Rivers and canals

Scotland's river quality has improved in recent decades. Almost half of our rivers are now of good or better quality. Plans are in place to improve the remaining poorer-quality rivers.

Summary

Key messages

- Scotland has approximately 125,000 km of rivers and 220 km of canals.
- Many rivers are relatively undisturbed by human activity, compared with the majority of rivers elsewhere in the UK and Europe.
- River quality has improved significantly in the last 25 years and just under half of our rivers are now of good or high status.
- Our poorer quality rivers are affected by agriculture, hydropower schemes and urbanisation.
- Ambitious targets have been set for rivers, with an objective for 96% to be at good or high status by 2027.
- There are still significant problems that need to be addressed through collaborative approaches, involving water users and land managers.

State and trend

State: Moderate - medium agreement, high evidence

Trend: Stable/improving - high agreement, high evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- Assessments are of the current "average condition"; some rivers are in a worse condition, and others are in a better one. Equally, the condition of some river waters is declining, while others are improving.
- Making any overall assessment is necessarily a simplification.
- We have taken account of the scale of any damage to the environment in these assessments; impacts can be locally damaging, but may have little effect on a national scale.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.

Overview

There are approximately 125,000 km of rivers in Scotland, varying from small highland burns to deep, wide lowland rivers such as the Tay. There is also a 220 km canal network.

Scotland's rivers are an important part of the landscape, providing water for industry and agriculture and habitats for wildlife. Some prestigious Scottish industries, such as whisky production and fishing, benefit from the high quality of the country's rivers. Fishing for salmon and sea trout takes place in almost every river, and angling for brown trout is also widespread. It has been estimated that freshwater angling across Scotland as a whole supports around 2,800 jobs, generating nearly £50 million in wages and self-employment income for Scottish households.

The canal network was built between 1768 and 1822 and ranges from the highland Caledonian Canal to the Forth and Clyde canals in the industrial Central Belt. Canals originally provided transport routes from the coast, improving access to supplies of raw materials like coal, iron-ore, stone and agricultural produce. In recent years much of the canal network has been regenerated to preserve our industrial heritage and support tourism. One example is the Falkirk Wheel, a spectacular 35 m boat-lift that joins the Union canal to the Forth and Clyde canal.

Rivers make a major contribution to the tourism industry, as well as to the quality of life of people living in Scotland. Rivers are some of our most important recreational resources, providing places to fish, swim, canoe, watch nature or simply relax.

Rivers are also important for the dilution of waste water. With appropriate management, our river waters have the capacity to provide these important services without damaging their ecology or compromising their other uses and benefits.

Electricity, gas and water supply account for over 2.7% of Scottish gross value added (the contribution to the economy of each individual producer, industry or sector in Scotland). Hydropower contributes 19.4% of the total electricity capacity of Scotland.

Water bodies with severely damaged ecological quality support few uses. They provide fewer social and economic benefits than good-quality waters, and are often visibly unpleasant, giving an impression of neglect; in some cases they even pose a risk to human health.

Listen to our rivers and canals podcast by Nathan Critchlow-Watton.

State

Scotland has around 25,000 km of rivers that are monitored and assessed, more than half of which are in good condition or better. This includes most of the rivers in the Highlands and Islands, where there are fewer pressures on the environment.

There is a decline in condition in the Central Belt, and in more intensively farmed areas.

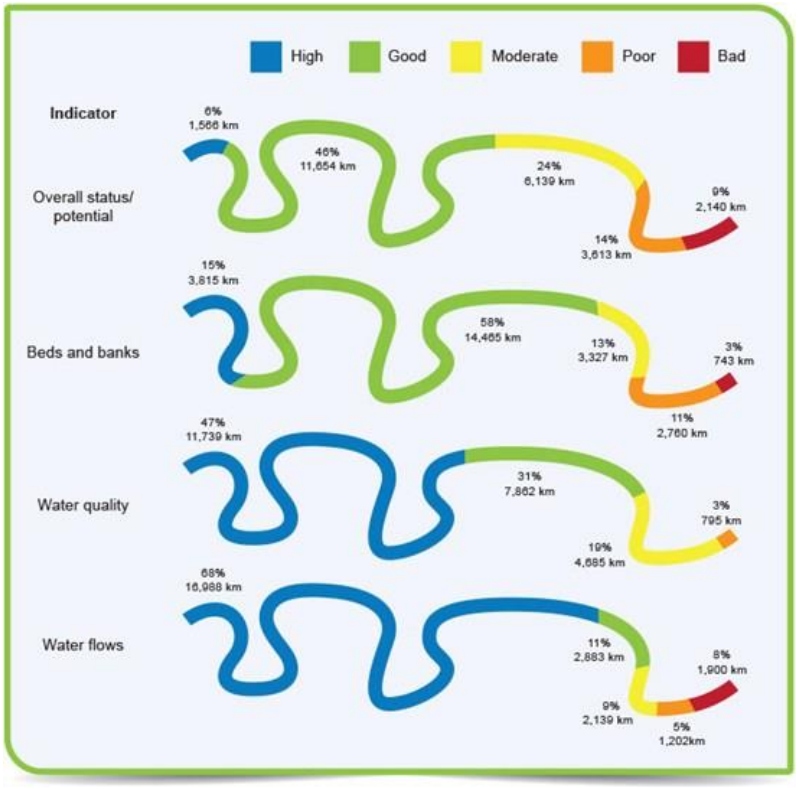

Figure 1: Status of Scotland's rivers and canals, 2012 data

You can find the full classification results for each individual water body by following the link to the water body classification tool.

Overall status

The Water Framework Directive (WFD) assessment applies to 25,000 km of rivers and all canals. The condition of Scotland's rivers and canals for 2012 is shown in Figures 1 and 2. To be at high or good status, rivers need to:

- be free from pollutants at levels that would harm the water, plants and animals they support;
- have minimal changes to their habitats and water flows;
- contain a certain range of plants and animals;
- not be negatively affected by invasive non-native species (INNS).

Rivers assessed as moderate, poor or bad reflect increasing impacts from human activities.

Canals and some rivers are man-made or have been significantly altered by human activity to provide an important socio-economic benefit; for example, damming a river for water supply. In these cases, the river or canal cannot meet good status, so it is assessed according to its potential. A modified or artificial river or canal is considered to have good ecological potential if it is free from pollution and managed in the best possible way to protect the environment and maintain the wider socio-economic benefits.

You can find more details about the classification scheme in the 2008 state of the water environment report. The classification scheme is explained in more detail in the policy statement on the Water Environment and Water Services (Scotland) Act 2003.

Around half of the assessed rivers and canals are at good or high status or potential.

Many of Scotland's rivers are relatively undisturbed by human activity compared with the majority of rivers elsewhere in the UK and Europe.

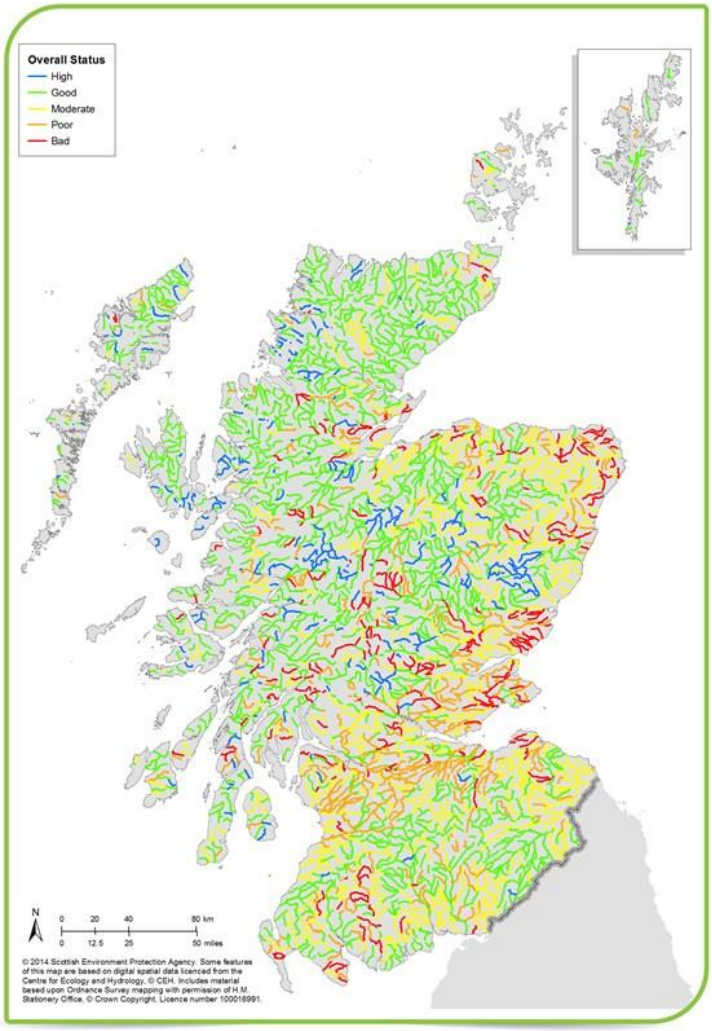

Figure 2: Overall status of rivers and canals, 2012 data

Beds and banks

The beds and banks of rivers and canals provide habitats that many plants and animals depend on. Some, such as rooted plants, and animals like some caddis flies, live attached to the riverbed. Other animals live among the different bed and bank habitats, using them for shelter, feeding and reproduction.

Eighty seven per cent of assessed rivers and canals were at good or high status for beds and banks in 2012 (Figure 3). Areas where the beds and banks are not in as good a condition are clustered in urban and industrial areas, such as the Central Belt, or where intensive agriculture has led to straightening and dredging rivers and removing bankside vegetation.

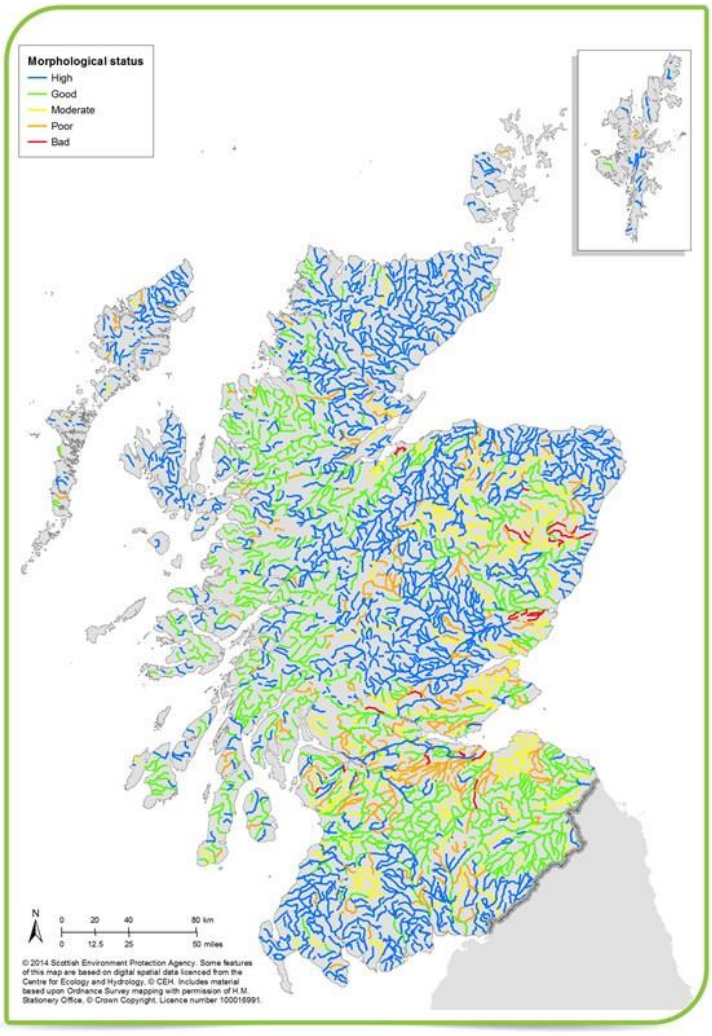

Figure 3: Status of the beds and banks and impact of fish barriers in rivers and canals in 2012

Note: The condition of the beds and banks in artificial water bodies, such as canals, is shown as good where best practice for their management is met.

Water quality

Water-quality status gives a representation of the condition of a river using a combination of chemical and biological pollution indicators. The plants and animals that live in our rivers are affected by a range of pollutants, including excessive nutrients, chemicals and sediment. Excessive inputs of nutrients can accelerate the growth of algae and other water plants, which leads to oxygen being removed from the water and major changes in the balance between the plants and animals living in the river. Other pollutants can poison organisms, reduce their growth or interfere with reproduction. Some of these pollutants break down very slowly in the water environment and can build up over time in sediments and plants, and sometimes within the bodies of animals.

There has been significant progress in preventing and reducing pollution over the last few decades; under the pre-WFD scheme, between 2000 and 2006 the length of rivers in Scotland that were affected by pollution was reduced by 37%.

In 2012, nearly 80% of assessed rivers and canals were at good or high status for water quality (Figure 4).

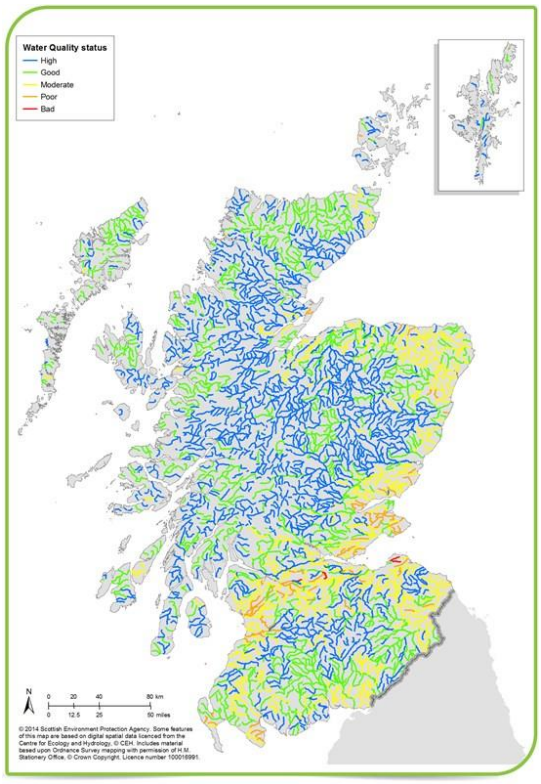

Figure 4: Water quality status of rivers and canals in 2012

Figure 5 shows how water quality has changed between 1991 and 2012. There has been a progressive decrease in the number of rivers and canals that are polluted or slightly polluted, and an increase in those that are unpolluted or unaffected by pollution.

The largest improvements have resulted from tighter controls over standards for waste disposed into rivers from sewage works and industrial discharges.

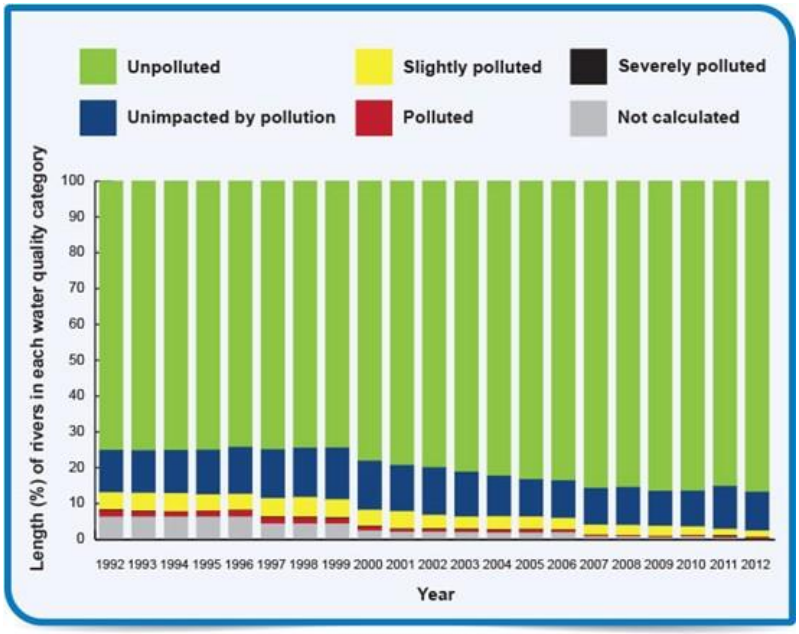

Figure 5: Improvements in water quality

Water flows

River ecosystems respond to changes in water flow. Rivers must contain enough water, throughout the year, to maintain the habitats of animals and plants, and to reduce vulnerability to pollution and high summer temperatures. Variations in flow are also needed to maintain a diverse habitat for different species, and trigger the migration of fish like salmon.

Around 80% of assessed rivers and canals were at good or high status for water flows in 2012 (Figure 6). Those at less than good status are concentrated in the Central Belt, in areas of intensive agricultural irrigation and in areas of the Highlands where water flows have been altered for the generation of electricity.

Although data on flows in rivers have been collected across Scotland for decades, the first full assessment of the state of river flows was only carried out in 2007.

The intensification of agriculture and increasing urbanisation (with the associated run-off, flood defences and increased demand for water) during the 20th century have resulted in changes to the flows of our rivers.

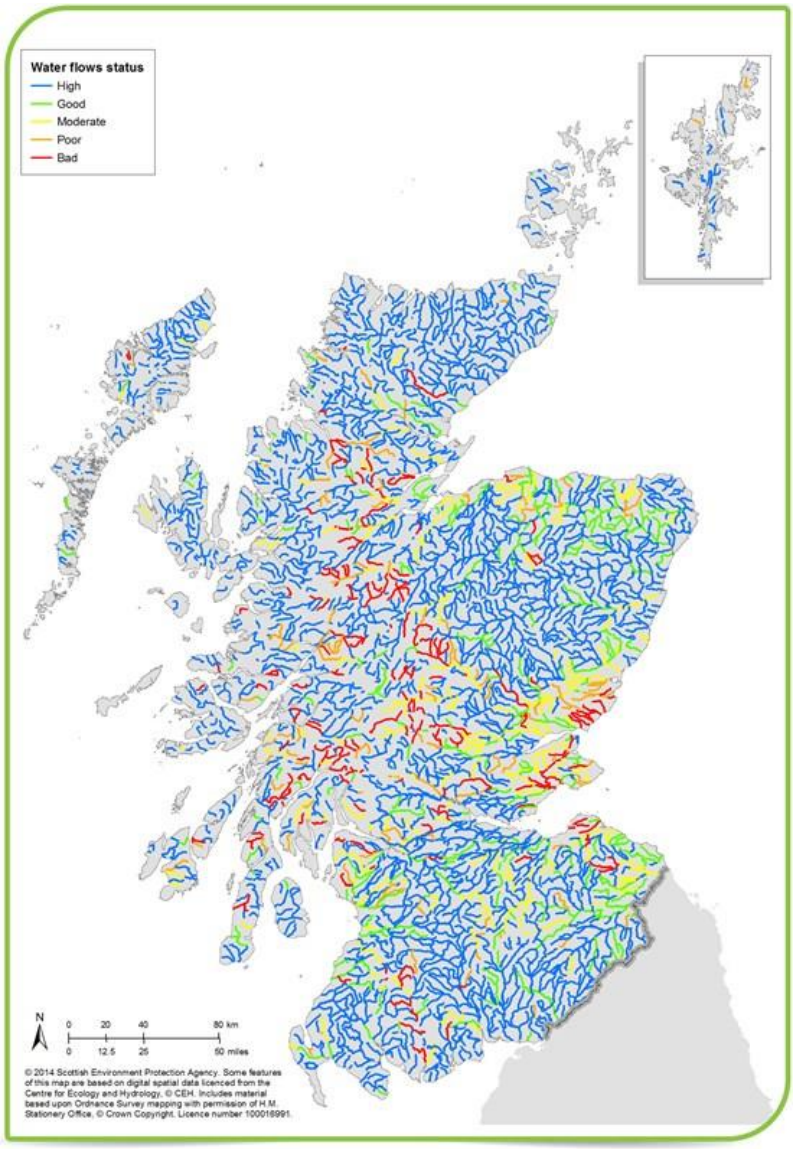

Figure 6: Condition of water flows in rivers and canals in 2012

Note: The condition of water flows in artificial water bodies, such as canals, is shown as good for those water bodies that achieve good ecological potential.

Invasive non-native species and wildlife

The wildlife of Scotland's rivers is generally in good condition. However, the ecological quality of some rivers can be affected by invasive non-native water plants or animals. Once established, they tend to thrive at the expense of our native water plants and animals.

Currently information is limited on where invasive NNS are causing problems, but in 2012, 345 km of rivers and canals were at moderate status for invasive NNS, while 570 km were at good status. The "Current condition and challenges for the future" report estimated that 7% of river water bodies are at risk of failing to meeting environmental objectives because of them.

Pressures affecting rivers and canals

Scotland's rivers are affected by pressures linked to activities within Scotland and outside our borders. Diffuse pollution and habitat damage are two of the main problems we face.

The 2009 river-basin management plan summarises the main pressures currently affecting Scotland's aquatic environment. Although rivers and canals are not considered separately, it was reported that overall, the main pressures on the environment are from:

- agriculture;
- sewage disposal;
- hydropower.

Agriculture

Well-managed farms present minimal risk to rivers and canals, but poor management can lead to serious problems from diffuse pollution. Diffuse pollution arises from land-use activities across a river catchment, rather than entering the water from a pipe or discharge. The problems it causes include excessive inputs of nutrients, run-off of harmful chemicals, such as pesticides, and too much sediment. Excessive inputs of nutrients and organic matter can reduce oxygen levels in the water, which harms aquatic animals.

In the past, rivers were dredged, straightened and widened to improve the drainage of surrounding agricultural land. These activities all affect river and bankside habitats and alter the ecosystem. Habitats can be damaged by alterations to field drainage, which increases the speed at which water runs off fields into rivers. This can lead to more frequent and severe downstream flooding and water-quality problems from the accumulated pollutants. For more details about the interactions between land use and rivers, read the soils topic.

Sewage disposal

In the past, sewage disposal was one of the major problems facing rivers. The situation has dramatically improved, with most sewage discharges now controlled and regulated. Despite these improvements, around 9% of rivers are still affected by sewage discharges.

This is due to a combination of poorly managed sewage works, inputs from individual septic tanks and discharges from overflowing sewage works and combined sewage outflows (CSOs) during storms. CSOs are often located in urban areas, and the combination of overflowing CSOs and run-off from roads and car parks, which often contains hydrocarbons, litter and road salt, can be very harmful to the wildlife of urban rivers.

Hydropower and water supply

Reservoirs built for water supply are often close to larger towns and cities in the south of Scotland, although there are notable exceptions such as Loch Katrine and Meggat Water. Hydropower facilities are mainly found in the uplands of Argyll, Perthshire and the Highlands. Water flows are altered by obstacles, such as weirs and dams, in rivers downstream from reservoirs and abstraction (water removal) points. These structures can affect ecosystems and species; for example, freshwater pearl mussels and migratory fish like salmon, which are prevented from spawning.

Urban development

In addition to the activities described above, increasing urban development puts significant pressures on rivers and canals in Scotland.

Urban development has involved dredging and straightening rivers, as well as reinforcing their banks to create flood defences. Building has taken place right on the edge of rivers. These activities reflect the increasing demands on land and water resources and have serious impacts on river ecology, leading to some rivers having their status downgraded. Loss of vegetation on riverbanks can also make rivers more vulnerable to pollution and erosion.

Changes to river flows have been recorded during the 20th century as a result of increasing urban development in which surfaces are 'sealed' beneath tarmac and buildings. Run-off from these surfaces can carry pollutants into rivers. It also increases the risk of flooding, because rain runs quickly from roofs and other hard surfaces into drainage systems, which lead to local rivers.

Alongside these challenges, increasing urban development also encourages the spread of invasive NNS in the form of many common garden plants sold at garden centres. If these plants are allowed to spread to wild habitats, they often thrive at the expense of native species.

Climate change

Climate change predictions suggest that we can expect milder, wetter autumns and winters and warmer, drier summers. Extreme weather is likely to become more variable and more frequent, leading to a greater risk of droughts and floods. Table 1 sets out some predicted changes and their likely effect on rivers.

Table 1: Potential impacts of climate change

Predicted change	Possible outcomes
Less overall summer rainfall	Less water in rivers to dilute pollutants. Longer periods in which rivers shrink to occupy a fraction of the width of their beds. This will lead to declines in the abundance of plants and animals.
More rainfall in winter/autumn, leading to higher annual river flows	Increased dilution. Pollutants washed into the sea faster, with less time to be broken down in fresh water.
Higher temperatures in all seasons	Excessive and damaging growth of water plants in rivers with existing nutrient problems. Increased demand for water at just the time when there is less of it that can be taken without reducing the ecological quality of our rivers and lochs. Invasive NNS already pose a significant threat to the ecosystems of our rivers and canals. A changed climate may tip the balance in favour of some of these currently benign species. Rivers not shaded by bankside vegetation may overheat, reducing oxygen levels for wildlife Reduced snow cover will result in changes in flow rates in spring, which will alter the life-cycles of some species of wildlife.
Increased frequency of extreme precipitation events (i.e. periods of more intense rain)	More of the pollutants that collect on roads and urban surfaces will be washed into rivers. Soil, nutrients and other pollutants from land washed into rivers. Increased erosion rate of storm-swollen rivers, leading to habitat changes. More frequent and powerful extreme events will cause sewerage systems to overflow more often and lead to increased flooding of land and property.
Sea-level rise	Direct loss of habitat at the mouth of the river. Changes in base levels of rivers, which affects discharge points and abstractions.

What is being done

Scotland has a long track record of protecting and improving the quality of Scotland's waters through action to prevent and reduce pollution. There are ambitious targets to achieve further improvements over the coming years, and these are set out in Table 2. The ultimate aim is for 96% of our rivers to be at good or high status/potential for habitats, water quality, invasive NNS and flows by 2027.

Table 2: Targets for improvements to the status of rivers to be achieved through the Water Framework Directive (WFD)

Overall status/potential	Target length (km) by year		
	2015	**2021**	**2027**
High	1,556	1,556	1,556
Good	12,963	15,384	22,476
Moderate	6,175	4,878	698
Poor	2,671	1,971	247
Bad	1,733	1,309	121
Total	**25,098**	**25,098**	**25,098**
Proportion of total at good or high status (%)	**58**	**67**	**96**

The scope of WFD improvements are far greater than any previous initiatives, and can be addressed under two broad themes.

Policy and legislation

The European Water Framework Directive provides a framework for protecting and improving the condition of the water environment across Europe, through the development of River Basin Management Plans (RBMPs). In Scotland we are implementing the WFD through the Water Environment and Water Services (Scotland) Act 2003, which makes SEPA responsible for coordinating the development of the RBMPs, working in partnership with many sectors, public bodies and non-governmental organisations, These same sectors and organisations are responsible for the successful implementation of the plans, by developing partnership initiatives, and delivering public investment programmes and responsibilities.

Any new activities likely to have an adverse impact on the water environment are controlled under the Water Environment (Controlled Activities) (Scotland) Regulations 2011, known as 'CAR'.

These include discharges of wastewater or industrial effluent, and abstractions for irrigation, hydropower or drinking water, as well as engineering activities in or near rivers. Scottish Water is building on the already considerable reductions in pollution from sewage discharges through the ongoing investment-planning process, which will also reduce the pressures from water abstractions for drinking water supply.

Flooding is predominantly a natural event, which can seriously affect people's quality of life and livelihood. The 2009 Flood Risk Management Act encourages a more sustainable approach to flood management, and will also provide opportunities to restore and enhance river habitats. Details of Scotland's approach to managing flood risk are available on SEPA's website.

Scotland's Land Use Strategy sets out the key principles for using Scottish land. These principles are embedded in River Basin Management Plan practice and will be given increased prominence in future RBMP delivery programmes.

The RBMPs offer opportunities for developing approaches to managing and improving our water environment at a catchment scale through more effective co-ordination between partners.

A catchment-scale approach is being used to tackle diffuse pollution to benefit the rural economy as well as improving the health of rivers. SEPA has created a Diffuse Pollution Management Advisory Group to ensure that actions to reduce diffuse pollution are managed effectively and that there is input from rural, environmental and biodiversity groups.

Part of the work of the group has been to set up a project based on partnerships between SEPA and farmers to work towards reducing diffuse pollution in 12 river catchment areas where it was a particular problem. The project uses a combination of approaches, including monitoring the water quality of 5,600 km of rivers to date and carrying out 1,270 farm visits, with a further 2,500 planned before the end of 2015.

SEPA estimates that around 75% of the farms visited have taken steps to reduce diffuse pollution. We believe that working with land managers and other stakeholders to identify pollution risks and agree on the best way to reduce them is the best way to ensure that effective action is taken.