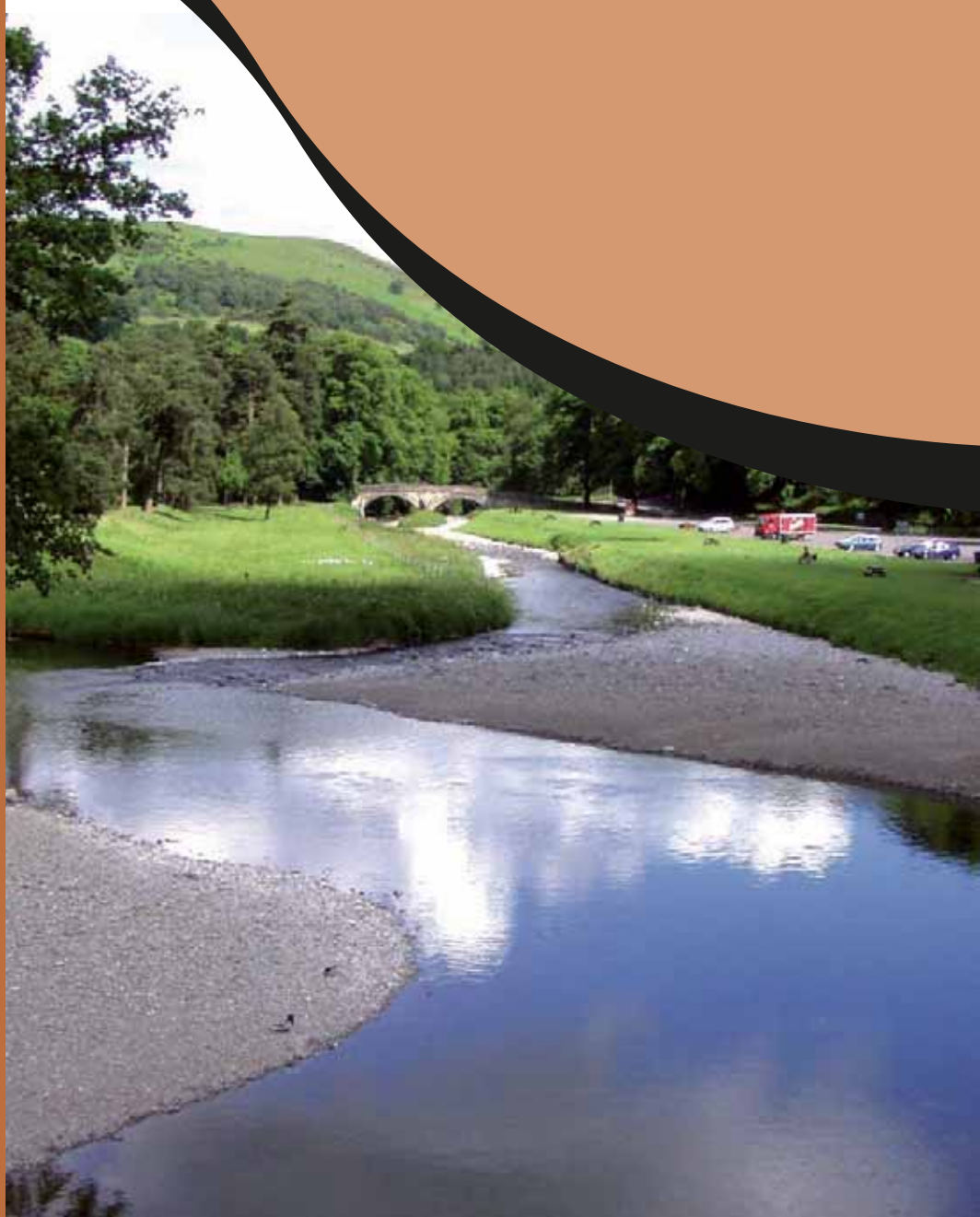
Environment Agency

SEPA
Scottish Environment Protection Agency

An interim overview of the significant water management issues in the Solway Tweed river basin district



Foreword

We are introducing a new way of managing the water environment in the Solway Tweed area called river basin planning. This involves setting objectives to protect and improve the water environment while promoting its sustainable use. River basin planning is the process that allows us to fulfil the requirements of the Water Framework Directive.

SEPA and the Environment Agency have developed this consultation on significant water management issues for the Solway Tweed river basin district with the Area Advisory Groups. These advisory groups include the key organisations from the Solway Tweed river basin district with an interest in the water environment. Together we have identified the environmental problems we need to address and considered what actions are required.

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

We believe river basin planning provides a real opportunity to co-ordinate our work across the Solway Tweed river basin district 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 sustainable use of the water environment by business and for recreation, which will have big social and economic benefits.

Please read those sections of this report applicable to you and consider in your response how we can all contribute to creating a better, greener Solway Tweed area.

Executive Summary

The Water Framework Directive established new and better ways of protecting and improving our water environment, with the overall objective of achieving co-ordinated and integrated water management across Europe. One of the Directive's requirements is the publication of an interim overview of the significant water management issues in each river basin district. This overview builds on the work described in our earlier characterisation report and is an intermediate step in the preparation of the river basin management plan for the Solway Tweed river basin district.

This consultation document provides you with an opportunity to contribute to the river basin planning process in the Solway Tweed river basin district. It seeks your views and opinions on the significant water management issues for the river basin district.

The main focus of this report is the identification of the significant water management issues that we think put our ability to achieve the environmental objectives of the Water Framework Directive most at risk. These issues are summarised in the table below. The most common problems affecting our water environment are pollution, abstraction and modifications to the physical habitat. However it is also important to consider the increasing pressure from the presence of invasive alien species.

Significant water management issues in the Solway Tweed river basin district

Pressure type	Key sectors
Diffuse source pollution	Agriculture Forestry Sewage disposal activities Electricity production (acidification)
Point source pollution	Sewage disposal activities
Abstraction and flow regulation	Water supply Agriculture Hydropower
Morphology	Agriculture Forestry Water supply
Alien species	Recreational, sporting and cultural activities

The report highlights the need for new and, in some cases national measures, for the UK, Scotland or England to be implemented in order to achieve the environmental objectives of the Water Framework Directive in the Solway Tweed river basin district. As well as your views on these and existing measures, we welcome your comments on our provisional identification of heavily modified and artificial water bodies in the Solway Tweed river basin district.

An interactive map available on our website (www.sepa.org.uk) provides an opportunity to identify the pressures affecting and measures to be applied to the water bodies in the Solway Tweed river basin district.

A shorter document, *A summary of the significant water management issues in the Solway Tweed river basin district*, is available separately from SEPA – both online and as a printed copy.

We will not be publishing a revised version of this report after the consultation period but will use the consultation feedback to inform the development of the draft river basin management plan. We have prepared this report slightly earlier than the Directive requires to allow more time for your responses to be taken into account when producing the first draft river basin management plan.

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1 Introduction

The Water Framework Directive (WFD) is a wide-ranging and ambitious piece of European environmental legislation which came into force in December 2000. Its overall purpose is to achieve co-ordinated and integrated water management across Europe in order to:

- prevent deterioration and improve the condition (status) of aquatic ecosystems including wetlands and groundwater;
- promote sustainable water use;
- reduce pollution;
- help reduce the effects of floods and droughts.

The Water Framework Directive applies to surface waters (rivers, lochs/lakes, transitional waters, coastal waters) and groundwater. Importantly, it recognises that actions in one part of a river basin may have impacts in another and that the activities of one set of water users may affect the interests of others.

When the Water Framework Directive was transposed into UK legislation, separate provision was made for the Solway Tweed river basin district because it straddles the English–Scottish border. Under the Solway Tweed Regulations,[1] the Scottish Environment Protection Agency (SEPA) and the Environment Agency (the agencies) were given a number of new duties and responsibilities to work together to deliver river basin planning in the Solway Tweed river basin district.

The interim overview of the significant water management issues (SWMI) is an important statutory requirement of the Water Framework Directive for all river basin districts. This consultation sets out the key issues affecting the water environment in the Solway Tweed river basin district. The report builds on the work of the characterisation report (Article 5 characterisation and impacts analyses[2]) and is an intermediate step in the preparation of the river basin management plan for the Solway Tweed.

A general introduction to the Water Framework Directive and river basin management planning can be found in a *River Basin Planning Framework for the Solway Tweed river basin district*.[3]

1.1 Purpose of this report

The Water Framework Directive requires SEPA and the Environment Agency to publish and make available for public consultation this overview of the significant water management issues identified in the Solway Tweed river basin district.

This consultation report provides you with an opportunity to contribute to the river basin planning process in the Solway Tweed river basin district and seeks your views and opinions.

We will not be publishing a final version of this report after the consultation period, but will use the consultation feedback to inform the development of the draft river basin management plan. We have prepared this report slightly earlier than the Water Framework Directive requires to allow more time for your responses to be taken into account when producing the first draft river basin management plan.

In addition to an overview of the significant water management issues, this document provides an update on further characterisation work, information on available measures and the development of new measures, and an indication of the number of water bodies that we do not expect to meet environmental objectives by 2015, particularly in relation to heavily modified water bodies (HMWBs). This is an opportunity for you to comment on these developing areas of work.

This report is supported by a short summary document and a web-based interactive map (www.sepa.org.uk). The interactive map provides an opportunity to identify the pressures affecting and measures to be applied to the water bodies within the Scottish part of Solway Tweed river basin district.

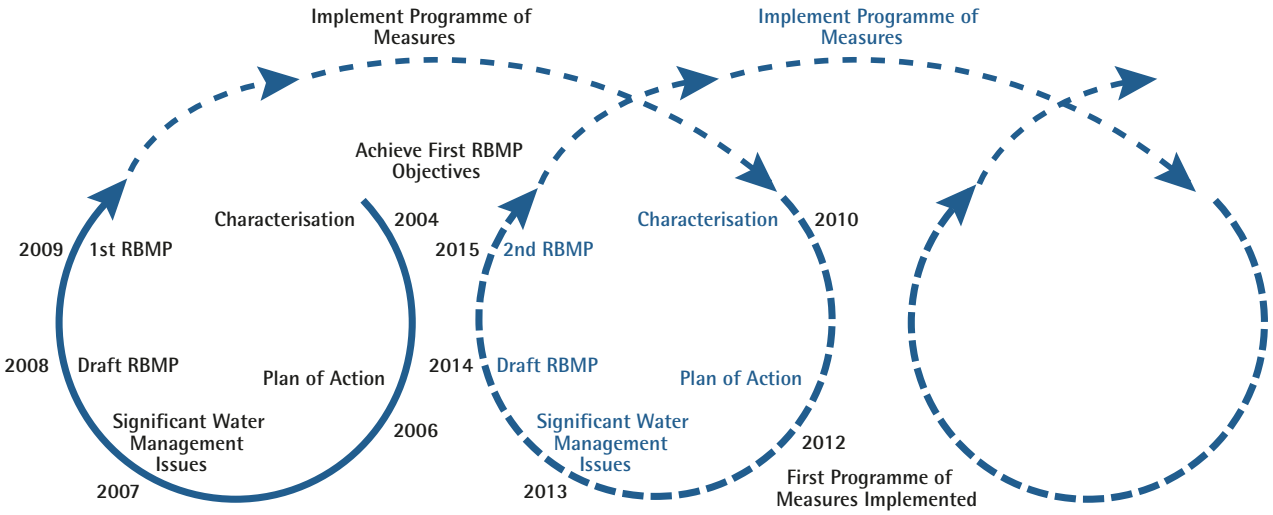
[1]The Water Environment (Water Framework Directive) (Solway Tweed River Basin District) Regulations 2004. Available at www.opsi.gov.uk/si/si2004/20040099.htm
[2]www.sepa.org.uk/pdf/publications/wfd/Article_5_Solway_Tweed.pdf
[3]www.sepa.org.uk/pdf/publications/wfd/RBMP_Solway_Tweed.pdf

1.2 The river basin planning process

The river basin planning process started in 2004 with the production of the characterisation report. This is followed by a series of steps as shown in Figure 1.

The significant water management issues consultation is the next step in the production of the first river basin management plan in 2009. As set out in the Plan of Action,[4] the Water Framework Directive requires an inclusive and participative approach during the production and implementation of the river basin management plans. The SWMI report offers an important opportunity for consultation.

Figure 1: The river basin planning process



Further information about the process of producing the river basin management plan for the Solway Tweed river basin district can be found on the SEPA website (www.sepa.org.uk/wfd/rbmp/solway_tweed.htm).

1.3 The role of the Area Advisory Groups

Stakeholder involvement is an important aspect of the Water Framework Directive. Through the Area Advisory Groups (AAGs), our partner organisations have contributed to finalising the significant issues at a sub-basin level. We have discussed the significant issues at AAG meetings where members had the opportunity to add up to three significant issues which they justified to be important at a local scale.

If we are to achieve improvements in the water environment and prevent further deterioration, it is important to ensure that the pressures impacting the water environment are sufficiently managed and controlled. We will need to work with partner organisations to develop an efficient and effective programme of measures to address the issues affecting the Solway Tweed river basin district. As part of this report, the Area Advisory Groups have provided us with measures relating to the sub-basins and members will be updating us regularly with measures at a water body level.

[4] www.sepa.org.uk/pdf/consultation/current/rbmp_poa/poa_solway_tweed.pdf

1.4 Further characterisation

Since the publication of the characterisation report in 2005 we have continued to gather additional information to improve our understanding of the environmental impact of pressures on our water bodies. Further monitoring, the development of regulation and the development of new environmental standards have all helped to enhance our knowledge of the risks posed to our water bodies.

1.5 Strategic Environmental Assessment

Many planning processes, including the development and adoption of river basin management plans (RBMPs), require a Strategic Environmental Assessment (SEA) to be carried out in line with the European Strategic Environmental Assessment Directive.[5]

The SEA will ensure information on the significant environmental effects of the RBMP is gathered and made available to consultation authorities and the public both during its preparation and prior to its adoption. The SEA will assess the significant environmental effects of strategic objectives and significant national and regional measures set out in the RBMP. As the RBMP itself sets out to protect and improve the water environment, the SEA will include an assessment of this as well as any wider non-water environmental impacts.

1.6 Next steps

During 2007/2008, the work of the agencies and the AAGs will focus on developing programmes of measures and environmental objectives for individual water bodies. As part of this process we will need to consider all water bodies that are not currently expected to meet the environmental objectives by 2015 and identify appropriate measures and/or objectives.

[5]Available at www.sepa.org.uk

2 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 Solway Tweed river basin district.

We wish to engage as wide an audience as possible and therefore welcome views from anyone who is interested in how the water environment is managed. We must receive your views on this consultation by 8 April 2008. All responses received 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 a series of consultation questions as listed below.

Please provide additional information to support your response.

2.1 Consultation questions

Significant water management issues

The main focus of this report is the significant water management issues we will have to deal with in the river basin management plan. These issues are described in section 6.

Please consider the following consultation questions.

- Do you agree that these are the significant issues impacting the water bodies within the Solway Tweed 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 which 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 that **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 in the Scottish part of the river basin district. 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 can 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 Solway Tweed river basin district and their ability to achieve the Water Framework Directive's environmental objectives (see section 7.2).

Map 10 (in section 7.2) shows the results of applying a screening tool to each water body provisionally identified as heavily modified. You may look at these in more detail on the interactive map (www.sepa.org.uk).

- Are there water bodies that have been provisionally 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?

2.2 How to respond

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

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.

2.3 Keeping you informed

As set out in this document, some of the measures will be carried out by our partners and can range from economic incentives to voluntary partnerships. The draft river basin management plan for the Solway Tweed 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 interest by e-mailing rbmp@sepa.org.uk or contact us at SEPA, Rivers House, Irongray Road, Dumfries, DG2 0JE (Tel: 01387 720502).

3 Introducing the Solway Tweed river basin district

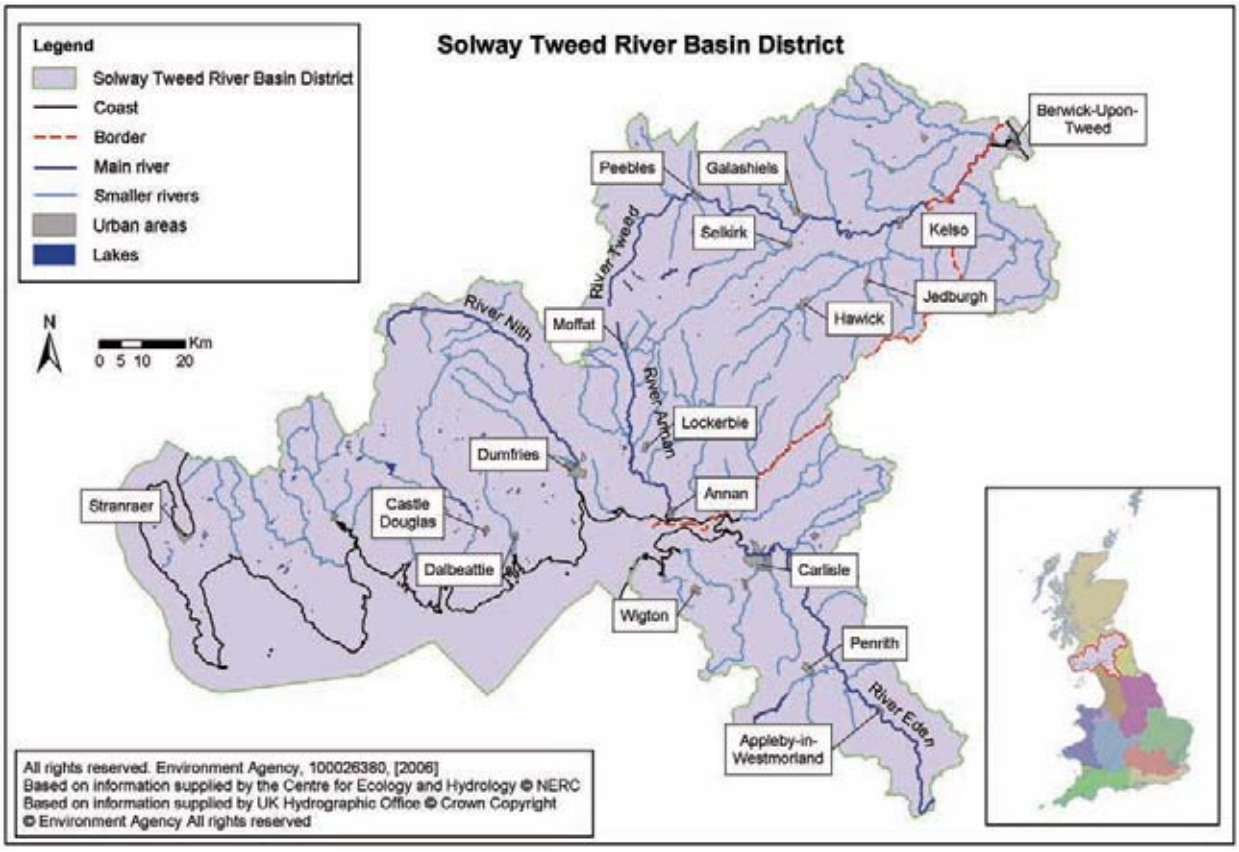
3.1 The Solway Tweed river basin district

The Solway Tweed river basin district (see Map 1) incorporates the catchments that feed into the Solway Firth and Tweed Estuary, the estuaries themselves and the groundwater that underlies the river basin district. The river basin district has an area of around 17,500 km^2 and incorporates much of the Scottish Borders, Dumfries and Galloway and the Eden and Esk valleys. The main river catchments include the Rivers Tweed, Eden, Esk, Annan and Nith, Dee-Ken and Cree and their associated wetlands.

The river basin district is largely rural and supports a wide range of internationally important habitats and wildlife, with many of the water bodies designated Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). There are also many excellent salmon and sea trout rivers in the river basin district.

The area is home to approximately 450,000 people with important economic activities including tourism, agriculture, forestry and manufacturing.

Map 1: The Solway Tweed river basin district



3.2 Characterisation of the Solway Tweed river basin district

The Water Framework Directive requires us to undertake an assessment of the pressures and impacts on the water environment in the Solway Tweed river basin district. The final report of this assessment (Article 5 characterisation report[6]) was published in 2005, following consultation in 2004. This report covers the following aspects of characterisation:

- identification of water bodies and their physical characteristics;
- identification of protected areas;

[6]www.sepa.org.uk/pdf/publications/wfd/Article_5_Solway_Tweed.pdf

- assessment of the pressures and impacts on rivers, lochs/lakes, estuaries, coasts, groundwater and groundwater dependent ecosystems such as wetlands;
- identification of those water bodies at risk of not achieving the Directive's objectives.

To help prioritise future action, the characterisation and impacts analyses were reported using categories agreed across the UK (Table 1).

Table 1: UK agreed reporting categories

Directive reporting category	UK reporting category	Action
At risk	Water bodies at significant risk (1a)	Consideration of appropriate measures can start as soon as practicable.
	Water bodies probably at significant risk (1b)	More detailed risk assessment to determine whether or not the water bodies in this category are at significant risk.
Not at risk	Water bodies probably not at significant risk (2a)	Focus on improving quality of information in time for second pressure and impact analysis report in 2013.
	Water bodies not at significant risk (2b)	Review for next pressure and impact analysis report in 2013 to identify any significant changes in the situation.

We are committed to continually improving and refining the results of characterisation as new data and monitoring results increase our certainty regarding the pressures and impacts operating on water bodies. More information on the reasons for refinement of characterisation and the benefits is given in a report published by the Department for Environment, Food and Rural Affairs (Defra) and devolved administrations (www.defra.gov.uk/environment/water/wfd/pdf/character-nextsteps.pdf).

The main purpose of ongoing characterisation is to provide a more accurate assessment of the pressures and impacts to enable us to implement better focused and more effective measures. Continued refinement since 2005 has led to greater certainty as to which water bodies are 'at risk' of not meeting the environmental objectives of the Water Framework Directive by 2015. This will enable the monitoring programmes and the programmes of measures to be correctly targeted and as cost-effective as possible.

See Annex A for more information on further characterisation undertaken in Scotland.

3.3 Protected area register

Protected areas are given particular protection under the Water Framework Directive. They include areas designated under a number of other EC Directives and areas identified in accordance with Article 7 of the Directive itself to protect the surface water or groundwater within them. The protected areas must be managed to achieve the protected area objectives, those of the relevant EC Directive.

Further information on the protected area register can be found on:

- SEPA's website at: www.sepa.org.uk/wfd/register
- Environment Agency's website at: www.environment-agency.gov.uk

4 Significant water management issues

This section of the report looks at the process of identifying the significant water management issues in the Solway Tweed river basin district. It introduces the work being undertaken to address these issues and to develop the programme of measures. Detailed discussion of the significant water management issues in the river basin district can be found in section 6.

4.1 What are significant water management issues?

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

Issues may arise from:

- ongoing human activity (e.g. farming, abstraction);
- historic human activity (e.g. abandoned mines, contaminated land);
- new development (e.g. increasing demand for drinking water supplies).

The significant issues are those issues that will warrant the most attention at the river basin district level during the first river basin planning cycle (2009-2015).

Significant issues have been identified using the following three principles:

- To what extent does the issue impact adversely on the achievement of the Water Framework Directive's objectives for each category of water body (rivers, lochs/lakes, transitional, coastal, groundwater) 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?

The significant issues for the Solway Tweed river basin district are discussed in section 6.

4.2 Identification of the significant issues

The significant issues have been identified using:

- data gathered for the characterisation report;[7]
- additional data gathered through further characterisation work;
- discussions with stakeholders through the Area Advisory Groups.

The pressures recorded against those water bodies that have been identified as being 'definitely at risk' (1a) and 'probably at risk' (1b) have been used to identify the significant issues.

Significant issues have been identified separately for each water body category (rivers, lochs/lakes, transitional, coastal and groundwater) because the pressures differ between the categories.

The significant issues have been defined in terms of the pressure type and the source (i.e. industry sector or activity) of the pressure; for example, point source pollution from sewage disposal activities, and morphology from land claim. Describing the significant issues to this level of detail has enabled us to identify existing measures.

Although a pressure may not impact the entire length or area of a water body, the whole of the water body will fail to comply with good status if the Directive's objectives are not achieved in a significant part of the water body.

[7] www.sepa.org.uk/pdf/publications/wfd/Article_5_Solway_Tweed.pdf

Significant issues have been identified, in part, by assessing the length (rivers) or surface area (lochs/lakes, transitional, coastal and groundwater bodies) of 1a and 1b water bodies impacted by each pressure. The length/area of water bodies impacted by each pressure was calculated for each water body category. Pressures were said to be significant if they impacted:

- more than 15% of the total length of rivers at risk;
- more than 20% of the total area of either lochs/lakes, transitional, coastal or groundwater bodies.

For the purposes of this report, these percentages have been used as a guide as to what is considered significant. Evidence collated from characterisation, water quality classification schemes, agency staff and Area Advisory Groups has been used to support the identification of significant water management issues in the Solway Tweed river basin district.

4.3 What are we doing in the Solway Tweed river basin district to address significant issues?

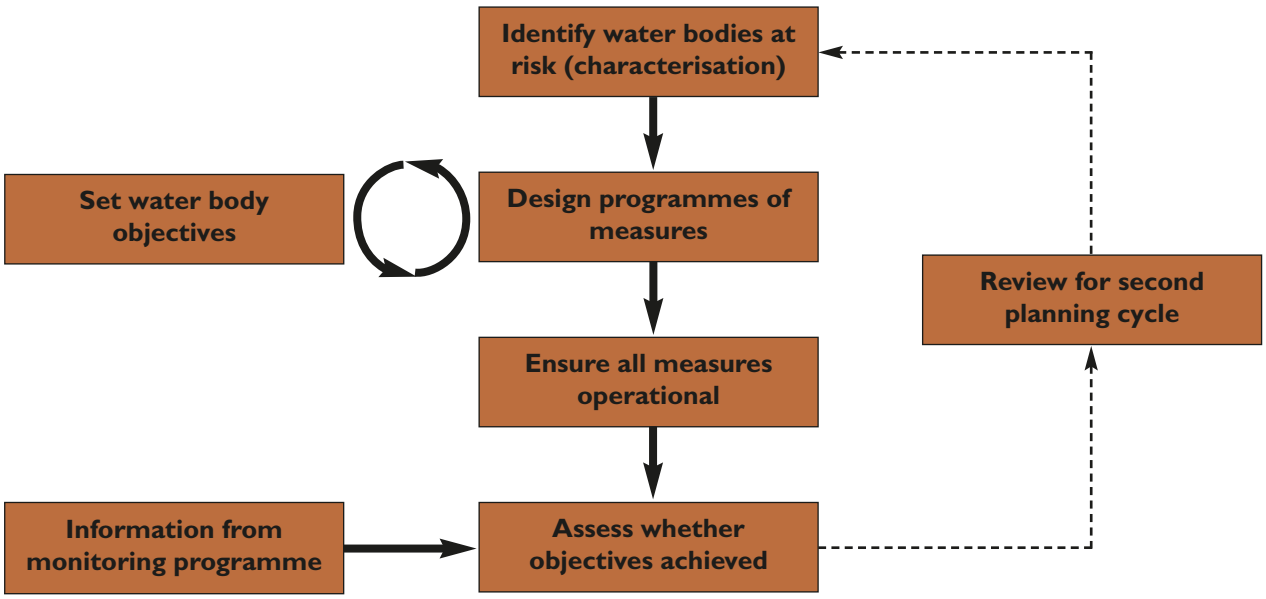
This report provides an overview of the management tools currently available to address the significant issues and highlights where there is a need to develop additional/new measures. Many of the measures implemented before the introduction of the Water Framework Directive will continue in their current form but some may need to be amended or revised to ensure that its environmental objectives are achieved. The report also begins to identify new measures that may be required to address the significant issues.

The Water Framework Directive requires a programme of measures (management tools) to be established for each river basin district. The measures implemented as part of the programme of measures should enable water bodies to achieve the environmental objectives of the Water Framework Directive. The programme of measures must be established by December 2009 and be made operational by December 2012 (Figure 2).

River basin planning requires us to consider all types of pressures on the water environment including those not previously considered in great detail. Consequently, this report identifies some significant issues for which we do not currently have effective management tools. There are also significant issues that have not previously been regulated; for example, aspects of morphology and diffuse pollution and, in Scotland, abstraction. New regulations have been introduced in Scotland and Defra is consulting on whether there is a requirement for new measures in England to address these issues.

While the environmental improvements resulting from new measures will not be immediate, some progress should be seen during the first river basin planning cycle.

Figure 2: The programme of measures cycle



It is not only through regulation that environmental improvements will be made. Much work carried out through partnerships and other organisations will contribute to the achievement of the WFD's objectives. These improvements may be a result of small-scale environmental projects and large-scale partnership projects but, whatever the scale, all will contribute to the final programme of measures.

All water bodies must meet the Water Framework Directive's environmental objectives. Identifying a problem as a 'significant issue' does not mean that the issue is more important than any other issue. The draft and the first river basin management plans will address all of the issues in the catchment 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.

4.4 Development of measures

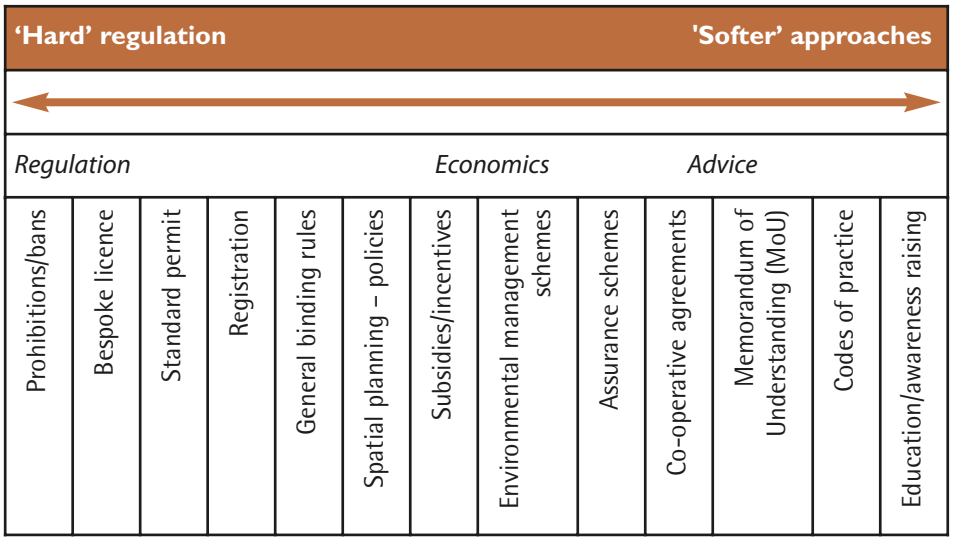
A measure is an action taken to reduce the negative impact of one or more pressures on one or more water bodies to help achieve the objectives of the Water Framework Directive.

The scale and type of measure can vary. In terms of scale, measures can be applied at a variety of levels from a national level down to a single water body. The type of measure can range from regulations and economic instruments to advice and voluntary actions on the ground (Figure 3).

The programme of measures consists of basic and supplementary measures as stipulated by the Water Framework Directive.

Basic measures are the minimum Water Framework Directive requirements for inclusion in the programme of measures and tend to be predominantly regulatory and economic. They are a fixed part of any combination of measures irrespective of whether these are necessary to achieve Water Framework Directive objectives. Examples include measures required as part of other European Directives such as the Urban Waste Water Treatment Directive and the Bathing Water Directive.

Figure 3: Continuum of measures



Supplementary measures are ones that are designed and implemented in addition to the basic measures with the aim of achieving the environmental objectives of the Water Framework Directive. They are predominantly non-regulatory. Examples of supplementary measures include codes of good practice and educational projects.

4.5 What are we doing to implement and develop measures?

Measures to address some of the significant issues are already in place. In Scotland, for example, the recent introduction of the Water Environment (Controlled Activities) (Scotland) Regulations 2005 will help us meet the requirements of WFD with regard to the control of abstraction and engineering activities. In England, examples of existing measures include the Water Act 2003 and water company Asset Management Plans. Defra recently consulted on whether there is a need for new measures to address morphological and diffuse pollution issues in England.[8]

This report focuses on the 'management tools' available rather than on the specific measures themselves, which are numerous and often site specific. Once the appropriate tools are in place it will be part of the river basin planning process to ensure that these tools are used to their full potential to implement specific 'on the ground' measures in order to achieve the environmental objectives of the Water Framework Directive.

A comprehensive, although not exhaustive, list of the measures currently available to mitigate or control the activity or pressure is detailed in this report for each significant issue. These measures include UK and respective national legislation and regulations, guidance and advice.

Additional measures

As new and better data become available, new pressures may be identified which may require the development of additional national measures in England and/or Scotland. The river basin planning process provides the framework for this second stage of identifying and assessing potential new national measures, although there may be differences in approaches taken within the Scottish and English parts of the basin due to differing legislative regimes. In addition, measures specific to a single sub-basin may be appropriate.

The cost-effectiveness of any new measures will have to be assessed using the appropriate methodology before they can be implemented.

The role of the Area Advisory Groups

The Area Advisory Groups have contributed to the collation of existing measures through group and one-to-one meetings. Together we have identified issues for which additional measures may be required to control or mitigate the pressure. These additional measures will be developed between responsible organisations where appropriate at UK, national and local levels.

The Area Advisory Groups and local partnerships will play a vital role in the development of new measures to address significant issues that can not be addressed through existing measures.

4.6 Measures to prevent deterioration in status

The Water Framework Directive requires measures to be put in place to prevent deterioration in the quality of water bodies. These measures are applied to all water bodies regardless of whether they are currently at risk with the aim of preventing deterioration in water quality and thus ensuring they continue to meet the required objective.

Much of the operational work undertaken by the agencies and our partner organisations already aims to prevent deterioration in status. The main types of 'no deterioration' measures are regulatory including licenses, registrations and general binding rules. We promote best practice along with numerous partner organisations in relation to a wide variety of different pressure types, in particular diffuse pollution and morphological activities.

[8]www.defra.gov.uk/corporate/consult/nadwp-hydromorphology/consultation-nadwp.pdf

5 The importance of climate change to the water environment

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 2 summarises the wide variety of implications of climate change for the environment.

Table 2: Implications of climate change for the significant water management issues

Significant water management issue	Examples of the implications of climate change
Pollution	• Changes in river flows could affect the impact of pollution in rivers and increase loading of pollutants to the sea. • Higher intensity rainfall will increase run-off from agricultural and other land into watercourses. • Enhanced plant/algal growth due to increased temperature and sunlight will exacerbate the effects of eutrophication.
Abstraction and flow regulation	• Increased likelihood of summer droughts will lead to reduced resources and changes in abstraction demand.
Changes to morphology	• More frequent and severe river flooding will lead to higher rates of river erosion.
Biodiversity and alien species	• Increased temperatures may provide more favourable conditions for alien species. • Higher temperatures will be less favourable for some native species.

6 Significant water management issues in the Solway Tweed river basin district

There is a wide range of significant issues affecting the water bodies of the Solway Tweed river basin district. Many of these issues (e.g. diffuse pollution from agriculture) affect a number of water body categories from rivers to groundwater. However, there are issues which are more localised in nature such as alien species.

The most common problems affecting our water environment are pollution, abstraction and modifications to the physical habitat, although we must also consider the increasing pressure from alien species. These problems originate from a range of sectors, as detailed in the following sections. The ticks in the summary tables in sections 6.1 to 6.4 indicate that the issue (pressure and sector) is considered to be significant for the water body category. This does not mean that the issue does not affect other categories, but that it is not considered to be significant.

We still do not fully understand the links between some pressures and ecological status resulting from human activity (e.g. the impacts on the morphology of a river system and the subsequent changes to the ecology). Similar uncertainty exists in terms of attributing some pressures to sources. This uncertainty will be reduced as further monitoring is undertaken and scientific understanding improves.

The significant issues identified in this report are based on current data and understanding. Many of these issues are already being addressed through existing measures although new measures are also being developed. The Solway and Tweed Area Advisory Groups were also asked to identify any other issues they felt were significant within the river basin district. The significant issues for the Solway Tweed river basin district are listed in Table 3; supporting evidence is available in Annex B for the Scottish part of the river basin district. These significant issues, along with other pressures, will be addressed through the programme of measures as part of the river basin management plan.

Table 3: Significant water management issues in the Solway Tweed river basin district

Pressure type	Key sectors
Diffuse source pollution	Agriculture Forestry Sewage disposal activities Electricity production (acidification)
Point source pollution	Sewage disposal activities
Abstraction and flow regulation	Water supply Agriculture Hydropower
Morphology	Agriculture Forestry Water supply
Alien species	Recreational, sporting and cultural activities

The same methodology was also used to identify significant issues for the Solway and Tweed sub-basins. These issues are detailed in Annex C. It is important to recognise these issues and to press through the Area Advisory Groups to ensure they are addressed.

The identification of the significant issues and the associated review of existing measures have enabled us to identify those issues for which there are no appropriate management tools. The following sections provide more detail about the significant issues and what is being done to address them. Sections 6.1 to 6.4 provide an overview of the main types of pressures while Sections 6.5 to 6.17 describe the pressures from different sectors and measures to address these problems.

6.1 Pollution

Perhaps the most well-known issue affecting the water environment is pollution. Pollution can threaten the quality of all parts of the water cycle from groundwater to rivers, lochs/lakes, estuaries and coastal waters. Pollution means that there is too much of a material (a pollutant) in the water that is harmful to water quality or aquatic plants or animals. A pollutant can be anything from a poisonous metal or pesticide to a nutrient which can choke waters with excessive growth, or even silt that can smother fish spawning beds.

Pollution comes from one of two sources:

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

The significant issues relating to the pollution of the water environment in the Solway Tweed river basin district are listed in Tables 4 and 5 for diffuse source and point source pollution respectively. Information on the individual significant issues can be found in sections 6.5 to 6.11. Map 2 shows the surface water bodies at risk from diffuse source pollution pressures and Map 3 shows the groundwater water bodies at risk. Map 4 shows the surface water bodies at risk from point source pollution pressures and Map 5 shows the groundwater water bodies at risk.

Table 4: Significant diffuse source pollution issues in the Solway Tweed river basin district

Pressure type	Key sector	Rivers	Lochs/Lakes	Transitional	Coastal	Groundwater
Diffuse source pollution	Agriculture	✔	✔	✔	✔	✔
	Forestry	✔	✔			
	Sea and coastal water transport				✔	
	Electricity production (acidification)	✔	✔			
	Sewage disposal activities	✔	✔	✔	✔	
	Total length/area	**2,333 km**	**18 km²**	**322 km²**	**177 km²**	**6,069 km²**

Table 5: Significant point source pollution issues in the Solway Tweed river basin district

Pressure type	Key sector	Rivers	Lochs/Lakes	Transitional	Coastal	Groundwater
Point source pollution	Sewage disposal activities	✔	✔	✔	✔	
	Manufacturing			✔	✔	
	Electricity generation			✔		
	Total length/area	**660 km**	**8 km²**	**325 km²**	**42 km²**	

6.2 Abstraction and flow regulation

Abstraction of too much water is another potential problem for both groundwater and surface water resources. If we remove too much water for drinking or commercial activities, we reduce the system's ability to dilute and cope with pollution. In extreme cases, river beds can dry up or salt water can be drawn into groundwater.

The significant issues relating to abstraction and flow regulation pressures on the water environment in the Solway Tweed river basin district are listed in Table 6. Information on the individual significant issues can be found in sections 6.12 to 6.14. Map 6 shows the surface water bodies at risk from abstraction and flow regulation pressures and Map 7 shows the groundwater water bodies at risk from abstraction pressures.

Table 6: Significant abstraction and flow regulation issues in the Solway Tweed river basin district

Pressure type	Key sector	Rivers	Lochs/Lakes	Transitional	Coastal	Groundwater
Abstraction and flow regulation	Water supply	✔	✔			
	Agriculture	✔	✔			
	Electricity generation		✔			
	Total length/area	**438 km**	**20 km²**			

6.3 Morphology

The morphological alterations (physical modifications) that have been made to our waters often result from engineering works carried out so that we can make use of our waters or lands. These activities can directly remove habitat, indirectly change flow or alter levels of sediments in our waters. Examples include:

- drainage of lands for development, agriculture or forestry;
- construction of flood defences or weirs to control river water levels;
- damming of lochs/lakes providing storage for power generation or water supply;
- port developments or construction of coastal defences to prevent flooding or erosion.

The significant issues relating to the morphology of the water environment in the Solway Tweed river basin district are listed in Table 7. Information on the individual significant issues can be found in sections 6.15 to 6.16. Map 8 shows the surface water bodies at risk from morphological pressures.

Table 7: Significant morphology issues in the Solway Tweed river basin district

Pressure type	Key sector	Rivers	Lochs/Lakes	Transitional	Coastal	Groundwater
Morphology	Agriculture	✔				
	Forestry	✔				
	Water supply	✔	✔			
	Total length/area	**1,574km**	**13 km²**			

6.4 Alien species

Our water environment also faces other threats such as alien species. These are non-native plants or animals which compete with, and over-run, our natural aquatic plants and animals.

The significant issues relating to alien species in the water environment in the Solway Tweed river basin district are listed in Table 8. Information on the significant issue can be found in section 6.17. Map 9 shows the surface water bodies at risk from alien species pressures.

Table 8: Significant alien species issues in the Solway Tweed river basin district

Pressure type	Key sector	Rivers	Lochs/Lakes	Transitional	Coastal	Groundwater
Alien species	Recreational, sporting and cultural	✔	✔			
	Total length/area (km/km^2)	**26 km**	**7 km^2**			

Consultation questions

For the significant issues discussed below in sections 6.5 to 6.17, please consider the following consultation questions. Please provide additional information to support your response.

- Do you agree that these are the significant issues impacting the water bodies within the Solway Tweed 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 which 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 that **you** can help deliver?

6.5 Diffuse pollution from agriculture

Farming has a major influence on our landscape, tourism, culture and natural heritage. It also makes a significant contribution to our economy. There are significant opportunities and challenges ahead for agriculture as the focus and level of farm support changes from production to environmental protection and wider rural development. A significant issue that will need to be addressed, both in this sense and for the Water Framework Directive, is diffuse pollution related to agriculture.

Environmental impacts

Diffuse agricultural pollution arises from land use activities such as livestock grazing, cultivation of land to grow crops and from farm steading run-off. Such activities can give rise to a loss 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.

These types of pollutants can be 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.

Diffuse agricultural pollution can have the following types of impact:

- Losses of nutrients from fertilisers, animal manures and slurries applied to land result in the proliferation of plant growth. This can smother rivers and estuaries while, in lochs/lakes and coastal waters, enhanced growth of plankton reduces light penetration and affects oxygen levels.
- Organic matter from animal manures, slurries and effluent from livestock feeds (e.g. silage) depletes oxygen from rivers. This, together with toxic components such as ammonia, reduces the number of animals and plants which can thrive in our rivers.
- Soil erosion can have a direct physical impact by smothering gravels in rivers and lochs/lakes (important to fish and other organisms) and reducing light penetration in estuaries and coastal waters. It is also important in the transport of other pollutants such as pesticides, nutrients and faecal pathogens attached to soil particles.
- Livestock manures and slurries, and access to watercourses by cattle and sheep can lead to significant losses of micro-organisms from faecal matter to bathing and shellfish waters. This can affect the amenity value of the water environment and pose a risk to human health.
- Losses of pesticides and veterinary medicines (including sheep dip) during handling, use and washdown can cause severe impacts to plants and animals in rivers and can affect the quality of drinking water.
- Nutrients from fertilisers, animal manures and slurries can enter groundwater, affecting the quality of water available for public water supply abstraction, and affecting rivers and other water bodies that are groundwater fed.

Diffuse pollution from agriculture is a significant issue for groundwater, rivers, lochs/lakes, transitional and coastal waters. It is estimated that over 80% of those water bodies at risk of failing to meet the WFD's environmental objectives by 2015 are affected by diffuse pollution from agriculture.

Annex B provides more information on the extent of diffuse pollution from agriculture in the Solway Tweed river basin district.

Addressing the problem

There are mechanisms in place that address issues of diffuse pollution related to agriculture. Current agricultural and environmental standards can contribute to the mitigation of the impacts of diffuse agricultural pollution, though they need to be effectively implemented by farmers and be subject to inspections.

In Scotland, the Scottish Executive recently consulted on the introduction of 'national' General Binding Rules (GBRs)[9] based on widely accepted standards of good practice. Further targeted controls will be required in certain areas where national GBRs are not sufficient to address the risk. In England, programmes such as Catchment Sensitive Farming[10] are already working towards this in certain priority catchments.

Advice, guidance and awareness raising on their own are unlikely to achieve the range of contributions to environmental protection and improvement asked of farmers. However, they will be an essential component of the package of measures required to address diffuse pollution. Voluntary, stakeholder lead and catchment management approaches should also be encouraged and targeted via Area Advisory Groups.

Measures to address diffuse pollution from agriculture are summarised in Table 9.

[9]Under the Water Environment (Controlled Activities) (Scotland) Regulations 2005 (CAR).
[10]www.defra.gov.uk/farm/environment/water/csf/programme.htm

Table 9: Measures to address the impacts of diffuse pollution from agriculture

What are we already doing about this?	
Regulation	• Nitrates Directive (91/676/EC) including Nitrate Vulnerable Zone action programmes • Controls on intensive farming (pig and poultry farmers) under the Integrated Pollution Prevention and Control (IPPC) regime • Silage, Slurry and Fuel Oil (SSAFO) Regulations • Regulatory control for protected areas (e.g. Bathing Waters Directive and Shellfish Waters Directive) • Shellfish Hygiene Directive • Sewage Sludge (Use in Agriculture) Regulations • Waste Management Licensing Regulations
Economics	• Agri-environment schemes • Cross-compliance measures • Farm assurance schemes/Assured Food Standards (AFS) (Red Tractor)[11]
Advice, partnerships and plans	• Codes of good agricultural practice and other guidance, e.g. Prevention of Environmental Pollution from Agricultural Activity (PEPFAA) Code,[12] Four-Point Plan (4PP),[13] Farm Soils Plan[14] • Catchment Sensitive Farming[15] • Catchment management plans • LEAF (Linking Environment And Farming)[16] • On the farm advice from non-governmental organisations (NGOs) such as Rivers/Fisheries Trusts and the Farming and Wildlife Advisory Group (FWAG)[17] • The Voluntary Initiative (pesticides)[18] • The Sheep Dip Pollution Reduction Programme[19] • Local Environment Risk Assessment for Pesticides (LERAP)[20]
What additional measures could we put in place?	
Regulation	• Encourage and promote nutrient management and efficiency • Increase enforcement activities with respect to banned pesticides • National General Binding Rules • Targeted rules • Water Protection Zones
Economics	• Targeted support via Rural Development Contracts (Scotland) and entry level and higher level schemes (England) • Ensure cross-compliance includes measures to protect water quality
Advice, partnerships and plans	• Extend the Catchment Sensitive Farming programme • Expansion of national voluntary pesticides initiative to cover a wider range • Local voluntary initiatives targeted at diffuse pollution • Revised guidance (e.g. PEPFAA guide) • Proactive agency 'on the ground' visits to promote compliance and good practice
What additional measures do you think should be developed? What can you do to help?	

[11] www.redtractor.org.uk
[12] www.scotland.gov.uk/Publications/2005/03/20613/51366
[13] www.sac.ac.uk/mainrep/pdfs/fourpointplan.pdf
[14] www.sac.ac.uk/mainrep/pdfs/farmsoilsplandec.pdf
[15] www.defra.gov.uk/farm/environment/water/csf/index.htm
[16] www.leafuk.org
[17] www.fwag.org.uk
[18] www.voluntaryinitiative.org.uk
[19] www.environment-agency.gov.uk/commondata/acrobat/sheepdip_1455439.pdf
[20] www.pesticides.gov.uk/safe_use.asp?id=207

6.6 Diffuse pollution from forestry

Natural forest was once an abundant habitat within the Solway Tweed river basin district. But over several centuries much of it was removed as fuel and construction material for industrial growth and to allow for sheep and cattle grazing. At the start of the 20th century, forestry cover in the UK was the lowest in Europe. From the 1930s onwards government policy led to rapid reafforestation, mainly with non-native species. However, this 'blanket afforestation' led to concerns over biodiversity, landscape impacts and pollution of the water environment.

The earlier large-scale programme of upland conifer reafforestation caused a number of problems for the water environment. This led to the introduction by the Forestry Commission, after extensive consultation, of a set of *Forests and Water Guidelines*[21] in 1988 to address these issues through improved management practices. Regular revisions have ensured the guidance continues to reflect the most recent research and operational experience.

Today's forest management is changing the emphasis from viewing forestry and woodlands as a threat to providing a range of significant benefits for the water environment. Examples include creating riparian woodland buffers to not only provide wildlife corridors and other ecological benefits, but also to reduce the transport of diffuse pollutants to the water environment.

Environmental impacts

Environmental impacts from forestry are generally much lower than those from other land uses. This is partly a result of the lower levels of inputs, cultivation practices and associated losses from forestry but also because of the effective application of codes of good practice which have transformed forestry practice over the past 15 years.

There has been some improvement in the impacts from forestry over recent years, partly due to effective application of codes of good practice. However, problems associated to diffuse pollution remain and involve:

- nutrient input to highly sensitive upland lochs/lakes;
- pollution incidents associated with spillages, erosion of roads or the felling and planting of forests.

Characterisation data indicate that more than a quarter of the rivers and lochs/lakes in the river basin district at risk of failing to meet the WFD's environmental objectives by 2015 are affected by diffuse pollution related to forestry activities. A particular concern is around upland lochs/lakes having high ecological status and which are very vulnerable to increased nutrient inputs associated with inappropriate reafforestation or felling. Typically this type of lake/loch is very rare across Europe and they therefore have important biodiversity value internationally.

Annex B provides more information on the extent of diffuse pollution from forestry in the Solway Tweed river basin district.

Addressing the problem

The forestry sector demonstrates that economic incentives and regulatory controls can dramatically reduce the adverse environmental impact associated with land management. The most significant problem is associated with some of the most sensitive water ecosystems in the area, where just small increases in nutrients can lead to significant changes to the water quality. The subsequent impact on the biodiversity of these water bodies can be substantial.

Addressing nutrient impacts in rivers and lochs/lakes requires planning at a catchment scale. Changes in land use such as reafforestation or felling need to be phased to ensure the area affected in any one year is small.

Measures to address diffuse pollution from forestry are summarised in Table 10.

[21]The 4th edition published in 2003 is available at www.forestresearch.gov.uk/PDF/fcgl002.pdf/$FILE/fcgl002.pdf

Table 10: Measures to address the impacts of diffuse pollution from forestry

What are we already doing about this?	
Regulation	• Effective controls over felling through felling licensing or forest plans • Environmental impact assessments (EIAs) required for forest road construction, quarrying and deforestation
Economics	• Compliance with the UK Forestry Standard[22] and its associated suite of forestry guidelines as a mandatory requirement of forestry incentives and felling controls
Advice, partnerships and plans	• Forests and Water Guidelines • Reduced application of pesticides through spatial planning • UK Woodland Assurance Standard[23] • Liaison between the agencies and Fisheries Trusts/District Salmon Fishery Boards (DSFBs) to improve understanding of the issue
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, partnerships and plans	• Phasing of land use change in the catchment of sensitive lochs • Build on Forest Stewardship Council schemes • Build on Forests and Water Guidelines
What additional measures do you think should be developed? What can you do to help?	

6.7 Diffuse pollution from sea and coastal water transport

Diffuse pollution from sea and coastal water transport can come from a range of sources including ferry-generated sewage, increased sedimentation and a range of chemical pollutants. The effect of tidal processes means that pollution may move within the water body and, at certain times, have a greater impact due to reduced dilution rates. But as with land-based diffuse pollution, it is the cumulative impact that tends to put the water body at risk.

In the Solway Tweed river basin district, only one water body at risk of failing to meet good ecological status is affected by diffuse pollution from sea and coastal water transport. Given that the issue is attributed to a single water body, it is proposed that this is not a significant issue in the Solway Tweed river basin district. It is therefore not included in the proposed list of significant water management issues in Table 3.

6.8 Diffuse pollution from acidification

Acidification of rivers and lochs/lakes occurs where high levels of acidifying pollutants are deposited from the atmosphere in catchments overlying hard, slow-weathering rocks where soils are thin and provide little buffering capacity.

Acidifying pollutants include:

- oxides of sulphur and nitrogen produced from the burning of fossil fuels such as coal and oil;
- ammonia from intensive livestock rearing.

[22]www.forestry.gov.uk/pdf/fcfc001.pdf/$FILE/fcfc001.pdf
[23]Available at www.ukwas.org.uk

These gases may be deposited from the atmosphere in:

- gaseous form (dry deposition);
- clouds (occult deposition);
- rainfall (wet deposition).

Upland areas receive higher levels of deposition because of higher rainfall and ground level cloud.

Sulphur and nitrogen oxides may be transported considerable distances in the atmosphere and may cross national boundaries before being deposited. Hence emissions of these gases from the rest of the UK and continental Europe contribute to acidification in the Solway Tweed river basin district. Similarly, emissions here contribute to the acidification problem in other countries.

Although acidification is a potential problem across large upland areas, evidence of damage to freshwaters in the Solway Tweed river basin district is most prevalent in south-west Scotland, particularly Galloway. Parts of the upper Eden catchment are also at risk. In Galloway, high levels of acid deposition fall on geologically sensitive catchments composed of granite or Ordovician sedimentary rocks. The Galloway area is also vulnerable because of the extent of catchment reafforestation. Woodlands (particularly coniferous ones) can exacerbate acidification by scavenging acidifying pollutants from the air. In addition, felling may result in a temporary increase in acidity owing to the leaching of excess nitrate from soils.

Environmental impacts

As well as an increase in acidity (lower pH), acidification results in increased concentrations of sulphate, nitrate and labile aluminium in freshwaters and reduced acid-neutralising capacity (ANC).

- The increase in acidity and toxic forms of aluminium cause a decline in the biodiversity of rivers and lochs/lakes. Fish, invertebrates and aquatic flora may all be affected, as may some birds associated with freshwaters (e.g. dippers). The effects of acidification may be mitigated to some extent by naturally occurring organic acids; highly coloured, peaty waters may therefore show less damage.
- Fish such as Atlantic salmon and brown trout are particularly sensitive to acidification and, in some waters, populations of these fish may be lost completely. Early signs of acidification damage include a progressive ageing of the trout population due to poor survival of the more sensitive eggs and fry.
- Aquatic invertebrate communities become impoverished as the more sensitive species are eliminated.
- Many species of molluscs, mayflies, some caddis flies and the freshwater shrimp Gammarus are acid-sensitive.
- Many species of diatoms (microscopic algae that live in lochs/lakes or on river beds) are also acid-sensitive. Diatom remains that are preserved in loch sediments provide a useful means of tracking acidification over time.

Annex B provides more information on the extent of diffuse pollution from acidification in the Solway Tweed river basin district.

Addressing the problem

The best way of reducing acidification is by reducing emissions of acidifying pollutants. This can be achieved by:

- using fuels with a low sulphur content;
- reducing our reliance on fossil fuels for electricity production;
- more stringent controls on the emission of acidifying pollutants from industry, agriculture, shipping and motor vehicles.

Acidification is an international problem requiring international action so it is most effectively tackled through concerted action at European level (e.g. Large Combustion Plant Directive, National Emission Ceilings Directive) or globally through international conventions and protocols.

However the effects of acidification may to some extent be mitigated by controls on land use such as:

- a ban on new planting or replanting of coniferous forests in the most sensitive areas;
- better planning of forestry developments to incorporate mixed age stands, more broadleaves and open ground.

Recent editions of Forests and Water Guidelines have used the critical loads methodology for preventing acidification. However we need to review this approach in partnership with the forestry sector in light of Water Framework Directive requirements.

Attempts have been made in some areas (including Galloway) to mitigate the effects of acidification by the application of lime, either directly to the water body concerned or to the catchment. We do not regard this practice as sustainable.

Measures to address acidification are summarised in Table 11.

Table 11: Measures to address the impacts of acidification

What are we already doing about this?	
Regulation	• Pollution Prevention and Control (PPC) Regulations • Local Authority Air Pollution Control
Economics	• Emission trading schemes
Advice, partnerships and plans	• Forests and Water Guidelines
What additional measures could we put in place?	
Regulation	
Economics	• Expand emission trading schemes
Advice, partnerships and plans	• Voluntary agreements to go beyond statutory requirements • Land management activities • Review Forests and Water Guidelines in light of WFD requirements
What additional measures do you think should be developed? What can you do to help?	

6.9 Diffuse and point source pollution from sewage disposal activities

Sewage is a mixture of wastewater from domestic sources (baths, sinks, washing machines and toilets), wastewater from industry and, in many older urban catchments, rainwater run-off from roads and other surfaced areas. Sewage can impact on the environment as both diffuse and point source pollution.

Environmental impacts

In urban areas sewers are constructed to collect sewage effluent and transport it to sewage treatment works. In most areas sewers allow the overflow of diluted sewage effluent during heavy rain in order to protect homes and properties from flooding as well as protecting the treatment works from flooding.

In rural areas many houses, small hotels and industrial sites are not connected to a public sewage treatment works and treatment is typically provided by septic tanks or small treatment works, many in private ownership. Much of the pollution from these is diffuse in nature and consequently more difficult to address.

Sewage effluent can be highly polluting as it contains:

- organic matter that removes oxygen from the water, potentially killing fish and other aquatic wildlife;
- nutrients which can allow algae to grow to nuisance levels, smothering fish habitats and requiring expensive treatment of water abstracted for industrial or domestic use;
- toxic substances from industry, household chemicals and run-off from roads which includes hazardous substances that do not degrade and accumulate within fish and marine mammals;

- sewage litter which can affect the amenity value of rivers and beaches;
- bacteria and viruses which can cause health problems with water contact sports such as swimming, canoeing or fishing.

Septic tanks have the potential to input nutrients to the water environment including nitrates, phosphates and ammonia. Discharges from septic tanks can also lead to increased biochemical oxygen demand (BOD), reducing oxygen availability for flora and fauna in the water body.

Characterisation data indicate that more than a third of the rivers and lochs/lakes at risk of failing to meet the WFD's environmental objectives by 2015 in the Solway Tweed river basin district are affected by point source or diffuse source pollution from sewage disposal activities.

Annex B provides more information on the extent of pollution from sewage disposal activities in the Solway Tweed river basin district.

Addressing the problem

Historically the primary mechanism to address pollution caused by sewage has been investment in sewers and sewage treatment works. Over the past ten years improvements have resulted in better water quality leading to improved fisheries and bathing waters. However, considerable investment is still required and, consequently, only a proportion of the environmental problems can be addressed in any one investment period.

Additional approaches that can be implemented include:

- reducing pollution at source (e.g. removing phosphorus from detergents), which will lower the costs of treatment and produce environmental benefits;
- reducing the amount of rainwater run-off that passes to sewers and thus reducing pollution from sewer overflows;
- identifying areas where pollution from septic tanks and private treatment works present a problem (an ongoing process for the agencies) and then applying mechanisms such as 'first time sewerage' programmes to deal with the issue.

Measures to address point and diffuse source pollution from sewage disposal activities are summarised in Table 12.

Table 12: Measures to address the impacts of point source and diffuse source pollution from sewage disposal activities

What are we already doing about this?	
Regulation	• Regulatory control over wastewater discharges to the environment • Water company controls on trade effluent discharges to sewer • Statutory controls over use of polluting substances in products • Habitats Directive Review of Consents • Planning policy
Economics	• Water company charging scheme provides incentives for industry to reduce the amount of trade effluent discharged to sewer • Ofwat Overall Performance Assessment • Water company Asset Management Plans/Quality and Standards • First time rural sewerage programmes
Advice, partnerships and plans	• Pollution prevention campaigns • Environmental best practice campaigns for industry • UK Water Industry Research - A common framework for capital maintenance planning • Codes of practice, e.g. on use of sustainable urban drainage systems (SUDS), British Standards • Septic tank systems (CIRIA publications[24]) • Selecting package wastewater treatment plants (CIRIA publications)

[24]www.ciria.org

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	• Review scheme of charges to provide incentives to reduce the amount of rainfall run-off passing to sewer • Increase/strengthen first time rural sewerage programmes
Advice, partnerships and plans	• Develop disconnection plan to reduce rainfall run-off inputs to sewer in problem catchments • Sewer survey programmes to identify infiltration problems • Pollution-reducing campaigns involving the National Advisory Group (in Scotland) and the AAGs • New regional partnership or national initiative with local authorities, water industry and manufacturers of septic tanks • Implement SUDS solutions to help reduce sanitary pollution and free up sewer capacity
What additional measures do you think should be developed? What can you do to help?	

6.10 Point source pollution from manufacturing

Point source pollution refers to a discrete and identifiable source of pollutants that are affecting the environment. Point source pollution relating to manufacturing can be varied and depends on the process at the factories involved.

Typical pollutants include heavy metals, chlorinated solvents, nitrates, phosphates, organic compounds and pesticides. Although controlled through permitting, discharges can adversely affect water quality and especially during times of low flow, when there is less dilution. Addition of any of these pollutants to the environment will impact on the local ecosystem around the discharges, but can also have a wider impact.

Only one water body in the Solway Tweed river basin district at risk of failing to meet good ecological status is affected by point source pollution from manufacturing. Given that the issue is attributed to a single water body, it is proposed that this is not a significant issue in the Solway Tweed river basin district. It is therefore not included in the proposed list of significant water management issues in Table 3.

6.11 Point source pollution from electricity generation

This issue refers to discharges from the generation of electricity that elevate the temperatures of the receiving waters – also known as thermal or heat pollution. Thermal pollution can occur as a sudden event or over a longer period, which can have a chronic impact on the environment around the discharge.

The most direct impact is to change the temperature of the receiving waters with a subsequent effect on the local ecosystem. All species have optimum temperatures for growth and a range of temperature in which they can survive. For some species, particularly some fish species, this range is quite small and any change in the ambient temperature can displace them from their natural environment.

Thermal pollution also typically decreases levels of dissolved oxygen in the water, resulting in less oxygen being available for organisms within the ecosystem. A further impact on dissolved oxygen can result from algae blooms, which are more likely as a result of elevated temperatures. There is also the potential to increase the metabolic rate of aquatic animals, resulting in higher rates of food consumption and a consequent drop in the availability of food. Reduced availability of food can have a dramatic impact on population numbers.

Only one water body in the Solway Tweed river basin district at risk of failing to meet good ecological status is affected by point source pollution from electricity generation. Given that the issue is attributed to a single water body, it is proposed that this is not a significant issue in the Solway Tweed river basin district. It is therefore not included in the proposed list of significant water management issues in Table 3.

6.12 Abstraction and flow regulation pressures and morphological change from water supply

Public water supplies are abstracted from rivers, lochs/lakes, reservoirs and groundwater. These supplies have faced a progressive increase in the volume of water used for domestic purposes. This long-term trend places increasing demands on water resources and consequently on the environment. This trend is mitigated to some extent by the reduction in the water consumption by industry over the past 50 years.

The potential for environmental impact from water supply arises from abstraction of water and the storage of water in reservoirs to support abstractions. Conversely, the creation of reservoirs over the years has in many cases provided an opportunity for the development of new diverse ecosystems, which also provide social and recreational benefits.

Environmental impacts

The amount of water in rivers and lochs/lakes varies naturally. Environmental impacts result when the ecology cannot tolerate the changes in water levels and/or flows. In the most extreme cases, abstraction can result in the drying up of rivers at low flows or exacerbation of the impacts associated with dry rivers.

The potential negative environmental impacts from water supply are associated with:

- the abstraction of water;
- the construction and operation of dams and associated engineering.

If not controlled, these may result in:

- low levels of water caused by direct abstraction from rivers (particularly during the summer) leading to damage to the ecology of rivers and their associated wetlands;
- low groundwater levels caused by abstraction leading to the drying out of small tributaries and wetlands and the reduction in river baseflows during periods of low rainfall;
- variable water levels in lochs/lakes and 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;
- interuption of flow of sediment downstream of dams depletes gravel needed by salmon and trout to spawn;
- loss of bankside river habitat for fish and invertebrates.

Approximately a quarter of at risk water bodies are affected by abstraction and flow regulation from water supply in the Solway Tweed river basin district.

Annex B provides more information on the extent of abstraction, flow regulation and morphological change from water supply in the Solway Tweed river basin district.

Addressing the problem

Over recent years water companies have invested substantially in the water supply infrastructure. This investment concentrated on improving drinking water quality, which is now of a very high standard when measured against European drinking water standards.

There are three approaches to reducing the impact of water supplies upon the water environment:

- **Development of new resources.** Although the potential for developing new sources of drinking water supply is limited, there are still opportunities for developing resources in some areas and using this to reduce the impact in the areas subject to water stress. Overall there may be a reduction in the environmental impact. This option is very expensive and it can substitute one environmental problem with another.
- **Development of existing infrastructure.** Water lost by leakage within the supply network represents a waste of high quality drinking water, which in turn causes unnecessary abstraction from the environment. Controlling leakage is an attractive means of reducing over-abstraction but it can be difficult to deliver with leaks hard to find. There is a balance between the costs involved in finding and repairing leaks, and the benefits which result. The economic level of leakage varies across the river basin district. Investment can also deliver benefits by providing additional compensation flows for downstream rivers.
- **Managing demand.** The progressive increase in the demand for water is unsustainable, making demand management an important priority. Improving water efficiency standards for domestic appliances such as washing machines and dishwashers and moving to dual flush toilets is crucial.

Measures to address the impacts of abstraction and flow regulation and morphological change from water supply are summarised in Table 13.

Table 13: Measures to address the impacts of abstraction and flow regulation and morphological change from water supply

What are we already doing about this?	
Regulation	• Regulatory control over levels of abstraction and the management of dams • Planning policy • Catchment abstraction management strategies • Habitats Directive Review of Consents • Drought plans • Water resources plans (national, regional, water company)
Economics	• Charging incentives ensuring the efficient use of water by industry
Advice, partnerships and plans	• Publicity campaigns promoting efficient water use by domestic customers • Restoring Sustainable Abstraction programme[25]
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
Economics	• Improve water efficiency standards for domestic appliances and include water efficiency as well as energy efficiency information for customers • Increase domestic metering (England)
Advice, partnerships and plans	• Increase influence on planning activities with respect to increases in housing • Codes of practice • Water efficiency campaigns
What additional measures do you think should be developed? What can you do to help?	

6.13 Abstraction pressures from 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 in the Tweed catchment.

The Tweed Area Advisory Group requested that abstraction from agriculture be included as a significant water management issue to recognise the impact of abstraction on the River Till in Northumberland. Surface water is abstracted in the Till catchment from the rivers for agricultural use for spray irrigation and root crops, particularly potatoes. Impacts associated with agricultural irrigation also occur on the Scottish tributaries draining to the Tweed.

Environmental impacts

Abstraction, particularly for irrigation, is typically required during dry weather when rivers are low. Consequently abstraction for irrigation exacerbates naturally occurring low flows. A typical irrigation pump can extract 1,200 m^3 of water over a period of 24 hours. This is equivalent to the average water used by 6,000 people. In addition, the distribution of crops means that farmers frequently have to rely on small burns and tributaries which, during periods of low flows, may not have sufficient water to support the abstraction without causing environmental impact.

[25]See www.defra.gov.uk/environment/water/resources/abstraction/index.htm

Abstraction from agriculture is typically at its highest levels between May and August. This has the following environmental impacts:

- Reduced summer flows occasionally lead to stranding of fish and drying out of wetlands.
- It increases the vulnerability of fish and other freshwater life due to raised temperatures in pools isolated by low flows.
- It exacerbates the effects of pollution due limited dilution.
- Small dams across rivers are sometimes built 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 the effects of diffuse pollution to seriously damage the ecology of small burns.
- Changes to 'flow variability' are important to many river species including salmon, trout and pearl mussels.

Addressing the problem

Abstraction licences are issued in England under the Water Resources Act 1991 and the Water Act 2003 for most abstractions over 20 m^3 per day. New licence applications are assessed for their potential environmental impacts and impacts on other water users. Abstraction licences may limit the amount of water that can be abstracted on an annual, daily or hourly basis (or all three) and may also include conditions on when water can be abstracted. These conditions are the principal way in which licences protect the environment. Water resource planning in England is achieved through catchment abstraction management strategies, which assess the environmental impact of current licensing practices and provide a framework to ensure that future licensing in the catchment is sustainable.

In Scotland, the new Controlled Activities Regulations provide a comprehensive control regime for abstractions. This will allow SEPA to manage water resources across Scotland and therefore ensure their long-term sustainable use. Controlling abstractions enables environmental impacts to be minimised and the water environment to be protected.

Unlike the majority of rivers in England and Wales, the Environment Agency does not currently license abstractions from rivers in the River Till catchment. However, a number of abstractions in the area of the River Till Site of Special Scientific Interest (SSSI) are consented by Natural England (formerly English Nature). Current consented levels of abstraction are a significant proportion of a very low flow. Rivers are often most sensitive at low flows, so this means there is potential for significant impacts.

One of the targets in the Environment Agency's corporate strategy, *Improving the environment in the north east region*,26 is to reduce the number of unsustainable abstractions from the River Till catchment. The Till Catchment Abstraction Management Strategy (CAMS) process is being developed and consultation is planned for summer 2007. In preparation for the Till CAMS, Natural England has issued time limits on all new and varied surface water abstraction licences. These will reduce the volume of water that can be abstracted. Targets are in place to reduce abstraction by 2008.

Abstractors in the River Till catchment are already working together to prepare for the impact of these changes; the North Northumberland Agricultural Abstractor Group was formed three years ago and consists of about 25 growers in the River Till catchment area. The group is working together so that farmers can manage the amount of water abstracted at peak times and is considering the potential for use of winter storage reservoirs.

In Scotland, 66 km of river within the Tweed catchment are adversely affected by irrigation. Discussions have started with farmers to investigate how these impacts can be mitigated.

Measures to address abstraction for agriculture are summarised in Table 14.

[26]http://publications.environment-agency.gov.uk/pdf/GENE0406BKMI-e-e.pdf

Table 14: Measures to address the impacts of abstraction from agriculture

What are we already doing about this?	
Regulation	• Regulatory control over the volume of water that can be abstracted and the time over which it can be abstracted • Catchment abstraction management strategies
Economics	• Charging schemes encouraging winter abstraction and storage
Advice, partnerships and plans	• Publicity campaigns/projects promoting efficient water use by farmers • Promote management agreements between farmers to ensure that abstractions are phased to avoid abstractions at the same time • Restoring Sustainable Abstraction • Catchment Sensitive Farming
What additional measures could we put in place?	
Regulatory	• Implement the Water Act requirements for licensing of cross-border rivers • Require efficient use of water • Ensure compliance with management agreements
Economics	• Further develop regulatory charging scheme to provide additional incentives to abstract when flows are high • Part-funding for irrigation ponds under Rural Development Contracts
Advice, partnerships and plans	• Promote best irrigation practice to ensure that water is used efficiently • Provide information on which rivers do not have capacity for further abstraction • Promote use of storage and sector-specific water efficiency measures
What additional measures do you think should be developed? What can you do to help?	

6.14 Abstraction and flow regulation pressures from hydropower

Hydropower generation uses the flow of water to generate electricity. In larger schemes the water is often stored in reservoirs until generation is required and, in some cases, the water is diverted across catchments to fill the reservoir. An alternative is 'run-of-river' schemes, which use the flow of water in a river to generate energy. These schemes remove water from a river (often requiring a barrage to regulate flow), pass it through a turbine and return it to the same river.

Large hydropower schemes can generate energy on demand and are less susceptible to the weather than energy produced by windfarms or run-of-river hydropower schemes. Additional pumped storage hydropower capacity (where water is pumped uphill to a reservoir in times of low demand) may be beneficial in future to match fluctuating supplies from large-scale intermittent sources such as wind and wave power with consumer demands.

Environmental impacts

The potential negative environmental impacts of hydropower are associated with the abstraction of water and the construction and operation of dams. If these activities are not controlled, they can result in:

- very low flows in rivers, which may periodically be virtually dry;
- 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 unscreened turbines;

- barriers to sediment movement downstream of dams, reducing the availability of gravels needed by spawning fish;
- loss of bankside river habitat for fish and invertebrates.

However, some hydropower reservoirs and rivers affected by hydro schemes create the conditions that have led to sites being designated under conservation legislation. For example, some reservoirs are operated to maintain constant reservoir water levels when black throated divers are nesting. In future it may be possible to deliberately create specific types of habitat at new hydropower sites.

In addition, some naturally inaccessible rivers were opened up to migrating salmon and sea trout as part of the mitigation measures for some hydro schemes and many reservoirs are used for angling (especially for brown trout). Hydropower developments often occur where there are waterfalls or rapids, and so coincide with the type of river used by canoeists and for rafting.

Addressing the problem

The main mechanism for addressing the negative impacts of hydropower schemes on the water environment is through the regulatory controls defined in licences issued by SEPA and the Environment Agency. The main aim of these controls is to balance the need to minimise impacts on the environment with the importance of renewable energy generation in combating climate change.

It is likely that many of the water bodies impacted by hydropower will be designated as heavily modified water bodies (see section 7.2) where restoration of the water environment to good ecological status cannot be delivered without causing a significant adverse impact on the purpose of the modifications.

Within this framework the agencies consider it is possible to deliver important improvements in the water environment by moving existing schemes towards modern standards of good practice. The following four approaches could deliver improvements in the water environment without significantly affecting energy generation:

- Redistribute the water currently available to the water environment to maximise the environmental benefits in a manner that does not affect energy generation.
- Identify changes that are not related to the volume of water released such as improvements to the physical quality of river and loch habitats to benefit fish migration and other species.
- Identify situations where a large environmental improvement can be delivered for minimal loss of generating capacity, e.g. through compensation flows to dry river channels.
- Apply best practice design to old hydropower schemes, replacing older technology with new more efficient equipment which uses less water to generate similar amounts of power.

Measures to address abstraction and flow regulation from hydropower are summarised in Table 15.

Table 15: Measures to address the impacts of abstraction and flow regulation from hydropower

What are we already doing about this?	
Regulation	• Regulatory control of licensed hydropower schemes • Fisheries (Electricity) Committee provides advice on measures to protect fisheries imposed via licences • Local authority development planning and control
Advice, partnerships and plans	• Voluntary agreements between hydropower and interest groups such as anglers • Catchment abstraction management strategies
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)*
What additional measures do you think should be developed? What can you do to help?	

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

6.15 Morphological change from agriculture

Farming has a major influence on our landscape, tourism, culture and natural heritage and makes a significant contribution to our economy. There are significant opportunities and challenges ahead for agriculture as the focus and level of farm support changes from production to environmental protection and wider rural development. A significant issue that needs to be addressed in this sense and for the Water Framework Directive are the physical modifications that have impacted on the morphology (the form and structure) of our water bodies.

Environmental impacts

Rivers are naturally dynamic; they flood adjacent lands, erode their banks and bed, and move sediment around. These natural processes help create a healthy river (or loch/lake) environment that will support a range of important flora and fauna.

Morphology describes the size, form and character of water body. Under natural conditions, rivers will create a shape, size and character that reflect the balance between local conditions and conditions within the wider catchment. Some agricultural activities (e.g. riverbank engineering) can affect this natural balance and result in morphological damage. This can lead to a loss of important habitats, changes to rates of erosion or sediment deposition and, potentially, an increased risk of flooding elsewhere in the catchment.

The activities associated with agriculture can result in the following types of environmental impact.

- Grazing and trampling of river banks by cattle can lead to loss of bankside habitats and vegetation, increased inputs of fine sediments and increased risk of bank erosion.
- The loss of habitat for fish spawning, invertebrates and aquatic plants may lead to increased risk of bank and bed erosion from sediment removal.
- The construction of embankments for flood defence can lead to the loss of floodplain wetlands and associated biodiversity. The presence of the structures can also result in a loss of in-channel habitats due to increased erosion during floods affecting fish, invertebrates and aquatic plants. Flood risk downstream may also be increased.
- The loss of bankside vegetation as a result of bank protection work often increases the risk of bank erosion downstream, resulting in loss of in-channel habitat supporting fish, invertebrates and aquatic plants.
- Channel straightening can result in a loss of in-channel habitats and significant changes to erosion and sediment deposition in the surrounding channel.
- The removal of riparian vegetation can lead to increased inputs of fine sediments, increased risk of bank erosion, loss of bankside habitats and elevated water temperatures.

The permanency of engineering structures means that many of these impacts are likely to be cumulative and long lasting.

River engineering in agricultural areas can have direct economic consequences for other land owners. Where engineering has substantially altered the natural character of a river, there may be unplanned impacts that must be addressed by upstream or downstream land owners. In severe cases, these impacts can result in a requirement for continued and costly maintenance works, including sediment management and erosion control.

In some areas of the country, land drainage and river engineering have contributed to increased flood risk. These impacts are typically restricted to areas where works are undertaken in an ad-hoc manner without full consideration of the flooding processes and other works within the catchment.

Addressing the issue

Some of the most productive agricultural land in the Solway Tweed river basin district occurs alongside rivers. This land has often been cultivated though centuries of investment to protect the land from flooding and to improve drainage. Compromising such important areas of agricultural production could have serious impacts upon rural economies and food production. However it is also important to recognise that constraining the space available to a river can harm the environment, create problems for downstream landowners and increase flood risk in urban areas.

There is a close relationship between measures to protect rivers from diffuse pollution and measures to restore river morphology. For example, the creation of buffer strips alongside rivers to reduce pollution also provides rivers with space to recover habitat diversity. Riparian woodlands reduce diffuse pollution and contribute to lower rates of bank erosion. Floodplain vegetation can also help store flows on floodplains, thereby alleviating downstream flood risks. These actions, which can deliver benefits to both farmers and the environment, will be promoted through single farm payments, agri-environment schemes and, in Scotland, the proposed General Binding Rules made under the Controlled Activities Regulations. Agriculture will also have an important role in managing flood risk, which may involve targeted re-establishment and restoration of floodplains.

Measures to address morphological impacts from agriculture are summarised in Table 16.

Table 16: Measures to address morphological impacts from agriculture

What are we already doing about this?	
Regulation	• Regulation to prevent new damage to the water environment by engineering works on rivers • Water Resources Act 1991 • Planning policy and guidance
Economics	• Single farm payments promote good agricultural practice • Forestry incentives promote riparian woodland, helping to stabilise banksides and aiding natural flood management • Agri-environment schemes
Advice, partnerships and plans	• Best practice advice on river management from NGOs • River Restoration Centre[27] manuals • Habitat enhancement schemes led by local voluntary initiatives • Catchment Sensitive Farming • Catchment flood management plans • Asset management plans for flood risk management systems (these will direct spending to high urban risk systems and away from rural maintenance)
What additional measures could we put in place?	
Regulation	• Development of General Binding Rules protecting buffer strips alongside rivers • New restoration regulations would allow investment to remove abandoned structures such as weirs and old embankments
Economics	• Sustainable and catchment orientated framework for addressing flood risk • Voluntary creation of wetlands through environmental stewardship schemes
Advice, partnerships and plans	• Work through catchment flood management plans to increase use of 'soft' defences and reduce peak flows where possible • Promote blocking of moorland grips and peat bog restoration • Promote land use changes to improve morphology • More effective awareness raising of the issues • Develop and promote sustainable drainage systems
What additional measures do you think should be developed? What can you do to help?	

[27]www.therrc.co.uk

6.16 Morphological change from forestry

Natural forest was once an abundant habitat within the Solway Tweed river basin district. But over several centuries, much of this forest was removed as fuel and construction materials for industrial growth and to allow for sheep and cattle grazing. The large-scale programme of upland conifer afforestation in the middle decades of 20th century caused a number of problems for the water environment and led to production of the *Forests and Water Guidelines* by the Forestry Commission in 1988 (see section 6.6).

Environmental impacts

The impact of forestry upon the physical structure of rivers is a historical problem caused by certain forestry practices over the past 60 years. This impact is now largely avoided by the application of good environmental practice.

Damage to the physical structure of rivers by forestry is associated with the following practices.

- Dense planting of coniferous trees up to the bank of rivers creates deep shading that prevents the growth of riparian vegetation which protects the river bank from erosion. The resulting erosion can result in shallow open rivers with little shelter for fish and low biodiversity.
- On steep hillsides, poorly sited culverts constructed as part of forestry road crossings can prevent the migration of fish upstream reducing the areas available for spawning.
- Inappropriate land drainage can increase the rate of rainfall run-off from hillsides. The result can be higher peak flows, and the scouring and erosion of river gravels and banks.
- Harvesting can result in direct damage to rivers by machinery crossing, or operating too close to, river banks.

How do we address this issue?

Most large conifer forests are managed under a Forest Plan (private sector) or a Forest Design Plan (national forest estate) which sets out long-term management proposals (including restructuring). These proposals are widely consulted upon and take account of the needs of the water environment as well as a range of other objectives. Changes in forest design practice now ensure that new forests have an appropriate mixture of open space and low density planting of deciduous trees alongside rivers and lochs/lakes. Importantly, they also ensure that the management of existing forests incorporates restructuring to take account of the needs of the water environment.

Forestry has long planning horizons: a commercial conifer forest is typically managed on a 50 to 80 year rotation. Guidelines on good practice in forest design were introduced about 15 years ago but are only implemented as forests mature. Some poorly designed plantations may not reach this stage for decades to come and, even when appropriate restructuring takes place, it may take many years for rivers to fully recover.

Forestry Commission grants and felling licences, including Forest Plans, are conditional on adherence to the UK Forestry Standard and its associated suite of forestry guidelines, including the latest edition of Forests and Water Guidelines. These cover the construction of roads and the drainage of land. This guidance has delivered substantial improvements in forestry practice. The Forestry Commission is working with SEPA and others to ensure that river crossings are appropriately designed.

Measures to address morphological impacts from forestry are summarised in Table 17.

Table 17: Measures to address morphological impacts from forestry

What are we already doing about this?	
Regulation	• Effective controls over felling through felling licensing or forest plans • Environmental impact assessments (EIAs) required for forest road construction, quarrying and deforestation • Controlled Activities Regulations – control crossings and engineering activities in rivers in Scotland
Economics	• Compliance with the UK Forestry Standard and its associated suite of forestry guidelines is a mandatory requirement of forestry incentives and felling controls
Advice, partnerships and plans	• Forests and Water Guidelines • UK Woodland Assurance Standard • Liaison between the agencies and Fisheries Trusts/DSFBs to improve understanding of the issue

What additional measures could we put in place?	
Regulation	
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
Advice, partnerships and plans	• Phasing of felling to concentrate efforts on rivers subject to morphological damage • Build on Forest Stewardship Council[28] schemes
What additional measures do you think should be developed? What can you do to help?	

6.17 Alien species from recreational, sporting and cultural activities

Invasive alien species are non-native organisms that successfully establish themselves in our aquatic ecosystems, resulting in damage to our natural biodiversity and creating potentially significant economic impacts. Numerous alien species have been introduced deliberately into the UK through, for example, agriculture, forestry, horticulture and fisheries. Many other species have, however, been introduced accidentally through these and other sectors.

Almost 1,000 alien species are present in the UK, though most are not presently strongly invasive or harmful to native biodiversity. But given the appropriate environmental conditions, a minority of alien species behave invasively and, on becoming established, can cause declines in native biodiversity and the transformation of ecosystems. The inter-connectedness of our water environments also assists the dispersal of invasive aquatic species.

Environmental impacts

Alien species have been divided by the UK Technical Advisory Group on the Water Framework Directive (UKTAG) for the purposes of its risk assessment into three categories of impact – high, low, and unknown. To make the task of assessing risk to the water environment manageable, work has concentrated on ten high impact species:[29]

- Australian swamp stonecrop (*Crassula helmsii*);
- Chinese mitten crab (*Eriocheir sinensis*).
- common cord-grass (*Spartina anglica*);
- floating pennywort (*Hydrocotyle ranunculoides*);
- Japanese weed (*Sargassum muticum*);
- North American signal crayfish (*Pacifastacus leniusculus*);
- parrot's feather (*Myriophyllum aquaticum*);
- slipper limpet (*Crepidula fornicata*);
- water fern (*Azolla filiculoides*);
- zebra mussel (*Dreissena polymorpha*);

These species were selected because:

- their impact is known to be severe;
- information on them is usually available for the water bodies in which they occur.

Scottish Natural Heritage (SNH) and Natural England identified records of known locations of these alien species in the Solway Tweed river basin district. Their presence indicates a risk that the water body will not achieve the WFD's environmental objective of good ecological status. The analysis was not a comprehensive assessment of all alien species but indicates the potential extent of the problem in the Solway Tweed river basin district.

[28]www.fsc-uk.org

[29]UKTAG guidance on the assessment of alien species pressures, January 2004. Available at: www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5332/TAG%202004%20%28PR1-16-03-04%29/view

No detailed assessment of ecological impact was made for any of the risk assessments of water bodies. For the purposes of the 2004 characterisation exercise,[30] the recorded presence of one or more of the species on the SNH/Natural England list was considered sufficient to place the water body at risk of failing to meet its environmental objectives under the WFD.

The following four alien species identified by UKTAG as posing a risk to water ecosystems, are present in the Solway Tweed river basin district.

- North American signal crayfish, *Pacifastacus leniusculus*, are present in several catchments. It has an impact on the fish abundance and age structure, as one of its main food sources are fish eggs and larvae. It also burrows into banks, releasing silt and causing possible slumping of banks.
- Japanese weed, *Sargassum muticum*, is a brown seaweed and impacts through smothering existing marine communities. It also has a potential economic impact as these communities may include shellfish beds. It was first recorded in Loch Ryan.
- Common cord-grass, *Spartina anglica*, is found along the Solway coast where it grows on mudflats and the adjacent merse, changing the habits to a monoculture and reducing the area of open mud available to estuarine birds. It also tends to change the pattern of accretion of silt.
- 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.

In addition, large stands of Japanese knotweed (*Fallopia japonica*) and Himalayan balsam (*Impatiens gladulifera*) are present along river banks. This can result in the structure and condition of riparian zones no longer corresponding to the requirements of the WFD high status morphological conditions. However, their presence does not necessarily indicate that a water body will fail to achieve good ecological status. Japanese knotweed on the Solway shoreline out-competes the native flora and creates an erosion risk during winter months.

Addressing the issue

Addressing alien species problems that prevent the achievement of good ecological status will require action targeted within specific water bodies and consideration of potential sources of re-infestation in the surrounding area.

Experience in controlling alien species has shown that:

- complete eradication is costly and difficult (and may even be impossible in practice);
- preventing introduction in the first place is easily most cost-effective outcome.

If a strategic approach is not adopted, there is also a risk of re-infestation from neighbouring sites or, for example, upstream river sections. Co-ordinated control programmes involving a wide range of partners and stakeholders have a much greater chance of success in the long term. Several pilot projects have adopted such an approach.

A three-level hierarchical approach adopted by the Convention on Biological Diversity (CBD) identifies prevention, detection/surveillance and control/eradication as the three main ways of dealing with invasive species. The approach is to:

- develop and instigate a programme of work to tackle existing aquatic alien species problems;
- prevent the further spread of invasive alien species already present;
- prevent new introductions of invasive alien species.

This approach is being adopted by the developing GB Framework Strategy for Invasive Non-native Species,[31] the implementation of which in Scotland is being overseen and informed by the work of Scottish Working Group on Invasive Non-Native Species lead by the Scottish Executive.

Through the AAGs and the river basin management plan, we will seek to engage with and involve partners. By focussing and prioritising effort, this approach can garner and spend limited resources in the most effective way to address the impacts of priority invasive alien species on the water environment.

Alien species may also be a priority for further research, monitoring and investigation in the first round of river basin planning so that we can, subject to available funding, address the gaps and justify measures in future rounds.

[30]Leading to publication of the Article 5 characterisation report in March 2005.
[31]The Invasive Non-Native Species Framework Strategy for Great Britain [draft], 2007. Available at: www.nonnativespecies.org/documents/Draft_StrategyV6.4.pdf

Case study

The Tweed Invasives Project[32] was established with the aim of achieving long-term sustainable control of giant hogweed and Japanese knotweed within the Tweed catchment. A full-time project officer is funded by contributions from statutory agencies (e.g. SEPA and SNH) and external funding (Heritage Lottery Fund, Landfill Tax Credit Scheme) and is responsible for raising awareness, providing advice and co-ordinating a range of control and management initiatives. Often the control is undertaken by landowners or volunteer groups but facilitated and co-ordinated by the project officer. The project has provided both training and materials (herbicides) to enable this control work to be undertaken. No single organisation has responsibility for tackling the alien species problems within the catchment, but there is now a shared agenda and commitment to the project's aims.

Table 18: Measures to address impacts from invasive alien species

What are we already doing about this?	
Regulation	• Import of Live Fish Act 1980 (as amended) and associated by-laws concerning crayfish • Wildlife and Countryside Act 1981 (registration) • The Prohibition of Keeping Live Fish (Crayfish) Order 1996/The Prohibition of Keeping or Release of Live Fish (Specified Species) (Scotland) Order 2003 • Salmon and Freshwater Fisheries Act; • Natural England and Rural Communities (NERC) Act 2006 • Planning policy • Regulation of the use of herbicides to control invasive plants in or near water through the Control of Pesticides Regulations
Advice, partnerships and plans	• Species Action Framework (Scottish Executive and Scottish Natural Heritage) • Biodiversity Action Plans; • NetRegs (www.netregs.gov.uk) advice on best practice for control of certain alien plant species • Local authority 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
Advice, partnerships and plans	• 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 • New codes of practice
What additional measures do you think should be developed? What can you do to help?	

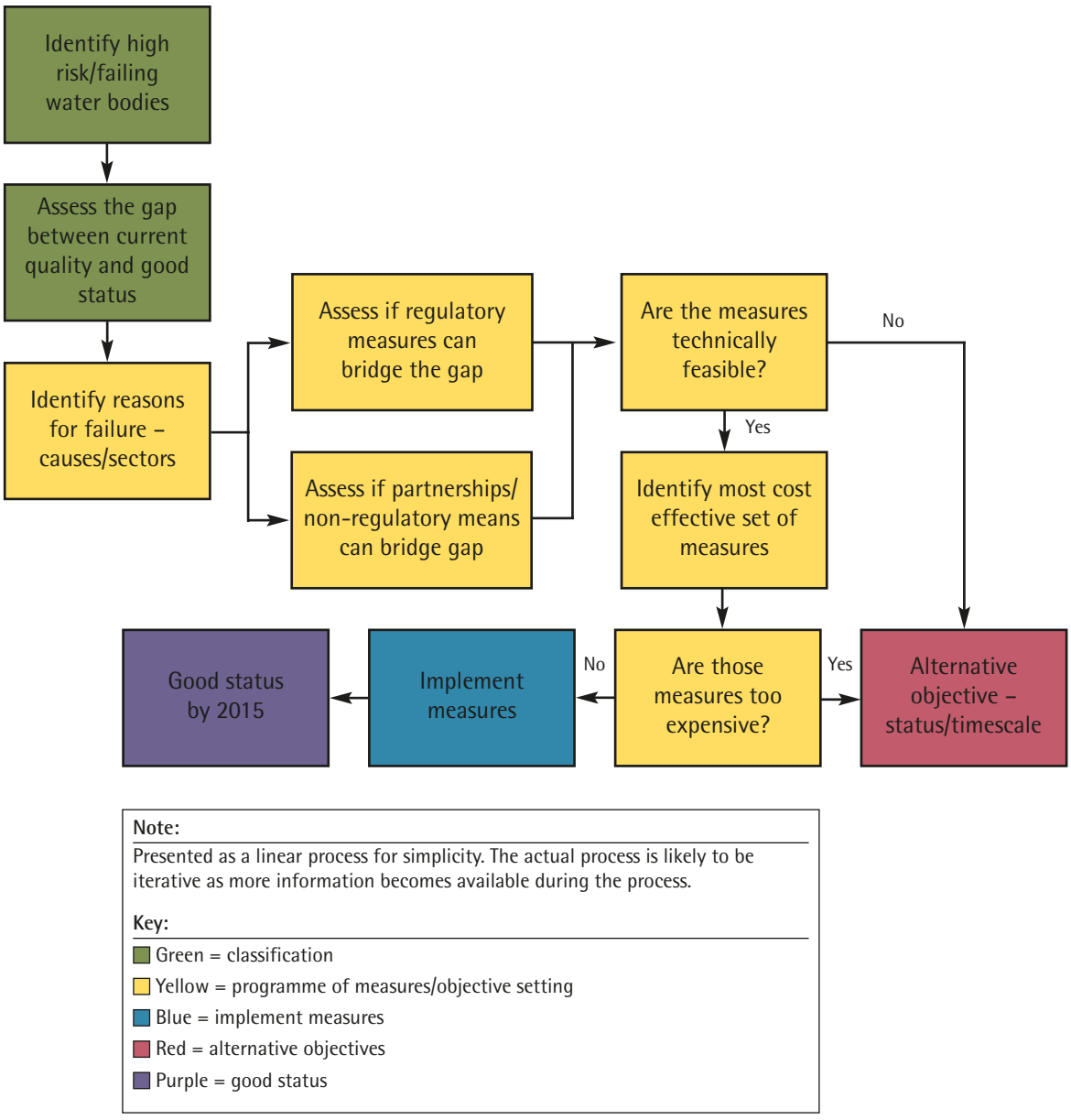
[32]See www.tweedforum.com/projects/inv

7 Next steps

7.1 Production of the draft river basin management plan

Now that we have identified the significant issues in the Solway Tweed river basin district, the next step is to consider in detail how we will address these issues at a water body level. To do this we will look at each water body to determine whether or not it is achieving the good status required by the Water Framework Directive. We will then identify the reasons for any failures and work with our partners to develop a set of measures that will ensure that the water body meets good status. This process is summarised in Figure 4.

Figure 4: Developing measures to ensure good status



We may find some water bodies that will not meet the WFD target of good status; an example might be where a water body has undergone physical modification, e.g. for hydropower or to prevent flooding. For these water bodies we will need to set alternative objectives (see section 7.2).

Details of work undertaken to date on the expected status of water bodies in 2015 is available in Annex D.

7.2 Objective setting

The Water Framework Directive's objective setting provisions are designed to allow the development of an appropriate balance between protecting and improving the water environment, and ensuring sustainable uses can continue and flourish. The Water Framework Directive requires us to aim to achieve good status when and where it is technically feasible and proportionate to do so. Objective setting is an improvement planning process which, through the appropriate use of the alternative objectives, will allow us to phase improvements over several river basin planning cycles without undermining the sustainable use of our water. Further information on objective setting can be found on the Scottish Executive website (www.scotland.gov.uk/Publications/2007/03/29111609/5).

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. The agencies have reviewed the provisional heavily modified water bodies in the Solway Tweed river basin district and are interested to hear your views.

Artificial and heavily modified water bodies

The environmental objective for artificial and heavily modified water bodies is good ecological potential by 2015 rather than good ecological status. We have identified artificial water bodies in the Solway Tweed river basin district but work is still ongoing regarding the identification of heavily modified water bodies. The work undertaken to date and how we intend to proceed is outlined below.

Artificial water bodies

Artificial water bodies (AWBs) are bodies of surface water entirely created by human activity. A separate classification scheme is being developed for AWBs that need to attain good ecological potential as opposed to good ecological status. Provisional AWBs were identified in the characterisation for the Solway Tweed river basin district carried out in 2004.

Heavily modified water bodies

In certain circumstances it is not possible for a water body to achieve good status due to substantial alterations made for specified water uses such as drinking water supply, hydropower generation, ports and harbours, urban land use and land drainage. The WFD recognises that the benefits of such uses need to be retained and allows these water bodies to be designated as heavily modified.

To designate a water body heavily modified, both of the following criteria must be met:

- The hydromorphological improvements necessary to achieve good ecological status would have a significant adverse effect on the wider environment or on a specified water use.
- Technical feasibility or disproportionate cost mean there is no significantly better environmental option by which the benefits served by the modifications could reasonably be achieved.

In the Article 5 characterisation and impacts analyses report for the Solway Tweed river basin district,[33] provisional heavily modified water bodies were identified on the basis of maps and local knowledge. There have been minor amendments to the number of provisional HMWBs since the Article 5 report.

UKTAG has developed a screening tool (www.wfduk.org) for use in determining which of these provisional heavily modified water bodies clearly meet the requirements above and should therefore be designated heavily modified without the need to collect additional information.

[33]www.sepa.org.uk/pdf/publications/wfd/Article_5_Solway_Tweed.pdf

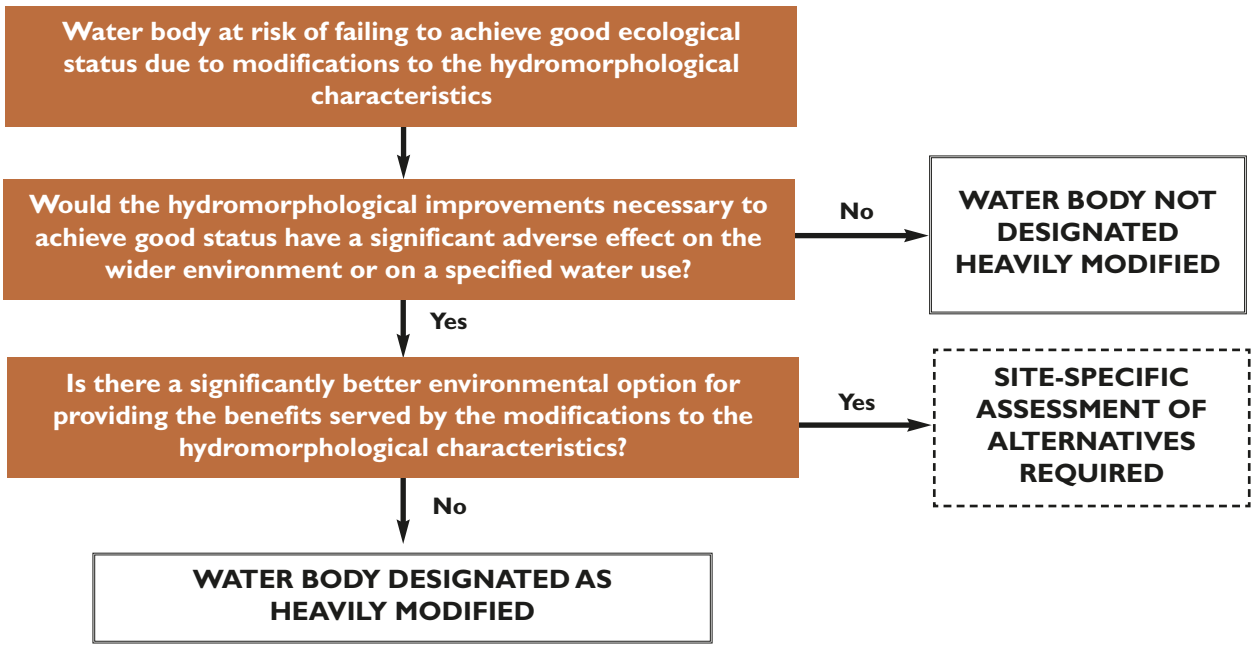
The uses associated with the modifications to the hydromorphological characteristics covered by the screening tool are:

- wider environment (impacts on national and international conservation objectives);
- drinking water supply;
- hydropower generation;
- ports and harbours;
- urban, residential and commercial land use.

This list of uses is not exhaustive. If the use associated with the modifications to the hydromorphological characteristics is not covered by the tool, a site-specific assessment will be undertaken to collate the necessary information required to determine whether the water body should be designated heavily modified or not.

The tests applied by the screening tool are described in Figure 5.

Figure 5: HMWB designation tests as defined by Article 4.3 of the WFD



The screening methodology does not deal with situations where there is a significantly better option for providing the benefits served by the modifications. For example if an impoundment has been built at a loch/lake outflow to provide a drinking water supply, a site-specific assessment may be required to determine whether the water supply could be provided by an alternative source. In situations where there is such an option, a site-specific assessment will be undertaken to decide if the option is technically infeasible or disproportionately expensive in the particular circumstances. Only then will designation be considered.

All site-specific assessments will be completed before publication of the draft river basin management plan.

During autumn 2006 the agencies assessed these water bodies to determine whether they meet the criteria in terms of significant adverse impact on use and significantly better environmental option. We applied the UKTAG screening tool to all 115 water bodies (identified in the Article 5 characterisation report as provisionally heavily modified) in the Solway Tweed river basin district and identified 42 water bodies that meet the criteria for designation as heavily modified (Table 19). Map 10 shows those water bodies that meet the criteria for designation as heavily modified and those water bodies for which site-specific assessments will be undertaken.

Table 19 lists the area and length of the confirmed HMWB. We now have to assess which HMWBs 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 19: Results of applying heavily modified water bodies screening tool in the Solway Tweed 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	343 km (6%)	6041 km	31 (6%)	521
Loch	21 km^2 (48%)	44 km^2	10 (31%)	32
Transitional	1.5 km^2 (0.4%)	390 km^2	1 (9%)	11
Coastal	0	1913 km^2 0	(0%)	8
Groundwater	0	15631 km^2	0 (0%)	74
Total	**-**	**-**	**42 (7%)**	**646**

Table 20: Reasons for water bodies being designated heavily modified

Use	Number of water bodies*
Drinking water supply	21
Hydropower generation	11
Land drainage	11
Urban residential and commercial land use	6
Wider environment	3
Ports and harbours	–

*The total number of water bodies designated heavily modified per use is greater than the total number of water bodies designated heavily modified within the river basin district. This is because a heavily modified water body may be affected by more than one use.

Site-specific assessments will be undertaken through one of the following two processes.

- For those provisional heavily modified water bodies where the activity responsible for their physical modifications is a controlled activity under the Controlled Activities Regulations (e.g. impounding works and maintenance engineering works), SEPA will use its licence review process to identify whether the above criteria for designation as heavily modified are met.
- For any provisional heavily modified water bodies still remaining, SEPA will use the advisory group networks and external partners to help gather the necessary information needed to determine whether the designation criteria are met.

The final consultation on which bodies should be designated as heavily modified water bodies will be undertaken as part of the draft river basin management plan consultation.

Consultation questions

Please provide your justification and supply relevant information to support your response.

- Are there water bodies that have been provisionally 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?

Table 21: Results of applying the heavily modified screening tool to provisionally identified heavily modified water bodies in the Solway Tweed river basin district

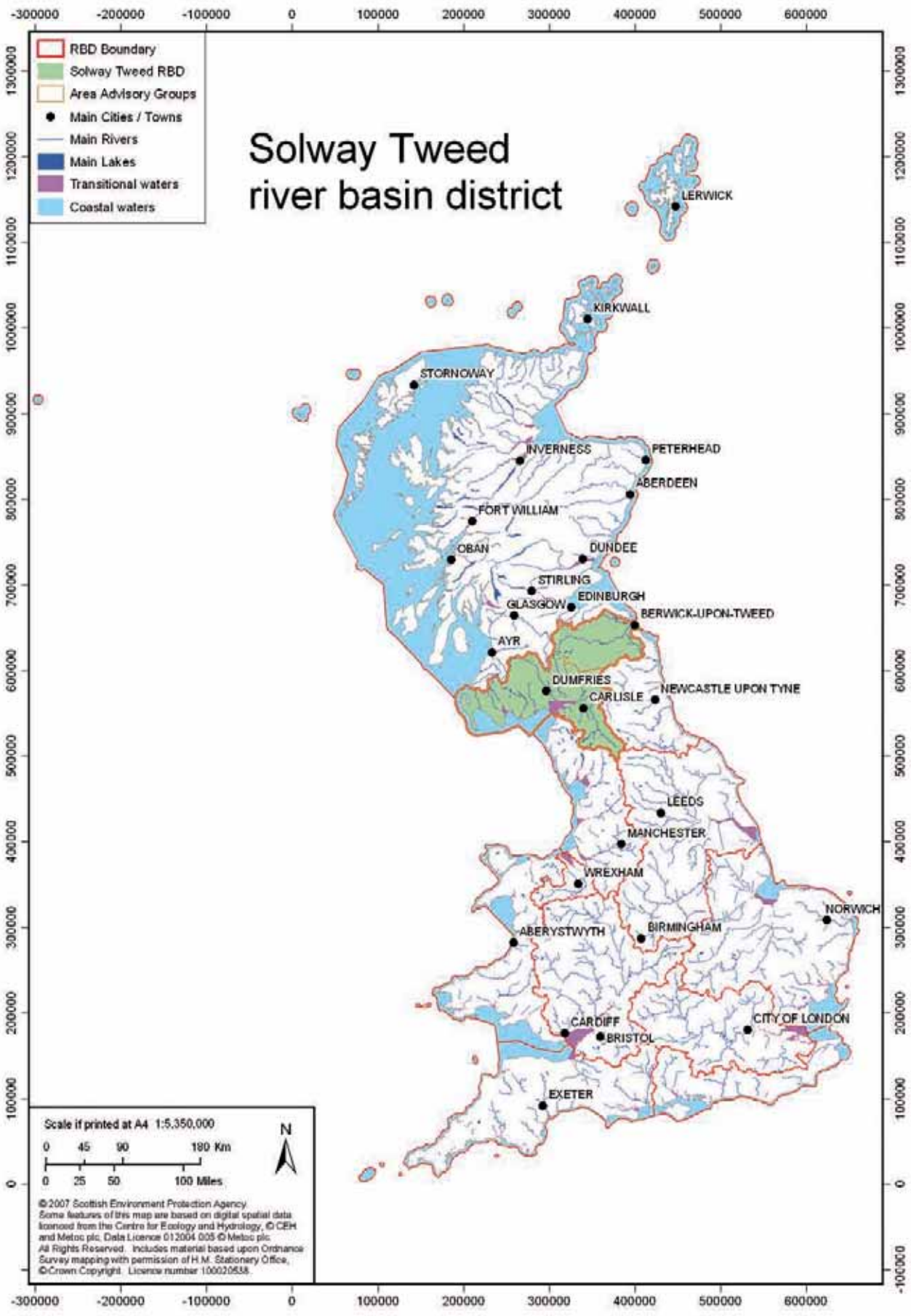
ID	Name	Category	Outcome
5102	Whiteadder Water	River	Heavily modified
5124	Watch Water	River	Heavily modified
5237	Ale Water	River	Heavily modified
5294	Megget Water	River	Heavily modified
5312	Lyne Water	River	Heavily modified
5320	West Water	River	Heavily modified
5322	Weston Burn/Hopehead Burn	River	Not heavily modified
5324	Biggar Water/Biggar Burn	River	Further assessment required
5325	Biggar Water/Biggar Burn (to Broughton)	River	Further assessment required
5334	Talla Water	River	Heavily modified
5336	Fruid Water (downstream of Reservoir)	River	Heavily modified
10494	Penwhirn Burn (d/s Penwhirn Reservoir)	River	Heavily modified
10501	Inch Burn	River	Further assessment required
10502	Pouton Burn	River	Further assessment required
10545	River Dee (Loch Ken Outlet to Tongland)	River	Heavily modified
10546	Black Water of Dee (Pullaugh Burn to Loch Ken)	River	Heavily modified
10551	Pullaugh Burn	River	Heavily modified
10558	Water of Ken (d/s Kendoon)	River	Heavily modified
10562	Water of Deugh (Carsphairn Lane to Water of Ken)	River	Heavily modified
10563	Water of Deugh (u/s Carsphairn Lane)	River	Further assessment required
10565	Bow Burn	River	Further assessment required
10569	Polharrow Burn/Mid Burn/Hawse Burn	River	Further assessment required
10573	Black Water	River	Heavily modified
10575	Carlingwark Lane	River	Heavily modified
10614	Afton Water	River	Heavily modified
10640	Black Grain	River	Further assessment required
10673	Black Esk	River	Heavily modified
10693	Tweeden Burn	River	Further assessment required
10722	Black Water of Dee (Clatteringshaws Reservoir to Pullaugh Burn)	River	Heavily modified
10761	Water of Ken	River	Heavily modified
GB102021072930	Wooler Water	River	Consult SNH/Natural England/local authorities
GB102021072950	Glen	River	Consult SNH/Natural England/local authorities

ID	Name	Category	Outcome
GB102021072980	Hetton Burn	River	Consult SNH/Natural England/local authorities
GB102021072990	Tweed	River	Consult SNH/Natural England/local authorities
GB102021073050	Till	River	Consult SNH/Natural England/local authorities
GB102075073380	River Wampool	River	Not heavily modified
GB102075073390	Wiza Beck	River	Further assessment required
GB102075073400	Crummock Beck	River	Heavily modified
GB102075073410	River Wampool	River	Further assessment required
GB102075073420	River Waver	River	Heavily modified
GB102075073430	River Wampool	River	Heavily modified
GB102075073440	River Waver	River	Heavily modified
GB102075073450	Gill Beck	River	Heavily modified
GB102075073460	River Wampool	River	Further assessment required
GB102075073480	Crummock Beck	River	Further assessment required
GB102075073490	Holme Dub	River	Further assessment required
GB102076070630	Hoff (Asby) Beck	River	Further assessment required
GB102076070640	Scale Beck	River	Further assessment required
GB102076070650	Swindale Beck	River	Not heavily modified
GB102076070670	Swindale Beck	River	Consult SNH/Natural England/local authorities
GB102076070680	Grisedale Beck	River	Further assessment required
GB102076070690	River Lowther	River	Heavily modified
GB102076070700	River Eamont	River	Further assessment required
GB102076070720	Hawestwater Beck	River	Heavily modified
GB102076070740	Glenridding Beck	River	Not heavily modified
GB102076070750	Low Gill (Crooks Beck)	River	Not heavily modified
GB102076070780	River Lowther	River	Consult SNH/Natural England/local authorities
GB102076070800	River Eamont	River	Further assessment required
GB102076070810	River Eamont	River	Further assessment required
GB102076070820	Hoff (Asby) Beck	River	Further assessment required
GB102076070830	Eden (Cumb.Mid), Lyvennet	River	Not heavily modified
GB102076070840	River Lyvennet	River	Not heavily modified

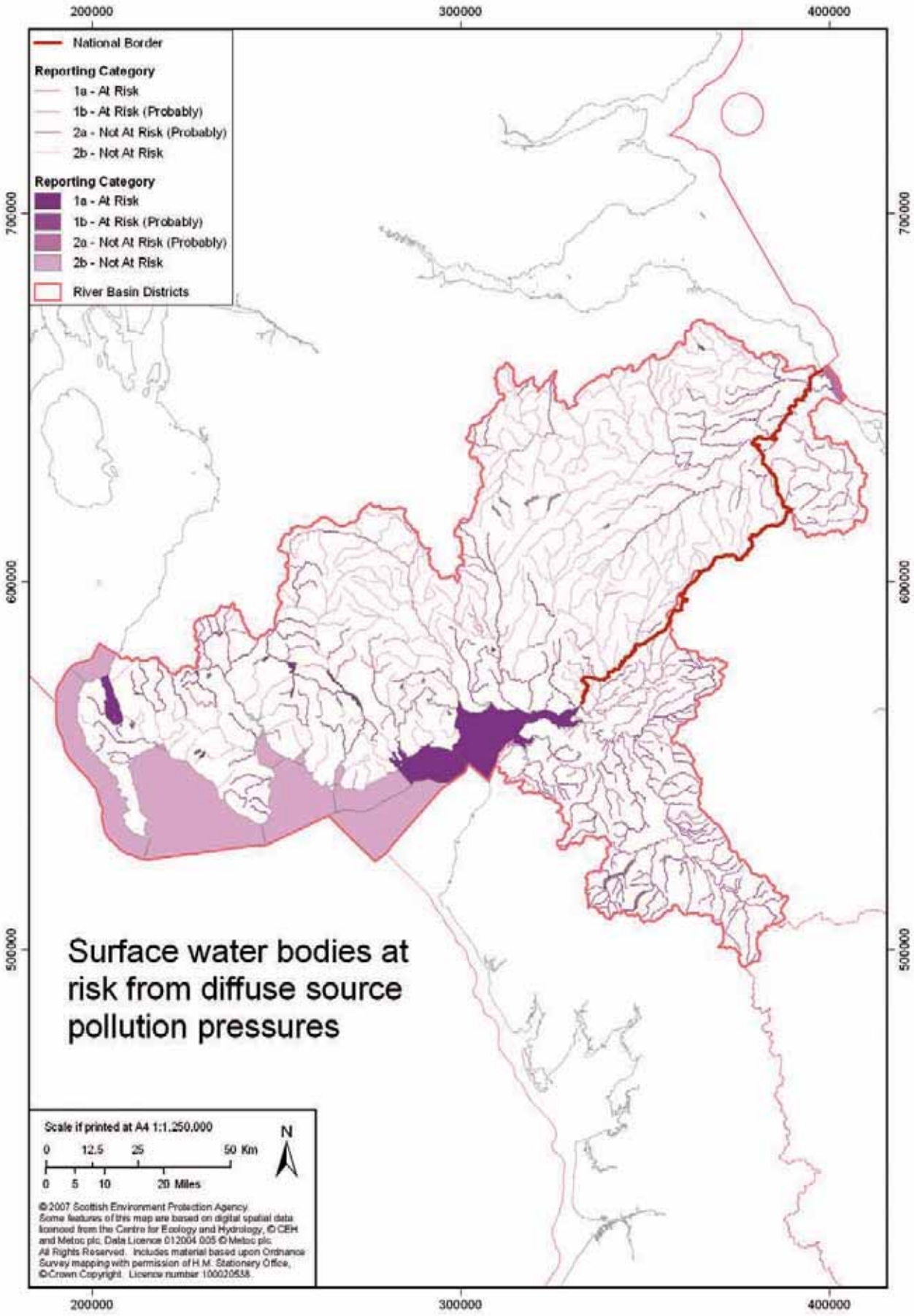
ID	Name	Category	Outcome
GB102076070860	Trout Beck	River	Not heavily modified
GB102076070870	River Lyvennet	River	Not heavily modified
GB102076070880	River Eden	River	Further assessment required
GB102076070930	Trout Beck	River	Consult SNH/Natural England/local authorities
GB102076070940	Dacre Beck	River	Consult SNH/Natural England/local authorities
GB102076070950	Crowdundle Beck	River	Consult SNH/Natural England/local authorities
GB102076070970	Skitwith Beck	River	Further assessment required
GB102076070980	River Eden	River	Not heavily modified
GB102076070990	River Eden	River	Consult SNH/Natural England/local authorities
GB102076071000	Milburn Beck	River	Not heavily modified
GB102076071010	River Lowther	River	Heavily modified
GB102076071020	River Eamont	River	Consult SNH/Natural England/local authorities
GB102076073710	River Caldew	River	Further assessment required
GB102076073770	Roe Beck	River	Further assessment required
GB102076073780	Pow Beck	River	Further assessment required
GB102076073850	Briggle Beck	River	Further assessment required
GB102076073880	River Caldew	River	Consult SNH/Natural England/local authorities
GB102076073890	Cairn Beck	River	Heavily modified
GB102076073900	Trout Beck	River	Further assessment required
GB102076073910	Pow Maughan Beck	River	Heavily modified
GB102076073940	River Eden	River	Further assessment required
GB102076073950	Powburgh Beck	River	Further assessment required
GB102076073970	Brunstock Beck	River	Heavily modified
GB102076073990	River Petteril	River	Further assessment required
GB10207607400	Blackrack Beck	River	Further assessment required
GB102076074030	River Petteril	River	Further assessment required
GB102076074050	Quarry Beck	River	Not heavily modified
GB102076074070	Butter Burn	River	Consult SNH/Natural England/local authorities
GB102076074120	Eden (Cumb. Lower)	River	Further assessment required
GB102077074140	Esk and Lyne	River	Further assessment required

ID	Name	Category	Outcome
GB102077074160	Drybeck (Hall burn)	River	Further assessment required
GB102077074190	River Esk	River	Further assessment required
GB102077074200	River Sark	River	Not heavily modified
GB102077074230	Back(Carwinley) Burn	River	Further assessment required
GB102077074280	Bailey Water	River	Not heavily modified
GB102077074290	Black Lyne	River	Further assessment required
GB102077074590	Kershope Burn	River	Further assessment required
GB202021073190	Tweed	River	Consult SNH/Natural England/local authorities
GB202021073200	Tweed	River	Consult SNH/Natural England/local authorities
GB202075073530	Causewayhead (Wath) Beck	River	Further assessment required
GB202076074130	Esk and Lyne	River	Consult SNH/Natural England/local authorities
100289	Whiteadder Reservoir	Lake	Heavily modified
100309	Megget Reservoir	Lake	Heavily modified
100310	Talla Reservoir	Lake	Heavily modified
100311	Fruid Reservoir	Lake	Heavily modified
100312	Alemoor Reservoir	Lake	Heavily modified
100321	Earlstoun Loch	Lake	Heavily modified
100325	Clatteringshaws Loch	Lake	Heavily modified
100326	Loch Ken/River Dee Marshes	Lake	Heavily modified
100332	Penwhirn Reservoir	Lake	Heavily modified
GB30229073	Haweswater Reservoir	Lake	Heavily modified
200316	Nith Estuary	Transitional	Heavily modified
GB510202110000	Tweed	Transitional	Consult SNH/Natural England/local authorities

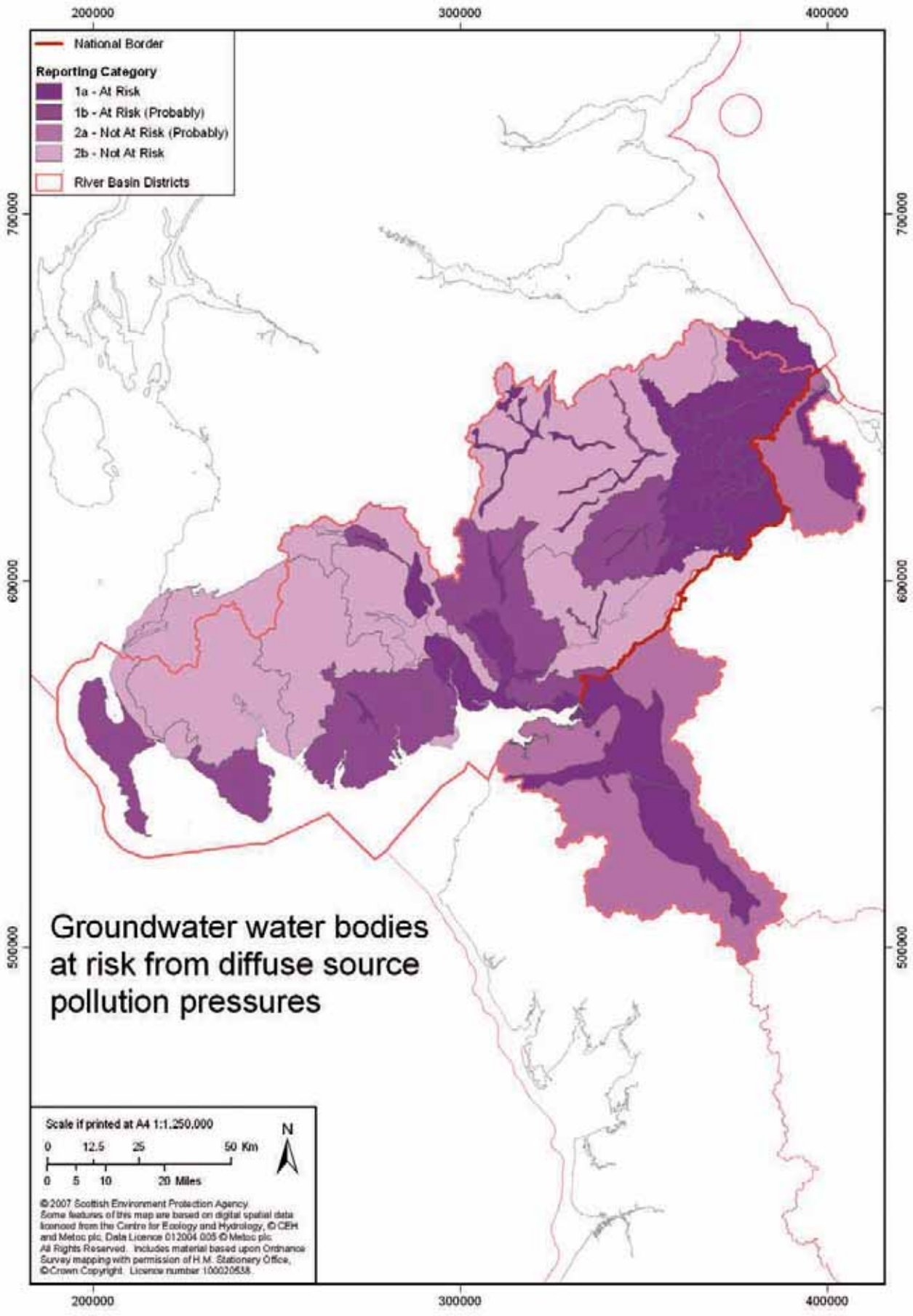
Map 1 : The Solway Tweed river basin district



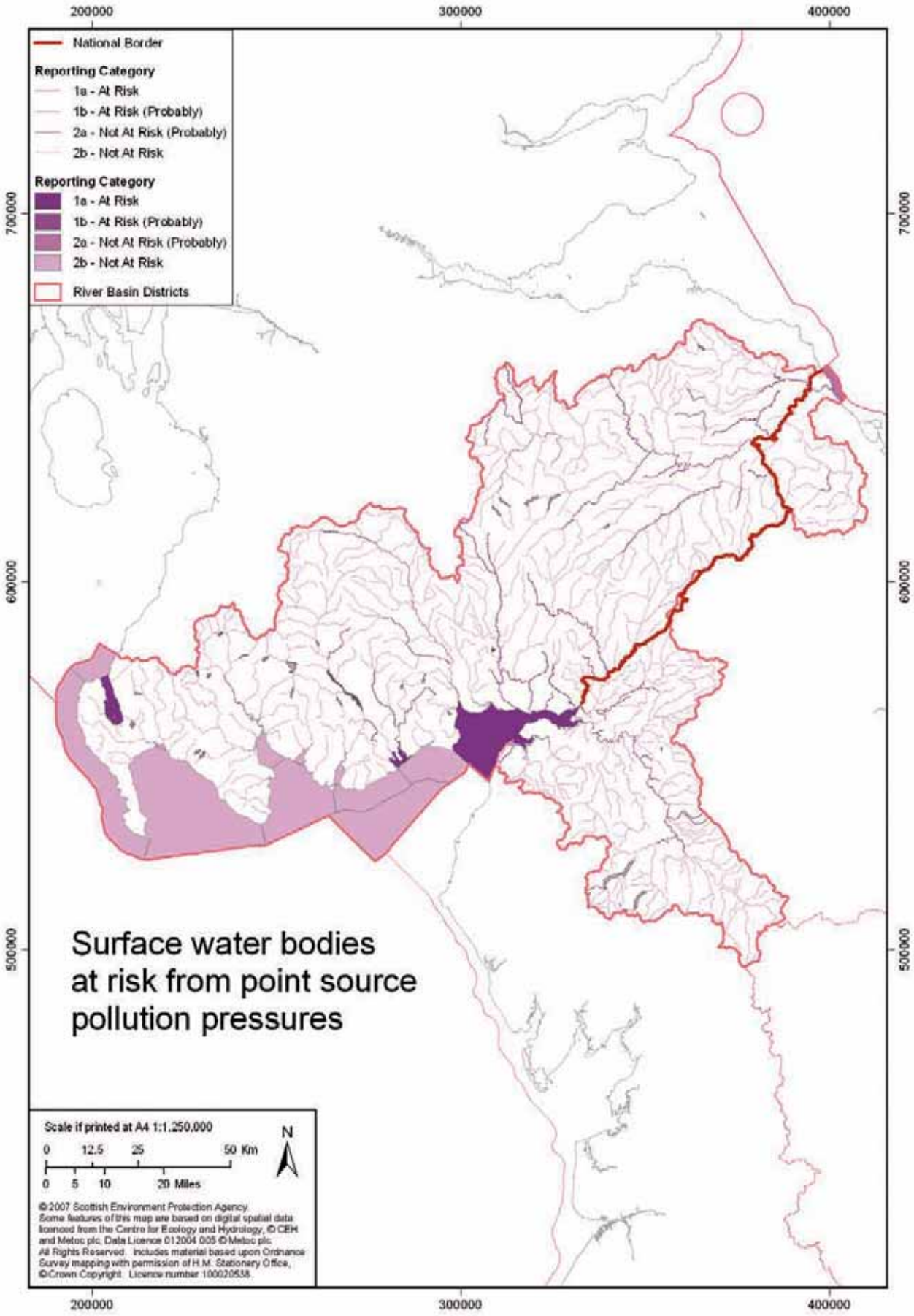
Map 2: Surface water bodies at risk from diffuse source pollution pressures



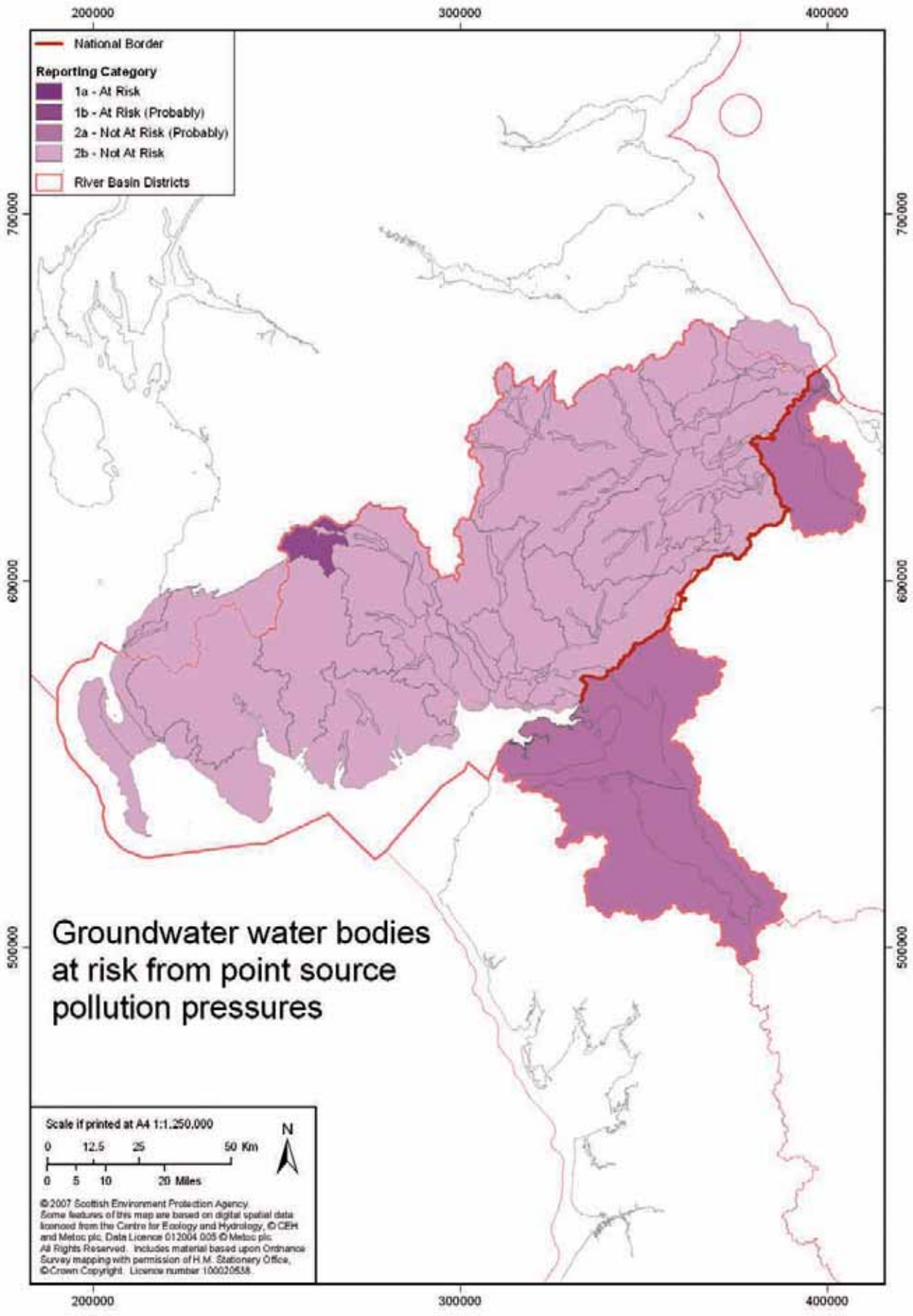
Map 3: Groundwater water bodies at risk from diffuse source pollution pressures



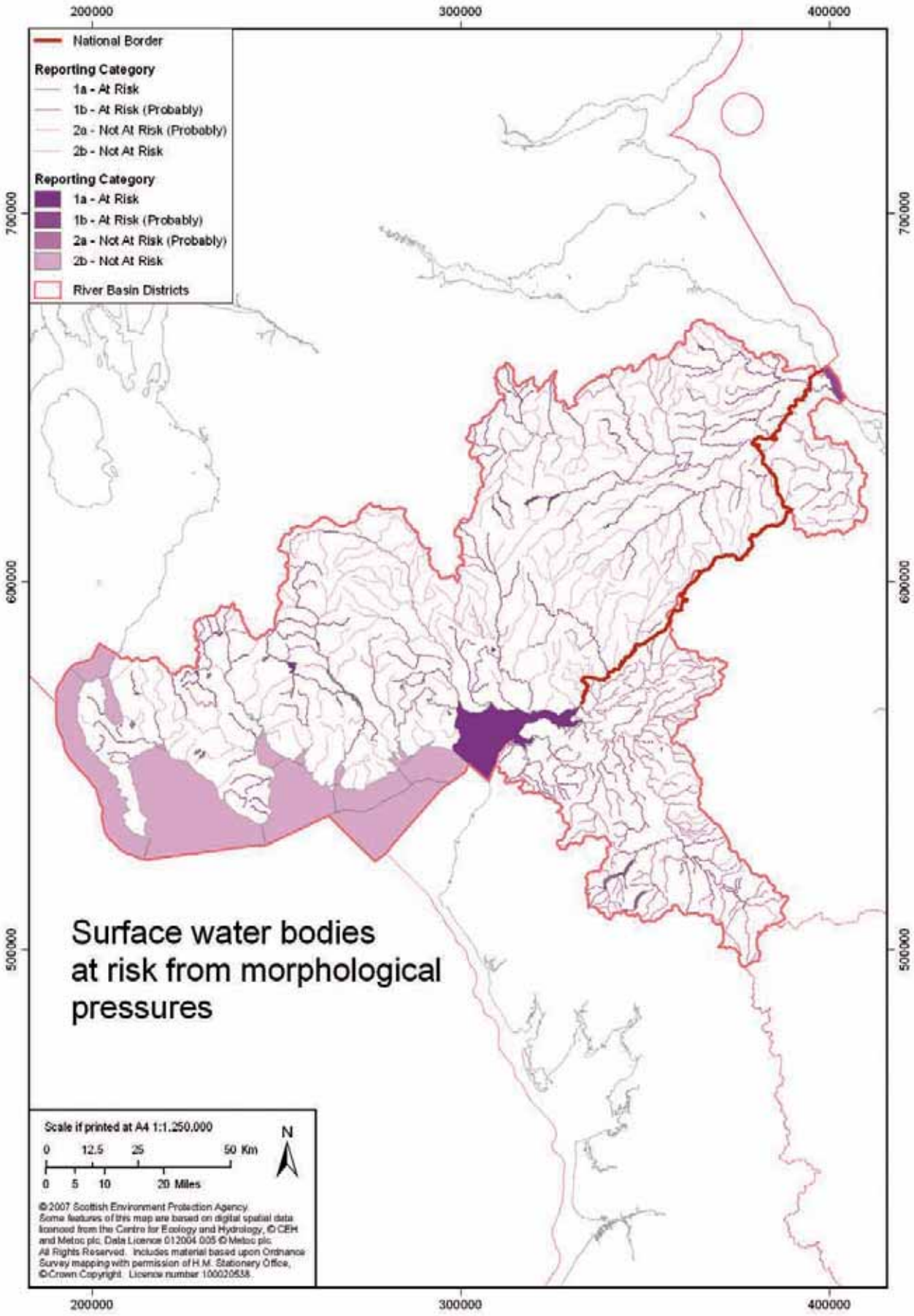
Map 4: Surface water bodies at risk from point source pollution pressures



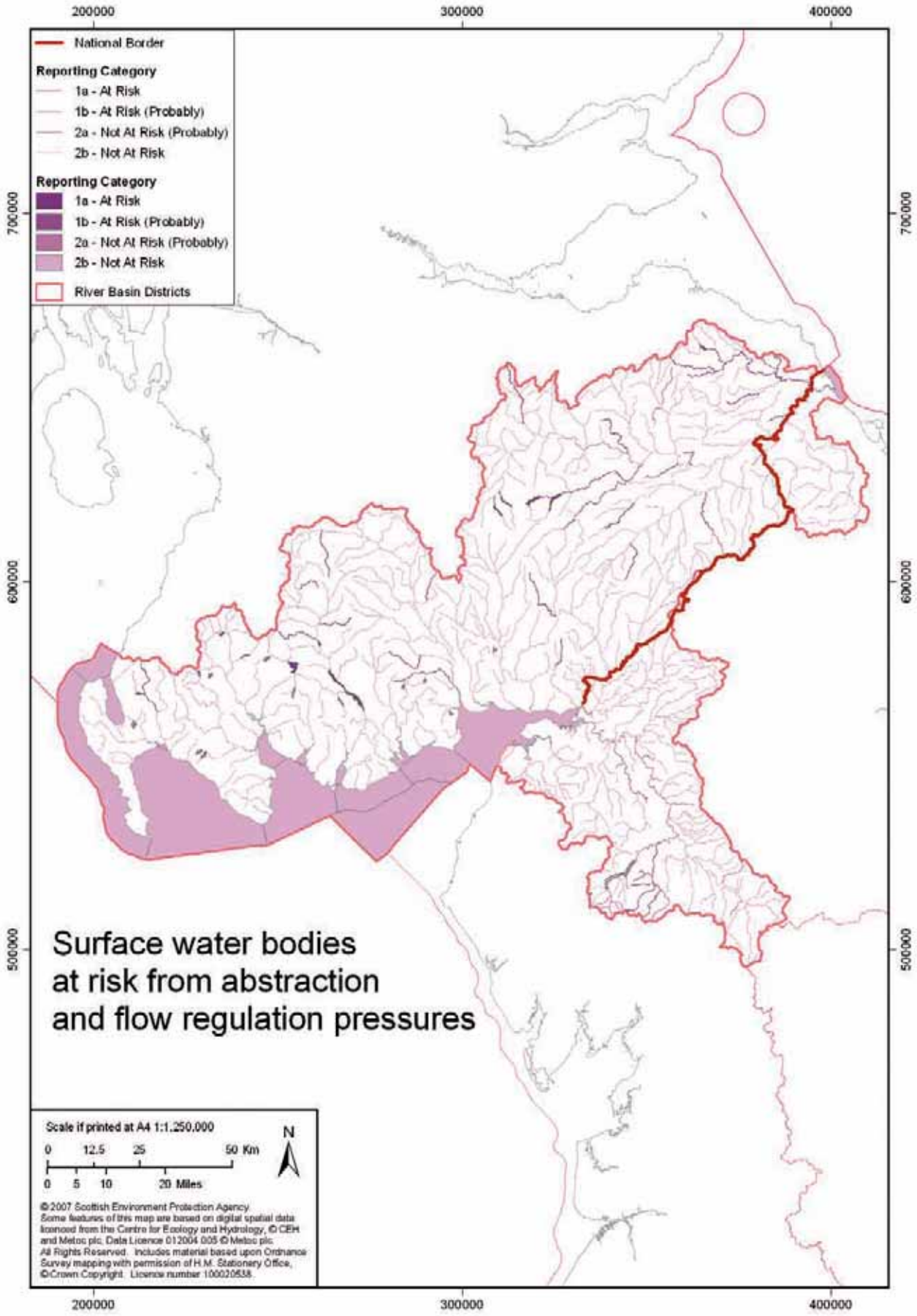
Map 5: Groundwater water bodies at risk from point source pollution pressures



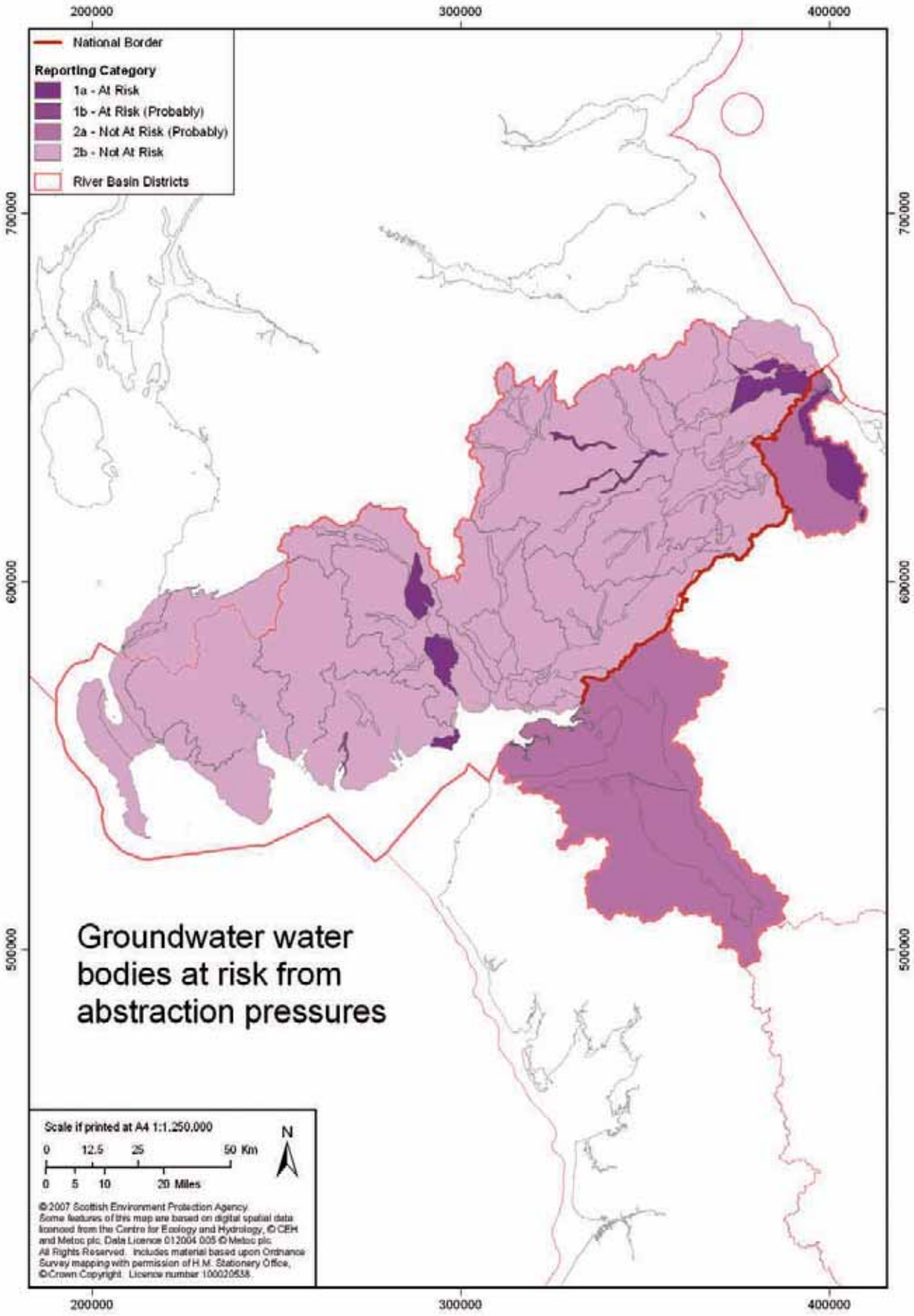
Map 6: Surface water bodies at risk from morphological pressures



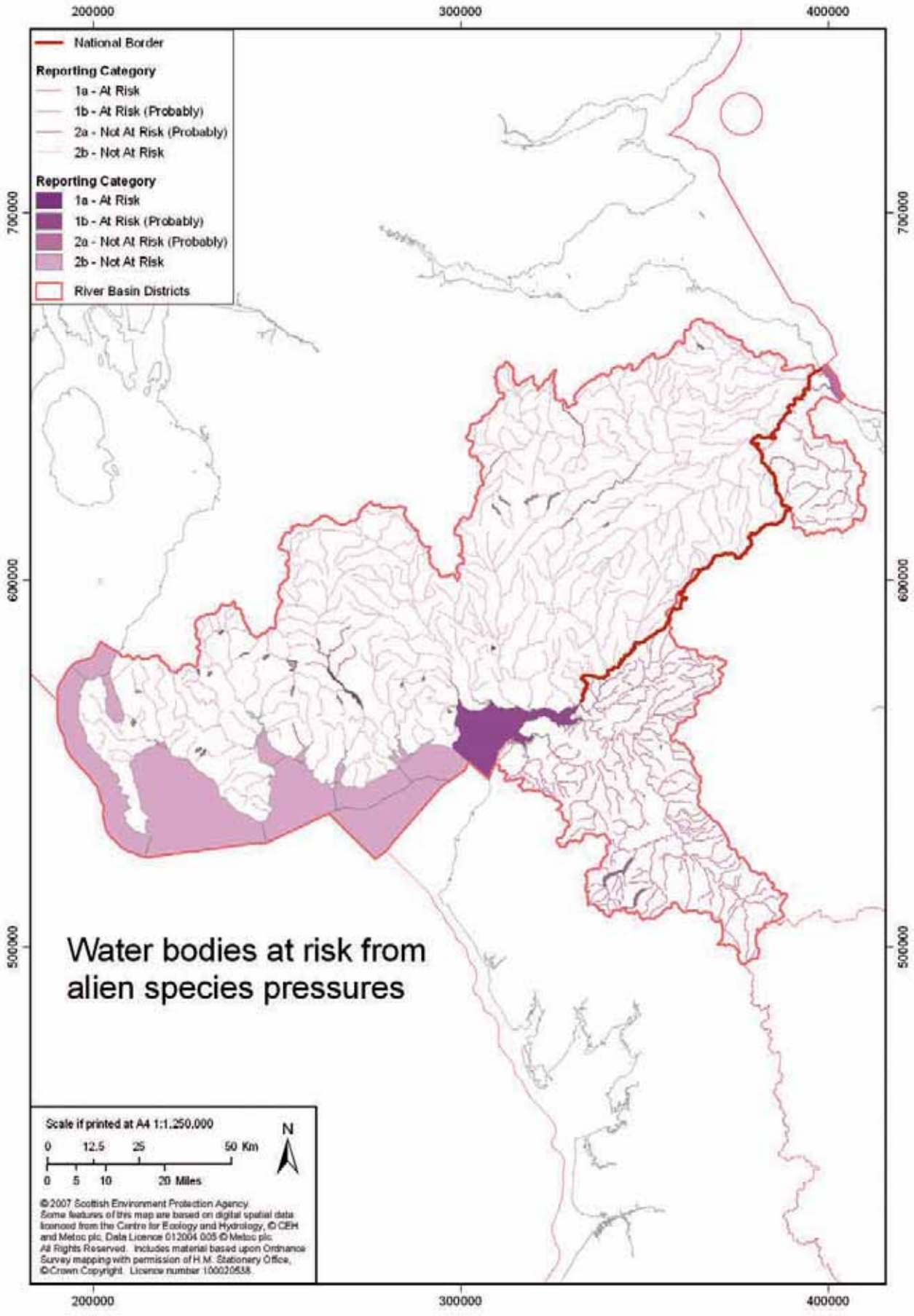
Map 7: Surface water bodies at risk from abstraction and flow regulation pressures



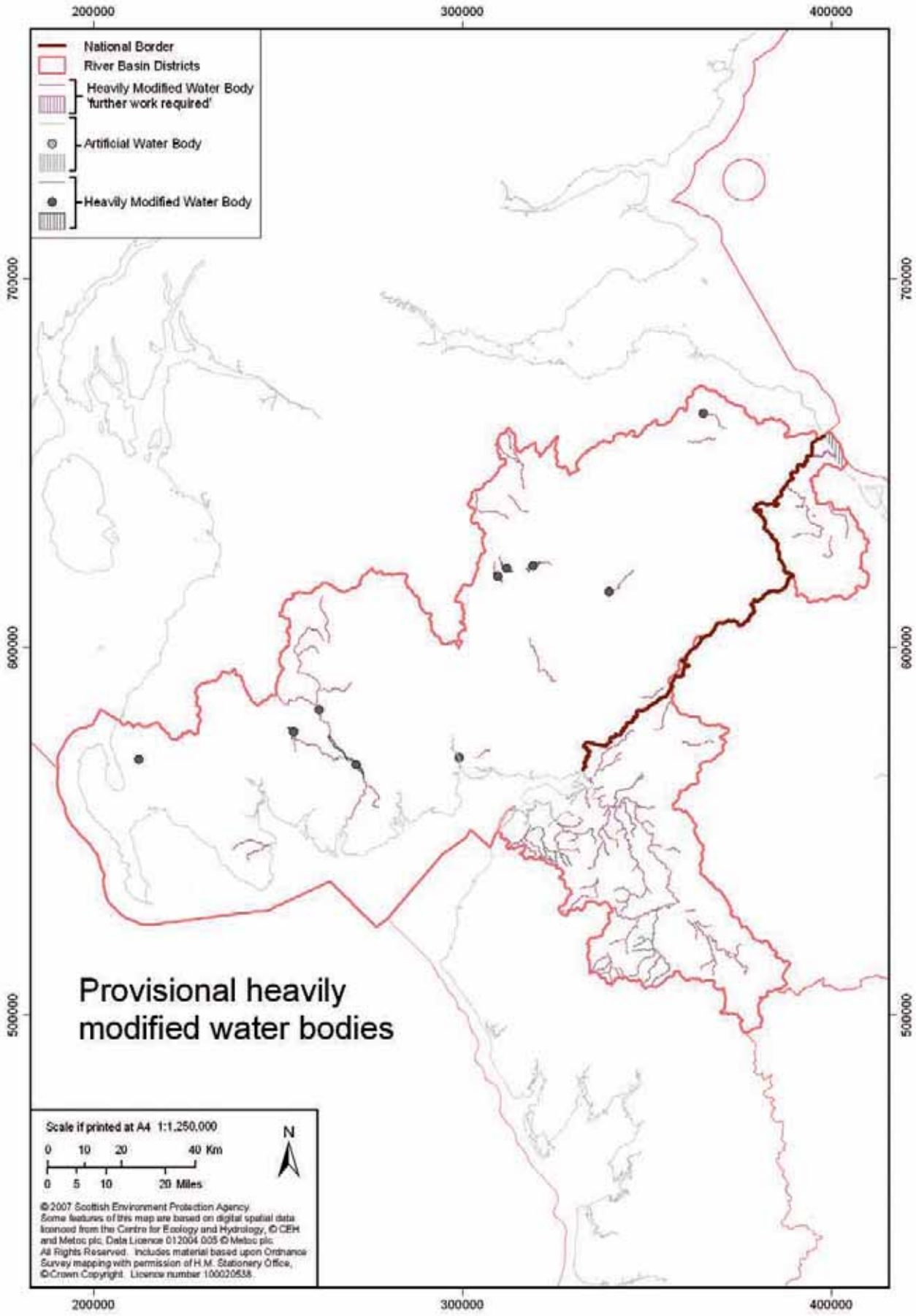
Map 8: Groundwater water bodies at risk from abstraction pressures



Map 9: Surface water bodies at risk from alien species pressures



Map 10: Provisional heavily modified water bodies



Annex A: Further characterisation undertaken by SEPA in the Scottish part of the Solway Tweed river basin district

A1 Introduction

Before the implementation of the Water Framework Directive (WFD), environmental assessments focused on pollution pressures, in particular point source pollution, and were supported by extensive chemical and biological monitoring information. The Water Framework Directive requires us to consider pressures that have not previously been taken into consideration when assessing the quality of the aquatic environment – notably abstractions, impoundments and morphological/engineering works.

Since the publication of the characterisation report in 2005, our understanding of the pressures and resulting impacts in the river basin district has improved mainly as a result of monitoring and the introduction of the Water Environment (Controlled Activities) (Scotland) Regulations 2005.[34] Furthermore, standards and classification schemes for some quality elements (e.g. nutrients) have been developed which have given us a clearer idea of those water bodies currently failing to achieve good status. This has enabled us to refine our assessment of which water bodies are at risk and be more confident in the results.

The focus of further characterisation has been upon those water bodies identified as being 'probably at significant risk' (1b) in the characterisation report. A greater degree of certainty regarding the status of these water bodies was required to determine whether additional measures are necessary and, if so, what these would be.

Numbers referred to throughout the text are for analyses carried out for all of Scotland, i.e. Scotland river basin district and the Scottish part of the Solway Tweed river basin district.

A2 Further characterisation methodologies

A2.1 Point source pollution

Since publication of the Article 5 report in 2005, environmental standards (UKTAG Environmental Standards[35]) have been developed at the UK level. Some of the physico-chemical and ecological standards are slightly different to the thresholds used in the initial characterisation. For example, diatom data has been reviewed against new nutrient standards for the assessment of 1b water bodies.

Where appropriate, any additional monitoring undertaken for WFD purposes such as intercalibration and the development of classification tools has been included. This was not available for all water body categories but, where appropriate, information has been used.

SEPA's water quality monitoring network has provided further results since 2004 which have also been used to reassess the risk category of the 1b water bodies. In addition a small number of 1b lochs have been reviewed using the acid neutralising capacity methodology and standing waters classification as indicators of water quality (both diffuse and point source).

The number of changes resulting from the review of water quality data has been minimal but has led to more certainty on the number of water bodies at risk.

A2.2 Diffuse source pollution

The diffuse pollution screening tool that was used in the initial characterisation has been further developed and now includes a wider range of potential diffuse pollutants. The tool allows the risk from all potential diffuse pollution pressures to be assessed based on pollutant inputs to the land surface and landscape factors which affect their transport. The tool has been applied to all 1b river water bodies and has resulted in only a few changes to the overall number.

[34]The Controlled Activities Regulations were approved by the Scottish Parliament in June 2005 and can be found at www.opsi.gov.uk/legislation/scotland/ssi2005/20050348.htm

[35]See www.wfduk.org/UK_Environmental_Standards

A2.3 Water resources

For water resources, additional work has been carried out validating the pressures as well as implementing an improved methodology for assessing their impacts (UKTAG Environmental Standards and Conditions). The new standards were used as the basis for making quantitative assessments of the water resource impacts of known pressures. This marks a significant development from the methodology adopted during the initial characterisation phase whereby assessments were largely based on the presence or absence of pressures.

The introduction of the Controlled Activities Regulations (CAR) has enabled the inclusion of authorised agricultural pressures, which were the main omissions from the previous assessment.

In total for all of Scotland, 2,356 river water bodies were assessed of which there are now 195 classed as 1a (definitely at significant risk) and 159 as 1b due to abstraction and flow regulation pressures compared with 208 and 345 as identified in 2005.

In total, 334 loch water bodies (surface area greater than 0.5 km^2) were assessed of which there are now 85 classed as 1a and seven as 1b due to abstraction and flow regulation pressures compared with 100 and 27 as identified in 2005.

A2.4 Morphology

The morphology review primarily used two methods to re-assess the 1b river water bodies. One method is expert judgement on-site using a set of standardised criteria, and the second is the application of river habitat surveys and MImAS[36] survey outputs. Both methods were used in combination with map assessments, aerial photography and old maps where available. Resource constraints meant it was not possible, even using these methods, to reassess all 507 water bodies. A total of 98 river water bodies were re-assessed.

The expert judgement assessments focused on the presence/absence/extent of conifer planting to the banksides. The River Habitat Survey/MImAS surveys focused on sites at risk from straightening/channelisation (agriculture pressures). Of the 98 river water bodies assessed, 30 remain 1b, 15 are 1a and 53 are now 2a (probably not at significant risk).

Surveying of the 1b lochs with a morphological pressure is being carried out as part of the Loch Habitat Survey trial work. Standards against which to apply the survey data are still under development, so results were not available for this report.

The river morphology standards have also been revised since 2004, but SEPA still holds insufficient information to be able to apply the standards to all water bodies. Longer term there is a rolling programme of monitoring targeting 'at risk' water bodies using the MImAS field survey. In addition, a database of morphology pressures (available summer 2007) will allow SEPA to undertake a preliminary classification for morphology of rivers and lochs. Monitoring will then be used to increase confidence in classification. These developments will inform classification for morphology and also the next round of characterisation work.

A2.5 Transitional and coastal water bodies

A review of 1b water bodies has been undertaken for transitional and coastal waters in Scotland as part of the ongoing WFD characterisation process. The purpose of this review was to reallocate as many 1b water bodies as appropriate to the 1a, 2a or 2b (definitely not at risk) categories.

The original characterisation process was completed during 2003. This review updated the information used then by making use of new data including:

- coastal classification results for 2004 (using SEPA's existing water quality classification scheme, not the WFD classification);
- shellfish growing waters results for 2004;
- bathing waters results for 2004.

[36]Morphological Impact Assessment System – tool developed to help characterise physical condition of rivers.

Changes to the transitional and coastal waters risk assessment process were made as follows:

- Class C and D downgrades associated solely with microbiology results at recreational waters (i.e. non-identified bathing waters) with a peak daily user count of <150 were changed to a 2a risk rating. It is considered unlikely that the discharges associated with these downgrades will affect the achievement of good status according to the quality elements defined in the WFD.
- Class C and D downgrades associated solely with microbiology results at shoreline waters were changed to a 2a risk rating. It is considered unlikely that the discharges associated with these downgrades will affect the achievement of good status according to the quality elements defined in the WFD.
- Class C and D downgrades associated with microbiology results at recreational waters (i.e. non-identified bathing waters) with a peak daily user count of >150 were changed to a 1a risk rating. It is considered likely that these waters will be re-designated as identified bathing waters in the near future.
- Class C and D downgrades associated solely with aesthetics were changed to a 2a risk rating. Poor aesthetic quality is unlikely to affect the achievement of good status according to the quality elements defined in the WFD.
- Failure of the EC Shellfish Directive's mandatory and guideline pH and salinity standards were discounted as they are associated with natural conditions such as high freshwater flows, and not with environmental deterioration. These downgrades were changed from 1a to 2b.
- The OSPAR[37]/WFD imposex classification system has been adopted instead of SEPA's historical classification method which was applied previously. Water bodies are now identified as 1a if they have VDSI scores ≥4, as 2a if VDSI scores are 2 to <4 and as 2b if VDSI[38] <2.
- Water bodies (excluding lagoons) should be identified as 1a for eutrophication if they are currently identified as a problem area under OSPAR or a sensitive area under the Urban Waste Water Treatment Directive.

The further assessments carried out on the 1a water bodies has led to 13 changing from 1a to 2a and four from 1a to 2b. Additional assessments were also carried out for the 1b water bodies; more than 50 changed from 1b to 2a, six from 1b to 1a, and two from 1b to 2b.

A2.6 Groundwater bodies

Initial characterisation was completed in 2005 on 124 groundwater bodies; 46% (by area) of groundwater bodies were identified as being at risk of failing the requirements of good status. Each body was, on average, approximately 600 km^2 in size.

The area at risk was considered to be an over-estimate, largely as a function of the considerable size of the groundwater bodies. The size of the groundwater bodies was, in turn, a consequence of:

- limited data on aquifers in Scotland;
- uncertainties as to the link between monitoring requirements and groundwater bodies.

A key strategy underpinning further characterisation in Scotland has been the subdivision of certain groundwater bodies where there was a wide variation in pressures or in geological conditions pertinent to the natural attenuation of pressures. This has been necessary in order to provide:

- more focussed assessment of areas at risk;
- a more suitable basis on which to design monitoring networks.

The process of subdivision was made possible by:

- data collected on pressures and geological characteristics during initial characterisation;
- finalisation of UKTAG monitoring guidance.[39]

The UKTAG guidance allowed for grouping of groundwater bodies by similar pressures and geological characteristics, even in at risk situations. This, in turn, meant that monitoring points were not required in all groundwater bodies.

[37]Oslo and Paris Convention
[38]Vas Deferens Sequence Index
[39]*Guidance on the selection of monitoring sites and building monitoring networks for surface waters and groundwater.* Public Working Draft (PR2), UKTAG, published 16 May 2005.

Subdivision focussed mainly on those groundwater bodies at risk. In accordance with UKTAG guidance, flow or geological boundaries formed the basis of the new bodies. Appropriate boundaries were selected using a standard set of national geological and hydrological datasets in order to ensure consistency of application. This meant that a small number of 'not at risk' groundwater bodies were also split. Of the original 124 groundwater bodies, 54 were subdivided to create a total of 343 bodies.

The latest round of further characterisation was completed in 2006. Its results were as follows:

- 33% (by area) of groundwater bodies were identified as being at risk of failing the requirements of good status;
- each body was, on average, approximately 230 km^2 in size.

The process of subdivision has allowed a much clearer indication of problem areas. This will allow better targeting of remedial action and will provide a much more transparent basis for the design of monitoring networks.

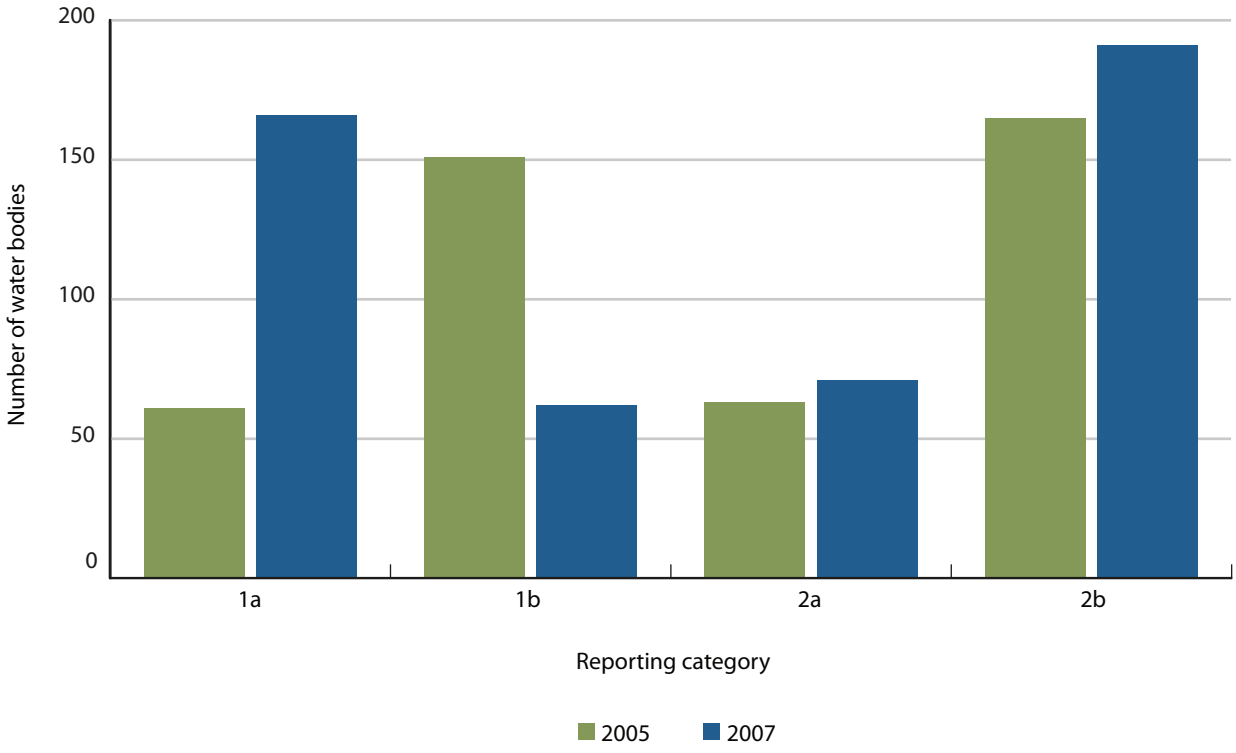
A2.7 Invasive alien species

No specific work has been undertaken in relation to alien species pressures but updated information received from Scottish Natural Heritage has been incorporated into the risk assessment.

A3 Summary results of further characterisation

Through the process of further characterisation it has been possible to significantly reduce the number of 1b water bodies (Figure A1). The reduction in the number of 1b water bodies has resulted in an increase in the number of 1a, 2a and 2b water bodies. This reflects the additional work carried out and our increase in confidence of the risk assessment review. We intend to further reduce the number of 1b water bodies over the next couple of years through collection of additional pressures information and ongoing monitoring data.

Figure A1: Comparison of number of water bodies per reporting category in 2005 (Article 5 characterisation and impacts analyses report) and 2007 (SWMI report)



Tables A1 and A5 provide detailed comparative information on the number and area/length of water bodies in each reporting category between 2005 (Article 5 characterisation and impacts analyses report) and 2007 (SWMI report).

Note that the numbers in tables A1 to A5 are for the Scottish part of the Solway Tweed river basin district only.

Table A1: River water bodies

	Reporting category	Number of water bodies		% of number		Length (km)		% of length	
		2005	2007	2005	2007	2005	2007	2005	2007
Rivers	1a	40	108	10.5	28.5	372	1,358	8.6	31.6
	1b	134	41	35.4	10.8	1,760	513	40.9	11.9
	2a	56	58	14.8	15.3	656	699	15.3	16.3
	2b	149	172	39.3	45.4	1,512	1,731	35.2	40.2
Total		379	379	100	100	4,301	4,300	100	100
Total at risk	**1a+1b**	**174**	**149**	**45.9**	**39.3**	**2,132**	**1,871**	**49.6**	**43.5**

Table A2: Loch water bodies

	Reporting category	Number of water bodies		% of number		Area (km^2)		% of area	
		2005	2007	2005	2007	2005	2007	2005	2007
Lochs	1a	9	14	36.0	56.0	12	24	37.2	77.0
	1b	8	4	32.0	16.0	14	3	46.3	9.6
	2a	3	2	12.0	8.0	2	1	5.9	4.0
	2b	5	5	20.0	20.0	3	3	10.7	9.3
Total		25	25	100	100	31	31	100	100
Total at risk	**1a+1b**	**17**	**18**	**68.0**	**72.0**	**26**	**27**	**83.5**	**86.7**

Table A3: Transitional water bodies

	Reporting category	Number of water bodies		% of number		Area (km^2)		% of area	
		2005	2007	2005	2007	2005	2007	2005	2007
Transitional	1a	2	4	20.0	40.0	321	324	82.8	83.7
	1b	3	1	30.0	10.0	4	0.28	1.0	0.1
	2a	0	0	0	0	0	0	0.0	0
	2b	5	5	50.0	50.0	63	63	16.2	16.2
Total		10	10	100	100	387	387	100	100
Total at risk	**1a+1b**	**5**	**5**	**50.0**	**50**	**325**	**325**	**83.8**	**84**

Table A4: Coastal water bodies

	Reporting category	Number of water bodies		% of number		Area (km²)		% of area	
		2005	2007	2005	2007	2005	2007	2005	2007
Coastal	1a	2	2	25	25.0	177	177	9.2	9.2
	1b	0	0	0	0	0	0	0	0
	2a	0	0	0	0	0	0	0	0
	2b	6	6	75	75.0	1,736	1,736	90.8	90.8
Total		8	8	100.0	100	1,913	1,913	100	100
Total at risk	**1a+1b**	**2**	**2**	**25.0**	**25.0**	**177**	**177**	**9.2**	**9.2**

Table A5: Groundwater bodies

	Reporting category	Number of water bodies		% of number		Area (km²)		% of area	
		2005	2007	2005	2007	2005	2007	2005	2007
Groundwater	1a	8	38	44.4	55.9	5,750	2,248	47.4	19.0
	1b	6	16	33.3	23.5	3,064	3,106	25.2	26.3
	2a	4	11	22.2	16.2	3,327	5,228	27.4	44.2
	2b	0	3	0.0	4.4	0	1,241	0.0	10.5
Total		18	68	100	100	12,141	11,823	100	100
Total at risk	**1a+1b**	**14**	**54**	**77.8**	**79.4**	**8,814**	**5,354**	**72.6**	**45.3**

A4 Outcomes of further characterisation

The main reasons for the changes in water body risk assessments are listed in Table A6. There may also have been changes to the risk assessment of individual water bodies as a result of:

- changes in the magnitude or nature of pressures impacting on water bodies;
- the cessation of existing pressures;
- awareness of new pressures.

These changes were made as and when necessary in order to maintain an up-to-date dataset.

A5 Future characterisation work

Characterisation is an ongoing process and a characterisation and impacts analysis of the river basin district must be undertaken every river basin planning cycle. Characterisation for the second cycle, which is due to be reported in 2013, will look at which water bodies are expected to be at risk of meeting good status by 2021. It will be possible in this second cycle to assess the outcomes of measures and to use information obtained from the new Water Framework Directive monitoring network.

Table A6: Main reasons for changes to water body risk assessments

Pressure	Reasons for change
Point source pollution	• Application of new UKTAG physico-chemical and ecological standards • River water quality classification results • Results of monitoring undertaken as part of the intercalibration exercise and classification tool development
Diffuse source pollution	• Further development of diffuse pollution screening tool to include a wider range of potential diffuse pollutants
Water resources	• Application of new UKTAG standards and thresholds • Information on agricultural abstractions obtained through CAR licence application process
Morphology	• New standards have been applied to some water bodies • Further assessment of some water bodies in relation to conifer planting to banksides and agricultural straightening/channelisation
Alien species	• Updated information from Scottish Natural Heritage
Transitional and coastal waters	• Use of new data including the 2004 coastal classification results, shellfish growing waters results and bathing waters results • Changes to criteria related to microbiology, aesthetics, pH and salinity
Groundwater	• Subdivision of certain groundwater bodies

Annex B: Evidence for significant water management issues in the Scottish part of the Solway Tweed river basin district

Table B1: Extent of diffuse source pollution from agriculture issue in the Scottish part of the Solway Tweed river basin district

Water body category	Significant issue	Length/area of at risk water bodies impacted	Number of at risk water bodies impacted
River	✔	923 km	69
Lake/loch	✘	2 km^2	3
Transitional	✔	322 km^2	3
Coastal	✔	177 km^2	2
Groundwater	✔	5,182 km^2	52

Table B2: Extent of the diffuse source pollution from forestry issue in the Scottish part of the Solway Tweed river basin district

Water body category	Significant issue	Length/area of at risk water bodies impacted	Number of at risk water bodies impacted
River	✔	923 km	69
Lake/loch	✔	15 km^2	7
Transitional	✘	–	–
Coastal	✘	–	–
Groundwater	✘	–	–

Table B3: Extent of the diffuse source pollution from sea and coastal water transport issue in the Scottish part of the Solway Tweed river basin district

Water body category	Significant issue	Length/area of at risk water bodies impacted	Number of at risk water bodies impacted
River	✘	–	–
Lake/loch	✘	–	–
Transitional	✘	–	–
Coastal	✔	42 km^2	1
Groundwater	✘	–	–

Table B4: Extent of the diffuse source acidification issue in the Scottish part of the Solway Tweed river basin district

Water body category	Significant issue	Length/area of at risk water bodies impacted	Number of at risk water bodies impacted
River	✔	364 km	34
Lake/loch	✔	8 km^2	6
Transitional	✘	–	–
Coastal	✘	–	–
Groundwater	✘	–	–

Table B5: Extent of the diffuse source pollution from sewage disposal activities in the Scottish part of the Solway Tweed river basin district

Water body category	Significant issue	Length/area of at risk water bodies impacted	Number of at risk water bodies impacted
River	✘	19 km	1
Lake/loch	✘	0.75 km^2	1
Transitional	✘	–	–
Coastal	✘	–	–
Groundwater	✘	–	–

Table B6: Extent of the impact of point source pollution from sewage disposal activities in the Solway Tweed RBD

Water body category	Significant issue	Length/area of at risk water bodies impacted	Number of at risk water bodies impacted
River	✔	612 km	32
Lake/loch	✔	8 km^2	2
Transitional	✔	325 km^2	5
Coastal	✔	42 km^2	1
Groundwater	✘	–	–

Table B7: Extent of the point source pollution from manufacturing issue in the Scottish part of the Solway Tweed river basin district

Water body category	Significant issue	Length/area of at risk water bodies impacted	Number of at risk water bodies impacted
River	✘	83 km	3
Lake/loch	✘	–	–
Transitional	✔	306 km^2	1
Coastal	✔	42 km^2	1
Groundwater	✘	–	–

Table B8: Extent of the point source pollution from electricity generation issue in the Scottish part of the Solway Tweed river basin district

Water body category	Significant issue	Length/area of at risk water bodies impacted	Number of at risk water bodies impacted
River	✘	–	–
Lake/loch	✘	–	–
Transitional	✔	306 km^2	1
Coastal	✘	–	–
Groundwater	✘	–	–

Table B9: Extent of the abstraction and flow regulation from water supply issue in the Scottish part of the Solway Tweed river basin district

Water body category	Significant issue	Length/area of at risk water bodies impacted	Number of at risk water bodies impacted
River	✔	306 km	22
Lake/loch	✔	9 km^2	6
Transitional	✘	–	–
Coastal	✘	–	–
Groundwater	✘	371 km^2	6

Table B10: Extent of the abstraction and flow regulation from agriculture issue in the Scottish part of the Solway Tweed river basin district

Water body category	Significant issue	Length/area of at risk water bodies impacted	Number of at risk water bodies impacted
River	✘	66 km	8
Lake/loch	✘	–	–
Transitional	✘	306 km^2	1
Coastal	✘	–	–
Groundwater	✘	150 km^2	1

Table B11: Extent of the abstraction and flow regulation from hydropower issue in the Scottish part of the Solway Tweed river basin district

Water body category	Significant issue	Length/area of at risk water bodies impacted	Number of at risk water bodies impacted
River	✘	60 km	4
Lake/loch	✔	11 km^2	3
Transitional	✘	–	–
Coastal	✘	–	–
Groundwater	✘	–	–

Table B12: Extent of the morphology from agriculture issue in the Scottish part of the Solway Tweed

Water body category	Significant issue	Length/area of at risk water bodies impacted	Number of at risk water bodies impacted
River	✔	451 km	42
Lake/loch	✘	–	–
Transitional	✘	–	–
Coastal	✘	–	–
Groundwater	✘	–	–

Table B13: Extent of the morphology from forestry issue in the Scottish part of the Solway Tweed river basin district

Water body category	Significant issue	Length/area of at risk water bodies impacted	Number of at risk water bodies impacted
River	✔	326 km	30
Lake/loch	✘	0.5 km^2	1
Transitional	✘	–	–
Coastal	✘	–	–
Groundwater	✘	–	–

Table B14: Extent of the morphology from water supply issue in the Scottish part of the Solway Tweed river basin district

Water body category	Significant issue	Length/area of at risk water bodies impacted	Number of at risk water bodies impacted
River	✘	103 km	9
Lake/loch	✔	9 km^2	7
Transitional	✘	–	–
Coastal	✘	–	–
Groundwater	✘	–	–

Table B15: Extent of the alien species from recreational, cultural and sporting activities issue in the Scottish part of the Solway Tweed river basin district

Water body category	Significant issue	Length/area of at risk water bodies impacted	Number of at risk water bodies impacted
River	✘	12 km	1
Lake/loch	✘	–	–
Transitional	✘	–	–
Coastal	✘	–	–
Groundwater	✘	–	–

Figure B1: Pressure types by industry sector impacting at risk river water bodies in the Scottish part of the Solway Tweed river basin district

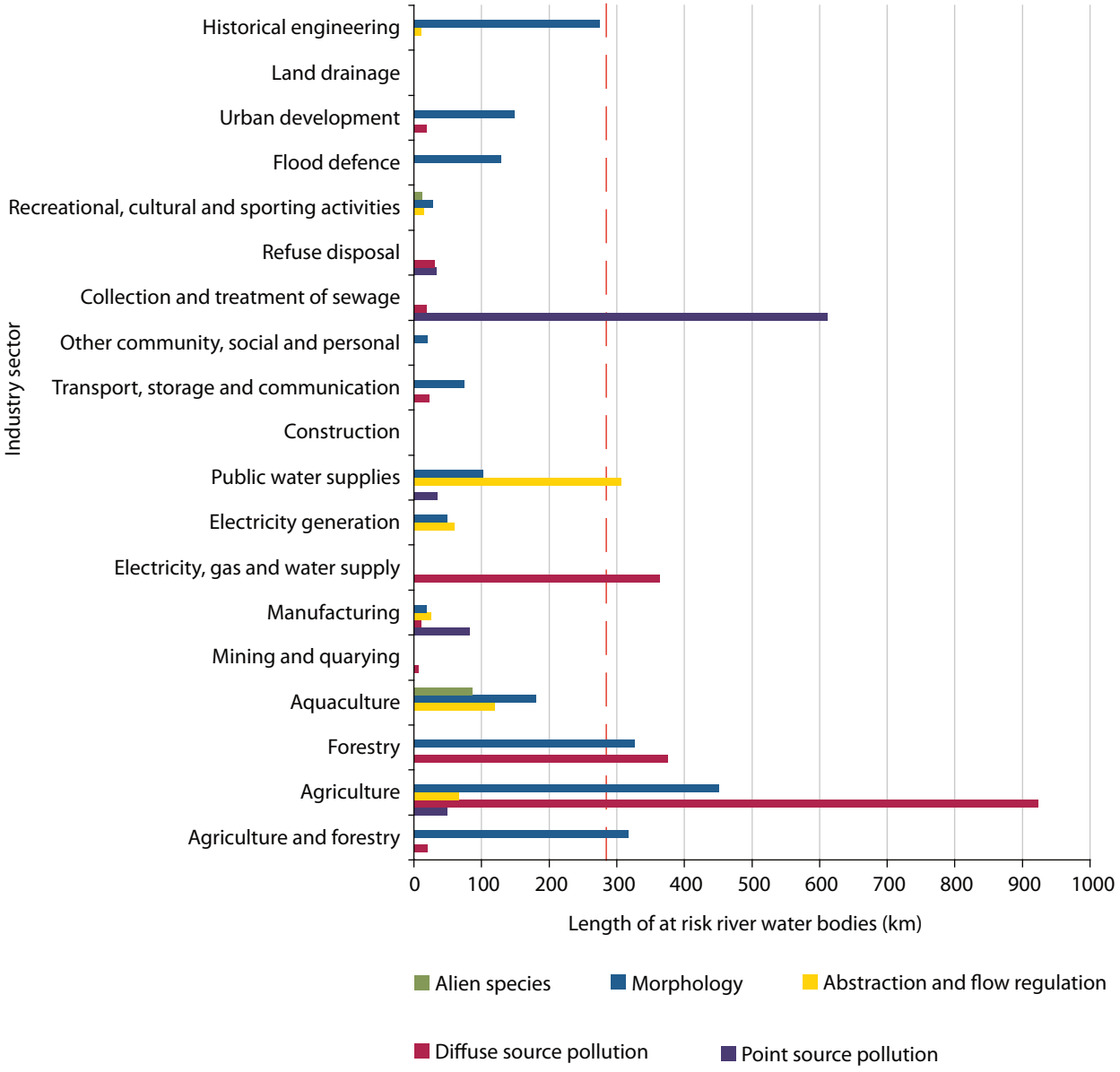


Figure B2: Pressure types by industry sector impacting at risk lake/loch water bodies in the Scottish part of the Solway Tweed river basin district

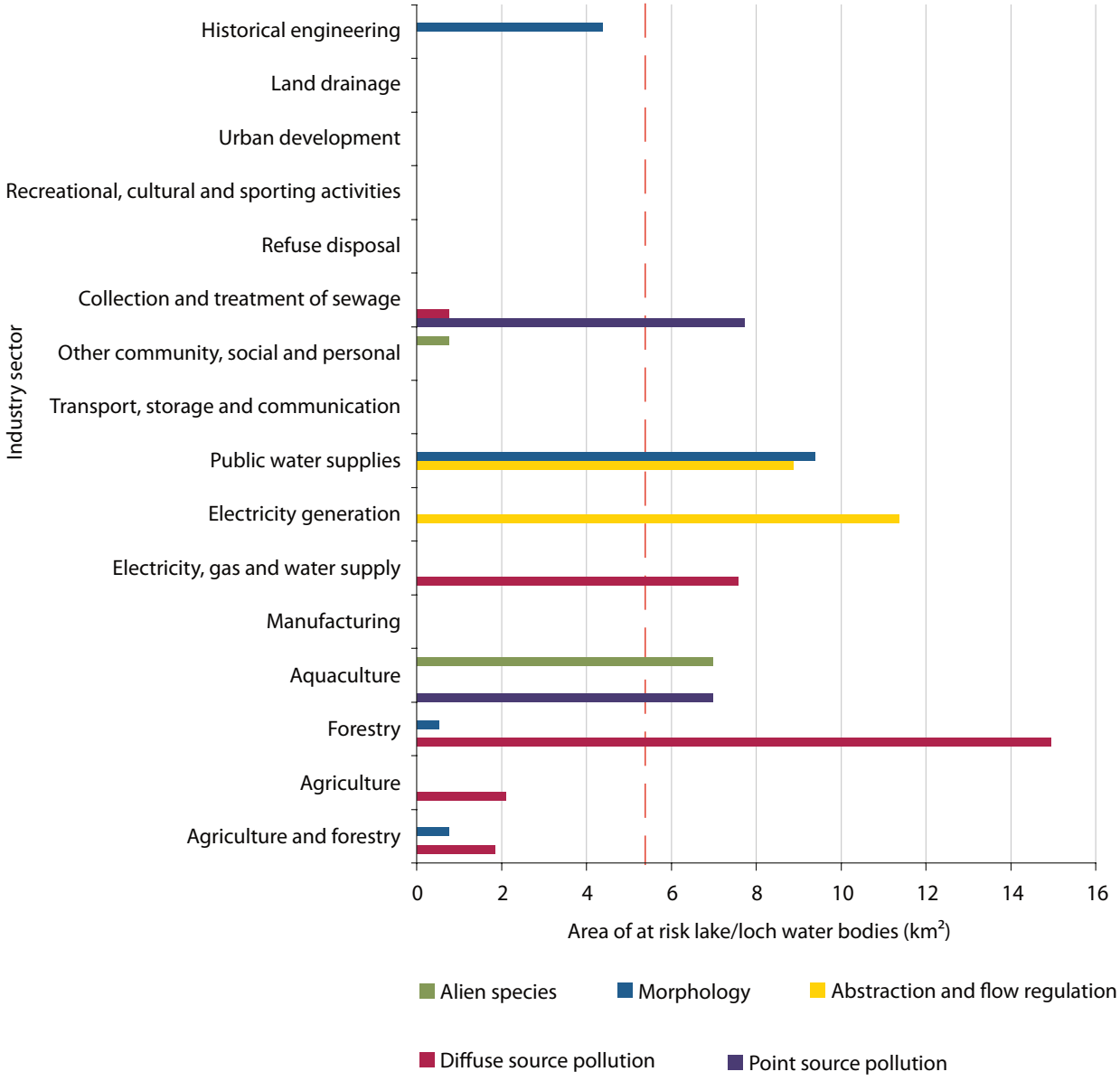


Figure B3: Pressure types by industry sector impacting at risk transitional water bodies in the Scottish part of the Solway Tweed river basin district

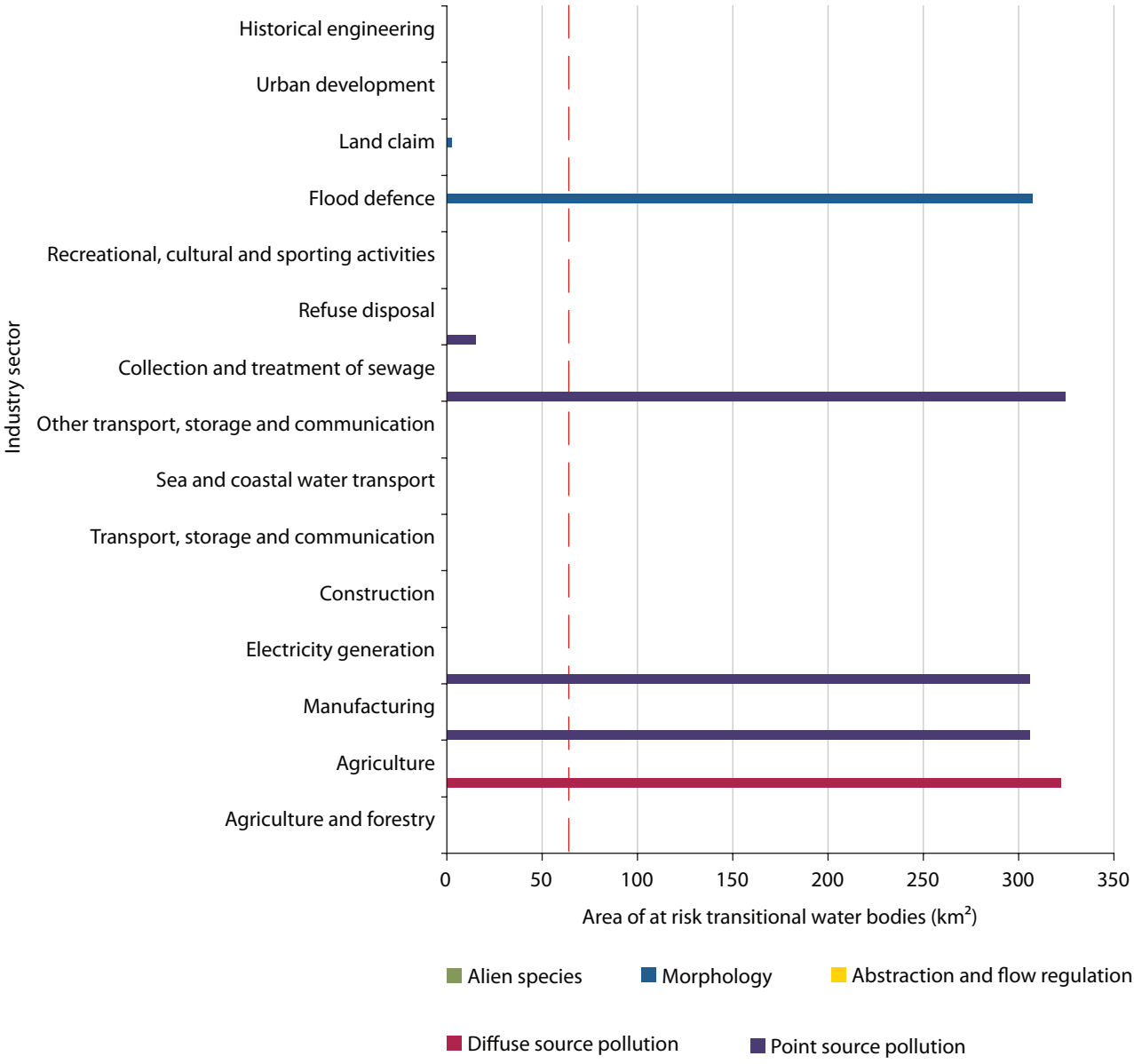


Figure B4: Pressure types by industry sector impacting at risk coastal water bodies in the Scottish part of the Solway Tweed river basin district

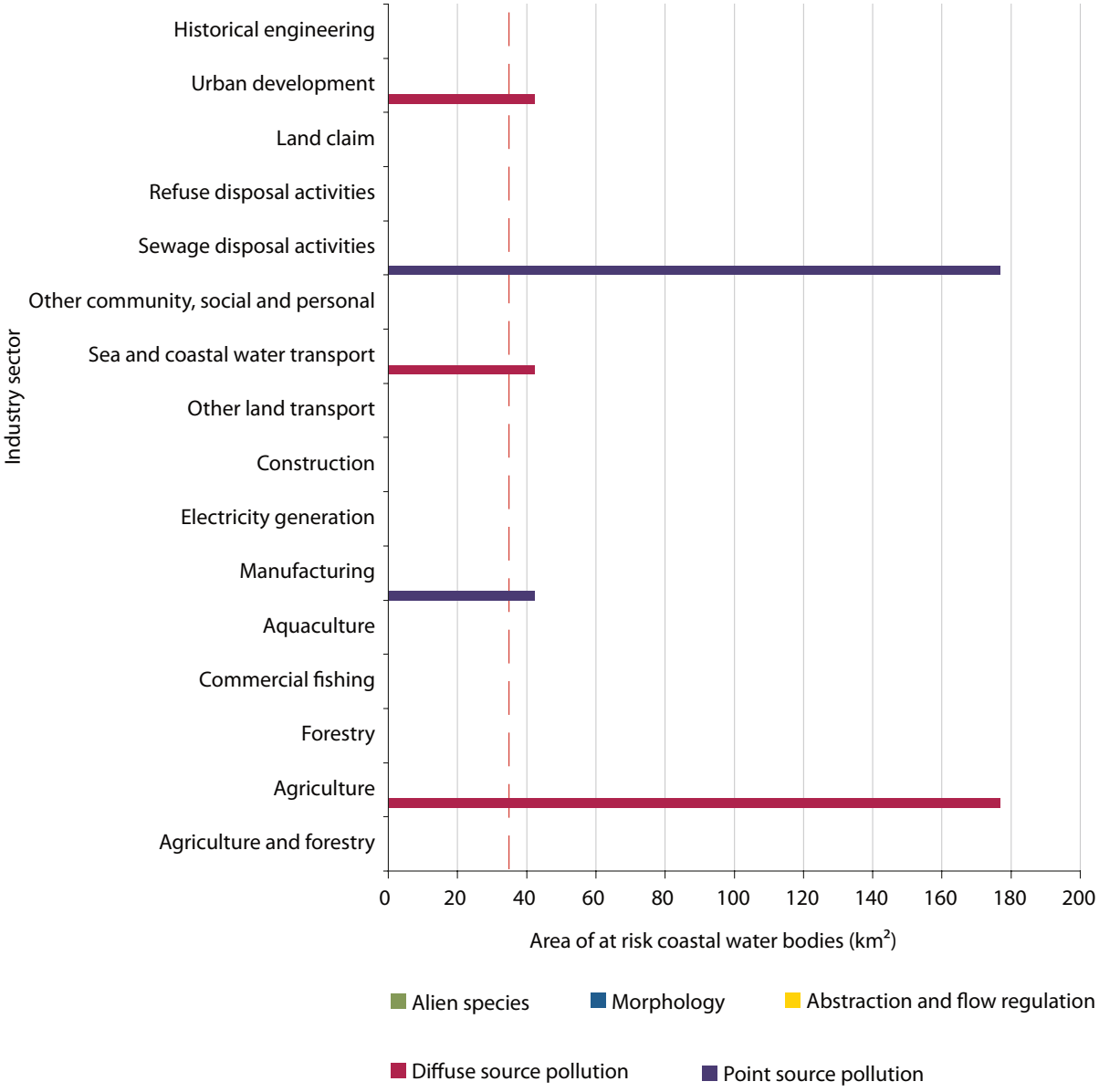
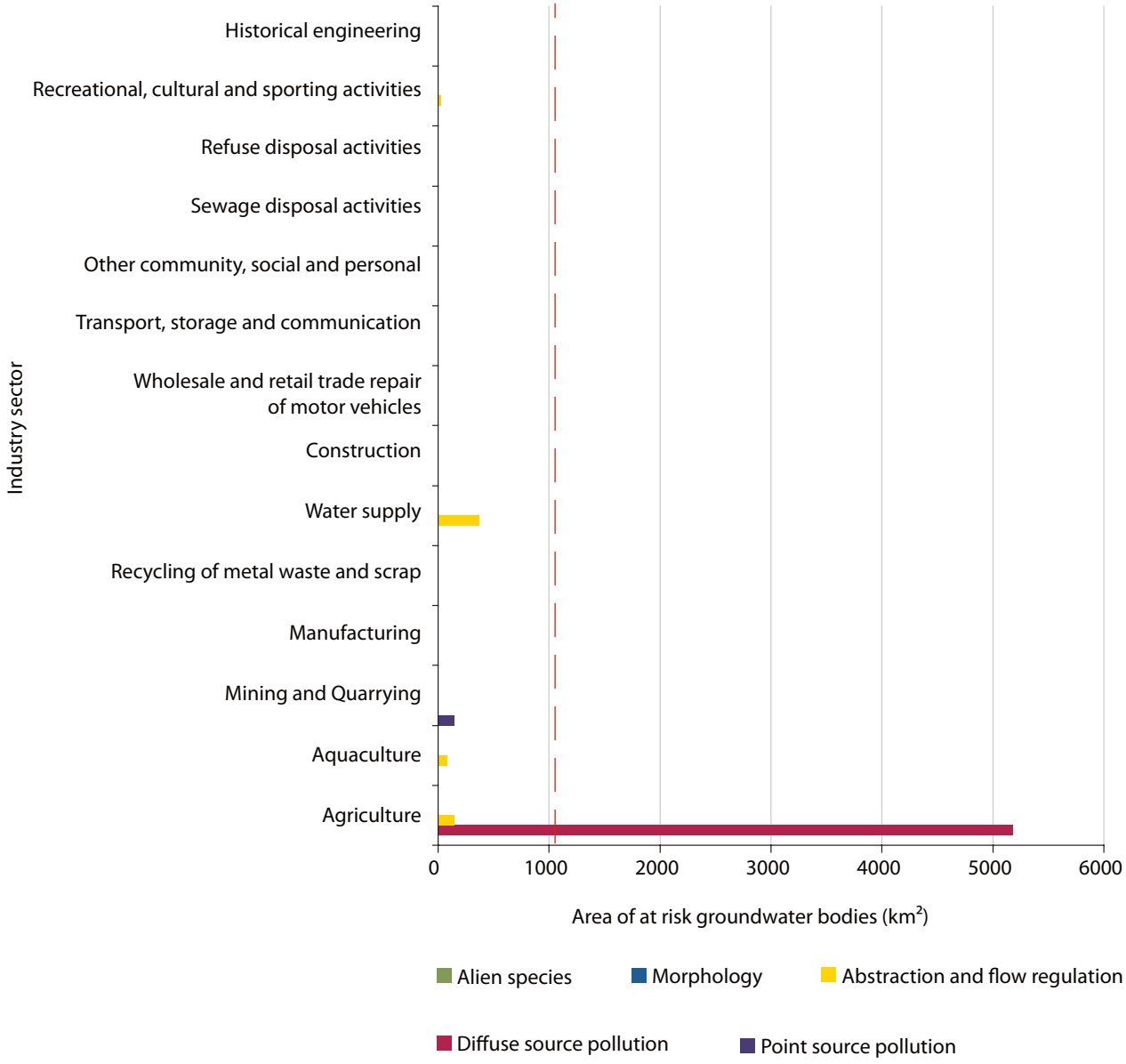


Figure B5: Pressure types by industry sector impacting at risk groundwater water bodies in the Scottish part of the Solway Tweed river basin district



Annex C: Significant issues in the Solway and Tweed sub-basins

Those issues that are not significant at the Solway Tweed river basin district level are highlighted in red.

Those issues added by the Solway AAG are highlighted in blue.

Numbers of water bodies are shown in brackets.

Table C1: Significant issues within the Solway sub-basin

Pressure type	Key sector	Rivers	Lochs/lakes	Transitional	Coastal	Groundwater
Diffuse source pollution	Agriculture	529 km (39)	1 km² (2)	322 km² (3)	177 km² (2)	3,012 km² (24)
	Forestry	368 km (34)	15 km² (7)	–	–	–
	Sea and coastal water transport	–	–	–	42 km² (1)	–
	Electricity, gas and water supply (acidification)	364 km (34)	8 km² (6)	–	–	–
	Sewage disposal activities	–	1 km² (1)	–	–	–
	Urban development	19 km (2)	–	–	42 km² (1)	–
Point source pollution	Sewage disposal activities	317 km (17)	8 km² (2)	325 km² (5)	177 km² (2)	–
	Aquaculture	–	7 km² (1)	–	–	–
	Manufacturing	78 km (2)	–	306 km² (1)	42 km² (1)	–
	Electricity generation	–	–	306 km2 (1)	–	–
Abstraction and flow regulation	Electricity generation	37 km (3)	11 km² (3)	–	–	–
Morphology	Agriculture and forestry	317 km (23)	–	–	–	–
	Forestry	324 km (29)	1 km² (1)	–	–	–
	Flood defence	63 km (3)	–	307 km² (1)	–	–
	Historical engineering activity	116 km (8)	4 km² (2)	–	–	–
Alien species	Aquaculture	33 km (3)	7 km² (1)	–	–	–

Table C2: Significant issues within the Tweed sub-basin

Pressure type	Key sector	Rivers	Lochs/lakes	Transitional	Coastal	Groundwater
Diffuse source pollution	Agriculture	394 km (30)	1 km^2 (1)	–	–	2,170 km^2 (28)
Point source pollution	Sewage disposal activities	259 km (15)	–	–	–	
Abstraction and flow regulation	Water supply	237 km (16)	8 km^2 (5)	–	–	
	Agriculture	47 km (7)	–	–	–	
Morphology	Agriculture	371 km (35)	–	–	–	
	Water supply	103 km (9)	9 km^2 (6)	–	–	
	Historical engineering activity	159 km (8)	–	–	–	
	Aquaculture	181 km (7)	–	–	–	
Alien species	Recreational, cultural and sporting activities	12 km (1)	–	–	–	

Annex D: Expected status of water bodies in the Scottish part of the Solway Tweed river basin district in 2015

D1 Water bodies that may not achieve good status by 2015

SEPA has used expert judgement to predict the degree of improvement that can be achieved for all at risk (1a and 1b) water bodies by 2015 by taking into account indicative measures. From now until the publication of the draft river basin management plan, the Area Advisory Groups (AAGs) will be refining these predictions. The AAGs will also identify indicative measures that can be undertaken by stakeholders.

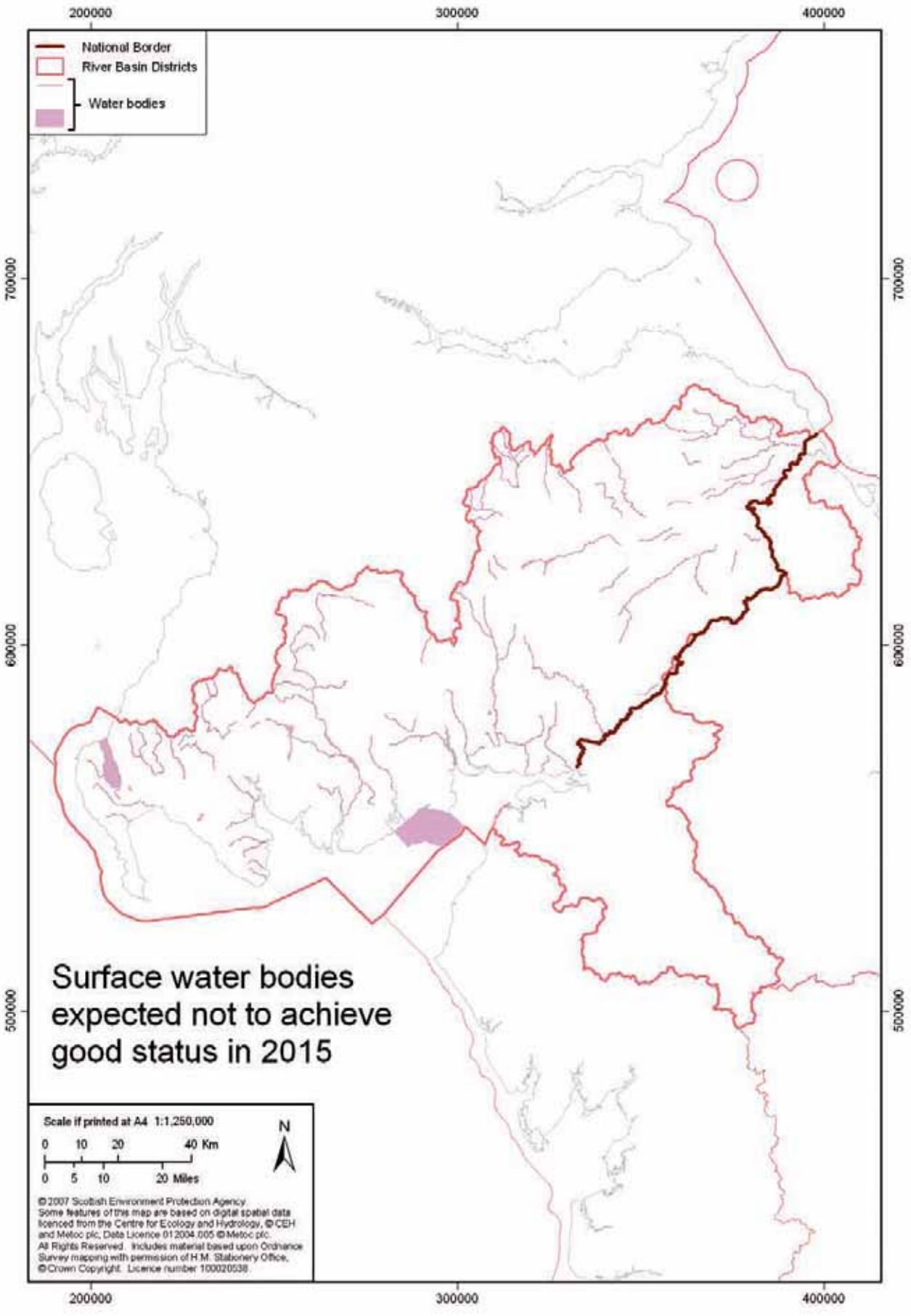
Environmental objectives will be set for individual water bodies in conjunction with the Area Advisory Groups and other partnership organisations. The objectives will be presented in the draft plan for consultation. The Water Framework Directive requires factors such as technical feasibility, disproportionate costs and cost-effectiveness of measures to be taken into account when setting the environmental objectives.

In the Scottish part of the Solway Tweed river basin district, 110 river, six loch, four transitional and 40 groundwater bodies are expected to fail to meet good status by 2015 (Table D1). Map D1 shows the surface water bodies expected not to achieve good status by 2015 and Map D2 shows the groundwater water bodies. A list of these water bodies is provided in Table D2.

Table D1: Summary of the number and percentage of water bodies expected to fail to achieve good status by 2015 in the Solway Tweed river basin district (Scottish part only)

Water category	Number of water bodies (total number of water bodies)	Percentage of all water bodies
River	110 (379)	29
Loch	6 (25)	24
Transitional	4 (10)	40
Coastal	0 (8)	0
Groundwater	40 (68)	59
Total	**160 (490)**	**33**

Map D1: Surface water bodies expected not to achieve good status by 2015



Map D2: Groundwater water bodies expected not to achieve good status by 2015

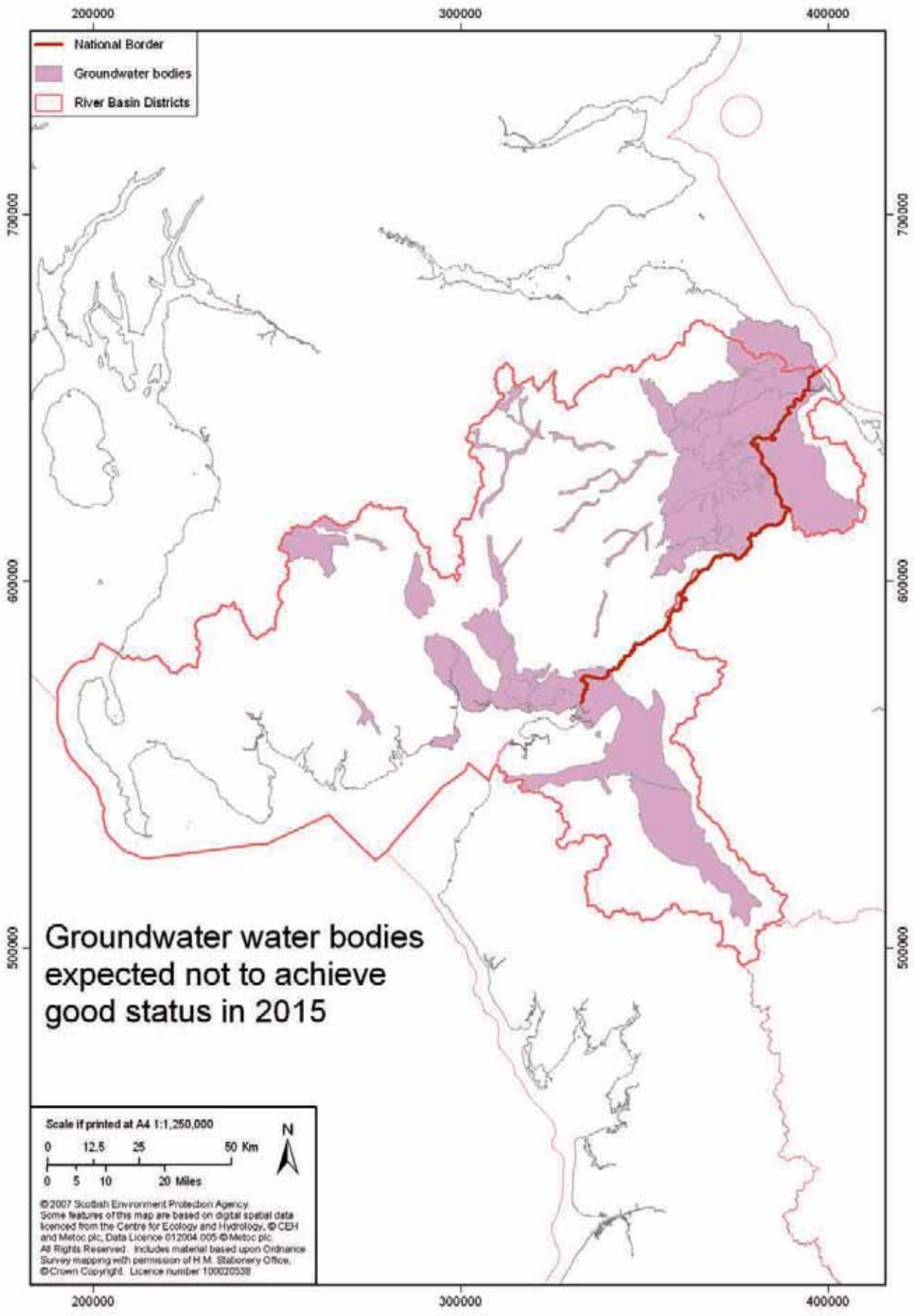


Table D2: List of water bodies not expected to achieve good status by 2015 (Scotland only)

Category	ID	Name	Length/area (km/km²)
River	5101	Whiteadder Water (Dye Water to Billie Burn confluences)	25.7
River	5102	Whiteadder Water (Whiteadder Reservoir dam to Dye Water confluence)	8.2
River	5105	Blackadder Water (Howe Burn confluence to Whiteadder Water)	10.0
River	5109	Howe Burn	11.8
River	5114	Billie Burn (Lintlaw Burn confluence to Whiteadder Water)	1.6
River	5116	Lintlaw Burn	6.8
River	5122	Dye Water	21.5
River	5124	Watch Water	9.5
River	5200	River Tweed (Coldstream to tidal limit)	18.6
River	5201	River Tweed (St Boswells Burn confluence to Coldstream)	34.0
River	5206	Bannock Burn	6.5
River	5208	Leet Water (Source to Lambden Burn confluence)	11.4
River	5210	Lambden Burn	17.1
River	5212	Trib upstream of Swinton Mill	10.1
River	5215	Eden Water (Hume Burn confluence to River Tweed)	20.7
River	5216	Eden Water (Source to Hume Burn confluence)	16.4
River	5217	Hume Burn	4.7
River	5218	Hareford Burn	8.6
River	5220	Teviot Water (Northhouse Burn to Kale Water confluences)	40.4
River	5226	Fawlaws Burn/Otter Burn	6.6
River	5231	Jed Water/Raven Burn (Kaim Burn confluence to Teviot Water)	15.4
River	5256	Allan Water (Source to Teviot Water)	13.5
River	5264	St. Boswells Burn	5.5
River	5265	Bowden Burn	11.5
River	5268	Turfford Burn	7.8
River	5280	Gala Water (Armet Water confluence to River Tweed)	27.3
River	5282	Gala Water (Source to Armet Water confluence)	7.3
River	5287	Ettrick Water (Ramseycleuch to River Tweed)	36.6
River	5290	Yarrow Water	23.0
River	5294	Megget Water (Megget Reservoir dam to St Mary's Loch)	3.7
River	5298	Caddon Water	18.7
River	5301	Leithen Water	17.3
River	5307	Eddleston Water/Cuddy Burn	19.2
River	5312	Lyne Water (Source to Tarth Water confluence)	22.5
River	5314	Tarth Water	11.4
River	5320	West Water	9.7
River	5321	Cairn Burn	6.5
River	5328	Kilbucho Burn	8.4
River	5329	Spittal Burn/Candy Burn	10.0

Category	ID	Name	Length/area (km/km^2)
River	5334	Talla Water	2.3
River	5336	Fruid Water (Fruid Reservoir Dam to River Tweed)	3.3
River	5404	The Stank	7.4
River	6844	Whiteadder Water (Billie Burn confluence to tidal limit)	17.0
River	10481	Sole Burn	8.8
River	10483	Black Stank	5.7
River	10492	Water of Luce (u/s Cross Water of Luce)	19.5
River	10493	Cross Water of Luce	24.5
River	10494	Penwhirn Burn (d/s Penwhirn Reservoir)	1.0
River	10495	Penwhirn Burn (above Penwhirn Reservoir)	7.6
River	10504	Ket Burn	7.6
River	10509	River Bladnoch (u/s Black Burn)	13.0
River	10510	River Bladnoch (d/s Loch Maberry)	1.5
River	10511	Pulganny Burn	8.0
River	10512	Polbae Burn	7.2
River	10515	Tarf Water (u/s Drumpail Burn)	17.8
River	10519	Bishop Burn	14.1
River	10520	River Cree (u/s Newton Stewart)	13.3
River	10521	River Cree (u/s Minnoch conf)	7.0
River	10522	River Cree (u/s Carrick Burn)	23.8
River	10523	Fardin Burn	6.4
River	10524	Clauchrie Burn	11.5
River	10525	Carrick Burn/Corwar Burn	9.3
River	10527	Water of Minnoch (River Cree to Water of Trool)	5.8
River	10528	Water of Minnoch (u/s Water of Trool)	20.4
River	10531	Water of Trool	2.9
River	10532	Gairland Burn	5.7
River	10538	Skyre Burn	8.4
River	10540	Big Water of Fleet	14.7
River	10541	Little Water of Fleet	13.5
River	10545	River Dee (Loch Ken Outlet to Tongland)	14.9
River	10546	Black Water of Dee (Pullaugh Burn to Loch Ken)	19.0
River	10547	Black Water of Dee (Loch Dee to Clatteringshaws Reservoir)	6.7
River	10548	Dargall Lane	3.5
River	10549	Cooran Lane/March Burn	10.0
River	10550	Garray Burn/Minnigall Lane	6.8
River	10551	Pullaugh Burn	4.3
River	10552	Cuttiemore Burn	3.3
River	10558	Water of Ken (d/s Kendoon)	6.8
River	10562	Water of Deugh (Carsphairn Lane to Water of Ken)	8.2

Category	ID	Name	Length/area (km/km^2)
River	10564	Pochriegavin Burn	5.3
River	10568	Polmaddy Burn	15.2
River	10572	Garple Burn/Margree Burn	15.2
River	10573	Black Water	13.1
River	10575	Gelston Burn/Carlingwark Lane	10.8
River	10589	Kirkgunzeon Lane	23.1
River	10598	New Abbey Pow/Glensone Burn	11.3
River	10600	Cargen Pow/Bogrie Lane	20.9
River	10601	Lochfoot Burn	1.9
River	10602	Under Brae Lane	6.3
River	10603	River Nith (Dumfries)	2.7
River	10604	Cluden Water/Cairn Water	30.7
River	10609	Old Water	14.1
River	10611	River Nith (Sanquhar - New Cumnock)	18.9
River	10614	Afton Water	15.4
River	10636	Lochar Water (below Black Grain)	4.2
River	10637	Lochar Water/Park Burn	23.7
River	10638	Amisfield Burn	7.6
River	10640	Black Grain	6.6
River	10641	Pow Water	11.3
River	10644	Dalton Burn	9.9
River	10648	Ryemuir Burn	10.6
River	10652	Wamphray Water	13.9
River	10665	Dornock Burn	6.6
River	10666	Kirtle Water (d/s Waterbeck)	19.2
River	10673	Black Esk	19.0
River	10722	Black Water of Dee (Clatteringshaws Reservoir to Pullaugh Burn)	0.6
River	10739	River Annan (above Threewaterfoot)	12.5
River	10754	Mouswald Burn	12.6
River	10759	Glenzier Burn	11.5
River	10761	Water of Ken	9.6
Lake	100321	Earlstoun Loch	0.5
Lake	100322	Castle Loch	0.8
Lake	100325	Clatteringshaws Loch	3.9
Lake	100326	Loch Ken/River Dee Marshes	7.0
Lake	100331	Loch Grannoch	1.1
Lake	100332	Penwhirn Reservoir	0.5
Groundwater	150112	Moffat bedrock and extensive sand and gravel aquifers	31.6
Groundwater	150115	Thornhill bedrock and extensive sand and gravel aquifers	75.9
Groundwater	150118	Lochmaben bedrock and extensive sand and gravel aquifers	101.1

Category	ID	Name	Length/area (km/km^2)
Groundwater	150125	Coldstream bedrock and localised sand and gravel aquifers	269.1
Groundwater	150126	Duns bedrock and localised sand and gravel aquifers	149.6
Groundwater	150127	Lower Tweed Valley Sand and Gravel	24.7
Groundwater	150128	Edrom Sand and Gravel	16.2
Groundwater	150129	Eden Valley Sand and Gravel	6.3
Groundwater	150130	Hownam Law bedrock and localised sand and gravel aquifers	289.2
Groundwater	150132	Halliburton bedrock and localised sand and gravel aquifers	187.8
Groundwater	150133	Lauderdale bedrock and localised sand and gravel aquifers	65.0
Groundwater	150134	Greenlaw Sand and Gravel	18.4
Groundwater	150135	Jedburgh bedrock and localised sand and gravel aquifers	314.3
Groundwater	150136	Hyndlee bedrock and localised sand and gravel aquifers	64.7
Groundwater	150137	Falla bedrock and localised sand and gravel aquifers	15.3
Groundwater	150138	Lower Teviot Valley Sand and Gravel	45.6
Groundwater	150139	Stank Burn Valley Sand and Gravel	6.7
Groundwater	150140	Bowmont Water Valley Sand and Gravel	5.2
Groundwater	150144	Ettrick and Yarrow Valley Sand and Gravel	33.3
Groundwater	150145	Tweed Valley Sand and Gravel	18.8
Groundwater	150146	Upper Ettrick Valley Sand and Gravel	11.9
Groundwater	150148	Upper Tweed Valley Sand and Gravel	32.5
Groundwater	150149	Biggar Valley Sand and Gravel	12.8
Groundwater	150150	Lyne Water Valley Sand and Gravel	13.4
Groundwater	150151	West Linton Sand and Gravel	19.5
Groundwater	150152	Upper Teviot Valley Sand and Gravel	15.1
Groundwater	150153	Slitrig Valley Sand and Gravel	3.7
Groundwater	150154	Borthwick Valley Sand and Gravel	6.2
Groundwater	150160	Ewes Valley Sand and Gravel	8.1
Groundwater	150161	Ecclefechan bedrock and localised sand and gravel aquifers	44.0
Groundwater	150163	Ecclefechan Coastal Sand and Gravel	60.0
Groundwater	150164	Solway bedrock and localised sand and gravel aquifers	107.3
Groundwater	150165	Solway Sand and Gravel	40.6
Groundwater	150166	Dumfries bedrock and extensive sand and gravel aquifers	81.3
Groundwater	150167	Lochar Water bedrock and localised sand and gravel aquifers	106.0
Groundwater	150168	Sanquar Sand and Gravel	9.4
Groundwater	150170	Moffat Water Sand and Gravel	8.9
Groundwater	150174	New Cumnock bedrock and localised sand and gravel aquifers	148.9
Groundwater	150179	Annandale Sand and Gravel	34.2
Groundwater	150183	Dee Valley Sand and Gravel	22.8
Transitional	200009	Auchencairn Bay/Rough Estuary	15.0
Transitional	200315	Annan Estuary	0.3
Transitional	200316	Nith Estuary	1.5
Transitional	200515	Solway Estuary	305.7