

Rivers and canals

Half our rivers are high or good quality but there are still problems to tackle. This requires collaboration between all water users.



Summary

Scotland's rivers are an iconic part of the landscape, and an important contributor to industry, agriculture, tourism and people's quality of life. The health of our rivers has improved significantly in the last 25 years and half are now good or high quality, although there are still significant problems. These must be tackled by integrated catchment management and a more collaborative approach between water users and land managers.

A better appreciation is needed of the benefits provided by a healthy river ecosystem, and a better understanding of the link between healthy rivers and a successful economy.

Introduction

Rivers make a substantial contribution to our quality of life. They are widely valued for providing drinking water and because of their importance as a habitat for wildlife. Our rivers are some of our most important recreational resources; places to fish, swim, canoe, watch nature or simply relax.

Scotland is renowned worldwide for the quality of its rivers. Many of our industries benefit from this reputation. Good quality rivers are of obvious importance for the success of:

- whisky producers;
- the tourism industry;
- recreational fishing;
- wildlife.

Many more businesses depend on rivers, for producing electricity, irrigating crops and washing raw materials, and also to absorb and process waste water. Our waters have the capacity to provide these important services without detriment to their ecological quality.

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

The 220 km [canal network](#) in Scotland was built between 1768 and 1822, ranging from the highland Caledonian Canal to the Forth and Clyde Canals in the industrial Central Belt.

The proximity of rivers to mountainous land creates dramatic and world-famous landscapes that are important in economic as well as cultural and recreational terms. According to a [visitor survey](#) for VisitScotland, scenery and the opportunity for outdoor activities are the main reasons UK and international visitors choose Scotland as a holiday destination.

The quality of our fishing is recognised the world over. 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 to Scottish households.

Electricity, gas and water supply account for over [2.7%](#) of Scottish gross value added. 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 ecological quality waters, and are often visibly unpleasant giving an impression of neglect; in some cases they even pose a risk to human health.

For more information on the benefits of a clean and well-functioning environment, see the topic [benefits from nature](#).

[Listen to our rivers and canals podcast](#) by Nathan Critchlow-Watton



Description of rivers and canals



Rivers with a catchment of greater than 10 km², and all canals, are classified under the Water Framework Directive (WFD). There are ~25,000 km of classified rivers; these are divided into ~2,400 separate water bodies, which represent both the main water body and the smaller tributaries in the catchment.

The classification assesses the health of the ecosystem, as indicated by the species composition and abundance of a range of water plants and animals. These indicators (such as the health of the plant population) can be used to show the condition of different aspects of the health of the environment.

The WFD classification system assesses the condition of our rivers; high status water bodies show very little human alteration from undisturbed conditions, with good status water bodies having only low levels of human alteration. Moderate, poor and bad status water bodies show progressively greater impact from human activities.

To be in a good condition, our waters need to be free of pollutants at concentrations that would harm the water plants and animals they support, have minimal changes to their habitats and water flows, and not be adversely affected by invasive non-native species (INNS).

More details on the classification scheme can be found in the 2008 [state of the water environment report](#) and the classification scheme is explained further in the [policy statement](#) on the [Water Environment and Water Services \(Scotland\) Act 2003](#).

The full classification results for each individual water body can be found by following the links at the [river basin planning](#) webpage.

Overall status

Just under 50% of our rivers are at good or high status (Figure 1 and 2). Many are relatively undisturbed by human activity, compared with the majority of rivers elsewhere in the UK and Europe.

Figure 1: Classification of Scotland's rivers, 2011 data

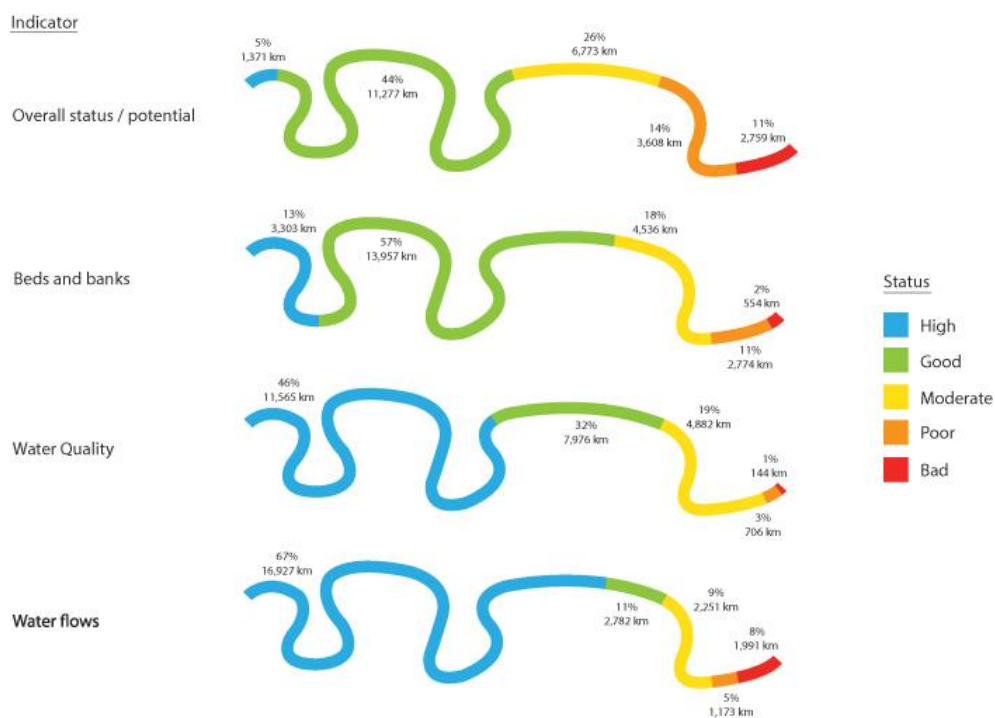
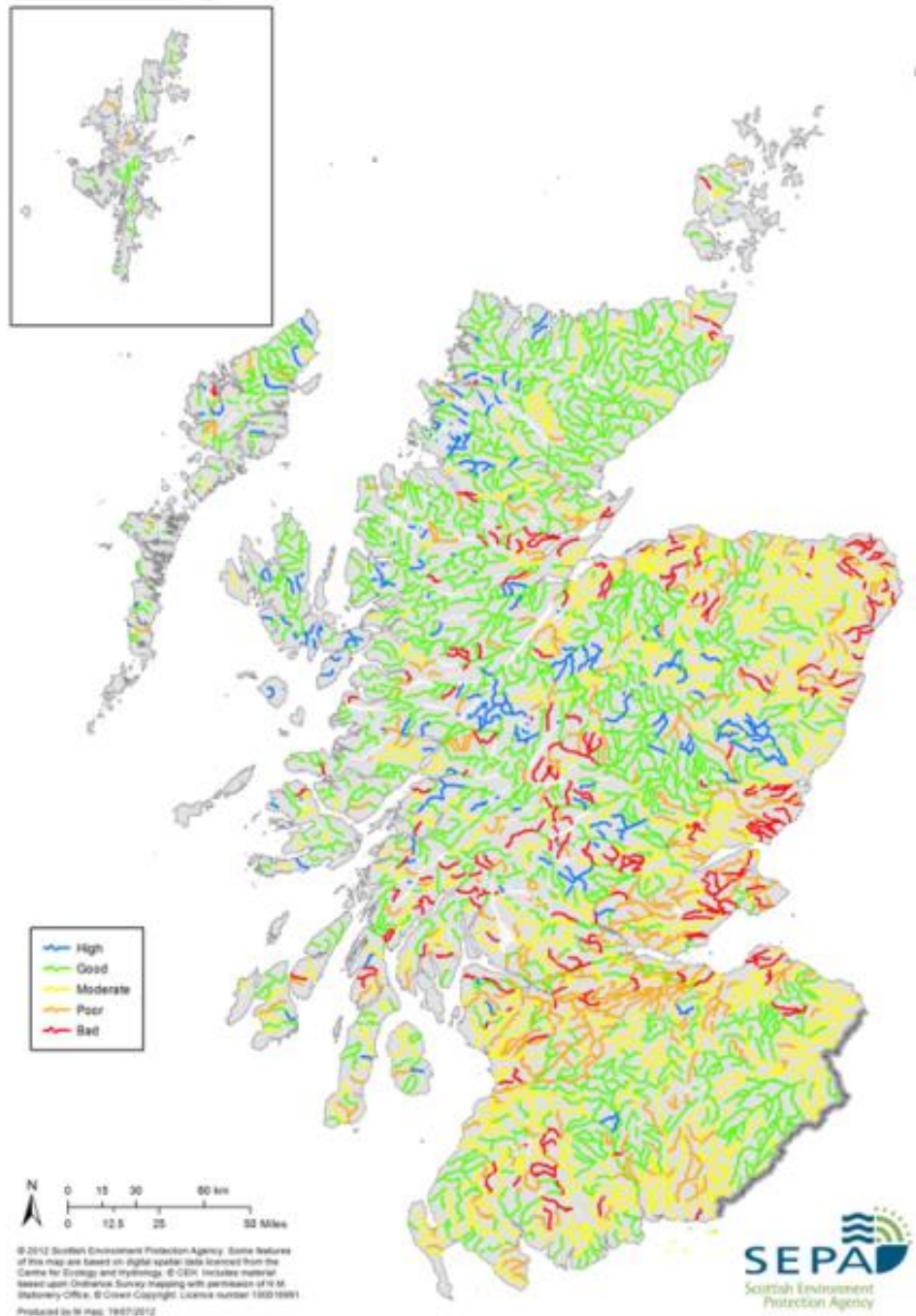


Figure 2: Overall status, 2011 data



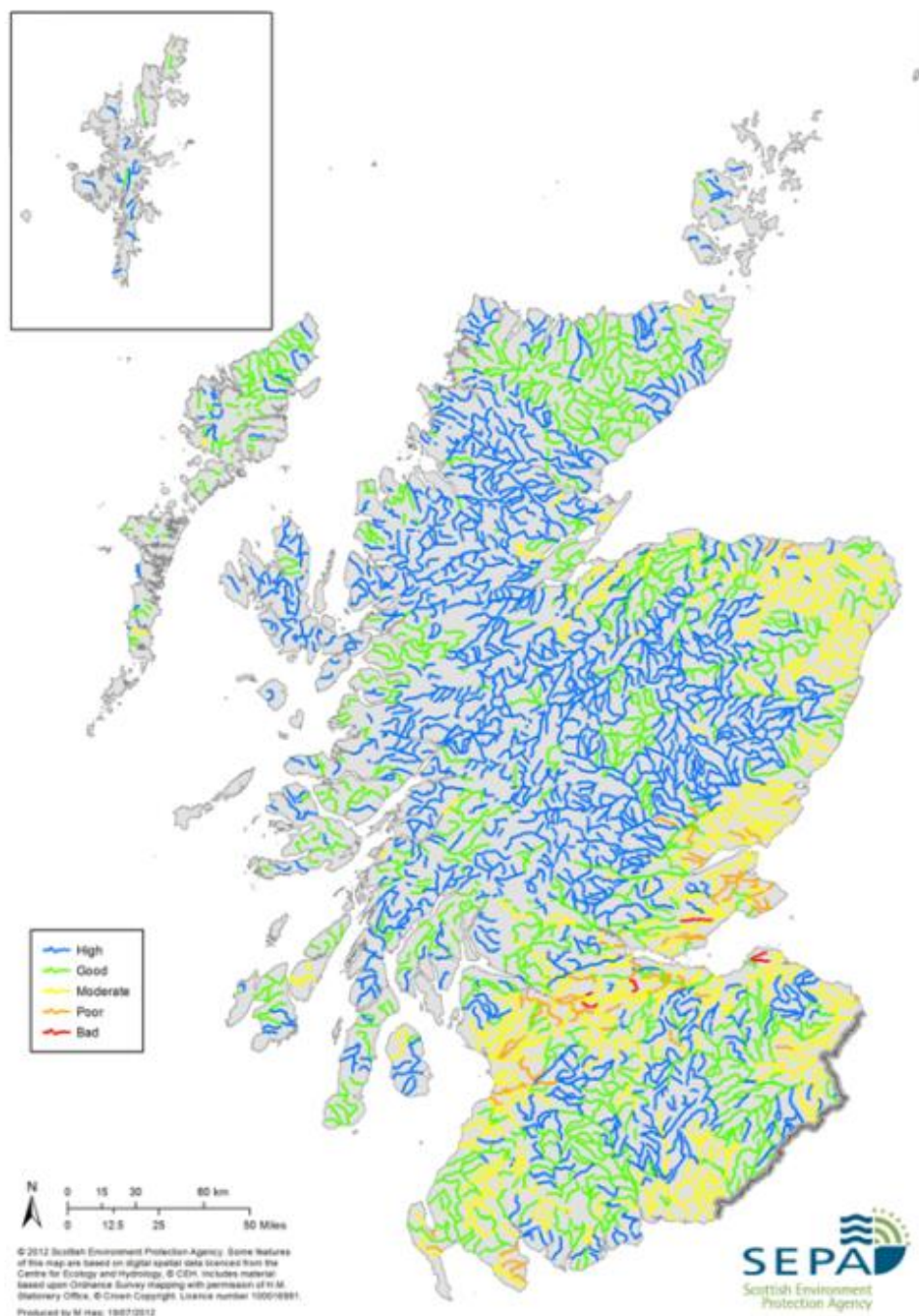
The majority of the rivers in the Highlands and Islands are at high or good status, as there are fewer pressures on the environment in those areas. There is a reduction in status in the Central Belt, and in the more intensively farmed areas.

Water quality

Different pollutants cause different impacts on water plants and animals. Excessive inputs of nutrients accelerate the growth of some algae and other water plants, causing oxygen depletion and major changes in the balance of different plants and animals. Aquatic animals can also be starved of oxygen as a result of inputs of organic matter (e.g. in sewage) using up oxygen as it decays. Other pollutants can be directly toxic, causing death of organisms, reducing their growth or interfering with reproduction. Some of these pollutants break down very slowly in the water environment and can accumulate over time, sometimes within the bodies of animals.

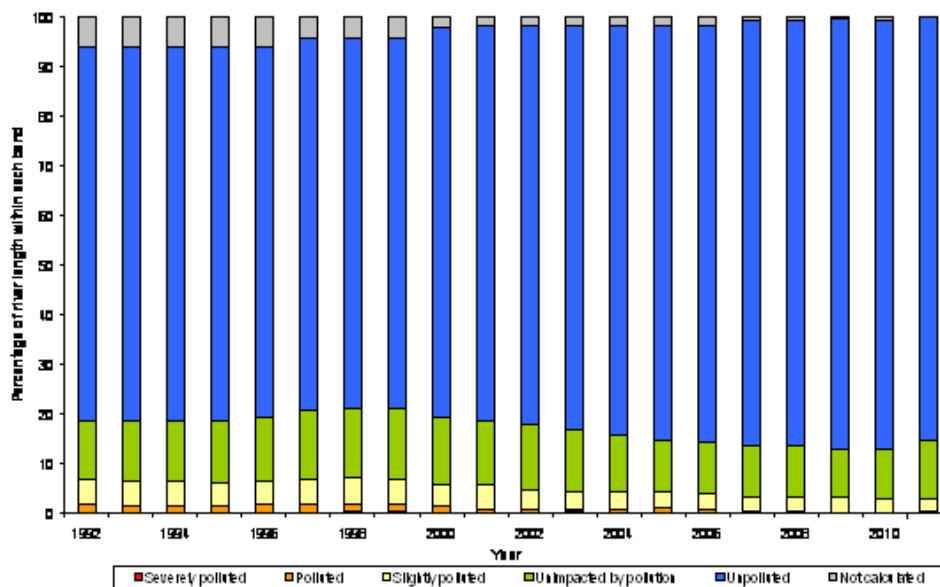
There has been significant progress in preventing and reducing pollution over the last few decades, and the water quality of 78% of rivers and canals is at good or high status (Figure 3).

Figure 3: Water quality of rivers and canals in 2011



Long-term [data](#) on water quality (using an indicator comparable to WDF indicator) show a steady improvement since the 1990s (the beginning of comparable, national monitoring of water quality) (Figure 4). The main improvement has been driven by increasing standards for disposal of waste to rivers from sources such as sewage works and industrial discharges.

Figure 4: Improvements in water quality



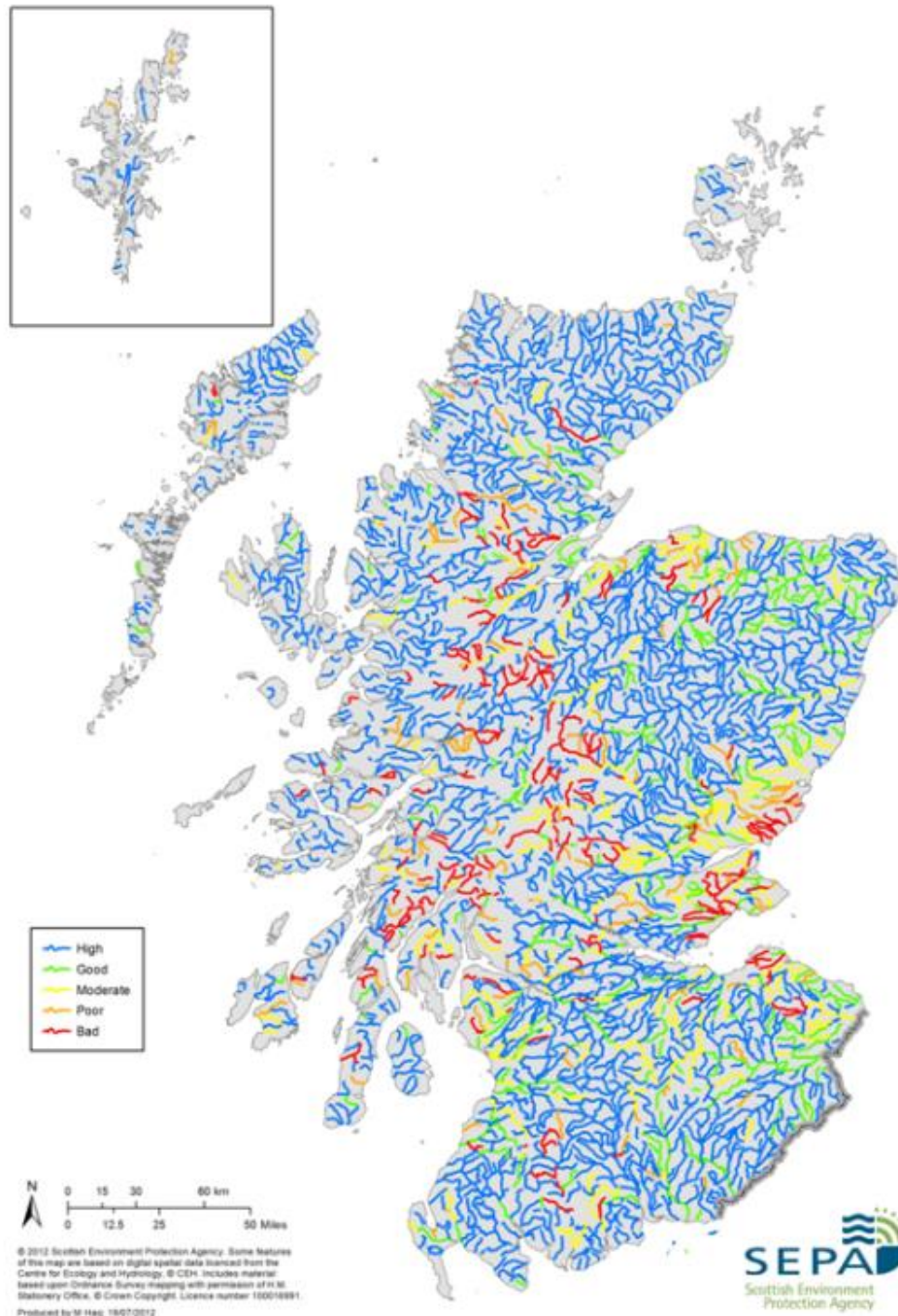
Water flows

The ecosystems of rivers are affected by changes in the pattern of water flow. Rivers must contain enough water to maintain the habitats of animals and plants, and to reduce vulnerability to pollution and high summer temperatures. However, variations in flow are also needed to maintain habitat diversity and trigger migratory fish (such as salmon) to migrate.

Seventy-eight per cent of rivers and canals are at good or better status for flows. Water bodies at less than good status are concentrated in the Central Belt, areas of intensive agricultural irrigation and areas in the Highlands where water flows are altered for the generation of hydropower (Figure 5).

Although data on flows in rivers have been collected across Scotland [for decades](#), the first classification of status was carried out in 2007. It is difficult to summarise the overall trend in flows, as there is a lot of variability between different rivers. When more years of classification data are available, it will be possible to summarise changes in flows across time. The intensification of agriculture and increasing urbanisation (with associated altered run-off, flood defence works and increased demand for water) during the 20th century have resulted in changes to the flows of our rivers.

Figure 5: Condition of water flows in rivers and canals in 2011



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

Beds and banks

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

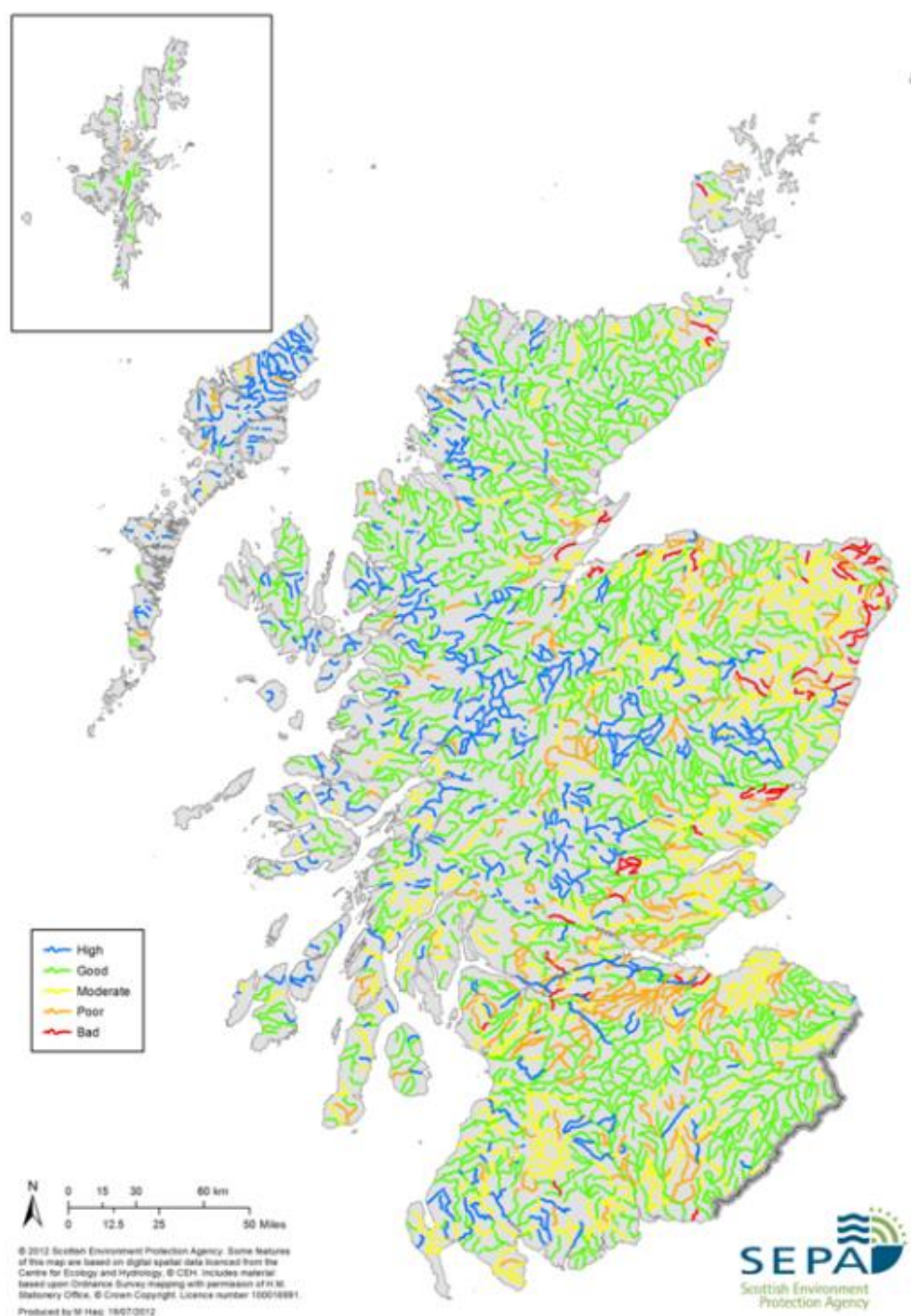
Alterations to beds and banks caused by activities such as dredging, river straightening and bank reinforcement can reduce the area, diversity and quality of habitats. Loss of vegetation on banks can also lead to increased vulnerability to pollution and erosion, and to reduced inputs of food sources.

An assessment has also been made of how man-made obstacles (such as weirs and dams) affect migratory fish such as salmon.

Changes in beds and banks and building of obstacles to migratory fish have caused downgrades in status across Scotland, mainly concentrated in areas of urban development (such as the Central Belt) and in areas where intensive agriculture has led to the straightening and dredging of rivers, as well as the loss of bankside vegetation (Figure 6).

The intensification of agriculture and increasing urbanisation have both resulted in significant changes to the landscape and to the beds and banks of rivers.

Figure 6: Condition of the beds and banks and impact of fish barriers in rivers and canals in 2011



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

Invasive NNS and wildlife

The wildlife of Scotland's rivers is generally in good condition; see the wildlife topic [rivers and lochs](#) for more details.

The ecological quality of surface waters can be affected by invasive non-native water plants or animals. Once they get a foothold, they tend to thrive at the expense of our native water plants and animals. The WFD classification includes an assessment of the impact of the species that pose the greatest risk to our rivers; currently information on where invasive NNS are causing problems is limited, but in 2011, 340 km of rivers and canals were at moderate status because of invasive NNS and 570 km were downgraded to good status. Although the data on invasive NNS are currently limited, they are recognised as a significant risk to Scotland's rivers.

Pressures affecting rivers and canals



A pressure is any activity that affects the environment; Scotland's rivers are affected by a number of different pressures, derived from activities both within Scotland and outside our boundaries.

The [2008 river basin management plan](#) (RBMP, a 6-yearly report), summarising the main pressures currently affecting Scotland's aquatic environment was published in 2009. Although rivers and canals are not separated out, it was reported that the main pressures on the aquatic environment are from:

- agriculture;
- sewage disposal;
- hydropower.

Climate change

Climate projections show that we can expect milder, wetter winters and hotter, drier summers. Extreme weather is likely to become more variable and more frequent, leading to a greater risk of both droughts and floods.

Table 2 sets out some projected scenarios, and the likely impacts of these changes on rivers.

Table 2: Potential impacts of climate change

Predicted change	Possible outcomes
Reduction in overall summer rainfall	<p>Less water in rivers to dilute pollutants</p> <p>Extended 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</p>
Increased average rainfall levels in winter/autumn, leading to higher annual river flows	<p>Increased dilution</p> <p>Pollutants washed into the sea faster, with less time to be broken down in the river</p>
Higher temperatures in all seasons	<p>Excessive and damaging growth of water plants stimulated in rivers with existing nutrient problems</p> <p>Increased demand for water at just the time when there is less of it that can be taken without impacting the ecological quality of our rivers and lochs</p> <p>Invasive NNS already pose a significant threat to the ecosystems of our rivers and canals. Our current relatively cool climate prevents many species from other parts of the world from establishing and posing a risk to native plants and animals. However, a warming climate may tip the balance in favour of some of these currently benign species, with a resulting threat to the ecological quality of our rivers and canals</p> <p>Rivers not shaded by bankside vegetation may overheat, reducing oxygen levels for wildlife</p> <p>Reduced snow cover, consequently change in flow rates in spring, with alterations to flow regimes and the life-cycles of some species of wildlife</p>

<p>Increased frequency of extreme precipitation events (i.e. periods of more intense rain)</p>	<p>More of the pollutants which collect on roads and urban surfaces washed into rivers</p> <p>Soil, nutrients and other pollutants from land washed into rivers</p> <p>Increased erosion rate of storm-swollen rivers, leading to habitat changes</p> <p>More frequent and powerful extreme events will cause both sewerage systems to overflow more often and lead to increased flooding of land and property</p>
<p>Sea-level rise</p>	<p>Direct loss of habitat at mouth of river</p> <p>Change in base level of river, implications for discharge points and abstractions</p>

Agriculture

Well-managed farms present a minimal risk to rivers, but poor management can lead to serious problems from diffuse pollution. (Diffuse pollution arises from land use activities across a catchment, rather than from a pipe or discrete discharge, for more details on the interactions between land use and rivers, see the [soils topic](#).) These problems include excessive inputs of nutrients, run-off of harmful chemicals such as pesticides and excessive inputs of sediment.

Historically, rivers have been dredged, straightened and widened as part of their agricultural management. These activities all impact on river and bankside habitats and alter the ecosystem, as well as potentially increasing the risk of flooding for downstream properties. Habitats can be degraded by alterations to field drainage, which increases the speed at which water runs off fields into rivers. This can also lead to increased flooding issues, and water quality problems from the accumulated pollutants.

Sewage disposal

Historically, sewage was one of the major issues facing rivers. The situation has dramatically improved, with most sewage discharges now suitably controlled and regulated. However, a large number of river water bodies (~9%, according to the [2008 RBMP report](#)) are impacted by sewage discharges. This is from 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 sited 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.

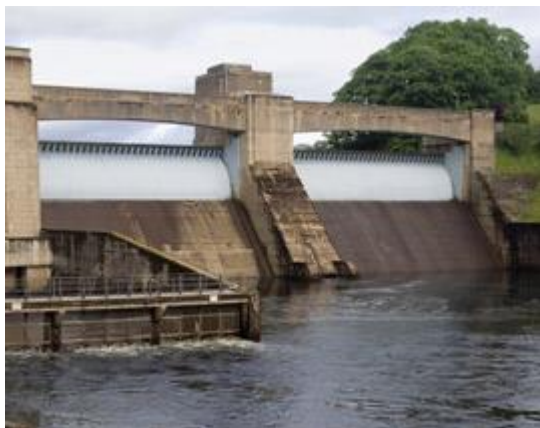
Hydropower and water supply

Reservoirs have been built for hydropower generation and water supply; water supply reservoirs are mainly found near to larger towns and cities in the south of Scotland. Hydropower schemes are predominantly in the uplands of central and northern areas of Scotland. Water flows are altered in rivers below the reservoirs and abstractions; this can have serious impacts on their ecosystems, and on iconic species such as salmon and freshwater pearl mussel. Targets for increasing renewable energy production are likely to lead to more hydropower schemes, and the impacts on rivers need to be carefully considered.

Urbanisation

Urban development, and the 'sealing' of surfaces beneath tarmac and buildings can have significant impacts on rivers. As discussed, run-off from these surfaces can carry pollutants into rivers, as well as increasing the risk of flooding (as rain rapidly runs off the roofs and hard surfaces into local rivers). Urban development often results in alterations to the banks and beds of rivers, with flood defence works (such as straightening, dredging and bank reinforcement) and building right up to the edge of rivers all having serious impacts on their ecology. Current policy approaches to development are starting to reverse these impacts, with initiatives like [Sustainable Urban Drainage Systems](#) helping to improve the quality of rivers.

Consequences of a change in rivers and canals



Rivers provide a variety of benefits; these benefits can be categorised into the ecosystem services provided (for a description of ecosystem services, read the [benefits from nature](#) topic). Damage to rivers can result in loss of the obvious benefits (e.g. drinking water and water for producing and processing food and drink), as well as less directly linked benefits such as the health benefits and tourism income resulting from the opportunities presented by a diverse and beautiful environment

Response by society



Scotland has a long track record of protecting and improving the quality of Scotland's waters through action to prevent and reduce pollution. Between 2000 and 2006 the length of rivers in Scotland that were affected by pollution was reduced by [37%](#).

The [RBMP](#) sets out Scotland's objectives for further improving the health of Scotland's rivers.

Table 3 shows the plan for achieving this; the target is for 96% of our rivers to be at good or high status/potential for habitats, water quality, invasive NNS and flows by 2027. This is discussed further in the [RBMP](#). River basin planning is a collaborative approach to managing and improving the environment, and offers opportunities for more effective co-ordination between partners

Table 3: Targets for improvements to the status of rivers to be achieved through the Water Framework Directive([WFD](#))

Overall status/potential	Length (km)		
	2015	2021	2027
High	1556	1556	1556
Good	12,963	15,384	22,476
Moderate	6175	4878	698
Poor	2671	1971	247
Bad	1733	1309	121
Total	25,098	25,098	25,098
Proportion of total at good or better status (%)	58	67	96

The scope of WFD improvements are far greater than any previous initiatives, and include:

- Ongoing work with farmers to reduce diffuse pollution from a range of land management activities
- Ongoing investment planning process to enable Scottish Water to reduce pollution from sewage disposal and to reduce pressures resulting from drinking water supply
- Measures to manage over-abstraction of water
- Remediating the effects of engineering activities that have caused damage to the beds and banks of rivers

Flooding is predominantly a natural event, which can seriously impact on people's quality of life and livelihood. The 2009 [Flood Risk Management Act](#) encourages a more sustainable approach to flood management, and will provide opportunities to restore and enhance river habitat. 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 taking a strategic approach to the use of Scotland's land. These principles are embedded in River Basin Management Plan practice and will be given increased emphasis in future RBMP delivery programmes.

Biodiversity will be enhanced through a range of initiatives and legislation, more detail is provided in the wildlife topic on [rivers and lochs](#).