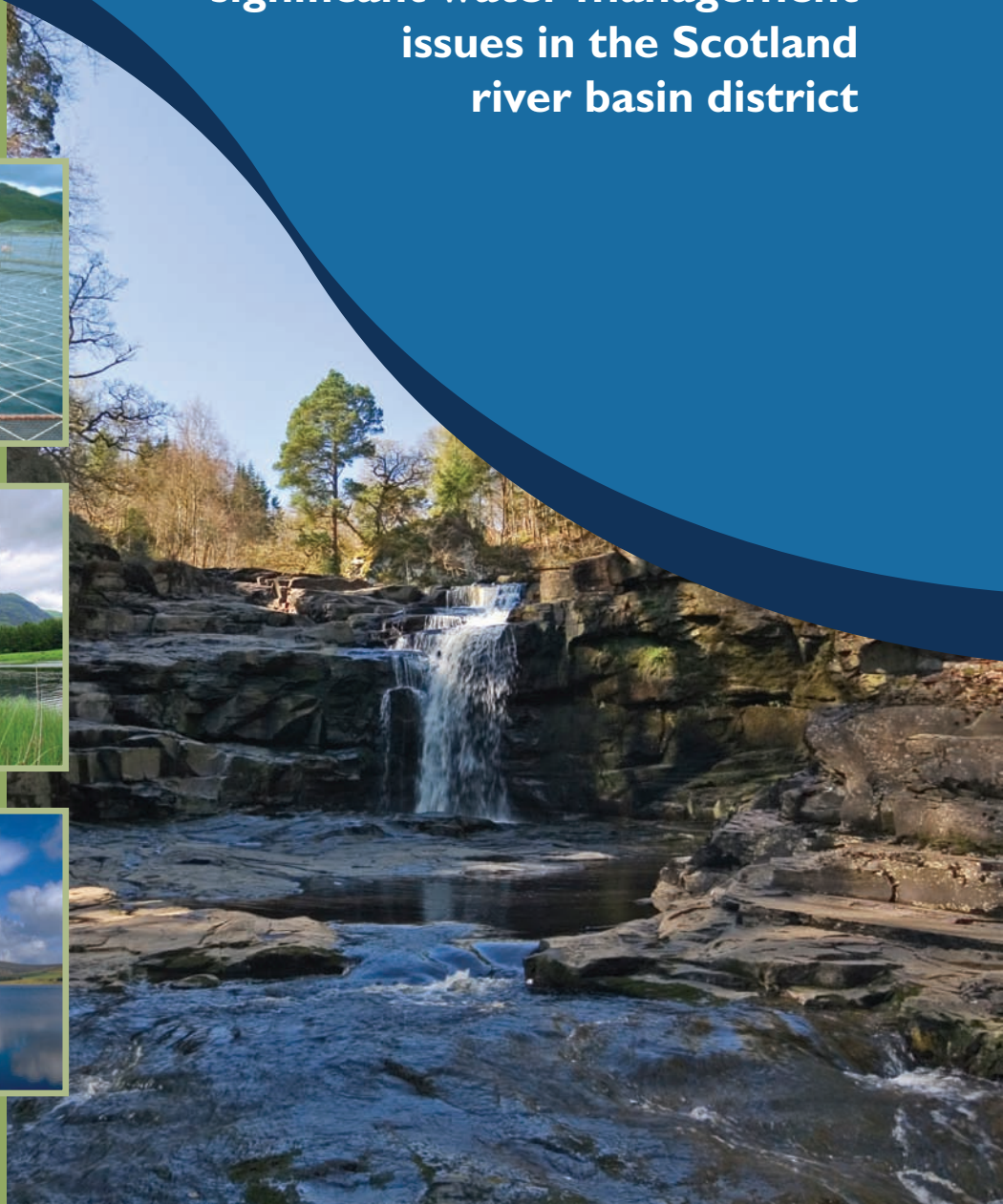
SEPA
Scottish Environment Protection Agency

An introduction to the significant water management issues in the Scotland river basin district



Foreword

We are introducing a new way of managing the water environment in Scotland called river basin planning. This involves setting objectives to protect and improve the water environment while promoting its sustainable use.

Overall, Scotland's water environment is in good condition but a wide range of problems exist at a local level. Assessments indicate that about 40% of Scotland's waters fail the environmental standards required to support good ecology.

This consultation document is intended to identify the issues which we have to address to deliver environmental improvements. SEPA has developed this consultation with the Area and National Advisory Groups set up early in the river basin planning process. These advisory groups include representatives of the key organisations with an interest in the water environment. Together we have identified the environmental problems we need to address and have considered what actions are required.

Next year SEPA and the advisory groups will produce a draft river basin management plan based on this report and the feedback we receive from you.

We believe river basin planning provides a real opportunity to co-ordinate our work across Scotland to deliver agreed environmental objectives. It is an innovative approach which will deliver two important benefits.

- It will improve the quality of our environment.
- It will facilitate the sustainable use of the water environment by business and for recreation, which will have major social and economic benefits.

Please read those sections of this report applicable to you and consider how we can all contribute to the development of a better, greener Scotland.

Contents

1 Introduction

This consultation report is an introduction to the most significant issues currently affecting Scotland's water environment. It is a summary of a more detailed significant water management issues report which is available on at SEPA's website[1]. The purpose of these reports is to provide the first step in the production of a river basin management plan for the Scotland river basin district.

SEPA has also produced a consultation report for the Solway Tweed river basin district which is based upon input from both Scotland and England.

The Scotland river basin district has been divided into eight sub basins. To encourage stakeholder participation, an Area Advisory Group has been set up for each sub basin. We have also created a National Advisory Group. Both the area and national advisory groups have been involved in the development of this report.

Together with the advisory groups we have identified the main water environment issues using the following three principles:

- To what extent does the issue impact adversely on the achievement of the Water Framework Directive's (WFD) objectives for each category of water body in the river basin district?
- To what extent is the evidence that the issue is likely to impact on Water Framework Directive objectives based on sound and substantiated science?
- To what extent will measures already being implemented in the river basin district fail to address current issues by 2015?

We need to focus action on addressing those issues that cause most environmental harm and those which have the greatest impact upon other users of the water environment. These issues are referred to as significant water management issues.

The significant water management issues are the pressures acting on the water environment that we think put our ability to achieve the environmental objectives of the Water Framework Directive most at risk.

All water bodies must meet the Water Framework Directive's environmental objectives. Identification of a problem as a 'significant issue' does not mean it is more important than any other issue. The draft and the first river basin management plans will address all the issues in the Scotland river basin district and not just those included here as significant. We hope that by looking first at those issues that cover the most area or length of water we can achieve the most gain.

[1] *Significant water management issues in the Scotland river basin district* - available at www.sepa.org.uk

2 The Scotland river basin district

The Scotland river basin district covers around 113,920 km^2 of land and water from Shetland in the north to Glasgow, Ayr and Edinburgh in the south. Around 4.8 million people live in the district, most in the central belt between Glasgow and Edinburgh. The landscape is varied – from the mountainous Highlands and the extensive coastline to the urban and industrial areas around Glasgow and Edinburgh.

Overall, Scotland's water environment is in good condition but a wide range of problems exist at a local level. Assessments indicate that about 40% of Scotland's waters fail the environmental standards required to support good ecology (Table 1).

These impacts include:

- Rivers, lochs, estuaries and groundwater along the east coast, central belt and south west which are polluted by diffuse agricultural pollution;
- Urban rivers polluted by sewer overflows and contaminated run-off from roads;
- Rivers and lochs in the highlands affected by abstractions and the construction of dams for hydropower and drinking water supply;
- Rivers and estuaries where damage to the physical condition (morphology) has been caused by urban development and agricultural intensification across lowland Scotland;
- Estuaries, rivers and lochs where invasive alien species have replaced native species.

This means that the central belt, the east coast and the south west have the poorest environmental quality. Addressing these problems delivers local amenity and recreational benefits to communities, which is particularly important for the regeneration of some of our more deprived urban areas.

Table 1: Summary of the length/area and number of water bodies at risk of failing good status in 2007 in the Scotland river basin district

Water category	Length/area at risk of failing good status in 2007(% of total)	Total length/area of all water bodies	Number of water bodies at risk of failing good status in 2007 (% of total)	Total number of water bodies
River	9,083 km (44%)	20,819 km	828 (41%)	2,008
Loch	633 km^2 (66%)	961 km^2	162 (52%)	309
Transitional	425km^2 (70%)	605 km^2	21 (53%)	40
Coastal	3,025 km^2 (6.6%)	45,796 km^2	53 (12%)	449
Groundwater	20,805 km^2 (31%)	66,567 km^2	142 (52%)	275
Total	**-**	**-**	**1,206 (39%)**	**3,081**

More information about the Scotland river basin district is available on the SEPA website (www.sepa.org.uk/wfd/rbmp).

3 Water environment issues

Perhaps the most well-known problem affecting the water environment is **pollution**. Pollution can threaten the quality of all categories of water (rivers, lochs, transitional, coastal and groundwater). Pollution is harmful to aquatic plants and animals, and may threaten drinking water and industrial water supplies. Pollution can be anything from a poisonous metal or pesticide to a nutrient which can choke waters with excessive weed growth, or even silt that can smother fish spawning beds.

Pollution comes from one of two types of source:

- point sources, e.g. pipes discharging effluents from industrial sites, wastewater treatment plants or mines;
- widespread sources (diffuse pollution), e.g. land use activities such as farming, forestry and urban areas.

The **abstraction** of too much water from rivers, lochs or groundwater is harmful to the environment and can compromise the water resources needed by other water users. If we abstract water from rivers, it reduces the amount of water available to dilute discharges and therefore makes pollution worse. In extreme cases, rivers can dry up or salt water can be drawn into groundwater. Dams are often constructed to allow the abstraction of water. These structures modify river flows and they can cause environmental problems downstream.

Morphology is the physical structure of a river, loch, estuary or coast including, for example, the banks and bed of a river and the shore of lochs or coastal waters. Engineering or the way the land is managed can change the morphology of these waters. This has a direct impact on animals and plants and can lead to increased flooding or erosion.

Invasive alien species is an increasingly recognised issue. These are non-native plants or animals which compete with, and may even over-run, our natural aquatic plants and animals.

When planning to improve the water environment, it is important to protect and improve all aspects of the water environment. There is little benefit in preventing pollution if most of the water in a river is removed by abstractions. Similarly, there is little benefit in controlling pollution and abstraction if the river morphology is reduced to a concrete channel. If we want to see environmental, social and economic benefits from our work we must think of the water environment as a whole.

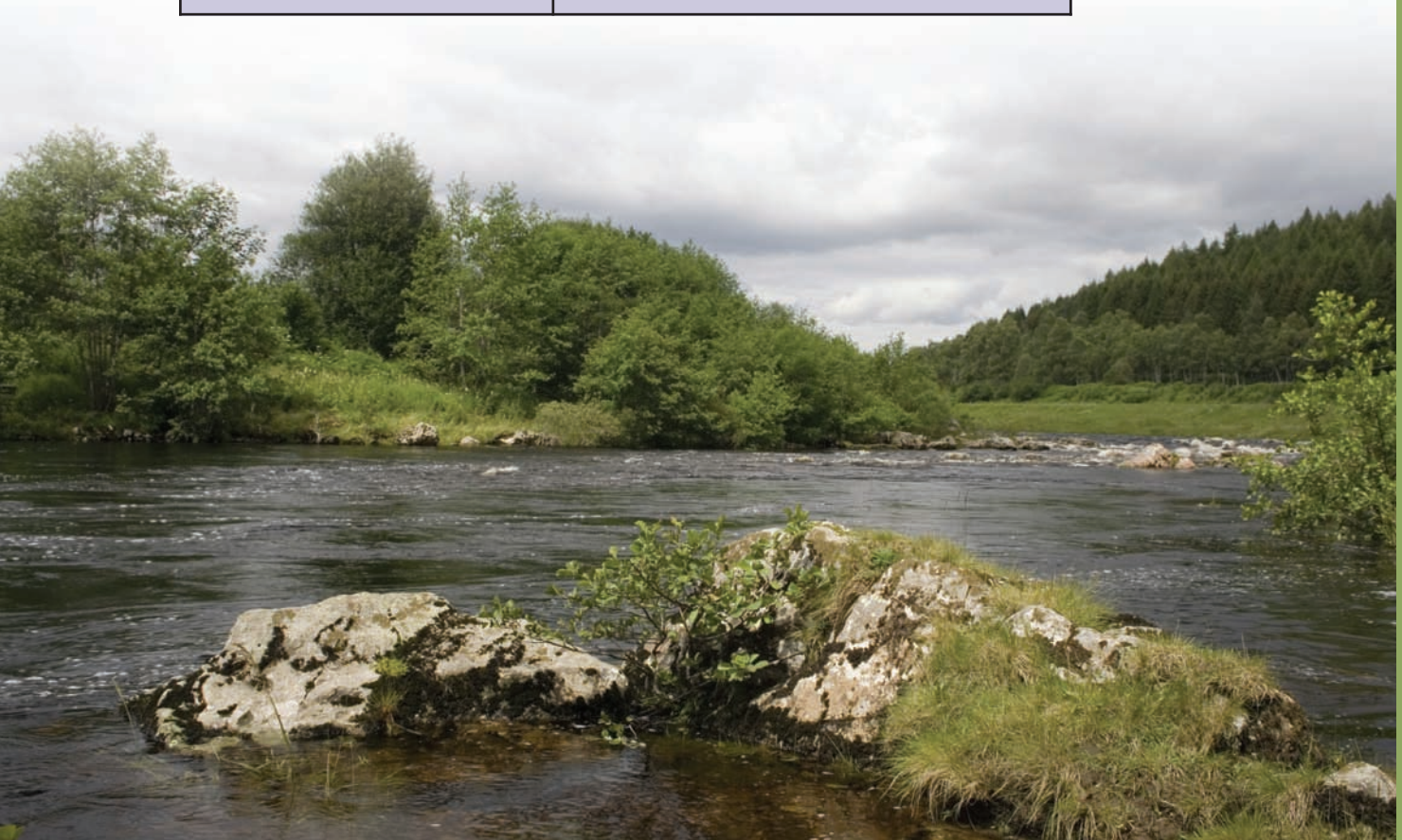
Information from our pressures and impacts analysis in 2005 and discussions with the Area Advisory Groups has helped us identify the main issues affecting the water environment in the Scotland river basin district. Table 2 lists the significant water management issues.

The following sections provide more detail on:

- the significant issues themselves;
- the measures currently available to address them;
- possible measures that could be put in place in the future.

Table 2: Summary of significant water management issues in the Scotland river basin district

Pressure type	Key sectors
Diffuse source pollution	Agriculture Forestry Urban development Sea and coastal water transport
Point source pollution	Collection and treatment of sewage Aquaculture Manufacturing Refuse disposal Mining and quarrying
Abstraction and flow regulation	Electricity generation Public water supplies Agriculture
Changes to morphology	Historical engineering Agriculture Electricity generation Urban development Land claim
Invasive alien species	All sectors



4 Diffuse pollution

This section describes four types of diffuse pollution identified as significant water management issues. Table 3 lists the lengths or areas of water bodies affected by these issues. The number of water bodies is given in brackets.

Table 3: Significant diffuse source pollution issues in the Scotland river basin district

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Diffuse source pollution	Agriculture	4,025 km (313)	143 km^2 (27)	177 km^2 (10)	973 km^2 (16)	16,946 km^2 (129)
	Forestry	652 km (53)	170 km^2 (21)	–	10 km^2 (1)	–
	Urban development	1,044km (88)	1 km^2 (2)	77 km^2 (4)	98 km^2 (2)	–
	Sea and coastal water transport	–	–	129 km^2 (7)	1,031 km^2 (17)	–
	Total	**5,339 km (446)**	**286 km^2 (48)**	**299 km^2 (16)**	**2,052 km^2 (34)**	**16,946 km^2 (129)**

4.1 Diffuse pollution: agriculture

Scottish agriculture has a major role in the protection and improvement of the environment with 75% of Scotland's land area, over 5.5 million hectares, used for agricultural production. Approximately 80% of this area is grassland and is used for livestock farming, particularly the rearing of beef and sheep. Arable farming is also a significant land use, particularly in the east of Scotland. Agriculture depends on the good quality of Scotland's water, air and soil.

Diffuse agricultural pollution arises from land use activities such as livestock grazing and cultivation of land to grow crops and from farm steading run-off. Such activities can give rise to a release of potential pollutants which individually may not have an impact but together, at the scale of a river catchment, can impact on water quality. Much of this pollution is unintentional and good agricultural practice can help address the problem.

The pollutants are transported to waters by a number of recognised routes. As a result, both land use and run-off management are important in the control of diffuse agricultural pollution.

Key message

Diffuse agricultural pollution is the most important cause of pollution in rivers, lochs and groundwater. We now understand how diffuse pollution works and the measures needed to address it. Educational, economic and regulatory tools which can help the agricultural sector reduce its impact on the environment and other people who use the water environment are urgently required.

What is the extent of the issue?

Diffuse pollution from agriculture is a significant issue for groundwater, rivers, lochs, transitional and coastal waters. It is estimated that nearly half those water bodies at risk of failing to meet the environmental objectives of the Water Framework Directive are affected by diffuse pollution from agriculture.

Main impacts

- Losses of nutrients from fertilisers, animal manures and slurries applied to land can result in excessive plant growth. This in turn smothers rivers and estuaries, reduces light penetration and affects oxygen levels in lochs and coastal waters.
- Organic matter from animal waste and products (e.g. silage) removes oxygen from rivers, damaging plant and animal life.
- Soil erosion can smother gravels in rivers and lochs, and reduce light penetration in estuaries and coastal waters.
- Diffuse pollution from agriculture upstream of abstraction points results in deterioration in water quality, leading to the need for more sophisticated and expensive water treatment for public water supply.
- Of the 61 designated bathing waters in Scotland, 45% are subject to microbiological contamination caused by agriculture. In addition, 60% of the 109 designated shellfish waters are affected by diffuse agricultural pollution.
- Scottish Water spends hundreds of millions of pounds to protect consumers from the impacts of diffuse pollution on drinking water. Private drinking water supplies in rural areas are also affected. The water is often drawn from shallow wells and springs, which have a greater susceptibility to pollution. Key contaminants include nitrates, *Escherichia coli* and pesticides.

What are we already doing about this?	
Regulation	• Nitrate Vulnerable Zone action programmes
Economics	• Farm Assurance schemes • Cross-compliance measures • Rural stewardship schemes
Advice	• Codes of practice and other guidance, e.g. Prevention of Environmental Pollution from Agricultural Activity (PEPFAA) Code, Four-Point Plan, Farm Soils Plan • The Voluntary Initiative • Catchment management plans • Farm advice from non-governmental organisations (NGOs)
What additional measures could we put in place?	
Regulation	• National General Binding Rules • Targeted rules
Economics	• Targeted support via Rural Development Contracts
Advice	• Revised guidance • Catchment officers to deliver one-to-one advice in priority catchments. • Further development of Good Environmental and Agricultural Condition (GAEC) • Pro-active 'on the ground' farm visits to promote compliance and good practice through the provision of advice
What additional measures do you think should be developed? What can you do to help?	

4.2 Diffuse pollution: forestry

By the start of the 20th century forestry cover in Scotland had fallen to below 5%, only half of which was native woodland. In common with the UK, this was the lowest figure in Europe. From the 1930s onwards government policy led to rapid reafforestation, mainly with non-native species, and Scottish forest cover is now 17% of the land area (compared with a European average of 33%). The Scottish Forestry Strategy includes a vision to expand woodland cover to around 25% of Scotland's land area.

Concerns over the environmental impact of what was termed 'blanket' afforestation led to a major change in the industry, with financial incentives for planting linked to a requirement to follow codes of good practice.

Key message

The forestry sector demonstrates that economic incentives and regulatory controls can dramatically reduce the adverse environmental impact associated with land management. The forestry sector has been very successful in reducing its impacts on the water environment.

What is the extent of the issue?

Diffuse pollution from forestry affects Scotland's surface water bodies, especially our lochs. The remaining significant problem is associated with some of the most sensitive water ecosystems in Scotland, where small increases in nutrients can have an undesirable impact.

Main impacts

- Phosphate input to highly sensitive upland lochs.
- Sediment delivery due to soil disturbance associated with roading, planting and clear felling.
- Increased nutrient input may result in higher levels of algal growth and algal blooms, which could impede recreational use.
- Forests planned prior to the 1990s did not allow space for rivers. Planting up to the river edge has led to the loss of bankside vegetation and the erosion of banks.

What are we already doing about this?	
Regulation	• Effective controls over felling through felling licensing or forest plans • Where appropriate, consideration through the Environmental Impact Assessment (Forestry) (Scotland) Regulations 1999
Economics	• Compliance with the UK Forestry Standard and its associated suite of forestry guidelines as a mandatory requirement of forestry incentives and felling controls
Advice	• Forests and Water Guidelines

What additional measures could we put in place?	
Regulation	• National General Binding Rules • Targeted rules
Economics	• Ensuring that compliance with the UK Forestry Standard (and hence the Forests and Water Guidelines) becomes a cross-compliance requirement within Rural Development Contracts • Use of Rural Development Contracts to support forest planting to protect water quality e.g. riparian woodland and shelter belts
Advice	• Phasing of land use change in the catchment of sensitive lochs
What additional measures do you think should be developed? **What can you do to help?**	

4.3 Diffuse pollution: urban development

The rain falling upon urban areas (roads, pavements, yards and roofs) creates polluted run-off. Frequently, this run-off drains to surface water drains which pass directly to the water environment. This type of pollution is toxic, creating an oily film on the bed of rivers killing fish and the insects that live in rivers.

Many people are unaware of the type of drainage system serving their homes or work places. Pollution can occur when chemicals, waste oil or other polluting materials are illegally disposed of 'down the drain' directly into watercourses (albeit often without an intent to cause pollution).

Key message

Despite substantial progress in recent years, this type of pollution is increasing as urban areas expand and traffic increases. Sustainable urban drainage systems (SUDS) are now required for new developments that drain directly to the water environment. However, significant challenges remain to provide treatment for existing discharges of urban drainage.

What is the extent of the issue?

At least 10% of rivers that are at risk of not meeting the Water Framework Directive's environmental objectives are thought to be affected by diffuse pollution from urban development.

Main impacts

- Oil from leaks and spillages, together with particulates from exhaust fumes, coat river beds with a toxic film which kills invertebrate and fish.
- Herbicides used to control weeds along roadsides and pavements, as well as spillages of domestic pesticides, kill plants in rivers.
- Misconnection of drains from properties and waste left on the street (including dog faeces) result in bacterial contamination and low oxygen levels (the result of breakdown of organic matter).
- In low lying urban areas where water cannot infiltrate due to the extent of impermeable surfaces such as roads and paved areas, rapid run-off increases flood risk.
- In areas of social deprivation, river pollution contributes to an impression of decay and neglect.

What are we already doing about this?	
Regulation	• Local authority development plans require SUDS • Local authority development control enforces the requirements for SUDS • General Binding Rule under Controlled Activities Regulations (CAR) requires all new surface water discharges to be treated by SUDS
Economics	• Scottish Executive is to develop a scheme of drainage charges based on the amount of impermeable area draining to sewer • Scottish Water is provided with funds under Quality and Standards to retrofit SUDS to surface water systems in industrial estates
Advice	• Scottish Water's technical manual specifies design requirements for SUDS
What additional measures could we put in place?	
Regulation	• Promote source control of polluted road drainage before its discharge into the public drainage system
Advice	• Promote the development of integrated surface water management planning in major urban areas • Pollution-reducing campaigns involving the National Advisory Groups and Area Advisory groups
What additional measures do you think should be developed? What can you do to help?	

4.4 Diffuse pollution: sea and coastal water transport

Operations and traffic in Scottish ports are diverse and associated with:

- ferries;
- container, bulk goods and general cargo transport;
- oil and coal;
- leisure and fishing.

Much of the cargo entering and leaving Scotland is in the form of raw materials such as oil, chemicals, petroleum, ores, grains and feedstuffs. Finished goods include vehicles, fresh foods, steel, timber, building materials, machinery and manufactured goods.

Ports are major providers of employment in Scotland. In addition, many contribute to local economies, through leisure activities such as yachting, sightseeing, angling and diving.

Ships and boats can cause diffuse pollution of our waters either from anti-foulants used to prevent fouling of hulls by marine organisms or ballast water discharges accidentally releasing oil. Tributyl tin (TBT) is the main anti-foulant which causes concern. The ban on TBT use by the International Maritime Organisation (IMO) means that all vessels entering Scottish ports must be TBT-free by 1 January 2008.

Key message

Although the IMO ban on the use of TBT on vessels less than 25 m has led to considerable environmental improvements along parts of the Scottish coastline as measured by imposex (change of sex) levels in dog whelks, there are still some downgraded areas. However, these tend to be near major ports where larger ships operate and should improve with time as a result of the later ban on ships greater than 25 m.

What is the extent of the issue?

Characterisation data indicate that approximately a third of transitional and coastal water bodies at risk of failing to meet the environmental objectives of the Water Framework Directive are affected by diffuse pollution from sea and coastal water transport.

Main impacts

- Chemical contamination resulting from the release of antifouling compounds can be toxic or have sub-lethal effects on marine invertebrates. Tributyl tin (TBT) is the main anti-foulant of concern.
- Oil released from ships can have a toxic or smothering effect on marine invertebrates and plants. Oil releases can arise during loading, when larger vessels discharge sea water from their compartments, or from accidents such as the grounding of vessels.

What are we already doing about this?	
Regulation	• EC Regulation ban on TBT treated vessels in European ports from 1 January 2008.IMO ban on use of TBT on vessels > 25m (2003) • The Merchant Shipping and Fishing Vessels (Port Waste Reception Facilities) Regulations 2003 • MARPOL Regulations for the prevention of pollution by oil 2007 • MARPOL's controls of sewage and litter are being brought into force by Merchant Shipping (Prevention of Pollution by Sewage and Garbage) from Ships 2007.
Advice	• IMO Convention on oil preparedness response and coordination 1990 measure for dealing with pollution incidents. • Ballast Water Management Plan for NW Europe: guidelines for vessels entering the OSPAR region (2007)
What additional measures could we put in place?	
Regulation	• Ratify IMO's 'International Convention for the Control and Management of Ships' Ballast Water and Sediments'
Advice	• Promote better use of port waste reception facilities through greater understanding among mariners of effects of discharging oily wastes and litter at sea
What additional measures do you think should be developed? What can you do to help?	

5 Point source pollution

This section describes five types of point source pollution identified as significant water management issues. Table 4 lists the lengths or areas of water bodies affected by these issues. The number of water bodies is given in brackets.

Table 4: Significant point source pollution issues in the Scotland river basin district

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Point source pollution	Collection and treatment of sewage	3,015 km (230)	88 km^2 (15)	369 km^2 (14)	2,417 km^2 (34)	-
	Aquaculture	145 km (15)	134 km^2 (23)	-	37 km^2 (3)	-
	Manufacturing	342 km (32)	14 km^2 (1)	190 km^2 (8)	1,279 km^2 (14)	2,460 km^2 (7)
	Refuse disposal	147 km (16)	-	123 km^2 (3)	230 km^2 (2)	4,510km^2 (14)
	Mining and quarrying	363 km (36)	-	-	-	6,428km^2 (14)
	Total	**3,488 km (287)**	**196 km^2 (34)**	**421 km^2 (16)**	**2,250 km^2 (42)**	**9,697 km^2 (29)**

5.1 Point source pollution: collection and treatment of sewage

Sewage is a mixture of water from domestic sources (baths, sinks and washing machines), water and human waste from toilets, industrial effluents and, in many catchments with older infrastructure, rainwater run-off from roofs, roads and other surfaced areas. In most areas, sewers are constructed to collect wastewater and convey it to sewage treatment works.

Key message

Sewage disposal is a long-standing source of pollution which has progressively improved over the past hundred years. The most serious problems are now associated with the sewers, which often date back to Victorian times. During heavy rain these sewers overflow into rivers, causing pollution. During prolonged periods of heavy rain, some sewers back up and contribute to flooding of urban areas. The management of surface water drainage is critical to a successful solution to the problems of both pollution and flooding. We need to develop integrated and sustainable surface water management plans for our urban areas.

What is the extent of the issue?

Pollution caused by inadequately treated sewage is the second most important source of river pollution and the most important for transitional and coastal waters. Of Scotland's river, transitional and coastal water bodies at risk of failing to meet the Water Framework Directive's environmental objectives, over a third are affected by point source pollution from the collection and treatment of sewage activities.

Main impacts

- The organic matter present in untreated sewage removes oxygen from the water, killing fish and other aquatic wildlife. The nutrients present encourage algal growth, smothering fish habitats and requiring expensive treatment of water abstracted for industrial or domestic use.
- Sewage contains toxic substances from industry, household chemicals and run-off from roads. These include hazardous substances that do not degrade and accumulate within fish and marine mammals.
- Sewage litter can affect the amenity value of rivers and beaches.
- Bacteria and viruses in the sewage can cause health problems with water contact sports such as swimming, canoeing or fishing, and can contaminate shellfish used for human consumption.
- Rivers polluted with sewage lose their value as a community asset.

What are we already doing about this?	
Regulation	• SEPA controls on wastewater discharges to rivers, lochs, etc. • Scottish Water controls on trade effluent discharges to sewer • Statutory controls over use of polluting substances in products
Economics	• Scottish Water charging scheme provides incentives for industry to reduce the amount of trade effluent they discharge to sewer
Advice	• Pollution reduction campaigns (Scottish Water) • Environmental best practice campaigns for industry
What additional measures could we put in place?	
Regulation	• Control of domestic products with regard to their impact on the environment (e.g. low phosphorus detergents)
Economics	• Scottish Executive to review scheme of charges to provide incentives to reduce the amount of rainfall run-off passing to sewer
Advice	• Develop integrated surface water management plans for all urban areas • Pollution-reducing campaigns involving the National Advisory Group and Area Advisory Groups
What additional measures do you think should be developed? What can you do to help?	

5.2 Point source pollution: aquaculture

Over the past 20 years commercial aquaculture in Scotland has become a successful economic sector and is now estimated to contribute over half the value of food exports from Scotland. The industry is dominated by salmon and sea trout farming in marine cages where production increased from about 5,000 tonnes/year in the 1980s to about 150,000 tonnes/year in 2006.

Key message

The aquaculture industry is highly regulated and consequently its environmental impacts are relatively small considering its extent. However, the input of nutrients into lochs leads to increased algal production; as a result, lochs turn green and face greater risk of algal blooms. For marine fish farms, the most important issues relate to the deposition of organic matter on seabeds and the impact of disease, parasites and escapes on native fish populations.

What is the extent of the issue?

Point source pollution from fish farms and fish hatcheries affects a fifth of the area of freshwater lochs in the Scotland river basin district at risk of failing to meet the environmental objectives of the Water Framework Directive.

Main impacts

- Nutrient discharges into freshwater lochs increase the probability of algal blooms, which may impact on tourism and other uses of the water environment.
- Natural processes break down organic material released by the industry (waste food and faeces), reducing oxygen concentrations in the water.
- The organic matter deposited on the seabed leads to significant changes in the animal and plant populations in the vicinity of the fish farm.
- Chemicals used to treat disease and parasites may have a toxic impact on wildlife in the vicinity of fish farms. If the parasites are not controlled effectively they may affect native migratory salmon and trout.
- Litter from fish farms can affect the amenity value of beaches and impact the wider ecology of our ecosystems.

What are we already doing about this?	
Regulation	• To protect the local environment, a SEPA licensing regime places limits on the rate or scale of discharges from fish farms • To protect the wider water body, SEPA applies an assimilative capacity approach under Scottish Executive Locational Guidelines following advice from Fisheries Research Services (FRS)
Economics	• Quality assurance schemes run by the industry
Advice	• Area management agreements have been developed leading to loch-wide treatment plans for sea lice • Code of Good Practice for Scottish Finfish Aquaculture

What additional measures could we put in place?	
Regulation	• Local authorities can use new planning controls over the location of new farms to minimise conflicts with other users and deal with landscape issues, etc. • The Aquaculture and Fisheries Act 2007 gives the Fish Health Inspectorate powers to monitor fish farms for adequate sea lice control and prevention of escapes
Economics/ regulatory	• The Tripartite Working Group is to develop environmental risk assessment of sites so that economic support and regulatory action can be directed at relocating a prioritised list of sites • Initiative to conduct strategic development planning for freshwater along similar lines to the marine sector location/relocation programme
What additional measures do you think should be developed? **What can you do to help?**	

5.3 Point source pollution: manufacturing

The level of water pollution from manufacturing has decreased dramatically over the past 40 years primarily due to the decline of heavy industry in Scotland and powerful regulatory controls. In addition, industry has taken a proactive approach by developing environmental management systems which deliver improved environmental performance and often cost benefits.

Key message

Key impacts caused by direct discharges from manufacturing are associated with the chemicals and food and drink sectors. Environmental impacts are partly a consequence of current operations and partly the result of historical operations which have contaminated sediments. The focus now is to control the use and production of potentially hazardous chemicals that can harm the environment via domestic and industrial discharges to sewer and through diffuse pollution.

What is the extent of the issue?

Data indicate that approximately 40% of Scotland's transitional and coastal water bodies at risk of failing to meet the environmental objectives of the Water Framework Directive are affected by point source pollution from industry.

Main impacts

- Degradation of the high levels of organic matter in the discharges reduces the oxygen concentration of the receiving water.
- Dissolved metals and hazardous organic chemicals can have a direct toxic effect on animals and plants, or can accumulate within the food chain.
- Metals and hazardous/persistent organic chemicals contaminate the sediment within estuaries.

What are we already doing about this?	
Regulation	• Pollution Prevention and Control (PPC) regime regulates industrial processes to minimise pollution • Controlled Activities Regulations (CAR) controls regulate discharges to the water environment • SEPA controls the use of certain dangerous substances through marketing and use regulations • Local authority development control ensures industrial developments are sited in appropriate locations • Local authority contaminated land regime
Advice	• Environmental management systems promoted as means to improve environmental performance • NetRegs (www.netregs.gov.uk) offers advice on best practice • SEPA offers advice on minimising water pollution through www.sepa.org.uk/wastemin • SEPA is a partner in HAZRED which provides guidance to businesses on reducing the use of hazardous raw materials along with case studies (www.hazred.org.uk) • Envirowise provides guidance on minimising use of hazardous raw materials and reducing water pollution (www.envirowise.gov.uk)
What additional measures could we put in place?	
Regulation	• Controls over Priority Substances as required by the Water Framework Directive daughter directive • New European chemicals regulation (REACH) will provide controls over the use of hazardous substances
Advice	• SEPA can work with the Government's Knowledge Transfer Networks to advise on new technologies to improve environmental performance • SEPA is currently strengthening the advice it gives to industry through its Environmental Protection staff as part of routine visits and will ensure advice on reducing water pollution is fully incorporated
What additional measures do you think should be developed? What can you do to help?	

5.4 Point source pollution: refuse disposal

Historically landfill sites were often inadequately engineered and, in some cases, had no lining. Polluted liquid (leachate) generated from the degrading waste was thus able to percolate through soil and rock, entering groundwater and contaminating surface waters. More modern landfill sites are designed to comply with the Landfill Regulations and are operated under the Pollution Prevention and Control Regulations. Landfills are required to contain and manage leachates by incorporating a base liner and leachate collection systems. Leachate levels must be minimised, and waste compacted and capped to minimise rainwater ingress.

Key message

This is a historic problem associated with old landfill sites that are now closed. Leachates form as water percolates through the waste, dissolving soluble compounds and the degradation products of chemical/biochemical reactions.

What is the extent of the issue?

Almost a third of transitional water bodies and just over a fifth of groundwater bodies in the Scotland river basin district at risk of failing to meet the Water Framework Directive's environmental objectives are affected by point source pollution from refuse disposal activities. Pressures from refuse disposal do not affect the quality of large areas of groundwater but may present long-term local risks.

Main impacts

- Some components of leachates are List I or List II substances under the Groundwater Directive on the basis of their toxicity, bioaccumulation and persistence properties.
- Refuse disposal sites pose a potential risk to private drinking water sources and rivers in close proximity.

What are we already doing about this?	
Regulation	• PPC regulations prevent new landfill sites from polluting groundwater • Measures required to address pollution at sites still operating under a Waste Management Licence • Impacts caused by closed landfill sites no longer subject to licensing can be addressed by the contaminated land regime
What additional measures could we put in place?	
Regulation/ advice	• Actions to implement the National Waste Strategy will progressively reduce the volume of waste going to landfill
What additional measures do you think should be developed? What can you do to help?	

5.5 Point source pollution: mining and quarrying

Discharge of polluting waters from disused mines became an environmental problem with the closure of many coalmines between the 1950s and 1990s. The cessation or reduction of groundwater pumping when deep mines closed resulted in the rebound of groundwater within the abandoned workings. Rising water levels lead eventually to discharges of iron contaminated water from mine entries, outcrop zones and discharge pipes. Once the mine water reaches the surface and comes into contact with air, a chemical reaction causes the formation of an iron pigment known as ochre.

Key message

This type of pollution is often caused by mines closed many years ago and there is no longer anyone directly responsible for controlling its source. One of the functions of the Coal Authority is to deal with contamination issues from historic coal mining sites. SEPA and the Coal Authority have developed a priority list of discharges to rivers from abandoned mines which require treatment. Current limits on funding make additional treatment unlikely in the near future.

What is the extent of the issue?

Approximately 30% of Scotland's groundwater bodies at risk of failing to meet the environmental objectives of the Water Framework Directive are affected by pollution from mining and quarrying.

Main impacts

- Rising iron-rich groundwater can contaminate overlying or adjacent aquifers, preventing their use as a source of drinking water or water for industrial processes.
- Rivers may be polluted by minewater flowing from adits and shafts within abandoned mines and through the migration of iron-containing groundwater.

What are we already doing about this?	
Regulation	• SEPA and the Coal Authority have a Memorandum of Understanding which provides the basis for the Authority's mine water programme • SEPA can impose controls on mine dewatering and its discharge from existing mines and quarries • SEPA can require the treatment of discharges from mines where a responsible person can be identified • Planning conditions imposed by local authorities minimise wider environmental impacts
What additional measures could we put in place?	
Regulation	• The Scottish Executive is considering the introduction of restoration regulations giving SEPA powers to intervene to treat discharges from non-coal mines
Economics	• Additional funding is required to allow the Coal Authority to treat polluting discharges from coal mines • Funding is required to allow SEPA to initiate work to treat pollution from non-coal mines
What additional measures do you think should be developed? What can you do to help?	

6 Abstraction and flow regulation

This section describes three types of water resource pressures identified as significant water management issues. Table 5 lists the lengths or areas of water bodies affected by these issues. The number of water bodies is given in brackets.

Table 5: Significant water resource issues in the Scotland river basin district

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Abstraction and flow regulation	Electricity generation	1,451 km (130)	279 km^2 (45)	48 km^2 (2)**	–	–
	Water supply	1,112 km (89)	192 km^2 (42)		–	–
	Agricultural irrigation	833 km (116)*	2 km^2 (1)*		–	2,068 km^2 (17)
	Total	**3,971 km (359)***	**362 km^2 (85)***	**48 km^2 (2)****	**–**	**2,068 km^2 (17)**

*Data from new licences provide more up-to-date information than Water Framework Directive characterisation data.
**This is cooling water abstraction at coastal power stations which affects transitional waters.

6.1 Abstraction, flow regulation and morphological change: electricity generation

Large-scale hydropower schemes covering hundreds of square kilometres were created in Scotland in the late 19th and early 20th centuries. Many of these schemes divert water across catchments to dams which hold the water until energy generation is required. There are 23 major schemes in Scotland supplied by catchments covering over 8,373 km^2 of mainland Scotland. A further 74 small-scale hydropower plants (installed capacity <2 MW) are owned by private companies and individuals, and there is some potential for further development of such schemes. These small-scale schemes may remove water from a river, pass it through a turbine and return it to the same river.

Key message

Although hydropower is an important source of renewable energy (and important in controlling carbon dioxide emissions), it causes major impacts on rivers in Scotland. Valuable improvements in the water environment could be achieved by moving existing schemes towards modern good practice without significantly affecting the amount of energy generated.

What is the extent of the issue?

More than 15% of river water bodies and 40% of loch water bodies are at risk of failing to meet the environmental objectives of the Water Framework Directive due to abstraction and flow regulation for hydropower.

Main impacts

- Low flows in rivers which may be virtually dry except during periods of heavy rain.
- Highly variable flows below generating stations, resulting in bare banks and potential stranding of fish.
- Highly variable water levels in reservoirs leading to regular drying out of the shoreline, preventing the growth of plants and spawning of fish.
- Barriers to fish migration caused by dams and death of fish entering turbines.
- Interruption of flow of sediment downstream of dams depletes gravels needed by salmon and trout to spawn.
- Impacts upon the morphology of rivers and lochs caused by changes in flow and sediment transport.

What are we already doing about this?	
Regulation	• SEPA imposes controls on licensed hydropower schemes • Fisheries (Electricity) Committee provides advice on measures to protect fisheries imposed via SEPA licences • Local authority development planning and control
Advice	• Voluntary agreements between hydropower companies and interest groups such as anglers
What additional measures could we put in place?	
Economics	• Encourage generation from existing large schemes with the potential to exceed 20 MW* • Make environmental best practice a criterion for eligibility for Renewable Obligation Certificates* (ROCs)
Advice	• Map showing potential constraints on hydropower development to facilitate the targeting of development
What additional measures do you think should be developed? What can you do to help?	

*Responsibility of Department for Business, Enterprise & Regulatory Reform/Ofgem

6.2 Abstraction and flow regulation: public water supplies

Public water supplies are extracted from rivers, lochs, reservoirs and groundwater. Water supplies have developed over a number of years and some have faced a progressive increase in the volume of water used for domestic purposes. In addition, communities have expanded in many areas resulting in increased demand for drinking water. This trend is mitigated to some extent by the reduction in water consumption by industry over the past 50 years particularly in the central belt areas of Scotland where heavy and manufacturing industry has declined.

In many cases reservoirs provide opportunities to develop new and diverse ecosystems which also provide social and recreational benefits.

Key message

The potential for environmental impact from water supply arises from abstraction and the storage of water in reservoirs to support abstractions. Changes in water levels are natural as the amount of water in rivers and lochs varies according to the season and between years. Environmental impacts result when the changes in water levels and flow exceed the levels of change to which ecology can adapt.

What is the extent of the issue?

Approximately 10% of water bodies in Scotland at risk of failing to meet the environmental objectives of the Water Framework Directive are affected by abstraction and flow regulation for public water supplies.

Main impacts

- Direct abstractions exacerbate low levels of water in rivers (particularly during the summer) with the potential to damage the ecology of rivers and their associated wetlands.
- Low groundwater levels caused by abstraction lead to the drying out of small tributaries and wetlands, and reduced river base flows during periods of low rainfall.
- Variation in water levels in lochs and reservoirs lead to regular drying out of the shoreline, preventing the growth of plants and spawning of fish.
- Barriers to fish migration caused by dams.
- Interruption of flow of sediment downstream of dams depletes gravels needed by salmon and trout to spawn. Impacts upon the morphology of rivers and lochs caused by changes in flow and sediment transport.

What are we already doing about this?	
Regulation	• SEPA controls on levels of abstraction, management of dams and efficient use of water
Economics	• Charging incentives encourage efficient use of water by industry
Advice	• Publicity campaigns promoting efficient water use by domestic customers
What additional measures could we put in place?	
Regulation	• Building standards to require rainwater capture and recycling for garden use and toilet flushing • Water efficiency included for eco housing as well as energy efficiency
Advice	• Improve water efficiency standards for domestic appliances and provide water efficiency as well as energy efficiency information for customers
What additional measures do you think should be developed? What can you do to help?	

6.3 Abstraction and flow regulation: agriculture

Abstraction of water for agriculture serves many purposes depending on the type of farming, e.g. water for crop irrigation, drinking water for livestock and washing down for dairy farms. The largest agricultural use of water is for irrigation and occurs primarily along the east coast of Scotland to support the production of fruits, vegetables and root crops such as potatoes.

Key message

Irrigation is typically required during dry weather when rivers are low. Consequently abstraction for irrigation exacerbates naturally occurring low flows. The distribution of crops means that farmers frequently rely on small burns and tributaries which, during periods of low flow, may not have sufficient water to support the abstraction without harming the environment.

What is the extent of the issue?

Approximately 10% of water bodies that are at risk of failing to meet the environmental objectives of the Water Framework Directive are affected by abstraction and flow regulation for agriculture.

Main impacts

- Reduced summer flows occasionally lead to stranding of fish and drying out of wetlands.
- Increases the vulnerability of fish and other freshwater life to high temperatures in pools isolated by low flows.
- Exacerbates the effects of pollution with very limited dilution for discharges, resulting in low oxygen conditions.
- Small dams across rivers are sometimes constructed to assist in the abstraction of water and can, if poorly constructed, impede the migration of fish.
- The effects of agricultural abstraction often combine with those of diffuse pollution to seriously damage the ecology of small burns along the east coast.

What are we already doing about this?	
Regulation	• SEPA imposes controls on volume of water that can be abstracted and the time over which it can be abstracted • Require efficient use of water
Economics	• SEPA's charging scheme provides incentive to abstract water in the winter and provide storage
What additional measures could we put in place?	
Regulation	• Require compliance with management agreements between farmers over timing of irrigation
Economics	• Develop SEPA's charging scheme to provide additional incentives to abstract when flows are high • Part funding for irrigation ponds under Rural Development Contracts Tier 3
Advice	• Publicity campaigns promoting efficient water use by farmers • Organise workshops for farmers on water efficiency • Promote management agreements between farmers
What additional measures do you think should be developed? What can you do to help?	

7 Impacts on morphology

This section describes five types of morphological impacts which have been identified as significant water management issues. Table 6 lists the lengths or areas of water bodies affected by these issues. The number of water bodies is given in brackets.

Table 6: Significant morphology issues in the Scotland river basin district

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Morphology	Historical engineering	2,182 km (185)	49 km^2 (17)	123 km^2 (7)	404 km^2 (5)	–
	Urban development	644 km (60)	–	0.2 km^2 (1)	–	–
	Agriculture	1,851 km (162)	1 km^2 (1)	–	–	–
	Electricity generation*	904 km (86)	298 km^2 (53)	–	–	–
	Land claim	–	–	204 km^2 (12)	229 km^2 (5)	–
	Total	**5,063 km (462)**	**339 km^2 (65)**	**213 km^2 (14)**	**525 km^2 (8)**	**–**

* See section 6.1.

7.1 Impact on morphology: historical engineering and urban development

Many of Scotland's rivers have a history of engineering interventions. These have had an important role in the growth of its economy. Embankments, erosion protection and dredging have allowed development and cultivation of land adjacent to rivers. Impoundments have helped irrigate crops and generate energy. Bridges, culverts and other similar structures underpin Scotland's transport network.

Key message

Engineering and urban development represent relatively permanent changes to the morphology of rivers. Changes in morphology are therefore incremental, with more and more rivers being affected. Despite considerable improvements recently resulting from controls over new engineering activities, there are few mechanisms for mitigating the impact of existing structures that cause environmental harm. However, there are many opportunities to achieve environmental improvements by removing redundant structures in rivers.

What is the extent of the issue?

More than 30% of river water bodies that are at risk of failing to meet the environmental objectives of the Water Framework Directive are impacted by morphological change from urban development or historical engineering.

Main impacts

- Hard engineering structures, particularly those that are mis-aligned, tend to deflect flow, increasing the risk of erosion downstream.
- Construction of embankments leads to loss of floodplain wetlands and associated biodiversity, and increased risk of flooding downstream.
- Hard bank protection and culverting of watercourses leads to loss of bankside vegetation, often with increased risk of bank erosion downstream and resultant loss of in-channel habitat with impacts on fish, invertebrates and aquatic plants.
- Artificial barriers (including culverts, weirs and dams) can prevent access to spawning sites or impede migrations to sea. This reduces fishery income and requires expenditure by fishery managers in trying to overcome the problem.
- Engineering can restrict access to rivers and remove opportunities to develop parkland or urban amenity spaces.

What are we already doing about this?	
Regulation	• Controlled Activities Regulations (CAR) prevent new damage to the water environment from engineering works on rivers (including from maintenance regimes) • Planning and development control used to identify restrictions on urban development and opportunities for restoration
Advice	• Planning Advice Notes warn against development on flood plains • Scottish Executive efforts to promote sustainable flood management
What additional measures could we put in place?	
Regulation	• The Scottish Executive is considering the introduction of river restoration and remediation regulations • Stronger planning constraints to prevent progressive loss of flood plains • Development of flood risk management plans under the new Floods Directive
Economics	• New funding framework to enable much more restoration work
What additional measures do you think should be developed? What can you do to help?	

7.2 Impact on morphology: agriculture

Some of Scotland's most productive agricultural land is alongside rivers. However there are difficulties in farming land in the vicinity of rivers, e.g. rivers move eroding into fields and floods can threaten livestock and damage crops. This has led farmers to straighten and deepen rivers, reinforce banks and construct flood defences. But constraining the space available to a river can harm the environment, create problems for downstream landowners and increase flood risk in urban areas.

Key message

Much of the work undertaken by farmers on rivers requires regular maintenance. If not properly designed, flood defence and erosion control work creates new problems for land managers downstream. Using public funds to provide more space for rivers could benefit farmers (e.g. reduced maintenance work) and the environment, as well as reducing flood risk downstream. It would also help reduce the impact of diffuse pollution.

What is the extent of the issue?

Approximately 20% of river water bodies at risk of failing to meet the environmental objectives of the Water Framework Directive are affected by morphological changes resulting from agricultural activities.

Main impacts

- Loss of natural bankside vegetation due to ploughing up to the edge of rivers or allowing grazing of river banks reduces food and habitat availability for fish.
- Construction of hard bank protection to control erosion deflects erosive flows downstream.
- Straightening and realignment of rivers to make it easier for farm machinery to operate close to river, or to lower water levels to drain land, reduces the diversity of river habitats.
- Loss of natural floodplain through channel deepening and creation of embankments can lead to increased flood risk downstream.

What are we already doing about this?	
Regulation	• Controlled Activities Regulations (CAR) prevent new damage to the water environment from engineering works on rivers
Economics	• Single farm payments promote good agricultural practice • Forestry Committee's woodland grant schemes promote riparian woodland
Advice	• Best practice advice from NGOs/SEPA/SNH/Forestry Commission on river management • Habitat enhancement schemes led by local voluntary initiatives
What additional measures could we put in place?	
Regulation	• General Binding Rules to protect buffer strips alongside rivers • New restoration regulations would allow investment to remove abandoned structures such as old embankments
Economics	• Sustainable and catchment-orientated framework for addressing flood risk
What additional measures do you think should be developed? What can you do to help?	

7.3 Impact on morphology: land claim

Land claim is the enclosure of intertidal or sub-tidal areas within impermeable banks followed by infilling for use by agriculture, housing, ports or industry. Initial phases of land claim in Scotland were undertaken to enclose salt marshes and mudflats with earthen banks for agricultural purposes. More recently, land claim for ports and marina, industry, energy generation and urban development has resulted in additional losses of intertidal areas within Scotland's transitional waters. This has reduced the capacity of some intertidal systems to support benthic, bird and fish populations, and increased vulnerability to rises in sea level.

Intertidal zones are an important buffer between the land and the erosive/flooding power of the sea. In estuaries these areas often have considerable biodiversity value and, along the coast, recreational value.

Key message

It is essential to maintain at least the present extent and regional distribution of mudflats. This will require, where possible, compensating for losses to development as a result of the restoration of mudflats. There will be increasingly strong pressure to restore intertidal areas in order to manage sustainably the flooding risks posed by sea level rises.

What is the extent of the issue?

Just over half of transitional water bodies at risk of not meeting the Water Framework Directive's environmental objectives are affected by land claim.

Main impacts

- Removal of intertidal mudflats reduces the availability of food for commercially important fish species.
- Increases the risks of erosion and flooding due to rise in sea level.
- Reduces the amenity value of some areas of the coastline.

What are we already doing about this?	
Regulation	• Local authority development controls on new areas of land claim • Use of the Environmental Impact Assessment Regulations by local authorities • Fisheries Research Service imposes controls on development below mean low water
Advice	• Coastal planning guidance, e.g. National Planning Policy Guideline 13 and Scottish Planning Policy 7 • UK Biodiversity Action Plans • Restoration demonstration projects by Scottish Natural Heritage and other NGOs
What additional measures could we put in place?	
Economics	• Develop funding mechanisms to promote managed realignment/retreat (as part of flood risk management plans)
Advice	• Develop a strategic approach to managed realignment projects
What additional measures do you think should be developed? What can you do to help?	

8 Invasive alien species

This section describes the effect of invasive alien species which have been identified as significant water management issues. Table 7 lists the lengths or areas of water bodies affected by these issues. The number of water bodies is given in brackets.

Table 7: Significant invasive alien species issues in the Scotland river basin district

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Invasive alien species	All sectors	315 km (7)	21 km^2 (4)	136 km^2 (4)	46 km^2 (1)	–

Numerous invasive alien species have been introduced deliberately into Scotland. Most deliberately introduced species contribute to the economy through, for example, agriculture, forestry, horticulture and fisheries. Many other species have, however, been introduced accidentally, for example through ballast water, angling equipment or other routes. Scottish Natural Heritage has identified almost 1,000 alien species present in the wild in Scotland. Most of these are not strongly invasive or harmful to native biodiversity. But given appropriate conditions, a minority of alien species behave invasively taking over parts of the water environment to the detriment of native species.

Key message

Overcoming problems with invasive alien species in order to achieve the Water Framework Directive's environmental objectives will require action within specific water bodies and consideration of potential sources of re-infestation. Complete eradication of invasive species is costly and difficult, and preventing introduction in the first place is by far the most cost-effective approach.

What is the extent of the issue?

More than 20% of Scotland's transitional water bodies are at risk of failing to meet the environmental objectives as a result of alien species. A number of rivers, lochs and coastal waters are also affected. Further work is required for all water body categories to establish the extent and severity of the problem.

Main impacts

Four key invasive alien species affect the water environment in Scotland:

- The North American signal crayfish, *Pacifastacus leniusculus*, has an impact on salmon and trout as one of its main food sources is fish eggs and larvae. It also burrows into banks, increasing their vulnerability to erosion.
- The Common cord-grass, *Spartina anglica*, grows on mudflats and adjacent salt marshes. It can change these habitats to a monoculture, reducing the area of open mud and potentially altering the pattern of accumulation of silt.
- The Australian swamp stonecrop, *Crassula helmsii*, is a highly invasive water plant which can form dense mats, completely out-competing native water plants and creating a poorer habitat for native invertebrates and fish. It is also extremely difficult to eradicate once established.
- The water fern, *Azolla filiculoides*, is a small floating water plant that can completely cover the surface of freshwater bodies (typically pond and lochs), leading to the shading out of light and loss of submerged water plants. This can lead to an impoverishment in the fauna.

What are we already doing about this?	
Regulation	• Control of Pesticides Regulations (use of herbicides to control invasive plants in or near water) • The Prohibition of Keeping or Release of Live Fish (Specified Species) (Scotland) Order 2003
Advice	• Species Action Framework (Scottish Executive and Scottish Natural Heritage) • NetRegs (www.netregs.gov.uk) advice on best practice for control of certain alien plant species • Local authority and local voluntary projects to address problem species
What additional measures could we put in place?	
Regulation	• Ban on introduction of a wider range of problem species through proposed amendments to Schedule 9 of the Wildlife and Countryside Act 1981 • Ban on sale of problem species through proposed amendments to Schedule 9 of the Wildlife and Countryside Act 1981 and proposed use of Order 14A • Review legislative barriers and link to available legislation
Advice	• Publicity to raise awareness about introduction, spread and need to control/eradicate problem species • Development of a detection/surveillance/control strategy for problem species • Partnerships to support research into control and eradication • Implementation of GB Framework Strategy and Implementation Plan when available
What additional measures do you think should be developed? **What can you do to help?**	

9 Climate change

It is not possible to consider significant water management issues without taking climate change into account. The hydrological cycle, a fundamental component of climate, is likely to be altered in important ways by climate change. Changes in the amount, timing and distribution of precipitation and run-off will lead to changes in water availability. Changes in the timing, intensity and duration of floods and dry spells will have environmental, social and economic consequences. Table 8 summaries the implications of climate change on different aspects crucial to the water environment.

Table 8: Summary of the implications of climate change for the water environment in the Scotland river basin district

Aspect	Implications
Pollution	• Higher river flows in the west and north will reduce the impact of pollution in rivers, but increase loading of pollutants to the sea. This will increase the risk of the failure to achieve microbiological standards at bathing beaches and in shellfish waters. • Higher intensity rainfall will increase sewer overflow rates, leading to an increase in the discharge of sewage. • Lower river flows in summer in the south and east will provide less dilution for discharges, with increased sewage treatment costs. • Enhanced plant/algal growth due to increased temperature will exacerbate the effects of eutrophication.
Abstraction and flow regulation	• Resources for hydropower generation will increase, especially in the west and east. • Increased likelihood of summer droughts will lead to reduced resources but higher abstraction demands (particularly from irrigation).
Changes to morphology	• More frequent and severe river flooding will increase demands for flood defence schemes. • There will be higher rates of river erosion where degradation of the river habitat has reduced bank protection. • Increased erosion from fields will lead to siltation of fish spawning gravels and increased nutrient loading of lochs and the sea.
Biodiversity and invasive alien species	• Higher temperatures may provide more favourable conditions for invasive alien species. • There will be changes in the abundance and distribution of native species, and the length of growing season. • Higher temperatures will be less favourable for some native species.

10 Next steps

Over the next 18 months, SEPA will work with the National Advisory Group and Area Advisory Groups to produce the draft river basin management plan for the Scotland river basin district. The Water Framework Directive requires the draft plan be published in December 2008 to allow for a period of six months public consultation before publication of the final plan in December 2009.

The identification and review of significant water management issues in the Scotland river basin district has enabled us to identify those issues we may be able to address through new or additional measures.

Our current assessment is that 39% of Scotland's waters are at risk of failing to achieve good status in 2007 (Table 1). Based on the potential measures identified, our assessment indicates that by 2015 the number of water bodies failing to achieve good status may have fallen to 27% (Table 9). By working in partnership with stakeholders through the advisory groups, we hope more improvements can be made and that the proportion of water bodies that will not meet good status will be significantly reduced. However despite these measures it is to be anticipated that some water bodies will not be able to meet good status by 2015

Table 9: Number and length/area of water bodies which may not achieve good status by 2015 in the Scotland river basin district

Water body category	Length/area not meeting good status by 2015 (% of total)	Total length/area of all water bodies	Number of water bodies not meeting good status by 2015 (% of total)	Total number of water bodies
River	6,468 km (31%)	20,819 km	592 (29%)	2,008
Loch	313 km^2 (33%)	961 km^2	84 (27%)	309
Transitional	354 km^2 (59%)	605 km^2	17 (43%)	40
Coastal	1,545 km^2 (3%)	45,796 km^2	23 (5%)	449
Groundwater	17,632 km^2 (26%)	66,567 km^2	123 (45%)	275
Total	**–**	**–**	**839 (27%)**	**3,081**

Not every water body can reasonably be expected to meet good status and, for these water bodies, the Water Framework Directive gives us the option of implementing alternative environmental objectives. One of the most important alternative objectives is good ecological potential which is set for artificial and heavily modified water bodies (HMWB). Water bodies can be designated as heavily modified where they have been subject to substantial changes to their physical structure for the purposes of navigation, water storage, flood defence and land drainage. For example, this occurs where a river is dammed to create a hydropower reservoir or a river straightened and the banks raised for flood defence purposes.

In our river basin characterisation report (www.sepa.org.uk/publications/wfd/index.htm) published in March 2005, provisional heavily modified water bodies were identified on the basis of maps and local knowledge. During autumn 2006 we assessed these water bodies again using a screening tool to determine whether they met both the following criteria:

- Would the necessary improvements to achieve good ecological status have a significant adverse effect on the wider environment or on a specified water use?
- Is there a significantly better environmental option?

This assessment confirmed the heavily modified water body identification for 226 out of the original 317 water bodies. A further 64 water bodies require more detailed site-specific assessments to determine whether they are heavily modified. Table 10 lists the area and length of the confirmed HMWB. SEPA now has to assess which HMWB are currently at high or good ecological potential and determine what measures can be put in place by 2012 in order improve the remaining to good.

Table 10: Number and length/area of confirmed HMWB in the Scotland river basin district

Water category	Length/area of HMWB (% of total)	Total length/area of all water bodies	Number of HMWB water bodies (% of total)	Total number of water bodies
River	1406 km (7%)	20,819 km	147 (7%)	2,008
Loch	304 (32%)	961 km^2	71 (23%)	309
Transitional	45 km^2 (7%)	605 km^2	6 (15%)	40
Coastal	7 km^2 (0.02%)	45,796 km^2	2 (0.5%)	449
Groundwater	0 (0%)	66,567 km^2	0 (0%)	275
Total	**-**	**–**	**226 (7%)**	**3,081**

Over the next year, the members of the Area and National Advisory Groups will be identifying additional measures required to deliver further improvements in the environment. In addition we hope that further measures will be identified as a result of responses to this consultation document. We will bring all these measures together into the draft River Basin Plan in which we will publish before 22 December 2008. The result will be further improvements in Scotland's water environment.

11 Consultation arrangements

This report is aimed at those likely to be affected by or have an interest in developing the river basin management plan to achieve the Water Framework Directive's environmental objectives in the Scotland river basin district.

We wish to engage as wide an audience as possible and therefore welcome views from anyone interested in how the water environment is managed. We must receive your views on this consultation by 8 April 2008. All responses will be taken into consideration during the development of the draft river basin management plan, which will be published by the end of 2008.

We welcome your responses on the consultation questions listed below.

Please provide additional information to support your response.

Significant water management issues

This consultation focuses on the significant water management issues we will have to deal with in the river basin management plan. These issues are outlined in sections 4 to 8 of this document and described in detail in the full report available on the SEPA website (www.sepa.org.uk).

Please consider the following consultation questions.

- Do you agree that these are the significant issues impacting the water bodies within the Scotland river basin district?
- Are there other significant issues at the river basin district level that have not been considered?
- Have we identified all the important existing measures that are being used to address these issues? Please identify any important existing measures that we have missed.
- Are there additional new measures that you think could make an important contribution to addressing a significant issue?
- Can you identify new or existing measures which **you** can help deliver?

Water bodies

The interactive map on the SEPA website (www.sepa.org.uk) allows you to look at the pressures, impacts and measures for individual water bodies. If you have comments on particular water bodies, it would be helpful if you could respond in the following format:

- Name and number of water body (from SEPA's website)
- Source of information, such as environmental monitoring data or personal observation
- Summary of information
- Potential measures which could be taken to improve the condition of the water body.

Environmental objectives

We would also like your views on our provisional identification of heavily modified or artificial water bodies in the Scotland river basin district and their ability to achieve the Water Framework Directive's environmental objectives (see section 10 of this document and section 12 of the full report).

Map 19 in the full report shows the results of applying the screening tool to each water body provisionally identified as heavily modified. You can look at these water bodies in more detail on the interactive map (www.sepa.org.uk). Detailed information about the screening process and its outcome is available in section 12.3 of the full report.

- Are there water bodies that have been identified as heavily modified or artificial which you believe could achieve good ecological status?
- Are there water bodies that have not been identified as heavily modified or artificial that you believe should be designated?

You can respond:

In writing: Significant Water Management Issues team
Scottish Environment Protection Agency (SEPA)
Clearwater House
Heriot Watt University Research Park
Avenue North
Riccarton
Edinburgh
EH14 4AP

By email: rbmp@sepa.org.uk

Via our website: www.sepa.org.uk

With regard to your response we will comply with the requirements of the Data Protection Act 1998 and use the information you provide only for this consultation. It will not be used, retained or distributed for any other purpose.

We will publish a digest of responses from this consultation on our website (www.sepa.org.uk) with details of how we will address issues raised. Please advise us if you wish your response to remain anonymous or not be attributable in the digest.

There will be no final publication of this consultation. Many issues will therefore need to be addressed through the river basin planning process.

11.1 Keeping you informed

The draft river basin management plan for the Scotland river basin district will set out a summary of the proposed measures for wider consideration. The consultation period for the draft plan must begin by 22 December 2008. If you wish to be kept informed about the draft river basin management plan, please register your interests by emailing rbmp@sepa.org.uk or contact us at SEPA, Clearwater House, Heriot Watt University Research Park, Avenue North, Riccarton, Edinburgh, EH14 4AP.

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