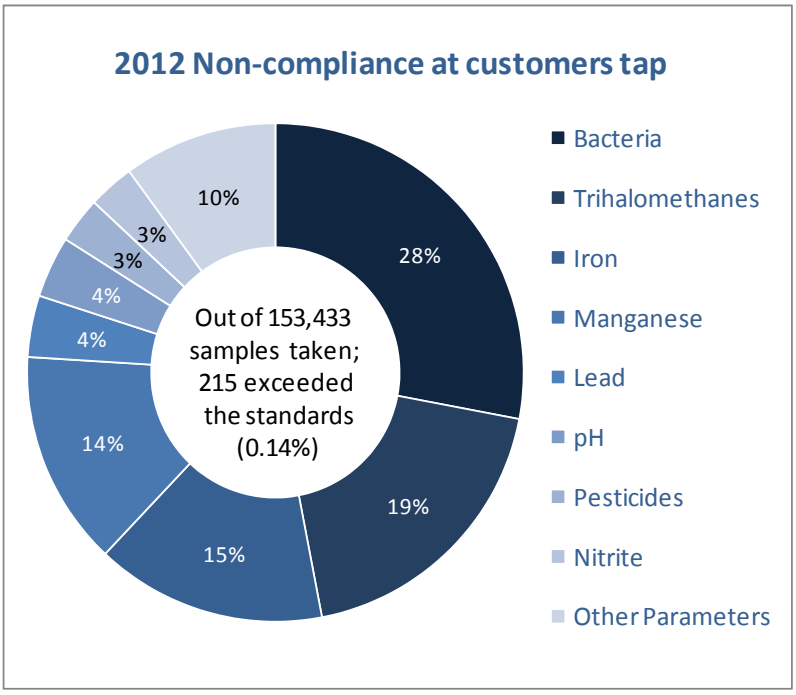
Compliance with the standards at customers' taps has improved considerably over the last 10 years, as shown in Figure 5.2, principally due to significant investment. However, it also shows that there is more to do before water quality in Scotland consistently achieves the same standard as that achieved in England and Wales.

Figure 5.2: Compliance with water quality standards over time



In 2012 we took 153,433 samples at customer taps and tested for 51 different impurities. These tests showed we exceeded the standards in 215 of those samples and mainly in relation to the 8 impurities shown in Figure 5.3.

Figure 5.3: Samples exceeding water quality standards

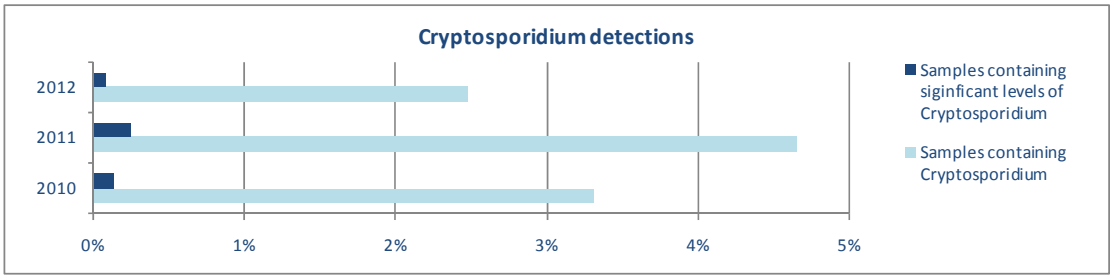


Our 2010 to 2015 improvement plan will improve drinking water compliance from 99.78% in 2009 to a forecast of 99.88% by 2014 (water quality compliance is measured over a calendar year). As a consequence of new issues emerging, not all of the known compliance issues will be resolved by the 2010 to 2015 improvement plan and further improvements are required.

In addition to sampling at the customer's tap we also monitor for the presence of cryptosporidium at our water treatment works. Cryptosporidium is a microscopic organism that can be present in untreated water contaminated by faecal matter. Unlike bacteria it is resistant to chlorine disinfection and can cause illness. Recent performance is shown in Figure 5.4. In 2012 there were 217 detections of cryptosporidium in the treated water supply leaving 77 water treatment works, 7 of which (at 5 water treatment works) were at a level considered a significant risk (more than 0.1 oocysts per 10 litres).

Our 2010 to 2015 plan will introduce new treatment or provide alternative supplies for 44 supplies to protect against cryptosporidium. This includes all of the supplies which have experienced significant detections in the last 3 years with the exception of Fair Isle which will be addressed in the 2015 to 2021 period. This will leave 32 supplies without treatment processes that can reduce or render cryptosporidium harmless by 2015. Our plan will make improvements at 12 sites to protect against cryptosporidium leaving 20 water supplies without treatment processes that can reduce or render cryptosporidium harmless. We will make improvements through catchment management and borehole / wellhead amendments at two sites, which have had previous low level detections, to reduce risk of cryptosporidium getting into the water supply. Two of the remaining 18 sites had low level detections in 2011, we will continue to monitor all of these sites and should issues arise promote these for appropriate improvements.

Figure 5.4 – Cryptosporidium detections over the past three years



Cause of non compliance

The majority of non compliances relate to the inability of our assets to consistently deliver high quality water mainly due to:

- **Impurities in our source water quality** - this can occur due to naturally occurring substances in the environment or through change of land based activities or habitation within the catchment. Possible climate change effects such as increased rainfall and temperature changes could have an effect on the catchment and source waters in the future.
- **Inadequate treatment processes** - while we have invested a significant amount over the past 20 years to enhance our treatment capability, there remain sites where our treatment may not be able to address all of the impurities that can occur in the source water. Equally some of our older assets, whilst having achieved compliance in the past, are not designed to current best practice and cannot reliably comply with drinking water standards.
- **Deterioration of drinking water quality in distribution to customers** – around 20% of our water supply network (circa 9,000km) is made from cast iron water main primarily laid before the Second World War. This material is no longer used as over time it rusts and iron is leached into the treated drinking water. This can cause discolouration and non-compliance with iron standards.

  Some water supplies are now treated to remove manganese from the source waters. Prior to this treatment being installed, manganese would pass into distribution and the water mains network is coated with a layer of manganese which can detach and cause discolouration or non-compliance with standards.

In a small but increasing proportion of cases non-compliance can be due to the customer's plumbing, typically relating to the levels of lead and bacteria.

Addressing non-compliance

Working with the DWQR we have reviewed all our supply systems and have identified those which have a history of non-compliance and need to be improved to ensure statutory compliance. We are currently improving many supplies in the 2010 to 2015 period to improve compliance and our plan for 2015 to 2021 allows for the resolution of all remaining known supplies that will remain non-compliant at March 2015.

Improving reliability of drinking water quality

The World Health Organisation has identified that the best way to ensure drinking water consistently meets the quality standards is to assess and mange the risks throughout the system, from the source water to the customers tap. In 2006 we began developing our 'Drinking Water Safety Plans' for all 236 supply systems across Scotland. The plans identify risks to water quality and supply and set out actions to manage those risks at acceptable levels. These are updated on a regular basis to take account of a changing operational environment.

Our Drinking Water Safety Plans are based on a structured risk identification and assessment process starting in the catchment of the source waters, considering the treatment processes, trunk mains and storage tanks, pumping stations, local distribution pipe work and the communication and supply pipes connecting to customers taps. All risks are assessed using the matrix shown in Figure 5.5 and no weightings are applied for the number of customers supplied.

Figure 5.5: Drinking Water Safety Plan risk assessment matrix

			Likelihood				
			Highly unlikely	**Unlikely**	**Medium**	**Probable**	**Almost certain**
			Conceivable but extremely small chance of happening in next 4-5 years	It is possible and cannot be ruled out in the next 4-5 years	As likely as not to happen in the next 4-5 years	Would be expected to happen in the next 4-5 years but there is a small chance it may not	Would be confident this will happen at least once in the next 4-5 years
Severity			**1**	**2**	**4**	**8**	**16**
Insignificant	Wholesome water or interruption <8 hours	**1**	1	2	4	8	16
Minor	Short term or localised non compliance, not health related e.g. aesthetic or interruption of 8-12 hours	**2**	2	4	8	16	32
Moderate	Widespread aesthetic issues or long term non compliance, not health related, or interruption of 12-24 hours	**4**	4	8	16	32	**64**
Major	Potential illness or interruption of 24-48 hours	**8**	8	16	32	**64**	**128**
Very Severe	Actual illness or potential long term health effects, or interruption of greater than 48 hours	**16**	16	32	**64**	**128**	**256**

Following engagement with the Customer Forum and the DWQR, our plan includes actions to address all identified risks to future water quality compliance in water supplies that score 64 or more (shaded blue in Figure 5.5). We will also consider those risks scoring 32 at any of the sites we are improving to ensure the correct long term solution is implemented. This will reduce but not eliminate all risks to the water supply and should support higher levels of compliance in the future. In the long term we would like to further improve the reliability of drinking water quality by reducing all risks that score 32 or above.

Planned investment

Our plan has been informed by investigations into previous exceedences of the water quality standards, our ongoing water quality monitoring at treatment works and customers' taps, and our Drinking Water

Safety Plans. For each issue we have studied all the available options to identify the lowest whole life cost solution.

We have only committed to investment solutions in this plan once all available options have been studied and the cause of non-compliance is understood.

Our plan adopts a mix of innovative and proven solutions as well as further investigations to confirm solutions. We have included operational solutions such as water mains cleaning and flushing to remove iron and manganese deposits that are affecting water quality at customers' taps and sustainable land management activities to manage the impact of catchment run-off on our raw water sources. We have also included innovative asset solutions such as reservoir mixing to control manganese levels entering our treatment works which, if successful, will avoid the need for additional investment to upgrade treatment works. We expect the rolling investment review (IR18) to consider the success of these innovative approaches and prioritise any further investment where appropriate.

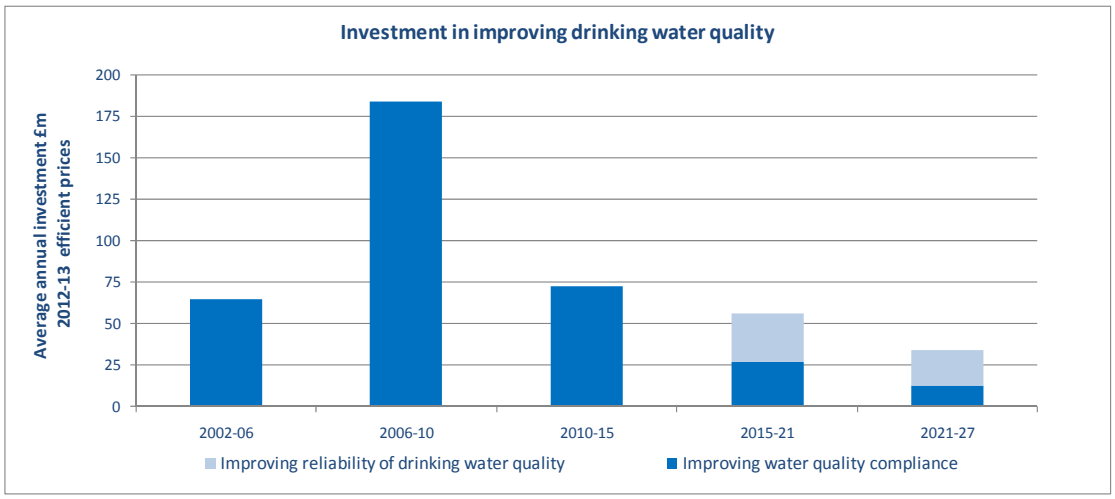
We plan to incur £340.1 million in the 2015 to 2021 period improving and protecting drinking water quality. Of this, £63.3 million is an allowance for solutions to confirmed problems that will be investigated in the early years of our plan. This allowance and investment priorities arising will be reviewed as part of the IR18 review. Table 5.1 summarises the planned investment we will make from 2015 to 2021 to improve drinking water quality.

Improvement Programme	2015-21 TOTEX £m (2012/13)			Output
	Committed		IR18	
	Capex	Opex	Totex	
Statutory improvement to address non compliance				
Non-compliant water into supply from 30 supplies (4 of which are future investigation for delivery under IR18)	88.4	-0.4	27.8	Up to 583,000 customers receiving improved drinking water
Non-compliant water in distribution supplying up to 1.5 million customers	61.0	0	14.2	Up to 1.5 million customers receiving improved drinking water
Reduction of iron and manganese levels in distribution, 88 areas	*57.9*	*0*	*0*	*647,000 customers receiving improved drinking water*
Investigations and reduction of iron and manganese in distribution in 15 areas	*3.1*	*0*	*14.2*	*Up to 853,000 customers receiving improved drinking water.*
Lead regulation compliance & customer requested lead communication pipe replacement	4.4	0	0	Removal of 6,500 lead communications pipes
Completion programme Non-compliant water into supply from 9 supplies; and reduced iron and manganese levels in 3 areas	24.1	0	0	205,000 customers receiving improved drinking water
Sub total	**177.9**	**-0.4**	**42.0**	
Improvements to increase reliability of drinking water quality				
Managing catchments and improving treatment to 71 supplies	**48.5**	**0.3**	**9.8**	Protection for 1.7 million customers
New treatment for 6 supplies	*15.5*	*0.05*	*0*	*Protection for 7,217 customers*
Improving existing treatment processes for 35 supplies	*31.6*	*0.25*	*0*	*Protection for around 1.3 million customers*
Investigate to confirm appropriate solutions for 2 supplies	*0.1*	*0*	*7.5*	*Protection for up to 12,900 customers*
Catchment improvements for 6 supplies	*0.8*	*0*	*0*	*Protection for 381,369 customers*
Emerging risks - catchment management opportunities for 22 supplies	*0.4*	*0*	*2.3*	*Reduced risk of supply contamination for up to 614,000 customers*
Enhancing networks and treated water storage to improve supplies	**15.2**	**0**	**4.6**	Improved supplies to over 2 million customers
Enhancing storage and networks in 31 supply systems and risks identified through inspection programmes	*9.4*	*0*	*0*	*Improved supplies to around 1.2 million customers*
Waterproofing and improving flow regimes at service reservoirs	*5.6*	*0*	*0*	*Improved supplies to around 350,000 customers*
Investigate disinfection throughout 1 system and improve	*0.2*	*0*	*4.6*	*Improved supplies for up to 178,800 customers*
Reducing risk of non-compliance in distribution cleaning 5,927km of water mains	35.2	0	4.5	650,000 customers with reduced risk of discolouration
Emerging risks to drinking water quality	0	0	2.4	Emerging risks identified during regular updates of drinking water safety plans
Sub total	**98.9**	**0.3**	**21.3**	
Total	**276.9**	**-0.1**	**63.3**	

Table 5.1: Planned investment to improve drinking water quality 2015 to 2021

Our historic, planned and forecast investment in drinking water quality is set out in Figure 5.6. This is over and above our planned annual investment to maintain existing levels of service and service risk. We expect that by improving reliability of drinking water quality, we will reduce future investment required to address non-compliance. However we do expect an ongoing requirement to address unlined cast iron mains as they deteriorate to a level which impact water quality.

Figure 5.6: Historic, planned and forecast investment in improving drinking water quality



Benefits for Customers

The benefits to customers of Scottish Water's plan is summarised in Figure 5.7 on the next page, which shows the percentage of customers supplied by systems with non-compliance issues, and risks. Figure 5.8 shows how our plan will improve this position by 2021.

Our planned investment will improve all supplies which currently do not reliably meet standards and reduce the risk of future non-compliance. Our drinking water quality investment programme, including studies and investigations, will benefit 3.96 million customers. As a result of our investment we would expect customers as a whole to experience:

- reduced exposure to contaminants that may cause illness;
- fewer occasions where they are required to boil their water or not use it;
- a reduced likelihood of experiencing levels of iron and manganese which cause significant discolouration and staining of washing;
- a reduced likelihood of a water quality incident that diminishes customer confidence in their water supply.

Figure 5.7: Reliability of drinking water quality to customers at 2015

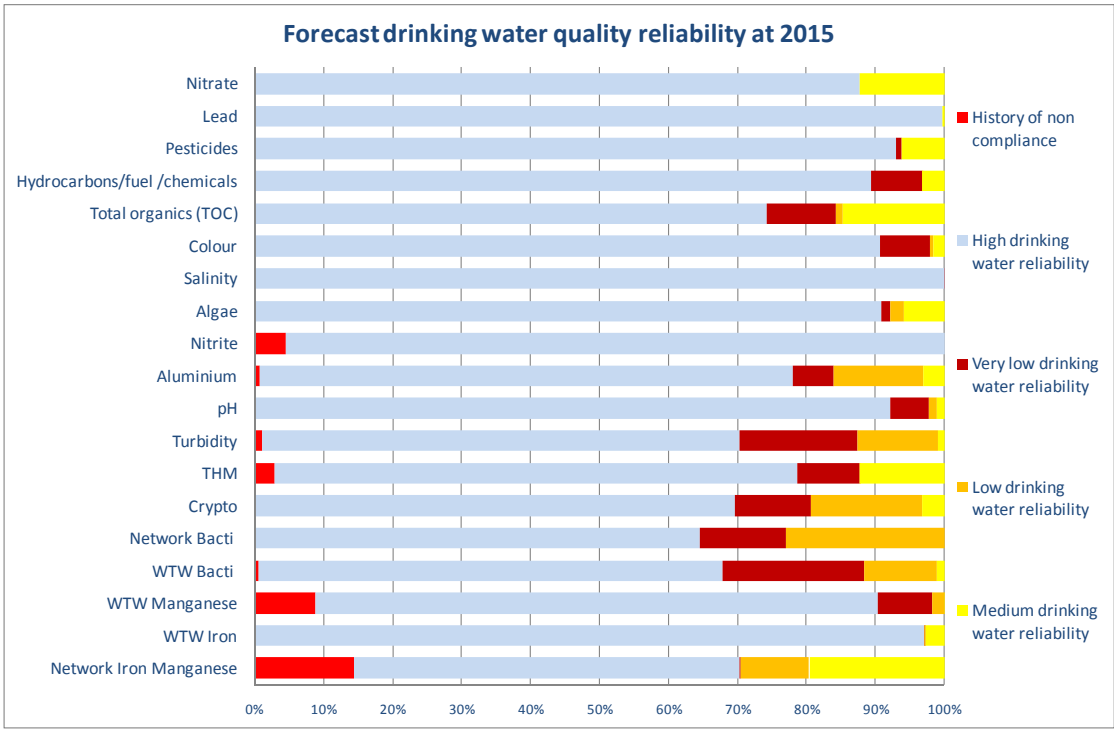
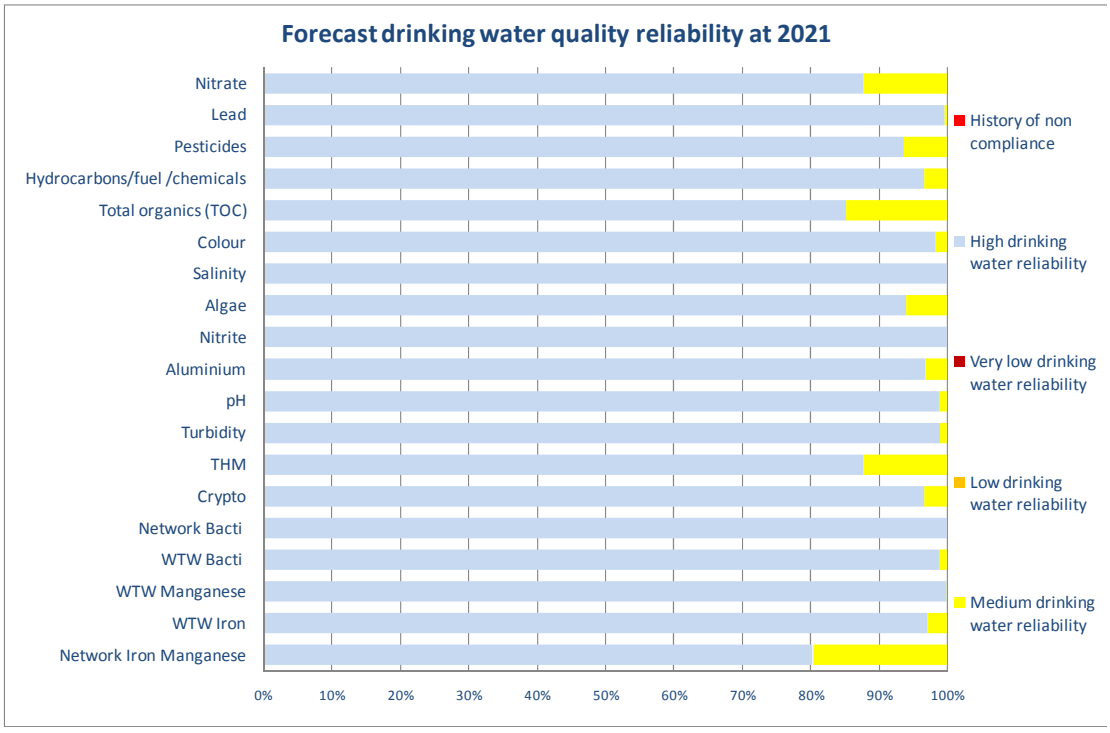


Figure 5.8: Reliability of drinking water quality to customers at 2021



Statutory improvement to address non-compliance

Our investigations programme has enabled us to agree with the DWQR the statutory requirements for 2015 to 2021, to address issues of non-compliance with the water quality standards. In developing the solutions to statutory issues we have looked at the drinking water quality risks in the supply system to ensure that our proposed solutions are the lowest whole life cost taking account of both compliance and reliability requirements. We have also looked at opportunities for strategic solutions such as rationalisation of treatment plants taking account of longer term costs of asset maintenance and operations.

We plan to invest £219.9 million to prevent the reoccurrence of historical non compliances, supporting the move to full compliance:

- 30 water supplies that do not comply with current standards serving 583,000 customers;
- rehabilitating 397km of water mains and cleaning 1,216km of water mains confirmed as causing non-compliance serving 647,000 customers and investigating 15 areas of the distribution network supplying 853,000 customers to confirm the cause of non-compliance;
- completing improvements to 12 supplies commenced in the 2010 to 2015 period under Q&SIIIb that will improve supplies to 205,000 customers; and
- replacing around 6,500 lead communication pipes to ensure ongoing compliance with lead standards and meet customer expectations.

Non-compliant water into supply from 30 supplies

We have confirmed 30 supplies that will remain non-compliant at March 2015. Our plan includes proposals to address all of these;

- improving 26 water supplies that do not comply with current standards serving 534,000 customers, and
- investigating 4 water treatment works that do not comply with current standards serving 49,000 customers.

Water treatment confirmed solutions

We have identified 26 water treatment works serving 534,000 customers where improvements are required to ensure water quality consistently meets the standards. Our plan, set out in Table 5.2, includes a mix of traditional process solutions and innovative operational and capital solutions proposed to address these statutory requirements.

At 2 sites, Amlaird and Burncrooks, the Water Industry Commission for Scotland has expressed concern that the solutions proposed may not be optimal. The DWQR require these schemes to be delivered as a priority and therefore we have agreed to ring fence the £20.2 million investment associated with these schemes within our confirmed investment for 2015 to 2021 until an independent technical review that satisfies the Commission and DWQR is undertaken.

Following consultation with the Drinking Water Quality Regulator, the project delivery dates for the Invermoriston and Fort Augustus water quality compliance project have been accelerated by one year.

Water Treatment Works	Customers served	Parameters		Solution
		Non-compliant	At risk	
Achmelvich	72	THM	Crypto	Decommission WTW and supply from Lochinver system.
Amlaird	34,783	THM, Bacteriological	Colour, Iron, Manganese	Decommission WTW and supply from Glasgow system. (Ring Fenced)
Back Tolsta	1,435	Bacteriological	THM, Manganese, Aluminium, Hydrocarbons	Replace with membrane plant.
Bayhead	1,017	THM, Aluminium	Colour, Turbidity, Algae	Decommission WTW and supply from Lochmaddy system.
Beasdale	8	Crypto	Bacteriological	Decommission WTW and supply from Mallaig system.

Water Treatment Works	Customers served	Parameters		Solution
		Non-compliant	At risk	
Black Esk	38,157	Manganese, Turbidity	None identified	Reservoir mixing & automated chemical dosing.
Boardhouse	4,852	Manganese	Colour	Automate chemical dosing systems and make improvements to clarification treatment process. Monitor and review if improvements resolve manganese issues. If not resolve under rolling enhancement programme.
Burncrooks	53,449	THM	Total organics	Replace with coagulated ultra filtration membrane plant. (Ring Fenced)
Fair Isle	69	Cryptosporidium	Colour, Salinity	Replace with reverse osmosis membrane plant.
Fort Augustus	580	THM	Cryptosporidium	Decommission WTW and supply from Invermoriston system.
Glenlatterach	43,002	Manganese, Aluminium		Install manganese removal filters.
Invermoriston	105	THM, Aluminium	Colour, Bacteriological, Cryptosporidium, Hydrocarbons	Replace with membrane plant and extend intake away from road.
Kaim	7,515	THM, Manganese	Colour, Bacteriological, Cryptosporidium,	Decommission WTW and supply from Glasgow system.
Killin	738	Manganese	None identified	Automated backwash of limestone pH adjustment systems to prevent manganese builds up.
Lochaline	185	Cryptosporidium	None identified	Replace with membrane plant.
Lochearnhead	262	Manganese	None identified	Automated backwash of limestone pH adjustment systems to prevent manganese build up.
Lomond Hills	56,103	Manganese	None identified	Install mixers in reservoir to prevent stratification and rapid changes in manganese levels at WTW.
Mannofield	231,414	Manganese, Nitrite	Cryptosporidium, Bacteriological, hydrocarbons	Trial an alternative treatment chemical and see if it reduces manganese levels. Make provision in the IR18, for manganese filters if it is not successful. Install automatic shutdown system to eliminate the risk of non-disinfected water entering supply and install pollution monitoring upstream of intake.
Papa Stour	31	Cryptosporidium, THM		Decommission WTW and supply from Eela System.
Roberton	35,032	Manganese	Colour, THM, Bacteriological Hydrocarbons	Install mixers in reservoir to prevent stratification and rapid changes in manganese levels. Improve control of chemical dosing systems, and install pollution monitoring in reservoir.
Savalbeg	848	THM	Colour, Bacteriological	Automate chemical dosing systems, increase Dynasand filter capacity and provide additional storage.
South Moorhouse	20,810	Manganese, Turbidity		Install reservoir mixing in two reservoirs.
South Uist	1,558	Manganese, Bacteriological	THM, Aluminium,	Replace with membrane plant.

Water Treatment Works	Customers served	Parameters		Solution
		Non-compliant	At risk	
Stoer	146	Cryptosporidium	Bacteriological, Colour, THM	Replace with membrane plant.
Tighnabruaich	834	Manganese	Bacteriological	Automated backwash of limestone pH adjustment systems to prevent manganese builds up.
Whalsay	1,089	Cryptosporidium, THM	Bacteriological	Replace with membrane plant.
Total	**534,094**			

Table 5.2: Investment to address statutory non-compliance

Due to the innovative nature of our approach it is not guaranteed the issues at all sites will be fully resolved. Reservoir mixing may not reduce the peak manganese levels in the reservoir to levels that the existing treatment works can manage, and the change in chemical dosing may not deliver the expected benefits. We have therefore included an IR18 allowance of £21.3 million (£1 million in 2015 to 2021 and £20.3 million in 2021 to 2024) to address any residual issues that remain unresolved.

***Innovation**: The plan includes improving 12 water treatment works that have supplied water that is non-compliant with the manganese standard. The standard treatment process to remove manganese from drinking water is to install additional chemical dosing and sand filtration. Having reviewed the root cause of the problems, at 9 of the sites we are proposing to use innovative, lower cost approaches to resolve these issues involving:*

- *The installation of mixers within our reservoirs at 4 sites to reduce the peak manganese levels which cause failures;*
- *Improvements to clarification or chemical dosing arrangement at 2 sites to improve existing manganese removal rates;*
- *Installation of backwashing systems to limestone contactors at 3 sites.*

Water treatment confirmed needs, unconfirmed solutions

We have identified 4 water treatment works, serving 48,883 customers where improvements are required to ensure water quality consistently meets the standards for Trihalomethanes (THMs), these are listed in Table 5.3. THMs are a chemical compound that form when chlorine used for disinfection combines with naturally occurring organic material in the water. They are invisible and if consumed at high concentrations over a long period could impact on health.

Innovation: THM analysis

We are developing laboratory analytical capabilities to analyse the characteristics of the organic pre-cursors that combine with chlorine to form THMs allowing targeted treatment optimisation. We will trial this at the 4 water treatment works set out in table 5.3 (and a further 2 in table 5.6) to determine if we can reduce THM formation adequately to achieve compliance. Where treatment optimisation is not sufficient to deliver sustained compliance the information gained will enable us to clearly define the process improvements we need to make. If successful this knowledge will be rolled out across our other chemical treatment sites to manage future risk to the quality of drinking water. We are also working to develop a THM modelling capability that may help us to reduce THM non-compliance in distribution.

At these sites the root cause of the problems is unclear due to the complex nature of THM formation. A robust solution to the problem would be to replace the plants with advanced membrane treatment processes at a cost of £34 million.

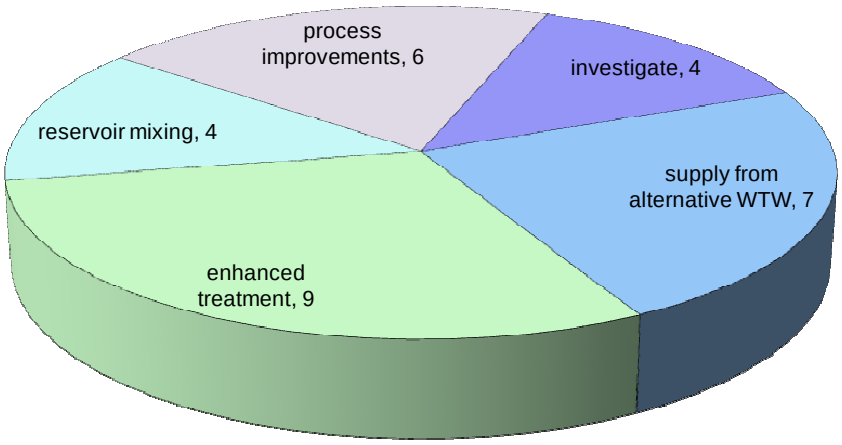
However we are optimistic that if we can understand the organics well enough we may be able to address one or two of these sites with process changes or additional chemical treatment. We have included an IR18 allowance of £26.8 million in our plan to deliver confirmed solutions to these problems and plan this is reviewed as part of the IR18 investment review in December 2017.

Water Treatment Works	Customers served	Parameters		Solution
		Non compliant	At risk	
Afton	40,501	THM	Bacteriological, pH, colour	Investigate to understand root cause of problem and develop optimal solution.
Ardrishaig	5,467	THM	Colour, Total Organics	
Barra	1,155	THM, Manganese	Hydrocarbons	
Tarbert (Argyll)	1,760	THM,	Total organics	
Total	**48,883**			

Table 5.3: WTW to be investigated to confirm solution to address statutory non-compliance

Figure 5.9 below summarises the types of solution being adopted to address the 30 supplies that currently have non-compliant water entering the distribution system.

Figure 5.9: Range of solutions used to improve drinking water supply compliance



Non-compliant water in distribution

Our plans have been informed by detailed water quality investigations to confirm the cause of non-compliance and the extent of the water mains network that is contributing to the non-compliance with standards.

Reductions of iron and manganese levels in distribution

We have included £57.9 million in our plan for 88 areas of local distribution, supplying around 647,000 customers, where we have identified that there has been non-compliance for iron, manganese or turbidity under normal operating conditions due to iron leaching from the old cast iron pipes or harmless deposits of manganese building up in the water mains. Following detailed investigations we have identified the most appropriate interventions are:

- To reline or replace 397km of cast iron mains and clean all 1,216km of distribution mains, in 78 areas of local distribution supplying 230,000 customers in 96,000 properties.
- To clean 10 trunk main systems supplying 482,000 customers (65,000 of which are also having their local distribution pipes improved) in 200,000 properties.

Investigations of iron and manganese levels in distribution

In 15 water supply systems, supplying 853,000 customers, there have been recent non-compliances for iron and manganese. In these systems we will undertake detailed network investigations to confirm causes of non-compliance and identify the optimum solution for delivery.

We have included an IR18 allowance of £14.2 million in our plan to deliver solutions to these problems and plan this is reviewed as part of the IR18 investment review in December 2017. Table 5.4 summarises the zones in our plan.

In the Bradan zones (A, B & C) we have agreed with the DWQR, through a regulatory 'Undertaking', to begin a programme of flushing and swabbing in advance to remove historically deposited manganese and provide an immediate reduction in water quality non-compliances for customers.

The cost of undertaking the investigations in the 15 water supply systems and the flushing and swabbing in Bradan zones is £3.1 million.

Water Treatment Works	Customers served	Parameters Non-compliant	Solution
Afton RSZ	40,501	Iron, Manganese	Investigate network, and develop optimum mix of cleaning and rehabilitation.
Amlaird RSZ	34,783		
Bradan A RSZ	95,915		Clean network to manage problems in line with undertaking with DWQR and investigate network and develop optimum long term mix of cleaning and rehabilitation.
Bradan B RSZ	61,258		
Bradan C RSZ	57,613		
Camps RSZ	107,720		Investigate network, and develop optimum mix of cleaning and rehabilitation.
Camphill RSZ (trunk main)	40,449		
Carron Valley B RSZ	70,312		
Greenock RSZ	79,486		
Lintrathen RSZ	89,948		
Pateshill RSZ	58,820		
Rawburn RSZ	17,148		
Roberton RSZ	35,032		
Spynie RSZ (Clunihill County and Conicavel WSZ)	41,499		
Whitehillocks RSZ	22,255		
Total	**852,739**		

Table 5.4: Distribution network to be investigated to confirm solution to address statutory non-compliance

Lead regulation compliance & customer requested replacement

To maintain compliance with the 2013 lead standard we will continue to treat water with phosphate to protect customers by reducing the levels of lead that leach from Scottish Water's communications pipes and customers' own supply pipes and plumbing. We acknowledge that this approach may not be 100% effective, and have therefore allowed in our plan for the removal of any lead communication pipe identified during the investigation of a lead non-compliance that may arise. If we find a lead supply pipe (owned by the customer) during such an investigation, we will notify the customer that they should replace their pipe.

To deliver the requirements of the DWQR information letters (4/2000, 4/2003 and 5/2006) we will replace lead communications pipes where we encounter them during maintenance work, or when requested by customers who have replaced their supply pipe.

Our plan allows £4.4 million for the anticipated removal of 6,500 lead communications pipes, which is around 9% of the remaining lead communications pipes in our water network.

Type of occurrence	Lead communication pipes replaced	Percentage of remaining lead communication pipes	Solution
Non-compliance with the lead standard at the customers tap.	500	0.7%	Investigate any failure replacing the communications pipe if it is found to be lead, and advising the customer to do likewise if their supply pipe is lead.
Opportunistic removal of lead from water supply network.	2,400	3.3%	Remove lead communications pipes when encountered during maintenance works.
Customer requested removal of lead communications pipes.	3,600	5.0%	Respond to customer request to replace lead communications pipes.
Total	**6,500**	**9%**	

Table 5.5: Lead compliance

We are aware there have been discussions within the industry regarding the acceptable concentration of lead in drinking water and its impact on public health. It is likely that any further reduction would require the removal or lining of Scottish Water communications pipes (from water main to property boundary) and customers supply pipes (from the property boundary to the kitchen tap).

In 2010/12 we undertook surveys to understand the amount of lead within the drinking water supply network. These indicate there are around 72,000 communications pipes and a similar number of customer supply pipes. However our surveys indicate that they are not always at the same properties.

If a change to standards were brought in this could require Scottish Water to invest in the range £100 million to £120 million replacing our pipe work, with customers required to invest £140 million to £160 million for theirs. These estimates exclude the cost of replacing lead plumbing within houses.

Undertaking a lead pipe replacement pilot has not been agreed as a customer priority at this stage and will be considered under the rolling investment review in December 2017. No IR18 provision has been allowed within the plan for this activity.

Completion of works commenced in 2010 to 2015

In the 2010 to 2015 period an allowance was made in the final determination to address emerging priorities and support continuity of investment. The Output Monitoring Group has approved a list of additional outputs to be delivered as part of the Q&SIIIb objectives. The delivery forecast for these additional outputs shows that the projects will not be completed until after March 2015 as planned. We have included investment of £24.1 million in the 2015 to 2021 period to complete these projects.

Improvements to increase reliability of drinking water quality

Following engagement with the Customer Forum and the DWQR, our plan includes actions to move towards a more proactive and preventative approach to improving the reliability of drinking water quality. We plan £98.9 million of improvements to increase the reliability of drinking water quality by:

- managing catchments and improving treatment for 71 supplies serving over 1.7 million (31%) customers;
- network or service reservoir enhancements to improve reliability of drinking water quality serving around 1.2 million (22%) customers; and
- cleaning 5,927km of water mains serving 650,000 (12%) customers;

We have also included an IR18 allowance of £21.3 million for further actions to reduce risks of future non-compliance in supplies serving around 800,000 customers that we are still investigating.

Managing catchment and improving treatment to 71 supplies

Through our drinking water safety plans we have identified 71 water treatment works, supplying 1.7 million customers, with identified risks to future drinking water quality. We plan to reduce these risks using a combination of conventional and innovative solutions, reviewed by the DWQR and Black and Veatch.

New treatment for 6 supplies

At 6 sites serving 7,217 customers we will invest £15.5 million enhancing treatment by replacing or adding to the existing treatment processes as set out in Table 5.6.

Water Treatment Works	Customers served	Parameters	Solution
		At risk	
Londornoch	2,176	Colour, Total Organics, THM, Bacteriological, Cryptosporidium, pH	Provide duplicate process stream to allow planned maintenance
Ness	1,179	Colour, THM, Bacteriological, Cryptosporidium, Manganese, Turbidity,	Upgrade existing processes to reduce loading on process units, new manganese removal stage and flocculation tank. New raw water main and intake
Stronsay	356	Cryptosporidium, Colour, Turbidity, Manganese, Bacteriological	Replace with membrane plant
Uig (Suainaval)	343	Cryptosporidium, Bacteriological, pH, Turbidity,	Improved water quality monitoring, automate chemical dosing systems and provide additional 'Dynasand filter capacity.
West Lewis	3,100	Bacteriological, Turbidity, Aluminium, Total Organics,	Automate chemical dosing systems, increase Dynasand filter capacity and provide additional storage
Yarrowfeus	63	Cryptosporidium, Turbidity	Install cartridge filtration unit and UV
Total	**7,217**		

Table 5.6: Sites with enhanced treatment to increase reliability of drinking water quality

Improving existing treatment processes for 35 supplies

At 35 sites serving 1.3 million customers we will invest £31.6 million improving the existing treatment processes as set out in Table 5.7. A lot of the planned improvements relate to automating the control of the existing processes to ensure high quality drinking water is reliably produced at all times.

Water Treatment Works	Customers served	Parameters at risk	Solution
Alexandria	18,003	Cryptosporidium, Bacteriological, Turbidity, Manganese, Aluminium, pH	Improvements to chemical dosing system filter outlet valves and provision of livestock fencing to protect water source.
Balmore	426,765	Bacteriological, Cryptosporidium, Turbidity, Aluminium,	Improvements to rapid gravity filters and provision of secondary disinfection.
Balquhidder	164	Manganese, Bacteriological	Installation of automatic backwash to limestone contactors to prevent manganese build up and improvements to existing treatment process.
Belmore	8,735	Bacteriological, Turbidity	Provide automatic plant shutdown, improvements to existing filtration systems and other treatment processes.
Bonnycraig	8,840	Cryptosporidium, Turbidity	Improvements to rapid gravity filtration system through provision of slow start and run to waste facilities.
Bradan	214,786	Bacteriological, Cryptosporidium, THM, Turbidity, pH, Aluminium, Total Organics	Install emergency failsafe disinfection and improvements to treatment process.
Braemar	480	Cryptosporidium	Improvements to Dynasand filtration process.
Bunessan	483	Cryptosporidium, turbidity	Improvements to filtration process to prevent membrane damage.
Camphill	40,449	Manganese, Cryptosporidium, Bacteriological, Colour, Total Organics, Hydrocarbons	Provision of continuous raw water monitoring to detect pollution, prevention of contamination of the water source due to proximity of transport routes, cover clarifier process units.
Carrick Castle	94	Bacteriological, Cryptosporidium	Provision of improved disinfection system and improved monitoring and control systems.
Carsphairn	83	Bacteriological	Provide automatic plant shutdown.
Corrie	325	Bacteriological	Provision of new disinfection equipment including monitoring and control.
Corsehouse	9,031	Algae	Upgrade clarification process to improve algae removal.
Dougliehill	12,221	Bacteriological, Cryptosporidium, Turbidity	Improvements to raw water aqueduct to prevent ingress of contaminated water and improvements to wash water recovery system.
Eela Water	5,551	Cryptosporidium, Turbidity	Improvements to filtration process.
Glendevon	130,634	Bacteriological, Aluminium, Hydrocarbons/ chemicals contamination	Improvements to disinfection systems to ensure continuous disinfection at all times, and cover open filters.
Greenock	79,486	Bacteriological, Hydrocarbons/ chemical contamination	Improve covers to wash water recovery tanks and improvements to clear water tank to prevent contamination.
Kinnesswood	89,607	Bacteriological, Cryptosporidium	Improvements to boreholes and livestock controls in catchment.
Kirbinster	11,674	Bacteriological	Improvements to disinfection system and chlorine contact arrangements.
Lintrathen	89,948	Bacteriological	Improvements to disinfection systems to ensure disinfection at all times.
Loch Ascog	3,134	Bacteriological, Contamination	Improvements to clear water tank to prevent contamination of treated water.
Loch Eck	13,292	Bacteriological, Turbidity	Improvements to telemetry systems.
Lochgoilhead	276	Bacteriological, Turbidity, Colour	Provision of new disinfection equipment including automatic shutdown and improvements to control system. Improvement to the clear water tank to prevent contamination of treated water.
Manse St Galashiels	9,366	Bacteriological, Cryptosporidium, Turbidity, Aluminium, Total Organics	Improvements to filtration and associated backwash system.
Newmore	5,264	Bacteriological, Cryptosporidium, Turbidity, Aluminium, Hydrocarbons	Automation of key chemical dosing processes and improved filter washing.

Water Treatment Works	Customers served	Parameters at risk	Solution
North Hoy	47	Bacteriological	Reduced risk of filter overloading causing bacteriological failures by increasing capacity to restore supply demand balance (see Appendix 12 supply demand balance investment).
North Lochs	2,366	Bacteriological	Improvements to disinfection system.
Penwhapple	8,871	Bacteriological, Turbidity	Install plant automatic shutdown.
Ringford	4,572	Bacteriological, Cryptosporidium	Catchment improvements to control livestock and borehole modifications.
Sanday	478	Bacteriological, Turbidity	Improvement to disinfection system and clarification systems.
Skerries	76	Manganese, THM, Salinity	Improvements to reverse osmosis treatment process to deal with high chloride and manganese in the raw water.
Strathyre	224	Iron, Manganese	Installation of automatic backwash to limestone contactors to prevent manganese build up.
Terregles	26,486	Cryptosporidium	Catchment improvements to control livestock and borehole modifications.
Turriff	70,909	Cryptosporidium, Turbidity, Aluminium, Algae	Improvements to chemical dosing systems and continued catchment management to reduce risk from algal blooms.
Whitehillocks	22,255	Bacteriological, Cryptosporidium, Turbidity, pH, Aluminium, Colour, Total Organics	Disinfection system improvements, additional water quality sensors and treatment process improvements
Total	**1,314,975**		

Table 5.7: Sites with improved treatment to increase reliability of drinking water quality

Investigation to confirm appropriate solutions for 2 supplies

We have identified 2 supplies serving 12,908 customers (Table 5.8) where there is a risk of THM non-compliance but the cause of the problem is unclear. A robust solution for the THM problems would be to replace the water treatment works with advance membrane treatment processes. However these solutions would cost in excess of £15 million. Our plan is to identify the root cause of the THM problems and confirm whether a lower cost chemical treatment solution would be effective. We have included an IR18 allowance of £7.5 million in our plan to commence delivery of solutions to these problems and plan this is reviewed as part of the IR18 investment review in December 2017.

Water Treatment Works	Customers served	Parameters at risk	Possible Solutions
Dhu loch	4,173	THM	Enhancement of existing plant or replacement membrane plant
Torra	8,735	THM	
Total	**12,908**		

Table 5.8: Systems to be investigated to confirm solution to address risks to drinking water quality

Catchment improvements for 6 supplies

At 6 supplies serving 381,369 customers we will invest £0.8 million to improve the reliability of drinking water quality by protecting our supplies from activities within the catchment which should reduce the risk of the source water being contaminated from naturally occurring and man-made sources. Our planned improvements are set out in Table 5.9.

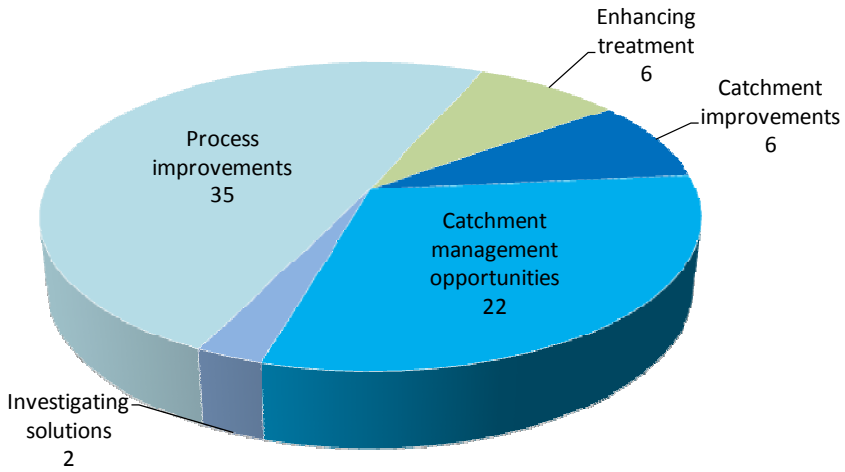
Water Treatment Works	Customers served	Parameters at risk	Solution
Herricks	5,483	Iron, manganese, Bacteriological, Cryptosporidium, Turbidity	Remove connections between raw water source and abandoned assets, improve fencing and covers.
Hopes	1,940	Cryptosporidium, Hydrocarbons	Improve protection of aqueduct at road crossings and extend catchment management plan to include the watercourse that runs alongside the raw water main.
Invercannie	297,970	Manganese, Turbidity, Algae, Pesticides	Catchment survey and monitoring. Delivery of catchment management, if required following catchment survey, to be delivered through an IR18 allowance.
Pateshill	58,820	Cryptosporidium	Improve fencing to prevent livestock gaining access to raw water reservoir.
Spey Badentinan	16,388	Bacteriological, Cryptosporidium	Catchment survey and monitoring. Delivery of catchment management, if required following catchment survey, to be delivered through an IR18 allowance.
Tiree	768	Cryptosporidium	Provide fencing to prevent livestock gaining access to source water.
Total	**381,369**		

Table 5.9: Sites with catchment improvements to increase reliability of drinking water quality

Emerging risks – catchment management opportunities for 22 supplies
We have identified 22 catchments where rising organic levels or pesticides use could pose a risk to drinking water quality in supplies serving over 614,000 customers. To prevent these becoming future issues that require a treatment solution we plan to undertake early stage monitoring and assessment of the suitability of the catchments for sustainable land management techniques. These techniques involve field walking, education, altering the flow of burns, incentivising land owners, changes to cattle feeding areas, and fencing to name but a few. Where catchments are identified as suitable we will seek to deliver improvements and have included an IR18 allowance of £2.3 million in our plan to begin catchment management activities. We plan this is reviewed as part of the IR18 investment review in December 2017.

Our planned improvements are summarised in Figure 5.10.

Figure 5.10: Investment to improve reliability of drinking water quality at WTW



Enhancing networks and treated water storage
Our drinking water safety plan assessments have identified risks to drinking water quality posed by the current configuration of the distribution network and treated water storage tanks. Risks identified include:

- Dead ends within the network which allows water to stagnate increasing concentrations of iron and manganese and potentially allowing bacteria to breed.
- Hydro carbon contamination of water where water mains have been historically laid through potentially contaminated land.
- Poorly designed ventilation systems on storage tanks which could allow contamination of stored water potentially allowing bacteria to breed.
- Poor waterproofing of tanks which could allow contaminated rainwater to ingress into the tanks potentially allowing bacteria to breed or cryptosporidium to enter.
- Poor circulation within tanks which allow zones of stagnant water to develop potentially allowing bacteria to breed.

Enhancing storage and networks for 31 supplies

We have identified 31 water supply systems where the current asset configuration has the potential to allow treated water to deteriorate or become contaminated to around 1.2 million customers. We plan to invest £9.4 million improving these systems and the proposed solutions are set out in Table 5.10.

Supply system	Customers benefiting	Parameters at risk	Solution
Alexandria	18,003	Iron, Manganese, Bacteriological	Disconnection of redundant pipe work no longer required.
Balmore	c.256,765	Bacteriological	Improvements to hydraulics in service reservoirs to improve disinfection.
Boardhouse	4,852	Manganese, Bacteriological, Hydrocarbons	Improvements to flow in service reservoirs to reduce risk of contamination through pipe work in garage forecourt and disconnect assets no longer required.
Cargen Borehole	2,740	Bacteriological	Improvements to screening and flap valves to prevent contamination to service reservoirs
Daer	178,784	Bacteriological	Improvement to air values to prevent contaminated water entering main during operation.
Dhu Loch	4,173	Manganese, Turbidity Bacteriological, Iron,	Improve remote monitoring for water levels and disconnect assets no longer required
Dougliehill	12,221	Bacteriological	Improve the service reservoirs to prevent contamination.
Foula	70	Bacteriological	Improve the service reservoirs to prevent contamination.
Gairloch	822	Iron, Manganese, Turbidity	Improve remote monitoring for water levels to prevent tank emptying and contamination of water supply.
Glenconvinth	5,523	Bacteriological	Improve the service reservoirs to prevent contamination.
Glendevon	130,634	Bacteriological	Improve secondary disinfection systems
Glenfarg	c.92,579	Bacteriological	Disconnection of redundant pipe work no longer required.
Glengap	3,486	Bacteriological	Improvements to screening and flap valves to prevent contamination to service reservoirs
Greenock	79,486	Bacteriological	Improvements to secondary disinfection and improve service reservoirs to prevent contamination
Herricks	5,483	Iron, Manganese, Bacteriological	Improvements to air valve arrangement to reduce risk of contamination, disconnection of assets no longer required
Inverness	68,597	Bacteriological	Improve the service reservoirs to prevent contamination.
Lintrathen	89,948	Bacteriological	Improve the service reservoirs to prevent contamination.
Lock Eck	13,292	Iron, Manganese, Turbidity	Disconnection of redundant pipe work no longer required.
Mannofield	c.181,414	Bacteriological	Improve the service reservoirs to prevent contamination.

Supply system	Customers benefiting	Parameters at risk	Solution
Neilston	9,234	Bacteriological	Protect service reservoir pumps from low temperatures to prevent contamination
Ness	1,179	Manganese, Turbidity	Improve the service reservoirs to enable cleaning to take place.
North Ronaldsay	70	Bacteriological	Improvements to hydraulics in service reservoirs to improve disinfection
Picketlaw	8,807	Manganese, Turbidity, Bacteriological,	Improve the service reservoirs to prevent contamination.
Sandy Loch	13,319	Bacteriological	Replace the service reservoirs to prevent contamination.
Tiree	768	Bacteriological	Improve remote monitoring for water levels and improve secondary disinfection.
Tighnabruaich	834	Bacteriological	Improvements to secondary disinfection and improve service reservoirs to prevent contamination
Tobermory	1,346	Bacteriological	Improvements to hydraulics in service reservoirs to improve disinfection
Torra	1,960	Iron, Manganese, Turbidity	Improve the service reservoirs to prevent contamination.
Torridon	70	Iron, Manganese, Turbidity	Improve the service reservoirs to prevent contamination.
Ullapool	1,702	Bacteriological	Improve the service reservoirs to prevent contamination.
Whitehillocks	22,255	Bacteriological	Improve the service reservoirs to prevent contamination.
Total	**1,210,416**		

Table 5.10: Sites with improved storage and network configuration

Waterproofing and improving flow regimes at service reservoirs
We clean and inspect around 400 storage tanks annually, through this programme we identify risks to water quality, principally relating to bacteriological failures. These generally relate to surface water ingress into the tanks due to inadequate waterproofing and poor flow through the tanks. We plan to invest £5.6 million reducing these risks by installing waterproofing and changing flow patterns to service reservoirs supplying around 350,000 customers.

Investigate disinfection throughout network
In the Daer system we have identified a risk of failing to reliably meet the bacteriological standards due to the decay of the chlorine (used to maintain disinfection of the water) through the network. The installation of secondary network disinfection could resolve this risk at a cost of around £8 million, however we have agreed with the DWQR to undertake a network disinfection study to identify the cause of bacteriological non compliances and decay of the chlorine through the system. We anticipate that this may allow a more innovative and lower whole life cost solutions to be identified. We have included an IR18 allowance of £4.6 million in our plan to begin delivering solutions to these problems and plan this is reviewed as part of the IR18 investment review in December 2017.

Reducing risk of non-compliance in distribution - cleaning water mains
We have identified through water quality investigations 350 areas of local distribution mains, supplying 596,000 customers, where there have been non-compliances for iron and manganese when unsteady flows occur, (burst mains or a significant change in customer demand).

***Innovation**: To undertake the lowest risk intervention of relining or replacing all cast iron mains to prevent iron leaching into the water, and cleaning all other pipes to remove manganese deposits would cost around £180 million. However due to the transient nature of these failures, we propose to undertake a programme of mains cleaning and water quality monitoring to try to manage the problem at a cost of £31.5 million.*

Our innovative approach may not be fully successful and we have therefore set aside an allowance of £4.5 million to begin rehabilitation of the areas. We plan this is reviewed as part of the IR18 investment review in December 2017.

In a further 48 areas supplying 54,000 customers we have detected elevated iron and manganese levels. To manage this risk and defer future investment in mains rehabilitation we plan to undertake a programme of mains cleaning and water quality monitoring to manage the problem at a cost of £3.5 million.

Investigating long term risks to water quality from cast iron mains
We are also planning to invest £0.2 million undertaking research and monitoring to better understand the rate of deterioration of water quality in unlined cast iron pipes. This will be a long term study that will be used to inform the rate at which we need to address the issue of unlined iron pipes.

***Innovation**: We are also undertaking research looking at the causes of iron and manganese non-compliance in distribution to better understand how operational activities may contribute to the disturbance of particulate material deposited in the mains and how we can introduce 'automated cleaning' to prevent discolouration at customers' taps.*

Emerging risks to drinking water quality
We anticipate new risks will emerge between 2015 and 2021. To begin dealing with these we have set aside an IR18 allowance of £2.4 million and plan this is reviewed as part of the IR18 investment review in December 2017.

Discoloured water
Discoloured water is primarily caused by the disturbance of iron and manganese deposits in the pipe network during times of unsteady flow when bursts occur. We estimate that by 2014/15 we will receive 8,000 to 10,000 complaints each year from customers relating to discoloured water. We expect that our planned improvements to drinking water quality through reducing iron and manganese levels will lead to fewer instances of discoloured water at customers' taps.

Taste and odour
Customers are naturally interested in the taste and odour of the water they use and every water supply has its own distinct taste and odour due to its natural composition. Individual customer reaction to a change in taste and odour of the water supply can vary greatly. We estimate that by 2014/15 we will receive 4,000 to 5,000 complaints each year from customers relating to four types of taste and odour.

Chlorine – Customer complaints about chlorine relate to both variability in levels and sustained elevated levels which are detectable to customers. We plan to continue to optimise the levels of chlorine used to ensure adequate disinfection and reduce complaints from customers. Improvements under our drinking water quality compliance and reliability programmes will also support operating at lower chlorine levels, particularly where water mains are rehabilitated and cleaned, or bacteriological risks are reduced.

Musty - Customer complaints about earthy or musty water generally relate to sources of drinking water where algae can form. We anticipate complaints in this area will reduce as planned investment in catchment management and improved treatment to reduce the risks posed by algae are delivered both in the 2010 to 2015 and 2015 to 2021 periods.

Metallic & TCP/Chemical - Previous investigations have shown that the majority of customer complaints of 'TCP/chemical' and 'Metallic' taste and odour complaints relate to domestic plumbing. As such we plan to continue providing advice to customers to flush the water through to remove the taste/odour and to have their domestic system examined by a qualified plumber.

We have not included any specific investment to address complaints regarding taste and odour of drinking water. We expect these to reduce through on-going improvements to operational management and quality control.

Private water supplies
We are supporting the DWQR and the Scottish Government to look at ways to improve the quality of private drinking water supplies. We have included no investment in the 2015 to 2021 period to connect any private supplies to the public network, as the priority supplies and most appropriate means of improving these has still to be determined.

Drinking Water Quality supplementary information

Measuring drinking water quality

Drinking water always contains very low levels of naturally occurring minerals and chemical compounds that treatment processes cannot fully remove; this is what gives different waters unique tastes. Drinking water should not contain any microbes that cause illness e.g. bacteria.

The levels of impurities allowed in drinking water are set out in EU Directives which are incorporated in Scots Law to protect the consumer from health impacts caused by short or long term exposure. Scottish Water monitors the quality of drinking water through an extensive sampling programme at water treatment works, in the distribution network and at customers' taps. In 2012 we carried out over 320,000 samples to monitor compliance with the statutory standards.

Impact on customers of exceeding the standards

The potential impact on customers of exceeding the standards is set out in the table 5.11 below.

Impurity	Affect on customer
Trihalomethanes	Invisible to customers and if consumed over a long period of time at high concentrations are linked to a potential increased risk of cancer.
Iron	Visible to customers as brown discolouration so elevated levels are unlikely to cause health problems as customers are unlikely to drink heavily coloured water.
Manganese	Visible to customers as black discolouration so elevated levels are unlikely to cause health problems as customers are unlikely to drink water that is heavily coloured or has particles in it. Causes staining of washing.
Lead	Invisible to customers and long term exposure to elevated levels can cause mental development problems, particularly in young children
Bacteria (Ecoli or coliforms)	Invisible to customers and can cause sudden illness with effects ranging from mild stomach upset to severe and sometimes fatal diarrhoea, dysentery, hepatitis and typhoid fever.
Nitrite	At elevated levels is thought to impact the oxygen carrying ability of young infants, and long term exposure is linked to increased risks of cancer.
Aluminium	Customers may taste elevated levels of aluminium in drinking water. At very high levels there is some evidence of it being a neurotoxin with the potential to impact on the brain.
Cryptosporidium	Invisible to customers and can cause illness such as diarrhoea, nausea and vomiting for periods up to a week, in severe cases can be life threatening to people with immune deficiency
Turbidity	A measure of how much particulate matter is in the water, becomes progressively visible to customers the worse it is. Not a health impact in itself but an indicator that other impurities may be present e.g. cryptosporidium, iron or manganese.
pH	Invisible to customers, pH is the measure of how acidic or alkaline water is. At elevated levels the water will have a bad taste, and at extreme levels could cause burns. Changes in pH can also affect the rate at which metals leach from plumbing.
Colour	Visible to customers as a brown tinge, not aesthetically appealing but no health impacts in itself. Can indicate other impurities are present such as iron, manganese or Trihalomethanes and can affect the capability of treatment processes.
Pesticides	Invisible to customers and if consumed over a long period of time at high concentrations are linked to an increased risk of cancer.
Hydrocarbons	Visible to customers as a film or detectable as a smell, are unlikely to cause health problems as customers are unlikely to drink water. However, if consumed could make customer sick.
Algae	Not always visible, but can cause poor taste and a musty smell. Some algae can be toxic.

Table 5.11: Potential impact on customers of exceeding the drinking water standards

Causes of non-compliance

Contamination in our source water quality

Contamination of source waters can occur due to natural changes in the environment or through change of land use or habitation within the catchment. Possible climate change effects such as increased rainfall and temperature changes could have an effect in the future.

We have experienced changes in our source water quality in the past and found that increases in the levels of organics, iron and manganese leached from the soil can reduce the effectiveness of our water treatment filters resulting in:

- Some bacteria remaining in the treated water as the solids reduce the effectiveness of the chlorine disinfectant.
- Cryptosporidium, which is resistant to chlorine disinfection passing into the treated supply.
- The organic material forming Trihalomethanes when it mixes with chlorine.

Changes in animal numbers and human activity within catchments can also affect the quality of the source water. If animal numbers increase the levels of bacteria and cryptosporidium from faecal mater can increase above those our treatment works are capable of dealing with. In addition over grazing can expose soils allowing more of it to be washed off and into burns and reservoirs.

Pesticide and fertiliser usage (which can cause algae blooms in reservoirs) can also affect the quality of source waters through wash off from farmland. Similarly fuel spills from roads, car parks and motorised water sports could result in hydrocarbons getting into source waters. Most water treatment works are not capable of removing these contaminants.

Inadequate treatment processes

While we have invested a significant amount over the past 20 years to enhance our treatment capability, there remain sites where our treatment may not be able to address all of the impurities that can occur in the source water.

Equally some of our older assets, whilst achieving historic compliance are not designed to current best practice and pose a risk to drinking water quality. For example:

- Pre 1990 treatment filters are not always designed to fully prevent some contaminated water entering the water supply on completion of cleaning (bacteria and cryptosporidium);
- Limited duplication of equipment preventing some equipment from being taken out of service for routine maintenance without compromising water quality (single compartment filters and tanks with no bypasses (bacteria and trihalomethanes));
- Basic control systems which cannot reliably meet the standards of water quality required today (bacteria, trihalomethanes, aluminium); and;
- Lack of dual disinfection systems and standby power which prevent un-disinfected water entering supply in the event of a power failure.

Deterioration of drinking water quality in distribution to customers

12,000km (25%) of our water supply network is made from cast iron water main primarily laid before the Second World War. This material is no longer used as over time it rusts and iron is leached into the treated drinking water causing discolouration and levels of iron that exceed standards at the customers property. Also the joints between the pipes in many instances are formed from lead solder which can leach into the water supply increasing the risk of exceedences at the customers tap.

Some supplies which are now treated to remove manganese were not in the past, as a result the water mains network is coated with a layer of manganese which causes discoloured water and failures to meet the standard, particularly when the normal flow of water in the mains is disturbed, for example after water mains burst.

Across Scotland there are lead pipes both within Scottish Water's network and customers own plumbing. When drinking water comes into contact with lead it can leach into the drinking water supply.

The condition of customers own taps can also cause bacteriological exceedences.

Options considered when developing solutions

Option		1	2	3	4	5	6	7	8	9	10	11
Impurity	**Levels of non-compliance with standards**	**Monitoring & catchment management**	**Reservoir mixing**	**Improve existing process to meet industry best practice**	**Alternative supply**	**Enhanced Filtration**	**Alternative disinfection**	**Air bubbling**	**Chemical treatment**	**Network cleaning**	**Water mains rehabilitation or replacement**	**Replace or reline pipes connecting house to public water main**
Trihalomethanes	Actual history			✓	✓	✓	✓	✓				
	Identified risk	✓		✓	✓	✓	✓	✓				
Iron	Actual history				✓	✓				✓	✓	
	Identified risk	✓			✓	✓				✓	✓	
Manganese	Actual history		✓		✓	✓				✓	✓	
	Identified risk	✓	✓		✓	✓				✓	✓	
Lead	Actual history								✓			✓
	Identified risk								✓			✓
Bacteriological	Actual history			✓	✓		✓			✓		
	Identified risk			✓	✓		✓			✓		
Nitrite	Actual history	✓		✓	✓		✓			✓		
	Identified risk	✓		✓	✓		✓			✓		
Aluminium	Actual history			✓	✓							
	Identified risk			✓	✓							
Cryptosporidium	Actual history				✓	✓	✓					
	Identified risk	✓		✓	✓	✓	✓					
Turbidity	Actual history			✓	✓	✓				✓	✓	
	Identified risk	✓		✓	✓	✓				✓	✓	
pH	Actual history			✓	✓	✓					✓	
	Identified risk			✓	✓	✓					✓	
Colour	Actual history			✓	✓	✓				✓	✓	
	Identified risk	✓		✓	✓	✓				✓	✓	
Pesticides	Actual history				✓	✓						
	Identified risk	✓			✓	✓						
Hydrocarbons	Actual history	✓		✓	✓							
	Identified risk	✓		✓	✓							
Algae	Actual history				✓	✓						
	Identified risk	✓			✓	✓						

Table 5.12 Options to resolve drinking water quality non-compliances and risks

Description of options Available

Table 5.12 sets out the options we have considered for ensuring compliance with the water quality standards where we currently have a history of non compliance, and where we have identified a future risk of non compliance. More detail about each option, and when they are suitable for use is set out below.

Option 1 – Monitoring & catchment management

Catchment management involves preventing or reducing the volume of the contaminate getting into the source water through managing land use. Through monitoring the raw water we can identify changes in

the levels of impurities. This information can then be used to develop catchment management approaches focused at improving the quality of the source water, or preventing its deterioration. If there is a problem with a supply, monitoring can enable us to change the supply the customers receive (where the network allows) or advise them of actions they need to take (e.g. boiling water).

Cryptosporidium

We monitor for cryptosporidium in the source waters and in the treated waters at all sites. If the levels in the treated water are considered a health risk, we may be required to notify customers that they should boil their water before drinking. This has happened previously, and where this has happened frequently or at elevated levels we have installed treatment that reduces its occurrence.

Catchment management to control Cryptosporidium can only be fully effective if all living animals and birds in the catchment are removed to prevent it being excreted in droppings. This is often not practical; however it can be effective to lower the volumes of cryptosporidium in the source water, reducing the risk until appropriate treatment is installed. We have implemented this approach previously in a number of catchments.

Where there are no detections, monitoring and catchment management can help keep the risks low, and reduce the need for treatment.

Other Impurities

To reduce the volumes of organic material and metals such as iron and manganese being released in catchments, three areas need to be addressed; exposure of the soils due to excavation or over grazing, drying out of peat beds, and the rate of run off. To tackle this we can undertake activities such as:

- Reducing the areas of exposed soil by working with farmers to reduce over-grazing, this could involve providing over-wintering areas for livestock to reduce the damage to vegetation in the winter.
- Working the forestry and wind farm industries to reduce the impact of their operations, particularly when felling trees and excavating foundations for wind turbines.
- Blocking up manmade ditches and reverting burns that have been straightened back to a meandering path. This reduced the speed at which rainwater runs of the hills reducing soil erosion, and helps keep peat wet, reducing the release of organic material.

We are currently trialling these activities in a number of catchments where the source waters are at risk. However where failures are currently occurring due to disturbance of the catchments it may take a number of years before benefits are realised. The benefits from catchment management take time to realise and are therefore better suited at preventing problems from occurring, through early intervention where a potential risk has been identified, rather than addressing a known compliance problem.

Chemical Impurities

To reduce the risk of pesticides and hydrocarbons entering the water supply we can work with farmers, landowners and recreational clubs (e.g. anglers and water sports) to ensure they are aware of and follow best practice approaches to minimise the risk of contamination. We can also look at the provision of buffer strips to reduce farm runoff and put in place monitoring programme to identify areas for improvement.

Option 2 – Prevention through Reservoir mixing

Breaches of the manganese standard can be a seasonal problem, caused by changes in water temperature in the reservoir and mixing of different layers of water which have formed over the spring and summer months. This option involves placing powered mixers within the open reservoir to encourage mixing of the layers and prevent high concentrations developing and getting into the water supply. We have recently used this option at a few sites and found it to be successful, so far. Its use however is dependent on the characteristics of each reservoir and the levels and nature of the manganese encountered.

Option 3 – Improving current processes to meet best practice

Our older water treatment works are incapable of being operated in line with latest best practice. This is due to best practice evolving over time as new knowledge is gained across the international water industry. Where this is the case we can upgrade the works to ensure it is capable of being operated in line with best practice. Four main areas of improvement have been identified through our drinking water safety plans:

- Improving the control of chemicals used to aid filtration thereby reducing exceedences of aluminium and trihalomethane – typically by automating the control of the quantities added to match the quality and volume of source water entering the treatment works. Improvements could involve changing the chemicals used, and or increasing the number of water quality sensors and the chemical control systems to allow them to respond automatically to changes in source water quality and the flow through the water treatment works.
- Improving filter cleaning methods to ensure the filters are capable of being properly cleaned and all waste water produced during cleaning is fully removed from the filter before being returned to service in line with best practice. Improvements will typically involve changes to the filtration systems to ensure they meet current best practice standards.
- Failsafe disinfection processes to ensure water entering supply is always disinfected. None of our water treatment works are manned 24 hours a day, however they are all monitored by our Intelligent Control Centre, and we have staff on standby to react to problems identified by our monitoring. Some water treatment works do not have a failsafe disinfection system which means if they fail due to equipment malfunction or loss of power the water entering supply may not be disinfected. Improvements will typically involve ensuring the disinfections systems are duplicated and are automatically controlled to ensure if one fails the other starts.
- Changing the layout and design of sites to ensure there is no possibility of hydrocarbons coming into contact with water. This mainly applies to standby generators which can only be accessed through the water treatment halls.

Option 4 - Changing the source by supplying from another Water Treatment Works or source

This option involves abandoning the source water and or the water treatment works with the problems and laying a new water main from an adjacent treatment works or source which can meet the standards. We use this option where it is economical to do so and the new water treatment works has sufficient water to supply the additional customers.

Option 5 – Enhanced Filtration

The simplest form of filtration involves passing water through sand. This can be effective if the source water quality is low in impurities and doesn't change. Where there are higher levels of impurities more advanced filtration techniques need to be used. The main technologies available are:

- Carbon filtration
- Multi layered filtration
- Chemically aided filtration
- Membrane filtration
- Manganese filtration

Carbon Filtration

Carbon filtration involves passing the water through a filter made of activated carbon which absorbs organic material. We have used this solution extensively in the past, and in general it is effective at reducing the level of organics in the water. However if the level of organics in the water is high it will quickly exhaust the carbon and the organic material will then pass straight through the filter. These filters are only effective at reducing exceedences of Trihalomethanes.

Multi Layered Filtration

Multi Layered Filtration involves passing the water through a filter built up from different layers of material. Such filters can be more effective than simple filtration but don't require chemicals. We have used this solution in the past; however there are limits to the level of impurity that can be removed. These filters can be effective at reducing exceedences of Trihalomethanes, Manganese and Iron.

Chemically Aided Filtration

Chemically aided filtration involves adding chemicals to the water to help bind together the fine particles, making it easier to catch them on filters. This technique is effective at reducing exceedences of Trihalomethanes and Cryptosporidium and is used extensively across Scottish Water. We are currently researching methods of setting up lower cost advanced filtration systems on small remote sites.

Membrane Filtration

Membrane filtration involves pumping water through very fine plastic membranes which strain out contaminants. This technique is highly effective at reducing exceedences of Trihalomethane and cryptosporidium and is extensively used across Scottish Water as it is currently more cost effective than chemically aided filtration on very small sites

Manganese Filtration

Manganese filtration involves the installation of additional filters specifically designed to remove manganese. These filters are required as manganese can change between the soluble state which filtration will not remove and the insoluble (particulate) state which filtration can remove. Manganese filters use chemicals to condition the water in advance of filtration to make the manganese become particulate so it is caught on the filters. We have used this solution extensively in the past and it is very reliable.

Option 6 – Alternative Disinfection

Drinking water is normally disinfected using chlorine as it is very effective at killing bacteria. However chlorine does not kill cryptosporidium and can form trihalomethanes if organic material is present in the water. There are alternative forms of disinfection that can be considered where these problems exist; these are Ultra Violet Disinfection and Chloramination.

Ultraviolet disinfection

This involves illuminating the water with a powerful ultraviolet lamp; the ultraviolet light kills bacteria and international studies have shown it can kill Cryptosporidium. To use ultraviolet light the water needs to be very clear which generally requires filtration in advance to remove colours that occur naturally in many of our source waters. In addition a chlorine compound requires to be added after disinfection to keep the water disinfected in the network. We are currently researching different combinations of simple filtration and ultraviolet disinfection to see if an effective combination can be developed.

Chloramination

This involves disinfecting the water at the treatment works using chlorine. After the water has been in a tank for 30 minutes and all of the bacteria has been killed ammonia is added to form chloramines. The chloramines then keep the water disinfected in the pipe network. The benefits of this approach are:

- Organics in the water react less with chloramines than chlorine reducing the level of Trihalomethane formation.
- Chloramines last longer in the water than chlorine on its own, providing improved bacteria protection in long networks.

The lower levels of chlorine in the water at the customers tap can help reduce taste and odour complaints about chlorine.

However there is a downside; where Chloramination is introduced special filters are required for patients on dialysis and for the owners of tropical fish. It can also cause the build up of a film of nitrifying bacteria within the pipe network, and may reduce the effectiveness of chemicals dosed to control the level of lead being leached from supply pipes.

Option 7 – Air bubbling

Air bubbling of the treated water can be used to reduce exceedences of Trihalomethane. This technique involves bubbling air through the treated drinking water in the storage tank at the water treatment works before it goes into the network. The air interacts with volatile Trihalomethane compounds forcing them out of the water and into the air. This can only be used where there is a separate storage tank after disinfection. Scottish Water is using this technique at a small number of sites

Option 8 – Chemical Treatment

Chemical treatment is an effective technique for controlling the level of lead in the water supply. It involves adding orthophosphoric acid to the water at the water treatment works. When this comes in contact with lead in water supply system it forms a lead phosphate layer reducing the amount of lead that is leached into the drinking water. To do this, the levels of chemical have to be carefully controlled to ensure the best possible layer is developed. The level of success of this approach depends on the lengths of individual pipes connecting properties to the water main and how much water is consumed. The longer the pipe and less water taken, the longer the water is in contact with the lead pipe and the higher the concentration of lead in the supply. We currently operate this solution in 93 supply zones covering 1.5 million customers

Option 9 – Network cleaning (Control in Network)

Where treated water with manganese in it (even when compliant with the standards) has entered the water supply it can turn into the insoluble state due to reacting with the chlorine use to disinfect the water. Over time this particulate material can build up as black sediment within the water mains. This can contaminate the clean drinking water entering the mains causing the exceedences of the standard for manganese and turbidity at the customers tap; this can be particularly acute after a disturbance in the water mains caused by a burst. To control this we can undertake both flushing which used the water in the main to scour the particulate material out of a hydrant. We can also undertake swabbing which involves forcing a foam sponge, or ice (a new technique we are testing), through the water mains to clean out all of the manganese; or complete replacement of the main. We use these approaches to help control levels of manganese in the network, or to clean out a network following the installation of manganese removal. This approach can disrupt customers experience when flushing and swabbing is being done. The approach is less successful as permanent solutions if the water entering supply is carrying elevated (but compliant) levels of iron or manganese.

Option 10 – Removal from the network

Cast Iron Pipes

Our pipe network contains over 12,000km of unlined cast iron, largely installed up until the late 1950's. As this rusts through contact with the drinking water it contaminates the mains with particles of iron (causing turbidity) which can leach into the drinking water. To prevent this we can either line the pipes or replace them. Lining pipes can only be done if the pipe is in good condition, which many are not as they are over 70 years old.

We have been relining pipes for many years using techniques such as spray applied epoxy and polyurethane lining. We are also now using an innovative technique that involved cleaning the main, and applying the linings using an air vortex created within the water main by blowing air through it. This has the benefits of improved quality and a faster return to service and hence reduced impact on customers.

When replacing pipes we use a number of techniques from digging trenches and laying new pipes, to pulling smaller pipes through existing pipes and using pipe bursting to pull a pipe of the same size though an existing water main. We only replace pipes when lining is not feasible or economic in terms of the remaining structural integrity of the main.

Lead Pipes

We currently estimate that there are between 70,000 and 80,000 lead pipes connecting customers' properties to the water mains. This option involves removing individual lead communications pipes from Scottish Water's network and advising customers to do likewise with their supply pipes. This approach is used in water supply zones where there are less than 1,000 customer properties with lead communications pipes on the grounds that this is the most cost effective approach. This approach tackles the cause of the problem – the lead pipes – and therefore is certain to reduce lead non-compliance but only if the customer removes their length of lead pipe. If they don't, the water supplied into the house could still be contaminated by the customer's supply pipe. To date, we have used this approach in 112 supply zones serving 73,100 customers.

Appendix 6: Improving water services and supply resilience

In summary:

- Most of our customers have never experienced an interruption to their water supply, and they expect us to take reasonable steps to ensure that this continues.
- We plan to improve the resilience of drinking water supplies to customers as part of our long term strategy to ensure service failures are close to zero and meet customers' expectations.
- Following extensive research and discussions with the Customer Forum we plan to invest £121.5 million improving resilience of drinking water supplies in the 2015 to 2021 period. The Customer Forum wish to consider the appropriate level of investment to be made and the benefits that this will deliver for customers.
    - £12 million improving physical security and ensuring our reservoirs comply with the new requirements of the Flood Risk Management Act.
    - £24 million improving availability of water supplies for 46,000 customers, and developing drought plans to manage services at times of reduced rainfall.
    - £54.8 million improving the resilience of supplies including; improving resilience of the Edinburgh water supply system; addressing supply risks identified through our Drinking Water Safety planning process; a mobile treatment plant and detailed investigations of critical systems to develop proposals for the strategy to improve resilience across Scotland. We have included an IR18 allowance of £12.1 million to begin implementing resilience improvements identified from our investigations.
    - £18.6 million improving the resilience of our dams.
- In addition we will invest to improve water services in the following areas as supported by the Customer Forum;
    - £4.6 million to improve the operation of our networks and £1.5 million of additional operating costs to reduce the average duration of minor interruptions to customers' supplies.
    - £0.8 million of capital and £1.4 million operating costs providing water efficiency advice and water saving packs.
    - £0.5 million assessing the level of pressure received by customers across our network and investigate the perceived acceptable level, and have included a £1.5 million IR18 allowance to allow any future improvements to be targeted.
- We will reduce our response time to visible leakage from 3 days to 1 day and will maintain the economic level of leakage at between 570 and 600Ml/day.

Water service strategy

Our strategy is to ensure customers have a continuous supply of high quality drinking water. We plan to progressively improve water services in line with our strategic projections, such that, by 2040, service failures are close to zero and no customer experiences repeat service failures. During 2015 to 2021 we plan to invest in operational and asset improvements such that by 2021:

- All repeat service failures are investigated, during which support and care is provided to customers, and a timescale for resolution of identified problems is provided.
- Our response times to service interruptions are further improved for customers.

- Areas at greatest risk to service failure are identified, enabling us to engage customers in deciding the priority for making more proactive interventions reducing the chance of customers being adversely impacted.

This Appendix sets out our plans to deliver these improvements. In this appendix all investment figures are provided in 2012/13 prices unless otherwise stated.

Ministers' draft objectives

Scottish Ministers' draft objectives for 2015 to 2027 set out that Scottish Water shall in respect of:

1.2 SERVICE STANDARDS OBJECTIVES

Build on the improvements made to date and continue to improve services to customers including those measures agreed with the Customer Forum.

2.2 SECURITY OF SUPPLY

a) Provide an appropriate level of physical security to Security Service standards agreed with the Scottish Government.

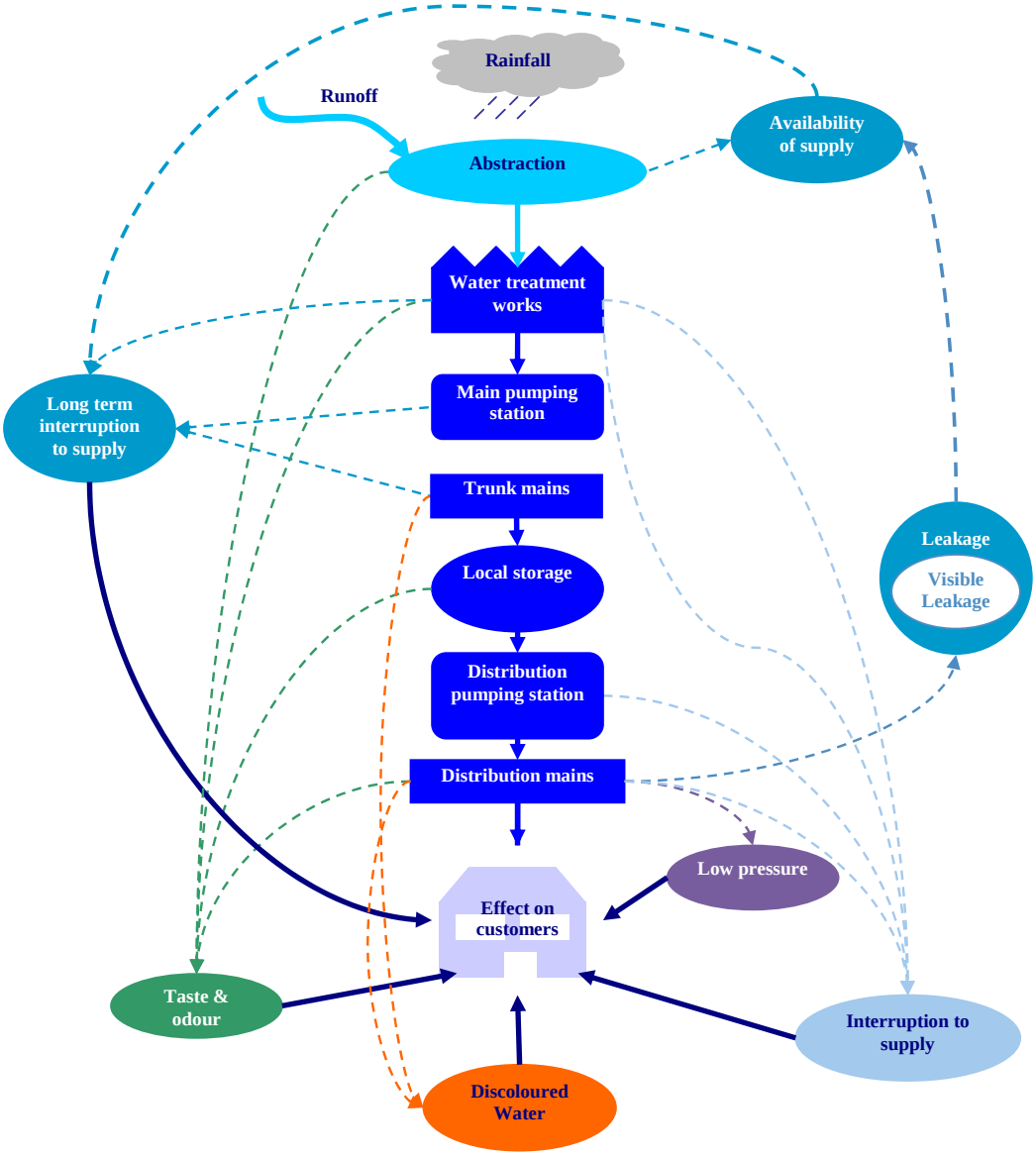
b) Provide the necessary improvements to provide a level of service in water supply zones, such that these zones are adequately protected against the risk of water shortages; and

c) Maintain a sufficient supply of water in all water supply zones that reflects the most cost effective operating regime, and takes account of the opportunities for demand management including leakage control and water efficiency measures.

Water service impacts on customers

To provide water supplies we abstract water from lochs, reservoirs, rivers, boreholes and burns. We treat these sources to remove naturally occurring impurities to provide safe drinking water. We then distribute this high quality water through an extensive network of pipes, pumping stations and storage tanks for customers to use for drinking, cleaning, recreation, gardening, or in business processes. The service received by individual customers can be affected by poor performance, failure or damage to different elements of the supply as shown in Figure 6.1.

Figure 6.1: Impacts water supply system can have on water services



Improving drinking water availability

Most of our customers have never experienced an interruption to their water supply, and they expect us to take reasonable steps to ensure that this continues. Fortunately we have only experienced a few events that have resulted in prolonged service failures to our customers:

- In 1991 the single pre-stressed concrete trunk main from Bradan WTW in Ayrshire burst affecting supplies to over 100,000 customers for up to 3 days. A similar trunk main at Crawhill near Grangemouth has failed twice in the past year but with minimal effect on customers' supplies due to alternative supplies being readily available.
- In March 1997 diesel contamination by a roads contractor of the raw water supply to Alnwickhill treatment works resulted in supplies to around 150,000 customers in Edinburgh being interrupted for two days.
- In December 1997 a diesel spill at Burncrooks water treatment works resulted in 60,000 customers being without supply for nearly a week.

- A water treatment works at Kirbister, Orkney was flooded on 26 October 2006 which affected supplies to up to 6,800 customers for up to 5 days.
- The 'Big Freeze' of November 2010 to January 2011 saw some customers without water for over a week due to frozen pipes and Scottish Water servicing over 2,000 requests for bottled water.

There have also been circumstances where we have come close to significant loss of supply, including:

- Low rainfall from the summer of 2003 into spring 2004 affected supplies in Tayside with over 250,000 customers put at risk. Extensive customer campaigns were carried out, asking them to use water wisely, as well as temporary supply augmentations being implemented.
- Low rainfall in the spring and summer of 2010 affected several sources in Dumfries and Galloway putting around 55,000 customers at risk. Extensive customer campaigns were carried out; asking them to use water wisely while we increased leakage reduction activities, put in place temporary supply augmentations and requested our first Drought Order in five years.
- Low rainfall in the spring and summer of 2012 in the north-west highlands and Western Isles put the supplies to around 35,000 customers at risk. Several alternative supplies had to be sourced and tankered, as well as working with customers, asking them to help us reduce demand to extend available supplies while we increased leakage reduction activities.
- Low rainfall in summer of 2013 affected supplies in Fife to over 350,000 customers. Customer campaigns were carried out asking customers to use water wisely while we increased leakage reduction activities and used alternative supplies to augment normal sources.

These historic events demonstrate that we are vulnerable to unexpected events or failures at critical assets that could leave us unable to continue normal supplies. Therefore we have identified that we need to improve the resilience[1] of water supplies to reduce the risk of future long term interruptions and meet customers' expectations for uninterrupted service.

Supply resilience

Resilience can be defined as the ability to maintain essential services under extreme circumstances. For water supply, one measure being used within the water industry is the ability to continue normal supplies in extreme events by having the capability to supply customers from an alternative supply. Our initial assessment of our ability to do this, and the capability of other leading companies, show that:

- We can supply around 15% of customers from alternative supplies.
- Anglian Water can supply around 74% of customers from alternative sources and are proposing to improve this to 100% over the next 10 to 20 years.
- Wessex Water can supply around 85% of customers from alternative sources and are investing to increase this to 92% by 2018.
- Yorkshire Water supplies around 99% of customers from a highly interconnected grid where supplies can be moved around effectively.

Many parts of Scotland are served by small water treatment works. In the event of localised water shortages or supply issues we can provide alternative supplies by tankering water by road from larger treatment works. Through experience we have found that tankering is not practical for water treatment works supplying more than 500 m3 per day due to the logistical challenges of tanker movements along rural roads. We have 122 water supply systems in this category serving around 24,000 customers in around 13,000 properties (0.5% of all customers).

The development of greater resilience involves the following:

- Ensuring critical assets are secure;
- Improving the supply system to ensure it has the necessary levels of duplication, reliability and resistance to withstand extreme events and maintain customer supply;

[1] Resilience is the ability of our supply systems to maintain services in extreme circumstances such as those caused by extreme weather, climate change (low rainfall or flooding), unforeseen asset failure or other unforeseen events.

- Improving our ability to respond to customers' needs and recover the service in the presence of extreme events;
- Improving the drought resilience of our reservoir storage;
- Managing demand through leakage management and providing water efficiency advice to customers;
- Reducing the risk of failure in critical assets;
- Improving operational response to normal operational events that cause short term interruptions to supply; and
- Ensuring customers have an adequate water pressure.

Planned investment

Our plan has been informed by investigations into the causes and risks of interruptions to supply, government guidance for security and resilience, climate change risk assessments and our Water Resource Plan. Table 6.1 summarises the planned investments we will make from 2015 to 2021 to improve the reliability of drinking water availability.

Improvement Programme	2015-21 TOTEX £m (2012/13)			Output
	Committed		IR18	
	Capex	Opex	Totex	
Statutory improvements to increase resilience of drinking water availability				
Security and Emergency measures requirements.	5.8		2.2	Compliance with legislative requirements
Flood risk management act – reservoirs management new obligations.	3.7	0.5	0.3	Improved management of 338 dams, and improvement to 45 dams to meet new obligations.
Sub total	**9.5**	**0.5**	**2.5**	
Improvements to increase future resilience of drinking water availability				
Improved drought resilience for 47,000 customers (SOSI)	24.0			47,000 customers with improved availability
Water supply resilience strategy & improvements	54.8		12.1	Assessing supply resilience for 4.1m customers and begin delivering improvements
Reducing risks of critical asset failure	18.6			Reduction in matters in the interest of safety at dams.
Sub total	**97.4**	**0.0**	**12.1**	
Improvements to water services				
Understanding water pressure level of service and improving where appropriate	0.5		1.5	Assess levels of pressure received by all customers, and begin making improvements if low levels of service are found.
Improve response times to reduce average duration of short term interruptions to supply	4.6	1.5		Improved response time such that average duration of interruption reduces
Improve response times to reported visible leakage from 3 days to 1 day	0			Improved response time from 3 days to 1 day to improve customer satisfaction
Water efficiency advice	0.8	1.4		Provision of water efficiency advice and water saving packs for 2% of customers
Sub total	**5.9**	**2.9**	**1.5**	
Total	**112.8**	**3.4**	**16.1**	

Table 6.1: Planned investments to improve resilience of drinking water availability

Our customer research has shown that improving the resilience of water supply is a priority area for service improvement. The Customer Forum wish to consider further the appropriate level of investment to be made and the benefits this will deliver for customers.

Statutory Improvements to increase resilience of drinking water availability

Statutory requirements to improve asset security

Working with the Scottish Government's Resilience Unit we have agreed investigations and improvements that require to be undertaken to further secure the water supply in Scotland. We plan to invest £5.8 million meeting these requirements, and have set aside an IR18 allowance of £2.2 million to address emergency shutdown requirements once these have been investigated.

Statutory requirements to improve reservoir safety

Reservoirs pose a significant threat to public safety should their dam be breached or be overtopped by the stored water. The last significant event involving a dam in the UK was caused by flood water damaging the Ullay Reservoir in Yorkshire in 2007. To manage the risks posed by reservoirs their management has been strictly controlled under the Reservoirs Act 1975. This has now been superseded by the Reservoirs Scotland Act 2011, which incorporates changes to reservoir management initiated under Flood Risk Management Act 2009. The new legislation has introduced the following changes:

- Responsibility for enforcing reservoir safety has moved from the Local Authorities to SEPA;
- The size of reservoir covered by the legislation has reduced from those storing over 25,000 cubic meter to those storing over 10,000 cubic meters;
- The risk assessment system applied to reservoirs have been amended, resulting in some reservoirs being classified a higher risk and other a lower risk;
- New requirements for managing reservoir safety have been introduced including developing and testing flood response plans, providing information boards;
- Ensuring all reservoirs which come under the statutory requirements are managed to the higher standard.

We plan to invest £1.3 million developing flood plans and providing information boards, and a further £2.4 million to improve 45 of our reservoirs confirmed as not meeting the new requirements. We have also set aside an IR18 allowance of £0.3 million to deal with improvements identified during 10 year inspections.

We have also identified £0.5 million of new operating costs over the period covering SEPA asset registration and subsistence fees, flood plan testing and statutory reporting.

Improvements to increase future resilience of drinking water availability

Improved drought resilience

Scotland is considered by most customers to be a wet country, due to the regular rainfall they experience; as such they consider the possibility of a drought occurring to be a very low. The drinking water supply system in Scotland has been developed based on the expected regular rainfall we receive. As such individual reservoir's storage can range from well in excess of 1 years supply, down to as little as 25 days. Therefore during abnormal dry periods water supplies are not replenished as fast as required to meet ongoing demand leading to the risk of water restrictions. This can be particularly acute for small burn sources where low levels of rainfall can quickly reduce the volumes of water available for use. Through our systematic approach to water resource planning we assess the availability of water to meet customer demand; where levels of service to customers required to be improved we assess the optimum way of doing this.

Figure 6.2: Fife reservoirs 2003 (Glen Devon) and 2013 (Ballo)

Water resource planning requires year by year forecasts of the expected demand for water from customers (average and peak day use), and the available volumes of water from water sources (reservoirs, rivers and boreholes) taking account of forecast rainfall patterns and climate change predictions. These forecasts are then compared to assess if there is a potential supply surplus (enough water) or deficit (not enough water). Forecasting both demand and availability are highly complex activities, more information about how we do this is set out at the end of this appendix and detailed technical information can be seen in our full Water Resource Plan, available on our web site.

Level of service

The volume of available water our sources can supply varies based on how much rainfall there is during the pattern of rainfall. Generally the higher the rainfall, the larger the volume of water available, however for reservoirs the amount we can store is also a factor. We assess whether normal supplies can be maintained with no restrictions based on the driest year we would expect over a 40 year period (1:40). If supplies can be maintained under such conditions, it implies that there is at most a 2.5% chance of such an event occuring **in any year**. This is the current minimum level of drought resilience, also called yield level of service, we currently plan to provide to meet customer expectations.

Our planned **customer** service levels, measured by the reliability of supplies at customers taps also takes into account our response to drought conditions.

While extreme natural events such as prolonged dry weather cannot be controlled by Scottish Water, we can take steps through drought planning measures to prolong supplies and aim to avoid customer supply restrictions. These activities will typically include:

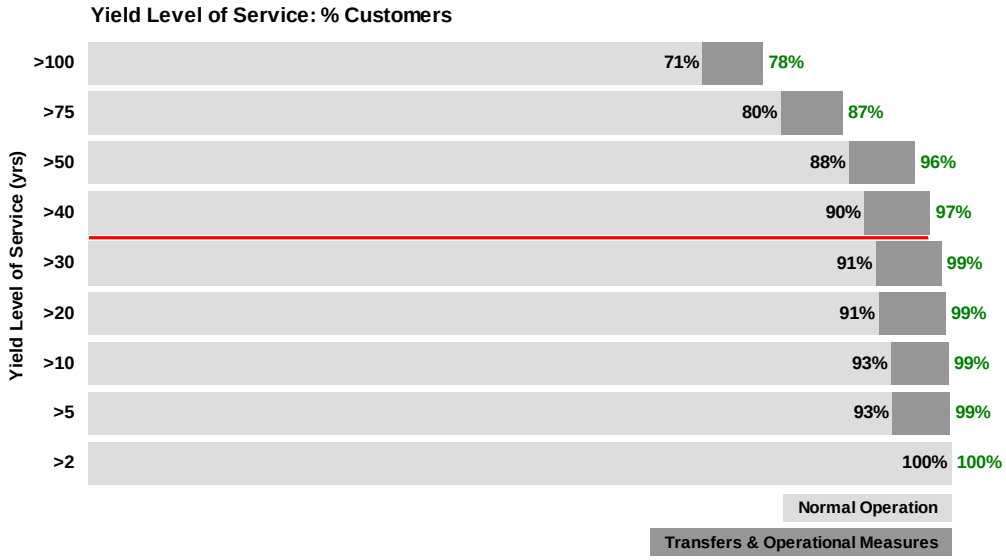
- **Reducing demand** through increased leakage control activities (beyond the regular economic cost levels) and appealing for customers to use water wisely.
- **Increasing availability of water** through tankering water in vehicles from other supplies, temporary links between supplies or obtaining permission to use temporary alternative sources.

Whilst we have set a 2.5% chance of customers experiencing water restrictions in any one year as our minimum level of service we recognise that actual levels of service are variable across Scotland. The causes of this variability are:

- the characteristics of different water sources, e.g. their size, location, rainfall patterns and storage levels all affect the amount of water available;
- the variability of demand from customers (for example the warm dry weather in July 2013 resulted in more people holidaying at home, resulting in higher than normal demand at some tourist hotspots), and changes in demand, e.g. the closure of a large water user such as a power station, one-off events such as Commonwealth Games, or leakage reductions; differences in historic design levels where the former authorities generally provided higher resilience to the cities than the rural areas;
- the degree of connection between different sources of water and treatment works.

To understand how levels of service vary across all customers we have assessed the percentage of customers receiving different levels of service resilience, ranging from a 50% chance of water restrictions in any one year (1:2 years) to a 1% chance (1:100 years). Our forecast 2015 position using this assessment is shown graphically in Figure 6.3. The red line shows our minimum level of service.

Figure 6.3: Forecast resilience of drinking water supplies at 2015



Our aim is to have no long term supply interruptions at customers' taps; to support this over the long term we plan to increase the resilience of service to 1:100 (1%) in any one year.

Planned improvements

Our water resource plan has identified that, around 94,000 customers in 53 supply systems will not meet the 1:40 level of service (2.5% chance or higher of water restrictions in any one year) in 2021. Our plan for 2015 to 2021 to improve resilience of water supplies is to:

Reduce demand:

- Continue to implement our Water Efficiency Plan and the promotion of water efficiency measures, particularly in the supply zones at highest risk of restrictions. In these areas we will look to provide free water saving packs;
- Continue to manage leakage at economic levels, and consider further reductions where it is technically achievable and the most cost effective method of improving the supply demand balance.

Increasing the availability of water:

- In 10 supply zones serving around 44,000 customers where we are certain of the supply demand deficit and have identified the most sustainable solution taking account of leakage levels; we will invest £20.8 million improving water availability as set out in Table 6.2;
- At Kyle of Lochalsh WTW which supplies 2,945 customers we have a complicated set of abstraction controls and are finding it difficult to operate within our license conditions. We are investigating this with SEPA and have allowed £1.2 million to begin making improvements as soon as the investigation has concluded;
- In 3 supply zones with small deficits serving around 9,500 customers, we will monitor and further investigate the systems to better understand the demand patterns and the availability of water. We have included no investment allowance for any improvements identified from these investigations;
- We have identified a further 39 supply zones, serving around 38,000 customers, that we forecast may be in deficit. We are uncertain about the accuracy of hydrological information (rainfall, water course flow and loch or reservoir storage volumes) used to assess the supply demand balance in these zones. To resolve this we plan to invest £2 million collecting further information for a total of

105 zones to improve our understanding of drought resilience. No allowance has been made for any resilience improvements that may arise from this new information being used in our supply demand balance assessment.

Innovation

During the delivery of improvements to water availability in the 2010 to 2015 period we have raised two dams to increase available storage. At one we have installed a 'piano key weir' which allows a long overflow weir to be constructed in a small space. This innovation allowed the same volume of water to be stored safely whilst reducing the height the dam was raised by 800mm, saving an estimated £0.5 million.

Regional area	WTW supply system	Customers supplied	Solution descriptions
North West Coast	Lochinver	573	Augment the available water supply by securing abstraction from a nearby loch.
Fort William	Mallaig	1,401	Increase water availability from the existing source by lowering the abstraction point.
Skye & Lochalsh	Waternish	320	Augment the available water supply by securing abstraction from a nearby loch.
Shetland	Sandy Loch	13,319	Augment the available water supply by securing abstraction from a nearby river source to top up the existing Sandy Loch Reservoir.
Western Isles	West Lewis	3,100	Increase water availability from the existing source by raising the height of the existing dam to provide additional storage.
Western Isles	Stornoway	9,604	Increase water availability from the existing source by raising the height of the existing dam to provide additional storage.
Western Isles	Benbecula	1,505	Augment the availability of water by installing pipe work in the existing loch to allow all available water to be accessed (loch splits into two at lower water levels).
Western Isles	South Uist	1,558	Replacing the existing source with a new loch source to increase available water supply
Argyll & Bute	Tullich	12,506	Increase the availability of water by amending the current compensation release arrangements from Loch Nell to making more water available for supply.
Orkney	North Hoy	47	Decommission the source and WTW and supply from South Hoy WTW which has better water availability.
Total		**43,933**	

Table 6.2: Planned improvements to water supply zones

We have investigated the leakage reduction and water efficiency opportunities for these zones; however the size of the deficit and current levels of leakage are such that further leakage reduction will not on its own resolve the identified deficits.

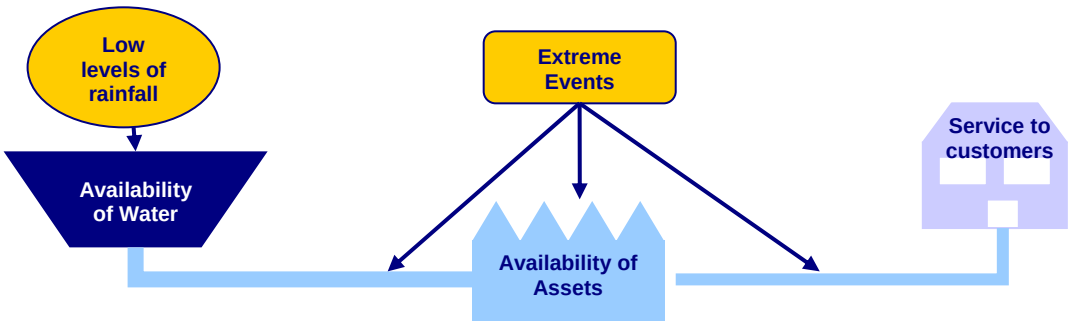
Water supply resilience improvements

A long term interruption to supply is one that lasts more than 2 days. These events are typically caused by extreme adverse weather conditions or when a strategic part of the water supply system is disabled due to failure, or external impacts such as malicious activity or other unexpected impacts.

Our research has confirmed that customers expect Scottish Water to take reasonable steps to minimise the chance of a long term interruption to supply occurring.

There are two main components to consider when assessing the likelihood of a long term interruption to supply occurring; they are the availability of water to enter the public supply system and the availability of the assets, as shown in Figure 6.4.

Figure 6.4: Factors affecting the resilience of drinking water supplies



The development of greater resilience involves two key aspects:

1. Improvements through the design of the supply system that ensure it has the desired levels of redundancy, reliability and resistance to withstand extreme events and maintain customer supply; and

2. Improvements in our ability to respond to customers' needs and recover the service in the presence of extreme, disruptive events.

If supplies are interrupted Scottish Water must supply a minimum volume of water to sustain health, through the existing infrastructure, tanks in the street or bottled water, as shown in Figure 6.5. We are currently investing to enable us to meet these minimum requirements.

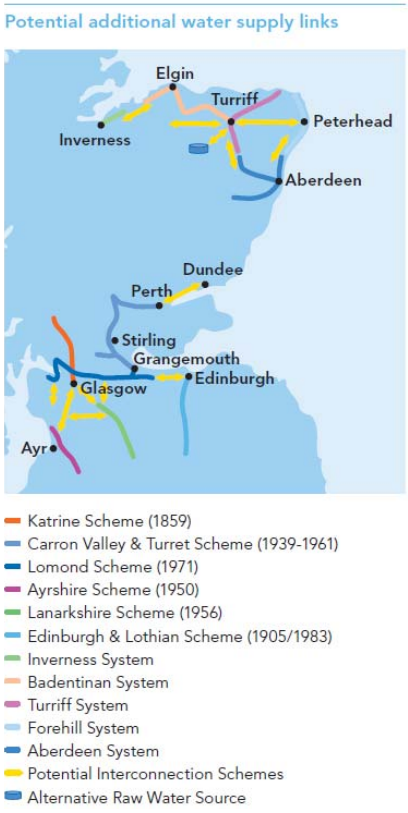
Figure 6.5: Providing emergency supplies

Strategy to improving resilience of supplies

Our long term aim is to improve the overall resilience of the supply systems such that extreme events would only have a short term impact on normal services, e.g. a short term interruption to supply or reduced pressure and flow for a period of time.

The majority of our customers receive their water supply from larger water treatment works through pipe networks with limited or no connections to water supplies from further afield. Should any of these water supplies fail (for example due to flooding, freezing, or unforeseen equipment failure) or water resources diminish in quality or quantity; we would then face difficulties in providing water supplies to a significant number of customers.

We have identified improved resilience of water supplies – to ensure the continuation of water supplies in challenging circumstances – as one of our key strategic priorities. Our customers have told us in their responses to **'Your Views Count'** that avoiding interruptions to supply that last longer than a few days is a top priority for improvement. By installing additional links between water supply systems for major towns and cities, we can develop a more comprehensive water network to serve the main urban areas of Scotland. This will allow us to provide operational flexibility to meet future demand requirements and be more resilient to climate change impacts. A more comprehensive water network may also allow us to protect our environment by using water more flexibly.



Our business plan sets out to undertake the investigation that will inform the strategy for extending the water network and allow us to discuss further with customers the plans to join up our water supply networks in the central belt to significantly increase the resilience of water supplies.

We estimate the cost of increased resilience to be in the order of £500 million to £750 million and would expect this to be implemented in phases over the next 20 years as shown in Figure 6.6, hopefully taking advantage of opportunities to reduce investment to meet new demand.

Figure 6.6 – Timescale for resilience improvements

Understanding & improving resilience of water supplies

Enhancing the **resilience of water supplies** to extreme events involves:

- Reviewing the overall resilience of the supply system to identify the parts most at risk;
- Increasing the monitoring and management of those parts of the supply system identified at highest risk;
- Developing response and recovery plans to deal with extreme events whilst minimising the impact on customers;
- Improving the robustness of the critical parts of the system to extreme events;

- Providing strategic network connections and surplus capacity such that customers can receive water supplies from more than one water treatment works.

Planned investments to increase resilience by 2021

We aim that all customers should have access to resilient water supplies by 2040, be that through our infrastructure and / or operational capability. Our plan for 2015 to 2021 is to invest £54.8 million to improve resilience of supplies and support response to extreme events.

Assessment of overall resilience

We plan to invest £4.2 million assessing the overall resilience of water systems supplying more than 15,000 customers and to develop options to improve resilience. We will follow best practice approches when undertaking our assessments as set out in the 'Supplementary Information' section of this Appendix. Our assessment will consider:

- For areas such as Aberdeen the implication of large populations being served from single river sources, and will consider if resilience is best delivered through a new reservoir or connections to neighbouring systems.
- For large populations being served by single water mains, we will consider if network reinforcement or connection to neighbouring systems is appropriate to protect against failure of critical assets;
- For areas such as Fife and Dundee if having isolated systems serving such large populations is appropriate, particularly considering the drought resilience of the systems and possible future impacts of climate change.

Drought plans

While our minimum level of service for water use restrictions is 2.5% (1:40) we have to plan to sustain services through more extreme drought events. We will invest a further £1.4 million in developing 125 system and 17 regional drought plans covering 1.35 million customers. This will complete our drought planning coverage and ensure we have agreed management plans in place with SEPA for when drought events occur. This will ensure that when a drought occurs, the operational measures to maintain services whilst minimising the environment are pre-agreed. Typically measure may involve encouraging customers to use water wisely, targeted leakage control activity, tankering to supplement supplies, reducing the volumes of compensation water released from reservoirs, and temporary abstraction of water from other sources. The development of drought plans collates, and where required obtains information required to allow quick regulatory approvals of activities by SEPA.

Tankering Strategy

We will develop our tankering strategy to overcome short-term supply shortfalls.

Mobile Water Treatment Works

Innovation – mobile treatment works

We propose to invest £3.1 million developing a vehicle mounted treatment works that will enable us to rapidly respond to the resilience events at smaller water treatment works.

Whilst mobile treatment works can be hired, they tend to have a lead time of 4 to 6 weeks which makes them impractical when managing a resilience event.

Immediate access to a mobile treatment works will provide resilience to events such as drought, where it can be used to treat an alternative source on its own or in conjunction with the existing treatment works (pre-agreed in our drought plans). The use of a mobile treatment works can also remove the need for tankering which can be disruptive to rural communities.

A mobile treatment works can also be used to treat existing sources if a treatment works is damaged by fire or flooding, or to supplement an existing works that is being used to fill tankers.

We would expect to use such a facility on a regular basis to help manage the risks associated with small sources particularly in the North West of Scotland and on the Islands.

Improve the resilience of Edinburgh water supply (Megget system)

We have been undertaking pipe sampling and condition assessments of the raw water supply systems across Scotland and have become aware that the 30 year old 900mm – 1100mm Ductile Iron main supplying the four Edinburgh treatment works is at high risk of failure. This main supplies:

- Glencourse WTW: This is the main treatment works for Edinburgh which can also be supplied from Talla, Glencourse and Loganlea Reservoirs. As a result, a failure of the Megget main will not impact on services to customers supplied from Glencourse.
- Roseberry WTW: This works supplies East Edinburgh and East Lothian and is also supplied from Roseberry Reservoir. As a result, a failure of the Megget main will not impact on services to customers supplied from Roseberry.
- Bonnycriag WTW: This works supplies Peebles, and also has access to a local water source. As a result, a failure of the Megget main will not impact on services to customers supplied from Bonnycraig.
- Marchbank WTW: this works can only be supplied from Megget reservoir. As a result, failure of the Megget main will directly impact on supplies to 60,000 customers supplied from Marchbank.

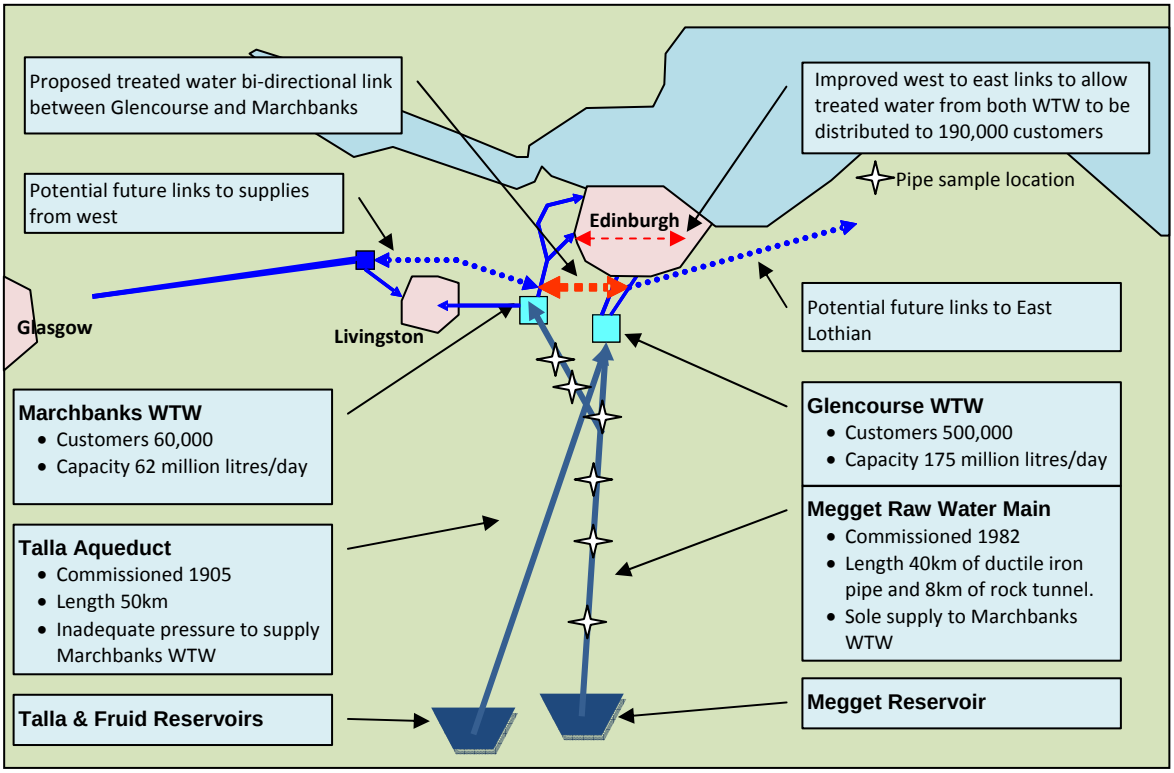
We believe a failure of this critical asset has a high probability of occurring in the next 5 years and would affect a significant number of customers. The traditional approach to resolving this would be to replace the raw water main. However we have looked at this from an outcomes basis and identified four options as set out in Table 6.3.

No	Option	Cost	Advantages	Disadvantages
1	Duplicate Megget Raw Mains	£70m	• New asset created providing high levels of reliability and resistance to extreme events up to capacity of new pipeline.	• Does not provide protection to loss of Marchbank WTW. • Impact on customers of a future failure remains unchanged.
2	Localised replacement of pipe work with least remaining life.	£35m	• Probability of failure reduced at points where condition has been confirmed. • Staged investment.	• Impact on customers of a future failure remains the same. • Elevated risk of service failures remains from areas not replaced.
3	Provide raw water pumping station and main to connect Talla, to Marchbank WTW	£21m	• Safeguards customers from failure of Megget raw main.	• Does not provide protection to loss of Marchbank WTW. • Pipe route through Pentlands Hills Country park
4	Provide treated water pumped supply from Glencorse network to Marchbank CWT	£21m	• Safeguards customers from failure of Megget raw main • Protects customers against loss of Marchbank WTW. • Enables future resilience to East Lothian by creating first section of a south Edinburgh trunk main. • Allows operational flexibility in use of Marchbank and Glencourse	• Increased pumping costs.

Table 6.3 - Edinburgh (Megget) water supply resilience options assessment

We plan to invest in option 4 (highlighted blue) in Table 6.3 as it is the lowest cost and provides the maximum benefit to customers. This option will allow us to operate the existing raw water mains at a higher level of failure risk, allow us to consider lower cost refurbishment options in the future such as relining the pipe without impacting on customers. We plan to invest £20.9 million in delivering this improvement. The planned resilience scheme and possible future extensions are shown in Figure 6.7.

Figure 6.7 – Edinburgh (Megget) water supply resilience improvement scheme



Resilience risks identified through DWSP

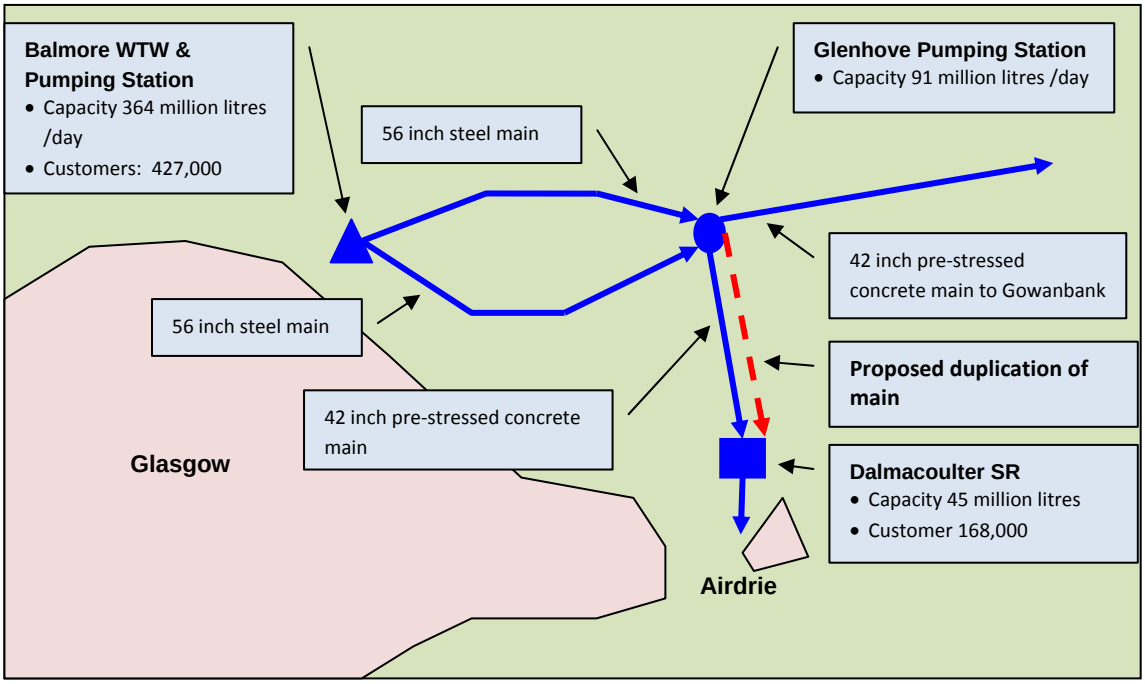
Our drinking water safety plan risk assessment system identified both risks to water quality, and risk to interruptions to supply. From this assessment system we have identified 12 supply systems identified with risk of 64 or greater which indicates there is a high probability of them occurring in the next 5 years and resulting in an interruption longer greater than 48 hours. We plan to invest £25.2 million reducing these risks in 12 systems serving 815,000 customers and the Sullom Voe oil terminal.

- 9 of the systems identified with resilience risks can be resolved through faster responses enabled by improved telemetry and monitoring, or localised protection and improvements to assets. These account for 10% of the planned investment.
- 3 of the systems identified with resilience risks account for 90% of the planned investment.

Dalmacoulter Service Reservoir Supply

Dalmacoulter service reservoir supplies 168,000 customers; it is supplied from Balmore water treatment work via twinned pipelines to Glenhove pumping station. The supply from Glenhove pumping station to the service reservoir is through a singe 1050mm pre-stressed concrete main. Experience has shown that pre-stressed concrete mains can be difficult to repair when they burst due to how they are constructed and research shows that failures begin to occur around 40 years after installation. Our proposed solution is to duplicate 5km of main from Glenhove pumping station to Dalmacoulter service reservoir as shown in Figure 6.8

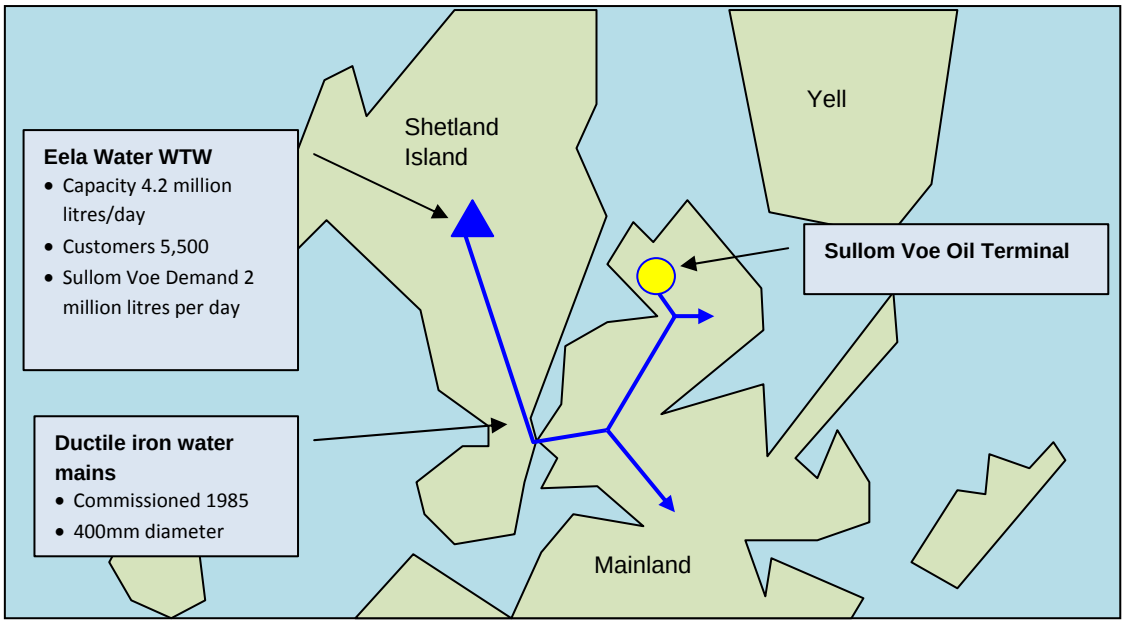
Figure 6.8 – Dalmacoulter Service Reservoir Supply Resilience



Eela Water Supply

Eela water supplies 4.2 million litres per day to 5,500 customer on the Shetland islands and Sullom Voe Oil Terminal as shown in Figure 6.9. The mains from the water treatment works run through areas of peat bog making bursts difficult to locate and repair. The Sullom Voe oil terminal takes around 50% of the water supply for 500 personnel and to run the various process systems and a power station which supplies 40% of the islands power. The terminal has 15 hours of storage in operation. Our proposal is to invest £8.8 million duplicating the mains where they run through peat bog to ensure supplies are maintained.

Figure 6.9 – Eela Water Supply resilience



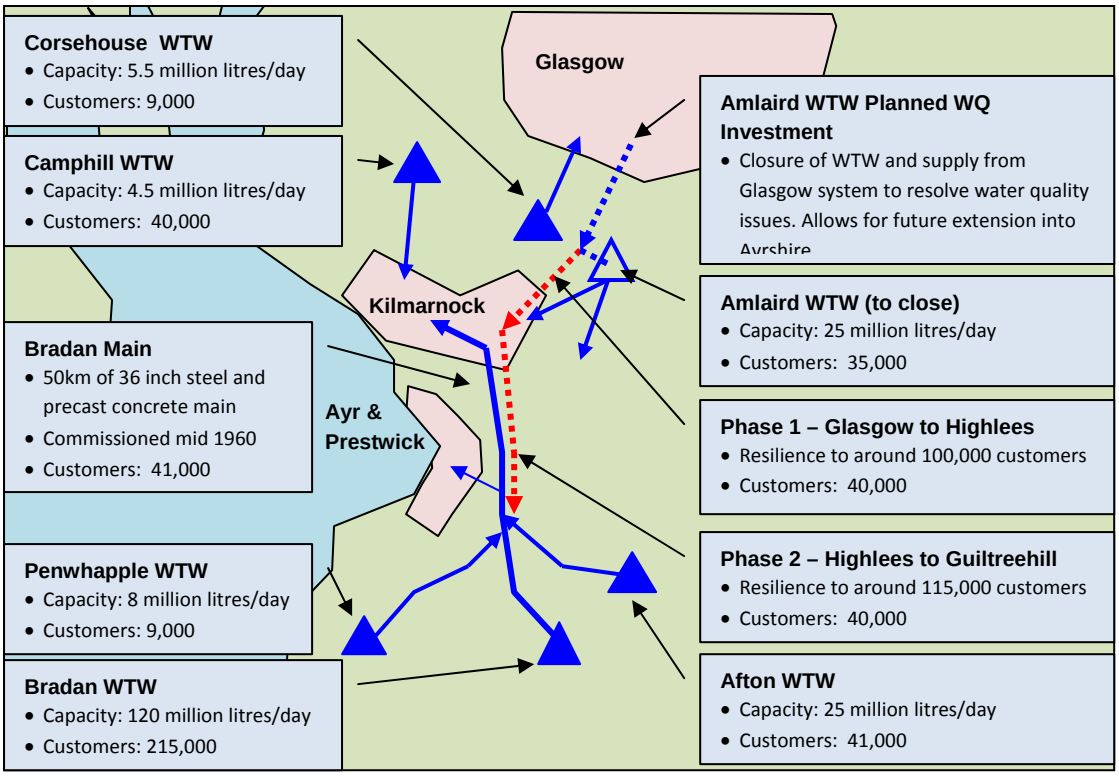
Assynt Supply System
The Assynt system supplies the Black Isle and has 8 hours storage which is insufficient for a site operating a large membrane treatment works. There have been several occasions in the last 3 years when the treatment works has shut down due to an alarm and the storage tank has emptied risking an interruption to supply. The lack of storage also gives very little time to carry out planned maintenance activities. Our proposals are to invest £10.1 million to provide 24 hours storage at the water treatment works significantly reducing risk of service disruption to customers.

IR 18 investment in resilience measures

Following the completion of our resilience assessment, we anticipate that priority schemes for delivery will be agreed with customers. One such priority scheme is likely to be providing resilience to the Bradan system where over 200,000 customers are supplied from one water treatment works and a single pre-stressed concrete main. As part of the water quality programme we are extending trunk mains from Glasgow as far as Amlaird (to allow Amlaird treatment works to be removed). Phase1 of the resilience scheme will extend the mains from Amlaird to Highlees Service Reservoir, improving the resilience to 100,000 customers. We would then look to extend the main to Guiltree Hill to provide resilience to a further 115,000 customers as shown in Figure 6.10. The priority for this will be confirmed by our resilience assessment and customer engagement.

We have included an IR18 allowance of £12.1 million to implement the early stages of our long term strategy to increase resilience of water supplies through increasing connectivity between water supply systems. We will discuss and agree these proposals with customers before December 2017.

Figure 6.10 Bradan system resilience improvements



Reducing critical asset risks

Scottish Water is the largest operator of dams in the UK, and we should be maintaining and operating our dams in line with best practice. Through our annual inspections (and more extensive 10 year inspections undertaken by independent inspecting engineers) we identify risks in the interest of safety which if not addressed could compromise the structural integrity of the dam. We currently deal with matters in the interest of safety as they emerge which can take up to 3 years to resolve.

We wish to move to a position where we have no outstanding matters in the interest of safety through proactively investing in emerging issues before they become matters in the interest of safety and plan to

invest £18.6 million accelerating resolution of identified emerging issues and reducing our overall risk profile through a more proactive approach. It is possible that by doing so our longer term costs of asset maintenance may reduce as the repairs we require to carry out will be smaller in nature. This investment is in addition to our planned asset maintenance and improvements required to meet the requirements of the Flood Risk Management Act.

We are currently undertaking an inspection programme of our raw water mains (the water mains that transfer water from abstraction points to the WTW) and trunk mains. This has identified a number of mains in poor condition, such as the raw water main that serves part of Edinburgh from the Megget reservoir. Some of these mains are only 30-40 years old and are showing unexpected levels of deterioration. Depending on the outcome of these surveys we may need to seek investment from IR18 to invest in additional resilience or accelerated maintenance of these critical mains.

Improvements to water services

Understanding water mains pressure

We aim to provide all customers with a minimum level of pressure of 1 bar (10 meters of water) at a flow of 9 litres per minute. In 2012/13 around 604 customers were on our low pressure register and this is reducing quickly. By 2015 our low pressure register is forecast to be at the 'churn level' of around 100 where any customer identified as experiencing low pressure will have their problem resolved, typically within 2 years or less.

Most properties with emerging pressure problems (confirmed to be receiving less than the minimum standard) are the result of customers highlighting an existing pressure problem that had not previously been reported. This often occurs where a property has changed hands and the new owner is used to a much higher pressure, however it can also be due to deterioration of the pipe network.

Over the last four years we have been managing the levels of pressure in our mains to reduce the levels of leakage, to "calm" the network and extend the life of water mains. Where we do this we ensure the supply pressure is always above the minimum standard, typically around double the minimum level of service stated above. When implementing pressure management we do occasionally receive additional contacts from customers experiencing lower pressure, however this is normally resolved by opening their stop cock fully as they (or previous owners) may have closed them partially to control the previously excessive pressure in the house plumbing.

There are also customers' properties (640 in 2011/12) who experience low pressure but who are excluded from the low pressure register. This is because these properties are at heights above Scottish Water's duty of supply, as set out under the Water Scotland Act 1980. When approached by these customers about low pressure, we inform them of this situation and advise them of how they can make their own arrangements using booster pumps to resolve the issue.

Low pressure is typically due to the elevation of the customer property in relation to the service reservoir supplying the property and / or the pressure in the water main supplying the zone. To alleviate these problems we will:

- Alter the supply zone boundaries by changing how the existing valves are operated and thereby enable water at an increased pressure to reach the customer;
- Install links to adjacent supply zones that operate at a higher pressure, to move the affected properties into the adjacent zone; and
- Provide localised pumps to ensure the property receives the required pressure.

In 2012/13 we investigated over 5,000 issues of perceived low pressure. We found that; around 20% of these related to customers internal plumbing issues; around 20% were related to a temporary operational incident or planned work on our networks; and the remaining 60% had water pressure above the minimum standard. It may be that what customers are responding to is managed changes in network pressures to reduce leakage where the new pressure may not meet customers' expectations based on their previous experience.

We have agreed with the Customer Forum that we need to better understand customers' expectations of the pressure that we provide and explore further customer service expectations to inform our future plans. We plan to invest £0.5 million in assessing the levels of pressure customers are receiving and exploring their expectations. At the request of the Customer Forum, we have included a £1.5 million IR18 allowance for priority improvement works that may arise from this improved understanding.

Reduce average duration of short term interruptions to water supplies

A short term interruption to supply is one that can last up to 48 hours. In general these are caused by asset failures, mainly water mains bursts (Figure 6.6) and on occasion failures at pumping stations or water treatment works. The majority of customers have supply restored within 6 hours and it is rare for an interruption to last more than 24 hours.

There are two factors to consider when proposing reductions in interruptions to supply:

- The **number of customers affected** by interruptions: to reduce this requires the number of asset failures to be reduced, or alternative means of supplying areas (duty standby on key processes and connectivity between supply systems) to be provided.
- The **duration of the interruption:** to reduce the duration of interruptions requires the time it takes to locate, provide an alternative supply (through network links from other supply zones or tankering) or fix an asset failure to be reduced.

In 2012/13 12,780 (0.5%) customers' properties experienced an unplanned interruption lasting more than 6 hours and 89,058 (3.5%) customers' properties experienced an unplanned interruption of greater than 3 hours.

To reduce the number of short term interruptions to customers' supplies requires the number of water main bursts (the primary cause) to be reduced. This involves:

- Improving the operation of the water mains to prevent pressure surges;
- Reducing the operating pressure of the water mains; and
- Rehabilitating poor condition water mains to prevent them failing.

The duration of short term interruptions to customers' supply depends on how quickly we are alerted to the problems, whether an alternative method of supply is available, and how fast we can repair the fault. The scope for us to reduce the duration involves:

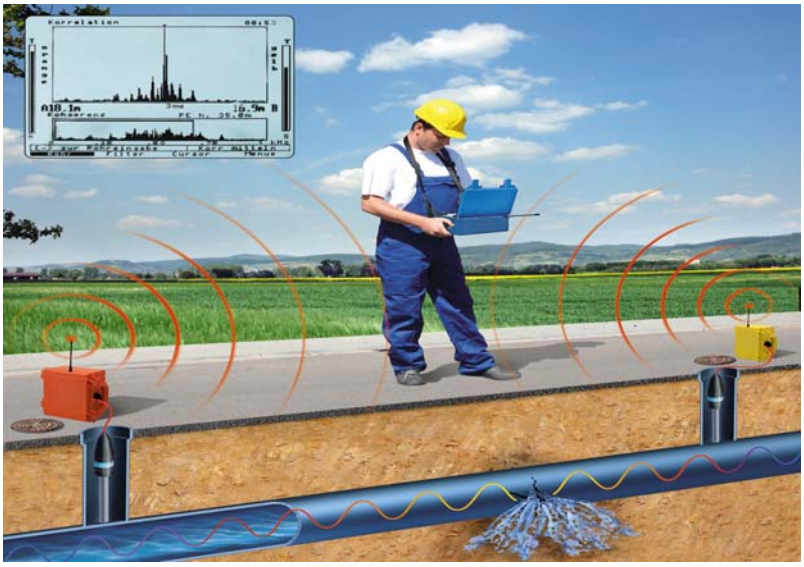
- Improving network monitoring and introducing real time analysis through our Intelligent Control Centre to identify water mains with higher than expected flow which are indicative of a burst, enabling us to respond before customers contact us;
- Increasing connections between water supplies, and tanker support (enabling us to pump water directly into mains from a tanker following the isolation of a burst) to enable supplies to be maintained or re-established whilst the repair is undertaken; and
- Increasing the number of response units that are available to reduce travel times and respond faster to bursts.

We plan to invest £6.1 million (£4.6 million in assets and £250,000 per year in operating costs) to further improve our speed of response to potential or actual short term interruptions to water supplies through further real time network monitoring to identify issues early and take action to restore or maintain supplies.

Response to visible leakage

Visible leakage is leakage that customers see rising from the ground. Currently, approximately 65% of leak repairs are in response to those seen by the customers in the form of water rising with the remaining 35% being detected by our leakage detection teams before they reach the surface as shown in Figure 6.11.

Figure 6.11: Leakage detection (Image courtesy of Megger)



Visible leakage does not normally affect the service customers receive (they are in effect a burst that is not causing an interruption to supply or reduction in pressure), but are seen as a waste of a valuable resource by customers. Scottish Water's current average response time to repair a visible leak is within 3 working days, following a planned response process.

Through discussion with customers and the Customer Forum, it is clear that customers wish us to reduce the time taken to respond and fix visible leakage (water running in the street) and the perceived waste of a valuable resource. As a result we plan to improve our response times to same/next day and thus improve our customers' perception of our services. We do not expect this to have a significant impact on our overall leakage levels or costs.

Leakage Levels

While it may at first seem appropriate to customers to address all leakage, the cost of preventing some leakage is so high, relative to the cost of producing water, that it is not economically justifiable. We have worked with the Water Industry Commission for Scotland to estimate the economic level of leakage (ELL) – that is the point where the cost of reducing leakage becomes greater than the savings from reduced water production. We are currently operating within assessed economic level of leakage of between 500-630Ml/d. If we were to reduce leakage towards the bottom end of the range we would incur transitional cost of around £10 million. We have made no allowance for these costs in our plan and expect to maintain leakage levels at 570- 600 Ml/d. We will continue to refresh our ELL assessments as and when key parameters (such as energy prices and improving technology and innovation in leakage find and fix procedures) indicate a likely material variation in the economics.

Changes in the economic level can also occur if for example, additional capacity is required to meet demand from new customers, or to improve the level of service for drought resilience. In these circumstances we compare the cost of future leakage reduction to the alternative cost of creating new resources and treatment capacity and the most appropriate option is then selected. In developing our drought resilience schemes (discussed above) this has been considered.

The Customer Forum has agreed it is not a priority to invest to reduce leakage levels beyond the economic level; however, it supports us undertaking further research and development into techniques that would allow the economic level of leakage to be reduced.

Our base service maintenance plan allows for the installation of further pressure management schemes; principally to "calm" the network and extend the life of our water mains (in lieu of asset replacement) this may also provide some small additional leakage reduction benefits.

Water efficiency advice

In the 2010 to 2015 period we commenced a water efficiency trial to understand the effectiveness of a variety of water efficiency devices and financial incentives to inform our strategy for managing water demand. Customers have told us that the issue of water efficiency needs to follow a similar path to

household waste recycling, starting with raising awareness of the consequences, providing good access to information and data, establishing acceptable levels of behavior in terms of how much water is ‘too much’, providing the ability to save water (access to facilities, devices, hints or tips) and therefore achieving the culture shift that water is treated as a precious resource.

We have included in our plan new operating costs of £1.4 million and capital costs of £0.8 million for increasing awareness and providing water saving packs and advice to household customers about the benefits to them of the efficiency use of water in the home.

Supplementary information - Assessing Resilience

What is resilience?

Water and sewerage services are critical to our way of life and have direct implications for the health of our economy, society and environment. Provision of sufficient asset capacity to satisfy demand is essential together with an adequate level of maintenance that ensures services are not affected during normal, planned operating conditions. However, planning for everyday conditions alone is not sufficient. Extreme events caused by hazards beyond Scottish Water's control such as flooding, drought and contamination, as well as failures of critical assets – can also disrupt services. These risks have to be managed by delivering an appropriate level of protection - this is called 'resilience'.

No water industry consensus exists on the definition of resilience; how it is measured or what an acceptable level is. The following definitions illustrate the difference between an asset focused and service focused perspective:

Resilience is the ability of assets, networks and systems to anticipate, absorb, adapt to and / or rapidly recover from a disruptive event.

The ability to maintain essential services under extreme circumstance.

Only 'disruptive' or 'extreme' events are considered to be resilience hazards e.g. failures of critical assets, extreme flooding, loss of an asset through fire or third party damage.

Figure 6.12 illustrates the concept of infrastructure resilience being provided through:

- Good design of the network and systems to ensure the necessary resistance, reliability and redundancy (spare capacity), and;
- By establishing good organisational resilience to provide the ability, capacity and capability to respond and recover from disruptive events.

Figure 6.12 – Components of Infrastructure Resilience - *UK Cabinet Office – Keeping the Country Running*

Justification for improving resilience of water supplies

The most visible hazards to the provision of an adequate and wholesome water supply are events, such as droughts and floods. The frequency and severity of some hazards may be increasing due to climate change, while others may not have been previously considered due to their very low probability.

Serious economic losses caused by failure of water assets linked to severe weather events have been observed across the UK including:

- Disruption of a continuous water supply due to drought.
- Inundation of water assets by intensive rainfall.
- Extreme freeze and thaw events causing bursts and leaks.
- Contamination of water sources
- Failure of critical assets such as trunk mains or loss of power supplies.

Scottish Water has endured some of these including:

- In 1991 the single pre-stressed concrete trunk main from Bradan WTW in Ayrshire burst affecting supplies to over 100,000 customers for up to 3 days. A similar trunk main at Crawhill near Grangemouth has failed twice in the past year but with minimal effect on customers' supplies due to alternative supplies being readily available.
- In March 1997 diesel contamination by a roads contractor of the raw water supply to Alnwickhill treatment works resulted in supplies to around 150,000 customers in Edinburgh being interrupted for two days.
- In December 1997 a diesel spill at Burncrooks water treatment works resulted in 60,000 customers being without supply for nearly a week.
- Low rainfall from the summer of 2003 into spring 2004 affected supplies in Tayside with over 250,000 customers put at risk. Extensive customer campaigns were carried out, asking them to use water wisely, as well as temporary supply augmentations being implemented.
- A water treatment works at Kirbister, Orkney was flooded on 26 October 2006 which affected supplies to up to 6,800 customers for up to 5 days.
- The 'Big Freeze' of November 2010 to January 2011 saw some customers without water for over a week due to frozen pipes and Scottish Water servicing over 2,000 requests for bottled water.
- Low rainfall in the spring and summer of 2010 affected several sources in Dumfries and Galloway putting around 55,000 customers at risk. Extensive customer campaigns were carried out; asking them to use water wisely while we increased leakage reduction activities, put in place temporary supply augmentations and requested our first Drought Order in five years.
- Low rainfall in the spring and summer of 2012 in the north-west highlands and Western Isles put the supplies to around 35,000 customers at risk. Several alternative supplies had to be sourced and tankered, as well as working with customers, asking them to help us reduce demand to extend available supplies while we increased leakage reduction activities.
- Coastal flooding and storm damage experienced in December 2012 from North Berwick to Peterhead was the most extreme and widespread in living memory
- Low rainfall in summer of 2013 affected supplies in Fife to over 350,000 customers. Customer campaigns were carried out, asking customers to use water wisely while we increased leakage reduction activities and used alternative supplies to augment normal sources.

Top date in most instances resilience has been delivered via response and recovery activities and not by fixed infrastructure resilience meaning that customers are affected by a loss of service. Confirmation of our level of fixed infrastructure resilience will provide the evidence necessary to support engagement with customers to explore the appropriate level of protection and agree future investment proposals.

Through UK water industry collaborative activities we have confirmed that we do not fully understand the vulnerabilities and resilience inherent in our asset base. Furthermore, having coped to date is not a guarantee of being able to cope in future and, Scottish Water is unlikely to have experience the most severe conceivable resilience events it will face. We do not necessarily know how the system and supply would cope with concurrent or prolonged duration events or what the economic level of resilience should be. Additionally our research suggests that our customers expect us to take reasonable steps to ensure the resilience of supplies.

As the climate continues to change, the likelihood of an event that causes service disruption will increase. In addition, assets continue to deteriorate with age and use, leading to a reduction in the reliability of the supply system compounding the vulnerability to failure. Demand for water is expected to grow as a consequence of population expansion and movement which in turn will cause the demand on water infrastructure to increase and possibly increase water stress on the environment.

A resilience planning process will help Scottish Water to decide where and where not to invest and identify the optimum mix of capital or operational solutions to achieve a customer agreed level of service resilience.

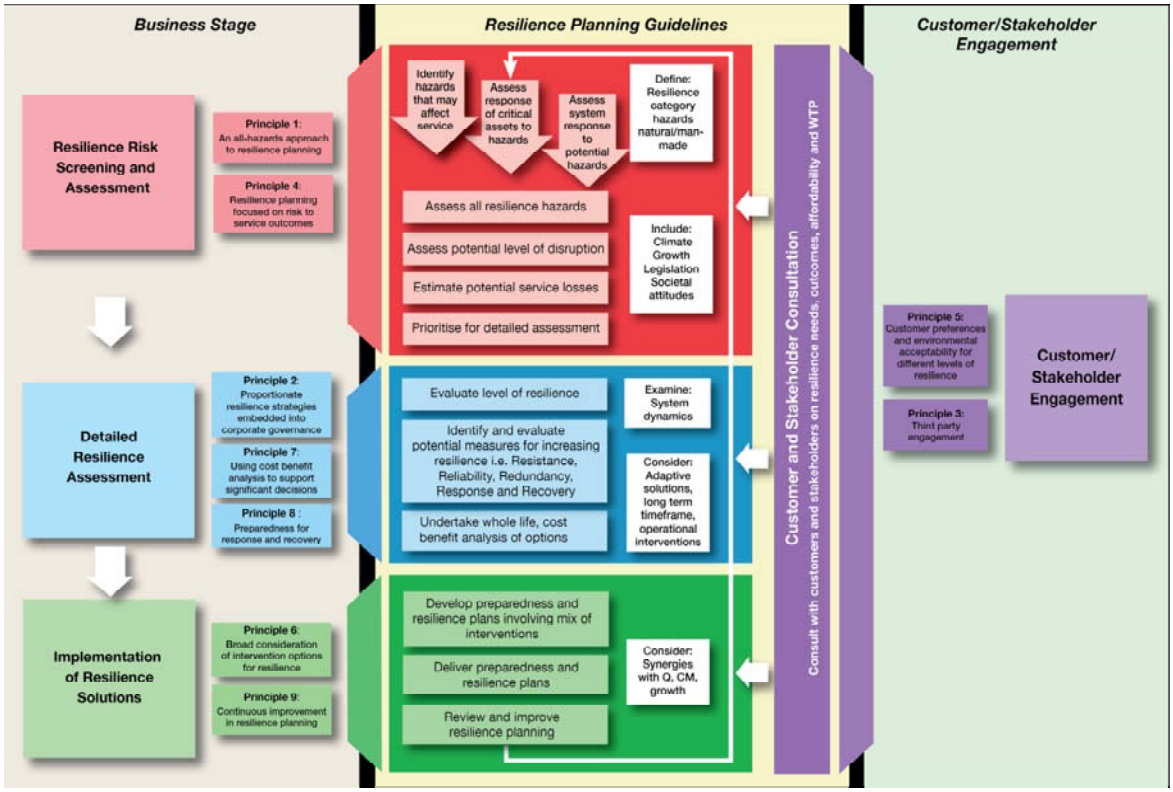
Process for Undertaking Resilience Studies

We currently have a limited understanding of supply resilience for customers. To improve our understanding and enable us to develop a detailed long term resilience strategy we plan to undertake resilience assessment studies of all water supply systems supplying populations of 15,000 or more.

Our assessments will also include the network modelling and scenario testing to confirm the level of resilience currently provided to customers, and the benefits of different improvement options for future discussion with customers.

We plan to apply the latest UK water industry approach (Figure 6.13) as set out in “Resilience Planning: Good Practice Guide - Summary Report (Ref. No. 13/RG/06/2 – May 2013)” as published by UK Water Industry Research Limited.

Figure 6.13 - Risk-based Resilience Planning Approach



The characteristics of this approach can be summarised as:

- An outcome-focused risk-based approach – integrated and forward looking.
- Providing guidelines and not a detailed methodology.
- Guidelines are informative in nature and not intended to be mandatory i.e. they do not replace existing company asset management planning processes.
- Introduces a move to supply systems-based thinking.
- Delivers a strategy around outcomes most at risk from a lack of resilience.
- Offers a primary role for customer/stakeholder consultation.

It adopts a risk-based, outcomes focused approach to emphasise delivered service to customers and value to the environment not simply resilience of fixed assets in isolation. It provides an explanation of resilience planning in the context of the UK water industry and presents a set of resilience planning guidelines intended to help introduce good practice concepts and approach to support development of water company business plans.

It is designed to facilitate discussion with other stakeholders in the process including customers and regulators (e.g. DWQR, WICS, SEPA and the Scottish Government).

Developing and agreeing a measure of resilience and determining the right level of protection and investment is not going to be easy. Work is ongoing within the UK water industry to develop metrics and apply the UKWIR good practice guidance.

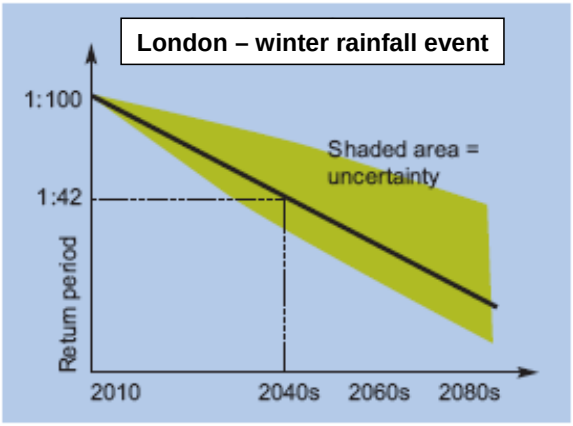
Resilience planning should seek to facilitate achievement of affordable solutions to safeguard the continued provision of water and wastewater services and of environmental benefits in the context of the occurrence of unpredictable or difficult to predict hazards. The resilience of water and sewerage assets cannot be viewed in isolation and should involve the interests of all stakeholders including the way Scottish Water interacts with other sectors. Customer accepted resilience strategies are particularly critical for robust water industry management and operation that ensures customers receive the service they expect.

Risk Assessment Methodology and Cost-Benefit Analysis

Existing risk assessment methodologies will be applied where they have been undertaken, for example where assessing drought or flood risk to service. Where assessments have not been undertaken we will develop suitable methods to allow quantitatively assess the risks.

The level of resilience to natural hazards is usually measured by stating the maximum return period of the event that the service can experience and continue to operate. A changing climate is likely to increase the frequency of extreme natural hazard events due to changes in weather patterns. This means future return periods will not equate to those seen today - Figure 6.14.

Figure 6.14 – Impact of Climate Change on Return Period - *UK Cabinet Office – Keeping the Country Running*



Because of this, an inconsistent approach to measuring resilience could easily misrepresent current and future protection standards and risks. If return periods change but resilience standards remain fixed, incremental investment will be required to regularly upgrade asset and service protection, rather than planning improvements in advance to serve future generations.

It is not feasible to guarantee services to consumers in all circumstances. It would be impossible in practice and hugely expensive to do so – particularly when the increased likelihood of extreme events associated with climate change is taken into account. The question remains of what target level of resilience consumers should receive and how should it be measured.

By applying the UKWIR RG06 approach consistently across the Scottish Water asset base it will allow presentation of actual resilience assessments and intervention choices. A process of regular two-way stakeholder engagement will follow, building upon SR15 customer engagement research Panel Activity 8 – Service Resilience. Over time the understanding of customers' expectations and willingness to pay for the protection offered above any current mandatory standards will emerge. Adoption of a more appropriate set of outcome focused resilience metrics as a basis for quantifying risk to service is recommended

Where improvement is required the optimum mix of interventions can only be determined by applying whole life cost benefit analysis (CBA) to a range of choices to bridge the gap between current and agreed target level of resilience. The advantage of using cost benefit analysis to justify interventions rather than using standards is that it allows the costs of interventions to be balanced against the benefits from risk reduction. This can be particularly useful when expenditure is constrained by affordability as it allows investments in one area to be balanced against investments in other areas such that interventions can be selected that overall deliver best value for money.

There is however several challenges in applying cost benefit analysis to resilience planning that are related to difficulties in valuing the benefits from risk reduction:

- Estimation of the likelihood of events can be problematic when considering resilience as hazards often involves low likelihoods for which there is often little historical information.
- Valuation of the benefits from reducing risks. This can be challenging as customers in most cases do not have direct experience of the severe service disruptions that arise from high consequence hazards.

The latest versions of CBA tools developed for use in investment planning by the UK water industry will be applied including the findings of research commissioned into willingness to pay surveys through UKWIR.

Benchmarking – England and Wales

We will compare and benchmark our approach to resilience planning with the companies in England and Wales. Resilience planning will have an impact across all water and wastewater service functions of the business. The approach and techniques applied initially to the water service will be developed in a way that is most suitable for use by the wastewater service.

Benefits for Scottish Water Customers

- Increased awareness of current limits of protection available to their water service.
- Opportunity to influence and agree a suitable resilience target for extreme events.
- Clarity of cost of service protection and opportunity to agree willingness to pay.

Benefits for Scotland

- Assessments of potential scale of impact from extreme natural events for use in multi-agency response and recovery planning.
- Information to help target community based resilience planning.
- Knowledge to influence planning of future developments.

Benefits for Scottish Water

- Creation of scale of index of criticality for use across the business.
- Identification of critical assets, systems and events that warrant additional investigation.

- Alignment of existing quantitative assessments of drought risk, flood risk, etc. in a single business scale or index of resilience.
- Alignment of output from risk and resilience assessments with corporate risk appetite.

Water Resource Plan

Our draft water resource plan (WRP) sets out, over a 25 year planning horizon, our plans to balance available supplies and customer demand, identifying areas that require improvement to ensure we can deliver a continuous supply of water to customers.

Statutory duties

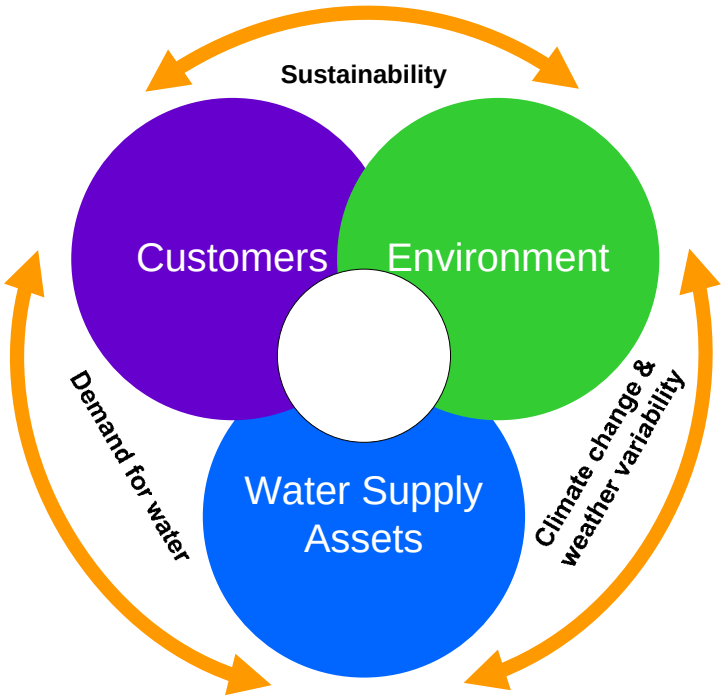
Our statutory duties require us to provide adequate and wholesome water whilst ensuring the efficient and sustainable use of water supplied. To do this we assess the ability of our water resources to meet customer demand at all times over a 25 year planning horizon to ensure customers are supplied during periods of peak demands and dry weather events. By undertaking such an assessment we can assess the sustainability of our water resources, allowing us to protect the freshwater environment whilst meeting customer demand. Over the past 10 years we have significantly improved the security of supplies to customer.

Water Resource Planning

When assessing the sustainability of the water we abstract we considered:

- The environmental impact on the water body;
- Wider environmental impacts such as carbon emissions;
- The economic impact on our customers;
- The ability of the source to meet demand for water during periods of dry weather; and,
- The resilience of sources to potential climate change impacts.
- The interaction of these is shown in Figure 6.15.

Figure 6.15: Water resource planning considerations



Water Resource Strategy

Our Water Resource Strategy is to:

- maintain a reliable supply demand balance over a 25 years planning horizon;
- continue to encourage sustainable use of water resources by managing leakage at the economic level and working with customers to further improve water efficiency;
- ensure all customers enjoy a level of drought resilience such that they have no more than a 2.5% chance of experiencing water use restrictions annually by 2027;
- improve or maintain resilience to long term supply interruptions at customers' taps, by ensuring appropriate resilience measures are in place, including higher levels of drought resilience for some zones.

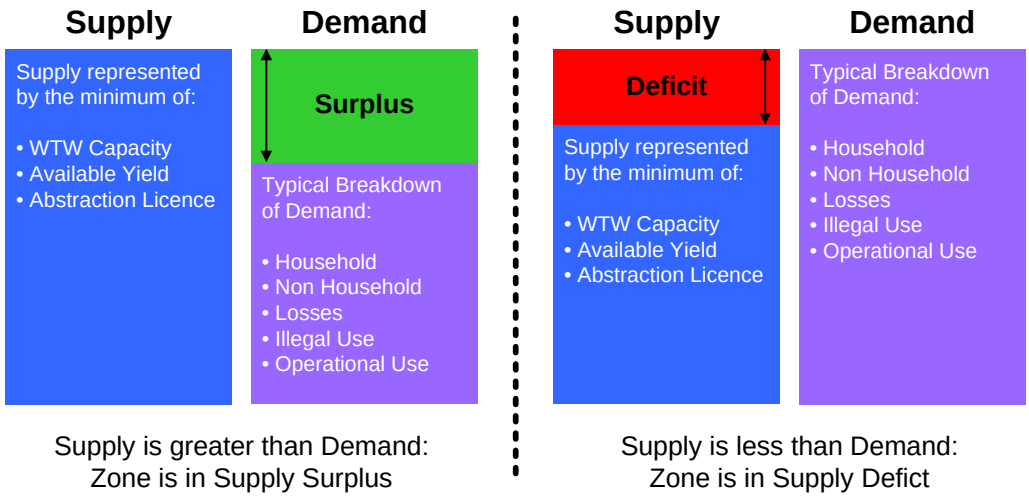
Assessing the supply demand balance

Water resource planning requires year by year forecasts of the demand for water from customers (average and peak day use), and the available volumes of water for supply. Supply is limited by:

- our physical asset base (water treatment work (WTW) capacity and raw water transfer infrastructure);
- the raw water volume (yield) from water sources (reservoirs, rivers and boreholes);
- the permissible abstraction limits (abstraction licence).

These forecasts are then compared to assess if there is a potential supply surplus (enough water) or deficit (not enough water). Forecasting both demand and availability are highly complex activities, using best practice supply demand balance tools, however the key components considered can be seen in the diagram in Figure 6.16, more detailed technical information can be seen in our full Water Resource Plan, available on our web site.

Figure 6.16: Concepts of supply demand balance



For customers forecast to be in supply deficit, we can choose to address the deficit in a number of ways including;

- managing leakage (including reducing leakage to offset additional supply-side investment);
- improving the way in which water is distributed to customers and between zones;
- improving the way water is treated;
- increasing the supplies of water available;
- helping customers to reduce their demand for water.

We expect to utilise all of these in our water resource planning. Also, for zones predicted to be in surplus it allows us to consider how and where this water can be used to support other zones or economic growth.

Level of service

The volume of available water our sources can supply varies based on how much rainfall there is during the year. Generally the higher the rainfall, the larger the volume of water available, however for reservoirs the amount we can store is also a factor. We assess whether normal supplies can be maintained with no restrictions based on the driest year we would expect over a 40 year period (1:40). If supplies can be maintained under such conditions, it implies that there is at most a 2.5% chance of such an event occuring **in any year**. This is the our current minimum level of drought resilience, also called yield level of service, we currently plan to meet customer expectations.

Our planned **customer** service levels, measured by the reliability of supplies at customers' taps, also takes into account our response to drought conditions.

While extreme natural events such as prolonged dry weather cannot be controlled by Scottish Water, we can take steps through drought planning measures to sustain supplies. These activates will typically include:

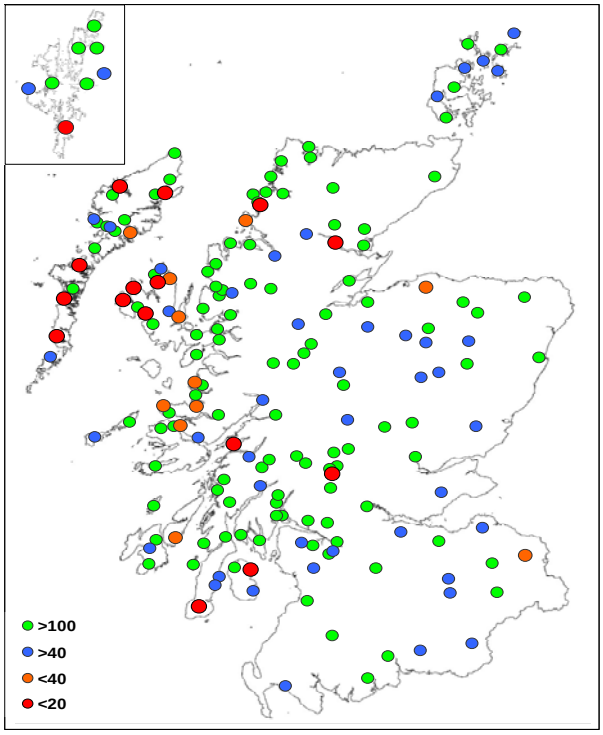
- increased leakage activities (beyond regular economic cost levels);
- tankering water in vehicles;
- appealing for customers to use water wisely;
- obtaining permission to use temporary alternative sources for water supply; and
- allowing a temporary reduction in environmental standards by reducing the normal compensation flow.

All of which will minimise potential restrictions to customers supplies with the aim of avoiding customer supply restrictions.

Variability of available water

The availability of water under normal circumstances is variable across Scotland as shown in Figure 6.17. Without an operational response interruptions to customers' supplies could occur more frequently than predicted and there would be a detrimental impact on the environment. Some water supply zones, especially the small ones, are sensitive to small changes in the rainfall, hydrology (how rainfall becomes flow and is stored), and consumption data used in the supply demand balance. It is therefore important that there is confidence in the quality of these datasets.

Figure 6.17: Yield level of service at 2014/15 by supply zone



When assessing the supply demand balance or developing drought contingency measures we have to take account of the large variations in the capability and flexibility of the 190 water supply zones we operate.

We have around 140 small, remote, rural communities with limited or no water main connections between the population centres, minimal storage, and limited mitigation options. Individually, these supplies can be maintained in an extreme event through measures such using road tankers or the use of temporary alterative water sources. However if the dry weather covers a large part of the region as it did in 2012 in the Western Isles, these can become far more difficult to manage.

In the central belt we have better water main connectivity, however there are systems supplying large population centres that are considered more vulnerable to drought risk, for example Tayside and Ayrshire because there are few alternative supply options. We also have limited capacity to move water west to east, where our largest sources are located and the majority of people live.

The amount of raw water available or yield level of service is one measure of resistance to a prolonged period of dry weather. In some systems therefore it may be appropriate to increase the yield level of service. Other methods of protecting service include, improved reliability from strategic trunk main links, resistance from failure of strategic mains by duplication and alternative strategies including tankering.

Vulnerability to climate change

Climate change is expected to increase the variability of rainfall patterns across Scotland which will impact on the availability of water. We have recently completed a vulnerability assessment of water availability based on climate change scenarios at 2040.

This assessment used 11 equally probable climate change scenarios applying the latest Met Office climate change projections within our existing water resource planning tools. The outcome suggested a range from little impact to up to 45% of customers being affected to different degrees.

Figure 6.18 shows the 2015 forecast percentage of customers receiving different levels of service resilience, ranging from 1:2 year or 50% chance of water restrictions in any one year to 1:100 or 1% chance. Figure 6.19 shows the impact of the **worst case** climate change scenario indicating the risk of water shortages increase for all customers.

Figure 6.18: 2015 service levels for availability of water

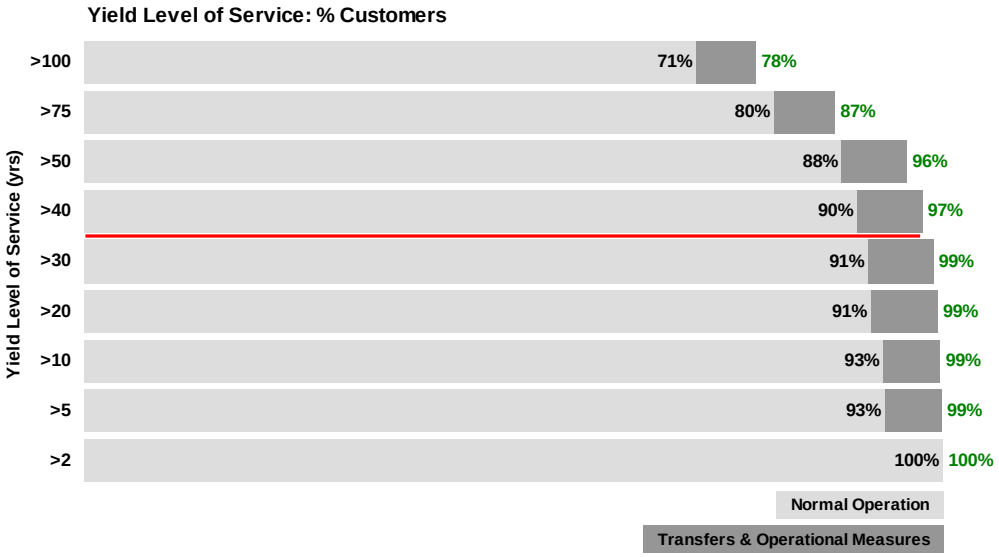
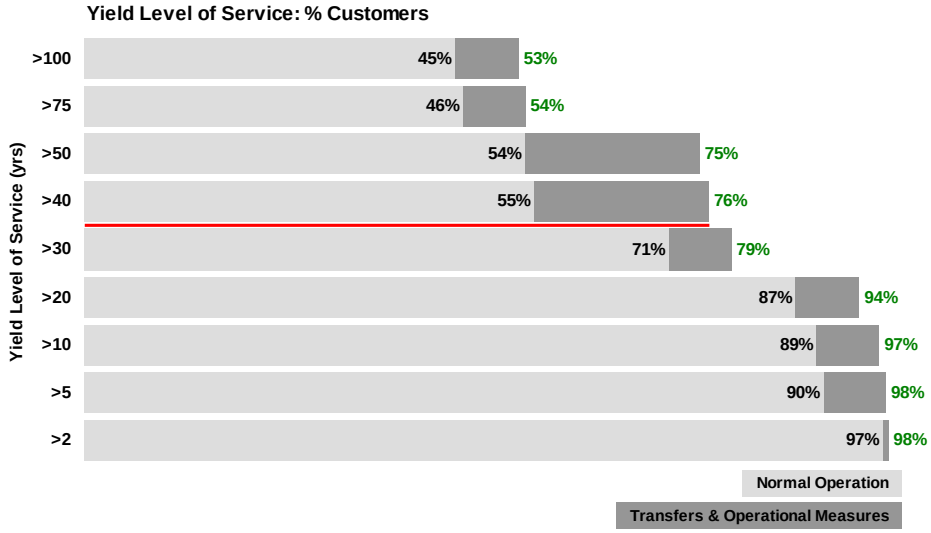


Figure 6.19: 2015 service levels for availability of water under worst case climate change scenario



Given the wide range of potential climate change scenarios and significant uncertainty, we do not think it is appropriate to invest in resilience for climate change alone at this time. Rather this work has identified our most vulnerable zones which we will examine in more detail. In addition it has shown the importance of gathering information to improve our understanding of the potential impacts and the appropriate form and timing of adaptation measures.

Appendix 7: Improving the water environment

In summary:

- Ministers' draft objectives require us to make statutory improvements to support compliance with the Water Framework, Marine Strategy Framework, revised Bathing Water and Urban Waste Water Treatment Directives.
- We plan to take forward improvements only where;
    - there is robust, scientific evidence that Scottish Water's activities are causing an impact on the water environment;
    - there will be a clear benefit from the proposed investment; and
    - investment to improve assets is the most sustainable way of achieving the required environmental outcome.
- We plan to invest £374.9 million in the 2015 to 2021 period to improve environmental water quality. This includes:
    - £174.4 million to complete agreed improvement work on 61 storm overflows impacting the River Clyde and its tributaries which was started during the 2010 to 2015 period.
    - £169.6 million for confirmed solutions to deliver statutory improvements required to meet EU Directives.
    - £7.9 million for confirmed solutions to address statutory improvements required to reduce odour impacts and to meet the Scottish Government's defined security requirements at waste water assets.
    - £9.6 million investigating Scottish Water's impact on the environment and developing appropriate solutions to enable us to support compliance with EU directives in future periods.
    - £13.4 million extending our sewer modelling coverage to support our duties under the Flood Risk Management Act and share information we have on flooding from sewers to support Local Authorities in developing Local Flood Risk Management Plans.
- We have made an IR18 allowance of £26.3 million to begin addressing confirmed needs arising from investigations completed in the 2015 to 2018 period and enable the delivery of £12.8 million of confirmed improvements which are necessary to meet the requirements of the Water Framework Directive.
- We expect that the investment levels to protect and enhance the environment will increase in the 2021 to 2027 period as a consequence of the outcomes of the ongoing and new investigations we are undertaking in this plan.

Scotland's water environment has steadily improved over the last 20 years as a result of significant investment by Scottish Water and through improvements to land management practices which are regulated by SEPA. By 2015, SEPA forecasts that around 60% of water bodies will be at good status or better[1]. As a result, the majority of our customers have told us that they tend to have a positive impression of the water environment.

However, in some areas, environmental water quality is not achieving such high standards and further improvements are required to support the Ministers' aim of achieving 97% of water bodies at good status by 2027. This appendix sets out our plans to reduce the impacts of our abstraction of water and collection and disposal of waste water on the water environment. These improvements have been agreed with SEPA and

[1] Based on 2009 River Basin Management Plan (RBMP) projected position for 2015 (Tables 2 and 3 Chapter 2 Scotland RBMP)

discussed with and supported by the Customer Forum. In this appendix all investment figures are provided in 2012/13 prices unless otherwise stated.

Ministers' draft objectives

Scottish Ministers' draft objectives for 2015 to 2027 set out that Scottish Water shall in respect of:

3.1 ENVIRONMENTAL WATER QUALITY

To Support compliance with the Water Framework, Marine Strategy Framework, revised Bathing Waters Directive and Urban Waste Water Treatment Directives:

i.) reduce the impact of its discharges, abstractions and impoundments so as to contribute to the achievement of the environmental objectives for water bodies and protected areas in line with the measures identified in the River Basin Management Plans and from monitoring and study of bathing waters.

ii.) undertake strategic studies to understand future investment requirements for discharges and abstractions identified as potentially contributing to the failure of environmental water quality objectives in line with the requirements of the River Basin Management Plans and revised bathing water directive.

iii.) work with SEPA and licensed providers to undertake catchment management and customer education to reduce the impact of Priority Substances being disposed of via the sewer and drainage system. In addition it shall undertake research which may assist in identifying the effective treatment of substances that catchment management may not be successful in reducing to acceptable levels.

iv.) improve intermittent discharges identified through modelling and agreed with SEPA as downgrading the aesthetic or environmental condition of water bodies to support compliance with the Urban Waste water Treatment Directive.

v.) in partnership with other stakeholders, SW shall take steps to reduce the impact of its discharges on sewage-related litter in the marine environment.

3.2 NATURE

Support the achievement of the Scottish Government targets for the proportion of natural features in favourable condition, work with Scottish Natural Heritage to identify and undertake management activities at identified sites that will contribute to achievement of the National Indicator *'Improve the condition of protected nature sites'.*

3.3 WASTE

Manage the environmental risk associated with sludge historically stored at waste water and water treatment sites as agreed with SEPA.

1.3 RURAL COMMUNITIES OBJECTIVE

To support delivery against the Government's priorities in rural communities, in particular with a view to improving water and sewerage provision in rural areas, Scottish Water shall:

a) Assist the Drinking Water Quality Regulator and SEPA with the assessment of the sustainable and cost effective options to address public health risks, limitations to sustainable economic growth and customer willingness to connect to public services associated with private water supplies and sewerage provision.

b) In light of the studies undertaken at a), connect communities to appropriate public water and/or waste water services as approved by Ministers.

4.1 FLOOD MANAGEMENT

Take all necessary steps to fulfil its duties and obligations required for the period 2015-2027 as set out in the Flood Risk Management (Scotland) Act 2009. In particular, Scottish Water shall:

(a) Assess flood risk from sewerage systems and update the latest assessment as required.

(b) Through its participation in the Metropolitan Glasgow Strategic Drainage Partnership and working collaboratively with their partners continue to deliver its agreed share of the improvements that will reduce the risk of flooding in Greater Glasgow;

(c) In partnership with responsible authorities, undertake studies to inform investment requirements in future regulatory periods as agreed with the Scottish Advisory and Implementation Forum for Flooding (SAIFF); and

(d) In partnership with responsible Authorities, commence its agreed share of the investment requirements arising from the flood studies as agreed with the Scottish Advisory and Implementation Forum for Flooding (SAIFF);

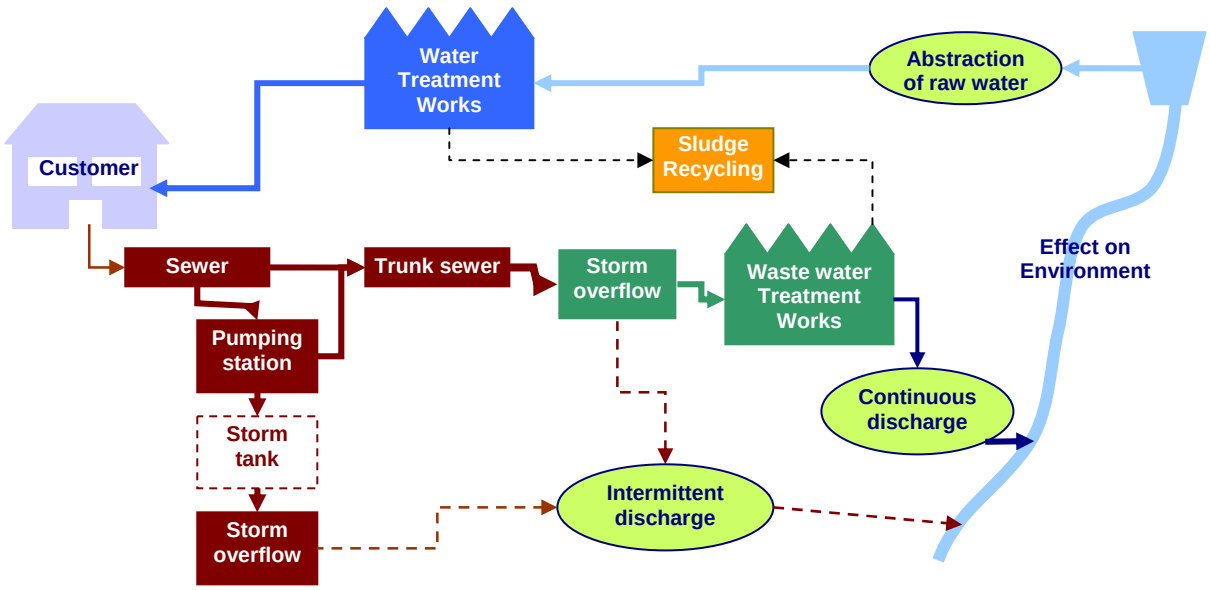
(e) Take action to protect its own assets where they lie within an area vulnerable to flooding.

(f) Take action to ensure reservoirs are monitored, inspected and maintained in accordance with the Reservoirs Act 2011 to ensure their structural integrity

Scottish Water's impact on Scotland's water environment

Scottish Water has the potential to impact the water environment when providing both drinking water and waste water services as shown in Figure 7.1.

Figure 7.1 – Scottish Water's service interactions with the water environment



To supply drinking water, we collect and store raw water, changing the natural flow regime of river and loch systems through the use of dams, weirs and water abstractions under licence from SEPA.

Our drainage service involves collecting rainwater from customers' roofs, paved areas and some roads on behalf of the local councils (surface water) and collecting domestic sewage and commercial and industrial discharges (waste water). We convey this through a network of pipes, pumping stations and storm tanks before treating it at waste water treatment works and discharging it back to the water environment under license from SEPA. Some of the surface water is collected in separate surface water sewers or sustainable urban drainage systems (SUDS) and is discharged direct to water bodies. Within the collection system, there are storm overflows which discharge untreated combined waste and surface water to water bodies during periods of heavy rain – this reduces the likelihood of the sewer network being overloaded and causing flooding of customers' properties.

Our water treatment works and waste water treatment works create a sludge waste which we further treat and condition to allow the majority to be recycled, with a small proportion disposed of to landfill.

The Scottish Environment Protection Agency (SEPA) is responsible for implementing environmental regulation. It does this by regulating abstractions from and discharges to the water environment, issuing licences and taking appropriate regulatory action where licence conditions are not met, which may include enforcement leading to prosecution. SEPA manage Scotland's water environment using around 3,600 management units called water bodies which cover rivers, estuaries, lochs, groundwater and coastal waters.

Planned investment

The main drivers for improvement in environmental water quality have been, and continue to be, European Directives that have been transposed into Scots law. The main European Directives are: the Urban Waste Water Treatment Directive, the Water Framework Directive, the revised Bathing Waters Directive, the Waste Framework Directive, the Industrial Emissions Directive, the Shellfish Directive and the Priority Substances Directive.

The basis for our plan is to only take forward improvements where the following three key principles are met:

- There is robust scientific evidence that Scottish Water's activities are causing an impact on the water environment;
- There will be a clear benefit from the planned investment; and
- Investing in our assets is the most sustainable way of achieving the required environmental outcome.

We have worked closely with SEPA to investigate the impact of our activities and to determine the most cost effective ways of meeting legislative requirements.

Innovation in action:

In preparing for this plan we carried out a comprehensive programme of environmental studies with SEPA to confirm how our assets impact on the water environment. Our Bathing Water studies used leading edge modelling techniques to help understand the requirements of the revised Bathing Water Directive. These studies demonstrated that improving Scottish Water discharges alone will not usually result in significant improvement to bathing waters and that, to achieve compliance, improvements in diffuse pollution must first be secured. As a result, we plan to defer improvement in our assets until diffuse pollution improvements are made, the results of these improvements are clear and the benefit attached to our asset interventions can be demonstrated.

Our plan is based upon the three principles set out above and has been informed by the outcome of 99 studies, undertaken in partnership with SEPA, to understand the impacts of around 1,400 assets. The studies demonstrated that around 600 (42%) of the assets investigated are adversely impacting receiving waters and protected areas. The remaining assets were confirmed as not having a significant impact and no investment is planned to these at this time.

Where the need for investment is confirmed, we have studied all the available options including innovative and non-capital investment options, such as surface water management and oxygenation of the water body or

catchment management to reduce diffuse pollution, in order to identify solutions that will deliver the environmental outcome in the most sustainable way.

We have agreed with SEPA areas that require further investigation or appraisal before committing to improvement We expect these studies to inform investment from 2018.

Having deferred significant investment for further investigation, the resultant plan is largely based on engineering solutions, such as improved treatment, providing additional sewer network capacity or providing additional infrastructure to transfer flows to more appropriate discharge locations. However, the solutions have been developed using leading-edge integrated river and sewer models to confirm the minimum standards to be met and to develop the optimum solutions. When developing solutions, we have considered a wide range of options, including surface water management interventions. We have found that this type of intervention is not a cost effective solution to resolve an existing lack of capacity but it may have potential to reduce the future risk of overloading.

Our approach to preparing this plan and the objectives and outputs required for 2015 to 2021 have been reviewed and supported by the Q&SIV Project Management Team, chaired by the Scottish Government. The plan has been reviewed by Black and Veatch who have confirmed that the identified improvements are required and that our planned solutions are appropriate. They noted that:

Innovation in action:

"…where statutory requirements allow more flexibility, the partnership approach [with SEPA] has allowed effective and pragmatic solutions to be agreed. A good example of this is the agreement that CSOs to the tidal sections of the Clyde can spill all flows in excess of 4 dry weather flows. A more confrontational approach might well have required flows of up to Formula A to be retained which would have resulted in significant additional engineering costs for little additional environmental benefit."

This innovation resulted in a significant reduction in scope for more than 60 storm overflows in Glasgow with an estimated cost reduction in the order of £100 million.

They also commented:

"In summary, the key to the definition of an appropriate programme of projects for 'Improving the Water Environment' is to have an effective working relationship with the other stakeholders, in particular the environmental regulator, SEPA. Our overall conclusion is that Scottish Water has achieved such a relationship with SEPA (and other parties, where required) and that this has allowed an appropriate mix of projects and investigations to be defined which will effectively meet Scottish Water's obligations without expending resources on sub-optimal schemes before the needs are fully understood. There is much from this approach which could be learnt by other water companies".

Our planned investment to protect and enhance the environment is set out in Table 7.1.

Improvement programme	2015 to 2021 Capex (2012/13)			Committed investment outputs
	Committed		IR18	
	Capex	Opex	Totex	
Statutory improvements required by SEPA to enhance the environment				
Urban Waste Water Treatment Directive	**296.4**	**1.02**	**3.7**	
WwTW Phosphorus Reduction	*65.8*	*0.97*		2 WwTW improved
WwTW Appropriate Treatment	*9.7*	*0.01*		20 WwTW improved
Sewer network improvements	*46.5*	*0.04*	*3.7*	67 Storm overflows / 15 SWOs
Sewer network – Glasgow Completion	*174.4*			61 Storm overflows
Water Framework Directive	4.0	0.02	12.8	18 abstractions serving 4 WTWs and 2 fish passes
Revised Bathing Waters Directive	**30.7**	**1.7**	**3.9**	
Completion programme (2 Bathing Waters)	*30.3*			2 bathing waters
Modelling updates and investigations	*0.4*		*3.9*	12 bathing waters investigations and improvements arising
Bathing beach clean up		*1.7*		Beach clean-up
Sludge management	8.1		3.7	10 sites improved, 10 sites monitored and investigated
Shellfish Directive	0			0 sites
Priority Substances Directive	3.4			1 National strategy
Flood Risk Management Act	13.4			203 Catchments
Habitats Directive	0.4	0.05		1 WwTW improved & 2 studies
Compliance Assessment Scheme	**1.0**		**1.8**	
WwTW	*0.5*		0.7	12 WwTW & 11 networks
Networks	*0.5*		1.1	
Preparation for future investment periods	**9.6**			
Storm overflow investigations	*7.4*			88 studies
Water Resources and Fish Pass studies	*0.9*			22 studies
National sludge strategy	1.3			1 study
Sub total	**367.0**	**2.8**	**25.9**	
Statutory improvements required to protect the wider environment				
Improvements required by Scottish Government to protect the water environment	5.5			16 sites improved & 2 studies
Improvement required by SEPA and local authorities to reduce odour nuisance	2.4	0.7	0.4	5 WwTW improved
Sub total	**7.9**	**0.7**	**0.4**	
Total	**374.9**	**3.5**	**26.3**	

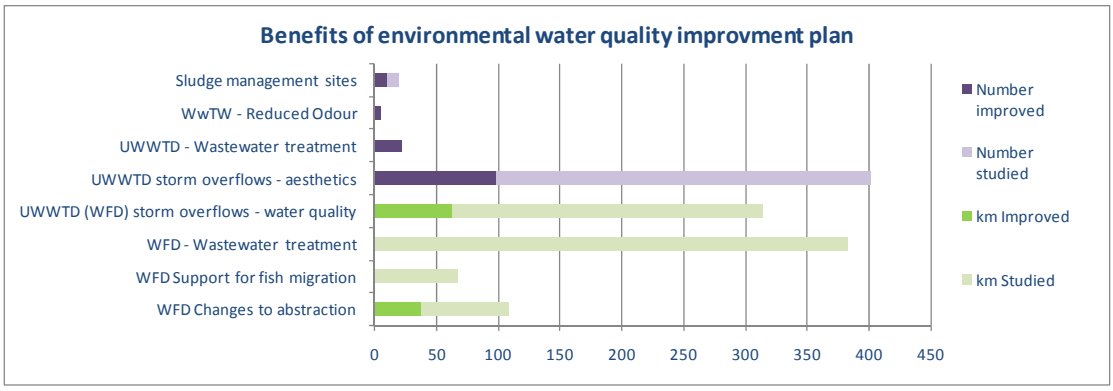
Table 7.1: Summary of planned investment to protect and enhance the environment

Benefits for customers

The benefits for our customers, in terms of an improved water environment, can be seen in Figure 7.2. Our plan will ensure that all assets identified as being non-compliant with EU directives and with a clear solution are improved.

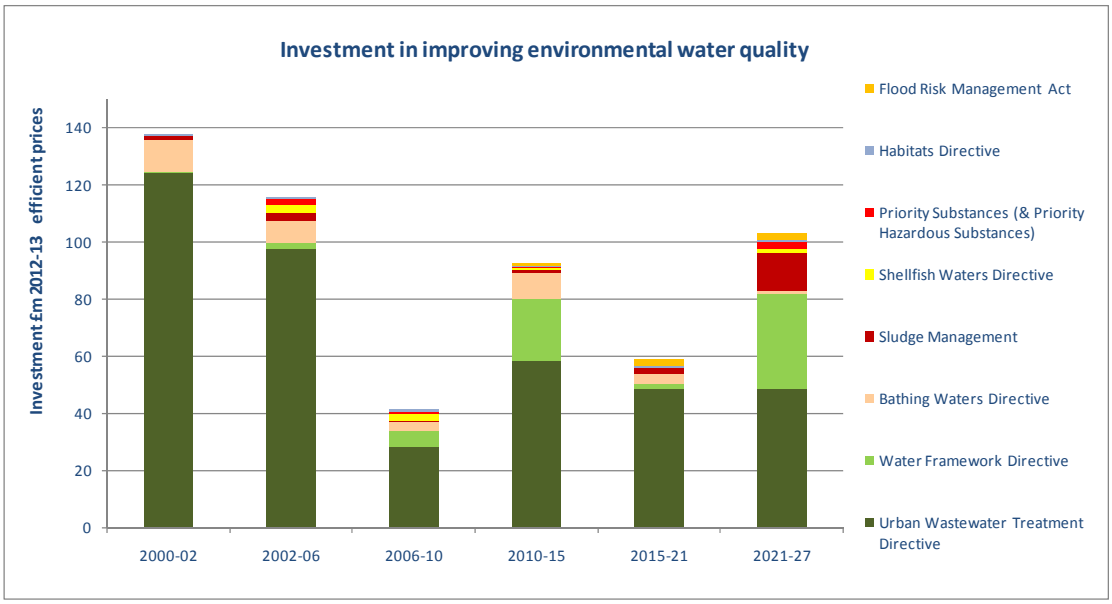
The joint study programme with SEPA will confirm where further improvements are required to support compliance with EU directives and will identify the most sustainable way of delivering these. This will allow informed decision making around the rate of future environmental improvements considering the available financing from customer charges and borrowing.

Figure 7.2 – Benefits of environmental improvement plan



Our historic, planned and forecast investment to improve environmental water quality is set out in Figure 7.3. This is over and above our planned annual investment to maintain existing levels of service and service risk. We expect there will be an increasing demand in 2021 to 2027 to deliver improvements to meet the Water Framework Directive deadline of 2027.

Figure 7.3 –Historic, planned and forecast investment in improving environmental water quality



We have included £12.8 million of confirmed investment that we could deliver between 2018 and 2021 as an IR18 allowance to be reviewed at December 2017 in context of the outcomes of WFD investigation programme and overall compliance phasing to meet the 2027 deadline.

Statutory improvements required by SEPA to improve the environment

The Urban Waste Water Treatment Directive (UWWTD)

This Directive requires effective collecting systems and 'appropriate' sewage treatment to be in place for all populations to protect water quality for fish and other aquatic life. It sets prescriptive standards to be met for such discharges with a deadline for compliance of 2005 or, where receiving waters have been designated as 'sensitive', 7 years after designation.

Over the past 20 years, we have invested significantly to bring our waste water treatment works (WwTW) and collecting systems to the standards required by the UWWTD. This has been one of the major contributions to recent improvements in Scotland's water environment. Our investigations have confirmed that, by 2015 we will have:

- 20 very small discharges where enhanced treatment and / or improvement to the discharge arrangements are required to achieve compliance;
- 2 large waste water treatment works in Glasgow, which discharge into the Lower River Clyde sensitive area designation, where levels of phosphorus require to be reduced;

When assessing whether waste water collecting systems are satisfactory, we confirm that storm overflows and surface water outfalls do not:

- operate in dry weather;
- downgrade water quality in the receiving water body (assessed using Water Framework Directive (WFD) and UWWTD standards); or,
- cause aesthetic pollution through the release of sewage related debris.

Our catchment studies and joint assessment with SEPA has identified that by 2015 we will have:

- 364 unsatisfactory storm overflows, identified through our Glasgow and Water of Leith catchment studies, and 15 unsatisfactory surface water outfalls that require improvement to provide appropriate collecting systems; and,
- 327 potential unsatisfactory storm overflows and 30 dual manhole systems that require investigation to understand whether improvement is required in a future investment period.

Table 7.2 summarises our current assessment of the number of overflows that may require improvement and our approach to addressing these.

Catchment	Unsatisfactory storm overflows at March 2015		Forecast unsatisfactory storm overflows at March 2021	Comments
	Confirmed	Potential		
Glasgow	284	n/a	172	Improvements phased to follow strategic solutions and minimise disruption to customers
Water of Leith (Edinburgh)	40	n/a	24	Improvements to remaining storm overflows will be considered as part of a strategic solution investigated under this plan.
River Almond (Livingston)	40	7	40 - 47	Improvements to remaining storm overflows will be considered as part of a strategic solution for WwTW investigated under this plan.
Surface water outfalls across Scotland	15	n/a	0	
Upper Clyde	0	32	tbc	All identified potential unsatisfactory storm overflows are being investigated in this plan. This could identify more unsatisfactory overflows in the catchment, or that those which are potentially unsatisfactory are not causing a problem and do not require improvement.
Tay Coastal	0	3		
Angus	0	4		
River Eden	0	4		
River Don	0	10		
River Carron	0	10		
Loch Lomond	0	0		
79 catchments across Scotland	0	294		
Totals	**379**	**357**	**tbc**	

Table 7.2: Known and potentially unsatisfactory storm overflows

It should be noted that Scotland's compliance with the UWWTD is comparable with that of England and Wales. This notwithstanding, the European Commission continues to take a strong interest in compliance with this Directive and will issue infraction proceedings if it considers that appropriate progress towards compliance is not being made.

Our plan makes no specific allowance for complying with DEFRA's proposed approach in England and Wales on combined storm overflow monitoring requirements. However, we do plan to improve monitoring on a number of key overflows where we believe that there is potential to cause environmental problems. If there is a requirement in Scotland to undertake a more comprehensive improvement of our monitoring arrangements, similar to that proposed by DEFRA, we estimate that an additional £100 million investment would be required.

A benefit of delivering improvements to meet UWWTD water quality compliance is that progress will be made towards meeting the water quality objectives of the Water Framework Directive since these often overlap, particularly when delivering improvements to the waste water collection system.

WwTW phosphorus reduction

Through the Glasgow Strategic Study, we have identified an innovative solution to the problem of meeting current requirements of the UWWTD and future requirements of the WFD and improving quality of the freshwater River Clyde.

Innovation in action

Daldowie and Dalmarnock waste water treatment works discharge into the Lower River Clyde which is designated as a sensitive area under the UWWTD. To comply with the Directive, phosphorus levels in the discharges require to be reduced and, traditionally, we would achieve this by enhancing the treatment process by adding chemical dosing plant and filtration equipment. This would result in a large increase in operational costs associated with the use of around 4 tonnes per day of ferric sulphate and sodium hydroxide and would significantly increase sludge production and treatment costs.

Our innovative approach to delivering compliance with both the UWWTD and WFD is to transfer these discharges out of the sensitive area and further down the River Clyde where Estuary standards rather than freshwater standards can be met. This saves in excess of £100 million in the whole life cost of the UWWTD traditional solution and reduces the carbon dioxide emissions when compared against an improved treatment option. In addition, this solution avoids the need to deliver further asset improvements that would be necessary to meet reduced ammonia, dissolved oxygen and soluble reactive phosphorus levels required for compliance with the Water Framework Directive by 2027.

We have included an allowance of £65.8 million in the committed programme to address the phosphorus levels in discharges from 2 large treatment works, serving over 500,000 customers in Glasgow. We are proposing that this allowance is ring fenced in our plan as there remain significant uncertainties regarding the construction cost of this project given that it involves significant tunnelling across parts of Glasgow. We plan to update the forecast costs of this scheme as we progress through the price control process and will seek to find further innovation if possible.

WwTW appropriate treatment

We plan to improve all WwTW discharges that are confirmed as being non-compliant with the UWWTD. Our plan includes £9.7 million to provide appropriate treatment to 20 very small rural discharges serving 944 customers.

A summary of the planned treatment works improvements to meet UWWTD requirements and support WFD objectives is set out in Table 7.3.

Environmental issue	Number of sites	Customers served	Solution
Unscreened discharge causing debris complaints	16	675	New septic tank and outfall to below low tide level
	2	40	New septic tank and reuse existing outfall
	1	35	Pump to public sewer network
Water body has moved leaving discharge onto dry land.	1	194	Relocate septic tank and extend outfall to a suitable location
Sub total	**20**	**944**	
Daldowie WwTW - phosphorus discharges to a designated 'sensitive water'	1	269,697	Move treated effluent discharge 13.3km downstream to where environmental standards can be met without enhanced treatment
Dalmarnock WwTW - phosphorus discharges to a designated 'sensitive water'	1	238,664	Move treated effluent discharge 3.6km downstream to where environmental standards can be met without enhanced treatment.
Sub total	**2**	**508,361**	

Table 7.3: Summary of improvements to WwTW to comply with UWWTD and support WFD

Sewer network improvements and Glasgow completion from 2010-15 period

Our approach to improving waste water collecting systems has been informed by our experience of the Glasgow Strategic Study which included leading edge modelling of water quality to confirm the discharges requiring improvement and the levels of improvement required. Our approach took account of the interaction of treatment and collecting system discharges on the water environment to agree appropriate discharge standards that meet both UWWTD and WFD requirements.

In this plan, we will invest £174.4 million to complete the work commenced in Glasgow during 2010 to 2015 to reduce the impact of 61 overflows discharging to the River Clyde and its tributaries, £44.1 million improving a further 67 overflows discharging to the River Clyde (51) and Water of Leith (16) and £2.4 million implementing

surface water action plans to address 15 unsatisfactory surface water discharges. A summary of the confirmed improvements is set out in Table 7.4.

Environmental issue		Number of sites	Solution
Statutory improvement to River Clyde and tributaries			
Commenced in 2010-15	Downgrading water quality & sewage debris.	21 Storm overflows	Provide screens and additional sewer capacity or storage to retain peak flows and debris within sewerage system.
	Sewage related debris	40 Storm overflows	Improve screens to retain debris in sewerage system.
Sub total		**61**	
Improved under this plan	Downgrading water quality & sewage debris.	5 Storm Overflows	Provide screens and additional sewer capacity or storage to retain peak flows and debris within sewerage system
	Downgrading water quality	8 Storm overflows	Provide additional sewer capacity or storage to retain peak flows within sewerage system.
	Sewage related debris	35 Storm overflows	Improve screens to retain debris in sewerage system.
	Downgrading water quality	3 Dual manhole systems	Remove overflows from foul sewer to surface water sewer and provide additional capacity in foul sewer.
Sub total		**51**	
Statutory improvement to Water of Leith and tributaries			
Improved under this plan	Downgrading water quality & sewage debris.	2 Storm overflows	Provide additional 500m3 of storage to retain peak flows within sewerage system to reduce phosphorus, ammonia and BOD impacts.
	Sewage related debris.	14 Storm overflows	Improve screens to retain debris in sewerage system or rationalise overflows and provide additional sewer capacity to eliminate spills.
Sub total		**16**	
Statutory improvement to surface water discharges			
Improved under this plan	Downgrading water quality	15 surface water discharges	Surface Water Action Plan setting out risks and actions required to prevent pollution of the water body
Sub total		**15**	
Total		**143**	

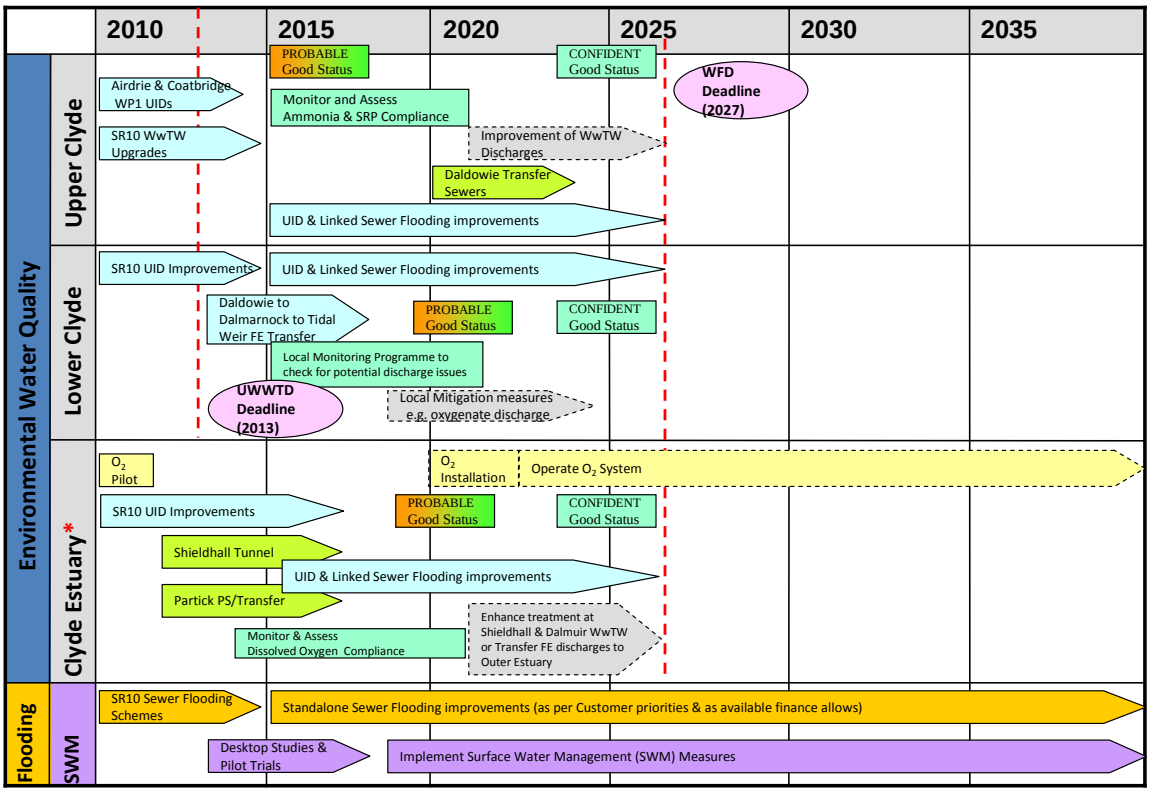
Table 7.4: Summary of improvements in 2015 to 2021 to collecting system to comply with UWWTD and support WFD

River Clyde and tributaries – Glasgow Strategic Study

To improve large urban catchments such as Glasgow may take a period of up to 20 years given the number of improvements identified, the sequencing of the local improvements with strategic enhancements, and the significant associated costs. In this plan we have set out that we will complete works on 61 overflows commenced in 2010 to 2015 period and improve a further 51 storm overflows in the Greater Glasgow catchment, leaving a further 172 overflows to be improved from 2021 onwards.

Figure 7.4 summarises our planned approach to improving the Glasgow collecting system.

Figure 7.4 Investment phasing in the Glasgow collecting system



In line with the phasing outlined within the Glasgow Strategic Study, subject to available financing and agreement of priorities, we expect to improve 172 storm overflows discharging to the River Clyde in the 2021 to 2027 investment period.

Water of Leith - Edinburgh

A study of this catchment has demonstrated that 40 storm overflows are impacting water quality and causing aesthetic problems in the river. Significant volumes of storage would be required to reduce the frequency and volume of discharges to levels that would allow WFD good status to be achieved.

The study has shown that, similar to Glasgow, a considerable extent of the Edinburgh sewer network is already at or beyond capacity. It has been identified that standalone solutions are appropriate for 4 zones containing 16 storm overflows in the outer reaches of the catchment and these are included in our plan for improvement (Table 7.3). In the more urban part of the catchment, the significant volumes of storm storage required coupled with land availability and city centre access restrictions requires a tunnel relief sewer to be considered. This option would allow storm flow to be transferred through the catchment to an alternative location in the sewer network, or to a coastal discharge location.

Innovation in action:

When developing the tunnel relief sewer solution for the Water of Leith, we will consider its potential to form the spine of a separate surface water drainage system to convey separated surface water from the urban area to the coast. At first, the tunnel will operate as a storm relief sewer but, over time, as redevelopment and surface water separation happens, storm overflows could be blocked off to form a surface water sewer.

An integrated catchment modelling tool is currently being developed with SEPA and the Local Authority to cover the wider Edinburgh catchment and this will be available in late 2014. We have agreed with SEPA that we will use this tool to confirm the appropriate solution for all identified flooding, water quality and aesthetic needs within the Edinburgh catchment, refining the potential strategic solution during the 2015 to 2021 period. This will confirm the strategic solution for 24 storm overflows already confirmed as requiring improvement and

we plan to begin delivery of this in 2021 to 2027 which will allow us to confirm appropriate improvements taking into consideration disproportionate cost, to meet the 2027 WFD compliance deadline.

River Almond – West Lothian

A study of this catchment into both UWWTD and WFD requirements has confirmed that 40 storm overflows are likely to be the cause of aesthetic problems in the River Almond. The study has also shown that 8 WwTWs discharging to the River Almond system have the greatest influence on environmental water quality. One option we are considering to resolve the WwTW impact is to remove discharges entirely from the river (see Water Framework Directive section). As the flow from these WwTWs is a significant proportion of the flow in the River Almond, removing these will exacerbate the impact from storm overflows, resulting in 7 further storm overflows requiring improvement to prevent water quality issues. Due to the levels of uncertainty regarding the strategic solution required to meet the WFD objectives we do not plan to improve any of the overflows identified as affecting water quality until the overall strategy for the River Almond is confirmed.

We have therefore set aside an allowance of £3.7 million in IR18 to begin improving these overflows once the strategic solution is confirmed. Table 7.5 summarises the confirmed needs to comply with the UWWTD and WFD.

Environmental issue	Number of sites	Potential Solution
Statutory improvement to River Almond and tributaries to meet UWWTD and WFD		
Confirmed sewage related debris	40 storm overflows	Improve screens to retain debris in sewerage system or rationalise overflows and provide additional sewer capacity to eliminate spills.
Potentially downgrading water quality as a result of removing WwTW flows	7 storm overflows	Provide additional 16,000m3 of storage to retain peak flows within sewerage system to reduce phosphorus, ammonia and BOD impacts
Total	**47**	

Table 7.5: River Almond confirmed needs to comply with UWWTD (& WFD)

Surface Water Outfalls – confirmed solutions

Working with SEPA, we have identified 15 locations where discharges from surface water drainage systems, primarily serving industrial developments, are impacting the water environment. A summary of the sites is set out in Table 7.6. We plan to reduce the environmental impact of these discharges using our innovative Surface Water Action Plan solution and will invest £2.4 million in delivering these.

Innovation in action:

We have agreed with SEPA that, rather than providing treatment to achieve an end of pipe standard for surface water outfalls, we will develop surface water action plans. This is a collaborative approach, working with SEPA and traders to achieve a better outcome by preventing contaminants entering the surface water system. This approach builds on our experiences in 2010-15 where working with local authorities, traders and SEPA has demonstrated that it is likely to achieve a more sustainable outcome than building large scale retention ponds that are often extremely difficult to locate and expensive to build.

There remains a risk that if the surface water action plan is unsuccessful, we may require to install end of pipe treatment. We have made no allowance for end of pipe treatment within the 2015 to 2021 period.

Site	Environmental issue	Length of water body impacted	Solution
Newhouse Industrial Estate SWO, Boness Rd Ns771610	Biological elements, Soluble Reactive Phosphorus (SRP), Dissolved Oxygen, specific pollutants, ammonia	4.2km	Preparation of Surface Water Action Plan
Badentoy Industrial Estate SWO, Aberdeen	Phytobenthos (phosphorus) and Invertibrates	4.8km	Preparation of Surface Water Action Plan
Dales Industrial Estate C SWO, Upperton Industrial Estate, Peterhead	BOD and Aesthetic	1.4km	Preparation of Surface Water Action Plan
Houstoun Industrial Estate (South) SWO; West Lothian	Phytobenthos (phosphorus) and Invertibrates	3.1km	Preparation of Surface Water Action Plan
Brucefield SWO, West Lothian	Phytobenthos (phosphorus)	3.9km	Preparation of Surface Water Action Plan
Prestonhall Industrial Estate SWO No 1, Cupar,	Phytobenthos (phosphorus) and Invertibrates	7.9km	Preparation of Surface Water Action Plan
Prestonhall Industrial Estate SWO No 2, Cupar,	Phytobenthos (phosphorus) and Invertibrates	7.9km	Preparation of Surface Water Action Plan
Gyle Industrial Estate SWO, Edinburgh	BOD, Phytobenthos (phosphorus) and Invertibrates	2.7km	Preparation of Surface Water Action Plan
Houstoun Industrial Estate (North) SWO, West Lothian	Phytobenthos (phosphorus) and Invertibrates	3.6km	Preparation of Surface Water Action Plan
East Mains SWO, West Lothian	Phytobenthos (phosphorus) and Invertibrates	2.1km	Preparation of Surface Water Action Plan
Whitehill, Inchcross & Whiteside SWOs, Bathgate	All Water Quality parameters	7.9km	Preparation of Surface Water Action Plan
St Monans Industrial Estate SWO, Fife	Phytobenthos (phosphorus) and Invertibrates	0.4km	Preparation of Surface Water Action Plan
Deans South 1 SWO, West Lothian	Specific Pollutants	2.1km	Preparation of Surface Water Action Plan
Deans South 2 SWO, West Lothian	Specific pollutants	2.0km	Preparation of Surface Water Action Plan
Inveralmond SWO, Perth	Hydrocarbons	0.6km	Preparation of Surface Water Action Plan
Total		**54.6km**	

Table 7.6: Surface water outfall discharges to be improved to support WFD

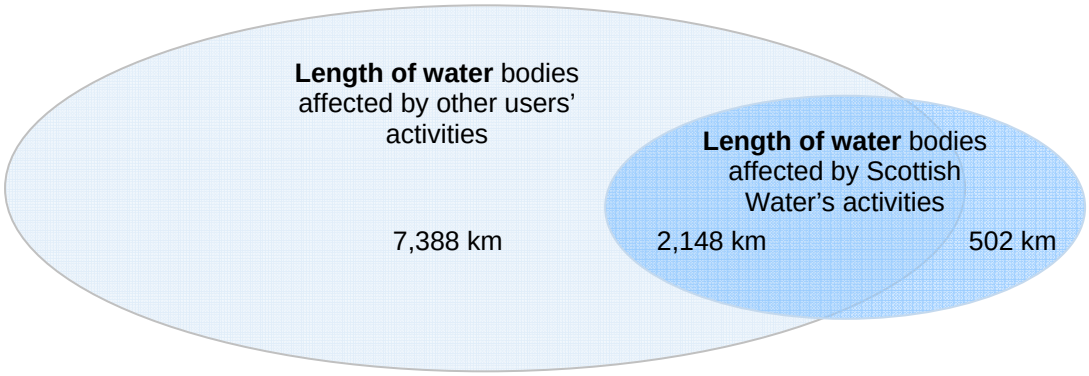
The Water Framework Directive

This wide-ranging Directive requires the integrated management of Europe's water bodies and for member states to improve water bodies to good status by 2027, unless it is disproportionately costly to do so. Scottish Ministers have set an objective that 97% of water bodies should be at good status, or better, by 2027. To achieve good status, a water body must be close to the condition that it would be in without the impact of human pressures. The status of a water body can be affected by abstraction, engineering works such as weirs and other structures and discharges from point sources (waste water treatment works and industry) and diffuse sources (rainwater run-off from roads and fields).

SEPA has forecast[1] that, by 2015, around 60% of Scotland's water bodies will be at good status. SEPA's assessment indicates that Scottish Water's activities may impact around a quarter of the 10,038km of water body predicted to be below good status, of which only 5% are solely impacted by Scottish Water activities, as shown in Figure 7.5.

[1] Based on 2009 River Basin Management Plan (RBMP) projected position for 2015 (Tables 2 and 3 Chapter 2 Scotland RBMP)

Figure 7.5 – Forecast length of water bodies not achieving good status by 2015



In addition to the investigations and improvements identified earlier (under UWWTD section) for waste water collecting systems that also address WFD requirements. In preparation for this plan we have also carried out investigations which have confirmed that:

- 13 waste water treatment works discharges may require to be improved to meet the WFD standards.
- 15 surface water outfall discharges from industrial estates need improved to meet the WFD standards.
- 40 abstractions require to be changed to meet the WFD standards.
- 10 sites operated by Scottish Water require improvements to facilitate the passage of migratory fish to meet the WFD standards.

Working with SEPA we have identified locations where we believe that water quality is potentially being downgraded by Scottish Water's discharges and where further investigation is required to understand requirements to meet WFD objectives at

- 54 waste water treatment works.
- 11 water treatment works where abstractions are made for drinking water supply.
- 11 locations where assets are potentially preventing the passage of migratory fish.

Households with private sewage treatment systems can also impact on water bodies. SEPA considers that the connection of some of these private discharges to the public sewerage system may be appropriate to support the delivery of WFD objectives. We are exploring with SEPA and the Scottish Government how these issues should be addressed and financed. We have made no allowance in our plan for any such investment.

Waste water treatment - confirmed solutions
SEPA identified 3 waste water treatment works which require improvement to support the delivery of WFD water quality objectives. We have investigated these and have developed solutions which would deliver the required improvement as set out in Table 7.7. Taking account of the delivery timescales for these projects, and potential demands for investment arising from the study programme to achieve overall WFD compliance by 2027, we have set out the £2.9 million investment for these solutions as an IR18 allowance to be reviewed at December 2017 in context of overall compliance phasing.

WwTW	Customers served	Environmental Issue	Solution
Edgehead Septic Tank	142	Contamination of ground water	Transfer discharge to nearby sewer network.
Newton Septic Tank	176	Contamination of ground water	Move discharge to a more appropriate water body.
Longriggend WWTW	143	Ammonia	Provide increased treatment (nitrifying filter) to reduce ammonia loading.
Total	**461**		

Table 7.7: Waste water treatment works included in IR18 requiring improvement to support WFD

Waste water treatment - confirmed needs undefined solutions

River Almond – West Lothian

The River Almond Study has demonstrated that discharges from 8 waste water treatment works set out in Table 7.8 would need to be improved to a standard approaching drinking water quality in order to meet the 'good status' objective in the River and its tributaries. Taking account of long term growth and potential improvements in discharge quality that may be required under the Priority Substances Directive, a more strategic solution of discharging the treated effluent to the Firth of Forth through a transfer sewer is likely to be a more sustainable solution. Given the scale of the strategic improvement required to deliver the environmental benefit this will also require a disproportionate cost assessment to be undertaken by SEPA as allowed by the Water Framework Directive.

However, the removal of the treated effluent which is estimated to contribute up to 50% of the river flow at some points could cause other ecological impacts. To develop the most sustainable solution, we have agreed with SEPA to further investigate the options to reduce Scottish Water's impacts on the catchment and to understand how the options and improvements planned by other users will affect the environment.

Site	Environmental issue	Potential Customers Served	Potential Solution
Statutory improvement to River Almond and tributaries			
Harthill WwTW (How Burn)	WFD Ammonia and Phosphorus impact on the How Burn tributary.	4,140	Advanced treatment technologies required to deliver waste water treatment works final effluent quality to levels beyond that normally required. Standards approaching those required for drinking water quality would be required for some WwTW and multi-stage filtration and chemical dosing would required to achieve these
Fauldhouse WwTW (Breich Water)	WFD Ammonia, BOD and Phosphorus impact on the Breich Water tributary.	5,155	
Winchburgh (Niddry Burn)	WFD BOD and Phosphorus impact on the Niddry Burn tributary	2,852	
Blackburn PFI (Almond)	WFD Phosphorus impact on the River Almond	12,238	
Livingston (Almond)	WFD Phosphorus impact on the River Almond	6,470	
East Calder PFI (Almond)	WFD Phosphorus impact on the River Almond	125,503	
Newbridge PFI (Almond)	WFD Phosphorus impact on the River Almond	32,587	
Whitburn PFI (Almond)	WFD Phosphorus impact on the River Almond	12,331	
Total		**201,276**	

Table 7.8: Waste water treatment works requiring investigation to support WFD in the River Almond

River Clyde - Glasgow

The Glasgow Strategic study has fully considered the requirements of the Water Framework Directive on the River Clyde and its tributaries. The solutions being delivered at Daldowie and Dalmarnock WwTWs to comply with the UWWTD will also deliver substantial improvement towards achieving good status in the River Clyde. However, modelling has indicated that during years with average or lower than average summer rainfall, the Clyde Estuary may not achieve good status without further improvements, potentially involving enhancement to treatment at both Shieldhall and Dalmuir WwTWs. One innovative approach to resolving this is to artificially increase the dissolved oxygen content in the river through oxygenation.

Innovation in action:

Through detailed estuary modelling, we have demonstrated that further improvements at Shieldhall and Dalmuir WwTWs are unlikely to result in a sustainable improvement to the water quality of the inner Clyde estuary and that impacts such as heavier than usual rainfall have a larger bearing on the predicted classification of this water body. The modelling demonstrated that the WFD objectives could only be reliably achieved during years with average or lower than average summer rainfall by the introduction of additional oxygen to the water body. We have undertaken further investigative work and a pilot plant demonstration project which has confirmed the practical application of this approach and allowed definition of a concept design and identification of costs.

SEPA's most recent monitoring data indicates that water quality continues to improve following the trend observed over recent decades. As a result the need for oxygenation has been deferred for consideration under the 2021 River Basin Management Plan cycle.

Another innovative approach that we have considered is how the hydrodynamics (the movement of water) within the river estuary affects water quality.

Innovation in action:

When undertaking the Glasgow Strategic Study we collaborated with experts from Heriot Watt University to develop an understanding of how the hydrodynamics of the river system could be used to contribute to improving the water quality of the inner Clyde Estuary. We investigated how we might use the tidal weir as a reservoir to help flush the estuary during dry weather and the level at which the Shieldhall WwTW outfall pipe discharges into the estuary to determine if the ebb tide could be used more effectively to disperse pollutants.

We do not plan to make any investment at Sheildhall nor Dalmuir WwTWs in the 2015 to 2021 period to support meeting the WFD objective for the Clyde Estuary. We will continue to work with SEPA to understand the benefit of investment planned to comply with the UWWTD and its impact on the quality of the river before committing to any further investment as shown in Figure 7.4.

Drinking water abstractions – confirmed solutions
Working with SEPA, we have recently investigated 132 abstraction points supplying water to around 1 million customers to understand their impact on 237km of water body. These studies concluded that improvements were required at 40 (33%) of these abstraction locations to support the WFD objectives.

We plan to invest £3.5 million in the 2015 to 2021 period improving abstractions to ensure sustainable solutions are delivered at 18 abstractions that supply 4 water treatment works which are also being enhanced to deliver improvements in drinking water quality as listed in Table 7.9.

WTW Supplied	No of abstractions	Customers Served	Length of water body improved	Drinking Water Quality Solution	Water Framework Directive Solution
Amlaird	9	34,783	1.7km	Decommission WTW and supply from Glasgow system.	Adjust intake structures to return flow to natural condition.
Kaim	1	7,515	9.7km	Decommission WTW and supply from Glasgow system.	Adjust intake structures to return flow to natural condition.
Manse Street	3	31,091	9.4km	Treatment improvement & maintenance – strategic replacement being considered.	Decommission existing intakes and use new source from the River Tweed.
Burncrooks	5	53,449	17.2km	Replace with coagulated ultra filtration membrane plant	Adjust intake structures to return flow to natural condition.
Total	**18**	**126,838**	**38km**		

Table 7.9: Planned improvements to abstractions to support WFD

At the remaining 22 abstraction points supplying 15 water treatment works set out in Table 7.10, we have included the £1.7 million of investment within an IR18 allowance to be reviewed at December 2017 in context of the outcomes of WFD investigation programme and overall compliance phasing.

WTW Supplied	No of abstractions	Customers Served	Length of water body improved	Solution
Dougliehill WTW	0	12,221	7.7 km	Changes to compensation release structure to allow release of additional flows.
Greenock WTW	1	79,486		
Glendevon WTW	3	307,852	14.2 km	Modifications to compensation structures at 2 WTW. Undertake groundwater testing to assess link (if any) between ground water (source) and local burn
Glenfarg WTW	1			
Lomond Hills WTW	0			
Kinneswood WTW	3			
Newton of Lathrisk WTW	2			
Turret WTW	8	161,651	5.6 km	Improvements and calibration of compensation releases.
Carron valley WTW	0			
Turriff WTW	1	99,238	0.2 km	Undertake groundwater testing to assess link (if any) between ground water (source) and local burn.
Gallowhill WTW	0			
Forehill WTW	0			
Rochomie WTW	0			
Rawburn WTW	1	17,148	4.5 km	Refurbish and bring back into use an old intake, including water quality and flow monitoring, reconfigure pipe work at WTW to ensure it can pass through all stages of treatment and change compensation release from main reservoir source.
Corsehouse WTW	2	9,031	8.4km	Modifications to compensation structures
Total	**22**	**686,627**	**40.6km**	

Table 7.10: Improvements to abstractions to support WFD included within IR18

Barriers to migratory fish – confirmed solutions
Working with SEPA, we have investigated 12 locations where our weirs or dams were thought to be preventing migratory fish from reaching 74.8km of water bodies suitable for breeding. The studies identified that improvements could be made at all 12 locations to support fish migration.

We plan to deliver improvements to 3 abstractions to support fish migration in the 2015 to 2021 period as set out in Table 7.11. One of these only requires changes to the way we operate our abstractions. At the St Marys Loch we are in discussion with the Local Authority about changing the way we operate our infrastructure as part of the Borders Flood Prevention Scheme since changes to the fish pass will be required when the Flood Prevention Scheme is delivered.

Structure blocking migratory fish	SW Treatment Works Affected	Customers Served	Length of water body improved	Solution
Loch Katrine and Loch Venachar abstraction regime	Balmore and Milngavie WTW	964,942	2.9km	Operational changes to compensation regime
Loch Katrine dam	Loch Katrine dam, supplying Balmore and Milngavie WTW	Included above	Included above	Modifications to compensation structures to facilitate provision of freshets to improve fish passage
St Mary's Loch impounding dam and compensation structures	Part of Edinburgh Regional supply systems but does not supply a particular WTW.	0	22.9km	Improvements to existing fish pass
Total		**964,942**	**25.8km**	

Table 7.11: Planned improvements to compensation regimes to support migratory fish passage

We have included the £8.2 million of improvements at 8 locations, set out in Table 7.12, within an IR18 allowance to be reviewed at December 2017 in context of the outcomes of WFD investigation programme and overall compliance phasing.

Structure blocking migratory fish	SW Treatment Works Affected	Customers Served	Length of water body improved	Solution
Loch Venachar dam	Loch Venachar dam, compensation following abstraction for Balmore and Milngavie WTW	Included above	2.9km	Modifications to dam low flow channel
Penwhirn dam	Penwhirn dam, supplying Penwhirn WTW	21,137	0.9km	Construct a new fish pass
Black Esk dam	Black Esk WTW	38,157	9km	Construct a new fish pass
Stantling Craig dam	Manse Street WTW	9,366	8.4km	Construct a new fish pass
Caddon Water intake	Manse Street WTW	Included above		Construct a new fish pass
Massan	Abandoned raw water intake structure	0	4km	Asset transferred to new owner.
Glenleith Burn intake structure	Glenleith Burn intake for Kettleton WTW	9,424	3km	Construct a new fish pass
Dye Water Intake	Rawburn WTW	17,148	21.5km	Construct a new fish pass linked to abstraction improvements
	Total	**1,060,174**	**50km**	

Table 7.12: Improvements to improve fish migration in support WFD included within IR18

Revised Bathing Waters Directive

The Scottish Government has designated 83 coastal and inland waters as Bathing Waters. Discharges from Scottish Water treatment works and storm overflows have the potential to impact 70 of these.

The original Bathing Waters Directive was introduced in 1976 and required designated bathing waters to meet minimum standards for bacteria which can be harmful to human health. Over the last 20 years, we have made significant investments at our waste water treatment works and sewer networks to secure compliance with the original Directive. A revised Directive was introduced in 2006 setting out new minimum standards to be met by 2015. Under the revised Directive, the minimum level to be achieved is 'sufficient' with higher standards classified as 'good' and 'excellent'.

To assess whether Scottish Water is required to further improve any of its discharges to meet the standards of the new directive, a study programme was undertaken in partnership with SEPA. This study programme covered 39 bathing waters which were predicted to fail to achieve the good standard of the new directive. The

results of studies have shown that past investment to meet the original Directive will allow us to meet the new minimum standards without further improvement at many locations.

In 5 locations, the studies have identified improvements that Scottish Water can make to improve bathing water quality in support of achieving sufficient status. The study programme has also shown that diffuse pollution from agricultural runoff (i.e. livestock waste being washed into water bodies) is a major source of pollution that can prevent bathing waters from meeting sufficient status. We have demonstrated that interactions between Scottish Water discharges and other impacts are complex and that more detailed investigations are required to confirm whether further improvements to Scottish Water assets are necessary.

By 2015, three of the five bathing waters where improvements to Scottish Water discharges will support the achievement of the sufficient standard will have been delivered, with the remaining two (Portobello West and Kirkcaldy) being progressed through the OMG under the Q&SIIIB objectives. This will leave 11 bathing waters which do not meet the sufficient standard and 2 where our impact or bathing designation has yet to be established:

- At 11 bathing waters, improvements to Scottish Water discharges may be required in the future depending on how successful SEPA are in reducing the levels of diffuse pollution to a level that will enable the sufficient standard to be met with / without Scottish Water investment.
- In 2013, a new bathing water was designated at Fisherrow in Musselburgh and we plan to carry out an investigation to confirm whether Scottish Water's assets are likely to impact on performance.
- It is also possible that Strathclyde Loch could be designated as a bathing water in the future and we have made an allowance to carry out an investigation to confirm whether Scottish Water's assets are likely to impact on performance.

Bathing Waters – confirmed solutions
Our plan allows investment of £30.3 million for the completion of improvements at Portobello West and Kirkcaldy bathing waters which are being investigated during the 2010 to 2015 period. At these bathing waters, our investigations indicate that significant improvements to existing collection and transfer facilities and extension of 2 existing long sea outfalls may be required to meet the minimum standards of the Directive.

In carrying out network modelling for our bathing water studies, we have identified a number of storm overflows which operate without adequate screening to retain debris. 8 of these overflows discharge direct to bathing waters, 59 discharge within 1km of the bathing water and a further 95 discharge within 5km of the bathing waters. The studies have demonstrated that these discharges do not impact on bathing water quality but, without adequate screens, discharges could result in sewage debris washing up on the beach or out to sea.

Innovation in action:

Following discussions with SEPA and the Customer Forum we plan to spend £1.7 million between 2015 and 2021 inspecting those beaches where our storm overflows operate without adequate screening. If debris is evident, we plan to deploy monitors within the overflows that will confirm when these overflows operate to allow notification to beach users and beach cleaning activities to be undertaken.

Bathing Water – unconfirmed needs and solutions
To support future decision making, we plan to invest £0.4 million updating water quality models at 11 bathing waters where background levels of diffuse pollution prevent sufficient status being achieved. At these locations, we will have installed monitors (by 2015) on our discharges and SEPA will be monitoring the success that their innovative catchment management techniques are having on diffuse pollution levels. The updated modelling will identify where reductions in diffuse pollution have been sufficient to allow Scottish Water discharge enhancement to deliver improvement to achieve sufficient status.

Ayrshire bathing waters

Studies of 3 bathing waters at Prestwick, Ayr and Heads of Ayr show that they are likely to fail to achieve sufficient status due to the bacterial load from the Rivers Ayr and Doon impacting on the bathing waters. To fully understand the impact that these rivers have on the bathing waters and to confirm the extent of bacteria loading in these rivers due to Scottish Water assets, a detailed river study is underway in the 2010 to 2015 period. We anticipate that the study will identify Scottish Water assets which, if improved, will positively

impact bathing water quality. We have included an IR18 allowance of £1.0 million to commence any agreed improvements arising from these studies.

Fisherrow bathing water

Fisherrow in Musselburgh was designated a bathing water for the first time in 2013. We are not yet clear how this bathing water will perform when subject to regular sampling but we have identified a significant number of Scottish Water assets which discharge close to the bathing water or into the River South Esk which may impact bathing water quality. We plan to investigate this bathing water from late 2014, using the integrated catchment modelling tool for Edinburgh, which is being developed under our FRMA obligations. We have included an IR18 allowance of £2.9 million to commence any agreed improvements arising from this study.

Strathclyde Loch

Strathclyde Loch is being promoted as a major outdoor swimming facility by the Local Authority; it is possible this could be designated as a Bathing Water. We have made an allowance in our plan to consider this further by supplementing other studies which we plan to undertake to understand UWWTD and WFD requirements in the Upper River Clyde. We have not included any allowance within the rolling programme to carry out any specific improvement works, as there is no confirmation of any timescale for bathing water designation.

Sludge Management

Waste Framework and Industrial Emissions Directives and Contaminated Land Regulations
When treating both drinking water and waste water, we remove pollutants from the water. This generates sludge waste which requires further treatment before recycling or disposal.

Between 1960 and the early 1990's, sludge lagoons and tanks were used to store sludge at some sites, particularly in remote and island locations. Following the introduction of the Waste Management Licensing Regulations in 1994 and the Landfill Directive in 1999, these lagoons were gradually replaced with dedicated sludge treatment centres or the sites were closed. However, in some locations the stored sludge has never been removed from site and this continues to have the potential to cause problems for the environment. Working with SEPA, we identified 30 locations where sludge had been stored or disposed of in a way that would not meet current regulations and poses a potential pollution risk to the water environment should rainwater drain through, or run over the stored sludge.

We have investigated all of these sites and found:

- At 8 locations, there is no residual evidence of any sludge storage impacts and we plan no further action.
- At 2 locations we have confirmed we are no longer the land owner and all liability for residual risks has been transferred to the new land owner.
- At 10 locations (including 3 where we do not currently own the land) further investigations are required to confirm whether a pathway exists between the stored sludge and the water environment.
- At 10 locations the sludge has been confirmed to pose a risk and requires stabilisation[2] or removal.

We plan to invest £6.6 million removing sludge to landfill, or remediating ex-situ the sludge stored at 10 sites as set out in Table 7.14.

[2] Stabilisation is an innovative approach that if successful avoids the costs of removing all the sludge from site

Site Location	Planned Solution
Confirmed Improvement to meet requirements	
Assynt WTW	Stabilisation of sludge ex-situ and landscape site to original condition
Clunas WTW sludge beds	
Old Calder WTW	
Sanday WTW	
Furnace WTW	Removal of sludge from site and landscaping to original condition
Glendye WTW Cake store	
Londornoch WTW Buffer Lagoon and Sludge Lagoons 1&2	
Savelbeg (Lairg) WTW	
Tiree WTW	
Torra WTW	

Table 7.14: Planned improvement in historic sludge storage locations

Rather than digging out the site, removing sludge off site and importing new material, we plan to carry out an innovative onsite sludge stabilisation approach at 4 sites where we believe this to be the most cost effective option. We will carry out a pilot trial to confirm that this approach is appropriate. If the sludge stabilisation process trial is not successful or if SEPA require the sludge to be removed from site, we have estimated that additional investment of around £3.5 million will be required to remove sludge from site.

We plan to invest a further £1.5 million investigating and monitoring sludge storage areas at 10 sites where the environmental risk has not yet been fully confirmed. Following these studies, we have made an allowance of £3.7 million within IR18 to begin the improvement works required. Table 7.15 sets out our proposals.

Site Location	Planned Solution
Unconfirmed Improvements	
Bareagle Sludge Lagoon 3rd Party Site	2 years further monitoring at non-Scottish Water owned site to confirm whether a path between source (sludge) and receptor (water body) exists Undertake priority activities to mitigate immediate risks if required.
Braidfell Sludge Lagoon 3rd Party Site	
Orbiston WwTW 3rd Party Site	
Big Brek Landfill (Quarry site and sludge drying beds)	2 years further monitoring to confirm whether a path between source (sludge) and receptor (water body) exists Undertake priority activities to mitigate immediate risks if required.
Invercannie (Sludge lagoon and drying beds)	
Loch Eck (Sludge lagoon and drying beds)	
Turret WTW	
Westray (Quarry site and sludge drying beds	
Golspie WTW	
Cupar WwTW	

Table 7.15: Planned improvement in historic sludge storage locations

Shellfish Directive

This Directive was introduced in 1979 and updated in 2006. The aim of the Directive is to protect and, where necessary, improve the quality of waters where shellfish grow and to contribute to the high quality of directly edible shellfish produced. Discharges of sewage effluent near to designated shellfish waters require additional treatment to meet bacteriological standards to ensure that the quality of edible shellfish is not

affected and poses no threat to human health. Diffuse pollution from agricultural run-off can also affect shellfish water quality.

There are currently 80 sites designated as Shellfish Waters by the Scottish Government. SEPA has identified 14 Shellfish Waters where water quality is currently downgraded. The source of this downgrading has yet to be confirmed so SEPA is undertaking further monitoring, modelling and source apportionment investigations using microbial source tracking to determine whether the bacterial source is from animals or humans. Should these investigations identify that Scottish Water's assets are contributing to the downgrade of water quality, we will be required to undertake more detailed studies.

We plan to undertake any studies required from 2021 which will allow compliance by 2027 (as Shellfish Waters is now a daughter directive of WFD). There is no allowance in our plan to carry out studies before 2021.

We have recently investigated the potential impact that our storm overflows could have on the Shellfish Waters in Loch Ryan. This concluded that reducing the discharges would result in negligible improvement to the Shellfish water and we are proposing no further action. SEPA will continue with their catchment management approach to reduce diffuse pollution in the catchment and monitor the benefits of the improvements we are currently making to the waste water treatment discharge into Loch Ryan, and the operation of our remaining storm overflows.

Priority Substances Directive

The Priority Substances Directive was introduced in 2008 by the European Commission and is aimed at progressively reducing the impact of substances which are toxic and persistent in the aquatic environment. It should be noted that these substances may not be toxic to humans at the levels which cause damage to the aquatic environment and, indeed, some are active ingredients in medicines, or are naturally occurring hormones (oestrogen).

In collaboration with SEPA and the wider UK water industry, we have recently completed a chemical investigation programme to improve our understanding of the prevalence of these substances in the environment, how these enter the sewer system and the effectiveness of existing and experimental treatment processes in removing and reducing concentrations. The results of this investigation suggest that there may be problems associated with some Scottish Water discharges, particularly where there is a lack of available dilution in the receiving water.

We plan to invest £3.4 million to develop a National Substance Strategy with SEPA which will ensure that Scotland and Scottish Water are able to take steps to comply with the PSD in a sustainable, proportionate and cost effective way. The National Substance Strategy will consider each substance separately and will draw conclusions on the future actions that Scottish Water or others should take to achieve compliance with the Directive.

Development of the strategies will require the collection of background data on each substance to identify likely source, uses and pathways of travel. Screening will be used to determine where further monitoring is required based upon catchment characteristics. Further work will be required to understand how treatment optimisation and source control can contribute to controlling these substances. Research work will be undertaken to identify innovative approaches to substance control both at source and through treatment plants.

Until these strategies are in place, we are not proposing to make any improvement at our treatment works to remove or reduce concentrations of these substances.

Flood Risk Management Act

Scottish Water is designated as a 'Responsible Authority' under the Flood Risk Management Act. This Act requires us to adopt an integrated approach to managing and reducing overall flood risk along with other Responsible Authorities, principally the Local Authorities.

SEPA is required to prepare flood risk assessments across Scotland for all types of flooding except for flooding from sewers that occurs as a result of blockages or asset failures. These assessments are required to identify areas potentially vulnerable to flooding and Scottish Water is required to support SEPA in the six yearly update of these flood risk assessments by:

- Sharing the information it has on flooding from sewers due to inadequate capacity
- Identifying the location and volumes of sewage released during heavier than usual rainfall in potentially vulnerable areas (to flooding).

Scottish Water is also required to support the Local Authorities in developing Local Flood Risk Management plans for vulnerable areas. This requires Scottish Water and the Local Authorities to undertake integrated sewer and watercourse flood modelling to identify the most cost effective and sustainable approach to reducing flood risk from surface water.

We plan to invest £13.4 million to develop sewer catchment models and contribute to the integrated sewer and water course flood models required to meet these obligations.

In addition to this FRMA sewer modeling requirement, we need to create sewer catchment models to support the development of solutions to resolve potentially unsatisfactory storm overflows (Table 7.7) and customer sewer flooding. We have built a sewer modeling programme to integrate all of these drivers, ensuring overlaps have been identified and discounted and that models will be suitable to resolve multiple needs. In addition to improving our models, there is an ongoing requirement to maintain models to ensure that they are up to date; this element is covered in our asset maintenance programme.

Habitats Directive (together with the Birds Directive)

The Habitats Directive was introduced in 1994 and identifies species of animals that are protected against disturbance, harassment and killing, and species of plant that are protected against picking, uprooting or destruction at any part of their life cycle. We must ensure that our activities and proposals will not adversely impact the integrity of these protected species and must consult Scottish Natural Heritage to clarify whether a development might have a significant impact and what mitigation measures can be put in place.

To support achieving favourable conditions in designated areas of the Moray Firth we will invest £0.4 million to remove bacteria from the Ardersier waste water treatment works final effluent discharge.

At Gladhouse reservoir, which supplies areas of Edinburgh, we have been asked to investigate reducing the top water level by 1.5 meters to improve the habitat for migratory geese. Similarly, at Ardnamurchan Burn we have been asked to investigate how our weir affects the lifecycle of freshwater pearl mussels. These two investigations will inform future restoration plans.

Compliance Assessment Scheme

SEPA introduced the compliance assessment scheme (CAS) in 2011. This new approach considers compliance against all aspects of our discharge licenses with a focus on environmental management conditions such as the ability to properly measure the flow handled by our assets.

Before the introduction of this scheme, compliance was generally assessed on the quality of the final effluent discharge rather than on wider compliance with license conditions. Implementation of the scheme has identified the need to review the appropriateness of licence conditions and that investment is required to provide new and improved flow monitoring equipment to allow proper recording of overflow and discharge rates in certain locations. These improvements will reduce the risk of non-compliance with our license requirements. We have allowed £1.0 million in our plan to improve flow and event monitoring equipment at 12 waste water treatment works and 11 network locations where the need for this equipment has been confirmed. We have set aside a further allowance of £1.8 million within IR18 for further improvements identified through site audits planned between 2013 and 2017.

Preparation for future investment periods

Storm overflow investigations

In 2006, we identified 965 storm overflow discharges and surface water outfalls (discharges from surface water drainage systems) that were potentially non-compliant with UWWTD. By 2015, although we will have improved 577 of these, our investigations suggest that in 2015 we will have 379 known unsatisfactory discharges and a potential 357 other discharges that may be unsatisfactory. Table 7.16 sets out the environmental issue and number of sites identified as potentially being unsatisfactory.

Environmental Issue	Environmental issues	Number of Sites	Typical stand alone solution
Water quality (Dissolved Oxygen, Ammonia, BOD and phosphorus) impacted by sewer storm overflows	147	327 Storm overflows	Rationalise overflows and provide additional sewer capacity to retain flows within the network to limit frequency and volume of storm discharges. Improved screening to prevent the discharge of sewage related debris to the environment.
Aesthetic impact from sewer storm overflows	207		
Water quality and/or aesthetic impact from sewer storm overflows operating during dry weather	45		
Water quality and/or aesthetic impact from dual manhole systems.	30	30 Dual manhole systems	Removal of links between foul and storm sewer network by blocking overflows and providing additional capacity within the foul network.
Total	**429**	**357**	

Table 7.16: Discharges to be investigated for compliance with UWWTD and WFD

We will invest £7.4 million investigating these discharges through studies in 88 separate catchments. In order to investigate the environmental problems identified, we will undertake studies split into four categories shown in Table 7.17. When studies are in catchments where sewer flooding is being investigated, or where we are required to meet obligations under the Flood Risk Management Act, we will undertake integrated studies to investigate all identified issues.

Type of Study	Studies	Needs resolved
Aesthetic study. Physical water body survey to determine whether there is actual evidence of sewage related debris to confirm whether improved screening is required	31	Aesthetic.
Drainage area, aesthetic and storm overflow water quality study. New or updated model of the sewer network to improve understanding of how assets operate. Includes asset survey, flow and rain monitoring. Where required, aesthetic investigations and new or updated water quality modelling of the river environment will be undertaken to allow the impacts from intermittent discharges to be assessed,	48	Environmental water quality, aesthetic, dry weather operation.
Strategic catchment study. Integrated study of impact from storm overflows and waste water treatment works. These studies cover multiple storm overflows and WwTW discharges likely to be impacting wider river systems (Upper Clyde, River Tay Coastal, Angus, River Eden, River Don, River Carron, Loch Lomond)	7	Environmental water quality and aesthetic.
Strategic solutions development study. Detailed investigation of solution scope to resolve known storm overflow needs in the River Almond and Water of Leith catchments.	2	Environmental water quality and aesthetic.
Total	**88**	

Table 7.17: Study programme types

In 7 catchments we have recognised that there may be interaction between treatment and collecting systems improvement requirements and we plan to undertake strategic catchment studies to identify the most efficient approach to resolving all identified environmental issues. These 7 catchments contain 63 storm overflows which are potentially non-compliant with UWWTD and WFD and 36 WwTWs that are potentially non-compliant with the Water Framework Directive. In delivering these integrated studies, we will work closely with SEPA who plan to undertake additional environmental monitoring and sampling to confirm whether the waste water treatment works are contributing to the downgrading of water quality.

Our solutions development studies in the Water of Leith and Almond Valley catchments will develop detailed solutions for environmental needs which we have already identified at 64 storm overflows and 8 WwTWs.

Our recent studies have shown that significant changes to the numbers of potentially non-compliant discharges can occur as new information becomes available from drainage area models. When developing our future study programme, we have considered investigation of innovative approaches where these might be applicable to the location.

Innovation in action:

In the Daldowie catchment in Glasgow we are investigating the use of a storm water wetland to both manage storm overflows and provide wetland treatment in place of traditional storage, or increased sewer capacity. This investigation will confirm the scope and scale of improvement works that we expect to be undertaken in the next investment period.

With SEPA, we have identified all potential Scottish Water pressures which could be contributing to a downgrading of water bodies, preventing the WFD objectives from being achieved. There are 54 WwTW discharges that will be investigated as part of our integrated catchment investigations to understand what improvements are required.

Water abstraction and fish pass investigations
Table 7.18 summarises the WFD pressures in relation to water abstraction and fish passage that we plan to investigate. We have allowed £0.9 million within our plan to undertake further studies into drinking water abstraction and barriers to fish passage.

Asset impacting the environment	Number of assets	Environmental pressure	Length of water body affected	Investigation
Waste water Treatment works	54	Phosphorus, ammonia and BOD discharges	382km	Integrated catchment investigation (see table 7.7)
Drinking water abstractions	11	Abstraction levels are impacting ecology	67km	Study to determine impact of abstraction and options for resolving identified issues.
Barriers to migratory fish	11	Barrier to migratory fish	66km	Study to determine impact of barrier and options for resolving identified issues.
Total	**76**		**515km**	

Table 7.18: Summary of pressures to be investigated by 2021 to support WFD

National Sludge Strategy
Our national sludge strategy was published in 2009 and promotes optimisation of our available recycling routes with 80% of our sludge treated through our PFI partners and the remaining 20% recycled to land by Scottish Water. From 2021, our current PFI contracts will begin to expire, providing the opportunity to reassess the optimum approach to recycling sludge. We plan to invest £1.3 million reviewing our national sludge strategy to consider how we can extract maximum value from our sludge in terms of energy, nutrients and other by-products and how best to organise our operations and future investments to achieve this. In our plan we propose an advanced anaerobic digester which will convert sewage sludge into electrical power. We will use information from this investment to inform our future national sludge strategy.

Statutory improvements required to protect the wider environment

Security of waste water assets

Working with the Scottish Government's Resilience Unit we have agreed investigations and improvements that require to be undertaken to protect the water environment in Scotland. We plan to invest £5.5 million meeting these requirements.

Statutory Odour Improvements

Waste water treatment works can generate malodour due to the nature of the material being treated. There are statutory requirements to control odour. These are set out under the 'Code of Practice on Sewerage Nuisance', which is enforced by Local Authorities and, where sites are subject to 'Waste Management Licenses', the control of odour emissions is enforced by SEPA.

Using malodour complaint information received from customers, local authority environmental health teams and SEPA, we have identified 13 sites that generate, on average, 4 or more complaints per year. We plan to invest £2.4 million in delivering the improvements within the odour improvement plans at 2 sites subject to waste management licenses and 3 other sites identified as causing a nuisance under the Code of Practice. In line with best practice, we have taken a phased approach to improvements and have set aside an allowance of £0.4 million for IR18 should further improvements be required to deliver the desired reductions.

Supplementary information - water environment

The Priority Substances Directive

This Directive is aimed at removing or reducing substances that are toxic within the aquatic environment, even at low levels. To date 33 substances have been identified and the list remains under review and is updated regularly.

The Priority Substances Directive requires potentially toxic substances to be reduced or removed from water bodies. The substances are ubiquitous in the environment and come from varying sources as shown in the Table 7.19.

Priority Substance Group	Typical Sources
Chemical compounds	Found in hand creams, and personal cleaning products. Kitchen, bathroom and industrial cleaning products. Flame retardants (which get onto clothing)
Chemicals used in plastics	These are present in everyday plastics such as shower curtains, gutters, down pipes and sewer pipes.
Metals such as, copper, nickel, zinc and lead.	These materials are common in household plumbing, building products such as roof flashing and are used in industrial processes.
Hormones such as oestrogen	Human waste – both naturally occurring hormones and those associated with birth control products are present in waste water.
Pharmaceuticals such as ibuprofen.	Human waste – medicines are not fully absorbed into the body so some passes through and into the waste water.

Table 7.19: Priority substances typical sources

Waste Framework, Industrial Emissions and Contaminated Land Regulations

To ensure that sludge produced by our treatment processes does not contaminate the water environment, we have to ensure compliance with:

The Waste Framework Directive

This Directive establishes the legislative framework for the management of waste in Europe. It sets the definition of waste and the essential requirements for the management of waste, along with encouraging the application of the waste hierarchy to drive reuse and recycling of waste over disposal options. It places responsibilities on Scottish Water to handle waste in a way that does not have a negative impact on the environment or human health, and to ensure that waste management operations are carried out under a permit or under the waste management licensing regime.

Industrial Emissions Directive

This Directive is the successor of the Integrated Pollution & Prevention Directive and combines several existing pieces of legislation, with the aim to minimise pollution from various industrial emissions. It may place responsibilities on a number of Scottish Water's sludge treatment and waste management activities, requiring these operations to be carried out under the requirements of a PPC permit. This is an integrated approach to regulation to ensure a high level of protection to the environment as a whole. Any permit must take account of the whole environmental performance of the plant e.g. emissions to air, water, land, generation of waste, energy efficiency, noise, and restoration of the site upon closure

Contaminated Land Regulations

A number of EU Directives relate to contaminated land issues, such as the Waste Framework Directive, Water Framework Directive, Groundwater Daughter Directive and the Environmental Liability Directive. In the UK, these regimes are covered under the Environmental Protection Act Part IIA, and the Contaminated Land Regulations in Scotland. These provide the legal framework for the identification and stabilisation of contaminated land, and are aimed at addressing land historically contaminated and which poses a risk to human health or to the environment. Where Scottish Water does not have appropriate licensing in place to deal with sludge storage and disposal activities, it is possible that storage sites could be classified as contaminated land and further remedial measures required.

Impact on customers / the environment of Scottish Water activities

The potential impact on customers and the environment of not achieving the standards is set out in the Table 7.20.

Pressure	Effect on environment
Over abstraction of water.	Causes the water body to dry up at times of low river flow, damaging aquatic plant life, and preventing fish moving with rivers.
Low levels of compensation water released from dams	
Minimal flow variability	Constant flow of water released from dams does not mimic natural condition where large flows occur and stimulate fish to migrate upstream.
Barriers to fish passage	Dams and weirs are too high for fish to pass, preventing them migrating upstream to spawn. Less fish in river systems and upper part of systems have no fish life.
Phosphorus discharges from storm overflows and waste water treatment works	Elevated levels of phosphorus in the water body can stimulate the growth of algae which causes imbalances in the natural river system, limiting the diversity of the aquatic life.
Ammonia discharges from storm overflows and waste water treatment works	Elevated levels of ammonia in the water body can stimulate the growth of algae which causes imbalances in the natural river system limiting the diversity of the aquatic life. In addition, ammonia at elevated concentration can 'suffocate' fish causing them to die.
Materials which deplete oxygen levels when decaying	Various organic and chemical compounds in waste water require oxygen when being broken down by bacteria. The oxygen is taken from the water which reduces the level available to aquatic life, in effect, suffocating them.
Bacteria	Bacteria in the water can become concentrated within filter feeders such as shellfish. Ecoli bacteria carried in faecal matter can pose a health threat if the shellfish is not cooked properly before consumption.
Priority substances	Elevated levels of toxic compounds in the water reducing the levels of aquatic life, or preventing it from being improved.
Stored sludge contaminating water body	Various organic and chemical compounds within stored water and waste water sludge can enter water bodies when mobilised by rainfall. These compounds can be toxic to aquatic life (ie Aluminium) or can require oxygen when being broken down by bacteria which reduces the level available to aquatic life, in effect, suffocating them.

Table 7.20: Environmental impacts of different pollutants

Options for improving environmental water quality

Table 7.21 summarises the options for improving environmental water quality, more detail about each is provided in this section.

Option	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Pressure on Water body	**Study to confirm pressure and solution**	**Review SEPA licence**	**Demand reduction**	**Connect to another network**	**Additional Water Sources**	**Provide a fish pass**	**Source control in catchment**	**Treatment to remove oxygen demanding elements**	**Treatment to remove nutrients**	**Treatment to kill bacteria**	**Surface water management**	**Storm water screening**	**Storm water storage**	**Improve sludge storage arrangements**	**Remove sludge from site / treat on site**	**First time provision of public sewerage**
Altering flow regime of water body	✓	✓	✓	✓	✓											
Barriers to fish migration at dams and weirs	✓	✓	✓			✓										
Waste water treatment works discharges	✓	✓					✓	✓	✓	✓	✓		✓			
Storm overflows discharges	✓	✓					✓				✓	✓	✓			
Surface water discharges	✓	✓					✓				✓		✓			
Risks from historically stored sludge	✓													✓	✓	
Waste water discharges from private households	✓	✓														✓

Table 7.21 Options for improving the environment

Table 7.21 sets out the options that we have identified could be considered to improve the quality of the water environment. More detail about each option and when they are suitable for use is set out below.

Option 1 – Study to confirm pressure and solution

Since 2006, Scottish Water and SEPA have been working together to understand how Scottish Water's activities impact the environment. This has seen two thirds of the Scottish Water activities suspected of causing a problem being discounted, and optimum solutions identified for those confirmed as a problem. The largest use of this approach to date has been in Glasgow where a strategic study has developed an entirely new strategy for improving the sewerage system in Glasgow.

Abstraction studies

Scottish Water abstracts water for the drinking water supply by taking water directly from burns or rivers or lochs, using dams to form storage reservoirs and controlling the volume of water being released into the river or burn; or pumping water out of aquifers using boreholes.

Where a water body is not at good status, our impact on the flow regime could be the cause and needs to be investigated. This will confirm the actual flow regime in the water body, confirm whether it is impacting on the ecology of the river and confirm if the abstraction regime should be changed. If a reduction in abstraction is required, the study will identify how to replace the lost water to ensure that the drinking water supply remains unaffected.

Barriers to fish migration studies

Scottish Water reservoirs and weirs can prevent fish passing up-river to spawn as a result of there being a physical barrier or contributing to low flows in the water environment, or both. To understand if fish passage

can be improved, specialist investigations are required. These identify whether installing a fish pass is physically practical, confirm the stretch length of river that will be made accessible, the volume of water required to run the fish pass (which can be considerable), and the impact on the water supply of losing this water. In addition, studies may identify changes required to the flow regime to stimulate fish passage such as releasing large volumes of water for a short period (called a freshet) to stimulate fish to migrate upstream.

Sewer network and waste water treatment study
Where a water body is not at good status and Scottish Water has surface water, sewer overflow or waste water treatment works discharges, a study is required to confirm the actual discharges which are causing the problem. In addition, sewer overflows on rivers at good status can be identified as potentially being unsatisfactory if these operate during dry weather or are creating litter. Again, these require study to confirm whether there is a problem.

Where studies confirm that there are problems, the studies of these will also identify the optimum way to reduce our impacts on the water body.

Three forms of study will be used, depending on the issues identified.

- Where the potential for a littering (aesthetic) problem has been identified, a study will be undertaken to confirm that littering is a problem using a standardised approach involving repeat site visits.
- Where dry weather operation is suspected or littering has been confirmed, a mathematical 'drainage area model' will be constructed. This will synthesise how the sewer system behaves and identify overflow frequency and volume and the additional capacity required in the sewer system to reduce this and resolve the problem.
- Where discharges are suspected of impacting on the quality of the water body, a 'drainage area model' and a river/costal water quality model will be constructed and linked together. The river/costal water quality model will show the impact of all discharges into the river (Scottish Water and non Scottish Water) to determine where the problems are, what is causing them and how these are best solved. New models will be constructed where these do not exist currently.

Phosphorus study
SEPA have identified 109 waste water treatment works where the levels of phosphorus may be causing ecological problems within the water body. This is based upon guidance from UKTAG, a national group that offers advice on the standards required to support good status. However, inconsistencies are being reported between the average levels of phosphorus and the condition of the ecology, in some area the phosphorus level are low and the ecology is poor, in other phosphorus is high and ecology is good. UKTAG have recently completed further work in this area to improve guidance and to ensure consistency across the EU.

To improve understanding in Scotland, Scottish Water is undertaking further investigations into the link between discharges and ecological impact in Q&SIIIB. Further investigations will improve understanding of source apportionment, determining whether problems are linked to average phosphorus levels in waste water discharges or peak phosphorus levels which are linked to run off from fields. The outcome of these studies will help determine whether improved treatment or a catchment management approach is most likely to improve Scotland's water bodies.

Option 2 – Review Licence Conditions

Studies can indicate that Scottish Water's current performance is not in line with the requirements of SEPA's licences which set the allowable level of abstraction and discharge. This can be because the information used within licences is based upon historical agreements, before accurate measurements have been taken or because changes have occurred in the networks and treatment assets. Conversely, studies can confirm that current performance is better than required in the licence.

In either of these circumstances, if the current performance levels meet those required to support river water quality standards, licences can be updated to reflect current practice at little cost and without asset enhancement.

Scottish Water and SEPA are currently working together to review current licenses against guidance and against environmental need to ensure consistency and this approach will be continued as further studies are undertaken.

Option 3 – Demand reduction

Where abstraction studies have indicated that Scottish Water needs to reduce the volume of water it abstracts, the water lost must be replaced to ensure that the drinking water supply remains unaffected. This

option reduces the demand for water, balancing the volume of water lost to the environment. The main ways to reduce demand are:

Reduce leakage
This involves undertaking more leakage detection and repair work, incurring additional operating costs. The size of the opportunity depends on the supply area with all having a level of leakage, below which, further reductions are not physically possible at this time. This solution provides reasonable certainty of achieving the outcome and has been used successfully on a number of occasions.

Water efficiency
This involves encouraging customers to become more water efficient, reducing demand. The volumes achievable depend on the size of the supply zone, customer behaviours, and scale of the customer engagement programme delivered. It also needs to be delivered in conjunction with leakage reduction to get customers' support for the approach. This solution has a lower certainty of achieving the outcome.

Option 4 – Connect to another network

Where abstraction studies have indicated that Scottish Water needs to reduce the volume of water it abstracts, the water lost must be replaced to ensure that the drinking water supply remains unaffected. This option involves providing a connection to another network which has surplus resources, ensuring that there is no impact on overall water supply resilience. This solution provides high certainty of achieving the outcome and we have used this approach on a number of occasions.

Option 5 – Additional water sources

Where abstraction studies have indicated that Scottish Water needs to reduce the volume of water it abstracts, the water lost must be replaced to ensure that the drinking water supply remains unaffected. This option involves increasing the available resources at the existing source by increasing the volume of a reservoir to store more water during times of heavy rain, or creating a new source to augment the existing source, for example by abstracting from a burn in an adjacent catchment or from boreholes in a local aquifer. The actual solution will depend on the local situation. This is a solution that provides high certainty of achieving the outcome and we have used this approach on a number of occasions.

Option 6 – Provide a Fish Pass

To help fish to pass our reservoirs and weirs we can provide fish passes. Two forms of solution exist:

Simple 'rock ladders' formed from an arrangement of rocks that form pools, allowing the fish to jump between pools and over the obstruction. These are only suitable for low level obstructions such as weirs and take very little water to operate.

Complex fish passes which are specially designed structures to control flow volume and speed to allow the fish to jump or swim up the structure and rest in calm areas. These are typically used for higher obstructions and require a continuous flow of water. This can significantly impact on the volumes of water stored, thus additional water may be required to sustain the water supply as set out in Options 3, 4, and 5.

Loch Katrine Fish pass

Scottish Water has a number of fish passes on its reservoirs and weirs but has not previously retrofitted fish passes to existing structures and cannot be certain of the outcome as it can take many years to encourage fish to migrate upstream.

Option 7 – Source control in catchment

Continuous discharges
In order to remove more pollutants at waste water treatment works, additional, complex stages of treatment using more chemicals and power are required. These enhancements can be expensive to construct, operate and maintain and create increased carbon emissions. Rather than enhancing existing waste water treatment works to remove nutrients and other substances, source control, where the pollutant is prevented from entering the sewer network or the environment, can provide a more sustainable solution.

Source control for continuous discharges involves working with customers to limit the types of substances disposed of in the sewers. In addition it may involve working with companies that make products used in the home, and government to limit the levels of substances included within products that enter the sewer. This is a relatively new area and the certainty of the outcome is still to be understood.

Intermittent discharges
Combined sewer overflows allow storm water to be released from the sewer to relieve pressure on the sewerage system and to reduce the risk of sewer flooding and pollution. Although pollutants in storm water discharges are heavily diluted by rainfall, significant and frequent discharges can cause environmental problems. Treatment of storm water discharges is possible but can be prohibitively expensive, requiring significant land and new assets whereas retaining storm water within the system requires significant reinforcement of the sewer network. Removing or reducing pollutant loads at source can reduce the risk of environmental damage through intermittent discharge.

Scottish Water's surface water systems are intended to convey rainwater from housing and industrial developments direct to the environment. However, through misconnection of waste water sewers and accidental spillages, these discharges can contain oil, cleaning chemicals and other substances associated with industrial processes which are capable of having a significant environmental impact. Scottish Water and SEPA have identified 15 surface water systems that are suspected of causing environmental damage and these will be investigated in order to develop surface water action plans which identify key activities for traders, SEPA and Scottish Water to undertake to minimise the risk.

Option 8 – Treatment to remove oxygen demanding elements

Where organic and chemical compounds in sewage discharges deplete available oxygen in the environment, there is less oxygen available to support aquatic life and fish kills can occur.

Where Scottish Water has small assets, typically serving populations less than 100, SEPA will regulate performance using simple licenses which require removal of solids and descriptive standards around visible pollution to be met. These standards will be met using basic treatment such as septic tanks, reed beds and soakaways reducing the demand on the receiving water body.

Where discharges from larger assets have the capacity to cause more serious environmental damage, SEPA regulate using complex licenses setting limits on the oxygen demanding elements of sewage discharges. In these cases, biochemical oxygen demand (BOD) and ammonia standards are introduced to protect the environment. The treatment solution will depend upon the level of treatment already available, the scale of the flow and load to be treated and the standards that need to be met.

At WwTW, primary settlement, secondary biological treatment involving the introduction of oxygen (activated sludge and biological filters), tertiary treatment involving further settlement or filtration and chemical dosing may all be required. Solutions to limit BOD and ammonia are well tested and understood and are set out within a standardised Scottish Water process selection matrix, similar to others in use elsewhere in the UK water industry.

Option 9 – Treatment to remove nutrients

Nitrogen and phosphorus are essential nutrients for plant growth. Elevated levels of these will encourage plant growth until it becomes an environmental problem and eutrophication occurs. Increased plant growth causes imbalance in the natural river system stimulating a demand for oxygen which can limit diversity of aquatic life, creating aesthetic problems and generating odour as plants and algae break down.

There can also be taste and odour problems associated with algal blooms, and these could lead to higher treatment costs if drinking water sources were compromised

The magnitude of effects depends on receiving water characteristics, waste water discharge loadings and environmental conditions with eutrophication rates increasing significantly with rising water temperature and lower flow conditions. Nutrient pollution is now recognised as one of the most significant single threats to the quality of our aquatic environment.

Nitrogen
To avoid problems with nitrogen in the water body, the waste water treatment works must break down ammonia to form nitrates through a process called nitrification. This process requires long retention times, an oxygen rich environment and strict controls on the rate of loading and alkalinity. Nitrates are then converted into Nitrogen gas through a process called denitrification.

There are many proven technologies that can be used to remove ammonia and reduce problems associated with nitrogen. Activated sludge plants, nitrifying sand and nitrifying trickling filters and package plants such as submerged aerated filters and sequencing batch reactors can all be used depending upon the loads and standards to be achieved. For smaller assets, reed beds can be used to achieve ammonia standards of 20 mg/l.

Phosphorus

In order to reduce phosphorus problems within the water body, Scottish Water uses chemical precipitation by dosing a chemical coagulant (ferric) into the waste water. These salts react with phosphate ions in the waste water to form metal phosphates that precipitate and are removed from the waste water along with other sludge from the process.

Scottish Water currently uses chemical dosing for phosphorus removal in around 40 locations. It is fairly well understood and works reliably and is considered a standard tertiary treatment process.

Scottish Water has previously considered alternative approaches to achieving phosphorus removal and carried out a review of some alternative technologies prior to developing the 2010 to 2015 investment programme. This review primarily considered biological removal of phosphorus but concluded that the sewage make up (low strength, high infiltration) and the existing treatment processes (small works, multiple process stages) were not suitable for successful implementation of this process.

With phosphorus now understood to be one of the most significant environmental problems, there is continued focus on research and development in phosphorus removal. Scottish Water and SEPA are continuing to study where reductions in phosphorus are required and Scottish Water will continue to consider where these emerging technologies present opportunities for application in Scotland.

Option 10 – Treatment to kill bacteria

Where treatment works discharge to bathing or shellfish waters, there may be a requirement to substantially reduce the bacteriological component of the discharge. Scottish Water's preferred approach to disinfecting sewage is to use ultraviolet (UV) radiation and this has been already been used at a number of locations. This process mimics the natural treatment that is provided to discharges in sunnier climates.

UV disinfection requires a very clean effluent stream (high transmissivity) so that the UV light can treat the full waste stream. As a result, upstream filters are required to remove particulate matter to ensure that the process is effective.

As an alternative to UV treatment, various chemicals can be used to disinfect treatment works discharges. Hydrogen peroxide or per-acetic acid can reduce bacteria content but are extremely expensive and can be dangerous to handle and as a result, these solutions tend to be used only as short term measures to provide treatment.

Option 11 – Surface water management

In order to reduce the volume of surface water (rain) entering the sewers, Scottish Water is investigating a range of surface water separation interventions. These range from disconnection of surface water run off from properties using soakaways, disconnection of surface water and highway drainage from the combined sewers and to retrofitting flow attenuation devices at individual properties. Scottish Water will pilot the cost benefit of different interventions before incorporating them into business as usual activities.

Option 12 – Storm water screening

Scottish Water has around 3,800 combined sewer overflows (CSOs) which are designed to relieve pressure on the sewerage system by providing managed overflow points. Some of these overflows operate very infrequently (once or twice per year in only times of very heavy rainfall) and many others do not operate at all.

Around 3,000 of these overflows have no screening provided on the discharge before it enters the environment. Where the overflow operates infrequently, these unscreened discharges are unlikely to cause any environmental impact but, where overflows are of significant volume, occurring frequently, littering of plastics and other sewage related items may occur downstream.

Through recent study programmes, Scottish Water has been investigating how CSOs perform and have identified locations where new screens should be provided. Further studies will be carried out to determine whether litter problems exist.

Openings in screens can range from 20mm in one direction (coarse) to 6mm in two directions and can be mechanically or manually cleaned. Equivalent performance can also be provided through package facilities which use hydrodynamics to generate flow vortexes in order to separate solids and to retain these and floatable material within the sewage system.

The type of screening installation will depend upon the significance of the discharge (volume and flow), the sensitivity of the receiving water and the accessibility of the installation.

Option 13 – Storm water storage

If overflows are shown to create environmental problems (water quality or littering) and these cannot be locally improved to meet environmental objectives, additional capacity must be created within the sewer network to retain flows without creating additional flooding or pollution risks.

Additional storm water storage can be provided in off-line or on-line storage facilities. On-line storage is provided by restricting flow and upsizing the upstream sewer network beyond the capacity required to transfer normal flows. Off-line storage is provided by diverting peak flows to tanks or shafts which fill up during heavy rainfall and are pumped out and returned to the sewerage system during periods of dry weather. Both of these approaches can be significantly costly with creation of large sewerage infrastructure involving significant surface disruption and excavation. These types of installation are used successfully to rationalise the number of overflows from the sewerage system but can create operational difficulties when the dry periods available to return stored flow to the system are not sufficiently long and the retention volume is, therefore, unavailable for storm flows and when debris and silt are deposited within the storage facility.

As an alternative to storm water storage, peak storm water flows can be transferred further down the sewerage system by providing relief sewers. Provision of transfer sewers can allow the number of overflows to be rationalised and the remaining overflows to be improved by providing appropriate screening and storm water handling at a reduced number of locations. Scottish Water's sewer network solutions consider a mix of both storage and transfer solutions, optimised using models of the sewer network to determine the most cost effective approach for each situation.

Storing storm water can improve waste water treatment works performance by managing incoming flow to ensure that peaks are less intense, helping to ensure that a consistent flow is maintained, avoiding wash out of the settlement and biological processes at the works.

Option 14 – Improve sludge storage arrangements

Historic sludge storage arrangements have been assessed to determine whether health and safety or environmental risk pathways exist. Many unused, historic sludge holding areas are unprotected and access for humans and livestock is not restricted. Where risks to either livestock or humans exist, we propose to install fencing to mitigate these until further investigations or remedial activities are undertaken. At some locations where investigations show that the sludge has fully broken down (mineralised) and no longer presents environmental or health and safety risks or investigations show that there is no risk to the environment, we will restore the site through simple landscaping.

Option 15 - Remove sludge from site or treatment on site

Where environmental risks have been established and there are direct links between stored sludge and nearby water bodies or where it would be prohibitively expensive to further establish that risks do not exist, we propose to make improvements to holding facilities by directly dealing with the stored sludge. Where there are significant volumes of sludge to be managed or where we have no outlet for any sludge removed, we plan to use an approach to treat sludge on site, making this safe and using it to profile and restore the site. We plan to pilot this approach at a number of locations to prove that this can be successfully applied. Where there are smaller volumes of sludge to be managed, we propose that these should be removed from site, taken to landfill and the site restored using imported material.

Appendix 8: Improving waste water services

In summary:

- Our customer research tells us that preventing flooding from sewers is a high priority for service improvement, and reducing pollution and odour are also areas for improvement.
- The majority of flooding incidents are caused by blockages in the sewers caused by inappropriate items being disposed of in toilets and drains.
- By listening to our customers we realise that our current approach to managing flooding, while consistent with that adopted across the UK water industry, could be improved.
- We plan to make progress towards understanding all those customers that are at risk of sewer flooding and progressively reduce the incidences and risk of sewer flooding to ensure that by 2040 service failures are close to zero and no customer experiences repeat service failures.
- Following extensive research and discussions with the Customer Forum we plan to invest £166.3 million from 2015 to 2021 to improve waste water services in line with customers priorities as follows;
    - £114.9 million to increase capacity of our sewer network so that we can remove all customers from the internal sewer flooding register as quickly as possible, typically within four years of their problem being confirmed. By 2021 the register of customers with a 10% chance of internal flooding will be in the range 250 – 280 properties.
    - Investment of £18.7 million to develop solutions to 400 external sewer flooding areas and deliver confirmed solutions to resolve around 159 known high priority external flooding issues where customers are experiencing repeat events. We have included a £25.1 million IR18 allowance to begin delivering solutions to the 400 external flooding areas being investigated.
    - Investment of £5.9 million to extend existing models and build new ones, beyond those required to support our Flood Risk Management Act obligations, to give a greater understanding of the customers' properties that have a resilience of less than 1:30 years.
    - Investment of £1.7 million in developing and piloting surface water management approaches to reduce the volumes of water entering the sewer system.
- In addition to this we will invest £13 million of operational costs to reduce incidents of flooding through a long term customer education campaign and targeted consultation approach to reduce the volume of inappropriate material disposed of via the sewer, with targeted advice in areas of repeat occurrences.

Waste water service strategy

Our strategy is to ensure that our customers have their waste water collected and safely returned to the environment without disrupting their lives.

In line with customers' priorities, we plan to improve service by progressively reducing the incidence of sewer flooding such that, by 2040, service failures are close to zero and no customer experiences repeat service failures. During 2015 to 2021 we plan to invest in customer engagement, investigations and asset improvements such that, by 2021:

- We have reduced the number of sewer flooding and pollution incidents caused by blockages in the sewer due to the disposal of inappropriate items in the sewer.
- All customers on our internal flooding at risk register at 2015 will have been removed from the register, or provided with a date by which they will be removed.

- The number of customers on our internal flooding at risk register will have reduced to a churn level of around 250 – 280 properties.
- We are providing support and care to customers during the investigation of their problems until these are fully resolved, including installation of temporary measures to alleviate the problem such as flood guards, given that many of these problems may take several years until they are fully resolved.
- We will have improved our understanding of the extent and risk of external sewer flooding, and will have begun to resolve high priority repeat instances. The external flooding register will fluctuate in size whilst investigation and validation work is undertaken.
- We will improve our understanding of the overall risk of customers' properties being flooded by carrying out integrated flood and water quality studies (where other statutory improvements are required) and dedicated flood modelling (where no statutory improvements are planned).

This Appendix sets out our plans to deliver these improvements. In this appendix all investment figures are provided in 2012/13 prices unless otherwise stated.

Ministers' draft objectives

Scottish Ministers' draft objectives for 2015 to 2027 set out that Scottish Water shall look to improve further on the level of services that it provides to its customers:

1.2 SERVICE STANDARDS OBJECTIVES

Build on the improvements made to date and continue to improve services to customers including those measures agreed with the Customer Forum.

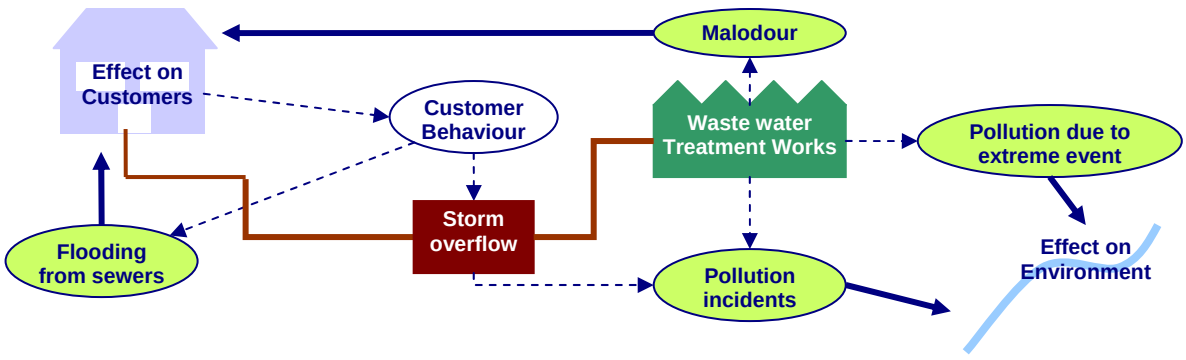
Waste water service impacts on customers and the environment

Our drainage service involves collecting rainwater from customers' roofs, paved areas and some roads on behalf of the local councils (surface water) and collecting domestic sewage and commercial and industrial discharges (waste water). We convey this through a network of pipes, pumping stations and storm tanks before treating it at waste water treatment works and discharging it back to the water environment under license from SEPA. Some of the surface water is collected in separate surface water sewers or sustainable urban drainage systems (SUDS) and is discharged direct to water bodies.

Within the collection system, there are storm overflows which discharge untreated combined waste and surface water to water bodies during periods of heavy rain – this prevents the sewerage network from being overloaded and causing flooding.

The key waste water service adverse effects on customers are set out in Figure 8.1.

Figure 8.1: Waste water services and linkages



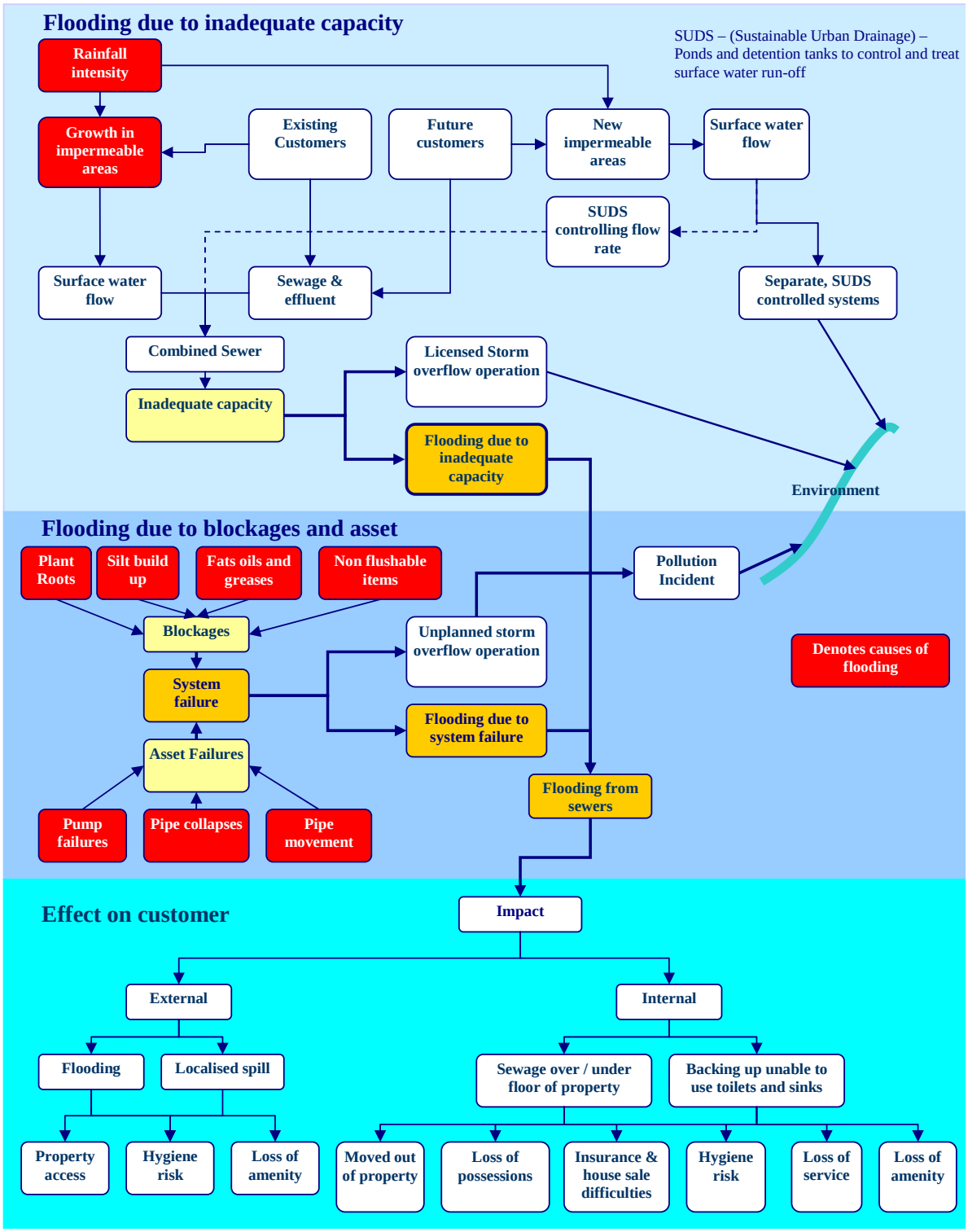
Flooding from sewers

Flooding from sewers occurs when sewage escapes from the sewerage network and directly affects customers, either by coming back out of baths, toilets and sinks, or through manhole covers as shown in Figure 8.2.

Figure 8.2: External flooding from manhole at Fullerton Avenue, Glasgow

The two main causes of sewer flooding are a lack of hydraulic capacity within the sewerage system and failure or blockage of the sewerage system. The detailed explanation of these causes and the impact on customers are shown in Figure 8.3.

Figure 8.3: Sewer flooding and pollution incident causes and impacts



Sewer flooding performance measurement

We record and respond to all incidents of sewer flooding reported to us. Where internal flooding of a customer's property has occurred, we investigate this to determine whether it was due to a blockage or because of inadequate capacity within the sewer system. The following incident types are recorded:

- ***Internal sewer flooding events due to inadequate capacity***. This records the number of internal flooding events that occur due to a lack of hydraulic capacity. Where the return period of the storm event is 1 in 10 years or less, properties impacted by the event are also recorded on our regulatory Internal Flooding Register.
- ***Internal sewer flooding events due to service failure.*** This is a record of the number of internal flooding events that occur due to a blockage in the system or by failure of assets e.g. a pump stopping.
- ***External sewer flooding events due to inadequate capacity.*** This is a record of the number of external flooding events that occur due to a lack of hydraulic capacity. Where the return period of the storm event is 1 in 10 years or less, properties impacted by the event are also recorded on our recently created regulatory External Flooding Register.
- ***External sewer flooding events due to service failure.*** This is a record of the number of external flooding events that occur due to a blockage in the system or by failure of assets e.g. a pump stopping.

Annual reported sewer flooding incidents have been broadly stable over recent years as shown in Figures 8.4 and 8.5. The figures also show that the number of incidents caused by blockages or asset failures is around 20 times more than those due to inadequate capacity. Figure 8.4 also shows the variability of flooding incidents due to inadequate capacity in any one year. This is caused by variability in annual weather patterns and where storm events occur, indicating the importance of understanding the risk of sewer flooding for all customers.

We are still compiling our external flooding due to inadequate capacity register and further improvements in data capture and recording are underway. As we improve how we capture information in this area we anticipate further fluctuation in the reported external flooding levels.

Figure 8.4: Annual reported flooding events due to inadequate capacity

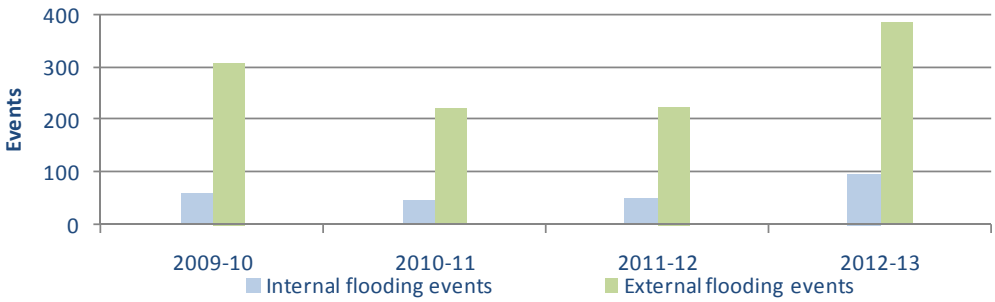


Figure 8.5: Annual reported flooding events due to blockages or system failure

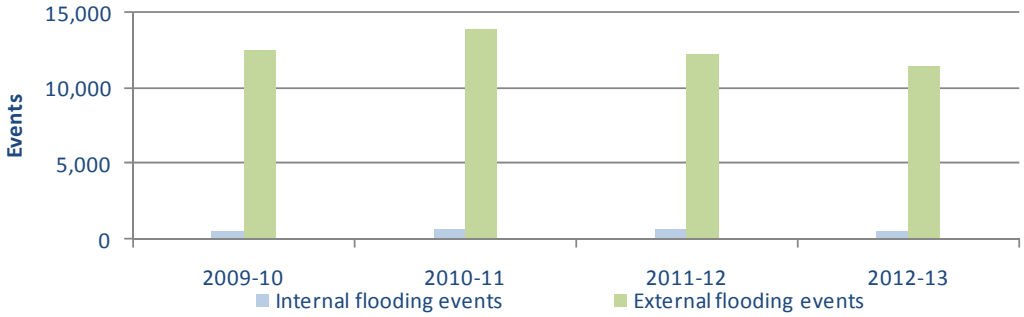


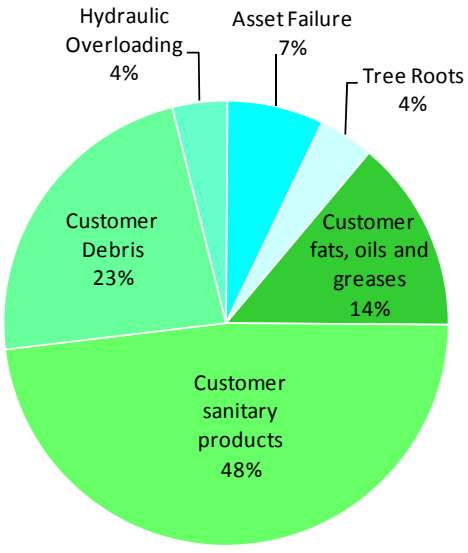
Figure 8.5 shows external sewer flooding incidents due to blockages or system failures have reduced since 2010/11. This is due to the improved way we resolve blockages in the sewer.

Innovation: CCTV inspection of repeat blockages

In 2011 we changed how we responded to sewer blockages with the aim of increasing customer satisfaction and reducing costs. We have provided our sewer response teams with CCTV equipment to enable them to confirm the cause of blockages once they have been cleared. Our team started inspecting sewers where there had been three previous blockages or more in recent years. The inspection enabled them to identify sections of damaged sewer and request follow up repairs. Along side these inspections we developed a rapid response process to ensure that defective sewers were repaired quickly reducing the chance of customers experiencing a repeat blockage. We now inspect all repeat blockages and have increased levels of customer satisfaction.

Our root cause analysis of all sewer flooding incidents, summarised in Figure 8.6, indicates that over 80% are caused by inappropriate items being disposed of within toilets and drains whilst 4% are caused by inadequate capacity. This suggests that encouraging customers to properly dispose of waste items will help reduce incidents of sewer flooding.

Figure 8.6: Root cause analysis of sewer flooding



Sewer flooding 2015 forecast performance

Internal flooding due to blockages and asset failures

By 2015, we forecast that each year there will be 600 to 650 internal sewer flooding events due to blockages and asset failures impacting an estimated 900 customers. The majority of these events will be caused by blockages in the small pipes which connect customers' properties to the main sewer (called a sewer lateral) and, as a consequence, the size of the flood event will be limited. Where this occurs we will respond quickly to clear the blockage and clean up the affected area.

We forecast 130 to 150 of these events will be caused by the larger main sewers becoming blocked. Impact from these events can be more substantial with larger areas affected and more customers impacted as a result. Whilst we will respond quickly to clear up the affected area, investigations and remedial actions are likely to take longer to complete.

Internal flooding due to inadequate capacity

Scottish Water designs new sewers to be capable of draining the surface water generated by a storm with a 1 in 30 year return period.

Regulatory practice in the UK is to create a flooding Register which records customers 'at risk' of internal flooding due to inadequate capacity based on actual flooding events in the following two categories:

- Customers that are impacted by a storm event with a 1 in 10 year return rainfall period (meaning they have a 10% probability of being flooded each year).
- Customers that are impacted by a storm event with a 2 in 10 year, or worse, return rainfall period (meaning they have a 20% probability of being flooded each year).

By 2015, we predict there will be 64 to 72 internal flooding events each year due to inadequate capacity affecting around 110 customers in these two categories. When such events occur the impact can be significant with large volumes of flood water being discharged from the sewer system during times of heavy rainfall.

By 2015 we forecast that there will be 340 to 370 properties on the internal sewer flooding register and that, on average, 72 properties will be added to the register each year as a result of new internal flooding events. The reasons for these can be increased storm run-off to the sewers due to additional paved areas or roof space in the area drained by the sewer system, or they may be properties that have always been at risk but the storm that causes flooding has only now occurred.

External Flooding due to blockages and asset failures

By 2015, we forecast that there will be 12,000 to 14,000 flooding events each year due to blockages and asset failures and that these will impact an estimated 24,000 customers. The impact of these events will range from a small spill from a manhole to larger areas of flooding if a main sewer is blocked. Again our response teams will respond to such incidents, clearing the blockage and cleaning up the areas affected.

External flooding due to inadequate capacity

By 2015, we predict that around 400 external flooding events will occur each year due to inadequate capacity affecting around 800 customers. We are currently establishing our external sewer flooding register, and currently expect that we will identify between 3,500 and 5,000 properties with a 10% probability of being flooded each year. We know that there is an overlap between events causing internal and external flooding with around 10% of external flooded properties expected to be associated with internal flooding events.

Whilst delivering improvements to reduce the properties at risk of internal flooding from overloaded sewers will reduce the number of properties at risk of experiencing external flooding, a significant remaining number will not be addressed by these schemes.

Environmental pollution incidents

Environmental pollution incidents occur when the sewerage system either becomes blocked, pumps stop operating, or there is an equipment failure at a waste water treatment works causing an unplanned direct or indirect discharge to a water body through overflow pipes or manhole covers as shown in Figure 8.3.

The severity of a pollution incident is measured based upon its impact on the environment, amenity levels of the receiving water, and economic impact on commercial businesses and farms. The three categories used to classify pollution incidents are:

- Major (Category 1) which cause extensive visible pollution and can damage the environment over a length greater than 1km killing in excess of 100 fish.
- Significant (Category 2), which cause significant visible pollution or littering and can damage less than 1km of receiving water, killing 10 to 100 fish.
- Minor (Category 3) which cause minor visible pollution or littering and can cause localised environmental damage killing less than 10 fish.

We have made significant improvements in reducing the number of pollution incidents we have each year. Through this targeted programme of work, we now understand the root causes of such incidents, which overlap with many of the causes of sewer flooding incidents. By 2015, we forecast there will be between 310 and 330 pollution incidents each year of which only around 10 will be classified as major or significant.

Pollution incidents and sewer flooding are interrelated as shown in Figure 8.3 and, as such, we anticipate our plan to reduce sewer flooding incidents will also result in a reduction in minor pollution incidents.

Malodour from waste water treatment works

Waste water treatment works can generate malodour due to the nature of the waste material being treated. Some treatment processes generate significant malodour for example where:

- Sewage is sprayed into a tank to mix it and encourage aeration;
- Sewage being treated emits high level of hydrogen sulphide which creates a strong rotten egg smell.

There are statutory requirements to control odour set out under the ‘Code of Practice on Sewerage Nuisance’, which is enforced by Local Authorities and, at sites subject to ‘Waste Management Licenses’, the control of odour emissions is enforced by SEPA. We have identified 5 waste water treatment works where statutory improvements are required; statutory investment to address these is explained in Appendix 7.

Using malodour complaint information received from customers, local authority environmental health teams and SEPA, we have identified a further 8 sites that generate, on average, 4 or more complaints per year. Taking account of the levels of complaint, customer priorities for service improvement and following discussion with the Customer Forum, we plan to defer improvements at these sites until after 2021. We will review this at IR18 should new information come to light regarding the level of nuisance being caused.

Planned investment

Our plan has been informed by investigations into the causes and risks of internal and external sewer flooding events. Table 8.1 summarises the investments we plan to make from 2015 to 2021 to improve the levels of services for customers.

Improvement programme	2015 to 2021 Capex (2012/13)			Output
	Committed		IR18	
	Capex	Opex	Totex	
Reducing Flooding and Pollution from sewers				
Internal flooding improvements	74.4		33.1	523 customers removed from at risk register
Internal flooding improvements - completion programme	7.4			
External flooding improvements	18.7		25.1	129 areas improved; 400 areas investigated and solutions developed
Flood resilience assessments	5.9			90% of customers assessed
Customer education programme		13.0		Reduced flooding incidents
Surface water management investigations	1.7	1.1		Surface water management strategy
Total	**108.1**	**14.1**	**58.2**	

Table 8.1: Planned investment to improve waste water services

Details of planned improvements

Internal flooding improvements

We believe that customers should not have more than a 3% probability of being flooded each year, and that our current approach of only resolving customers who have been flooded by a storm event with a 10% probability of returning each year does not align with the priorities of customers.

Our plan is to remove all customers who are on the sewer flooding at risk register at 2015, and emerging customers (added to the register after 2015) as quickly as possible, typically within four years of their problem being confirmed. All customers will be given support and regular updates as we investigate their problem, and once a solution has been identified they will be given a date for resolution.

When resolving customers' issues, our improvement schemes will restore the capacity of the sewer to provide resilience to all customers in the local area to a 1:30 year storm event. We anticipate this may improve sewer flooding resilience for around 6 neighbouring customers in addition to the customer recorded on the sewer flooding register. As our investigations and modelling progress we will be able to confirm the overall benefits of each solution.

In addition to the £7.4 million investment to complete sewer flooding improvements in Glasgow commenced in the 2010 to 2015 period, we plan to invest £107.5 million to increase the capacity of our sewer networks removing capacity constraints that are causing internal flooding of customers' properties. This comprises:

- £40.4 million delivering solutions for 123 customers, 61 of which are addressed through our integrated strategy for improving Glasgow's drainage system. We estimate that around a further 730 neighbouring customers may also benefit by having their resilience to flooding restored to 1:30 by these schemes.
- £20.6 million developing and delivering solutions for 75 customers with confirmed problems. We estimate that around a further 400 neighbouring customers may also benefit by having their resilience to flooding restored to 1:30 by these schemes.
- £46.5 million developing and delivering solutions to 325 customers who we expect to be added to the register from April 2013. We estimate that around a further 1,900 neighbouring customers may also benefit by having their resilience to flooding restored to 1:30 by these schemes.

We have allocated £33.1 million of this investment as an IR18 allowance to allow a review of the emerging rate of new properties affected and unit costs of resolution at December 2017.

We expect the number of customers with a 10% chance or greater of internal flooding to reduce from a forecast of 340 to 370 properties in 2015 to 250 to 280 properties in 2021.

External flooding improvements

We are currently establishing an external sewer flooding register and the investigation processes to support this. As such we are less certain about the number of customers at risk of external sewer flooding. However based on what we have confirmed, we plan to invest:

- £11.7 million delivering developed solutions to external flooding associated with internal flooding (mainly as part of our integrated strategy for improving Glasgow's drainage system).
- £7.0 million developing solutions to 400 high priority external sewer flooding areas suffering from frequent repeat events.
- We have included a £25.1 million IR18 allowance to begin delivering solutions to the 400 external flooding areas and investigate emerging priority areas identified from the established external sewer flooding register and flood risk studies.

We also plan to support customers affected by repeat external sewer flooding by providing, where appropriate, temporary measures such as sandbags or landscaping to reduce the damage to their properties where risks are known and understood.

Assessing sewer flooding resilience

To move from a reactive approach to a proactive approach we plan to invest £5.9 million in modelling the sewer network to assess the flooding risk that customers are exposed to. We will deliver this as part of our wider sewer modelling programme for Flood Risk Management and Environmental quality obligations, covering around 300 catchments and over 90% of our connected population. Using this intelligence we will develop a long term strategy for increasing resilience to flooding for all customers.

Customer education programme

To improve services, we plan to reduce flooding and pollution incidents due to system failures by encouraging customers to properly dispose of waste items that are sometimes inappropriately flushed down the sewer. We plan to invest £13 million engaging with customers through a long term education campaign. This will comprise of a national campaign to raise awareness and sensitivity of the issue followed by targeted advice focused on areas experiencing repeat flooding events covering around 5% of all customers. We also plan to work with the wider water industry and sanitary product manufacturers to improve labelling of products and to improve understanding of what is 'flushable'.

The outcome of this approach is uncertain as it depends upon customers being willing to change their behaviour. Should this campaign be successful, further extensions could be considered under the rolling enhancement programme.

Surface Water Management

The lack of sewer network capacity can have significant customer impacts and capacity is under continued pressure from climate change, urban creep and growth. The progressive removal of surface water from the network has the potential to help alleviate these pressures. However removing surface water requires alternative uses, storage or flow routes to be provided to prevent surface flooding. We believe that surface water management techniques will be one of many approaches needed to increase the resilience of sewer networks against flooding.

Following discussion with the Customer Forum we plan to invest £1.7 million developing a Surface Water Management Strategy. This will identify the characteristics of catchments where surface water management techniques are both technically and economically suitable and develop design guidance.

Supplementary information - Options for improving service

Methods of alleviating sewer flooding due to inadequate capacity

Sewer network improvements

Network improvements which would reduce the frequency and amount of sewer flooding could involve:

- Providing additional sewer capacity through bigger sewers, additional relief sewers or by using underground storage tanks;
- Re-configuring the sewer network, where possible, to address 'hot spots' by diverting flows into other parts of the sewer network;
- Removing 'surface' water from the sewer system to alleviate sewer capacity issues;
- Sewer refurbishment and replacement to address sewer deterioration; and
- Localised pumping to prevent backflows in the customers' sewer.

These options are generally 'tried and tested' and, provided adequate modelling is carried out, are generally guaranteed to deliver the required reductions in the incidence of sewer flooding. However as asset based solutions can be expensive they must be developed in an integrated way that maximises the benefits to customers from investment. By considering all properties which fall below our minimum design standard of a 1:30 rainfall event and by improving the drainage system capacity, the risk to many more customers may be reduced, improving the overall level of benefits provided to customers.

Localised protection

These are customer- side solutions which involve safeguarding the customer from internal flooding from sewers by preventing flows returning back into properties. These solutions do not address the cause of the flooding (lack of capacity) but can prevent the impact from occurring. This type of scheme requires to be carefully targeted to, and is only effective at resolving, specific local issues.

Where flooding is caused by overland flow of sewage escaping from a sewer, some temporary relief can be provided to customers by providing them with flood guards for their doors and air bricks. This can reduce the impact within their homes, if they are at home when the flooding occurs but does not tackle the cause of the problem. We have offered protection measures to properties on the internal flooding register, where we have confirmed that the solution is feasible and within reasonable cost limits. Within our approach, we intend to use improved catchment models to look beyond the register to identify properties at risk of internal or external flooding. We will then consider proactive protection measures that reduce the risk of flooding even where flooding has not previously occurred.

Sustainable urban drainage

It is possible that long term changes could be delivered through diversion of surface water from the foul sewer network. This can be achieved by:

- Encouraging customers to use grey water through the use of water butts,
- Encouraging customers to disconnect roof drainage and use garden soakaways,
- Encouraging customers to remove impermeable paving and replacing it with permeable paving such as gravel, or products that allow rainwater to pass through.
- Removing historic water course connections to sewers by forming new dedicated culverts or open water courses where possible.
- Diverting surface water from the foul sewers (e.g. road gullies) and into new surface water sewers discharging to the environment through newly constructed attenuation ponds (to prevent the water course flooding and provide appropriate treatment).
- Sewer repair and relining to reduce infiltration.
- Integrated solutions with the Local Authorities to optimise the management of surface water flows reducing the overall risk of flooding (considered under Flood Risk Management Act).

In some locations we may be able to form an agreement (Section 29e) with industrial customers to reduce discharges for short periods when flows are high, thereby preventing flooding, or removing their surface water from the sewers permanently (say to replace treated water in an industrial process).

Methods of alleviating flooding and pollution incidents due to system failures

Customer awareness and behaviours

Customer behaviour has a significant impact on the number of sewer blockages, through the disposal of inappropriate items and fats, oils and greases down sewers.

Through 'Bag it and Bin it' campaigns targeted in areas where blockages of this type occur the frequency and volume of inappropriate items can be reduced, resulting in less blockages and fewer sewer flooding incidents. In addition working with the wider water industry, clear guidelines about what is and is not flushable could be established to help ensure that consumers are clear on how they can dispose of such products.

The volumes of fats, oils and greases entering sewers can be reduced through the use of proper disposal routes (collecting the material in containers and having it recycled by approved companies) and the installation of fat traps at commercial kitchens to catch residual material from sinks.

Increased sewer cleaning and maintenance

The number of sewer flooding events due to blockages and collapses in sewers could be reduced through an increase to levels of maintenance activities such as pro-active cleaning and jetting of sewers to remove silt and prevent blockages. These activities could also involve increased use of proactive CCTV inspections, to identify potential problems at an early stage, and resolving these with measures such as sewer repair and relining (which we have recently undertaken to substantially reduce the number of repeat blockages).

Appendix 9: Supporting economic development

In summary, during the 2015 to 2021 period:

- We expect to connect around 110,000 new household and 3,000 new business properties to the water and waste water networks.
- We expect 100% of new demand for water services and 60% for waste water services to be supplied from existing treatment works.
- We forecast a demand for additional waste water capacity for around 40,000 people by 2021, mainly in rural areas.
- We forecast investing around £218.9 million in meeting demand from customers. We plan this is a ring fenced allocation and is reviewed in as part of the IR18 review to reflect actual and forecast demand.
- We plan to work with developers and communities to enable adoption of Sustainable Urban Drainage Systems (SUDS) and pumping stations and have set aside an IR18 allowance of £6.3 million to contribute to resolving outstanding problems.
- We anticipate investing £28.7 million of infrastructure charges to provide strategic network capacity to meet overall infrastructure requirements of new demand.
- We will relocate our services as required to support transport infrastructure projects and have set aside an allowance of £14 million to meet those needs.

Introduction

This appendix sets out Scottish Water's planned investment from 2015 to 2021 to meet customers growing demand for water and waste water services. In this appendix all investment figures are provided in 2012/13 prices unless otherwise stated.

Ministers' draft objectives

Scottish Ministers' draft objectives for 2015 to 2027 set out that Scottish Water shall in respect of:

STRATEGIC CAPACITY FOR NEW DEVELOPMENT OBJECTIVES

(a) Identify and make provision to service demand for new 'strategic' capacity to meet all new housing development and the domestic requirements of commercial and industrial customers for the period 1 April 2015 to 31 March 2025. In doing so, Scottish Water shall take account of: extant development plans and their associated action programmes, the General Register Office for Scotland's population projections and the SEPA/Scottish Water Memorandum of Understanding on the Impact of Proposed Development on the Public System.

(b) Prioritise the delivery of that part of the investment specified under (a) in accordance with:

- the spatial priorities identified in the National Planning Framework,
- development priorities identified by local authorities in their Structure Plans/Strategic Development Plans; and
- associated action programmes and Local Plans/ Local Development Plans and Local Housing Strategies.

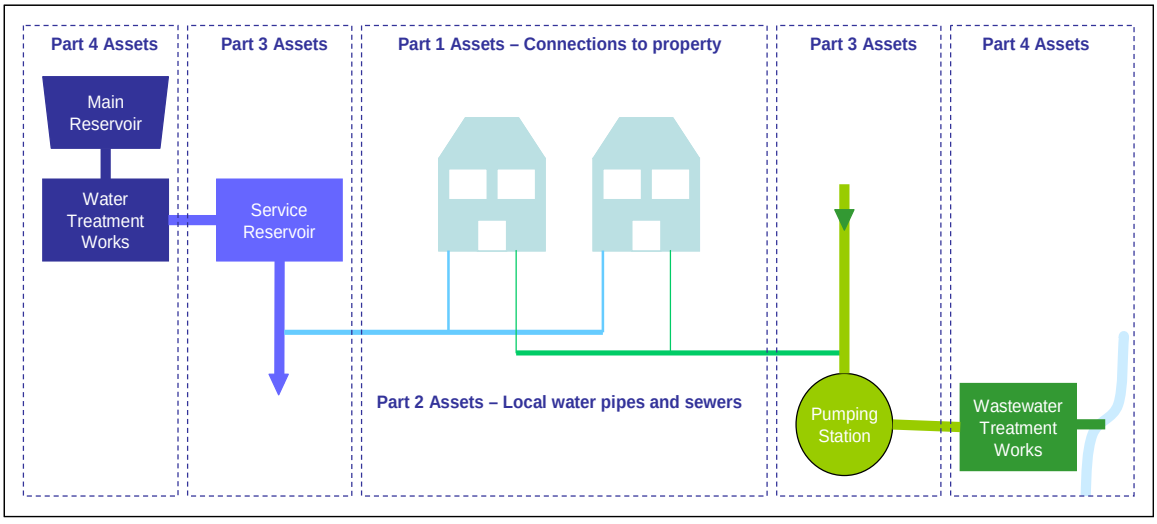
In addition, so as to minimise the likelihood of redundant assets, Scottish Water shall act in a manner so as to ensure that such 'strategic assets' are delivered in support of committed development. This shall be ascertained in accordance with the developer confirming, as a minimum, the following:

i.) Land ownership or control;
ii.) The development is supported by the local plan and/or has full planning permission;
iii.) The time remaining on the current planning permission;
iv.) That plans are in place to mitigate any network constraints that will be created by the development through a minute of agreement with Scottish Water; and
v.) Reasonable proposals in terms of annual build rate within the approved development.

Scottish Water's statutory duty

Scottish Water has a statutory duty to provide water supplies and to drain domestic sewage, surface water and trade effluent where it can be provided at reasonable cost. When considering the demand from new customers, the impact on different parts of the supply system has to be assessed. If allowing new customers to connect will impact on the services to existing customers, enhancements must be made in advance. The responsibility for providing for new demand is split between Scottish Water and the developer, depending on which part of the system is affected. Figure 9.1 shows the different parts of the system.

Figure 9.1: Separation of water and waste water system when considering development



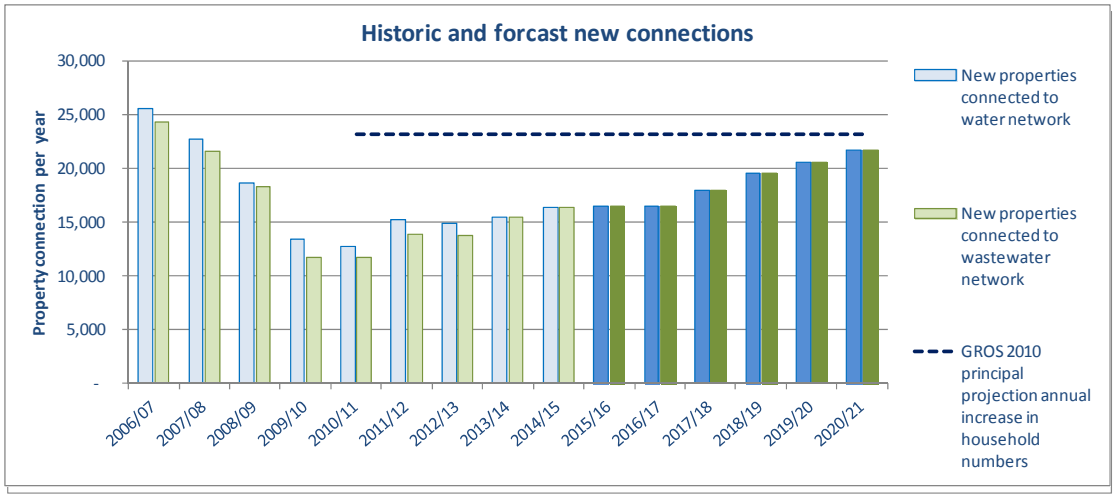
- Part 1 elements are paid for entirely by the new customer (typically the developer).
- Part 2 elements include new water mains and sewers in housing developments, and extensions to or increases in the capacity of existing pipes servicing the new development or new business premises. These are funded by the new customer (developer). However they can reclaim a reasonable cost contribution (RCC) from Scottish Water which takes into account the future income from water and waste water charges which will be received. This RCC is currently a maximum of £1,770 per house for sewerage, £1,499 per house for water, or 6 times the estimated annual meter income for business premises, or the costs incurred whichever is the lower.
- Part 3 elements such as service reservoirs, trunk mains and pumping stations which require to be upgraded to service a single development are paid for by the new customers (developer) and are included within the assessment of reasonable cost contributions.
- Part 3 strategic elements where a part 3 element such as a trunk main is required to be made larger to serve multiple developments, e.g. to supply a planned expansion of a town, Scottish Water will invest in the additional capacity to enable these future developments to take place using the 'infrastructure charge'. The infrastructure charge is a cost (currently £315.40 per property for each service i.e. £630.80 for both waste and water services) recovered from developers for every new property connected, specifically intended to fund strategic infrastructure.
- Part 4 treatment capacity elements are funded entirely by Scottish Water through customer charges and borrowing.

Demand from new customers

Growth trends

Over the last 10 years, the number of properties served by Scottish Water has grown by around 8% and is forecast to grow by a further 21% by 2035 based on the principal household projection from the National Records of Scotland's (NRS)[1]. Our historic and forecast new property connections for 2015 to 2021 are shown in Figure 9.2, these have been revised up as agreed with the Customer Forum. As can be seen we are predicting a rise in new connections across the 2015 to 2021 period on the assumption of an economic recovery below the NRS 2010 principal projection.

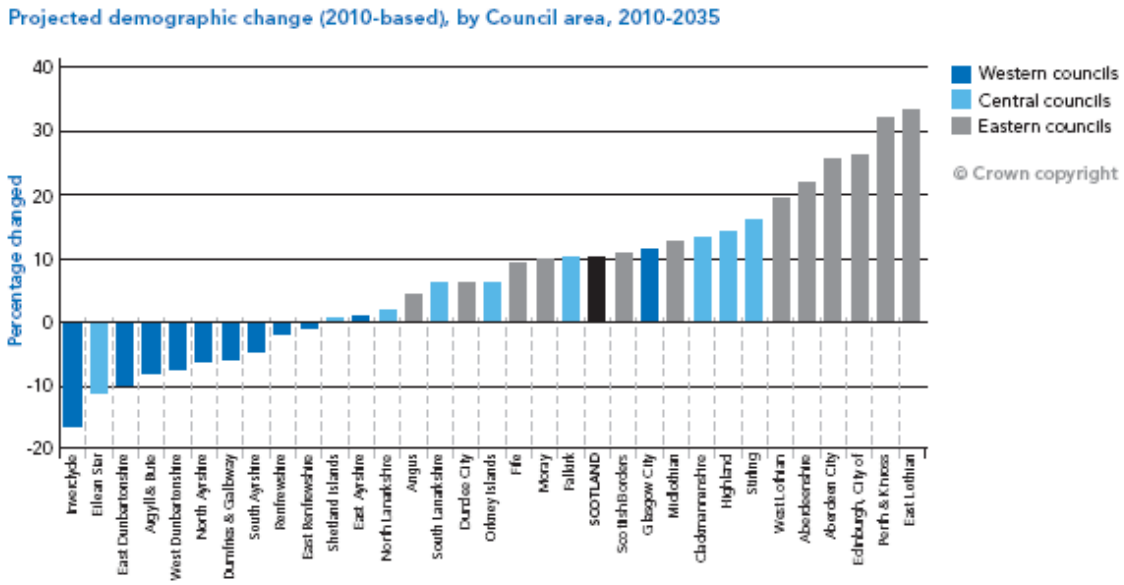
Figure 9.2: Historic and forecast new property connections by service



In terms of population the high and low migration alternative projections suggest a variability of +/- 5% by 2035. The distribution of the population within Scotland is predicted to reduce in the west and increase in the east as shown in Figure 9.3.

[1] From 1 April 2011, the General Register Office for Scotland merged with the National Archives of Scotland to become the National Records of Scotland (NRS).

Figure 9.3: NRS Projected demographic change 2010-2035



Investment requirements

Between 2015 and 2021 we anticipate connecting around 113,000 (4.5%) new household and business properties/premises to the water and drainage systems, and estimate requiring additional waste water treatment capacity for around 40,000 people.

Part 2 & Part 3 Investment

The investment demand from parts 2 and 3 elements is driven directly by four factors:

1. The rate of house building in Scotland. Currently, this is averaging around 15,000 properties per year, having dropped from over 20,000 in 2007. Through regular discussions with the main developers (in terms of house units constructed) we anticipate this slowly rising over the period 2015 to 2021 resulting in around 110,000 new household customers.

2. The rate of commercial growth. We anticipate around 3,000 new commercial business connections over the 2015 to 2021 period.

3. The number of connections that require part 2 and 3 infrastructure installed. Currently this is around 56% of connections, with the other connections simply connecting directly to existing infrastructure. We anticipate this will remain the same in 2015 to 2021.

4. The average cost of the part 2 and 3 infrastructure installed. We anticipate that this will remain around 26% for water connections and will increase to 75% for waste water connections as we are now beginning to pay RCC contributions for Sustainable Urban Drainage Systems (ponds and swales etc for controlling surface water runoff) which increases the average cost of servicing a development.

We forecast we will pay £108.3 million in reasonable cost contributions to developers between 2015 and 2021, £49 million from 2015 to 2018 and £59.3 million from 2018 to 2021 (IR18 allowance).

Part 3 Strategic network investment

Part 3 strategic investment is funded from infrastructure charges levied on each new connection. Based on current demand we forecast investing £28.7 million to extend or increase capacity of strategic water mains, sewers and pumping stations, enabling us to allow new development access to spare capacity at existing treatment assets. The schemes delivered will be aligned with the council 10 year structure plans and build rates planned by developers. It is possible that demand for new strategic network capacity may exceed the allowance in our plan, depending on the location and rate of new development. If this is the case we would expect this to be taken account of within the IR18 review if we are not receiving additional income for new connections above that assumed in our financial models.

Part 4 investment

Assessing the demand for additional treatment capacity is complex, requiring the population forecasts from the National Records of Scotland, the spatial allocation of new homes in council structure plans, and the capacity of our water and waste water systems to be brought together. Using this information, the future demand on the water and waste water treatment works can be assessed. In addition, we work with SEPA to understand the environmental capacity of water bodies to sustain increased abstraction of water, or discharges of treated waste water.

We expect the population we serve will increase by around 96,000 between 2015 and 2021, while overall household occupancy continues to reduce resulting in 110,000 new household customer connections.

Our assessment has identified that around 60% of waste water demand can be met from existing waste water treatment assets, with additional treatment capacity required to meet the demand from around 40,000 people.

We forecast that 100% of water demand can be met from existing water treatment capacity, made available as we have reduced leakage levels.

We have developed solutions and costs to meet the forecast demand at the rural waste water treatment works taking account of engineering limitations when increasing capacity (e.g. if we are accommodating demand from an additional 35 people, and the standard sizes of septic tanks are 25 and 50, we will design based on 50 people). Our assessed solutions to meet the forecast demand by 2021 would effectively provide capacity for around 58,000 people due to the modular sizing of solutions for small rural waste water treatment works.

Using this analysis we have included an investment allocation of £80 million in our plan to finance additional part 4 strategic capacity during 2015 to 2021. Once new developments meet the criteria set within the Ministers' draft objectives we will assess the most suitable solution for that particular location. We have included £48.6 million of this investment as and IR18 allowance to be reviewed in light of the actual and latest forecast demand at December 2017.

Adoption of developer constructed assets

Scottish Water has identified a number of waste water pumping stations built by developers which currently serve customers but do not meet our minimum adoptable standard, where the developer has now gone out of business. There are also a number of sustainable urban drainage systems (ponds) that have been constructed by developers over the years which have not been adopted and do not meet the recently agreed adoptable standard.

We plan to develop a process with key stakeholders to deal with these issues, ensuring that all other avenues for recovery of costs from developers are exhausted. We have made an initial assessment of the costs of bringing these assets up to standard to allow formal adoption and then maintenance and operation. We plan to invest £1.4 million in new asset maintenance and £3.8 million in operation of assets successfully adopted from developers, and an IR18 allowance of £6.3 million to deal with the adoption and operation of the remaining assets, which are serving existing customers.

New non-domestic customer meters

When connecting new non-domestic developments / premises, they must be provided with a meter to ensure they can participate in the competitive market place. Annual volumes of these are subject to the normal pressures of economic growth and development however we anticipate connecting around 3,000 new business premises over the 2015 to 2021 period. Additionally as business premises merge, divide or change use (from domestic to non-domestic) there is a need to install new meters, often at the request of Licensed Providers; we forecast installing around 6,000 new meters to fulfil this customer demand. Some business premises currently do not have meters installed; we forecast installing 9,000 additional new meters as these are identified with Licensed Providers. We forecast that between 2015 and 2021 we will undertake a total of 18,000 first time meter installation at an estimated cost of £9.1 million. The costs may vary depending on the type of meter selected and the specific configurations of the property for installation.

Service relocations

Scottish Water has a statutory duty to support the relocation of water and waste water services to allow transportation improvements to be delivered. The physical relocation works can be undertaken by either Scottish Water or the Transportation Authority with the costs split between both based on the condition of the infrastructure replaced. We forecast we will invest £6.9 million between 2015 and 2018 and the same between 2018 and 2021 (IR18 allowance).

Investment Summary

Table 9.1 summarises our planned investment in the 2015 to 2021 period.

Programme	TOTEX £m (2012/13)				Output
	Committed		IR18 allowance		
	Capex	Opex	Capex	Opex	
Reasonable Cost Contributions (Part 2 & 3)	49.0	0.4	59.3		Contributions to 113,000 new connections to households and business'
Treatment Strategic Capacity (Part 4)	31.4		48.6		New waste water capacity for 58,000 people
Adoption of developer constrained assets (Part 2 & 3)	1.4	3.8	6.3	1.5	Maintaining, operating and resolving adoptions of part 2 & 3 assets
First time installation of non-domestic meters	9.1				Installation of 18,000 non domestic meters.
Statutory requirement to relocate services for transport infrastructure projects	6.9		6.9		
Sub total	**97.8**	**4.2**	**121.1**	**1.5**	
Provision of strategic infrastructure	28.7				Financed through infrastructure charges
Total planned investment	**126.5**	**4.2**	**121.1**	**1.5**	

Table 9.1: Investment summary 2015 to 2021

We plan that, consistent with the approach in the current price control, the planned growth allocation should be ring-fenced within the investment plan and reviewed when the rolling enhancement programme is updated in 2018, taking account of the latest information.

Our planned and historic investment in connecting new customers (excluding infrastructure charge related investment) is set out in Figure 9.4.

Figure 9.4: Investment in connecting new customers

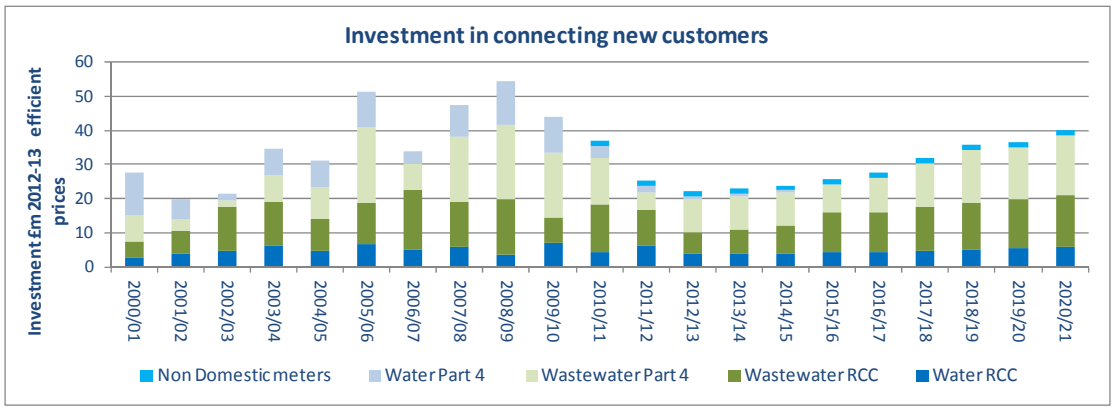


Figure 9.4 shows that investment over the last 15 years in additional capacity to enable new customers to connect has been volatile. The causes for this were:

- Between 2002 and 2006 there was no objective for Scottish Water to meet all the development needs of Scotland. Consequently investment in new capacity only occurred where treatment works were upgraded to deliver water and waste water quality improvements.
- Between 2006 and 2015 a new objective to meet the development needs of Scotland was put in place (the same as set out for 2015 to 2021).
- The new objective and coincidental housing boom resulted in significant investment in new capacity between 2006 and 2009 to release identified development constraints, and strong demand.
- Between 2010 and 2012 the demand for new connections reduced by around 50% due to the economic downturn. Using the flexibility of the objectives, we adjusted the construction start dates for new capacity projects to match the revised house building rates of developers, deferring investment.
- We are now seeing an increase in house building activity as the economy moves into growth, and forecast a gradual rise in demand over the next six years.

Our experience over the past 15 years has shown that the current approach to managing investment in this area is effective at dealing with the volatility in the house building sector whilst ensuring the Scottish Government's objectives are delivered at lowest cost to customers.

Appendix 10: Improving the customer experience

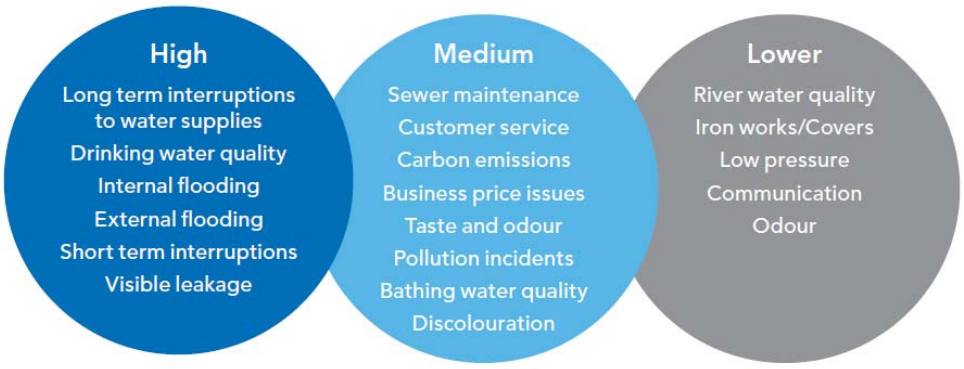
Scottish Water is committed to delivering leading customer service to all of our customers. This means we deliver the following activities:

- We will ensure that all customers, their needs and expectations sit firmly at the heart of our decision making. A comprehensive 'Voice of the Customer' programme will be used to ensure that we are listening to, and acting on, customer feedback in day to day service delivery and in strategic developments. While Licensed Providers and business end user customers will sit within this programme and benefit from all of these developments the plan also includes commitment to deliver enhancements that will meet their specific needs.
- It is evident that customers expect the same level of service from us as they would from any other service provider – we are committed to investing in service channels and technology to ensure services are provided with minimal customer effort at a time and place that suits them.
- To increase customer awareness and understanding of Scottish Water we will build a dynamic programme of co-created customer information initiatives, through media and community activities. This will be linked to a structured schools education programme.
- Household and business Customer Experience Measures will be introduced as a critical measure of our performance; and used to firmly link customer feedback to our business improvement programme. These dynamic new measures will track performance against the volume of issues impacting on customers as well as how Scottish Water has recovered service.
- **Our services – your rights** is a new publication that has been developed to increase customer access to Guaranteed Service Standards and Price Promise. We are committed to continue to develop material in this style to ensure customers have easy access to critical service information. We will also enhance and up-rate our Price Promise and Guaranteed Service Standards respectively.

Overview

This appendix sets out Scottish Water's emerging proposals for improving customers' experience, and how we will work with them to build relationships based on a shared understanding and awareness. This includes communication and engagement, response times, services tailored to meet the needs of Licensed Providers and water efficiency.

Figure 10.1 – Customers' relative priorities for further service improvement



Service strategy

We are committed to continuously improving customer experience, delivering service levels that are leading among service providers, while working hard to keep bills affordable and ensure value for our customers.

In Figure 10.1, above, we set out our customers' views of service priorities. Our priorities in terms of the customer experience, as supported by the Customer Forum and highlighted above, are that we will work to provide an outstanding customer service, while improving how we build relationships with our customers. We plan to continue to improve customer service, by working more closely with our customers, and demonstrating to them how we are acting on their feedback. During 2015 to 2021 we will improve service to customers through a series of process improvements as well as implementing new service related capabilities so that by 2021:

- Through a significant system upgrade our customers will be able to contact us with minimal effort through an extended range of channels allowing customers greater choice including; over the phone, by email, allowing dynamic use of our web site and online services, through social media and of course by letter.
- This system upgrade will allow us to ensure we always provide easy to access information on our services, and enable customers to request and manage services through direct online access.
- The speed of our response to customer issues will be reflective of the issue and customers' circumstances. During resolution we will always maintain contact and ensure the issue is resolved to the customer's satisfaction.
- Licensed Providers will find us even easier to deal with as a wholesaler and provide their customers with the levels of service they expect.
- Customers will have a deeper relationship with Scottish Water in relation to key issues such as water efficiency and waste disposal and be part of initiatives that will deliver better outcomes for them, the environment and their future charges.

We have listened to customer feedback which outlines their expectation around our delivery of meaningful and proactive communication and recognise that this will contribute to customers' visibility of our services. In particular in the delivery of investment projects a key goal will be to provide a positive customer experience, with community engagement. We will do this through establishing feedback mechanisms and responding to customers' needs, always providing relevant information and updates for customers on works in their area. We will work with customers to ensure minimum disruption and where possible provide wider community benefit.

Our customer Code of Practice will form the basis of a range of customer service information literature - improved and simplified such that it is easy to access and understand for all customers. A key development in our commitments will be to merge our existing guaranteed service standards and price promise.

We will establish a dynamic new measurement to deliver an understanding of our services and performance with all our customers, not just those who are affected by service disruption. We have established an engagement and consultation programme that is influencing the direction of customer co-created initiatives on subjects such as disposal of waste and water efficiency. This will be the beginning of a journey we will take with our customers to meet their desire to understand our services and connect with us. Opportunities will be identified to ensure that we continue to engage customers in the development of future plans, seeking their involvement in these and explaining our ongoing plans for efficiency and service improvement.

At the heart of our plan sit our people and the ongoing need to develop our employee base to ensure that we have the right resources, customer service skills, engagement and motivation to deliver. Through the establishment of an Institute of Customer Service accredited training programme we have secured significant improvements in customer experience and will continue to deliver improvements aligned with customers and their expectations.

Our priorities for improvement

Customer Expectations

Customers have told us through research that they expect the same high levels of service from us that they would receive from other service providers; this was particularly evident in their desire to see us deliver leading service levels and experience. Customers generally trust that they will have no problems with their waste and water service, however if they do, they want to be able to contact us easily and have their issue dealt with quickly and with minimum effort. It is acknowledged that minimising time and effort will become increasingly important drivers of satisfaction therefore they are a key focus of our Service Strategy. Customers have reinforced this view, throughout research activities and ask that we increasingly engage them in improvement works in their area, helping them to understand the services that we provide, the benefit of our investments with a view to building awareness of the value that we provide to them and their community and the role that they could have in improving services.

We will build a relationship with our customers through communicating and engaging with them in four main ways:

- When customers contact us with a service issue.
- When undertaking service improvement (construction) projects we communicate with local communities and individuals who could be affected or benefit from works, delivering proactive engagement events to build relationships and secure involvement in our activities.
- General awareness campaigns to engage groups of customers.
- Through the ongoing representative research programme, agreed with the Customer Forum, that will continue to shape strategy and policy decisions.

We will ensure that we take maximum opportunity to engage customers in each of these opportunities to inform and develop their understanding of the services that we provide. We will seek to build on new opportunities to build relationships with our customers.

For us to become valued and trusted our customers need to know what we do for them. It is important that this partnership with customers is built on a firm foundation of understanding of what ‘value’ means to them. A number of communication channels will continue to be used to raise general awareness of what Scottish Water does and how customers can support improving services, for example:

- National media to promote wider customer awareness on issues such as our ‘warm pipes’ campaign in the run up to winter, and use water wisely in times of low rainfall.
- Information featured on our website and videos on You Tube to provide customer advice and showing repair works which have been undertaken.
- Engaging communities through schools and education centres (such as science centres) to support the education of future generations. We will build a mobile education programme, ‘Making It Clear’ that will offer opportunities to schools across Scotland to give our customers and future generations the chance to participate in hands-on, interactive water themed activities, workshops and science shows where they can learn about water and waste water related topics.
- Making It Clear will support the 4 capacities, experiences and outcomes of Scotland’s Curriculum for Excellence with the aims of embedding science skills and inspiring young people in their choice of career. Scottish school pupils would enjoy sustained science experiences on a water theme.
- Through specific initiatives such as water efficiency trials and catchment management we are engaging with local communities and stakeholders to develop ways we can work together to deliver a better outcome.

As current research confirms that general customer awareness is low, we will embark on a more structured programme of customer engagement. This will be shaped with our customers and will focus on building their understanding of our services through the media and community activities.

Contacting Scottish Water

Customers can contact Scottish Water 24 hours a day, 7 days a week through our contact centre via the phone, email, by completing a contact form on our website or by letter. All of these communications channels will continue to be managed through our integrated customer relationship management systems. Customers can follow us on social media; while small at this stage this route is recognised as

a channel of choice for some customers and we will continue to develop our presence. In the future we anticipate an increasing number of contacts with Scottish Water will be via social media channels and these will become integrated into our systems to ensure we further improve customer satisfaction.

Communicating when improving services
When developing projects to improve services our teams will engage with local communities, building partnerships based on trust and value as a foundation for engagement. This will help to inform communications approaches taken (through understanding customers, their needs and concerns). We aim to build tailored communications packages that will engage and involve them in works in their area. We will also continue to work with local media to help build awareness of any work we are doing, informing a wider group of customers on what is happening in their area. Continued investment will be made in our website, to increase ease of access to information, particularly focused on the provision of community updates aligned to the current search by postcode for projects being undertaken in local areas.

Contacting Scottish Water
During 2015 to 2021 we plan to further improve our communication channels with customers by enhancing our Customer Relationship Management system.

- Develop integrated channels of choice allowing customers to use whatever communications channels suits them best, be it letter, phone, email, text messaging or social media linked together. A system upgrade will ensure the provision of enhanced contact management which means customers will be able to have a seamless conversation with us across all channels.
- Develop the online capabilities as technology progresses in conjunction with new systems, which allow customers to move from self help through to requesting services directly on-line by enhancing the ease of accessibility and the capability of our website.
- Where there is an established customer demand, ensure availability of real time customer service engagement through use of web chat as a contact and interactive channel for customers.
- Delivery of proactive service updates linked to asset performance.
- Provide self help information easily accessible through on-line channels.
- Delivery of local face to face communication, during service issues or times of disruption ensuring consistent and relevant updates when customers need it most.
- Evolving our approach to allow us to offer customers new communications channels to customers as they are developed.

Communicating during service improvements
The options for improving communication during service improvements include:

- Using the opportunity to better inform customers about all of the services we deliver and how customers can communicate with us about what they would like.
- Working with communities early in the developments to enable partnership development and their input into the aspects of the project that will affect their daily life.

Improving general awareness
To improve overall awareness of what we do will require a structured approach which will increase overall levels of awareness of who is responsible for water and wastewater service, and how customers can be part of the journey to deliver service improvements. This means:

- Establishing an understanding of customers' level of engagement and needs, while taking in to consideration their views on what 'value' means to them and what will ultimately make a difference.
- Build, with customer input, an advertising and engagement programme to raise overall awareness of our services and increase sensitivity around issues relating to water and waste water services.

Customer feedback has identified the expectation that they will receive more information on how they can get involved in delivering improvements. For this reason there will be a series of national and local initiatives which will focus on those service issues that customers can work in partnership with us to help resolve, these may include:

- Sewer flooding customer engagement initiative;
- Water efficiency linked to benefits to customers;
- Warm pipes campaigns in the run up to winter, and
- Use water wisely campaigns during periods of low rainfall.

Outlining Scottish Water's Service Commitments

Scottish Water operates within a Customer Service Code of Practice. This Code outlines the minimum service standards that our customers should expect. This document has been developed under the heading **'Our service – Your rights'** as the first step towards the introduction of a plain English, customer focused set of commitments. The document currently includes details of our Guaranteed Service (GSS) and Price Promise Standards (PPS).

Price Promise Standards were introduced by Scottish Water as an industry leading concept in 2010. This standard sits alongside Guaranteed Service Standards and provides rebates of certain charges should we fail, under normal operating conditions, to deliver our minimum guaranteed levels of service. Price Promise Standards generally require customers to actively claim a rebate from Scottish Water. However there are two service areas, low pressure and internal sewer flooding, where customers are identified on Scottish Water registers as not receiving the service expected. In these cases we make proactive rebate payments.

Customer research indicates that customers welcome the levels of service commitments and payments, and are recognised as an incentive for us to be more accountable for service, positively affecting perception of Scottish Water. Customers consistently, across all sectors, have expressed 'timescale' of response as an important issue in determining customers' satisfaction.

There are a number of improvements that we will deliver. These include:

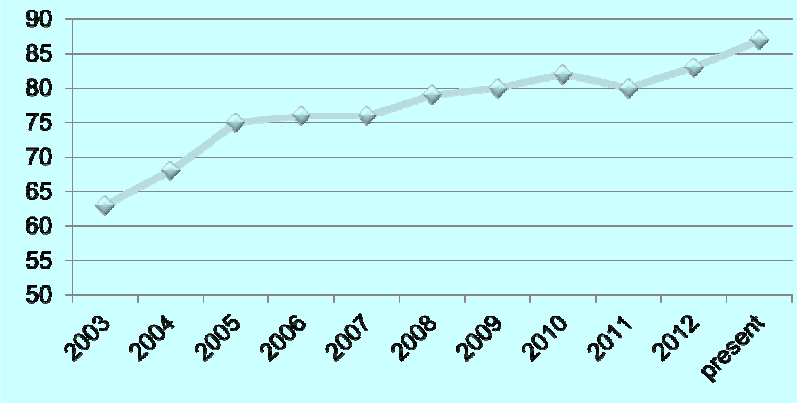
- Merging the Guaranteed Service Standards and Price Promise Standards schemes into one set of customer commitments.
- Enhancing our Price Promise for those customers whose properties are at risk of internally flooding from overloaded sewers and who unfortunately experience an actual flooding event.
- Up-rating our Guaranteed Service Standard payments to reflect the effects of inflation since they were last set.
- Reviewing the existing service standards and definitions, particularly those within Price Promise Standards to ensure clarity.
- Investigating the opportunities to introduce proactive/ automated payments to customers in recognition of service interruptions in areas such as 'unplanned interruptions'. This move will need to be closely aligned to system and knowledge investments and will support improvements in service experience as a driver to reduce interruptions as well as a proactive offer to customers when we recognise interruptions have occurred.
- Introducing a communications commitment and care process for those customers who feature on service improvement registers.

Scottish Water will continue to evolve the Code of Practice suite of customer information to ensure accessibility for all customer groups. Documents will be provided at key customer touch points and through partner organisations such as local authority libraries and Citizen Advice Services.

Measuring customer experience

Scottish Water has consistently improved customer satisfaction levels since 2003 (see Figure 10.2) and is committed to further improving end to end customer journeys to deliver leading service levels. Central to our Service Strategy is the commitment to minimise disruptions to customers, but where incidents do occur we always aim to deliver first time resolution and leading service recovery.

Figure 10.2 – Customer satisfaction (%) over time



The Customer Experience Score was introduced in 2010 to track ongoing customer satisfaction levels. It has been at the heart of a cultural change that has been felt across Scottish Water. The Customer Experience Score has established ownership of customer satisfaction and is closely aligned to our service improvement plan.

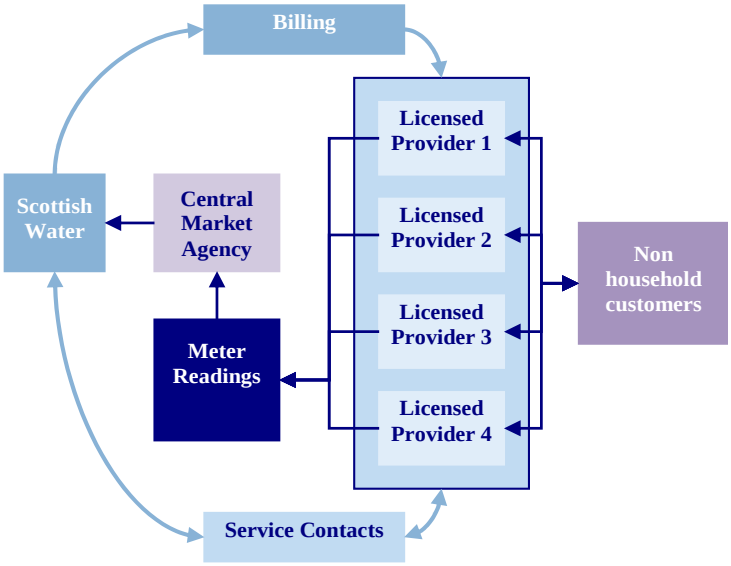
We plan that a development of this measurement tool will sit at the heart of new performance measures that we will introduce in 2015. The Customer Experience Measures for both household and business customers will ensure that delivery of excellent service to customers continues to be a key driver of Scottish Water's performance. Similar to the Service Incentive Measure established by Ofwat, the Customer Experience Measures will combine quantitative contact metrics with qualitative customer research feedback. The Customer Experience Measures will ensure continued focus on delivering what is right for customers. The measures will be a key tool that we will use to monitor and demonstrate the delivery of improvements on behalf of customers.

Licensed Provider services

While Licensed Providers and their customers will benefit from all of the improvements that Scottish Water will deliver, Licensed Providers also have some specific service expectations and needs, as they compete with each other to service their non-household customers.

Since 2008 all business customers are provided with services through Licensed Providers who buy wholesale services from Scottish Water and offer retail services to their customers as shown in Figure 10.3.

Figure 10.3 – Non-household customers' market arrangements



The way in which Scottish Water interacts with Licensed Providers should be invisible to business customers, as the customer interface is managed by the Licensed Provider. These detailed interactions with Licensed Providers are governed by the market framework arrangements and will continue to evolve over the coming years as they have done since the market opened. We will continue to work closely with Licensed Providers to ensure we provide them with the service that they and their customers need to meet changing expectations.

Licensed Provider Communication with Scottish Water

In the same way as we plan to offer enhanced on-line services and communication through electronic media to the household customers, we are planning to develop similar services for Licensed Providers allowing them to meet the needs of business customers efficiently and effectively. Areas currently being explored include:

- Offering Licensed Providers the ability to book appointments on-line, to meet the needs of their customers in a seamless way,
- Providing the ability to check the status of a job on line; and,
- Enhancements to the current notification process for planned work notifications, through the use of enhanced web portal capabilities and communication media.

Response levels

Business customers expect the same level of response as household customers when there is an issue with their service. Where we introduce changes to improve response times, these will apply to business customers as well, although communications will follow the processes which apply to the competitive market.

Tariff structures

Our research has shown that business customers wish us to review the existing charging arrangements. We will work with Licensed Providers, the Scottish Government and the Water Industry Commission to explore possible future wholesale charging arrangements that would be consistent with Minister's principles of charging.

Business metering

Scottish Water is obliged to install meters at all business premises with a water supply where this is practicable. All new business premises connecting to the water supply for the first time are metered. Annual volumes of these are subject to the normal pressures of economic growth and development. Additionally as premises merge, divide or change use, there is further churn in the market, leading to a need for removal of old meters and installation of new meters.

We currently offer a choice of pulse-enabled meters to Licensed Providers and their customers through a meter menu. Our selection of meters and the choices available on the meter menu will continue to be kept under review, taking on board wider manufacturer and industry developments. We currently consult with Licensed Providers on issues affecting meter choice on an annual basis and will continue to do so.

In terms of meter choice, we will continue to offer pulse-enabled meters as standard to give customers and Licensed Providers the choice to use smart metering technology which allows consumption to be read automatically and logged over time, allowing business customers to manage their consumption. This technology is currently more expensive than a traditional meter to install.

Licensed Providers can also chose to instruct suitably accredited companies to undertake certain metering, new connection and data logging activities, thus offering choice and flexibility. The framework supporting this is still in its early stages and we will continue to support its development.

Licensed Providers and business customers have identified the importance of meter accuracy to ensure that volumes of water consumed and bills are accurate. To improve overall accuracy, and support advanced metering infrastructure, it is recommended meters are replaced every 15 years. Investigations show that this frequency would allow us to continue to assure Licensed Providers and business customers that consumption and bills are accurate. It is forecast that around 84,000 meters will require to be replaced between 2015 and 2021.

Community involvement

We agree with the Customer Forum that there is more that can be done to get close to customers and to help them co-produce outcomes for themselves, their community and the water and sewerage systems as a whole.

We will build on the work done to improve customer education on blockages to sewers caused by customer behaviours; to develop, with the Customer Forum, potential approaches to customer education, care and support; and to subsequently trial and evaluate such approaches.

Supporting business growth

We plan to work closely with Licensed Providers and business customers in matters specifically under the direct control of Scottish Water (wholesale) and that may facilitate business growth. We will engage with the Customer Forum in reviewing progress in this area.

Customer advice services

In our plan we have set out two areas where we wish to engage with our customers to deliver better outcomes for Scotland. Firstly we have launched our campaign to raise awareness and sensitivity of the issues of sewer flooding caused by the inappropriate disposal of waste items down toilets and drains. Secondly, we will continue with our communication and engagement activities related to the efficient use of water and how this can benefit customers, for example by reducing their energy bills through the use of less heated water.

This is an area that we are keen to explore further with customers to understand other areas where we can provide advice or added value services to our customers.

Appendix 11: Climate change and carbon

In summary:

- We will implement our strategy for climate change and carbon, and discharge our duties under the Climate Change Act, through a number of key activities.
- For Climate Change adaptation, our planned improvements to water supply resilience and sewer system capacity and operation will increase our ability to deal with a changing climate. We will continue to develop our understanding of how climate change impacts water availability and our sewer network, to develop solutions to improve longer term resilience to such change and, more specifically, we will:
    - improve our understanding of water flows in key zones by integrating climate models into water resource plans
    - improve our monitoring of raw water to understand quality impacts
    - invest in further monitoring of waste water catchments to understand climate impacts; and
    - update our assessments of risk from climate change and contribute to Scotland's Climate Risk Assessment.
- On Carbon, we will continue to monitor and manage our carbon emissions and, in particular, will:
    - continue to trial more sustainable ways of working;
    - deliver increased energy efficiency (via the invest to save programme);
    - deliver increased renewable generation (via the invest to save programme); and
    - assess the carbon in our capital investment, and work with partners to seek opportunities to reduce this in delivery.
- We have been assessing carbon across our business for the past seven years and our carbon footprint, at 442,000 tonnes per annum, is comparable with other water companies and equates to circa 125kg per household – low compared with other consumed services.

Introduction

Our climate change strategy is to secure a service to customers that is resilient to climate change, and will contribute to the goals of Scotland's Climate Change Act.

Climate change presents risks to the service we provide to our household and non-household customers. These risks need to be understood sufficiently clearly to enable appropriate planned responses and ensure we continue to provide a safe and resilient service to customers in the future. The majority of Scottish Water's greenhouse gas (GHG) emissions that contribute to climate change are associated with the consumption of electricity from the national grid.

As well as taking steps to deliver a resilient service, reduce the cost of electricity consumption and contribute to a sustainable Scotland, the responsibility to act is underpinned by the Climate Change (Scotland) Act. This places a duty on public bodies in Scotland to contribute towards government goals on carbon mitigation and to Scotland's Climate Change Adaptation Plan.

Scottish Ministers' draft objectives for 2015 to 2027 set out that Scottish Water shall in respect of:

CLIMATE CHANGE ADAPTIATION

Improve Scotland's resilience to climate change by continuing to invest in modelling the likely impact of climate change on its assets, and where appropriate, investing to manage risks arising from climate change impacts.

CLIMATE CHANGE MITIGATION

Contribute towards Scotland meeting its climate change obligations of achieving greenhouse gas emissions reductions in Scotland of 42 per cent by 2020 and by 80 per cent by 2050, by taking all necessary steps to fulfil its duties and obligations required of it as set out in the Climate Change (Scotland) Act 2009. In particular Scottish Water shall:

(a) work with relevant stakeholders to assess, pilot, and where appropriate, implement measures needed over the 2015-2027 period to reduce its direct greenhouse gas emissions and energy usage;

(b) ensure that all investments made as a consequence of these Directions take into account the associated carbon impact; and

(c) invest to reduce its demand for Scotland's resources (water and electricity from the national grid) where it is cost effective to do so.

We plan to implement our strategy and discharge our duties under the Climate Change (Scotland) Act through the activities summarised below and described further in this Appendix.

We will implement active management and reporting of carbon, integrating into our business planning further developments relating to the effects of climate change, and reporting annually under the sustainability reporting guidance.

Work under flooding drivers and delivery of guaranteed service standards (in particular surface water management) will contribute further to meeting policy objectives. Our proposals covering water resource planning, widening risk assessment work and investment in monitoring will ensure we contribute fully to government objectives for a resilient service in Scotland.

We will invest in cost effective and efficient renewables as a key part of future carbon management. Coupled with the application of embodied carbon management tools and further study and pilots to find more sustainable ways of working, we will continue to meet minister's policy objectives.

Other parts of the plan will support carbon reduction and climate adaptation strategies, but are not considered specifically here. These include surface water management planning, flood risk management work, sustainable land management etc.

An evidence-based approach to Climate Change

Our strategy is founded on extensive studies undertaken in the current period and also wider work within the water industry. The study work has enabled us to develop an evidence based approach to adapting to climate change, and also in taking steps to mitigate emissions. We can then plan to a*dapt* to climate change by understanding changes and secure a resilient service and to *mitigate* climate change by reducing the greenhouse gas emissions that contribute to climate change.

Climate Studies

The water industry has undertaken a number of studies to understand impacts on assets and services and to develop tools (for example water resource planning) to enable the industry to respond appropriately. Further, we undertook several climate change studies within the current period.

Climate projections are complex and uncertain in the pace and extent of change. Through UKWIR[1], we now have tools that enable projections to be used in water resource planning, and to better understand the risks and appropriate responses.

In contrast to water resources, studies indicate more uncertainty with respect to drainage. It is not possible to integrate climate projections by simply adding a locally generated 'climate factor' to drainage area models – this has been shown to be too uncertain. Given the inability to fully model future climate impacts for drainage, improved monitoring is the principal approach.

A key need identified in the studies undertaken in the current period is for improved *long term* monitoring. Choices relating to climate change that can not readily be modelled would need to be informed by long run data sets and trend analysis to understand the extent and range of potential impacts. Coupled with other work this would help us understand when adaptation measures should be taken. Specific monitoring needs identified have included:

- Raw water quality – to better understand catchment trends and inform thresholds for action
- Raw water flows – to support the climate projections used in water resource planning
- Waste water flows and quality– to understand how catchments respond to rainfall change
- Sewerage quality – to understand septicity and risks from low flows.

Carbon Studies

We have been assessing carbon across our business for the past seven years and our carbon footprint, at 442,000 tonnes per annum, is comparable with other water companies and equates to circa 125kg per household – low compared with other consumed services. We have the lowest carbon water service in the UK industry, and over the past five years emissions have fallen by 10% despite continued improvements to deliver higher service levels, meet growth in demand and improve statutory compliance. Leakage management, energy efficiency and renewable energy generation have supported this reduction.

Studies in the 2010 to 2015 period have helped us to understand that:

- The operational carbon benefit of separating surface water from sewers may be outweighed by the carbon associated with creating alternative systems (for example with SUDS etc).
- There may be a net carbon benefit in leakage reduction (supply zone specific) and we are looking into how this can be integrated within future leakage planning.
- Innovative approaches which could reduce carbon, such as varying treatment works operation regimes and switching to passive systems, need to be considered alongside their impact on the service to the customer.

Planned studies relating to Climate Change during 2015 to 2021

The strategy to understand changes and secure a resilient service will be delivered through this Business Plan across a number of activities. Previous studies indicate it is important to establish a long-term monitoring approach to understand the extent and pace of potential climate change. Planned studies in the period to 2021 will therefore build on the previous studies undertaken in the current period.

Long term changes will be identified through trended data and analysis to support informed future choices based on how climate change manifests in reality. This will look at how plans may need to be adapted to future expected performance. In addition, further risk assessment work will be required in the period to 2021 to accommodate updates to climate projections and the requirement to contribute towards future iterations of Scotland's Climate Change Risk Assessment.

[1] UKWIR – UK Water Industry Research Ltd is the collaborative research agency of the UK water industry. It undertakes research projects across all areas of industry activity. Scottish Water has led the climate research programme since 2009. An overview of projects is available at www.ukwir.org.uk

The specific project areas to be developed through to 2021 are as follows:

Water Resource Planning (WRP) - Climate Change Modelling

In order to support future Water Resource Plans, we plan to deliver full climate modelling across 52 Water Resource Zones identified through vulnerability assessment as being at risk. A key element of improving water resource planning identified by the climate studies and existing WRP work is the need for more flow and rainfall data. This will ensure future Water Resource Plans benefit from trend analysis to validate climate projections.

Raw Water Quality

Climate change can impact raw water quality as well as quantity. Specifically, there are parameters that are vulnerable to catchment changes, namely nutrients, dissolved organic carbon, and turbidity. Additionally, algae are identified as a risk.

We will improve raw water monitoring to understand long term trends and the consequential impact on water treatment works performance. Long term data will enable us to understand threshold points where it may be necessary for additional steps to protect drinking water quality. Such steps may simply be increased maintenance, backwashing or filter changes, or may indicate a potential future investment need to address deteriorating water quality.

We will undertake additional samples to be taken annually to understand raw water quality. The majority of additional sampling is operational related – the sampling kit is present, or on site monitoring already occurs, and this just needs to be increased in frequency. However, there may also be a need for a small number of additional sampling points, or to develop in-line monitoring.

Waste water and Sewerage Monitoring - Flow

There are a number of risks to our waste water assets which are associated with rainfall, drainage flows and loadings to treatment works, and a lack of monitoring capability to understand climate change. Examples include:

- The effect of low rainfall and higher temperatures on septicity and loading at treatment works
- The effect of high rainfall and increased intensity on sewer capacity, spill frequency, weak effluent and flushing out treatment works
- The potential flood risk based on flood studies.

In the period to 2021, we will focus on improved monitoring within named waste water catchments across Scotland to provide a representative Pan-Scotland picture of climate impacts. The purpose of this work is to understand how catchment flows may be impacted by climate (and environmental) change using trended data which will help understand how things are changing in reality and reduce uncertainty. This project will use catchments that are representative across Scotland, covering the regional variations in rainfall frequency and intensity projected by the climate studies undertaken during the current period.

In addition, further waste water quality monitoring will be undertaken to understand how effluent quality may vary over time as, in recent years, there have been low flow conditions in networks which have presented concerns regarding the concentration of effluent and the ability to treat to meet receiving water conditions.

Waste water and Sewerage Monitoring – Corrosion risk

There are risks of hydrogen sulphide gas production, septicity and increasingly corrosive effluent in several catchments in periods of prolonged dry weather.

We will undertake further monitoring in several catchments as recommended by studies undertaken in the current period. Additional operational work will be required to deliver increased sampling of load in order that flow-load trends may be modelled, and to understand how vulnerable catchments may be to increased septicity and hydrogen sulphide generation (odour risks, aggressive flows may damage concrete).

Further Climate Risk Assessment

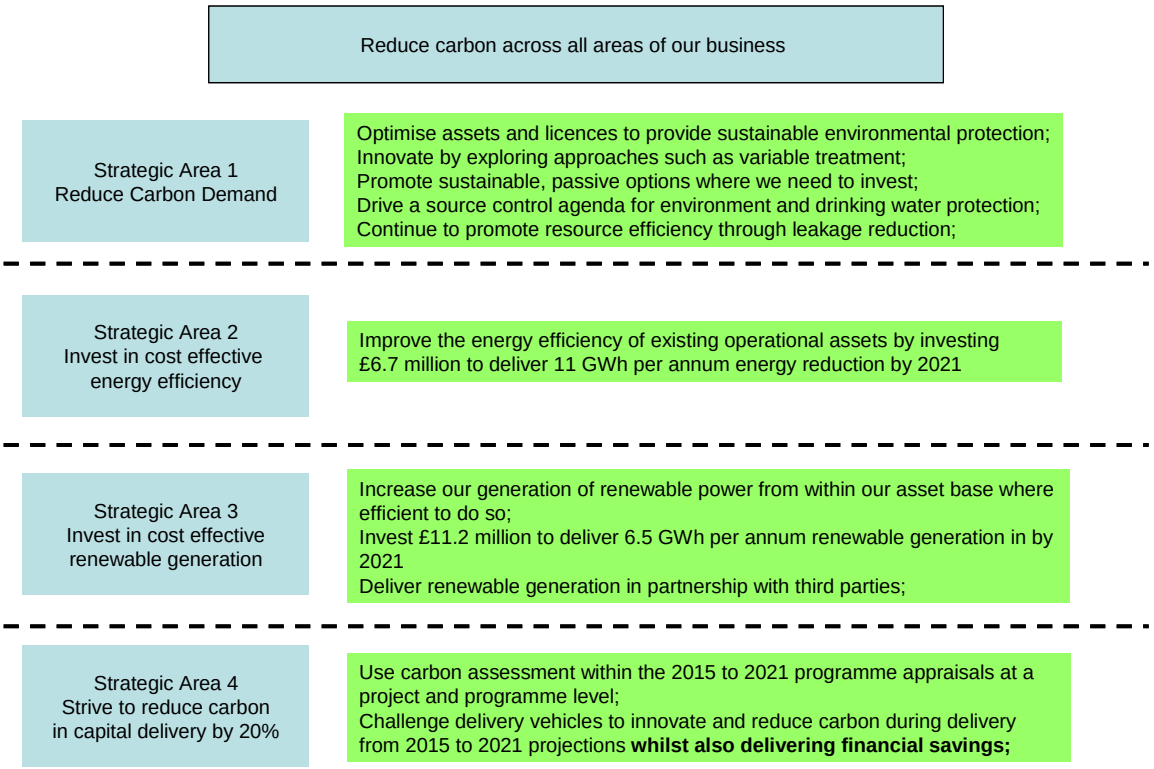
The climate risk assessment in the current period explored potential climate impacts and developed a framework for assessing risk across Scottish Water assets. This has enabled identification of monitoring needs to understand the point at which specific interventions may be required. It also enables Scottish Water to feed in to Scotland's Climate Change Risk Assessment as required under the UK Climate Change Act.

Utilising the approach used in this assessment and the additional work in the industry by UKWIR, further detailed climate risk assessments are planned at 10 water and 10 waste water assets. These will facilitate an improved understanding of longer term asset planning, inform near and longer term adaptation responses, and enable more generic adaptation measures to be rolled out more widely as appropriate.

Carbon emissions

Our carbon strategy contributes to the Scottish Government's aims on climate change to reduce carbon on behalf of customers. It builds on the reduction in carbon achieved to date, the studies undertaken in the current period, the continued assessment of carbon within our operations, and our increased understanding of wider opportunities to be more sustainable. A summary is presented below.

Figure 14.1 – Summary of planned developments relating to carbon



In the period to 2021, we will reduce the drivers of carbon emissions through source control measures (for example Sustainable Land Management to improve drinking water, urban diffuse pollution management through Surface Water Plans and source control for Priority Substances Directive); ongoing work with SEPA to evaluate environmental needs and ensure appropriate treatment; and continued delivery of the water efficiency, enhanced energy efficiency, greater renewable generation and limited carbon produced in the development of capital projects.

The specific project areas are as follows:

Variable Waste water Treatment – Reducing Demand

We have a programme to vary treatment at some waste water works according to environmental need and will extend this to a further five works, depending on the benefits case. This will seek to demonstrate how scaleable variable treatment is and inform IR18.

Retrofit sustainable solution

We recognise that previous 'pump away schemes' may not be optimal in a carbon context and wish to explore and trial the benefits of alternative passive solutions. We will identify and fully scope the costs and benefits for an appropriate site and, more specifically:

- identify a suitable site where we currently pump treated or untreated effluent significant distances, and where there may be an alternative local treatment or discharge solution – e.g. wetland and reedbed; and
- assess the energy, carbon and cost effectiveness of switching from pump away to local treatment or discharge, including the carbon and cost implications of delivery of a passive wetland system.

This will look to inform the merits of retrofit projects in the future.

Energy Efficiency

Electricity consumption represents the major source of carbon emissions for Scottish Water. It is also a key cost driver for the business. Extensive work has been conducted to understand the costs and benefits of future energy efficiency programmes. Through site evaluation across major consuming assets across the water and waste water asset base, opportunities have been found covering pump efficiency, aeration efficiency, dissolved oxygen controls and other measures to reduce consumption. The key focus remains on cost effectiveness to ensure the best return to the customer.

Planned energy efficiency investment is explained in the 'Investing to reduce the costs of service', Appendix 12.

Renewable Energy

As for energy efficiency, it is important to ensure that we focus on cost-effective opportunities to deliver value to the customer through reduced energy consumption. The renewable generation programme will use a range of energy sources and yield carbon benefits.

Planned renewable energy generation investment is explained in the Investing to reduce the costs of service appendix.

Carbon assessment in project appraisal

We have developed a tool for estimating the carbon incurred in the delivery of capital projects.

Working with our delivery partners, we will look to reduce carbon below current levels in the development of future capital projects (sometimes referred to as embodied carbon).

Appendix 12: Investing to reduce the cost of service

In summary:

- Our 'invest to save' programme to reduce the cost of services involves investments specifically where the payback period extends beyond 2021 and is primarily focused on energy initiatives. Our programme comprises a mix of proven delivery with more innovative technology.
- The programme involves an investment of £17.9 million in energy efficient assets and renewable energy generation to reduce annual operating costs by £2.3 million by 2021.
- We will also invest £23.3 million in an advanced sludge anaerobic digestion plant. This is a strategic initiative to provide the vital organisational capability required to determine and deliver the least cost long term sludge strategy when the PFI waste water contracts transfer to Scottish Water post 2021.
- We expect our self-generation capacity will increase by 14GWh to over 75GWh, representing over 16% of our current 450GWh annual consumption.
- In addition, we expect to be able to reduce consumption from existing assets by over 11GWh per annum, effectively offsetting increased energy demand from our planned capital enhancement programme.
- In the process of identifying the investments for the plan, we have rejected some with long paybacks (e.g. lead pipe removal and some water treatment works rationalisation) while others will be studied further.

Invest to save strategy

Our strategy is to make investments that will reduce the long term costs of delivering water and waste water service to customers or increase the resilience of future services. 'Invest to save' opportunities are defined as opportunities where the payback period extends beyond 2021.

Our 'Invest to save' investments will enable us to reduce energy consumption, enhance our self-generation and build our organisational capability in sustainable sludge management. This strategy is also consistent with the Scottish Government's aims to increase the use of water industry assets for renewable energy generation and support the goals of the Climate Change (Scotland) Act 2009.

These plans are consistent with our longer term strategic direction and intent for energy. This comprises:

- Reducing energy consumption by improving the capability of our assets and improving operational performance management;
- Increasing and maximising self-generation where there is a good return for customers, supporting the Hydro-nation agenda;
- Hosting private renewable energy investment on our land which offers an attractive return while being fully compatible with exercising our statutory duties;
- Deploying innovation and technologies that maximise value from our asset base and reduce whole-life cost; and
- Optimising our energy purchasing strategy to maximise benefit for customers in terms of price risk mitigation against rising energy costs.

In this appendix all investment figures are provided in 2012/13 prices unless otherwise stated.

Background and key drivers for change

We consume around 450GWh per year providing water and waste water services to over 2.4 million homes and 159,000 business premises. We presently generate 7% of our annual consumption of electricity and expect this to increase to 13% as we exit 2014/15. The cost of our energy (net of current self-generation benefits) in 2013/14 is expected to be £45 million, around 13% of our operating costs.

In the period 2010 to 2015, increasing energy demand as a result of our capital enhancement programme has largely been offset by reductions in consumption, primarily driven by the leakage reduction programme. We have now achieved the Economic Level of Leakage (ELL) and therefore there is limited scope for offsetting further increases in demand through leakage control.

In the period 2015 to 2021, our 'invest to save' plans will not only reduce costs by 2021 but also further enhance self-generation going forward into the subsequent period. By reducing our external energy purchases we also reduce our exposure to higher and more volatile energy prices.

Our 'Invest to save' programme

Our 'invest to save' programme for 2015 to 2021 includes: (a) installation of new equipment at treatment works to reduce consumption, (b) renewable generation and (c) a sustainable long-term sludge strategy. The investments for (a) and (b) are summarised in the table below.

The combined investment is £17.9 million in 2015 to 2021 and the expected savings by 2021 is £2.3 million per annum. These savings are then expected to be maintained thereafter.

Initiative area	Investment (£m)	Energy (GWh pa)	Savings (£m pa)	Payback (years)
Energy Efficiency	6.7	11.0	1.1	6.1
Renewable generation (hydro and photovoltaics)	11.2	6.5	1.2	9.3
TOTAL	**17.9**	**17.5**	**2.3**	**7.8**

Table 12.1: Summary of planned investment

Installation of new equipment at treatment works to reduce consumption

External benchmarking with several companies in England and Wales has confirmed that there is scope to improve energy use at our waste water assets while our water assets are comparatively efficient. Our planned investment will install variable speed drives, replace surface aeration with diffuse aeration, replace and refurbish pumps and install real-time control to optimize our energy usage, predominantly at waste water treatment works.

An investment of £6.7 million will save over 11GWh per annum, with an expected annual saving of £1.1 million. Further energy savings were identified through our investigations but, following discussions with the Customer Forum, were excluded from the plan owing to length of payback and viability.

In addition to the 'invest to save' initiatives discussed above, our plan involves other initiatives to reduce energy consumption and the cost of consumption including:

***More smart metering*:** By March 2015 we will have installed over 4,000 smart meters to send half-hourly data to our supplier thus enabling more flexible management of energy consumption and actual rather than estimated reads. The meters provide valuable information on the consumption of assets and have been self-financed through reductions in consumption and costs under the Government's Carbon Reduction Commitment Scheme. They have supported opportunity identification in our plan and will aid validation of benefits. Our plans include the extension of smart metering to sub-processes at our major waste water treatment works to further this capability. The expected benefits will similarly self-finance this sub-metering installation programme.

Reducing the cost of energy consumed: We have introduced demand management initiatives (e.g. Seasonal Time of Day (STOD) and triad management) and will extend this further. Where Scottish Water's electricity tariffs vary by time, day and season, we can partly manage our operational activities to transfer consumption from higher to lower tariff periods. This is presently limited to available plant control whilst remaining within quality compliance targets. For 2015 to 2021 we will further develop this capability through improvements to control, measurement and management of electricity use.

Renewable self-generation

By March 2015 we will be generating a further 25GWh, taking Scottish Water to around 13% self-generation. This follows the development of several renewable projects in the current period, primarily using hydro generation.

For 2015 to 2021, we plan to invest £11.2 million in a number of renewable generation projects, with an expected annual saving of £1.2 million. The projects were identified from a preliminary study and set of renewable generation schemes. The plan includes the investment for a subset of the original schemes considered with a total installed capacity of 6.5GWh pa. They are mostly hydro schemes but they also include wind and solar photovoltaic schemes.

The programme utilizes proven technology but also more innovative solutions such as DifGens. DifGen is a new technology for generating energy whilst simultaneously reducing pressure in the water network – Scottish Water installed the world's first DifGen on a strategic water trunk main in 2013.

Long-term sustainable sludge strategy

Seven out of the ten water and sewerage companies in England and Wales have installed advanced anaerobic digestion (AAD) of sludge at some of their waste water treatment works. However, Scottish Water has not yet taken this route, partly because some 80% of Scottish Water's sludge output is processed at those waste water treatment works operated under PFI contracts and partly because energy prices have not justified the investment. Two of our PFI sites already use sludge as a fuel for energy generation.

We plan to start adopting this approach for our directly managed sludge operations, initially via a pilot plant. This is a strategic initiative critical to determining the least cost sludge management strategy and is particularly urgent for Glasgow with the Daldowie PFI contract (dealing with around 50% of our sludge) expiring in 2026. Through building and operating this pilot plant we will also gain valuable operating experience and organisational capability. The quantity of sludge is reduced via this process and the quality much improved making it easier to recycle to agriculture, thus significantly reducing risk through loss of land bank and tighter recycling standards.

For comparison, we conducted feasibility studies at two locations, Perth and Dalderse waste water plants.

The use of advanced anaerobic digestion to convert sewage sludge into methane gas for burning in gas turbines will produce around 7.5GWh of installed capacity. The investment is £23.3 million with expected annual savings of £1.4 million.

Taking our 'invest to save' programme and sustainable sludge strategy together we expect our total installed capacity will increase by 14GWh to over 75GWh by 2021, representing over 16% of our present 450GWh annual consumption.

Other 'invest to save' initiatives – not pursued

Our 'invest to save' initiatives, discussed above, have been selected from a range of project options on the grounds of their financial return and strategic significance to Scottish Water. In the process other options have been considered and rejected.

As an example we looked at 90 water treatment works where we currently add phosphate to the water supply to protect customers from lead. We identified 44 works where removing the lead pipes (and providing a grant to customers to remove theirs) could be more cost effective in the long term. As we would give customers 10 years advance notification of the removal of the pipes to allow time for them to be removed when their kitchens were replaced, this delayed the benefits of the scheme to the point whereby it was not longer viable. We also looked at further asset rationalisation of our water treatment works but given the length of payback also agreed not to pursue at this time.

Other 'invest to save' initiatives

We are continuing to look at other projects to more fully gauge whether they would be a reasonable investment. They include surface water separation from our sewer network, asset rationalisation, renewable energy generation and energy efficiency investments. We are also working in partnership with a number of universities and research institutions on a number of projects with the aim of identifying new technologies and innovation that will add value, for example in nutrient recovery at waste water treatment works.

In addition, we are presently undertaking trials at two waste water treatment works in a joint initiative with SEPA. By varying the level of treatment according to the capacity of the receiving environment we aim to achieve a better overall environmental outcome at lower overall cost. There are costs associated with enhancing the control and monitoring of our treatment processes in order to vary the level of treatment; opex savings will result from lower chemical and energy usage.

Summary

Our 'invest to save' plan and sustainable sludge strategy will bring benefits to customers through significant efficiencies, much greater long-term service stability and mitigation over future energy costs with a lower carbon footprint. We will continue to look for opportunities to invest to reduce longer term costs of service delivery and will raise any new opportunities for consideration at the IR18 investment review.

Appendix 13: Revenues

- The Customer Forum has highlighted that our customers are most likely to recognise the Consumer Prices Index (CPI) as the primary measure of inflation in the United Kingdom. We agree with this view and are therefore planning that charges for all customers be set relative to CPI inflation in the 2015 to 2021 period.
- The overall household price cap across the 2015 to 2021 period will be 1.75% below CPI. We believe that this real terms reduction will keep average prices significantly lower than the average in England and Wales in the 2015 to 2021 period.
- The Customer Forum has highlighted that certainty in knowing the actual level of bills is important to our customers. This plan agreed with the Customer Forum is therefore based on:
    - fixing a nominal price increase of 1.6% a year in each of 2015/16, 2016/17 and 2017/18 for our household customers. In addition we have limited the price increase for 2014/15 to 1.6%;
    - setting an indicative nominal price increase of 1.6% a year in each of 2018/19, 2019/20 and 2020/21 for household customers only, that will be subject to assessment at the time based on out-turn and forecast CPI;
    - committing that, should the application of the price cap methodology require household prices in 2018-21 to exceed the indicative price increase of 1.6% a year then, prior to the application of such an increase, Scottish Water, the Customer Forum, and the Commission will consider whether any, or all, of the increase above 1.6% can be off-set by overall favourable external factors, re-phasing of IR18 allowances to after March 2021, or by returning any early sustainable out-performance to customers.
- The assumption for growth of the household charging base averages 0.74% across the period of our business plan. The wholesale customer base is assumed to remain stable.
- We have agreed with the Customer Forum that a revenue cap is set for wholesale customers, based on an assumed average annual price change of CPI – 0.3%, but this real price change will be subject to annual adjustment to reflect actual growth.
- The charging base for non-household customers over the 2015 to 2021 period reflects the proposed introduction of charging for vacant properties which should commence no later than April 2017.

Overview

The Customer Forum highlighted that customers recognise the Consumer Prices Index (CPI) as their primary measure of inflation because of its publicly recognised status as the UK Government's measure of inflation, and its use as the index for changes to pensions and benefits. We therefore plan that changes in prices in the 2015 to 2021 period should be considered in the context of CPI. We plan an overall household charge cap of 1.75% less than CPI over the 2015 to 2021 period.

The Customer Forum has highlighted that certainty in knowing the actual level of bills is important to our customers. We have therefore agreed with the Customer Forum that the overall household price cap will be operated in accordance with the following three principles:

1. A fixed nominal price increase of 1.6% pa in each of 2015/16, 2016/17, and 2017/18 for household customers only, albeit that any over/under recovery of revenue in these three years may be adjusted for in 2018 to 2021 under the price cap arrangements. This follows a limiting of the household price increase in 2014/15 to 1.6% in light of the pricing intention for 2015 to 2018.
2. An indicative nominal price increase of 1.6% pa in each of 2018/19, 2019/20 and 2020/21 for household customers only, that will be subject to assessment at the time based on out-turn and forecast CPI.

3. If the application of the price cap methodology would require household prices in 2018 to 2021 to exceed the indicative price increase of 1.6% pa then, prior to the application of such an increase, Scottish Water, the Customer Forum, and the Commission will consider whether any, or all, of the increase above 1.6% can be off-set by overall favourable external factors, re-phasing of IR18 allowances to after March 2021, or by returning any early sustainable out-performance to customers.

Our wholesale revenue in the 2010 to 2015 period has been significantly below that expected as a result of the challenging economic conditions and the focus on improving water efficiency by customers and licensed providers. In the 2015 to 2021 period, we expect significant uncertainty in the wholesale customer revenue base because of changes to charging arrangements that will occur over the next 6 years and further efficiency in customers' water and waste water service consumption arising because of increased market competition.

We have agreed with the Customer Forum that it is therefore appropriate to introduce a wholesale revenue cap for the 2015 to 2021 period. This would protect household customers from the risk of under-recovery of wholesale revenues and provide the incentive for full revenue collection by licensed providers as the average price per non-household customer would be further reduced if more revenue is collected than expected. The planned wholesale revenue cap assumes that average wholesale charges will increase annually by CPI-0.3%.

Summary Forecasts

Our customer revenue projections for 2015 to 2021 are as follows:

Revenue forecast (£m outturn)	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Household	811	830	849	870	890	912
Wholesale revenue	283	287	306	311	316	321
Other revenue	6	6	6	6	7	7
Total Revenue	**1,100**	**1,123**	**1,161**	**1,187**	**1,213**	**1,240**

Table 13.1: Revenue forecast

Our planned household charge caps (the degree to which household charges will change in relation to the previous year) are shown in table 13.2 below.

Charge Caps	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2015-21 period
Household	**1.6%**	**1.6%**	**1.6%**	**tbc**	**tbc**	**tbc**	**CPI minus 1.75%**
- water	*1.6%*	*1.6%*	*1.6%*	*tbc*	*tbc*	*tbc*	*CPI minus 1.75%*
- wastewater	*1.6%*	*1.6%*	*1.6%*	*tbc*	*tbc*	*tbc*	*CPI minus 1.75%*

Table 13.2: Household charge caps

The forecast of CPI that we have applied to household and wholesale charges in our financial model has been set in line with the long term Bank of England target of 1.9% per annum[1].

	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
CPI Inflation	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%

Table 13.3: Inflation forecast applied to household charges

Table 13.4 below shows how we have calculated the wholesale revenue cap that we require for the 2015 to 2021 period.

[1] Bank of England Inflation Report August 2013: '*The MPC's remit makes clear that its primary objective is price stability, as defined by the 2% target for CPI inflation.*'

Revenue Cap Workings, £m	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Previous Year Wholesale Revenue (base)	278	283	287	306	311	316
Customer Base Change	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Forecast Price Change (CPI – 0.3%)	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
Wholesale Revenue Forecast (base)	**283**	**287**	**292**	**311**	**316**	**321**
Charging for Vacant Properties	-	-	15	-	-	-
Proposed Wholesale Revenue Cap	**283**	**287**	**306**	**311**	**316**	**321**

Table 13.4: Wholesale revenue cap calculation

We have forecast a wholesale revenue base of £278 million for 2014/15 based on our expected 2013/14 position of £285 million and the subsequent combined impact of 2.57% RPI inflation and the wholesale k-factors for the final year of the 2010 to 2015 period.

There is a significant increase in the wholesale revenue cap in the third year of our forecast. We expect that the introduction of charging for vacant business properties will allow for £15 million of additional revenue to be collected from 2017/18 from properties that are currently receiving a service but paying no charge (further details on this and other changes to the wholesale charging arrangements are explained towards the end of this appendix).

The remaining sections of this appendix outline the methodology and assumptions underpinning the revenue forecasts for both household and wholesale customer groups.

Household – Methodology and Assumptions

As with previous strategic reviews, we have used the National Records of Scotland (NRS[2]) projections on population[3] and households[4] to inform our assumptions on future growth in the household charging base. In addition, we have used the NRS annual estimates[5] of households and dwellings to provide a relevant historical context to help validate the forward looking projections.

We have also examined the historic WIC4 datasets to identify trends in band D equivalent property numbers and properties qualifying for charge reductions over the past six years.

Population, Households and Connected Properties

The NRS projections set out in table 13.5 forecast a growing number of households over the 2011 to 2021 period from which we would assume an increasing number of household properties.

[2] Please note that in previous strategic reviews, we referred to the General Register Office for Scotland (GROS) as the principal data source for population and household forecasts. From 1 April 2011, the General Register Office for Scotland merged with the National Archives of Scotland to become the National Records of Scotland (NRS).

[3] Projected Population of Scotland (2010-based), published by National Records of Scotland 26 October 2011.

[4] Household Projections for Scotland (2010-based), published by National Records of Scotland 14 June 2012.

[5] Estimates of Households and Dwellings in Scotland, 2012.Published by National Records of Scotland 9 July 2013.

	NRS Population Projection[3] (000s)	NRS Households Projection[4] (000s)	Households Annual Increase (000s)	*Implied Average Household Occupancy*
2011	5,251	2,368		
2012	5,282	2,396	28	*2.20*
2013	5,312	2,423	27	*2.19*
2014	5,340	2,449	26	*2.18*
2015	5,365	2,473	24	*2.17*
2016	5,390	2,498	24	*2.16*
2017	5,414	2,522	24	*2.15*
2018	5,438	2,545	23	*2.14*
2019	5,462	2,567	22	*2.13*
2020	5,486	2,589	21	*2.12*
2021	5,509	2,609	21	*2.11*

Table 13.5: NRS forecast of population and households

In order to validate the accuracy of the household projections in table 13.5, we have compared this forecast data with the most recent 'annual estimates' that are also provided by the NRS. The NRS annual estimates (produced separately from the NRS forward looking projections) are the closest approximation to the 'actual' number of households in Scotland and provide enough historic data to establish a declining trend for growth in households over the past six years as shown in 13.6 below:

	NRS Population Annual Estimate (000s)	NRS Households Annual Estimate[5] (000s)	Households Annual Increase (000s)	*Implied Occupancy Rate*
2006	5,117	2,295		*2.23*
2007	5,144	2,318	24	*2.22*
2008	5,169	2,337	19	*2.21*
2009	5,194	2,351	14	*2.21*
2010	5,222	2,364	13	*2.21*
2011	5,300	2,375	11	*2.23*
2012	5,314	2,386	11	*2.23*

Table 13.6: NRS annual 'estimates' of population and households

We have combined the trend data for household annual increases from table 13.6 with the projections data in table 13.5 and with our own datasets to allow an illustrative comparison to be made:

All figures 000s	NRS Households Annual Increase 'Estimate'	NRS Households Annual Increase 'Projections'	Scottish Water Annual Return: Average change to connected household properties (Net)[6]	Scottish Water Annual Return: Average change to billed household properties (Net)	Scottish Water forecast: Average change to connected household properties (Gross)	Scottish Water forecast: Average change to connected household properties (Net)
2007/08	22		22	26		
2008/09	18		19	17		
2009/10	14		13	18		
2010/11	13		11	14		
2011/12	11		12	12		
2012/13		28	13	12		
2013/14		27			15	11
2014/15		25			16	12
2015/16		24			16	12
2016/17		24			16	12
2017/18		24			18	14
2018/19		23			19	16
2019/20		22			20	17
2020/21		21			21	18

Table 13.7: All available data for households (estimates, projections, forecasts)

Comparing the two time series in table 13.7 suggests that the NRS household projections appear very optimistic relative to the recent trend data from the NRS annual estimates. Given the timing of when the projections were made, it is likely that they did not fully reflect the continuing economic downturn and subsequent impact on house building in Scotland.

From this analysis, we have concluded that our forecasts for the household charging base from 2013 to 2021 should not explicitly follow the NRS household projection data but instead reflect the historic trend data identified in table 13.7.

We have based our forward forecast (the final two columns in table 13.7) on the level of connections that we are currently making and a fairly optimistic view that we will see some economic recovery between 2015 and 2021. Our forecast of 'net' new connected properties reflects a reduction in the underlying household charging base of around 3,,500 properties per year due to demolitions of existing housing stock[7]. We typically see a higher figure for new connections in a year compared to new properties being added to the charging base due to the impact of demolitions.

In summary, our forecast suggests that we will be connecting 110,000 new household properties in the 2015 to 2021 period and with 21,000 properties demolished in that time to leave a net increase in connected properties of 89,000.

Household Charging Base

To corroborate our forecast of 'net' new connected properties, we have also examined the recent trends in our band D equivalent charging base (as set out in the annual WIC4 return).

We express the value of our household charging base with reference to council tax 'Band D Equivalents'. This allows us to convert the range of households that pay their bills according to their respective council tax bands into a standard and consistent measure.

[6] All Scottish Water figures are based on the financial year (April to March). NRS estimates are for calendar year, adjusted to financial year using a 0.75 and 0.25 weighting.

[7] We have used the historic trend data for annual demolitions provided by the Scottish Government: *http://www.scotland.gov.uk/Topics/Statistics/Browse/Housing-Regeneration/HSfS/Demolitions*

It is important to note that the level of band D equivalents is significantly lower than the number of households in Scotland (due to the relative number of households in band A to C properties compared to those in band E to H properties).

Table 13.8 below shows the rate of change in our band D equivalent charging base over the past five years, calculated from the WIC4 returns for each year:

	WATER Band D Equivalents (000s)	*Annual Increase (000s)*	*Rate of Change*	WASTE WATER Band D Equivalents (000s)	*Annual Increase (000s)*	*Rate of Change*
Sep 2007	1,908			1,815		
Sep 2008	1,930	*22*	*1.14%*	1,835	*20*	*1.07%*
Sep 2009	1,950	*20*	*1.05%*	1,852	*17*	*0.94%*
Sep 2010	1,961	*11*	*0.58%*	1,862	*10*	*0.52%*
Sep 2011	1,976	*15*	*0.74%*	1,874	*12*	*0.69%*
Sep 2012	1,989	*13*	*0.66%*	1,886	*12*	*0.61%*

Table 13.8: Band D Equivalent trend

Over these past six years, the annual percentage change for both water and wastewater band D equivalents has reduced. This has been primarily caused by the challenging economic conditions over this period which in turn has heavily constrained the rate of new house building in Scotland.

We have used an average growth rate from the last 3 years of WIC4 reports for 'Water Band D Equivalents' to forecast forward to 2021. Assuming that growth will rise to 0.9% by 2020/21, this growth rate of 0.74%, applied to the September 2012 position, , suggests an increase in band D equivalent properties of approximately 91,000 between 2015 and 2021.

Household Charges

Household charge caps are a key output of our financial modelling process. The calculation of these charge caps is highly sensitive to changes in either our expenditure plans or our forecast of other sources of financing, including available borrowing. The calculated charge caps shown below in table 13.9 are required to fund the expenditure and financing projections outlined in our business plan. Charges for years 2018/19, 2019/21 and 2020/21 have been set nominally assuming that CPI is 1.9%, these will be subject to assessment at the time based on out-turn and forecast CPI.

Charge Caps	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2015-21 period
Household	**1.6%**	**1.6%**	**1.6%**	**[1.6%]**	**[1.6%]**	**[1.6%]**	**CPI minus 1.75%**
- water	*1.6%*	*1.6%*	*1.6%*	*[1.6%]*	*[1.6%]*	*[1.6%]*	*CPI minus 1.75%*
- wastewater	*1.6%*	*1.6%*	*1.6%*	*[1.6%]*	*[1.6%]*	*[1.6%]*	*CPI minus 1.75%*

Table 13.9: Charge caps

In previous price control periods, household charges have been indexed to the Retail Prices Index (RPI). However, we plan to link customer charges to CPI inflation in the 2015 to 2021 period reflecting the feedback we have received from the Customer Forum.

Since January 2010, RPI has averaged around 0.75% ahead of CPI. For this plan, we have assumed a differential of 0.75% between RPI and CPI across the forecast period. If we had continued to use RPI inflation for prices in the 2015 to 2021 period, the k factor for equivalent annual charge caps would be -1.05% (reflecting our forecast average 0.75% differential between CPI and RPI).

Using the CPI forecast, as shown in table 13.2 with the charge caps shown in table 13.9, average household charges for the 2015 to 2021 are forecast as follows:

Household Tariffs	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Average Household charges (forecast outturn prices)	£338	£344	£349	£355	£361	£366	£372
Average Household charges (12/13 prices)	£320	£319	£318	£317	£316	£315	£314

Table 13.10: Average household charges

Affordability

We have agreed to commence work with the Scottish Government and other stakeholders, including the Customer Forum, by April 2015 to investigate if more can be done to support vulnerable customers within the principles of charges laid down by Scottish Ministers.

Non-Household – Methodology and Assumptions

To prepare our wholesale revenue forecasts, we have examined in detail our experience in the 2010 to 2015 regulatory period, analysed the underlying trends in the wholesale market and assessed the likely impact of expected changes in the wholesale charging arrangements across the 2015 to 2021 period.

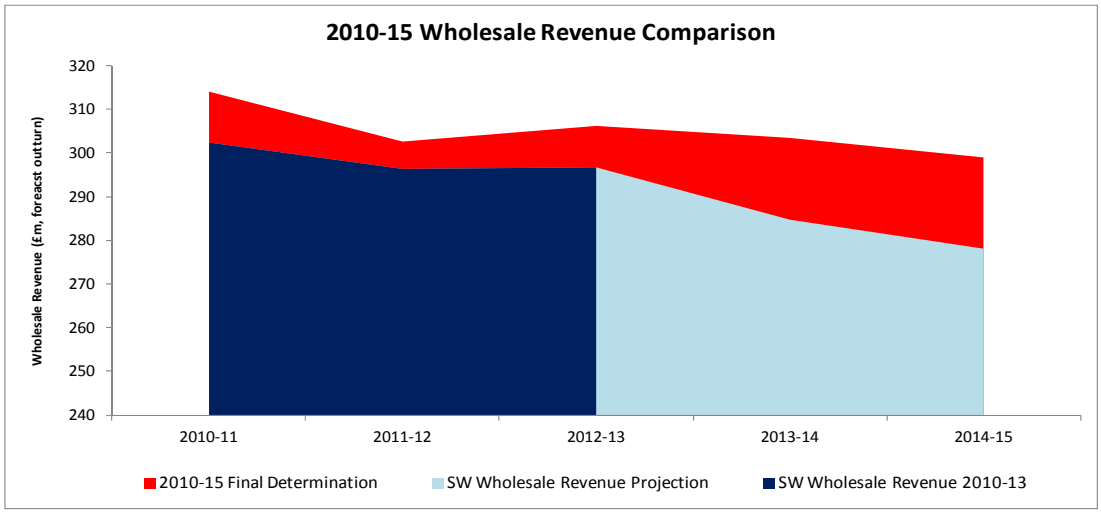
When taken together, these factors combine to present a very uncertain picture for wholesale revenue in the near to medium term and this has heavily influenced our proposal to introduce a revenue cap mechanism.

2010 to 2015 Period Experience

When forecasting the likely level of revenue for the 2015 to 2021 period, we have taken into account the experiences of the 2010 to 2015 period.

The red shaded area in figure 13.1 represents a forecast £68 million shortfall of revenue in 2010 to 2015 below the 2009 Final Determination expectation[8:]

Figure 13.1 – 2010 to 2015 Wholesale Revenue against Final Determination



If this situation were to occur again in the 2015 to 2021 period then we believe there would be a significant risk to household customer charges.

[8] For comparison purposes, we adjust the Final Determination wholesale revenue forecasts to account for the impact of actual price inflation in the period.

We believe the use of a wholesale revenue cap will protect household customers from such adverse changes in the business customer market. We also believe that a revenue cap mechanism will incentivise Licensed Providers to maximise revenue collection as any upside in revenue that is recovered in any year of the 2015 to 2021 period (beyond that assumed in the initial cap calculations) will result in lower average wholesale charges in subsequent years.

The use of the revenue cap therefore provides the dual benefit of protecting household customers from the underlying uncertainty in the wholesale market but also creates a strong incentive for all wholesale market participants to work together to maximise business customer and therefore wholesale revenue.

Wholesale Base Trend

Whilst there has been a significant level of uncertainty surrounding the total value of the wholesale customer base in recent years, we have observed some consistent trends since market opening in 2008.

Over these past five years, in real terms, the value of our combined wholesale customer base has contracted by 17%. An important aspect of this trend has been the impact of differential charge caps for each service as we rebalanced our charging base – both between households and wholesale and within the wholesale sector itself.

Beyond the rebalancing process, changes in customer numbers and consumption patterns have also had an impact on our wholesale customer base. Increased customer awareness and competition between Licensed Providers has seen water efficiency measures take effect in the wholesale market driving a reduction in consumption.

We anticipate this pattern continuing over the 2015 to 2021 period. However, we are assuming that marginal growth in the number of connected business properties will offset the continued decline in consumption.

Wholesale Market Changes 2015 to 2021

For the 2015 to 2021 period, we have identified a number of potential changes to the wholesale charging arrangements that will impact the level of wholesale revenue. In our analysis, seven potential changes in the wholesale market have been identified and reflected in our forward view of potential revenues from the 2014/15 position. These are summarised below:

	Annual Revenue Impact by 2021
Extension of the charitable exemption scheme	£0 million - £6 million reduction
Schedule 3 and other special deal customers moving off network at the end of their current contract	£0 million - £5 million reduction
Closure of large industrial sites in Scotland	£0 million - £1 million reduction
Impact of competition and water efficiency drive	£0 million - £10 million reduction
New customers connected and gap site identification projects	£3 million - £10 million increase
Schedule 3 customers moving to full charges at the end of their current contract	£4 million - £11 million increase
‘Charging for Vacant Properties’ legislation	£10 million - £20 million increase

Table 13.11: Wholesale market changes

There remains a significant degree of uncertainty over the likelihood, details and timing of most of the changes outlined in table 13.11 above, as demonstrated by the uncertainty of the future of the largest industrial consumer, Ineos at Grangemouth, in September 2013. Due to the high level of uncertainty we have reflected a broadly neutral position within our revenue cap modelling, with the exception of inclusion of £15 million per annum from the proposed ‘Charging for Vacant Properties’ legislation into the planned revenue cap from 2017/18.

Wholesale Revenue Cap

To calculate an appropriate level of wholesale revenue cap for the 2015 to 2021 period, we have applied an assumed underlying growth rate of 0% and an expected annual real price reduction of 0.3% to our forecast 2014/15 wholesale revenue position. Our assumption of 0% for underlying growth reflects our view that an increase in wholesale service connections in the 2015 to 2021 period will offset changes in consumption patterns.

Under this mechanism, the outturn value of the wholesale revenue cap will move in line with changes to CPI; i.e. if CPI outturns at a level other than the 1.9% assumed in this plan, the wholesale revenue cap will change to reflect this. Year on year changes in the underlying value of our wholesale charging base will also be affected by the various factors that we have outlined in this appendix. We have assumed that there will be an additional £15 million of wholesale revenue collected from 2017/18 due to legislative change in relation to charging for vacant properties.

Appendix 14: Costs and efficiency

In summary:

Our plan is based on the optimal balance of operational and capital costs that delivers services at the lowest whole life cost for customers

Operating costs

- We have made significant efficiency improvements over the last 12 years and benchmarking shows that the opportunities for ongoing improvement are smaller than they have been in the past.
- The primary focus of our operating cost efficiency plan is further innovation and productivity improvements, investment to improve energy efficiency and generate further renewable energy generation, and reducing the costs associated with service failures by preventing these from happening.
- Overall our ongoing efficiency and productivity improvement programme will deliver savings of around 1% per annum on our controllable operating costs that offset the forecast operating cost pressures associated with delivering higher service levels and meeting new statutory objectives.
- It is important to note that there are several cost areas that are not fully in our control. While indexing of costs by RPI will protect us from most cost changes, there are risks of one-off changes to our costs (e.g. business rates) that we may not be able to manage within this plan.

Capital costs

- Our plan proposals take account of the strategic and innovation efficiencies identified in the development of the solutions to deliver the required improvements, including operational solutions and rationalisation of assets, taking account of the synergies between investment areas.
- Our investment plan costs are primarily based on the actual costs of delivery through 2006 to 2011.
- We expect to continue to improve the efficiency of our investment activities and have identified opportunities to improve on the costs used to prepare this plan by 13%. We have set ourselves a stretching challenge to deliver additional efficiencies beyond those we have identified such that we will improve efficiencies by 14.4% to 17.9% over the period from the historic costs used to cost this plan (assuming that future costs are indexed by RPI).
- Our efficiency plans focus on behavioural change and changes to ways of working and are a mix of revised procurement arrangements, streamlining our investment management processes and improved productivity within our supply chain. Therefore we are dependant on our supply chain working in partnership with us to deliver more value for our customers.
- We have reduced the capital maintenance costs in our plan by a further 4% to reflect our Totex benchmarking comparisons with the leading companies in England and Wales.
- Our benchmarking analysis shows that the efficiency challenge we have set ourselves is challenging.

Foreword

This Appendix explains the basis of the costing of our plan and the key changes to operating and capital costs forecast over the 2015 to 2021 period as a consequence of our efficiency and service improvement plans.

Operating costs

Overview

We have made significant efficiency improvements in operating costs over the last 11 years and benchmarking shows that the opportunities for ongoing improvement are smaller than they have been in the past.

Operating costs are the recurring costs incurred in the daily delivery of our services, as opposed to the capital investment in creation or replacement of assets such as treatment plants, pipes, vehicles or IT equipment.

Operating costs fall into two primary categories:

- Directly controllable costs, such as salaries, transport, customer services, office costs and chemicals;
- Costs outside of direct control, such as local authority business rates, cost of revenue collection, bad debt, pension contributions, and levies / fees to third parties.

Operating costs can change due to reasons outside management control and as a consequence of our plans to improve services and meet legislative objectives. These latter costs we refer to as new operating costs.

Forecast operating costs

The Commission set out in their information note to the Customer Forum that they consider a range for annual operating costs of between £320 million and £345 million (in 2011/12 prices) should be expected for the period 2015 to 2021. Restated in 2012/13 prices, consistent with the cost base of our plan, the expected range would be £329 million to £356 million.

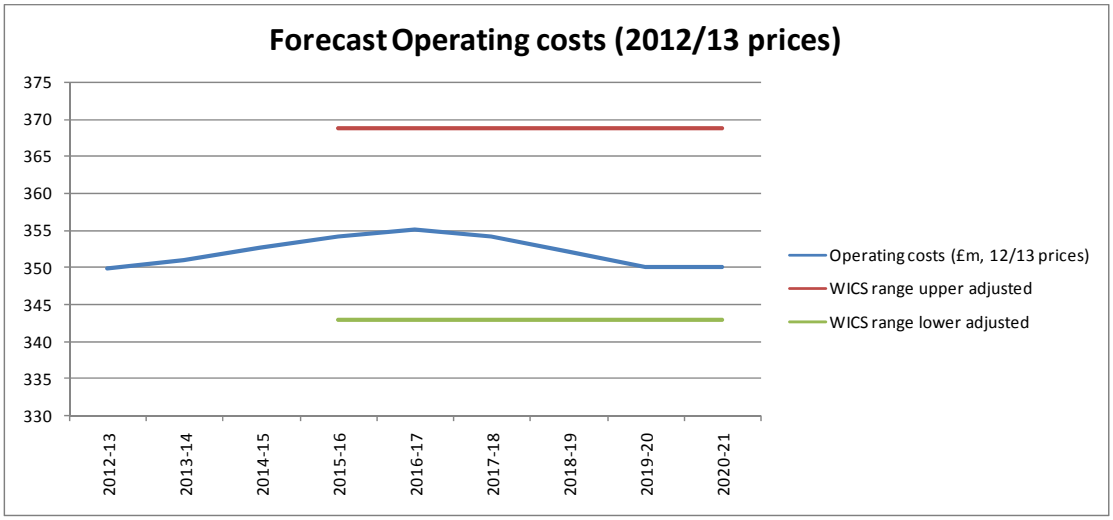
Since this expectation was set, based on our actual 2011/12 expenditure, we are incurring additional costs of £13 million outside our control that should be reflected in an adjustment to the upper and lower range limits. These additional costs relate to:

- Bad debt (£5 million): Our historic bad charge since 1996/97 has averaged 4.0% of household revenue. We expect that we can reduce our future bad debt charge to around 3.8% of household revenue, although this will be challenging because of the uncertain impact of the UK Government welfare reforms on future levels of bad debt. An underlying charge of 3.8% of revenue would equate to £29 million in 2012/13 prices, a real increase of £5 million on the bad debt charge of £23 million in 2011/12 (£24 million expressed in 2012/13 prices). A bad debt charge of £29 million was included within our 2012/13 base operating costs of £350 million (see Table 14.1 below).
- Energy (£4 million): 2011/12 was a very favourable year for the cost of energy because of good fortune in our purchasing for that year. In real terms, our 2011/12 energy costs were £3 million lower than the preceding year. Our real energy costs have risen by £4 million since 2011/12; £1 million in 2012/13, which is included in our 2012/13 base operating costs of £350 million, and by £3 million in 2013/14. The increase in real energy costs is due to increases in the commodity price of energy (£3.5 million) and pass-through regulatory costs (£2.1 million) that have been partially offset by our generation income.
- Cost of collection (£2 million): Our cost of household collection fee, payable to the local authorities, will increase by £2 million in 2014/15 under the terms of the draft Billing and Collection Order for 2014 to 2018 that will shortly be presented to the Scottish Parliament for approval. The real fee increase is to ensure that the local authorities are fairly compensated for the overall effect of administering the Billing and Collection Order.
- National Insurance (£2 million): Our employers national insurance contribution will increase generally from 10.4% to 13.8% in April 2016 as a consequence of a change announced in the 2013 UK budget reflecting the removal of the state pension contracted-out element.
- Pensions auto-enrolment: There will be an increase in our pension costs in 2013/14 arising from the auto-enrolment of employees into our pension scheme. This could increase our costs by up to £1 million.

Adjusting the Commission's range for the above increases in third party costs outside our control would result in a revised range of £342 million to £369 million.

Our plan sets out that our operating costs will be broadly stable at around £352 million on average across the 2015 to 2021 period taking account of new operating costs arising from our statutory and service improvement plans, broadly offset by our planned efficiency improvements as shown in the graph below.

Figure 14.1: Forecast operating costs



Our overall forecast is built up from the components shown in the Table 14.1.

£m, 2012/13 prices	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
2012/13 Base Operating Costs	**350**	**350**	**350**	**350**	**350**	**350**
Severance Cost Reduction	-3	-3	-3	-3	-3	-3
Base Efficiency Plan	-8	-9	-10	-11	-12	-14
Forecast Base Operating Costs	**339**	**338**	**337**	**336**	**335**	**333**
Energy Cost Increase (2013-2015)	3	3	3	3	3	3
Cost of Collection Increase (2014/15)	2	2	2	2	2	2
National Insurance Contributions Increase	0	2	2	2	2	2
Adjusted Base Operating Costs	**344**	**345**	**344**	**343**	**342**	**340**
SR10 new operating costs 2013-15	7	7	7	7	7	7
SR15 new operating costs	3	4	5	5	5	7
SR15 Invest to Save Benefits	0	-1	-2	-3	-4	-4
Forecast Total Operating Costs	**354**	**355**	**354**	**352**	**350**	**350**

Table 14.1: Annual operating costs

The changes to our operating costs over the 2015 to 2021 period, relative to our base operating costs in 2012/13 are set out below.

Severance cost reduction

We expect to reduce annual severance costs by £3 million from £4 million in 2012/13 to £1 million a year in the 2015 to 2021 period. In line with Scottish Government policy, we operate a no compulsory redundancy policy within Scottish Water but require £1 million per annum financing to facilitate business restructuring and associated re-skilling of our employees.

Base efficiency plan

We expect that we can generate £14 million of efficiencies relative to our 2012/13 base operating costs by 2020/21.

The primary focus of our base efficiency plan in 2015 to 2021 is further productivity improvements and reducing the costs associated with service failures by preventing these from happening. Many of these efficiency gains will be achieved through the innovations set out in our business plan that are enabling productivity gains as well as improving service for customers. These will be augmented by the 'invest to save' benefits included in our plan to reduce energy demand and increase renewable energy generation. We have and will continue to look at sourcing opportunities to reduce the costs of service delivery.

Our analysis shows that by continuing our move towards a more planned and preventative approach to service delivery and routine maintenance we should see further productivity gains in our own workforce and supply chain and reduced costs associated with the costs of recovering failures, clean-ups and alternative supplies. In support of this we are introducing condition monitoring technology, widely used in manufacturing and petro-chemical industries, to reduce the number of unscheduled plant shutdowns that can affect service to customers. We expect that condition based monitoring and intervention will also, in the longer term, reduce the costs of routine maintenance of our assets by reducing the number of visits and manual inspections.

Our new Intelligent Control Centre uses technology to allow us to sustain high quality services, by pulling together information to identify potential problems and take action before they affect service to our customers, through our leading use of information systems. The planned development of further intelligent controls during 2015 to 2021 will support our aims of moving to an ever more planned approach to both operation and operational maintenance, and allowing greater remote control of assets.

In addition to this we continue to seek ever more innovative ways to deliver services such that we can reduce the costs of service provision; such as:

- Using sustainable land management techniques to improve the quality of raw water such that we can use fewer chemicals in drinking water treatment processes;
- seeking to operate our waste water treatment plants to a standard that is appropriate to the actual conditions; and
- using pressure management techniques to control the level of interruptions to supply and reduce leakage further.

Costs outside management control

In this plan we have only included for known cost increases as described above, and summarized below:

- Energy: £4 million increase; £1 million in 2012/13 and by a further £3 million in 2013/14.
- Cost of collection: £2 million increase from 2014/15.
- National Insurance: £2 million increase from 2016/17.

It is important to note that there are several costs we incur that are not fully in our control. While indexing of costs by RPI will protect us from most cost changes, there are risks of one-off changes to our costs that we may not be able to manage within this plan. Appendix 16 provides more details of these, but the main risks are a revaluation of business rates in 2017, changes to employer pension contributions, introduction of a road works levy, changes to the cost of collecting household charges by local authorities and changes in the level of non-payment by household customers.

It is noteworthy that in the current period exogenous risks such as business rates and carbon tax increases have materialised at a total cost of £147 million. It has only been possible to absorb these additional costs due to favourable financial conditions in the 2010 to 2015 period. If costs of a similar magnitude materialise in the 2015 to 2021 period it is likely that we may need to utilise the financial reserve, reprioritise this plan and/or seek a redetermination of charges.

New operating costs

New operating costs are the costs of operational solutions to deliver enhanced service levels or meet statutory obligations or the additional operational costs arising from the new capital assets constructed to deliver higher service or compliance.

Table 14.2 below summarises the key elements that contribute to the new operating costs in our plan.

£m, 2012/13 prices	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
SR10[1] new operating costs 2013-15	**7.0**	**7.0**	**7.0**	**7.0**	**7.0**	**7.0**
SR15[2] new operating costs	**3.5**	**4.0**	**4.6**	**5.1**	**5.5**	**6.7**
Statutory committed	*0.5*	*0.9*	*1.3*	*1.3*	*1.3*	*2.4*
Statutory IR18 allowance	*0.0*	*0.0*	*0.0*	*0.3*	*0.5*	*0.8*
Service improvement committed	*3.0*	*3.1*	*3.4*	*3.5*	*3.6*	*3.6*
Service improvement IR18 allowance	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Invest to Save Benefits 2015 -2021	**0.0**	**-0.2**	**-1.0**	**-2.0**	**-3.6**	**-3.7**
Renewable energy	*0.0*	*-0.1*	*-0.5*	*-1.3*	*-2.5*	*-2.6*
Energy efficiency	*0.0*	*-0.1*	*-0.5*	*-0.8*	*-1.1*	*-1.1*
Forecast Total New Operating Costs	**10.5**	**10.8**	**10.6**	**10.1**	**8.9**	**10.0**

Table 14.2: Summary of new operating costs

The SR10 new operating costs are those we will incur from the projects currently being delivered in the 2010 to 2015 period to deliver the Ministers' Directions.

The SR15 new operating costs are based on the outcomes of our whole life cost assessment of the solutions to meet our statutory obligations and deliver our planned service improvement plan. These include the £13 million operational costs over the period for delivery of the customer engagement and education programme to reduce instances of sewer flooding due to blockages and encourage water efficiency. Our new operating costs for 'statutory committed' are lower than in previous periods due to the reduction in the number of treatment works' improvements we need to make and the benefits of the seven water treatment works rationalisation solutions which reduce current operating costs. The IR18 allowance is for the operation of SUDS schemes that are forecast to be adopted in the 2018 to 2021 period. We have made no further estimate of operating costs associated with IR18 investment allowances as it is difficult to predict these when there is such uncertainty regarding the solutions that will be implemented.

In our plan we plan to invest to improve energy efficiency of our assets, reducing energy consumption by around 10 GWh, and generating an additional 14 GWh of renewable energy from advanced anaerobic digestion, hydro and photovoltaic generation. This 'Invest to Save' benefit during 2015 to 2021 will reduce our operating costs by £3.7 million a year in 2020/21 and beyond.

Summary

We have made significant efficiency improvements over the last 12 years and our benchmarking shows that the opportunities for ongoing improvement are smaller than they have been in the past.

Overall our ongoing efficiency and productivity improvement programme will offset the underlying operating cost pressures associated with delivering higher service levels and meeting new statutory objectives.

[1] SR10 is the planning period 2010 to 2015 (5 years)
[2] SR15 is the planning period 2015 to 2021 (6 years)

Capital Costs

Overview

Capital costs are the costs incurred replacing or improving or building new assets (treatment works, pipes, vehicles, IT equipment etc.)

Capital costs fall into two primary categories;

- Maintenance costs for renewing worn out assets. Without adequate maintenance, the assets would deteriorate such that their performance would decline, affecting services experienced by customers.
- Enhancement costs for extending existing assets or providing new assets to meet new demand or provide higher levels of service.

Efficient capital expenditure

Regulatory practice in the UK has been to use Cost Base (an idealised set of projects) to assess the relative efficiency of companies and the opportunities for improvement. As much as Cost Base gave a comparative view of relative efficiency of water companies in the UK, it is no longer useful to assess efficiency as it is not updated in England and Wales. It is also problematic to use in isolation due to the process of costing idealised projects. Most significantly, the "Infrastructure Cost Review" published by HM Treasury / Infrastructure UK in December 2010, prompted us to look at our costs in a different way, seeking to understand our performance in total costs incurred against other water companies and other asset intensive industries where data was available.

In early 2011 we embarked on a project to understand the real opportunities for efficiency that we can deliver for our customers in the actual projects we build. We established our 'Frontier efficiency' project to take a long hard look at our practices and behaviours that influence costs. While we have tracked our cost base position, we were conscious of the limitations of cost base assessments. We have looked in depth at our costs of asset delivery and have analysed our processes and each component of cost in detail. We have done this with the support of recognised leading companies in cost management and capital delivery. From this we have identified where our costs are efficient and where we have opportunities to improve our cost to deliver.

Our assessment of opportunities to reduce our asset delivery costs has focussed on the costs we used to price our 2015 to 2021 investment plan. The pre-efficient costs used to price our plan come from our in-house cost database, the Engineering Estimating System (EES). EES is populated with the costs of projects we have completed in the past and allows us to use these cost components to price future projects. To have a statistically robust data set requires data from a reasonably long time period. As we began costing our plans in mid 2011 the cost dataset that informs our plan comes mostly from projects constructed in 2006 to 2011.

Our analysis of costs and benchmarking has shown that there are two components that ensure efficient asset delivery;

- Effective investment decision making, and
- Efficient delivery arrangements.

Effective investment decision making

This relates to the effective and efficient use of information, resources and appropriate governance to streamline processes and make savings in the preparatory stages of the investment process that leads to confirmed capital projects. For the early stages of project development, information is gathered on the current service issues, asset performance and condition and their operation. This information is critical to ensuring that any issues are accurately diagnosed and appropriate solutions identified. If options are well-formed and decisions are well-made, it can reduce the need for later re-appraisal and reassessment within the future stages of a project. Well-formed options require good information, intelligent analysis and appraisal, and a depth and breadth of knowledge and experience.

From analysis of our costs incurred in delivery over 2006 to 2011 we identified that our enabling costs (the costs that are not directly incurred in construction of assets) appeared higher than other sectors and some other water companies. There may be justifiable reasons for these historic costs in relation to the operational environment we were in at that time, such as uncertainty of solution leading to extended optioneering to identify lowest cost solutions, the additional costs of studies and data capture to inform design, and the changing of programme priorities to react to emerging priorities.

Our approach in developing the 2015 to 2021 investment plan supported by studies in the 2010 to 2015 period should ensure that for those areas of the programme that have been through this study process we should see reduced costs associated with uncertainty of solutions and information. Obviously we are already part way through the delivery cycle for the 2015 to 2021 programme and we expect that whilst we can make further improvements in the effectiveness of decision making across all programme areas we will not likely see the full benefits of the changes we are implementing to improve asset information until the 2021 to 2027 investment programme.

We plan to improve the gathering and processing of information on our assets, so that their condition and service provision is better understood and timely interventions can be made and that designers have robust information to work with, to avoid costly delays or redesigns. This along with our asset lifecycle planning process will enable Scottish Water to take a more informed and strategic approach to its investment, identify and appraise possible solution options over a longer time horizon.

Our analysis has identified opportunities to reduce the costs of the optioneering and design process. We are working closely with our engineering consultants and alliances to improve the productivity and quality of design and, where possible, to apply greater reutilisation and standardisation and enable us to secure bulk purchases and volume discounts in procurement.

Through up-skilling of our staff and some in-sourcing we have reduced our reliance on support from external parties in the development and management of our capital programme in the 2010 to 2015 period, reducing our capital overheads from those in our historic costs. We will continue to develop our internal working environment and capability, and further reduce our reliance on external parties to reduce the overall cost of delivery.

These changes are expected to take some time to develop and mature to the point of being fully effective. Consequently, we have commenced the process of engagement and are looking for early progress in forming new alliances and working with alliance partners and internally to improve our processes and information.

Efficient delivery arrangements

We have identified the following key areas where we can improve efficiency of delivery;

- Streamlined supply chain arrangements to reduce fees;
- Reduction in delivery overheads; and
- Increased productivity in construction.

We are currently procuring new delivery alliances that will seek a reduction in the management fees through a greater volume of self delivery within the Alliances and less sub-contracting, creating fee-on-fee arrangements. We are also seeking to reduce the delivery overheads through these revised arrangements through greater visibility of our programme allowing better resource planning in the alliances.

Our capital cost analysis included working on site with contractors to observe opportunities for productivity gains, and we have already seen improvements in 2011 to 2013 in productivity as a consequence of this early work. Ongoing working in partnership with our Alliance contractors to share best practice and unlock these productivity savings across the whole programme will be a focus of our efficiency improvement in the 2015 to 2021 period.

In the 2010 to 2015 period we have also secured improvements in supply costs through off site fabrication in areas such as membrane plants where forward programme visibility has given clarity to opportunities to set up more efficient off site production arrangements. This will be extended wherever possible in the 2015 to 2021 period. We will seek to give more forward visibility to secure greater savings from our supply chain through innovation and work bundling to reduce site overheads through better programming.

Capital maintenance demand

Our capital maintenance requirements have been informed by risk models, stewardship models and bottom up demand assessments. We have compared the overall Totex (operational and capital maintenance) costs of our plan with those of the leading companies in England and Wales. This has identified the opportunity to make a strategic efficiency of a further 4% to our capital maintenance plans to achieve leading Totex efficiency levels. At this stage we have not identified where these strategic efficiencies are or the potential risk to service that may arise through these. However in accordance with our approach to setting out the best offer we can for our customers we have included an additional

stretch efficiency to our capital maintenance plan of around 4% to bring the costs in our plan in line with leading companies performance.

Summary

The Commission set out in their Information Note 5 to the Customer Forum the seven elements in planning and delivering investment that contribute to ensuring value for money from capital investment.

Our approach to developing our business plan has taken account of strategic efficiencies, information benefits and appraising alternatives opportunities.

Our efficiency plan addresses opportunities for improvements in project scoping and design, project procurement, delivery planning and project management based on our review of our own performance and benchmarking across other industries.

We believe that we can move substantially towards the capital efficiency frontier through the change programme and benefit-release activities that we have put in progress. The analysis of the identified efficiency benefits indicates an average 13% reduction against the historic costs used to prepare our investment plan. We will continue to analyse our costs to identify opportunities for improvement as well as developing delivery partnerships that push forward the efficiency frontier.

We have set ourselves a stretching challenge (when compared to our benchmarking analysis) to deliver additional delivery efficiencies beyond those we have identified such that we will improve efficiencies by 14.4% to 17.9% over the period from the historic costs used to cost this plan (assuming that future costs are indexed by RPI). These efficiencies are over and above the strategic and innovation efficiencies identified in development of the solutions to deliver the required improvements. They represent a significant challenge for Scottish Water as we focus on behavioural change and ways of working to realise these benefits.

Annex1 – Benchmarking

Much of the benchmarking analysis that can be undertaken is through comparison with the English and Welsh companies or between similar activities internally within Scottish Water. International benchmarking is useful to share and identify new ideas and trends, but the substantive differences in the structure, ownership and financing of the water and waste industries across Europe hinders obtaining significant insight from direct analytical comparison across Europe.

Our cost benchmarking analysis uses two approaches. One approach looks at aggregated categories of costs against measure of service output that relates to the customers serviced. The other approach looks to build up yardstick project or activity costs with which to compare costs both internally within Scottish Water and across comparator companies.

Benchmarking total capital maintenance and operating costs

For previous reviews, studies were undertaken to benchmark the capital maintenance and operating costs for Scottish Water with the corresponding costs for the companies in England and Wales. This work focused on comparison with efficient benchmark companies of Anglian Water, Wessex Water and Yorkshire Water as they were the more efficient companies. It involved the estimation of costs functions and after-model adjustments (known as special factors).

The regulatory approach in the UK has since moved towards a more holistic approach. This has looked to develop analysis of the total costs of operating costs and capital expenditure. In a development of this approach, we have looked to compare the level of investment of capital maintenance and operating costs over the period 2006 to 2011 and compare these with the leading companies in England and Wales.

The analysis showed that the combined capital maintenance and operating costs for the period to 2010/11 for Scottish Water were lower than the efficient benchmark. When broken down we identified that our operating costs were close to benchmark and hence the capital maintenance investment was lower than the benchmark level. However we have seen an upward trend in capital maintenance since 2010/11 and our analysis suggest that the planned investment levels for both operating and capital maintenance are at the efficient benchmark levels.

In addition to the approach to benchmarking the level of total expenditure with England and Wales described above, Scottish Water has also looked at more detailed benchmarking analysis. This analysis focuses on the operating costs and capital costs at a more granular level. In broad terms, the results of this analysis support and complement the findings from the main benchmarking analysis.

Our primary assessment of capital efficiency has come from a business review of the stages of a capital project, known as the ‘Frontier’ project. This looked at the real costs of capital projects delivered and the delivery process.

Appendix 15: Finance tables

- In forecast outturn prices, our assessment of the overall cost of delivering our business plan for the 2015 to 2021 period is £8,059 million. We propose to fund our plan with revenue from customer charges of £7,024 million, net new government borrowing of £720 million, funding from other sources of £95 million and by utilising £220 million of cash balances carried forward from the 2010 to 2015 period.
- All forecasts for the 2015 to 2021 period are based on household customer charges increasing by 1.6% in 2014/15.
- Our customer price profiles in the 2015 to 2021 period reflect indexation using a forecast of CPI of 1.9% per annum in line with the Bank of England's inflation forecast as at November 2013. Our expenditure forecasts have been indexed using a forecast of RPI at 2.8% for 2013/14 and 2.65% per annum thereafter.
- Our plan estimates that we will open the new regulatory period with a cash balance of £240 million and this will be used to part finance completion projects from the 2010 to 2015 period. We plan to exit the 2015 to 2021 period with a cash balance of £20 million.
- In our plan, we expect to maintain financial strength over the 2015 to 2021 period at a level close to our exit position in 2014/15.
- The new 'rolling investment review' process requires our capital investment plans to be updated and reviewed in December 2017. This review will potentially change our investment plans for the second half of the regulatory period which in turn could impact upon our forecast of capital allowances and associated tax charges.
- The estimated funding requirement is sensitive to actual inflation levels and the costs of delivering the capital investment programme.
- It is likely that other circumstances in the 2015 to 2021 period will vary from those set out in our business plan and impact upon our financial resource requirements. These changing circumstances may require greater or lesser financial resources than forecast in this plan.

Introduction

This appendix summarises the key financial information, associated assumptions and outputs contained within our 2015 to 2021 financial model for Scottish Water's wholesale regulated business activities. Our financial projections are presented in outturn prices (unless otherwise stated) and comply with International Financial Reporting Standards (IFRS).

As with previous price control periods, we have applied a forecast of RPI to our base year costs to produce outturn expenditure profiles. For this Business Plan, we have assumed an annual rate of RPI at 2.65% across the 2015 to 2021 period. Our forecast of RPI has been guided by the historic differential between RPI and CPI[1] and the Bank of England forecast for CPI at 1.9%[2].

The tables that follow, and the financial information contained therein, align with our projections as set out in the Business Plan. Please note that due to rounding differences, some tables may not add up to exact totals.

[1] Since January 2010, RPI has averaged around 0.75% ahead of CPI.

[2] Bank of England Inflation Report, November 2013.

Financial Summary

The principal financial projections and underlying planning assumptions associated with our Business Plan are summarised below.

Financial Overview

The key financial projections for 2015 to 2021 are set out in table 15.1:

Financial projections £m, forecast out-turn	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**
Turnover	1,100	1,123	1,161	1,187	1,213	1,240
Profit before interest and tax	**225**	**227**	**240**	**247**	**254**	**263**
Net interest payable (inc PFI)	188	191	193	196	197	201
Profit before tax	**37**	**36**	**47**	**51**	**57**	**62**
Tax	8	8	10	11	12	13
Retained profit	**29**	**28**	**37**	**40**	**45**	**49**
Capital investment	564	579	595	575	592	607
Net new borrowing	120	120	120	120	120	120
Regulatory Capital Value (closing)	7,227	7,557	7,899	8,223	8,568	8,931
Closing debt	**3,584**	**3,704**	**3,824**	**3,944**	**4,064**	**4,184**

Table 15.1: Financial projections

Turnover excludes income from infrastructure charges as this is accounted for as deferred income. This is held on the balance sheet until the associated investment is undertaken.

Financial Ratios

Our forecast financial ratios are set out here in table 15.2:

Financial ratios	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**
Cash Interest Cover II	1.60	1.56	1.53	1.58	1.57	1.56	1.54
Funds from Operations to net Debt	10.5%	10.2%	10.0%	10.2%	10.1%	10.1%	10.0%
Gearing	55%	55%	54%	54%	53%	52%	52%

Table 15.2: Forecast financial ratios

A more detailed discussion on our financial strength (assessed against the WICS financial tramlines) is included in Page 12.

Financing and Expenditure

The overall financing required to meet the expenditure commitments of our plan is set out in table 15.3:

Financing and Expenditure £million	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	Total
Customer revenue	1,100	1,123	1,161	1,187	1,213	1,240	7,024
Net new borrowing	120	120	120	120	120	120	720
Infrastructure Charges Income	11	11	12	14	15	16	79
Disposals	6	6	1	1	1	1	16
Use of Cash Balances	46	51	51	19	24	29	220
Total Financing	**1,283**	**1,311**	**1,345**	**1,341**	**1,373**	**1,406**	**8,059**
Capital investment	564	579	595	575	592	607	3,512
Operating costs	383	395	404	413	421	432	2,448
PFI contracts	166	169	174	179	183	188	1,059
Interest	166	169	173	176	179	183	1,046
Change in Working capital	4	-1	-1	-2	-2	-4	-6
Total Expenditure	**1,283**	**1,311**	**1,345**	**1,341**	**1,373**	**1,406**	**8,059**

Table 15.3: Forecast financing and expenditure

The above table provides a high level summary of all the areas where we expect to incur expenditure in delivering our plan and the sources of finance that we expect to fund it.

In the following sections, each contributing line of table 15.3 is set out in more detail.

Financing Forecast

It is important to note that our financing projections assume that our household tariffs in 2014/15 rise by 1.6%.

Customer Revenue

Our customer revenue projection for 2015 to 2021 is outlined here:

Revenue forecast (£m outturn)	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Household	811	830	849	870	890	912
Wholesale	283	287	306	311	316	321
Other income	6	6	6	6	7	7
Total Income	**1,100**	**1,123**	**1,161**	**1,187**	**1,213**	**1,240**

Table 15.4: Revenue forecast

Further details on how we have created our customer revenue forecast are available in our Business Plan.

Net New Borrowing

To finance the delivery of our capital enhancement programme, as set out in our Modified Business Plan, we will require £720 million of net new borrowing over the 2015 to 2021 period:

£m, forecast out-turn	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Opening debt	3,464	3,584	3,704	3,824	3,944	4,064
Closing Debt	3,584	3,704	3,824	3,944	4,064	4,184
Net New Borrowing	**120**	**120**	**120**	**120**	**120**	**120**

Table 15.5: Net new borrowing profile

Other Areas of Financing

In addition to the main sources of funding from customer revenue and net new borrowing, we also expect to receive funding from three other areas.

Infrastructure Charge Income

Infrastructure income is generated from developer contributions based on a charge per property connected to the water and/or waste water supply network.

The planned receipt and utilisation of infrastructure charges is set out in table 15.6 below. The table also shows that we intend to use the forecast unutilised infrastructure charges from the 2010 to 2015 period to part finance sewer flooding investment, recognising that much of the need for this investment arises from past new connections to the sewerage system.

£m, forecast out-turn	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Opening Infrastructure Creditor	18	22	26	30	35	40
2015-21 Infrastructure Charges Income	11	11	12	14	15	16
Utilisation of 2015-21 Income	-4	-4	-5	-6	-7	-8
Utilisation of 2010-15 Balance	-3	-3	-3	-3	-3	-3
Closing Infrastructure Creditor	**22**	**26**	**30**	**35**	**40**	**45**

Table 15.6: Infrastructure income creditor balance

Asset Disposals

We receive income when we sell assets that are surplus to requirements. For this plan we expect to raise additional income early in the 2015 to 2021 period from the sale of land at Alnwickhill in Edinburgh. This is reflected in table 15.7.

£m, forecast out-turn	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Revenue from Asset Disposals	6	6	1	1	1	1

Table 15.7: Forecast income from disposals

Use of Cash Balances

We expect to exit the 2010 to 2015 period with £240 million of cash balances. The planned cash utilisation profile is summarised in table 15.8.

£m, forecast out-turn	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Opening Cash Balance	240	194	143	92	73	49
Closing Cash Balance	194	143	92	73	49	20
Cash Utilised	**46**	**51**	**51**	**19**	**24**	**29**

Table 15.8: Cash balance profile

Expenditure Forecast

Capital investment

Our forecast of capital expenditure for the 2015 to 2021 period is shown in table 15.9 below. Further details on how we have developed our capital expenditure forecast can be found in our Business Plan.

Capital Expenditure Profile	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	TOTAL
Maintenance (£m, 2012/13 prices)	275	277	279	281	283	285	1,680
Enhancement (£m, 12/13 prices)	119	160	206	204	203	200	1,092
2015-21 Regulated Capital Expenditure (£m, 2012/13 prices)	**394**	**437**	**485**	**485**	**486**	**485**	**2,772**
Nominal Inflator (RPI)	1.08	1.11	1.14	1.17	1.20	1.23	
2015-21 Regulated Capital Expenditure (£m, forecast outturn)	**426**	**486**	**553**	**569**	**585**	**599**	**3,218**
2010-15 Completion Costs	134	89	37				260
Investment funded from 2015-21 Infrastructure Charges	4	4	5	6	7	8	34
Total Capital Investment (£m, forecast outturn)	**564**	**579**	**595**	**575**	**592**	**607**	**3,512**

Table 15.9: Capital Expenditure by type

Operating costs

Our forecast of operating costs for the 2015 to 2021 period is shown in table 15.10 below. Further detail about our forecast operating costs and associated efficiency profile is set out in Appendix 14.

£m, 12/13 prices	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
2012/13 Base Operating Costs	**350**	**350**	**350**	**350**	**350**	**350**
Severance Cost Reduction	-3	-3	-3	-3	-3	-3
Base Efficiency Plan	-8	-9	-10	-11	-12	-14
Forecast Base Operating Costs	**339**	**338**	**337**	**336**	**335**	**333**
Energy Cost Increase (2013-15)	3	3	3	3	3	3
Cost of Collection Increase (2014-15)	2	2	2	2	2	2
National Insurance Contributions Increase	0	2	2	2	2	2
Adjusted Base Operating Costs	**344**	**345**	**344**	**343**	**342**	**340**
New operating costs 2013-15	7	7	7	7	7	7
2015-21 new operating costs	3	4	5	5	5	7
2015-21 Invest to Save Benefits	0	-1	-2	-3	-4	-4
Forecast Total Operating Costs	**354**	**355**	**354**	**352**	**350**	**350**
Nominal Inflator (RPI)	1.08	1.11	1.14	1.17	1.20	1.23
Forecast Operating Costs (forecast out-turn prices)	**383**	**395**	**404**	**413**	**421**	**432**

Table 15.10: Forecast operating costs breakdown

PFI Service Fees

Our forecast of PFI service fees for the 2015 to 2021 period is shown in table 15.11:

PFI Service Fees	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
PFI Service Fees (£m, 12/13 prices)	**152**	**152**	**152**	**152**	**152**	**152**
Nominal Inflator (RPI)	1.08	1.11	1.14	1.17	1.20	1.23
Total cash cost for PFI (£m, forecast out-turn)	**166**	**169**	**174**	**179**	**183**	**188**

Table 15.11: PFI cash costs

Under IFRS principles, the PFI contracts are treated as finance leases. The total PFI service fees for each year are allocated between three elements: operating costs, interest cost and finance lease repayment as show here in table 15.12:

PFI Service Fees (£m, forecast outturn)	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
PFI Operating Costs	125	128	133	138	142	147
PFI Interest Repayable	22	22	20	20	18	18
PFI Capital Repayment	19	19	21	21	23	23
Total cash cost for PFI	**166**	**169**	**174**	**179**	**183**	**188**

Table 15.12: PFI analysis for IFRS accounting

Interest on borrowings

Our interest cost comprises three elements: interest payable on embedded debt; interest payable on new debt drawn down thereafter; and interest that we receive from holding cash balances.

Opening embedded debt for April 2015 (i.e. long term loans held at March 2013 that will still be outstanding at March 2015) is forecast to be £2,865 million. The associated weighted average interest rate on this embedded debt will be approximately 5.0% as summarised below:

Embedded debt	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Opening embedded debt (£m)	2,865	2,745	2,626	2,503	2,380	2,255
Scheduled repayments(£m)	120	119	123	123	125	135
Closing embedded debt (£m)	2,745	2,626	2,503	2,380	2,255	2,120
Embedded Interest costs (£m)	**140**	**134**	**127**	**121**	**114**	**108**
Weighted average interest rate	5.0%	5.0%	5.0%	4.9%	4.9%	4.9%

Table 15.13: Embedded debt interest profile

We have assumed an average interest rate of 3.5% in 2013/14, 3.75% in 2014/15 and 4.0% for each year in the 2015 to 2021 period.

Please note that the new borrowing showing in table 15.14 below includes re-financing of debt due for repayment in that year (per table 15.13 above) and not just the additional net new borrowing set out in table 15.3. The cumulative new debt position also reflects the new debt that we expect to take in the final two years of the 2010 to 2015 period:

Interest Costs on New Debt (£m, outturn prices)	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
New debt for re-financing	*289*	*115*	*120*	*119*	*123*	*123*	*125*	*135*
Net new debt	*85*	*110*	*120*	*120*	*120*	*120*	*120*	*120*
Total new debt taken	**374**	**225**	**240**	**239**	**243**	**243**	**245**	**255**
New debt since March 2013	374	599	839	1,078	1,320	1,563	1,809	2,063
Interest costs on new debt	**5**	**17**	**26**	**36**	**46**	**55**	**65**	**75**

Table 15.14: New borrowing interest profile

Combining these two interest costs with our expected income from interest receivable provides our forecast of total interest payable for the 2015 to 2021 period as follows:

Interest Payable (£m, forecast outturn)	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**
Interest on embedded debt	140	134	127	121	114	108
Interest on new debt	26	36	46	55	65	75
Total Interest Payable	**166**	**170**	**173**	**176**	**179**	**183**
Less Interest Received	0	-1	0	0	0	0
Total Interest Payable	**166**	**169**	**173**	**176**	**179**	**183**

Table 15.15: Total interest payable

Tax

Our estimate of the corporation tax payable in the 2015 to 2021 period is set out in table 15.16 below:

£m, forecast outturn	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**
Profit before taxation	37	36	47	51	55	62
Corporation tax rate	21%	21%	21%	21%	21%	21%
Tax Charge	**8**	**8**	**10**	**11**	**12**	**13**
Tax payable	**0**	**0**	**0**	**0**	**0**	**0**

Table 15.16: Tax breakdown

The tax charge reflected in the Profit and Loss Account is the deferred tax charge for the relevant year. However, from a tax payable perspective, we are forecasting to pay over no corporation tax to HMRC for the 2015 to 2021 period because of 'tax losses brought forward' into the 2015 to 2021 period and the capital allowances that will be generated from our investment programme.

Rolling Capital Investment

The new 'rolling investment review' process requires our forward looking capital investment plans to be updated and reviewed in December 2017 (and thereafter at three year intervals).

This review will potentially change our investment plans for the second half of the regulatory period which in turn would impact upon our forecast of capital allowances and associated tax charges.

Financial Statements

In this section we present the forecast financial statements[3] for our business plan:

- profit and loss account from 2015/16 to 2020/21;
- balance sheet from 2015/16 to 2020/21; and
- cashflow statement from 2015/16 to 2020/21.

This section also includes a number of explanatory tables that explain in more detail some of the figures shown in the financial statements.

[3] The format of the financial statements set out in this section was agreed with the WICS as part of the 2012/13 Annual Return query process. Additional financial information is included in the Cashflow statement to support Regulatory analysis and to improve transparency around the financial ratio calculations.

Profit and Loss Account

£m, forecast outturn	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Turnover *(table 15.4)*	**1,100**	**1,123**	**1,161**	**1,187**	**1,213**	**1,240**
Operating expenditure *(table 15.10)*	383	395	404	413	421	432
PFI operating costs *(table 15.12)*	125	128	133	138	142	147
Depreciation charges - non infrastructure assets	222	224	227	229	231	234
Depreciation charges - infrastructure assets	14	14	14	14	15	15
Depreciation charges - PFI assets	19	19	19	19	19	19
Infrastructure capital maintenance charge	118	122	125	128	132	131
Amortisation of deferred income	-1	-1	-1	-1	-1	-1
Operating profit	**220**	**222**	**240**	**247**	**254**	**263**
Profit or loss on disposal of fixed assets	5	5	0	0	0	0
Net interest receivable less payable *(table 15.15)*	-166	-169	-173	-176	-179	-183
PFI interest payable *(table 15.12)*	-22	-22	-20	-20	-18	-18
Profit before taxation	**37**	**36**	**47**	**51**	**57**	**62**
Taxation – current *(table 15.16)*	0	0	0	0	0	0
Taxation – deferred *(table 15.16)*	-8	-8	-10	-11	-12	-13
Retained Profit	**29**	**28**	**37**	**40**	**45**	**49**

Table 15.17: Profit and loss account

Balance Sheet

£m, forecast outturn	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Fixed Assets						
Tangible assets *(table 15.21)*	5,405	5,615	5,835	6,029	6,232	6,448
PFI assets *(table 15.22)*	364	345	326	306	287	268
Third party contributions	-14	-13	-12	-11	-10	-9
Other Operating Assets and liabilities						
Working capital *(table 15.23)*	-305	-311	-316	-322	-329	-340
Cash *(table 15.8)*	194	143	92	73	49	20
Net operating assets	**5,644**	**5,779**	**5,925**	**6,075**	**6,229**	**6,387**
Non-operating assets and liabilities						
Borrowings (excl. govt. loans)	-1	-1	-1	-1	0	0
Financial reserve	0	0	0	0	0	0
Investment in subsidiaries	35	35	35	35	35	35
Total non-operating assets and liabilities	**34**	**34**	**34**	**34**	**35**	**35**
Provisions for liabilities & charges						
Deferred tax provision	-475	-482	-492	-503	-515	-527
Post employment asset / (liabilities)	-191	-191	-191	-191	-191	-191
Other provisions	-4	-3	-3	-3	-3	-3
Total provisions	**-670**	**-676**	**-686**	**-697**	**-709**	**-721**
Net assets employed	**5,008**	**5,137**	**5,273**	**5,412**	**5,555**	**5,701**
Capital and reserves						
Government Loans	3,583	3,703	3,823	3,943	4,064	4,184
PFI debt/lease *(table 15.22)*	363	344	323	302	279	256
Retained earnings	1,120	1,148	1,185	1,225	1,270	1,319
Pension surplus/(deficit)	-191	-191	-191	-191	-191	-191
Other reserves	133	133	133	133	133	133
Total capital & reserves	**5,008**	**5,137**	**5,273**	**5,412**	**5,555**	**5,701**

Table 15.18: Balance sheet

Cashflow Statement

£m, forecast outturn	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Regulatory income and expenditure						
Turnover	1,100	1,123	1,161	1,187	1,213	1,240
Operating expenditure *(table 15.10)*	-383	-395	-404	-413	-421	-432
PFI operating costs *(table 15.12)*	-125	-128	-133	-138	-142	-147
Capital maintenance expenditure	-298	-308	-318	-329	-340	-352
Amortisation of deferred income	1	1	1	1	1	1
Operating profit for regulatory purposes	**295**	**293**	**307**	**308**	**311**	**310**
Reconciliation of regulatory operating profit to net cash flow						
Operating profit for regulatory purposes	295	293	307	308	311	310
Movement in working capital	-6	-1	-1	0	-1	1
Capital maintenance expenditure	298	308	318	329	340	352
Amortisation of deferred income	-1	-1	-1	-1	-1	-1
Net cash flow from operating activities	**586**	**599**	**623**	**636**	**649**	**662**
Taxation						
Taxation paid	0	0	0	0	0	0
Returns on investments & servicing of finance						
Interest received *(table 15.15)*	1	1	0	0	0	0
Interest paid *(table 15.15)*	-167	-170	-173	-176	-180	-183
PFI interest payable *(table 15.12)*	-22	-22	-20	-20	-18	-18
PFI finance lease repayments *(table 15.12)*	-19	-19	-21	-21	-23	-23
Net cash flow from returns on Investment & servicing of finance	**-207**	**-210**	**-214**	**-217**	**-221**	**-223**
Net cash flow before investment and maintenance charges	**379**	**389**	**409**	**419**	**428**	**439**
Capital expenditure and financial investment						
Capital enhancement expenditure	-264	-268	-274	-244	-249	-253
Capital maintenance expenditure	-298	-308	-318	-329	-340	-352
Infrastructure Charges Income *(table 15.6)*	11	11	12	14	15	16
Disposal of fixed assets *(table15. 7)*	6	6	1	1	1	1
Net cash outflow from investing activities	**-545**	**-560**	**-580**	**-558**	**-573**	**-588**
Net Cash flow before financing	**-166**	**-171**	**-171**	**-139**	**-144**	**-149**
Financing						
New Government loans *(table 15.14)*	240	239	243	243	245	255
Government loans repayments *(table 15.14)*	-120	-119	-123	-123	-125	-135
Financial reserve	0	0	0	0	0	0
Net cash inflow from financing	**120**	**120**	**120**	**120**	**120**	**120**
Increase (decrease) in cash and cash equivalents *(table 15.8)*	-46	-51	-51	-19	-24	-29
Net cash flow	**166**	**171**	**171**	**139**	**144**	**149**

Table 15.19: Cashflow statement

Balance Sheet Assumptions

In section 2 above, table 15.3 sets out the total value of capital expenditure we plan for the 2015 to 2021 period. However, for infrastructure investment funded through third party contributions gross costs are matched with the associated receipts as summarised below:

Asset Additions, £m, forecast out-turn	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**
Total Capital Investment *(table 15.9)*	564	579	595	575	592	607
2015-21 Infrastructure Charge Utilisation	-4	-4	-5	-6	-7	-8
2010-15 Infrastructure Charge Utilisation	-3	-3	-3	-3	-3	-3
Total Asset Additions	**557**	**572**	**587**	**566**	**582**	**596**

Table 15.20: Asset additions for 2015 to 2021

The following table reconciles the above asset additions with the tangible assets line shown in the balance sheet:

Tangible Assets £m, forecast outturn	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**
Opening Tangible Assets	5,203	5,405	5,615	5,835	6,029	6,232
Total Additions	557	572	587	566	582	596
Depreciation in the year	-222	-224	-227	-229	-231	-234
Infrastructure Capital Maintenance Charge	-118	-122	-125	-128	-132	-131
Depreciation Charge - Infrastructure Assets	-14	-14	-14	-14	-15	-15
Disposals	-1	-1	-1	-1	-1	-1
Closing Tangible Assets	**5,405**	**5,615**	**5,835**	**6,029**	**6,232**	**6,448**

Table 15.21: Tangible assets note

As outlined in section 4 above, PFI contracts are treated as finance leases under IFRS principles. This means that the PFI contracts sit on our balance sheet as a depreciating asset (funded by a corresponding debt/lease obligation).

The annual deprecation charge is reflected in our Profit & Loss account and set in line with the remaining term structure of the PFI contracts. The annual capital repayment amount is reflected in our cashflow statement.

PFI Assets and Lease Obligation £m, forecast outturn	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**
PFI Assets (opening)	383	364	345	326	306	287
Depreciation Charge	-19	-19	-19	-19	-19	-19
PFI Assets (closing)	**364**	**345**	**326**	**306**	**287**	**268**

PFI debt/lease (opening)	382	363	344	323	302	279
Capital Repayment *(see table 15.12)*	-19	-19	-21	-21	-23	-23
PFI debt/lease (closing)	**363**	**344**	**323**	**302**	**279**	**256**

Table 15.22: PFI assets

Other Assets and Liabilities

The profile of our forecast working capital position across the 2015 to 2021 period is set out here:

Working Capital £m, forecast out-turn	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**
Stocks	2	2	2	2	2	2
Trade and other debtors	67	68	71	74	76	78
Trade and other creditors	-107	-110	-115	-120	-127	-135
Licensed wholesale charge prepayment	-24	-26	-26	-27	-27	-28
Short-term capital creditors	-107	-109	-111	-113	-115	-117
Accruals	-136	-136	-137	-138	-138	-140
Balance Sheet Working Capital	**-305**	**-311**	**-316**	**-322**	**-329**	**-340**

Table 15.23: Balance sheet working capital breakdown

Financial Strength

Our financial strength is measured relative to the Financial Tramlines which are derived from a suite of cash-based financial ratios[4].

The following limits have been set by the WICS for each of the three financial ratios that comprise the Financial Tramlines:

	Cash Interest Cover II	**Flow of Funds from Operations to Net Debt**	**Gearing**
Upper Limit	2.20	13.0%	50%
Discussion Line	2.05	12.4%	
Middle Line	1.90	11.75%	
Warning Line	1.75	11.1%	
Lower Line	1.60	10.5%	55%

Table 15.24: WICS tramlines

Scottish Water Ratio Forecast

In setting this business plan, we expect to broadly maintain our forecast 2014/15 financial strength across the 2015 to 2021 period.

Financial ratios	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**
Cash Interest Cover II	1.60	1.56	1.53	1.58	1.57	1.56	1.54
Funds from Operations to net Debt	10.5%	10.2%	10.0%	10.1%	10.1%	10.1%	10.0%
Gearing	55%	55%	54%	54%	53%	52%	52%

Table 15.25: Financial ratios calculations

In these final three tables, we present a more detailed breakdown as to how each ratio in table 15.26 has been calculated.

The figures in these tables can be cross referenced to the financial statements shown above in tables 15.17, 15.18 and 15.19.

[4] Financial tramlines as set out in WICS Note 7 for the Customer Forum.

£m, forecast outturn	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Net cash flow from operating activities	580	586	599	623	636	649	662
Working Capital Adjustment	6	6	1	1	0	1	-1
Tax paid	0	0	0	0	0	0	0
Interest received	1	1	1	0	0	0	0
Capital maintenance expenditure	-286	-298	-308	-318	-329	-340	-352
Funds net of capital maintenance expenditure	**301**	**295**	**293**	**306**	**306**	**309**	**309**
Interest paid (including PFI)	188	188	191	192	195	198	200
Cash interest cover II Ratio	**1.60**	**1.56**	**1.53**	**1.59**	**1.57**	**1.56**	**1.54**

Table 15.26: Cash interest cover II calculation

£m, forecast outturn	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Net cash flow from operating activities	580	586	599	623	636	649	662
Working Capital Adjustment	6	6	1	1	0	1	-1
Tax paid	0	0	0	0	0	0	0
Interest received	1	1	1	0	0	0	0
Interest paid (including PFI)	-188	-188	-191	-192	-195	-198	-200
Funds from operations	**399**	**404**	**410**	**432**	**440**	**451**	**460**
Cash & cash equivalents	240	194	143	92	73	49	20
Financial Reserve	0	0	0	0	0	0	0
Government loans	-3,464	-3,584	-3,703	-3,823	-3,943	-4,064	-4,184
Other loans (including PFI finance lease)	-382	-363	-344	-323	-302	-279	-256
Net debt excluding retirement benefit obligations	**-3,606**	**-3,754**	**-3,904**	**-4,054**	**-4,172**	**-4,294**	**-4,420**
Retirement benefit obligations	-191	-191	-191	-191	-191	-191	-191
Net debt	**-3,797**	**-3,944**	**-4,095**	**-4,245**	**-4,362**	**-4,484**	**-4,611**
Funds from Operations to Net Debt	**10.5%**	**10.2%**	**10.0%**	**10.1%**	**10.1%**	**10.1%**	**10.0%**

Table 15.27: Funds from operations to net debt calculation

	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Net debt (£m)	-3,797	-3,944	-4,095	-4,245	-4,362	-4,484	-4,611
Regulatory Capital Value (£m, forecast outturn)	6,914	7,227	7,557	7,899	8,223	8,568	8,931
Gearing Ratio	**55%**	**55%**	**54%**	**54%**	**53%**	**52%**	**52%**

Table 15.28: Gearing ratio calculation

Appendix 16: Business environment, risk and opportunity

- Our plan is based on a number of assumptions about the future and, inevitably, circumstances in the 2015 to 2021 period will vary from those set out in our plan. This may require greater or lesser financial resources than assumed in the plan.
- The outcomes of this plan are more dependent than ever before on the engagement of customers and co-operation of third parties to deliver higher levels of service and efficiency, making the outcomes of our plan less predictable.
- Our plan adopts a mix of innovative and proven solutions to deliver improvements to service. We expect the IR18 investment review to consider the success of the innovative approaches and prioritise further investment where appropriate.
- It is possible that new priorities for improvement will emerge during the 2015 to 2021 period as a consequence of legislative or environmental change. We expect these priorities to be addressed through the IR18 investment review.
- Historic events demonstrate that we are vulnerable to unexpected events or failures at critical assets or extreme events that could leave us unable to maintain normal supplies to all our customers.
- By 2021, we forecast a reduced cash balance of £20 million.

Introduction

Scottish Water is publicly owned and financed through borrowing and the revenues from customer bills.

Scottish Water faces a variety of influences in the delivery of essential services, some of which are common to the UK water industry and a number of which are unique to our business model or individual operating environment.

Our operating environment has characteristics with implications for cost, risk and service. These include the following:

i.) the geography, topography and population distribution of Scotland;

ii.) the legal and regulatory requirements; and

iii.) issues arising from the historic development of the industry in Scotland.

The purpose of this Appendix is to set out the known key factors that could influence the financial or service outcomes of our business plan.

Financial outcomes

As we deliver a service to our customers within a firm financing constraint, the regulatory framework continues to incorporate regulatory mechanisms that enable us to mitigate the impact of external influences and financial risks effectively, including logging and interim determinations.

The Water Industry Commission for Scotland has identified financial tramlines based on key financial indicators to assess the financial strength of Scottish Water's plan and monitor the outturn performance for the period 2015 to 2021.

By 2015 we forecast a cash balance of £240 million, which we will then utilise in the 2015 to 2021 period, to finance the delivery of services to customers. By 2021, we forecast a reduced cash balance of £20 million.

There are a multitude of factors out with management control that could affect performance in the period. The table below highlights the key risks currently identified and the associated potential financial impact during the 2015 to 2021 period. As it is not possible to reliably assess the specific financial impact of these risks, we have set out the potential ranges of costs or a possible sensitivity for each risk.

We acknowledge that the economic growth, general inflation and interest rate assumption risks could also result in favourable circumstances.

Influences	Risk	Scenario / sensitivity	Estimated Value (£m) of potential sensitivity in 2015 to 2021 period
Economic	Economic growth	Household customer base grows by 0.1% per annum more than the assumed 0.74% in our plan	Increase to net additional costs (investment in excess of revenue) in the 2015 to 2021 period, requiring further rephasing of IR18 investment allowances
	General inflation	If the difference between CPI for prices and RPI for costs was 1% rather than 0.75% assumed in our plan	The margin between revenue and cost over the period would reduce our cash position by c£80 million.
	Business rates	The potential impact of a business rate revaluation in 2017	Based on the c40% increase across 2010 to 2015, rates revaluation could increase costs by £100million for the period 2017 to 2021.
	Revenue collection	Impact of Welfare Reform on cash collection	£8 million impact for every 1% reduction in cash collection from case load associated with Welfare Reform.
	Interest charges	An increase in nominal interest rates of 1% relative to our plan assumptions	Increase in costs by c£40million in the period.
	Accessibility of new borrowing	£100 million reduction in new borrowing availability with no change to investment plans	Charges would have to rise by 0.35% above CPI.
	Fixed nominal prices to 2018	Inflation in the 2015 to 2018 period exceed the 1.9% assumption in our plan by 0.2%	The margin between revenue and cost over the period would reduce our cash position by c£35 million.
Legal and policy	Cryptosporidium	Detections requiring upgrading of any of 20 water treatment works that do not have adequate treatment.	Increased investment of up to £50 million.
	Sludge	Loss of agricultural routes	Increase cash costs by around £50 million.
	Roadwork repairs levy	Proposals to introduce an annual levy of around £5 million	Increase cost of £30 million over the period.
	First Time Provision	Delivery of six waste water projects that SEPA indicated would supply environmental benefit.	Estimated cost £14.5 million.
	One UK Retail Market	Size and scope of the potential changes to the Scottish retail market is at this stage unknown.	Estimated costs at this stage unknown.
	Urban Waste water Treatment Directive	Compliance with the potential DEFRA position across the UK on Combined Sewer Overflows	An increase in investment of up to £100 million in the period.
	Odour	New sites emerge with statutory requirement to improve	Estimated costs of £10 million for the 8 locations with known low level of complaints not included in this plan.

Table 16.1: Financial outcome risk analysis

Economic influences

Economic factors that could affect our business that are out with management control include the following:

Economic growth

For the plan period, non-household customer revenue is assumed to be reasonably stable and the growth in household customers is assumed to be 0.74% per annum over the next period.

The planned revenue cap for non-households means that their average price will increase (decrease) with decreases (increases) in volume and customer numbers. Revenues will remain relatively stable and costs change only marginally with any change in volume and customer numbers.

The price control for households means that the average price will remain relatively stable. While higher (lower) growth would then be expected to increase (decrease) revenues more than costs over the longer term, within the 2015 to 2021 period higher growth is likely increase costs in excess of revenues and would require further re-phasing of IR18 investment allowances to accommodate the increased costs.

The United Kingdom has encountered its first period of recession for 18 years and this has affected customer growth. Looking forward, the economic and customer growth rates remain uncertain. For every 0.1% reduction (increase) in the growth rate, household income would reduce (increase) by about £20 million over the period 2015 to 2021.

General inflation
For the 2015 to 2021 period, we have assumed that household prices will rise in relation to the Consumer Price Index (CPI), costs will rise in relation with the Retail Price Index (RPI), and that RPI inflation will be 0.75% pa more than CPI inflation.

If the difference was1% more rather than 0.75%, then revenues would under provide for costs over the period to 2021 by around £80 million.

Business rates
For the plan, we have assumed that costs will rise by the RPI for the economy as a whole. However, our input prices may differ from the general price index.

It is important to note that there are several costs we incur that are not fully in our control. While indexing of costs by RPI will protect us from most cost changes, there are risks of one-off changes to our costs that we may not be able to manage within this plan. The main risks are a revaluation of business rates in 2017, changes to employer pension contributions, introduction of a road works levy, changes to the cost of collecting household charges by local authorities and changes in the level of non-payment by household customers.

For example, business rates are updated periodically and this reflects a specific input inflation not reflected in the general economy. The last valuation was made in 2010 and the next one is scheduled for April 2017. There is uncertainty regarding the implications of the next revaluation of business rates and the level of transitional relief that will be applied. If business rates increased from 2017 onwards by a similar amount to the rise observed in 2010 (i.e. about 40%) the potential impact would be about £100 million over the remaining period to 2021.

Revenue collection
Household bills are generally unmetered and collected by Local Authorities in Scotland. An agreement was reached with the Convention of Scottish Local Authorities (CoSLA) in May 2013 for a new Billing Order to encompass the four year period 2014 to 2018. While this new Billing Order will ensure ongoing stability to 2018, there could be changes thereafter which could impact on our cost of collection or bad debt levels.

The UK Government has introduced Welfare Reform which has changed the way that social benefits operate. In April 2013 changes to Housing Benefits came into effect which has meant tenants who under occupy their homes face a reduction in their housing benefit. The Universal Credits scheme is looking to combine several benefits and be introduced from late 2013 through to mid 2017. Where previously benefit payments were received weekly net of housing benefit and some other deductions (including council tax arrears), Universal Credit will include payment for rent and will be paid on a monthly basis.

Amendments to Housing Benefits and the introduction of Universal Credits could increase the risk of reduced collection levels and a subsequent increase in bad debt levels should vulnerable households struggle to keep up with payment.

If the Welfare Reforms led to less cash being collected from those customers on benefit schemes, then for each 1% reduction in cash collections there would be a reduction in revenues of about £8 million over the period.

Interest charges on borrowing
Scottish Water borrows finance from the Government. The plan assumes the interest rate for new borrowing at 4%. An increase in nominal interest rates of 1% would increase our costs over time, and if occurring by 2015/16, by around £40 million over the period.

Accessibility of new borrowing
To finance delivery of our plan we require £720 million of new borrowing over the 2015 to 2021 period. It is possible that economic circumstances could dictate that the level of available borrowing is lower than that required, and as set out in the September 2013 draft Scottish Government budget.

If borrowing was to be £100 million lower over the 2015 to 2021 period and all other costs remain the same and there is no change to the investment plan, then charges would need to rise to 0.35% above CPI (a rise of 0.45% in total).

Fixed nominal household prices to 2018
We have assumed in our plan fixed price increases of 1.6% pa in each of 2014/15, 2015/16, 2016/17 and 2017/18 for household customers, with an overall household charge cap of 1.75% less than CPI over the 2015 to 2021 period. Any under or over recovery during 2015 to 2018 may be adjusted for in 2018 to 2021 under the charge cap arrangements.

If inflation exceeds the 1.9% assumption in our plan by 0.2% in 2015/16, then the margin between revenue and cost over the period would reduce our cash position by around £35 million.

If the application of the charge cap methodology would require household prices during 2018 to 2021 to exceed 1.6% per annum the, prior to the application of such an increase, Scottish Water, the Customer Forum and the Water Industry Commission for Scotland will consider whether any or all, of the increase above 1.6% can be offset by overall favourable external factors, rephasing of IR18 investment to after 2021, or by returning any early sustainable out performance to customers.

We have discussed with the Customer Forum the prospect of significant price increases after 2018 should inflation or other costs out with our control be materially greater than we have assumed in our plan, given the low fixed prices we have agreed for 2015 to 2018.

Legal and policy influences

In the water and waste water sector the legal and policy developments play an important role in how the service is required and expected to change. Quality and environmental legislation is enacted in Scotland particular to the requirements of Scotland, meaning it is not always consistent with the approach in England and Wales. The regulatory framework also differs, with regulation of Scottish Water by the Water Industry Commission for Scotland (the Commission), the Scottish Environment Protection Agency (SEPA) and the Drinking Water Quality Regulator for Scotland (DWQR).

Our plan is set out to deliver a defined set of Minsters' objectives, which lays out our current legislative and service improvement priorities in the 2015 to 2021 period. While flexibility within the plan to move regulatory requirements within the period is possible, any significant changes to the plan require additional financing. Examples of where legislation and policy could change within the period are discussed below.

Cryptosporidium
The findings of the DWI report into Welsh Water's cryptosporidium incident in 2005/06, which found illness from cryptosporidiosis at relatively low levels of oocysts in the final waters, increase the likelihood of the Consultants of Public Health Medicine (CPHM) taking precautionary actions, such as boil notices, at low levels of crypto detections.

Our 2010 to 2015 plans will introduce new treatment or provide alternative supplies for 44 supplies to protect against cryptosporidium. This includes all of the supplies which have experienced significant detections in the last 3 years with the exception of Fair Isle which will be addressed in the 2015 to 2021 period. This will leave 32 supplies without treatment processes that can reduce or render cryptosporidium harmless by 2015. Our plan will make improvements at 12 sites to protect against cryptosporidium leaving 20 water supplies without treatment processes that can reduce or render cryptosporidium harmless. We will make improvements through catchment management and borehole / wellhead amendments at two sites, which have had previous low level detections, to reduce risk of cryptosporidium getting into the water supply. Two of the remaining 18 sites had low level detections in 2011, we will continue to monitor all of these sites and should issues arise promote these for appropriate improvements.

If all these sites were to require upgrading to provide robust treatment the likely capital costs would be up to £50 million.

Sludge
Sludge is a by-product arising from water and waste water treatment process and can be disposed through one of a limited number of routes: agriculture, incineration, land reclamation or landfill.

Current outlets for recycling of sludge to agricultural land could be lost due to the perception by farmers and key industries (e.g. Scottish whisky industry) that human sewage sludge associated with their end product might not be acceptable to their customers. The loss of the agricultural route would result in the need for alternative routes to be sourced, with the disposal of sludge to landfill being the most viable but expensive option.

Around half of our sludge is treated by a Scottish Power subsidiary at the PFI operated Daldowie Sludge Treatment Centre. There is a risk that the sludge composition results in a breach of the sludge specification for the calorific value or ash content, rendering it unviable.

This loss of agricultural routes could increase operating costs by about £52 million over the period, with a similar amount for loss of incineration routes.

Road work repairs levy
The Strategic Consultation on Works on Scottish Roads commenced by the Scottish Government in April 2013. The consultation highlights the road network as an asset and considers the use of contributions to costs of making good long term damage to the road network. The paper specifically highlights utility companies as main contributors to existing road works due to the requirement to repair, renew or replace assets placed within the roads network.

It is generally accepted than once a road has been disturbed through a period of works, it reduces the road's lifespan. The consultation describes a solution where any company requiring to conduct a period of works to repair, renew or improve assets would be required to pay a levy to compensate the roads authority for the accelerated programme of roads renewals required to maintain the standard of the roads network.

Current indications would suggest the requirement would be for Scottish Water to pay fees of around £5 million a year over the period.

First Time Connection Provision for Private Water Supply and Wastewater Discharges
Where new customers wish to connect to the public system, be they existing households (private discharges), new communities or individual property developers, we will provide capacity at an existing treatment facility or at a new treatment facility, where this is cost effective. The developer will finance the provision of all required infrastructure, and will subsequently receive the statutory reasonable cost contribution from Scottish Water.

We have undertaken 20 studies to understand the costs of connecting private waste water discharges to the public sewerage network where SEPA had identified concerns regarding the quality of the water environment due to these private discharges.

From the studies we have conducted, SEPA has identified six locations where there is sufficient evidence that private discharges are downgrading the local water bodies and that connection to a public sewer network is a possible solution. Should innovative solutions not be available and these locations be connected to the public sewerage system, we estimate the costs associated to be between £10,000 to £45,000 per household, and a total capital cost of around £14.5 million.

We are also currently working with DWQR to assess the public health risks, economic limitations and customer willingness to connect private water supplies to public water services.

One UK Retail Market
The successful opening of the retail market in 2008 has seen 12 Licensed Providers granted licenses to operate in Scotland, providing increased choice and service to approximately 130,000 customers.

Indications from the UK government are that they foresee the market in England and Wales following Scotland's lead, with the possibility of the market opening in 2017.

A risk exists that the approach to market opening in England differs materially from Scotland and in time, the market in Scotland will reform to fall into line with processes in England. This could result in significant costs to redesign systems, processes and governance for Scottish Water, the Central Market Agency (CMA) and Licensed Providers. Under the current CMA funding agreement, Scottish Water is liable to pay one third of the costs to operate the CMA with Licensed Providers paying the remaining two thirds based on market share. The potential costs that may arise are unknown at this stage.

Urban Waste Water Treatment Directive (UWWTD)
On 18 October 2012 the European Court of Justice ruled against the UK in respect of the long-running infraction case on the Urban Waste Water Treatment Directive (UWWTD) focussed on Combined Sewer Overflows (CSOs) at Thames (London) and Whitburn (Sunderland). This case arose following representations to the European Commission (EC) that the UK was not compliant with the UWWTD in respect of spill frequency at a number of locations across the UK. The EC case has been founded on a view from the European Commission that there should be no more than 20 spills per annum from a single CSO. This position attempts to quantify in law the objective of the UWWTD; that spills should occur only where there is excessive rainfall.

DEFRA has informed all the water companies in England and Wales in July 2013 that all CSOs should be monitored by 2020. This letter was also passed to the Scottish Government and discussions with DEFRA continue. While the European Court of Justice has not issued a further statement, compliance with the DEFRA request could require an additional investment of around £100 million with significant ongoing costs.

Odour
Waste water treatment works can generate malodour due to the nature of the waste material being treated. There are statutory requirements to control odour set out under the 'Code of Practice on Sewerage Nuisance', which is enforced by Local Authorities and, at sites subject to 'Waste Management Licenses', the control of odour emissions is enforced by SEPA. We have identified 5 waste water treatment works where statutory improvements are required; statutory investment to address these is explained in Appendix 7.

Using malodour complaint information received from customers, local authority environmental health teams and SEPA, we have identified a further 8 sites that generate, on average, 4 or more complaints per year. Taking account of the levels of complaint, customer priorities for service improvement and following discussion with the Customer Forum, we plan to defer improvements at these sites until after 2021. We will review this at IR18 should new information come to light regarding the level of nuisance being caused.

Longer term legal and policy influences
There are a few legal and policy influences that we are aware of that we do not expect to affect our 2015 to 2021 plan but remain watchful of to ensure we can influence these on behalf of our customers.

Lead free networks
We are aware that in the longer term there may be a move towards lead free water supplies and customers' plumbing to protect public health. We have assessed the long term costs of such a policy to be of the order of £150 million and will remain watchful of developments.

Other factors affecting financial outcomes
Factors that could affect our business plan and are subject to some uncertainty but we have some management control over include the following:

Capital efficiency
The plan has been developed to maintain the current service, to extend it to new customers, to meet EU and other legal obligations for improvement and to improve it consistent with customers' priorities as identified through our research. To ensure the overall affordability of this plan for customers we have planned the delivery of capital projects at a significantly reduced cost, as expressed in a capital efficiency challenge of up to 17.9 % by 2021.

We plan to apply major changes to the way in which we manage capital projects. Scottish Water has a track record of delivering major improvements, having introduced major operational efficiencies and innovative capital solutions in previous price control periods. Our financial projections assume that these efficiencies will be delivered in a timely way through the period. These savings, in turn, rely on the cooperation and collaborative working of our contract suppliers.

The assumptions made in the plan relating to capital efficiency present Scottish Water and our partners with a major challenge for the next period. For a 1% point reduction in efficiency in each year of the plan the financial position would worsen by about £30 million over the period.

Completion of existing projects
Our forecast statutory investment costs include the costs of completing the Ministers' Q&SIIIb objectives which will continue beyond March 2015 due to the necessary time to confirm and deliver solutions to improve intermittent discharges to the River Clyde in Glasgow, and the additional outputs to accelerate

priorities for drinking water quality improvements and sewer flooding. Our current forecast of the completion costs is £260 million (out-turn prices equivalent to £238 million in 2012/13 prices). However as these projects, being progressed under the 'seven stage process', are not yet fully developed there is a risk that these completion costs could change. We plan to update the forecast costs of this work as we progress through the price control process. Additional financing that may be required arising through the seven stage process is not included within our plan

Upgrading of discharges at Dalmarnock and Daldowie Waste Water Treatment Works
In our plan we have proposed an innovative solution to address enhancements required to these discharges to meet Urban Waste Water Treatment Directive and Water Framework Directive requirements. This solution involves transferring the discharges from the upper River Clyde to the Lower River Clyde which can receive the discharges at their current standards. To do this involves construction of a tunnel sewer through Glasgow to transfer the discharges. We have concerns regarding the cost of this solution as there are significant risks in the estimates in relation to ground conditions. We intend to work with contractors to understand these risks to secure a robust estimate for the cost of this work. We have included an allowance in the committed programme of £65.8 million which we are proposing is ring-fenced, using the seven stage approval process, given the significant uncertainties regarding the construction cost of this project. We plan to update the forecast costs of this work as we progress through the price control process.

Service outcomes

Scottish Water operates a complex system of infrastructure and non-infrastructure assets. Investment has been targeted within recent years to maintain, upgrade and replace assets which are deemed not to perform to appropriate standards.

Action by Scottish Water has reduced the frequency of failure incidents at waste water treatment works and improved water quality. Sustained improvements over the period 2010 to 2015 led to only two waste water treatment works failures in 2012, while water quality compliance in 2012 reached the highest level since 2002.

Incidents that require attention, however, can still happen. The incidents discussed here, should they arise, are significant, the specific nature of which are unpredictable and therefore out with the direct control of management. These include adverse weather and operational hazards

In addition to incidents that can affect service we have adopted many innovative solutions to deliver the service improvements set out in our plan. Therefore, the outcomes of this plan are more dependent than ever before on the engagement of customers and co-operation of third parties to deliver higher levels of service, making the outcomes of our plan less predictable

Adverse weather

Incidents of abnormally adverse high or low rainfall are often attributed to climate change and can contribute to adverse events within the network that affect the customer service:

Flooding:
Our plan includes provision to invest in 71 water and 15 waste water non-infrastructure assets at risk of a 1:200 year flooding event, following studies undertaken during 2010 to 2015. However there are further assets at risk. A further 258 water and waste water assets have been identified as high risk for which studies are planned.

Equally prolonged heavy rainfall can exceed the capacity of our sewers to convey high volumes of surface water resulting in flooding of customers' properties. We are investigating the actual resilience levels of our sewer network over the 2015 to 2021 period to enable us to more proactively improve sewer capacity before our customers experience flooding.

Drought:
Our plan includes investment at 11 sites to address supply-demand balance deficits identified against drought conditions that have a 1:40 chance of occurring. However, further sites are at risk. We plan studies in 39 zones to assess future investment needs. We are also undertaking an assessment of the actual resilience levels we have across Scotland to identify what investment may be required to achieve a 1:100 level of service.

Operational hazards

There are several operational hazards that can lead to adverse events within the network that affect the customer service:

Contamination:
Incidents of accidental or deliberate contamination of the water supply can occur within the network, which result in water being unfit for consumption and loss of supply over a widespread area.

Redevelopment:
The development of sites can lead to changes to the sewerage network that can have environmental impact and can lead occasionally to incidents such as issues with odour. We are monitoring a few sites where redevelopment is changing the operation of our network and there is the potential for there to be such an event during the development transition (e.g. the impact on Shieldhall WwTW from the new Southern General hospital and the visual and malodour impact on the hospital from Shieldhall WwTW).

Critical asset failure:
Most of our customers have never experienced an interruption to their water supply, and they expect us to take reasonable steps to ensure that this continues. Fortunately we have only experienced a few events that have resulted in a prolonged service failure to our customers as set out in Appendix 6.

These historic events demonstrate that we are vulnerable to unexpected events or failures at critical assets, or extreme events that could leave us unable to continue normal supplies.

Our initial assessment indicates that around only 15% of our customers can be provided with a normal service from an alternative source of supply in the event of the loss of a critical asset (treatment works, raw water supply or certain strategic trunk mains).

We are aware that some of our assets, while still performing, are either nearing or are beyond their asset life expectancy. A portion of these assets are of significant size, are key to our infrastructure network and/or have limited resilience. We are monitoring closely a few mains that could cause significant loss of supply were there to be a mains collapse, with key examples listed below.

Example	Population served
Bradan Trunk main and control valves	215,000
Balmore raw water tunnel	500,000
Megget raw water main	340,000
Turret trunk main	162,000

Table 16.2: Examples of populations at risk fed through single water main

In our plan we propose to undertake detailed investigations of our critical assets / systems and their capability to deal with unforeseen events or catastrophic asset failure, and develop proposals for the strategy to improve resilience of our water supplies to extreme events across Scotland.

Access to technology:
Scottish Water's supply chain as well as overall business model depends on the ongoing availability and commitment of key suppliers and partners for access to technological equipment and solutions. The loss of access to a technology or supplier can have adverse effects on the timing of project development and completion, with consequential effects on service to customers. An example of this is in membrane treatment at 15 sites on the west coast, where the Koch membranes used to treat water are no longer in supply.

Innovative solutions

Our plan adopts a mix of innovative and proven solutions. We have included operational solutions such as mains flushing to remove iron and manganese deposits that are affecting water quality at customers' taps and sustainable land management activities to manage the impact of catchment run-off or livestock encroachment on our raw water sources. We have also included innovative asset solutions such as reservoir mixing to control manganese levels entering our treatment works which, if successful, will avoid the need for additional investment to upgrade treatment works. We expect the IR18 investment review to consider the success of these innovative approaches and prioritise any further investment where appropriate.

We are also implementing a long term customer education campaign and targeted consultation approach to reduce the volume of inappropriate material disposed of via the sewer, with targeted advice in areas of repeat occurrences. The aim of this is to reduce the frequency of flooding of customers

properties due to blockages. The outcome of this approach is uncertain since it depends upon us being able to successfully influence customer behaviour.

Appendix 17: Performance monitoring

Our proposals for measuring and monitoring performance in the 2015 to 2021 period are summarised below.

- Three major areas of measurement of performance have been developed through discussions with the Customer Forum, the Water Industry Commission for Scotland and other stakeholders;
  - Measuring customer service;
  - Measuring financial performance; and
  - Monitoring output delivery.
- The current Overall Performance Assessment measure will be retained with minor amendments as agreed with SEPA and DWQR, and an amendment to the customer contact measure to shorten the period for a substantive response to formal complaints from 10 days to 5 days.
- Customer satisfaction will be measured in a new Customer Experience Measure, with a view in the longer term to developing additional measures that allow comparison with other sectors.
- Wholesale service will continue to be measured through the current Key Performance Indicators and we will seek to develop further measures of satisfaction with Licensed Providers.
- Financial performance will be monitored through the financial tramlines set out by the Commission in its note to the Customer Forum in addition to the existing cash measure of financial performance.
- Enhancement output delivery will continue to be monitored through the Overall Measure of Delivery (OMD).
- Areas that the Customer Forum has agreed as being customer priorities are being looked at with a view to developments for monitoring and performance measures in the future.
- We are developing several measures including a Resilience of Supply Index (ROSI) to monitor how we manage the risk of water supply restrictions in future and an Asset Health Indicator to monitor stewardship of our assets.
- In many instances the new developments require the collation of data to understand the baseline performance before performance monitoring can start.
- We have agreed with the Customer Forum that there will be an annual meeting between Scottish Water and the Customer Forum specifically for the purpose of looking at levels of service and our performance.

Measuring customer service

Scottish Water's service performance is currently monitored through the Overall Performance Assessment (OPA). The OPA is calculated by scoring 17 individual performance measures, each weighted to reflect importance to customers, and aggregating each score to establish an overall index of service performance. In recent years we have significantly improved our OPA performance and by 2015 we will have caught up with the service performance of the leading companies in England and Wales.

For the next price control period a framework with four major areas of measurement for customer service has been developed through discussions with the Customer Forum and the Commission. The four major areas are as follows:

- The **OPA** will be retained in its entirety with minor adjustments to reflect consistency of performance monitoring of drinking water quality and environmental compliance as agreed with DWQR and SEPA respectively. This will ensure that essential components of service performance will continue to be monitored and that recent improvements in performance will not be compromised in the pursuit of new measures of performance.

- Customer satisfaction will be measured through new **Customer Experience Measures** for household and business customers with a view to performance being benchmarked in the longer term against our peers and comparator sectors.
- Wholesale key performance indicators to measure service to licensed providers.
- For service areas that the Customer Forum has agreed as being customer priorities for improvement, measures are being developed in conjunction with the Customer Forum with the potential for monitoring some new service performance measures in the future.

Overall Performance Assessment

The OPA will be retained in its entirety, with three minor changes for the period 2015 to 2021:

- An amendment to waste water treatment works to balance priority on compliance across all works. We will move away from the position where compliance is based on a percentage of the population receiving service from a compliant treatment works, to an absolute number of failing works. The agreed amendment will band failing works as follows:
    - 1 - 5 failing works: 1 point lost from each failing works
    - 6 - 10 failing works: 2 points lost from each failing works
    - 11 - 20 failing works: 3 points lost from each failing works

  The definition of a failing works will remain the same as the current OPA approach and, based on our forecast performance at March 2015, we expect no change in our OPA score for this measure. This change has been agreed with SEPA to reflect the environmental importance of complying with all discharge licenses.
- An amendment to the drinking water quality service measure to align with the DWQR measurement of overall compliance. This increases the number of quality parameters being considered and reduces the over-emphasis currently placed on small water supply zones with relatively few samples. The agreed amendment will measure performance based on a linear range from a minimum performance level of 99.42%, achieving 5 points, to a maximum performance level of 100% achieving 50 points. The assessment of compliance will be that reported annually by DWQR. We forecast that by March 2015 this amendment will reduce our OPA score by 2 points.
- An amendment to the customer contact measure. We will reduce the period for a substantive response to formal complaints from 10 days to 5 days to align to our Guaranteed Service Standards.

Table 17.1 shows the weighting of each measure within the OPA.

	Indicator	Maximum score
Water supply	Inadequate pressure	37.50
	Unplanned supply interruptions	37.50
	Hosepipe restrictions	12.50
	Security of Supply Index absolute	12.50
	Security of Supply Index variance against target	12.50
	Water quality	50.00
	Water pollution incidents (Category 1 & 2)	12.50
	Leakage	12.50
Wastewater service	Sewer flooding incidents due to inadequate capacity	25.00
	Sewer flooding incidents due to other causes	37.50
	Sewer flooding, properties at risk.	12.50
	Wastewater pollution incidents (Category 1 & 2)	25.00
	Wastewater pollution incidents (Category 3)	12.50
	Sewage sludge disposal	12.50
	Non compliant waste water treatment works	50.00
Customer service	Customer contact	18.75
	Assessed customer service	37.50
Total		**418.75**

Table 17.1: Planned OPA performance

We aspire for our performance to be 'best in class', and this is reflected in our approach towards OPA where we have agreed a three tier approach with the Customer Forum based around the following thresholds:

- We aspire to be best-in-class, achieving an OPA score at, or above, 400. The Customer Forum recognises that this is unlikely to happen consistently based on the experience from England and Wales[1].
- We plan to be leading, achieving an OPA score at, or above, the leading companies' threshold in every year. It is acknowledged by the Customer Forum that, occasionally, this may not be achieved because of significant events.
- We commit to achieving an average OPA score across the 2015 to 2021 period that exceeds the leading companies' performance threshold (i.e.: an average score across 2015 to 2021 that exceeds 382.5), in recognition of the occasional risk to delivering a leading level of customer service.

The OPA performance thresholds are shown in Table 17.2.

	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Best in class performance threshold	400	400	400	400	400	400
Leading companies performance threshold	380	381	382	383	384	385

Table 17.2: OPA performance thresholds

We have agreed with the Customer Forum that the current exclusions that apply to the OPA calculations will continue during 2015 to 2021 and that we will identify and report on these to an annual performance review meeting with the Customer Forum. We have also given the Forum the commitment that we will continue to have an annual independent audit and verification of our OPA score

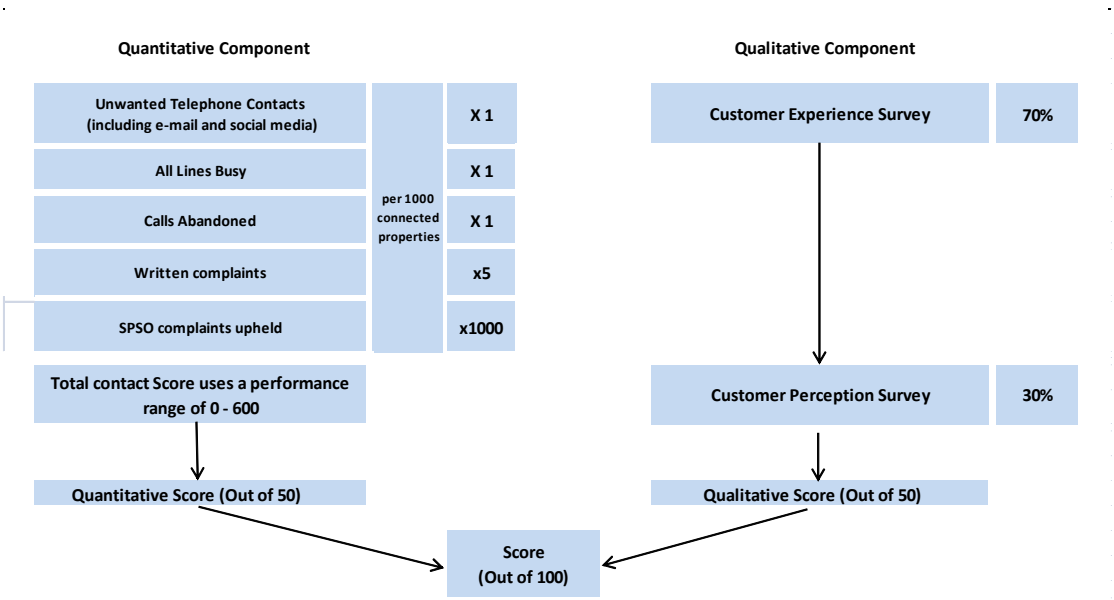
Customer Experience Measure

The Customer Experience Measure (CEM) is our planned measure of customer satisfaction. It comprises of a quantitative component based on the number of negative customer contacts and complaints received, and a qualitative component based on a survey of satisfaction with respect to recently resolved contacts and an independent survey of consumer perceptions of service. The CEM represents a development of the key components of the Service Incentive Mechanism (SIM) introduced in England and Wales in 2010 with some refinement and development to meet the needs of Scottish Water and its customers.

The household CEM takes our current Customer Experience Score survey (CES) forward in its representation of customers' qualitative views. We currently undertake a household Customer Experience Score survey which provides detailed feedback on service delivery across the business. The household CEM will also extend to include the perceptions of customers who use the services daily but do not experience direct contact with Scottish Water. In terms of overall qualitative weighting between service and perception measures we have included a 70% service, 30% perception split as this recognises that, when contact is made, Scottish Water has significant impact upon people's lives, and response in those situations is crucial. The diagram below summarises the components of the household CEM.

[1] The equivalent score reflects that given the revised scoring being introduced for drinking water quality and our improvement plans for SOSI, Scottish Water's equivalent score will be between 3 and 4 points below that recorded in England and Wales, where only one company has achieved an equivalent score above 400 points.

Figure 17.1: Component of the household Customer Experience Measure



The CEM also takes into account a quantitative measure of the customer experience from a measurement of the total number of complaints/contacts per thousand properties connected. This is complementary to proposals for development of SIM in England and Wales (UKWIR Report Ref No 12/CU/01/6).

The perception survey programme has been established and a number of new Customer Experience surveys are in development. This activity will progress with a view to being able to run a shadow reporting programme on the Customer Experience survey. It will allow us to establish accurate forecasting and begin agreeing targets for improvement. We have agreed with the Customer Forum that the qualitative survey elements of CEM will be conducted independently and that we will seek independent audit and verification of our CEM score.

We plan to operate the household CEM on a shadow basis from April 2014 with a view to establishing a baseline level of performance during 2014/15 and a CEM improvement plan by March 2015.

The Customer Forum has highlighted to us that there are some customers who may have been affected by events and have chosen not to contacts us. Our customers' views are important to us and we welcome the Forum's insight on this matter. We have discussed with the Forum how we could capture proactively the views of those customers who have not contacted us but have been affected by events, as well as the experience of those customers who have been in contact as a result of an event. We have agreed to work with the Forum with a view to including a separate component element (weighting to be agreed) covering the customer experience of our response to events within the household CEM by 2015.

We have given the Customer Forum assurance that the disaggregated elements of the household CEM can and will be benchmarked with the SIM in England and Wales as it is constituted currently. We will also continue to monitor changes in the SIM in England and Wales and will review them where they may present opportunities to refine the CEM and benchmark service levels. We will discuss any changes to SIM which would affect comparability with CEM with the Customer Forum to assess any effect on the understanding of CEM this might have.

We, along with the Customer Forum, recognise that further steps could be taken to achieve a better understanding of business customers' perceptions of the service outcomes they experience and agree that they will, together, seek to conclude discussions with all relevant parties aimed at developing a business CEM by March 2015 to capture:

- Licensed Providers' views as a customer of Scottish Water.
- Scottish Water component of business users' experience.
- Scottish Water service to the Developer community.

In addition, we are taking steps to develop improved working relations with business customers where that is relevant to matters specifically under our direct control and which may facilitate business growth. We will engage with the Customer Forum in reviewing progress on this strand of work.

High Esteem Test

We recognise that there is a wider and longer term aim to be able to compare the customer satisfaction of Scottish Water with other sectors. One of the main difficulties in attempting to quantify customer satisfaction for such comparison is that the view of any customer is, in large part, a function of that customer's expectations of performance. We currently take part in the UKCSI measurements of customer satisfaction and believe, along with the Customer Forum, that there is merit in exploring how this can be used as part of a benchmark measure to give a comparative view of customer satisfaction across sectors. Therefore, we have agreed with the Customer Forum to bring forward proposals for building a robust benchmark tracking survey for agreement with the Forum and implementation by March 2015.

Wholesale KPI

Scottish Water monitors the overall performance of its service to retailers across the range of its activities. This is not only to maintain service standards, but also to ensure that there is no bias in the provision of services to retailers. The overall measure takes account of wholesale services and response to requests associated with trade effluent, connections, disconnections, bylaws, metering and billing.

We are currently looking at a number of additional areas to monitor, including: improving the transactional survey of retailers on completion of service requests; developing reports on escalations; and reports on transactional billing quality.

Potential developments in service measurement

The identification of customer priorities has led to consideration of how those areas are currently measured, and to the consideration of additional and supplementary monitoring where there is currently insufficient coverage or visibility. We will work with the Customer Forum to agree separate service activity measures in the following areas for implementation from April 2015:

- external flooding due to hydraulic overloading;
- the annual number of properties externally flooded;
- visible leakage;
- carbon footprint reduction;
- extreme weather events excluded from OPA; and
- SPSO escalated and upheld complaints.

Some of these priorities relate to performance that is covered in the OPA and some may be inherently picked up through the CEM. Where new measures are being considered, further data will need to be collected over the early part of the next period to inform discussions around improvements with the Customer Forum.

Measuring financial performance

We set out in the planned dashboard the financial parameters that are likely to be required to ensure that Scottish Water maintains an appropriate level of financial strength over the medium to long term. We will monitor these through the tramlines set out by the Commission across the planning period, taking account of both actual and forecast performance.

While the tramlines will monitor the on-going level of financial strength, it is also important that we continue to monitor our performance against the cash measure that has been used since 2006. Measuring our cash performance ensures that there is transparency between performance due to management action and the favourable or adverse impact of external circumstances on our financial position.

Monitoring output delivery

The progress in delivering the required outputs is monitored through the 'overall measure of delivery' (OMD), which provide a high-level measure monitoring the delivery of the Ministers' objectives. The 'Output Monitoring Group' monitors Scottish Water's progress in delivering the investment required to

achieve the Ministers' objectives. The industry representatives in the group include the Commission, the Drinking Water Quality Regulator, the Scottish Environment Protection Agency, Consumer Futures, Scottish Water and the Scottish Government.

The OMD is designed to provide a snapshot view of our investment performance. It provides an objective assessment of output delivery progress by taking account of outputs that are 'ahead', 'on' or 'behind' target at each stage of delivery. The measure combines information about output performance with information about capital expenditure to produce a single OMD score. The result is a rounded view of actual investment delivery performance that can then be compared with the position that Scottish Water forecasts in its Delivery Plans.

The OMD has been developed for the period from 2015 to take account of the rolling investment programme. At the start of each regulatory review period a proportion of investment will be known and defined. We will have an OMD for each defined investment programme as they become defined. In the 2015 to 2021 period we expect to have three OMD scores to monitor, Q&SIIIB completion, our 2015 to 2021 committed plan and the IR18 plan that is confirmed in December 2017.

Corporate measures

Carbon footprint

We have been measuring and reporting operational carbon performance annually since 2007, with footprint reports available on our website. Carbon is measured using water industry standard tools developed with the Carbon Trust, which are updated annually to take full account of the DEFRA/DECC changes in emission factors and assessment rules. We will continue to provide a full annual carbon report detailing emissions across our activities, trends and explaining year to year changes. We will also use this to update and improve future carbon projections.

During the period 2015 to 2021 we will also, for the first time, be measuring embodied carbon – the carbon associated with investment. We will estimate the projected embodied carbon impact of the enhancement programme, and utilise carbon assessment tools within the capital process to report carbon in delivery.

Asset Health Indicator

For the next period we have looked to develop an asset health indicator to monitor the progress of capital maintenance and asset stewardship. The asset health indicator reflects the expected remaining life of the assets given the maintenance programme. Differences between outturn and expected indicators reflect changes in activities which impact on the expected remaining life of the assets and asset health.

The Indicator has been developed with a view to providing a measure of asset stewardship. An interim period is needed to review and assess how the indicator reflects and informs what is happening to the asset stock. We will review it mid-way through the next period with a view to it informing how asset stewardship has progressed, and might need to be taken forward for the remainder of the period to 2021.

Resilience of Supply index (RoSI)

We are developing with the Commission the Resilience of Supply index (RoSI) as a measure of the overall resilience of water supply for customers taking account of all the risks associated with a loss of supply from source to tap. It is a development from the Security of Supply Index (SoSI) focusing on outcomes to customers and providing a means of assessing overall resilience of water availability over time. The first stage of its development has focused on water resources and we are in the process of extending it to include treatment capacity and Controlled Activity Regulations restrictions. This is with a view to it replacing SoSI on the dashboard early in the next period.

Annual Review Meeting

We have agreed with the Customer Forum that there will be an annual meeting between Scottish Water and the Customer Forum specifically for the purpose of looking at levels of service and performance as represented by: OPA; the CEM; the High Esteem Test; Wholesale KPIs - and the component parts of each; and other agreed service activity measures under development. Following any such meeting the Customer Forum undertakes to write to us identifying any issues it considers relevant to the question of service level and wider performance monitoring; we agree to consider the issues raised.

Planned Performance Dashboard

Table 17.3 sets out the planned performance dashboard for 2015 to 2021. We expect this to develop over time as we agree new measures or changes to measures with the Customer Forum and the Commission.

Measure to be reported	Expected performance 2015	Expected performance 2021
Measuring customer service		
Overall Performance Assessment (OPA)	380 - 400	385 – 400 6 year average: >382.5
Household Customer Experience Measure(CEM)	n/a	tbc
Business Customer Experience Measure (CEM)	n/a	tbc
High Esteem Test	n/a	tbc
Wholesale key performance indicator	98%	>98%
Monitoring financial performance		
Adjusted Cash Interest Cover II	1.60	1.54
Funds from operations to net debt	10.5%	10.0%
Gearing	55%	52%
Cash out-performance	n/a	>0
Monitoring Output Delivery		
Delivery of Q&SIV Outputs (OMD Measure)	n/a	To be determined as part of the delivery plan
Completion of Q&SIIIb outputs delivery (OMD Measure)	tbc	250
Measuring corporate performance		
Carbon footprint (kg/household)	125	<125
New service measures to be developed		
Security of Supply Index	Band B (97%)	Band B (99%)
Resilience of Supply Index	To be developed	To be developed
Number of properties at risk of external flooding from sewers due to hydraulic overloading	tbc	tbc
Annual number of properties externally flooded from sewers	tbc	tbc

Table 17.3: Planned Performance Dashboard 2015 to 2021

SCOTTISH WATER AND THE CUSTOMER FORUM

Minute of agreed modifications to Scottish Water's draft business plan for 2015-21

INTRODUCTION

1. The formal document setting out the procedures for the setting of charges for water in Scotland – "Strategic Review of Charges 2015-21: Innovation and Choice" issued by the Water Industry Commission for Scotland, had at its heart an invitation to Scottish Water and the Customer Forum for water to agree the business plan the Water Industry Commission would consider in determining charges for 2015-21. This Minute of Agreement represents the agreement reached and as sought in the formal procedures for the Strategic Review of Charges 2015-21.

2. This minute of agreement should be read in the context of Scottish Water's draft business plan for the 2015-21 period. Scottish Water's draft business plan is agreed by the Customer Forum unless, and to the extent, modified by this minute of agreement. For completeness, by 28 February 2014, Scottish Water will update its draft business plan for all the matters set out in this minute of agreement to create "the agreed business plan".

3. Where the term 'Customer Forum' is used throughout this document and referring to matters beyond the current process for the price review and current powers to agree, this reference is not intended to imply that a decision has been taken on the future of the Customer Forum and any future role it may have. This is simply a short-hand for consistency and identifies areas where customer input to discussions and arrangements will be appropriate and important, whatever the particular form of that customer body.

DELIVERING FOR CUSTOMERS

Overall Performance assessment (OPA)

4. Scottish Water and the Customer Forum aspire for Scottish Water's performance to be 'best in class', and this is reflected in the agreed approach towards OPA where a three tier approach is agreed, based around the following thresholds:

	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Best in class performance threshold	400	400	400	400	400	400
Leading companies performance threshold	380	381	382	383	384	385

- Scottish Water aspires to be best-in-class, achieving an equivalent[1] OPA score at, or above, 400. It is recognised by the Customer Forum that this is unlikely to happen consistently based on the experience from England and Wales.
- Scottish Water plans to be leading, achieving an OPA score at, or above, the leading companies' threshold in every year. It is acknowledged by the Customer Forum that, occasionally, this may not be achieved because of significant events.

[1] The equivalent score reflects that, given the revised scoring being introduced for drinking water quality and Scottish Water improvement plans for SOSI, Scottish Water's equivalent score will be between 3 and 4 points below that recorded in England and Wales. Only one company has achieved an equivalent score above 400 points.

- In recognition of this occasional risk to delivering a leading level of customer service, Scottish Water commits to achieving an average OPA score across the 2015-21 period that exceeds the leading companies' performance threshold (i.e.: an average score across 2015-21 that exceeds 382.5).

5. The following detailed points with regard to the OPA have been agreed in addition to those identified for the drinking water quality measure and the waste water treatment compliance in the draft business plan:

   - Exclusions: the current exclusions that apply to OPA are to continue during 2015-21. Scottish Water to identify and report the exclusions to the OPA calculation to an annual performance review meeting with the Customer Forum.
   - Response to formal complaints: the period for a substantive response to formal complaints to be reduced from 10 days to 5 days.
   - Independent verification of the OPA: Scottish Water to continue to undertake an annual independent audit and verification of its OPA score

Customer Experience Measure (CEM)

6. A separate Customer Experience Measure (CEM) will be introduced for each of household and business customers. The non-household CEM is to include Licensed Providers, businesses and developers. Scottish Water will work with the Customer Forum on the development of the measures for agreement and implementation by March 2015.

7. The following detailed points with regard to the introduction of a Household Customer Experience Measure (CEM) have been agreed:

   - Perception survey: the perception survey is to constitute 30% of the qualitative element of the household CEM.
   - The qualitative survey elements of CEM to be conducted independently of Scottish Water.
   - Timetable: Scottish Water to operate the household CEM on a shadow basis from April 2014 with a view to establishing a baseline level of performance during 2014/15 and a CEM improvement plan by March 2015.
   - Affected non-contact customers: A commitment from Scottish Water to work with the Customer Forum in developing for implementation by March 2015 a separate component (weighting to be agreed) element of household CEM covering the customer experience of Scottish Water's response to planned and unplanned Scottish Water service events from those customers who are likely to have been affected but have chosen not to contact Scottish Water.
   - SPSO complaints upheld: These are given a weighting of 1000 times 'unwanted' contacts within the CEM. Scottish Water will also report on escalated and SPSO complaint levels in the annual performance review meeting (see note 17).
   - 'Calls Abandoned' and 'All Lines Busy': to be included within the quantitative element of CEM.
   - Independent verification of the CEM: Scottish Water to seek independent audit and verification of its CEM score.

8. It is agreed that the disaggregated elements of the household CEM can and will be benchmarked with the Service Incentive Mechanism (SIM) in England and Wales as it is constituted currently. It is noted that SIM is currently under review and any changes to SIM which would affect comparability with CEM will be discussed with the Customer Forum to assess any effect on the understanding of CEM this might have.

9. Scottish Water and the Customer Forum will keep the relative weightings of the components of the CEM under review.

10. Scottish Water and the Customer Forum recognise that further steps could be taken to achieve a better understanding of business customers' perceptions of the service outcomes they experience and agree that they will, together, seek to conclude discussions with all relevant parties aimed at developing a non-household CEM by March 2015 to capture:

    - Licensed Providers' views as a customer of Scottish Water.
    - Scottish Water component of business users' experience.
    - Scottish Water service to the Developer community.

11. Scottish Water are taking steps to develop improved working relations with business customers where that is relevant to matters specifically under the direct control of Scottish Water and which may facilitate business growth. Scottish Water will engage with the Customer Forum in reviewing progress on this strand of work.

High Esteem Test (UKCSI)

12. Scottish Water and the Customer Forum agree that benchmarking Scottish Water's customer satisfaction against other utilities and companies in other sectors would be of value. Scottish Water and the Customer Forum have agreed that Scottish Water will bring forward its proposals for building a robust benchmark tracking survey to the Customer Forum for agreement and implementation by March 2015.

Additional Service Activity Measures

13. Scottish Water will work with the Customer Forum to agree separate service activity measures in the following areas for implementation from April 2015.

    - external flooding due to hydraulic overloading.
    - the annual number of properties externally flooded.
    - visible leakage.
    - carbon footprint reduction.
    - extreme weather events excluded from OPA.
    - SPSO escalated complaints and upheld complaints.

Customer engagement

14. Scottish Water and the Customer Forum are committed to working together throughout the 2015-21 period on deepening customer engagement. Each year, as appropriate, a wider programme of research into customers with particular service requirements will be conducted. This work may encompass, for example, vulnerable customers, customers within particular geographic areas, customers with particular service improvement needs, research to inform future customer driven priorities and long term issues such as lead pipe replacement, rural sewerage provision, and private water supplies.

Customer education

15. Scottish Water and the Customer Forum agree that there is more that can be done to get close to customers and to help customers co-produce outcomes for themselves and the water and waste water system as a whole, through more comprehensive customer education, care and support arrangements.

16. Building on work done to improve customer education on blockages to sewers caused by customer behaviours, Scottish Water will engage with the Customer Forum during 2014/15 with a view to developing potential approaches to education, care and support programmes, and the subsequent trialling and evaluation of such programmes.

Annual review meeting

17. The Customer Forum and Scottish Water agree that there will be an annual meeting between Scottish Water and the Customer Forum specifically for the purpose of looking at levels of service and performance as represented by: OPA; the CEM; the High Esteem Test (UKCSI); Wholesale KPIs - and the component parts of each; and other agreed service activity measures under development. Following any such meeting the Customer Forum undertakes to write to Scottish Water identifying any issues it considers relevant to the question of service level and wider performance monitoring, and Scottish Water agrees to consider the issues raised.

CUSTOMER PRICES

18. The financial modifications and mechanisms set out in this minute of agreement are intended to achieve the following prices for customers.

Household customers

19. There will be an overall household price cap of CPI-1.75% across the 2015-21 period – this is the overall price control that is consistent with achieving annual nominal price increases of 1.6% in 2015-21 assuming that actual CPI adheres to the assumptions given in note 22 below. This mechanism protects both customers and Scottish Water from actual inflation differing from that assumed in this note of modifications. The overall household price cap will be operated in accordance with the following three principles:

    (a) A fixed nominal price increase of 1.6% pa in each of 2015/16, 2016/17, and 2017/18 for household customers only, albeit that any over/under recovery of revenue in these three years may be adjusted for in 2018-21 under the price cap arrangements. This follows a limiting of the household price increase in 2014/15 to 1.6% in light of the pricing intention for 2015-18.

    (b) An indicative nominal price increase of 1.6% pa in each of 2018/19, 2019/20 and 2020/21 for household customers only, that will be subject to assessment at the time based on out-turn and forecast CPI.

    (c) If the application of the price cap methodology would require household prices in 2018-21 to exceed the indicative price increase of 1.6% pa then, prior to the application of such an increase, Scottish Water, the Customer Forum, and the Commission will consider whether any, or all, of the increase above 1.6% can be off-set by overall favourable external factors, re-phasing of IR18 allowances to after March 2021, or by returning any early sustainable out-performance to customers.

20. Affordability: Scottish Water agree to commence work with the Scottish Government and other stakeholders, including the Customer Forum, by April 2015 to investigate if more can be done to support vulnerable customers within the principles of charges laid down by Scottish Ministers.

Wholesale customers

21. There will be a target annual wholesale price change in 2015-21 of CPI-0.3%, but this would be subject to annual adjustment to reflect actual growth and CPI so that Scottish Water's revenue complies with the annual wholesale revenue cap as adjusted for out-turn CPI.

OTHER FINANCIAL CHANGES

Inflation assumptions

22. The inflation assumption forecasts are modified as follows:

- CPI for prices will be reduced to 1.9% pa in line with the Bank of England's inflation forecast of November 2013.[2]
- The differential between CPI and RPI will be reduced to 0.75%.
- In light of the falling forecasts for RPI, the RPI cost assumptions for 2013/14 and 2014/15 shall be reduced to 2.8% and 2.65% respectively.

This is set out, for clarity, in the table below.

	2013/14	2014/15	Each year from 2015/16 to 2020/21
Modified CPI for prices	-	-	1.9%
Draft business plan CPI for prices	-	-	2.0%
Modified RPI for costs	2.8%	2.65%	CPI+0.75% (i.e.: 2.65%)
Draft business plan RPI for costs	3.0%	2.9%	CPI+0.9% (i.e.: 2.9%)

Household growth

23. The Commission set out in note 22 that household growth may exceed that set out in our draft business plan. In response to this, the assumption on household growth has been increased from an average of 0.67% pa in the draft business plan to an average of 0.74% pa in this note. This revised average growth assumption is based on an assumed rising annual growth from 0.6% in 2015/16 to 0.9% in 2020/21. The assumed financial consequences arising from this additional growth (in out-turn revenues and costs) are:

	£m
Additional customer revenue	11
Additional infrastructure charge income	7
Additional investment in strategic infrastructure	(4)
Additional reasonable cost contributions	(11)
Additional investment in strategic capacity	(13)
Net cash cost in 2015-21	(10)

24. To the extent that growth exceeds the assumptions set out in our draft business plan, as amended above, the further net additional costs (investment in excess of additional revenue) would require further re-phasing of IR18 investment allowances to after March 2021, beyond those set out in note 27 below.

Investment levels and priorities

Updates to draft business plan forecasts

25. Cash provision is being made for the £61 million SR10 investment risk provision that was highlighted in the table commentary accompanying the draft business plan but omitted from the accompanying financial model projections. This cash provision is essential in the context of the Commission's guidance to lower significantly the closing cash balance at March 2021.

26. Recognition, but no overall net cash adjustment, is being made for two compensating understatements in the draft business plan that were identified by the Commission through their business plan review process, which are:

- a cost increase of £21 million to correct for an understatement in relation to reasonable cost contributions (RCC).
- infrastructure charge income is increased to reflect an under-statement by £3 million to £4 million a year. This will provide additional income that off-sets the additional RCC, albeit that part of this may need to be invested in additional strategic infrastructure capacity.

[2] www.bankofengland.co.uk/publications/pages/inflationreport/2013

IR18 allowances

27. To create a positive cash balance of £20 million at March 2021, £40 million (2012/13 prices) of IR18 allowances need to be re-phased to after March 2021. The impact on the phasing of IR18 is set out below.

All figures £m (2012/13 prices)	2018-21	2021-24	Total
Modified IR18 allowances	259	280	539
Draft business plan IR18 allowances	299	240	539
Re-phasing of IR 18 allowances	(40)	40	-

Additional investment priorities

28. Any additional priorities for investment including lead pipe replacement pilots, private water supplies and sewerage provision to rural communities, acceleration of Water Framework Directive actions, and reduction in the economic level of leakage will be considered under the rolling investment review in December 2017 taking account of the available financing in relation to section 19 of this agreement. To the extent that financial provision is required for further additional investment priorities the value of the IR18 re-phasing to after March 2021 set out in note 27 above would need to increase further.

Improving resilience of water supplies

29. The Customer Forum has sought a robust methodology for assessing the risks, costs and benefits associated with large projects to improve resilience within the system. The procedure set out by Scottish Water in January 2014 provides the basis for such robust assessments and sets out how Scottish Water will consult and seek the support of the Customer Forum on these issues over time. This procedure will be incorporated into Appendix 6 to “the agreed business plan”.

30. Scottish Water and the Customer Forum agree that part of the assessment process to be undertaken by Scottish Water into the issues of resilience will include developing a risk assessment to facilitate discussion with customers and allow them to come to judgements about the scale of risk to assets and how it is assessed and the priority for addressing these risks.

Price Promise and Guaranteed Standards

31. Scottish Water and the Customer Forum have agreed a simplification and enhancement of Scottish Water’s Price Promise and Guaranteed Standards of Service.

32. Scottish Water has committed to merging the two schemes, promoting them to customers using Plain English both in its publications and on the website; and taking a more proactive approach to offering rebate and compensation payments. Scottish Water has agreed that higher levels of payment should be made available and that they will be implemented from April 2015 as follows:

- all the financial payments are uprated in light of inflation since they were last uprated.
- on unplanned interruptions to supply to move to give a rebate of 25% to 100% of annual water charge for between 2 and 5 incidents in future, rather than 3 and 6.
- where a customer suffers from internal sewage flooding, the rebate will be increased to a minimum of band D level of household waste water charges.

Cash balances

33. The forecast closing cash balance, including the financial reserve, at 31 March 2021 is reduced to £20 million.

Financial performance

34. Scottish Water and the Customer Forum agree that the description in 'Innovation and Choice' that outperformance could potentially be used to "reduce charges, provide additional customer service improvements, improve the condition or performance of the assets in place, or build up its financial reserve" are the appropriate areas for engagement between Scottish Water and the Customer Forum.

35. The Customer Forum accept that "outperformance would be shared at the discretion of Scottish Water at this point, provided its financial strength did not exceed the upper limit of the tramlines", and both parties accept that that "if Scottish Water's financial strength reaches the upper limit and is forecast to stay there for the remainder of the price control period, the company would use the proceeds over that limit to the benefit of customers, subject to the agreement of the Water Industry Commission for Scotland (the Commission) and the Scottish Government".

36. Both parties recognise that Scottish Water will seek to trigger discussions with the Customer Forum, Commission and other stakeholders when the circumstances indicate this would be either beneficial or necessary, with the Commission having the power to determine when discussions under the tramlines should take place if this is not already happening voluntarily. Scottish Water and the Customer Forum recognise that the Scottish Government as owners of the company would have to be party to any agreement on the use of outperformance.

Summary of the forecast out-turn cash impact of the financial changes and limiting of price increases

37. For completeness, tabulated below are each of the financial adjustments and their impact on the forecast closing cash balance at March 2021.

Modification	Cash impact of modification £m	Closing cash balance at 31 March 2021 £m
Cash (including financial reserve) balance in draft business plan		117
Additional net investment requirements arising from omissions from draft business plan financial model	(61)	56
Impact of reduction in household price increase in 2014/15 from 3% in draft business plan to 1.6%.	(97)	(41)
Reduction in 2015-21 prices to 1.6%.	(72)	(113)
Reduction in forecast RPI for costs: • arising from reduction in 2013/14 from 3% to 2.8%. • in the annual differential between RPI and CPI from 0.9% to 0.75% in 2014-21 • arising from a reduction in forecast CPI by 0.1% to 1.9%	18 46 31 95	(18)
Impact of increase in assumed average household growth from 0.67% pa to 0.74% pa	(10)	(28)
Rephasing of IR18 allowances to after March 2021 (£40m 2012/13 prices)	48	20

38. An updated financial appendix containing all of these changes will be provided in 'the agreed business plan'.

Signed

……..

Peter Peacock
On behalf of the Customer Forum

30 January 2014

……..

Douglas Millican
On behalf of Scottish Water

30 January 2014

Appendix 19:

Letter from the Customer Forum to the Water Industry Commission 30 January 2014

Alan Sutherland
Chief Executive
Water Industry Commission for Scotland
First Floor
Moray House
Forthside Way
Stirling
FK8 1QZ

30th January 2014

Dear Alan

Minute of Agreement on Scottish Water Draft Business Plan 2015-2021 between the Customer Forum and Scottish Water – January 2014

I write in my capacity as Chair of the Customer Forum and in formal response to your letter to me of 15th October 2012 in which you invited the Customer Forum "to seek to agree by April 2014 a Business Plan for delivery by Scottish Water in 2015-20 (Note: subsequently changed to 2021). Such a Business Plan should be fully consistent with Ministerial Objectives and with the views and ranges that the Commission will set out in notes and papers over the period to early 2014..".

That letter reflected priorities from the Scottish Government to the Commission set out in a letter of 13 June 2012 which, inter alia, advised the Commission that in the Strategic Review of Water Charges: 2015-21, "Ministers support the aspiration to increase and improve customer involvement in the setting of investment priorities to deliver the levels and quality of service they deserve for the charges they pay. They expect Scottish Water and its regulators to assist fully in the work of the Customer Forum."

I am pleased to be able to formally advise you that the Customer Forum and Scottish Water have reached agreement on the Scottish Water Business Plan for the period 2015-21. That agreement meets the terms of the remit given to us, and both the spirit and specific terms of the guidance set out in – Strategic Review of Charges 2015-21: Innovation and Choice. Further, the agreement fits within the parameters established through the 22 Information Notes issued by the Commission, and, I believe, meets Ministerial objectives as they have been set out to the Customer Forum. The agreement reached is represented by the attached Minute of Agreement and dated 30 January 2014 signed by myself and the Chief Executive of Scottish Water, setting out the modifications to the draft business plan published by Scottish Water on 30th October 2013. The Customer Forum considers the Minute of Agreement represents a positive outcome for customers which also allows Scottish Water to deliver continuing improvements in service in the coming period.

While the formal position is as set out in the immediately preceding paragraph it may be helpful to the Commission to have a further description of the process through which agreement has been reached. What follows has been agreed as a fair representation of the matters covered, by Scottish Water.

The Strategic Review of Charges 2015-21: Innovation and Choice, sought to establish an iterative process between Scottish Water and its customers, as represented by the Customer Forum. Over the period since the autumn of 2011 the Customer Forum and Scottish Water have met formally on some 27 occasions (21 Full Forum, 6 Engagement Committee), in addition there have been briefings and a number of informal liaison meetings between me as Chair of the Customer Forum and the Chief Executive of Scottish Water, and the Forum met the full Board of Scottish Water informally on one occasion and I have met informally with the Chair of Scottish Water on at least one occasion.

Throughout the iterative process, as you are aware, I have made a point of keeping in touch with you as Chief Executive of the Commission in order to advise you of emerging issues and the desired direction of travel of the Forum, in order to ensure the Forum was not straying beyond any parameters set and that our considerations were appropriate. I have further met formally with Consumer Futures on two occasions, and further with them and all the sponsors of the Forum on at least another two occasions. I

have sought to keep Scottish government officials regularly informed of progress on a similar basis to the discussions I have had with you. The Forum has participated in the formal quinti-partite meeting called by the Commission between all the relevant stakeholders to the process on the matter of the Scottish Water draft business plan.

In addition, the Customer Forum has: discussed methods of approach with Prof. Stephen Littlechild and Harry Bush – both experienced in deeper customer engagement within regulatory settlements at the UK and international level; sought the formal help of the Independent Assessor on one occasion and sought advice on particular issues from him informally on a number of occasions; held bi-lateral discussions with each of the DWQR, SEPA, and Scottish Public Service Ombudsman office; briefed the relevant Parliamentary Committee Convener and Committee Clerk on Customer Forum objectives and activities on two occasions; briefed MSPs on one occasion; met with the Convention of Scottish Local Authorities on two occasions; met with the Innovation Panel appointed by the Commission on one occasion; and met with the serving Minister for Infrastructure on two occasions to brief them of Forum objectives and progress. I believe the significant liaison activities above have contributed to informing the Forum's activities and in also keeping key stakeholders informed.

The iterative process envisaged between Scottish Water and the Customer Forum has worked well and it has been conducted in a very constructive and professional manner, for which I give significant credit to Scottish Water, particularly as not all the messages we have been giving have been comfortable for them to receive. Scottish Water has almost invariably been represented at Finance Director or Chief Executive level in the discussions and the commitment of the Chief Executive and his Board to a serious dialogue with customers has been evident throughout. It is also apparent to us that the matters we have raised in discussions have been listened to and, where achievable, Scottish Water has actively sought to accommodate the Forum's views and aspirations.

As the relationship between the Customer Forum and Scottish Water has developed and strengthened over the period it is clear we have been on a journey of exploration involving a significant depth of engagement on a wide range of issues and as a consequence, potential initial approaches to issues we have explored and discussed have matured, evolved and developed, giving rise to the propositions Scottish Water made in their draft business plan. I believe it would be fair to characterise the engagement as one in which shared positions have emerged from a process involving, a company with a high degree of professional expertise and commitment to delivering ever improving customer services, and keen to actively seek out and hear to customer views, engaging with an ever more informed Customer Forum equally keen to assert customer interests and priorities in the price setting process.

Further, I believe the ongoing role played by the Commission in the form the various inputs of staff, and principally by you as Chief Executive in helping bring Scottish Water and the Customer Forum towards a point of common agreement, has been crucial.

In consequence, the process of iterative discussions between the Customer Forum and Scottish Water allowed Scottish Water to come forward with a Draft Business Plan which they made clear attempted to be as close to `near final' as they could achieve by the stage it was published. Indeed, the process established meant it was really not possible to come forward with anything other than a near final draft business plan, as all the components of the business plan had been visible and subject to detailed discussion throughout the process. There was very little in the Draft Business Plan which was not anticipated and there were a number of areas where the research findings and the input of the Customer Forum, and the willingness of Scottish Water to hear what the Customer Forum was saying, has resulted in an evolving emphasis and priority being given to important issues like sewer flooding, the question of the customers' experience of water pressure and visible leakage, and price issues, for example. There has also been a welcome evolution of the central role customers can play in ongoing dialogue throughout a settlement period, and not just every time there is a price review. The draft business plan of course sits firmly within the framework of the longer term Strategic Projections produced and consulted on by Scottish Water and upon which the Customer Forum formally commented to Scottish Water.

The process we have worked through with Scottish Water breaks down into what are five distinct phases, following the initial familiarisation of the Customer Forum with the company and its priorities and performance.

Phase one involved significant customer research undertaken principally by Scottish Water, with input as to content and conduct from the Customer Forum. The Customer Forum also commissioned its own research specifically to explore affordability and willingness to pay issues. Further the Customer Forum commissioned reports on the effects of the enduring difficult economic circumstances on household incomes, and advice on issues around the use of RPI and CPI as measures of inflation, from an

independent academic source. In addition, the Customer Forum commissioned a report on the significant benefit and tax credit changes that have been being implemented, to understand their impact on household incomes. Most importantly, arising from the research undertaken by Scottish Water, the Customer Forum and Scottish Water formally agreed what that research was telling us about customer priorities for investment and customer service. That agreement is represented within the concluding report on the research in the publication `Listening to Our Customers' published by Scottish Water. All of the research material referred to above is publicly available on the Scottish Water and Customer Forum websites.

Phase two involved the Customer Forum receiving eight detailed Service Improvement Reports (SIRs), copies of which were made available to the Commission and relevant other regulators at the time. The SIRs were essentially reports on aspects of service and the need for expenditure which would form the detailed component parts of what would make up the core of the Scottish Water business plan. Importantly, each of the service improvement reports referred back to the customer research referred to above and the agreed priorities for investment arising, as one important part of the considerations, thus linking the customer research directly to the investment considerations. Each SIR was the subject of detailed discussion between the Customer Forum and Scottish Water, typically for a couple of hours on each report. Where at the end of those discussions the Customer Forum still had outstanding questions or points to make, those were followed up briefly in writing and Scottish Water either reported back to the Forum on those matters, or they were accounted for in the evolving positions referred to above. One specific discussion concerned discretionary elements of potential spending which were worked through and specifically amended and agreed, and which then formed part of the draft business plan.

The third phase concerned the work to publish the draft business plan and where the Forum was involved in discussions through seeing a draft draft plan. The draft business plan published, because of the discussions referred to above, in effect, already contained a significant level of agreement already reached between the Customer Forum and Scottish Water through the iterative process.

The fourth phase, subsequent to the publication of the draft business plan, involved the Customer Forum considering its response. As stated above, there were very few surprises in the plan because of the nature of the plan development process so, for example, the key investment priorities were as we had understood they would be following the discussion on the SIRs. The Forum regarded the plan as `near final', but still capable of potential further improvement. The Forum set out for Scottish Water a detailed response to the plan, signalling areas in which it sought further discussion. These further `fields for engagement' (below) became the agenda for the final phase:

- Investment levels and priorities (resilience issues)
- Tramlines
- Performance measurement
- Customer engagement
- Business customers
- Price Promise and Guaranteed Standards of Service
- Communication and supply pipes.
- Customer education and care.
- Support to the most vulnerable customers.
- Framing the long term view of improved customer services.
- Prices.

The fifth and final phase was slightly different in character to all the phases up to this point, taking the form of a negotiation on some matters of principle, and some of detail. The Customer Forum, as required by the terms of the agreement establishing it, had appointed members to an Engagement Committee, comprising myself and two other Customer Forum members. The Scottish Water members comprised the Chief Executive and two other senior colleagues. The Engagement Committee met on three separate occasions and for around 12 hours of very detailed discussion, to agree on issues and what has become the attached Minute of Agreement. It is important to stress that throughout the entirety of the process both parties have sought not to characterise the discussions as `win or lose'. Even in this negotiating phase, which benefited considerably in my view from the relationships built through the engagement over the preceding couple of years, the character was one of better understanding ambitions and perspectives, from which agreed positions emerged.

As you are aware, the Engagement Committee met immediately at the conclusion of the last phase with you as Chief Executive of the Commission to set out where we had got to in our discussion and what we had concluded, and to ensure there was nothing that we had done or had failed to do that would require us to have further discussion.

I believe the process that the Commission established for this price review, with the active support of the Scottish government and other key stakeholders, has given rise to a considerable empowerment of customer interests at the heart of the price setting process. That has been principally achieved by the invitation to the Customer Forum and Scottish Water to seek to agree the business plan, giving focus and real power to the process. I also believe the fact that the Customer Forum was independent of all the key stakeholders, and has no statutory powers in relation to Scottish Water, considerably facilitated the ability of both parties to openly share emerging thinking. The process established has also resulted in what appears earlier and more detailed consideration of a wide range of service improvement issues, and transparency to customers and the Commission that would not have been so apparent in previous price review procedures.

I have pleasure in now attaching for the consideration of the Commission the agreed position between customers, as represented by the Customer Forum, and Scottish Water, in the attached Minute of Agreement. The Customer Forum hopes the agreement provides the basis for the Commission's considerations toward preparing the determination of charges and for Ministers to finalise the Principles of Charging and final Ministerial Objectives.

Yours sincerely

Peter J Peacock
Chair
Customer Forum