The river basin management plan for the Solway Tweed river basin district 2009–2015

Chapter 2: Environmental objectives

Contents*

*Appendices for this document are available on the SEPA website at:
www.sepa.org.uk/water/river_basin_planning.aspx

1. Introduction

This chapter describes the ambition to maintain and progressively enhance the Solway Tweed's water environment over the next 18 years. The objectives set to achieve this ambition provide the basis for the integration management of the river basin district and develop resilience in a changing climate.

You can find information on the objectives for individual water body using the interactive map on SEPA's website: www.sepa.org.uk/water/river_basin_planning.aspx

Around half (49%) of the water bodies in the Solway Tweed river basin district are currently at good status or better. For these waters, the objective is to prevent deterioration in their status. For the remaining water bodies the aim is to improve and restore them to good status, with as many as possible reaching this target during the first cycle. However, in deciding if a water body can reach good status in 2015 the agencies have also sought to strike the right balance between the ambition for the water environment and the benefits that we all derive from its sustainable use. Setting the right pace of improvement is particularly important and the objectives for enhancing and restoring the water environment take account of the time needed to meet the technical challenges of designing and implementing the necessary changes and the time needed by water users to make those changes without suffering disproportionate burdens.

Where achieving good status by 2015 would be infeasible or disproportionately expensive, improvements are phased over the periods 2015 to 2021 and 2021 to 2027 in order to progressively achieve the overall aim for 2027. The reasons for extending the timescale for achieving good status beyond 2015 are set out and explained in Section 3.

Realising the benefits of an environmental improvement to a water body often depends on improvements having first been made elsewhere. For example, providing for fish passage at a dam will not deliver the full benefit if the waters made accessible to the fish are in a poor condition. The planned improvements for each catchment have been phased with such interdependencies in mind.

The quality of our bathing waters, shellfish waters and drinking water sources is not always dependent on the ecological quality. They can deteriorate if they became contaminated with bacteria or other pathogens that can affect human health. Preventing deterioration that would compromise the benefits we derive from the protected area is also a key objective of this plan. For more information on protect areas, see Chapter 5: www.sepa.org.uk/water/river_basin_planning.aspx

For a small number of water bodies, good status cannot be achieved, even by 2027. This is because there is currently no feasible and effective means available for making the necessary improvements. For these water bodies a lower (less stringent) objective than good status has been set. Section 4 provides further information about these water bodies.

Such lower objectives may nevertheless involve achieving a significant improvement in the condition of the water bodies. For example, even if the best overall status that can be achieved for a water body is moderate, it may still be feasible and proportionate to improve the condition of some aspects, eg its water quality, to good status. Where this is the case these improvements will be part of the objective for that water body.

Some 16% of surface water bodies in the river basin district are heavily modified or artificial water bodies such as reservoirs. Despite their artificial or heavily modified characteristics, protecting these water bodies is also a core aim of this plan. Such water bodies can and do provide valued sites for biodiversity and recreation, and the condition of other water bodies often relies on their protection (eg safeguarding the passage of fish). For more information on heavily modified and artificial water bodies see Chapter 4: www.sepa.org.uk/water/river_basin_planning.aspx

In the future, there may be certain circumstances where allowing deterioration of a water body may be appropriate. Deterioration is permitted when the benefits to human health, human safety or sustainable development outweigh the benefits to the environment and society or where there are other overriding public interests. Such water bodies are said to be 'exemptions' to the rule of preventing deterioration. The process of deciding whether any future exemptions would be appropriate is discussed in Section 4.2.

2. Objectives for improving the Solway Tweed's water environment

Tables 1 to 7 summarise the objectives for the water bodies of the Solway Tweed river basin district. The objectives represent the best estimate of what can be expected to be achieved by 2015, 2021 and 2027.

You can find out about the objectives for individual water bodies using the interactive map available on SEPA's website: www.sepa.org.uk/water/river_basin_planning.aspx

As part of each six-yearly review of the river basin management plan and in line with guidance issued by ministers, SEPA and the Environment Agency will review the projected improvements on the basis of further, detailed information they have gathered. As a result, it may become clear that some water bodies will achieve their objectives earlier than anticipated, or that things are worse than thought and the improvement will take longer than planned or require additional measures.

Setting appropriate objectives has involved making judgements about what improvements are technically feasible and not disproportionately expensive to make and by when. This was done by identifying the pressures causing the adverse impacts and the measures needed to reduce or remove those pressures.

In identifying priorities, the following are considered:

- the severity of the impact;
- confidence in the classification of the water body and the scale of the improvement needed to achieve good water quality;
- the geographic extent of the impact (ie is the impact affecting hundreds of metres, a few kilometres or 10s of kilometres?);
- whether addressing the impact would also contribute to achieving other objectives (eg objectives for protected areas);
- the timing of planned measures to address any other pressures affecting the status of the water bodies concerned.

Water bodies have been prioritised for action in the period up to 2015 only where there is high confidence that there is a problem. This ensures that investment in measures is not wasted on water bodies that subsequently turn out to have been at good status. Where there is uncertainty about the classification of a water body, improvements have been phased for 2021 or 2027. This allows time for further monitoring and assessment, with the aim of improving confidence in time to identify, and secure the delivery of, any measures necessary to achieve good status or good ecological potential by the planned deadline.

In most cases where a water body has an objective for achieving good status in 2021 or 2027, actions will still be taken to improve the water body in the interim. These actions may enable a water body to improve in status (eg from poor to moderate) by 2015 but only reach good status by 2021 or 2027. You can find out about interim improvements planned for particular water bodies using the interactive map available on SEPA's website: www.sepa.org.uk/water/river_basin_planning.aspx

Water bodies adversely affected by multiple pressures (eg physical modifications to the bed and banks, over-abstraction, etc), were assessed separately to identify when each pressure could be tackled. The assessments were then combined to identify the earliest date by which all the pressures would be addressed.

In England, the objective setting process is based on six steps:

- **Step one:** Identify current or planned measures and assess how far these go to meeting default objectives.
- **Step two:** If default objectives are not achieved after step 1, identify potential additional measures.
- **Step three:** Identify cost-effective options for these additional measures.
- **Step four:** Appraise cost-effective option(s) for additional measures to see whether they are currently technically feasible and proportionately costly (by comparing the costs of the measures with the benefits and other impacts implementing the measure will deliver) and identify how much further these take us to meeting default objectives.

- **Step five:** If default objectives are not achieved after steps 2-4, identify and appraise additional local measures and evaluate how much further these take us to meeting default objectives.
- **Step six:** Identify and report final water body objectives (default or alternative objectives) and any justifications for alternative objectives.

Appendix C sets out the detailed information on actions appraisal for individual pressures and biological elements which are relevant to English water bodies in the Solway Tweed river basin district. The Appendix includes more information on the justification for setting alternative objectives.

Table 1: Planned improvements to the status of rivers other than artificial and heavily modified rivers *

Overall status	2008		2015		2021		2027	
	Number of water bodies	Length (km)	Number of water bodies	Length (km)	Number of water bodies	Length (km)	Number of water bodies	Length (km)
High	5	39	5	39	5	39	5	39
Good	211	2362	247	2765	294	3377	427	5090
Moderate	172	2168	166	2154	127	1604	22	252
Poor	60	735	37	428	31	426	8	110
Bad	15	206	8	126	6	65	1	21

* Status here refers to the combination of the ecological status and surface water chemical status of the water body.

Table 2: Planned improvements to the status of heavily modified rivers and artificial river-like water bodies such as drainage channels*

Overall status	2008		2015		2021		2027	
	Number of water bodies	Length (km)	Number of water bodies	Length (km)	Number of water bodies	Length (km)	Number of water bodies	Length (km)
Good potential or better	13	124	16	175	18	184	51	629
Moderate potential or worse	44	546	41	496	39	487	6	41

* Status here refers to the combination of the ecological potential and surface water chemical status of the water body.

Table 3: Planned improvements to the status of lochs/lakes other than artificial and heavily modified lochs/lakes*

Overall status	2008		2015		2021		2027	
	Number of water bodies	Area (km^2)	Number of water bodies	Area (km^2)	Number of water bodies	Area (km^2)	Number of water bodies	Area (km^2)
High	0	0	1	1	1	1	1	1
Good	3	1	4	1	5	2	12	14
Moderate	13	17	12	16	11	16	6	5
Poor	3	2	2	2	2	2	0	0
Bad	0	0	0	0	0	0	0	0

* Status here refers to the combination of the ecological status and surface water chemical status of the water body.

Table 4: Planned improvements to the status of heavily modified and artificial lochs/lakes*

Overall status	2008		2015		2021		2027	
	Number of water bodies	Area (km²)	Number of water bodies	Area (km²)	Number of water bodies	Area (km²)	Number of water bodies	Area (km²)
Good potential or better	4	4	7	10	8	10	15	18
Moderate potential or worse	12	21	9	15	8	15	1	7

* Status here refers to the combination of the ecological potential and surface water chemical status of the water body.

Table 5: Planned improvements to the status of estuaries*

Overall status	2008		2015		2021		2027	
	Number of water bodies	Area (km²)	Number of water bodies	Area (km²)	Number of water bodies	Area (km²)	Number of water bodies	Area (km²)
High	5	57	5	57	5	57	5	57
Good	5	27	5	27	5	27	7	638
Moderate	2	611	2	611	2	611	0	0
Poor	0	0	0	0	0	0	0	0
Bad	0	0	0	0	0	0	0	0

* Status here refers to the combination of the ecological status and surface water chemical status of the water body.

Table 6: Planned improvements to the status of coastal waters*

Overall status*	2008		2015		2021		2027	
	Number of water bodies	Area (km²)	Number of water bodies	Area (km²)	Number of water bodies	Area (km²)	Number of water bodies	Area (km²)
High	0	0	0	0	0	0	0	0
Good	7	1871	8	1913	8	1913	8	1913
Moderate	1	42	0	0	0	0	0	0
Poor	0	0	0	0	0	0	0	0
Bad	0	0	0	0	0	0	0	0

* Status here refers to the combination of the ecological status and surface water chemical status of the water body.

Table 7: Planned improvements to the status of groundwater*

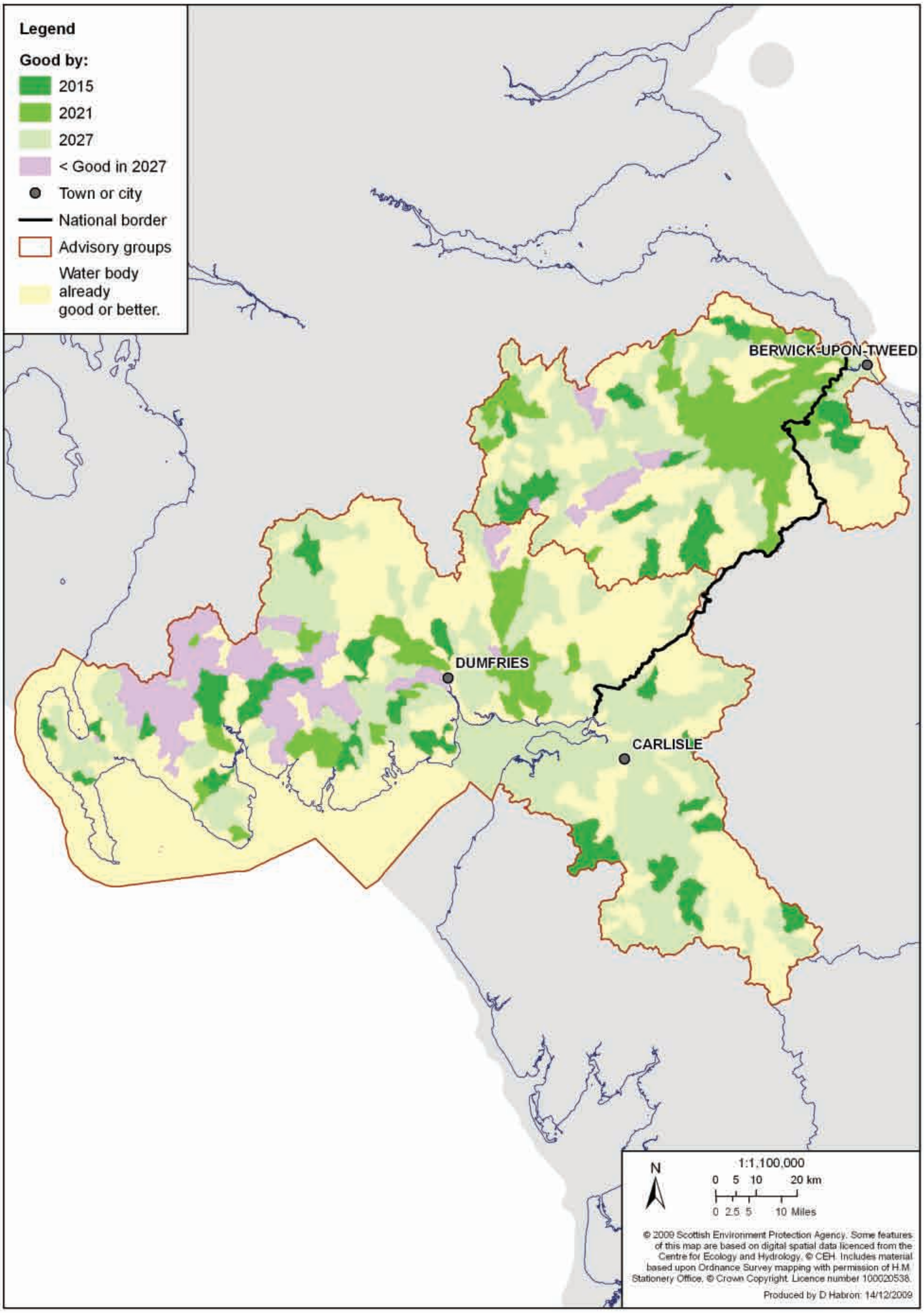
Overall status	2008		2015		2021		2027	
	Number of water bodies	Area (km²)	Number of water bodies	Area (km²)	Number of water bodies	Area (km²)	Number of water bodies	Area (km²)
Good	60	13446	60	13446	63	13635	68	15042
Poor	13	2238	13	2238	10	2049	5	641

*Status here refers to the combination of the groundwater quantitative and chemical status for the water bodies.

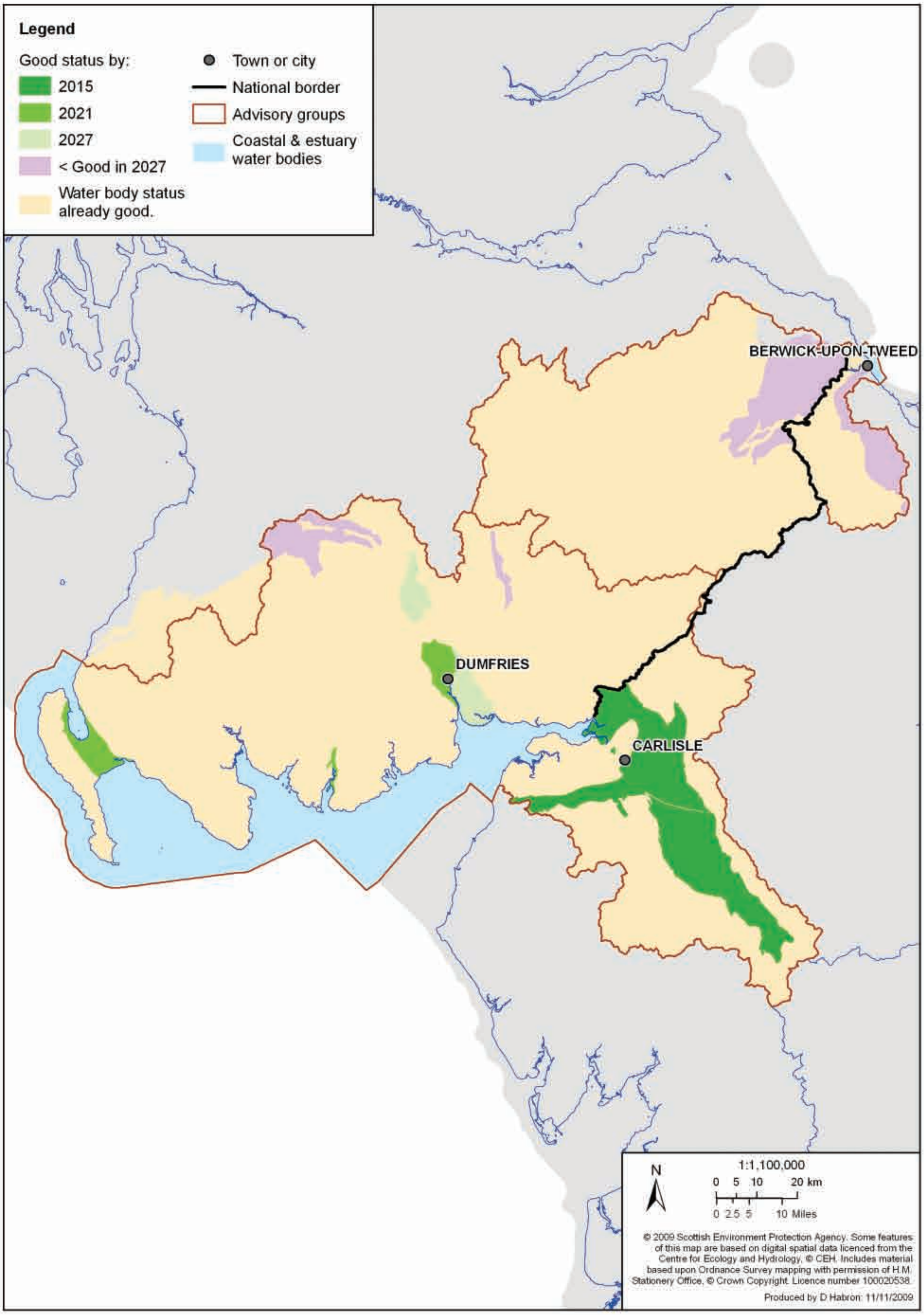
Table 8: Planned improvements to the chemical and quantitative status of groundwater*

Overall status	2008		2015		2021		2027	
	Number of water bodies	Area ground-water (km²)	Number of water bodies	Area ground-water (km²)	Number of water bodies	Area ground-water (km²)	Number of water bodies	Area ground-water (km²)
Good Quantitative Status	63	14,655	63	14,655	67	15,113	72	15,652
Poor Quantitative Status	10	1,029	10	1,029	6	571	1	32
Good Chemical Status	65	13,707	66	13,783	67	13,864	69	15,074
Poor Chemical Status	8	1,977	7	1,901	6	1,820	4	610

Map 1: Environmental objectives for surface water bodies in Solway Tweed



Map 2: Environmental objectives for groundwater bodies in Solway Tweed



3. Reasons for setting extended deadlines on some water bodies

3.1 Water quality issues

Point source discharges: discharges from waste water treatment works

Significant improvements have been made to the water quality of Solway Tweed's water environment over the last few decades, partly as a result of the implementation of earlier European directives including the Urban Waste Water Treatment Directive and the Habitats Directive. Of the remaining water quality problems, discharges of waste water account for the majority of the point source discharge impacts on water bodies.

The deadline for achieving good status has been extended from 2015 to 2021 or 2027 in 13 water bodies affected by sewage discharges (Table A1). This is because the scale of improvements needed to achieve good status can only be achieved in phases extending beyond 2015 for reasons of disproportionate cost and technical infeasibility.

Details on each water body can be found using the interactive map available on SEPA's website:
www.sepa.org.uk/water/river_basin_planning.aspx

Addressing the impacts caused by urban waste water discharges typically involves measures such as major upgrades to sewage treatment works or the re-location of discharges of treated urban waste water by means of new sewers. Over the last few decades, measures have been implemented to improve the majority of discharges. The remaining impacts are among the most difficult to solve.

Making the necessary improvements requires considerable investment of time and resources to plan and design the works, obtain the necessary development permissions and undertake the capital engineering works. Designing effective solutions is a lengthy and complex process. If adequate time and expertise is not invested, the solutions identified are likely to fail to deliver or to cost much more than necessary. Attempting to develop and implement solutions too quickly will result in schemes failing to deliver or incurring disproportionate expense.

Evidence from previous investment programmes and studies of similar investment programme delivery across the UK indicates that very large capital investment programmes are unlikely to deliver efficiently and on time taking account of:

- contracting industry capacity;
- disruption to customers;
- safety;
- constraints involved in gaining the relevant authorisations for the works;
- inflationary impacts;
- project completion rates;
- efficiency of capital expenditure.

For example, the limit for timely and efficient delivery of an investment programme by Scottish Water is around £450 to £500 million per year.[1]

Together these challenges make it technically infeasible to deliver an investment programme above this level and recent experience suggests that attempts to do so are unsuccessful. The delivery of any large investment programme requires experienced staff with detailed knowledge of a water company's assets. The delivery of water company investment programmes also depends on the availability of experienced staff in consultants and civil engineering contractors. This resource is limited.

There are established investment planning processes for water companies (called Quality and Standards in Scotland and Price Review in England). These processes are used to plan the phased delivery according to priorities of environmental improvements to problem sewage discharges. The improvements planned by 2015, between 2015 and 2021 and then between 2021 and 2027, represent what it is technically feasible to deliver without a high risk of disproportionate expense being incurred.

[1] *Factors to be considered when determining the appropriate size of the next capital programme for Scottish Water*, LECG Ltd, 2007
www.watercommission.co.uk/UserFiles/Documents/SW%20Capital%20Programme%20-%20Summary%20Final.pdf

Diffuse source pollution

There are just over 100 water bodies that are currently failing to achieve good status as a result of diffuse source pollution and have extended deadlines to 2021 or 2027. Appendix A1 lists the individual water bodies subject to diffuse pollution which have extended deadlines for achieving good status. Further details of the individual water bodies can be found using the interactive map on SEPA's website: www.sepa.org.uk/water/river_basin_planning.aspx

There are three main sources of diffuse pollution preventing the achievement of good status or good ecological potential in the Solway Tweed river basin district:

- agriculture;
- acid deposition;
- urban.

Agricultural diffuse source pollution

The deadlines for achieving good status for around 95 water bodies affected by diffuse pollution from agriculture have been extended because completing improvements by 2015 in all water bodies so affected would be disproportionately expensive.

The risks from agricultural activities depend on a wide range of factors including:

- soil characteristics;
- topography of the land;
- prevailing climatic conditions;
- number of such activities in a catchment.

This makes it difficult to predict precisely the effects of particular measures.

Because of this uncertainty, programmes of measures need to be built up gradually and iteratively. If a learning approach is not adopted, there is a high chance that a programme of measures will under-deliver or over-deliver (ie as a result of the inclusion of measures that are ineffective or surplus to requirements). The risks are that the intended environmental improvements will not be realised or the measures will impose unnecessary restrictions and burdens on the agricultural sector, or both. Imposing unnecessary costs and burdens on farmers in an effort to address all impacts resulting from diffuse pollution from agricultural sources by 2015 would be counter-productive and disproportionately expensive.

In order to avoid disproportionate burdens on farmers, improvements will be phased in a way that allows iterative development and refinement of the programme of measures on the basis of feedback from monitoring programmes on the effectiveness of earlier measures.

Pollution from acid deposition

Acid deposition results from the burning of fossil fuels that emit acid-forming gases (sulphur and nitrogen oxides) into the atmosphere. The gases react with moisture in the atmosphere to form sulphuric and nitric acid, which can then reach the land and water bodies via precipitation. The main sources of the sulphur and nitrogen oxides are emissions from industries burning coal and oil, and vehicle emissions.

Acidification impacts on the status of just over 30 rivers and lochs in the Solway Tweed river basin district (Table A.2). The amount of acid deposition has substantially reduced as a result of controls on emissions of acidifying gases (in particular sulphur dioxide) within the UK and internationally[2]. UK emissions of sulphur dioxide have decreased markedly since 1970; total sulphur dioxide emissions fell by 82% between 1990 and 2006 to 676,000 tonnes. This compares with targets for 2010 of 625,000 tonnes under the UNECE Gothenburg Protocol and 585,000 tonnes under the EU National Emissions Ceiling Directive. Total emissions fell by 86% between 1980 and 2006 compared with the UNECE Second Sulphur Protocol targets of reductions of 50% by the year 2000, 70% by 2005, and 80% by 2010[3].

The timetable for the full recovery of acidified water bodies is difficult to predict. It is dependent on natural conditions in catchment soils and the water environment, and expected to take up to several decades. Because of the uncertainty about the rate of recovery and the likelihood that recovery times will be prolonged, it is not possible to predict with any confidence when the conditions needed for good status will be achieved. For some water bodies, recovery may not be until after 2027.

[2]The EU National Emissions Ceiling Directive sets limits for emissions of ammonia, nitrogen oxides, sulphur dioxide and volatile organic compounds (VOCs) to be achieved by 2010. The Gothenburg Protocol (United Nations Economic Commission for Europe, 1999) also sets ceilings for these emissions. The UK ratified the Protocol in 2005.
[3]www.defra.gov.uk/evidence/statistics/environment/airqual/aqemsox.htm

3.2 Water quantity issues

Abstraction for agricultural purposes

The deadline for nine river water bodies affected by abstraction for agricultural purposes in this basin in Scotland. This is because completing the necessary improvements by 2015 in the water bodies affected would be disproportionately expensive.

Assessing the impact of irrigation abstractions is complex. Often adverse impacts are most likely to result not from one farmer's abstraction, but from the cumulative effect of simultaneous abstractions by a number of farmers within a river catchment.

The impact also depends on weather conditions. In the series of wet summers experienced in 2007, 2008 and 2009, farmers needed to irrigate less and there was more water available that could have been used for irrigation without posing a risk to flows and levels in water bodies. In dry summers, crop irrigation requirements are much greater and the water availability much more limited.

On top of this, irrigation requirements vary from year to year for example, it can vary depending on the crops being grown. Some crops require much more water than others.

Designing effective programmes of measures requires a good understanding of the pattern of abstraction and the risk it poses to the water environment. Because of the complexities, this understanding will take several years to develop in each affected river basin. With relevant monitoring in Scotland only beginning in the summer of 2007, there has not yet been enough time to develop a sufficient understanding for all water bodies affected by irrigation abstractions. This means it is not possible to be certain what measures are needed to achieve good status.

Asking farmers to take expensive measures that may prove unnecessary (because the gap to good status turns out to be smaller than estimated) or insufficient (because the gap is larger than estimated) would risk incurring disproportionate expense. In the worst case scenario, an entirely different set of measures may prove necessary and the original investment by the farmer would have been wasted.

To avoid imposing potentially unnecessary costs and disproportionate burdens on farmers, the achievement of good status has been phased. For those water bodies for which the predicted gap to good status is largest, the deadline has been extended to 2027. For others, the deadline has been extended to 2021.

This is because, where the gap proves to be large, the necessary measures to achieve good status are likely to involve:

- construction of large water storage ponds that the farmer would fill during the winter months or wet years when plenty of water is available and draw on to support irrigation during dry weather in the summer;
- a shift to alternative, lower water-demand crops or to livestock production.

These measures will require significant investment of time and resources in their planning, design and implementation. Farmers will need time to deliver such measures if they are to maintain the viability of their farm businesses. Consequently, where such measures are most likely, taking account of the uncertainties in current understanding, the deadline for achieving good status has been extended to 2027. Demanding a faster pace risks placing disproportionate burdens on farmers.

Abstraction and impoundment for public drinking water supply

The deadline for achieving good status has been extended beyond 2015 in around 20 water bodies affected by abstraction and/or impoundment associated with public drinking water supply.

This is because the scale of improvements necessary to achieve good water flows and levels in all the relevant water bodies can only be achieved in phases extending beyond 2015 for reasons of both technical infeasibility and disproportionate cost.

Addressing the impacts caused by the abstractions and impounding works used by water companies for drinking water supply usually involves:

- major programmes of works, eg to limit leakage by re-lining mains supply pipes;
- altering existing impoundments to provide higher compensation flows to the downstream river.

The latter may also require alternative water sources to be developed, with associated infrastructure costs.

As discussed above, designing effective solutions is a lengthy and complex process. Implementing such measures requires considerable investment of time and resources to plan and design the works, obtain the necessary development permissions and undertake the capital engineering works. If adequate time and expertise is not devoted, the solutions identified are likely to fail to deliver or to cost much more than necessary.

Abstraction and impoundment for hydropower generation

The deadline for achieving good status has been extended beyond 2015 for 10 water bodies affected by abstraction and impoundment for hydropower. This is because completing the improvements by 2015 in all the water bodies so affected would be disproportionately expensive.

Large hydropower schemes typically include multiple storage reservoirs formed by large dams and numerous smaller diversion dams. The latter capture river flow and divert the water into the storage reservoirs from which it is abstracted to drive generator turbines. Many of the reservoirs and the rivers downstream are substantially altered in character and have therefore been designated as heavily modified water bodies. Some of the smaller diversion dams are sufficiently large to downgrade the status of the affected water bodies and the latter have also been designated as heavily modified water bodies.

Achieving good ecological potential in these water bodies can require major engineering works to install fish passes and/or to enable the controlled release of a proportion of the reservoir water to provide compensation flows for downstream rivers. It is a major undertaking for these complex schemes to identify an appropriate flow regime and design the necessary works to deliver it.

It will require considerable time and resources if the best possible ecological quality in the affected rivers and reservoirs is to be realised and significant adverse impacts on renewable energy generation avoided. The process needs the involvement of a wide range of interested parties as well as considerable investment of time and expertise by both the operator and the regulator. Consequently, designing, planning and tendering for the works and securing the necessary finance can take several years.

Attempting to achieve good ecological potential in all the affected water bodies by 2015 would risk the implementation of inappropriate solutions that fail to deliver the desired ecological benefits or are unnecessarily expensive. There is a high risk that solutions developed without sufficient background environmental information or without sufficient input from third parties would incur disproportionate expense.

Phasing improvements up to 2027 means better solutions for the water environment can be found with the least possible loss of renewable energy generation capacity. It avoids having to spread too thinly the limited pool of specialist expertise needed to plan and design such improvements. It also allows the knowledge gained on the effectiveness of different solutions to be incorporated into the detailed design of measures for subsequent schemes.

3.3 Habitat issues

Extended deadlines have been set for 135 water bodies affected by physical modifications to their beds, banks or shores or by dams and weirs on rivers that act as a barrier to the passage of migratory fish.

Appendix A1 lists the individual water bodies subject to such alterations and for which the deadline for achieving good status has been extended beyond 2015. Further details on each water body can be found using the interactive map available on SEPA's website: www.sepa.org.uk/water/river_basin_planning.aspx

Engineering modifications to beds, banks and shores

We have extended the deadline from 2015 to 2021 or 2027 for water bodies that are currently failing to achieve good status as a result of modifications to their bed, banks or shores. This is because completing the necessary improvements by 2015 in all the water bodies so affected would be disproportionately expensive.

Evidence from the UK and other countries[4] demonstrates that successful habitat restoration projects need careful design and management. Such projects are prone to failure if appropriate skills and expertise in design and management are lacking. Data on the impacts of engineering modifications to rivers, lochs/lakes and coasts is currently limited and there are significant gaps in the evidence base of what actions are effective in mitigating for these impacts.

[4]See, for example, *River Restoration: Managing Uncertainty in Restoring Physical Habitat*, S. Darby and D. Sear, published by John Wiley & Sons, 2008.

There is limited experience and expertise on which to base the design and delivery of habitat restoration projects of the scale necessary to achieve good status or good ecological potential in all surface water bodies. To ensure resources are invested to best effect, the number of projects tackled initially needs to be limited so that experience and expertise are not spread too thinly. As our knowledge of designing and delivering habitat improvements increases, so will the number of projects able to be tackled at any one time.[5]

If such an iterative, learning approach is not adopted, there is a high chance that projects will be started that are costly and which fail to deliver the improvements necessary to achieve good status or good ecological potential. At best, this would cause delays and incur the expense of further work to design and plan the implementation of additional improvements. At worst, it could result in objectives not being achieved by the planned deadline and gaining no benefit from the investment made.

The resources invested must deliver environmental improvements. If not, there is a high risk of incurring disproportionate cost, with investment that is not balanced by the benefits it delivers. The phasing of improvements will enable the efficient and effective use of resources.

In Scotland:

- In 2008, SEPA identified and funded a series of small-scale restoration projects. Extra projects are being added each year as experience grows. The projects are partnership projects in which the partners contribute resources. The programme is also supported by public funding. The results of intensive monitoring of a proportion of the projects will be used to inform the design of subsequent projects.
- SEPA is prioritising action in catchments where measures will contribute to the achievement of other objectives (eg biodiversity conservation, diffuse pollution reduction, flood management). This reduces the risk of incurring disproportionate expense if the improvements to the condition of the beds, banks or shores do not deliver as large an ecological benefit as expected.
- Action is being targeted where confidence in the classification of the water body is high and hence confidence that measures are needed to achieve good status is also high.
- Legislation is being introduced that enables SEPA to facilitate restoration or, if necessary, take action itself.

In England, the Environment Agency has started to work with stakeholders to improve the evidence base in the first river basin planning cycle and is developing a number of catchment trials and pilots to:

- trial the effectiveness of restoration and mitigation measures;
- collect additional data to determine cause-and-effect relationships between pressures and impacts on ecology;
- develop mechanisms to plan and deliver measures through catchment-based partnerships;
- investigate the cost/benefit of mitigation measures.

The results of these investigations will guide the selection, in future river basin planning cycles, of appropriate measures where there is high confidence that they will deliver improvements to ecological quality.

Barriers to fish migration

The deadline for achieving good status has been extended from 2015 to 2021 or 2027 for some water bodies that are currently failing to achieve good status as a result of barriers affecting the continuity of rivers for fish migration. This is because completing the necessary improvements by 2015 in all water bodies so affected would be technically infeasible or disproportionately expensive.

Many impoundments on rivers and lakes/lochs allow for fish passage. Impacts on continuity for fish migration result from impoundments that have no such provision. These include:

- large dams used to store water for public drinking water supply or hydropower generation;
- smaller dams and weirs, many of which are no longer actively used.

Providing fish passage at large storage dams involves major engineering works to construct suitable fish passes. It also requires other works to restore a sufficient flow in the river downstream of the dam to trigger and support fish migration. The reasons why such works have been phased beyond 2015 are the same as those explained in the section on abstraction and impoundment for public drinking water supply and hydropower generation in Section 3.2 above.

[5]See report produced for SEPA: *River Restoration at the Catchment Scale in Scotland: Current status and opportunities*, D. Gilvear and R. Casas, Centre for River EcoSystem Science at Stirling University, June 2008
www.clim-atic.org/documents/P08002-RRScotland-final_draft%20report+app.pdf

There are plans to provide for fish passage at three smaller dams and weirs by 2015. However, the ownership of these dams is often unclear and this can increase the time taken to make improvements.

The most downstream dams are prioritised to be tackled first and, where relevant, work on these dams is timetabled in line with the scheduling of improvements to the quality of the fish habitat upstream.

Coniferous plantations on banks and shores

The deadline for achieving good status has been extended from 2015 to 2021 or 2027 for 39 water bodies that are currently failing to achieve good status as a result of coniferous plantations on their banks and shores. This is because completing the necessary improvements by 2015 in all water bodies so affected would be technically infeasible and disproportionately expensive.

Dense stands of coniferous forests on the banks of rivers or the shores of lochs and lakes can have a dramatic effect on the ecological quality of rivers. Too much shade leads to:

- bare, eroding banks;
- wider, shallower channels;
- loss of aquatic plants;
- reduced productivity of fish and aquatic invertebrates.

Where these problems occur, forests need to be re-structured to create a buffer zone between the water's edge and the conifer plantation. This requires trees to be felled and removed, and the buffer zone re-planted with an appropriate mix of tree species and other vegetation.

In most cases, creating suitable buffers is not practicable without the felling of large areas of the surrounding forest. This is because of the difficulty in accessing the affected river corridors to harvest the trees. To undertake such felling on the scale necessary to address all the affected water bodies by 2015 would be beyond the capacity of the forestry sector. It would also require many trees to be felled before maturity and result in significant economic losses for the forestry sector.

To manage these difficulties, felling plans have been brought forward for those forests having significant adverse impacts on the status of rivers or lochs. Felling work in other forests has been phased according to the severity of the risks and the maturity of the trees concerned.

4. Reasons for setting lower (less stringent) objectives for some water bodies

This section explains why, for reasons other than natural conditions affecting the rate of recovery, a small number of water bodies are not expected to be able to achieve good status even by 2027.

4.1 Water quality problems

Minewater pollution to groundwater

As a result of past mining activities two groundwater bodies in the Solway Tweed river basin district are significantly polluted. For these water bodies, it is not expected to be able to achieve the water quality needed for good status even by 2027. Instead, the aim is to achieve an objective of less than good status. The water bodies concerned are listed in Table B1 in Appendix B.

In deep mines, groundwater is pumped from the mines to allow access to the minerals through underground shafts and passageways. When mining stops and mines close, groundwater levels rebound and flood the workings.

Where the recovering groundwater comes into contact with the exposed rocks of the mine workings, it can become contaminated with iron and other heavy metals and its pH reduced (ie made more acidic) due to oxidation of naturally occurring metal sulphides. It is technically infeasible to remove the heavy metals and restore the pH of groundwater by 2015.

Over time, the quantities of metals entering the groundwater from the exposed workings will reduce and cease as the exposed rock faces become fully oxidised, and the quality of groundwater will recover as the pollutants are flushed through and diluted. The slow flushing times of groundwater mean that recovery will take many decades and water quality (ie chemical status) is not expected to reach good status until well after 2027.

Agricultural diffuse source pollution of groundwater

In four groundwater bodies affected by diffuse source pollution from agricultural sources, it is not expected to be able to restore the water quality needed for good status even by 2027. These water bodies have been set a lower objective than good status because they are all significantly adversely affected by pollution resulting from past applications of nitrates to agricultural land. The water bodies concerned are listed in Table B2 in Appendix B.

Nitrates are used in fertilisers to promote the growth of agricultural crops. Not all nitrates in fertilisers are taken up by the growing crops and, instead, leach into the sub-soil and then groundwater.

Concentrations of nitrates in groundwater have built up over decades. Because of the slow flushing rates of groundwater and continuing, albeit lower inputs of nitrates, the concentration of nitrates in groundwater will take decades to decline sufficiently for the groundwater quality to recover to that required to achieve good status.

It is technically infeasible to remove nitrates from groundwater or otherwise increase the rate of recovery of the affected groundwater. Consequently, good status will not be achieved until after 2027.

In the meantime, action is being taken under the Nitrates Directive to ensure that future applications of nitrates to agricultural land are closely matched to crop requirements and do not result in a further build-up of excess nitrates in groundwater.

4.2 New developments for hydropower, flood defence or public drinking water supply

Even though preventing deterioration of status is one of our primary objectives, there are circumstances under which allowing deterioration is judged to be appropriate. Such exceptions to the rule, or "exemptions", provide for developments whose benefits to human health, the maintenance of human safety or sustainable development outweigh the benefit to the environment and society of preventing deterioration of status or which are otherwise of overriding public interest.

As of September 2009, there are no water bodies in Solway Tweed which have deteriorated due to developments for the purposes of flood protection, hydropower generation or public drinking water supply. However should applications for exemptions arise there are appropriate processes in place to allow these considerations to occur.

4.3 Impacts of invasive non-native species

North American signal crayfish

Once established in a river or loch/lake, North American signal crayfish cause significant damage to the native plant and animal communities. Currently, five river water bodies and one loch/lake water body in the Solway Tweed river basin district are not at good status because of the impacts of this invasive non-native species.

Once established in a water body, it is currently infeasible to remove North American signal crayfish populations, or sufficiently mitigate for their impacts, in order to enable good status to be achieved[6].

Different measures have been tried within the UK and elsewhere including capture/harvesting techniques and the use of pesticides. Although some of the techniques tried have extremely destructive effects on the structure and function of the aquatic ecosystem, none of them have proved effective at a water body scale. Research to identify an effective method is being undertaken.

Given the resilience of North American signal crayfish to all currently available control methods, affected water bodies have been set an objective lower than good status. The objectives represent the highest possible ecological status the bodies can reasonably achieve in the absence of effective control methods.

The water bodies concerned are listed in Table B4 in Appendix B.

Before each update of the river basin management plan, the availability of effective control measures will be reviewed, taking account of studies in the UK and around the world. If and when reasonably effective techniques are developed, objectives will be revised accordingly.

[6]See research commissioned by Scottish Natural Heritage: www.snh.gov.uk/pubs/results.asp?q=signal+crayfish&rpp=10