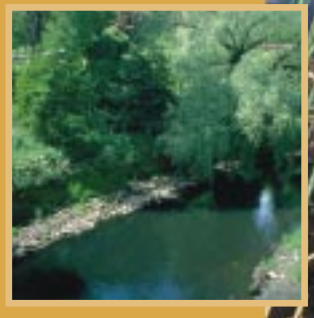
SEPA
Scottish Environment Protection Agency

Scotland River Basin District

Characterisation and impacts analyses required by Article 5 of the Water Framework Directive

SUMMARY REPORT



Cover images

Main - Loch Meadie, Sutherland

Top to bottom - Linwood Water Treatment Works, Renfrewshire

- Grangemouth
- Outfall pipe
- River Clyde, Kelvinside, Glasgow

The Future of Scotland's Waters

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Scottish Water

River Basin Characterisation

- Analysis of its characteristics, and
- Review of the impact of human activity on the status of surface waters and on groundwater

Published 22 March 2005

Foreword

Over the coming years, important decisions are going to be made about how we, in Scotland, protect and improve our valuable water resources and, on the pages that follow, we set out some important information about the pressures and impacts upon the water environment.

This work is one of the first steps under the Water Framework Directive which came into force in Europe in 2000 and established new and better ways of protecting, improving and using Europe's rivers, lochs, estuaries, coasts, canals, wetlands and groundwater.

We have worked hard during the last three years to collect information that is informative and useful to key individuals, organisations and decision-makers. However, there is still much to be done to fully understand the impacts, and further work is planned for the years ahead.

Work has been undertaken by a range of organisations including the Scottish Environment Protection Agency (SEPA), British Geological Survey, British Waterways, Fisheries Research Services (marine and fresh water laboratories), Macaulay Institute, Scottish Executive, Scottish Natural Heritage and Scottish Water.

SEPA consulted on a draft of this report, which covered the whole of Scotland, between July and September 2004. This report takes into account the responses received for which we are very grateful. We intend to continue this participative approach throughout our work on the Directive as we monitor, assess, plan and take action to improve Scotland's water environment.

Dr Campbell Gemmell

Chief Executive
Scottish Environment Protection Agency

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Linwood Water Treatment Works, Renfrewshire

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Executive summary

This report is the most detailed assessment ever produced on the pressures and impacts on the water environment in the Scotland river basin district. It represents one in a series of reports on the United Kingdom's water environment. The work has been undertaken by a range of organisations including the Scottish Environment Protection Agency (SEPA), British Geological Survey, British Waterways, Fisheries Research Services (marine and fresh water laboratories), Macaulay Institute, Scottish Executive, Scottish Natural Heritage and Scottish Water.

Water bodies

To allow us to manage and report on our water environment more effectively, we have divided it into water bodies. This has been done in accordance with the requirements of the Directive and having regard to UK guidance. Water bodies may be entire bodies of water such as lochs or parts of bodies of water such as river sections. The water body units have been identified using natural features, for example where two rivers join, as well as pressures acting on waters, for example where a large dam has been built. In total we have identified 2,005 river, 309 loch, 40 transitional, 449 coastal and 106 groundwater water bodies in the Scotland river basin district.

We have assessed all of these water bodies to find out whether there is a risk that the pressures on them could stop them meeting the Directive's objectives unless management measures are taken. We have had to carry out this assessment before an internationally agreed definition of good status has been finalised, so it will be subject to future revision as more information becomes available.

Point source pollution and assessment of impact

A total of 285 river, 38 loch, 18 transitional, 110 coastal and 17 groundwater water bodies are affected by point source pollution pressures. The main cause is sewage disposal activities, with commercial fishing and manufacturing processes the next most important causes.

Diffuse source pollution and assessment of impact

A total of 488 river, 57 loch, 18 transitional, 59 coastal and 21 groundwater water bodies are affected by diffuse source pollution pressures. The main cause of diffuse pollution is agriculture. The next most important causes are urban development, forestry, production of power and transport resulting in acidification, and sea and coastal water transport.

Abstraction and flow regulation and assessment of impact

A total of 494 river, 114 loch, 1 transitional and 11 groundwater water bodies are affected by abstraction and flow regulation pressures. No coastal water bodies are affected. Of those affected, 256 river and 75 loch water bodies have been provisionally identified as artificial or heavily modified because of the effects of dams.

The main causes of abstraction and flow regulation impacts are hydropower and the collection, purification and distribution of water. The next most important causes are mining and quarrying, and abstraction for golf courses.

Morphological alterations and assessment of impact

A total of 667 river, 120 loch, 16 transitional and 43 coastal water bodies are affected by morphological alterations. Of these, 256 river, 75 loch, 9 transitional and 10 coastal water bodies have been provisionally identified as artificial or heavily modified. These water bodies are unlikely to be able to achieve good ecological status because of the impact of the modifications to support beneficial uses.

Morphological alterations have a variety of causes such as agriculture and forestry, hydropower, urban development, dredging, land claim and recreational purposes.

Summary of water bodies affected by all pressures

The initial characterisation assessment indicates that overall about 43% of water bodies in the Scotland river basin district may not meet the Directive's environmental objectives. These include 913 river, 167 loch, 23 transitional, 128 coastal and 25 groundwater water bodies.

In the Scotland river basin district, morphological pressures along with abstraction and flow regulation pressures are the most common causes of risk for rivers and lochs. For rivers, diffuse pollution is as important as abstraction and flow regulation. Transitional, coastal and groundwater bodies are mainly at risk from point and diffuse source pollution pressures. These causes reflect the diverse geographic nature of the district. While many of the causes of risk arise from larger population centres and more intensively farmed areas, some of the more remote areas are at risk from pressures such as acid deposition and hydropower schemes.

Future work

This assessment is only the first step towards improving our water environment through integrated river basin management. Information will continually be improved and refined making the next cycle of characterisation more accurate than this first assessment. In the next stage we will develop the characterisation by improving our information from all sources, including regulated and non-regulated sectors and by incorporating additional monitoring data. This will help generate the 'Significant Water Management Issues' in the river basin, as required by Article 14 of the Directive, in 2007.

SEPA will use the information in this report to help amend the environmental monitoring programme. We will work in partnership with other organisations and sectors that contribute to the risks to the environment to design and carry out a programme of measures to achieve the environmental objectives of the Directive.

Further information on river basin characterisation and other Water Framework Directive related work is available on our website at http://www.sepa.org.uk/wfd/index.htm.

Beinn Eighe, Wester Ross

1. Introduction

1.1 Overview

The Water Framework Directive (the Directive)[1] is a wide ranging and ambitious piece of European environmental legislation. The Directive is transposed within the Scotland river basin district via the Water Environment and Water Services (Scotland) Act 2003 (WEWS Act).

The Directive's overall objective is to bring about the effective co-ordination of water environment policy and regulation across Europe in order to:

- prevent deterioration and enhance the status of aquatic ecosystems, including those dependent on groundwater;
- promote sustainable water use;
- reduce pollution;
- help reduce the effects of floods and droughts.

This report is the most detailed description ever produced on the pressures on the water environment in the Scotland river basin district. This analysis has been reported separately to the Commission. The work has been undertaken by a range of organisations including the Scottish Environment Protection Agency (SEPA), British Geological Survey, British Waterways, Fisheries Research Services (marine and fresh water laboratories), Macaulay Institute, Scottish Executive, Scottish Natural Heritage and Scottish Water.

This is one in a series of reports on the United Kingdom's water environment, bringing in the start of a new era of environmental protection. We are modernising the way we manage and protect the water environment as required by the Water Framework Directive. The Directive requires man-made pressures on the water environment to be assessed and managed in an integrated way across surface and groundwaters.

The Directive sets out a planning cycle for river basin management which consists of four main parts:

- **characterisation** of river basin districts including an assessment of water bodies at risk of not achieving the Directive's objectives as a result of man-made pressures;
- environmental **monitoring** informed by river basin characterisation;
- setting of environmental **objectives**; and
- design and implementation of a **programme of measures** to achieve environmental objectives.

Throughout this document you will see references and electronic links to reports and papers that have been produced in the course of carrying out this work, providing more detail and technical information that you may find helpful. In particular, we have provided detailed map-based information on the water environment on SEPA's website.

A timetable for the Directive's main requirements is shown in Table 1.

Table 1: Water Framework Directive timetable

Year	Requirement
2000	• Directive comes into force
By 2003	• Transpose requirements to member state law • Identify river basin districts (RBD) and Competent Authorities
By 2004	Undertake RBD characterisation to include: • Assessment of pressures and impacts on water status • Economic analysis of water use • Provisional identification of heavily modified and artificial waters • Register of protected areas
By 2006	• Monitoring programmes operational • Finalise EU register of intercalibration sites • Consult on RBMP production work programme
By 2007	• Consult on significant water management issues overview in RBD
By 2008	• Publish full draft RBMP for consultation

[1]A copy of the Water Framework Directive is available at http://europa.eu.int/eur-lex/pri/en/oj/dat/2000/l_327/l_32720001222en00010072.pdf

Year	Requirement
By 2009	Publish final first RBMP to include: • Environmental objectives • Programme of measures • Monitoring networks • Register of protected areas • Heavily modified and artificial water body designations
By 2012	• Programme of measures operational
By 2013	Review for the first RBMP: • Characterisation assessments • Economic analysis Consult on significant water management issues overview for 2nd RBMP
By 2015	• Achieve environmental objectives of first RBMP • Publish 2nd RBMP and thereafter every six years

This report covers the initial **characterisation** of the cycle, including an assessment of pressures and impacts on the district's waters. This is important because it will help us to shape the monitoring strategy and provide a starting point for the design of a programme of measures.

The main steps of characterisation are:

- identifying water bodies and their physical characteristics (Sections 3 and 4);
- identifying protected areas (Section 5);
- assessing the pressures and impacts on rivers, lochs, estuaries, coasts, groundwaters and groundwater dependent ecosystems, such as wetlands (Section 6);
- identifying which water bodies are at risk of not achieving the Directive's objectives;
- an economic analysis of water users and services in the district (this is presented in a separate report).

To allow us to manage and report on our water environment more effectively, we have divided it into **water bodies.** Water bodies may be entire bodies of water such as lochs or parts of bodies of water such as river sections. These units have been identified using natural features, for example where two rivers join, as well as pressures acting on waters, for example where a large dam has been built. As a result we have identified 2,005 river, 309 loch, 40 estuarine, 449 coastal and 106 groundwater water bodies in the Scotland river basin district.

The physical and chemical nature of these water bodies has been described and each water body assigned to one of a limited number of **types.** The type indicates, in very general terms, the sorts of plants and animals that are likely to be present. For example, the sorts of animals and plants that are found in shallow, exposed coastal waters are very different from those found in deep sea lochs. The type is important because it affects what the environmental objectives mean for the different types of water.

The next step is to identify water related **protected areas.** These have mainly been designated under a number of other European directives because they require special protection. Examples include bathing waters and areas identified for the protection of water dependent species and habitats. Establishing a register of protected areas will help us to manage water bodies in a way that meets the protected area objectives.

A key part of characterisation is the **assessment of pressures and impacts** on the water environment. This information is used as part of a risk screening exercise to identify those water bodies that are at risk of failing the environmental objectives set out in the Directive. The results will be used to prioritise both our environmental monitoring and those water bodies where management action is required. The assessment will also highlight where there are pressures that clearly need to be tackled by planning appropriate improvement action immediately.

The difficulty and complexity of such an analysis should not be underestimated. Previous environmental assessments by SEPA have focused on pollution pressures and have been supported by extensive chemical and biological monitoring information. The new assessment has involved integrating and interpreting information on different types of pressures, and we have had to develop new methods in a short space of time. The following pressures have been examined for their impacts on water bodies (Sections 6.2 to 6.6):

- point source pollution – such as effluent from waste water treatment works and industrial discharges;
- diffuse source pollution – including run-off from farmland, urban areas and acid rain;
- abstraction and flow regulation – including abstractions for water supply, manufacturing processes, and impoundment of water by dams or weirs for a range of uses such as hydropower and navigational purposes;

- morphological alterations – for example land claim for ports or housing, structures for coastal protection;
- alien species – introduced species which can result in a loss of natural biodiversity.

1.2 Interpreting the results of the pressure and impact assessments

The main purpose of this assessment is to identify which water bodies are likely to fail to meet their environmental objectives. Annex 1 outlines the environmental objectives and discusses some of the issues surrounding the assessment. These issues and plans for further characterisation are further discussed in the introductions to the reports sent to the Commission.

Achievement of 'good status' is one of the key environmental objectives of the Directive. Good status means that certain standards have been met for the ecology, chemistry and quantity of waters. In general terms, good status means that waters show only a slight change from what would normally be expected under undisturbed conditions. Another key objective is to achieve protected area objectives. We have undertaken an assessment, using the latest compliance reporting where possible, of whether protected areas are likely to achieve their objectives.

Further stages in the pressure and impact assessment are likely to change the number of waters at risk of failing the Directive's objectives as better information becomes available and practical constraints allowed for in the Directive (for example, the technical feasibility of improvement actions) are taken into account.

Action on the water bodies likely to fail their environmental objectives may take the form of a programme of measures or further assessment to decide on appropriate steps (Box 1).

It is important to remember that the purpose of the assessment is to help shape the monitoring programme and to provide a starting point for river basin management planning. SEPA consulted on proposals for river basin management planning between May and July 2004.

Box 1

What does it mean if a water body is at risk or not at risk?

If a water body is at risk it means that:

- we will further characterise the water environment over the period to 2007 by the use of additional monitoring and by the information provided by activities authorised under the Controlled Activities Regulations;
- new licence applications and transferring licences related to these water bodies will be given higher priority and from April 2006 we will focus the review of activities authorised under the Controlled Activities Regulations on water bodies identified as being at risk;
- we consider that it may need a programme of measures to ensure it meets the Directive's environmental objectives;
- by 2008, all water bodies identified at risk following further characterisation will be included in the first draft river basin management plan;
- we will consider whether it is technically feasible for the water body to meet good status without disproportionate costs;
- we will consider whether alternative objectives should apply (for example, a longer timescale for meeting good status, or objectives for a heavily modified or artificial water body).

If a water body is not at risk it implies that:

- at present we have no major concerns but will review these water bodies in future years;
- we will still need to regulate pressures to ensure that no deterioration in status occurs.

1.3 Purpose of this document

This report covers the initial characterisation stage of the process outlined above, including a risk screening assessment of pressures and impacts on the Scotland river basin district waters. The economic analysis of water use is presented in a separate report.

Some of the terminology used in this report comes from the Directive. It will allow the European Commission to assess the UK's compliance with the Directive and will also allow other member states to use the document more easily. In some instances where particular Directive requirements are presented, lochs may be referred to as lakes and estuaries may be referred to as transitional waters.

A general introduction to some of the technical aspects of the Directive can be found in SEPA's previous consultation document *'The Future for Scotland's Waters'* published in May 2002[2].

1.4 Next steps

SEPA will use the information in this report to help establish an environmental monitoring programme, improve the risk assessments where appropriate and start to look at risk management options. We will work in partnership with other organisations and sectors that contribute to the risks to the environment to design and carry out a programme of measures to achieve the environmental objectives of the Directive.

Further information on river basin characterisation and other Water Framework Directive related work is available on our website at http://www.sepa.org.uk/wfd/index.htm.

[2]See http://www.sepa.org.uk/publications/wfd

Outfall pipe

2. Scotland river basin district

River basin districts will be the main areas used for co-ordinating the management of the water environment. They comprise river basins and their associated transitional waters, coastal waters and groundwaters. There is one river basin district solely in Scotland (Scotland river basin district) and nine river basin districts solely in England and Wales. Two further river basin districts cross the border between Scotland and England: the Solway Tweed and Northumbria river basin districts. Map 1 shows the river basin districts in mainland UK.

This report refers to the Scotland river basin district.

Environmental characteristics

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

Overall, the district has fewer environmental problems than most others in the UK. The Highlands are mountain ranges of sandstone and granite, rising to Britain's highest mountain, Ben Nevis. Much of the Scottish uplands are characterised by large tracts of blanket bog which are more extensive in Scotland and Ireland than elsewhere in Europe. The oceanic climate and varied topography of the western Highlands and Islands give rise to a diverse and rich botany. The district supports important habitats and wildlife, including 235 water dependent Special Areas of Conservation and Special Protection Areas.

There are significant environmental problems in parts of the district, in particular around the larger population centres of Glasgow and Edinburgh. Although many large rivers and estuaries, such as the Clyde in the west and the Forth in the east, have seen marked improvements over the last 20 years, water quality problems remain. Land use in the north eastern part of the district is largely agricultural which can give rise to diffuse pollution problems.

The Scotland river basin district has a relatively high rainfall in relation to the rest of the UK, particularly in the west. About 90% of water supplies come from surface waters, the remainder from groundwater.

It is the largely clean environment of the district that attracts many tourists and supports particular industrial sectors. There are many excellent salmon rivers in the district and the generally clean water supports sectors such as fish farming and whisky manufacturers.

Shee Water, Glenshee

3. Surface waters: water bodies, types and reference conditions

3.1 Water bodies

Water bodies are the basic management and reporting units of the Directive. For surface waters they can be whole or parts of rivers, canals, lochs, estuaries or coastal waters. The main purpose of identifying water bodies is so that we can describe their status accurately and compare it with their environmental objectives.

Surface water bodies have been identified using natural features as well as known pressures and existing water quality information[3]. As a result we have divided surface waters in the Scotland river basin district into 2,005 river, 309 loch, 40 transitional and 449 coastal water bodies.

The Directive applies to inland surface waters, transitional waters, coastal waters and groundwaters, but for practical purposes, we used size thresholds from the Directive's typology system to initially identify river and loch water bodies. These thresholds are 0.5 km^2 for the surface area of lochs and 10 km^2 for river catchment area. Water bodies identified using these thresholds are referred to as baseline water bodies. Numbers presented throughout this report refer only to baseline water bodies. The length of baseline rivers is measured to their source mapped at 1:50,000 scale.

SEPA has identified and assessed additional small waters[4] where justified by environmental concerns and to meet the requirements of regulatory legislation such as for drinking water supplies. These small waters represent the range of issues encountered for many other small waters. A total of 580 small rivers and 200 small lochs have been identified for the Scotland river basin district. Better information is needed to characterise these and other small waters and this will be taken forward in future years[5].

3.2 Water body types and reference conditions

Surface water bodies are grouped into different types according to their physical and chemical characteristics. The types indicate, in very general terms, the sorts of plants and animals that are likely to be present in water bodies of that type in undisturbed conditions. For example, the sorts of animals and plants that are found in shallow, exposed coastal waters are very different from those found in deep sea lochs.

Reference conditions (equivalent to high status) are set in relation to the ecology we would expect to find in each type and represent undisturbed or nearly undisturbed conditions. They provide the basis on which the quality status classification scheme will be built, consisting of high, good, moderate, poor and bad status.

River types and reference conditions

River types in Scotland are defined according to system A of the Directive[6]. This system uses altitude, catchment size and geology to define the types. The system creates 27 possible types of which 21 are found in Scotland, England and Wales and 15 types are found in the Scotland river basin district (Map 2).

Reference conditions[7] for river types describe the plants, macroinvertebrates, fish and physicochemical conditions we would expect in undisturbed or nearly undisturbed conditions. The approach used to establish reference conditions in rivers varies with the availability of data. Rivers or stretches of river of a specific type that display only very minor effects from pressures were used to help define reference conditions. However, for river types with few examples of undisturbed sites, reference conditions were derived by expert judgement and modelling.

Loch[8] types and reference conditions

The ecological conditions of lochs, like other surface waters, change naturally to form a continuous variety of types. These types are determined principally by the characteristics of their catchments. To achieve a balance between dividing lochs into a large number of different types and a smaller, manageable number, the loch types in the UK are based on the natural characteristics that have the greatest bearing on their ecological condition. These are the geology of the catchment, expressed as the base status (alkalinity) of the loch, and the depth of the loch, expressed as the mean depth[9].

[3]More detailed information on the guiding principles on water body identification can be found in the European guidance paper http://forum.europa.eu.int/Public/irc/env/wfd/library?l=/framework_directive/guidance_documents/identification_bodies&vm=detailed&tsb=Title
[4]See http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5420/view for more detailed information on small waters
[5]Small waters are included in the interactive map and downloadable data available at http://www.sepa.org.uk/wfd/characterisation.htm
[6]The technical processes used in constructing the river typology are summarised in the UKTAG paper at http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5312/view
[7]Descriptions of reference conditions for rivers can be found at http://www.wfduk.org/tag_guidance/Article_05/Type%20specific%20reference%20conditions/view
[8]Loch has been used in place of the Directive term lake throughout this document.
[9]The technical processes used in constructing the lake typology are summarised in the UKTAG paper at http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5312/view

This approach complies with system B of the Directive. The other factors in system B (altitude, latitude, longitude and size) are of less relevance to ecological character at this scale and are therefore allocated to a single category for the UK. This results in 12 possible loch types, with a shallow and deep version of each of six geological types. The reference conditions described for these types will inform non-specialists which fauna and flora they might expect in each loch in an undisturbed condition[10].

Of the 12 possible loch types, 10 types are present in the Scotland river basin district (Map 3).

Transitional and coastal water types and reference conditions

In the UK system B is used to divide transitional and coastal waters into types[11]. In this system the obligatory factors are latitude, longitude, tidal range and salinity. The optional factors of mixing characteristics, mean substratum composition and wave exposure are also used, as these are important in determining the ecology of transitional and coastal waters. This approach results in five transitional and nine coastal water types for Scotland, all of which are represented in the Scotland river basin district (Maps 4 and 5).

This small number of physical types does not fully describe the diverse range of habitats that are found in transitional and coastal waters. SEPA is developing, in conjunction with the UK Technical Advisory Group (UKTAG), additional habitat-specific reference conditions. This will enable us to allocate a mix of appropriate habitat-specific reference conditions to each of the physical types[12].

3.3 Artificial and heavily modified water bodies

Artificial water bodies

Artificial water bodies (AWBs) are bodies of surface water created by human activity. There are a number of reasons why AWBs are important.

- Many AWBs currently or potentially support important aquatic ecosystems.
- Some AWBs may have a significant impact on non-AWBs and managing them will help us to protect the non-AWBs.
- Many AWBs are important for water supply reasons and their water quality and hydrology must be managed so that the Directive requirements can be met.
- Many AWBs have secondary uses (e.g. artificial reservoirs are often used for recreation) that require the water quality, ecology and water quantity to be managed appropriately.
- AWBs have been designed to support specified uses, which provide valuable social and economic benefits. These should be allowed to continue within a framework of sustainable management.
- Many AWBs support significant wider environmental interests such as wetlands and heritage features.

A separate classification scheme will be developed for AWBs that need to attain good ecological potential, as opposed to good ecological status.

As part of the characterisation work we have identified provisional AWBs. To date loch-type AWBs, such as man-made reservoirs, flooded gravel pits and canals have been provisionally identified as AWBs. This work will be developed in the near future as classification schemes are developed. Map 6 shows provisional AWBs and canals. In the Scotland river basin district, 29 river (canal), 1 loch, 1 transitional and 8 coastal water bodies have been provisionally identified as artificial.

Heavily modified water bodies

Sometimes it is not possible for a water body to achieve good status because of substantial alterations made for specified purposes such as navigation, water storage, flood defence and land drainage. The Directive recognises that the benefits of such uses need to be retained and allows these water bodies to be designated as heavily modified water bodies (HMWBs). The presence of physical alterations does not lead automatically to designation as HMWBs and neither does designation necessarily mean that mitigation measures will not be required. Designation enables objectives to be set that allow the benefits of the use to be maintained while ensuring that other pressures can be managed and, where possible, the adverse effects of the physical alterations mitigated. A separate classification scheme will be developed for HMWBs that need to attain good ecological potential, as opposed to good ecological status.

As part of the characterisation work we have identified provisional HMWBs. In the Scotland river basin district 227 river, 74 loch, 8 transitional and 2 coastal water bodies have been provisionally identified as heavily modified.

[10]Descriptions of reference conditions for lakes can be found at http://www.wfduk.org/tag_guidance/Article_05/Type%20specific%20reference%20conditions/view
[11]More detailed information on transitional and coastal water typology can be found at http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5312/view
[12]Descriptions of reference conditions for transitional and coastal waters can be found at http://www.wfduk.org/tag_guidance/Article_05/Type%20specific%20reference%20conditions/view

4. Groundwaters: water bodies and characteristics

4.1 Water bodies and characteristics

Scotland is geologically diverse, containing many aquifers with differing characteristics. The aquifers are grouped into categories based on how groundwater flows within them and how much water is available for abstraction. They range from the low productivity mountainous highlands to low-lying, highly productive sandstone basins.

The flow mechanism and size of the aquifer is important as this indicates how much interaction there is between the rock and the groundwater. Greater interaction means that more contaminants are likely to be removed or reduced by physical filtration, chemical or biological reactions. In general, with the exception of a few locations in the central valley and southern Scotland, bedrock aquifers are dominated by flow in fractures and hence the potential for reducing contaminants is minimal. The protection provided by overlying rock layers and deposits is therefore the key element in the assessment of vulnerability to pollution in bedrock aquifers.

Groundwater bodies have been identified to reflect the aquifer types; currently there are 124 groundwater bodies in Scotland of which 106 are assigned to the Scotland river basin district. Where groundwater bodies do not fully follow a particular river basin, they have been assigned to the most appropriate river basin district. The groundwater maps show the groundwater bodies assigned to the river basin district. The overall number of water bodies may rise in the future as some of the large groundwater bodies are subdivided due to ongoing pressure and impact analysis.

In areas above high productivity aquifers, groundwater bodies have been identified using geological and major catchment boundaries. In areas above low productivity bedrock aquifers, groundwater bodies have been identified using surface water sub-catchments as a surrogate for groundwater boundaries. Islands have been included where:

- there is a population of greater than 50 people; or
- a groundwater public water supply exists; or
- a groundwater dependent ecosystem or surface water has been identified; or
- current activities already affect groundwater.

Map 7 shows the groundwater bodies and typology based on simple models of flow patterns and groundwater chemistry[13].

4.2 Terrestrial ecosystems and surface water bodies dependent on groundwater

The environmental objectives for groundwater also consider ecosystems and waters dependent on groundwater quality and quantity. For example, a wetland or river fed by groundwater may require certain amounts or quality of water to allow it to function properly. Land based areas like this are called groundwater dependent terrestrial ecosystems (GWDTEs) and have been identified using surveys and predictive tools.

GWDTEs in Scotland have been identified in association with Scottish Natural Heritage (SNH) following UK guidance[14]. We have only included GWDTEs in areas designated under the Habitats and Birds Directives in this initial assessment. This will allow us to prioritise work on these ecosystems. Further work will be required to assess other GWDTEs in the future.

Ecosystems have been considered to rely on groundwater when:

- groundwater dependent ecosystems have been mapped by SNH; or
- a productive aquifer is at the surface and it is predicted that groundwater could be sustaining an ecosystem.

The second, predictive, method of assessment was used in areas where ecosystem mapping is not in place and followed UKTAG guidance. It is likely that future assessments will rely more heavily on ecological mapping and surveys rather than on this predictive method.

Surface water bodies are considered to be groundwater dependent when they are thought to be linked to a productive aquifer at the surface. Present understanding of these links is limited and our current assessments will be improved as we consider these relationships in later studies.

Map 8 shows terrestrial ecosystems and surface water bodies dependent on groundwater.

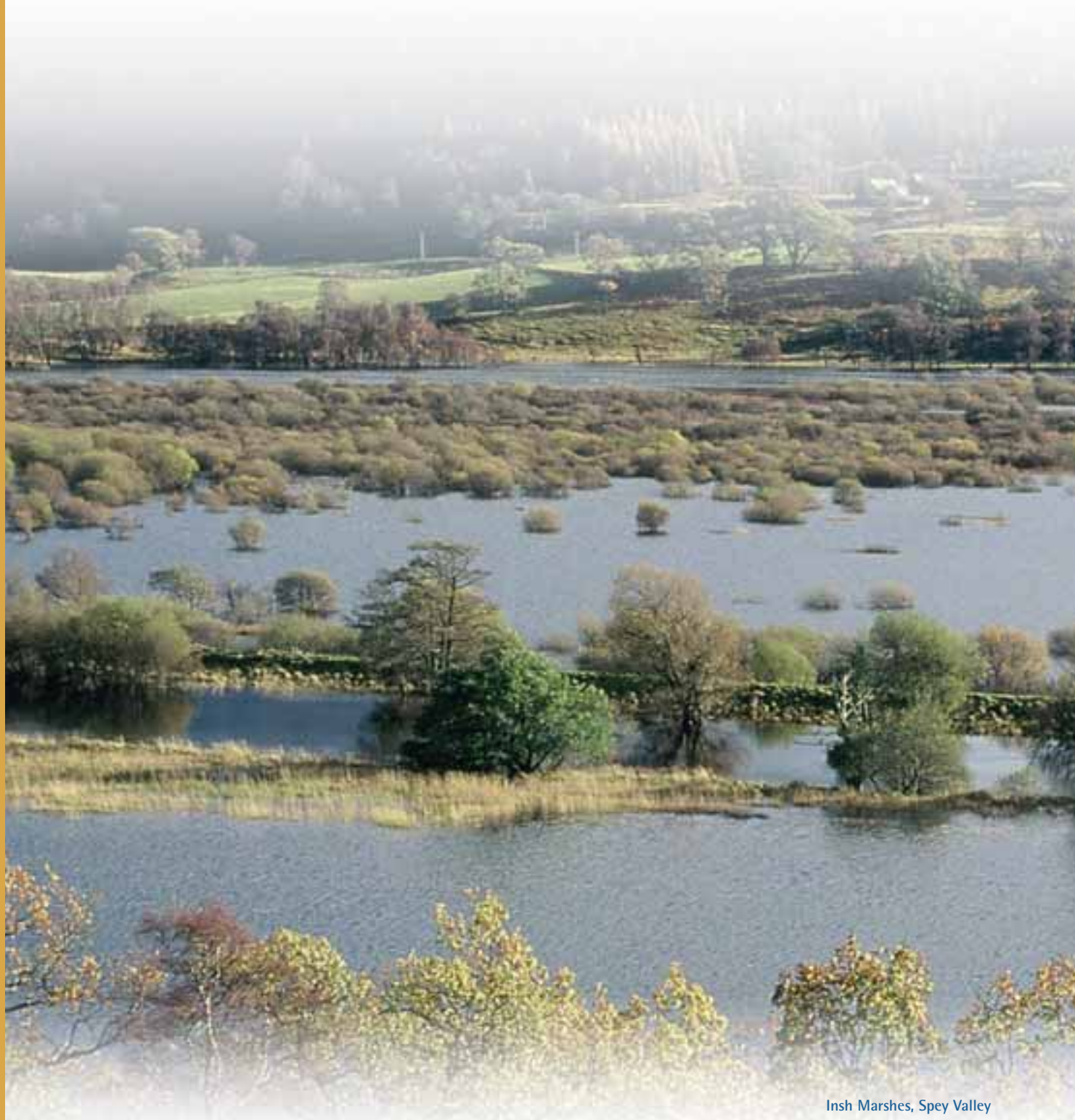
[13]For more detailed information on how groundwater bodies were delineated see http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5420/view
[14]See http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5332/TAG2003%20WP%205a-b%20%2801%29/view

Box 2

Wetlands and the Water Environment and Water Services (Scotland) Act

Wetlands are an important part of Scotland's water resources. They can play an important role in the functioning of fresh and transitional water ecosystems, in many instances have significant conservation value and can be important in flood mitigation. The importance of wetlands in Scotland is recognised in the WEWS Act which includes wetlands to a greater degree than the Water Framework Directive itself.

A programme is being planned which will identify wetlands directly associated with surface water bodies. Once this has been completed a wetland monitoring programme will be established to help protect and assess these areas.



Insh Marshes, Spey Valley

5. Protected areas

Protected areas are given particular protection under the 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 Directive requires us to establish a register of protected areas[15]. This will help to ensure that water bodies are managed to achieve the protected area objectives. The register consists of a list of sites and a set of maps showing the relevant protected areas (Maps 9 to 12).

There are regular reviews of designations included within the Protected Area Register. In particular reviews are currently under way for designations covering bathing waters, shellfish waters, nutrient sensitive areas and freshwater fish. These reviews will result in changes to the Protected Area Register over the next two years.

SEPA recognises that nationally identified areas, such as other waters used for bathing and Sites of Special Scientific Interest, are also important. These areas will be taken into account during river basin management planning.

5.1 Waters used for the abstraction of drinking water

Drinking water protected areas are the only protected areas which must be identified by virtue of the Water Framework Directive itself, rather than as a result of another Directive. They will replace the system of drinking water protection currently provided by the Surface Water Abstraction Directive (75/440/EEC), to be repealed at the end of 2007.

Protected areas for drinking water supplies have been identified as water bodies that supply a daily average of more than 10 m^3 of water for drinking, or supply more than 50 persons. In the Scotland river basin district it is proposed that 353 water bodies are identified as Drinking Water Protected Areas (Map 9). The Scottish Executive is in the process of designating these protected areas; this should be completed during March 2005.

5.2 Areas designated to protect economically significant species

These are protected areas established under earlier EC directives aimed at protecting shellfish (79/923/EEC) and freshwater fish (78/659/EEC). There are 102 shellfish waters and 14,427 km of designated freshwater fish stretches in the Scotland river basin district (Map 10).

5.3 Recreational waters

These are bathing waters designated under the Bathing Water Directive (76/160/EEC). There are 55 bathing waters in the Scotland river basin district (Map 10).

5.4 Nutrient sensitive areas

These comprise nitrate vulnerable zones designated under the Nitrates Directive (91/676/EEC) and areas designated as sensitive areas under the Urban Waste Water Treatment Directive (91/271/EEC). In the Scotland river basin district there are 10 areas designated as Nutrient Sensitive Areas (Map 11).

5.5 Areas designated for the protection of habitats or species

These are areas previously designated for the protection of habitats or species where maintaining or improving the status of water is important for their protection. They comprise the aquatic part of Natura 2000 sites designated under the Birds Directive (79/409/EEC) and the Habitats Directive (92/43/EEC)[16]. In the Scotland river basin district there are 235 areas designated as water dependent Natura 2000 sites (Map 12).

5.6 Assessment of protected area objectives

We have undertaken an assessment of whether protected areas are likely to achieve their objectives, where possible using 2003 compliance reporting for the Shellfish Waters Directive, Freshwater Fish Directive and Bathing Waters Directive. The exceptions to this approach are nutrient sensitive protected areas, where designation was taken to indicate a risk of failing the objectives. Protected areas for water dependent habitats and species have been initially assessed by SNH. The assessments are preliminary and do not pre-empt those to be reported under the Habitats Directive in 2007. There is no assessment for Drinking Water Protected Areas as these are new protected areas established by the Directive and no objectives have yet been set.

Results of the assessments are incorporated into Sections 6.2 to 6.5.

[15]The register can be viewed at http://www.sepa.org.uk/wfd/characterisation.htm.
[16]More detailed information on how these areas were selected can be found at http://www.wfduk.org/tag_guidance/Article_06-07/view

6. Pressure and impact analysis

6.1 Introduction

The pressure and impact analysis reviews the impact of human activity on surface waters and on groundwater. It identifies those water bodies that are at risk of failing to meet the Directive's environmental objectives. This first cycle of the characterisation process represents a risk screening exercise. Protected area objective assessments are based mainly on compliance reporting (see Section 5.6). **Annex 1 summarises the environmental objectives and discusses the issues and difficulties surrounding the analysis.** The assessment is important because it will shape monitoring programmes and provide a starting point for river basin management planning.

A significant uncertainty in carrying out this pressure and impact assessment is that good status has not yet been defined across Europe. This task is under way and will feed into further cycles of risk assessment and the final classification scheme used. For this report, we have used criteria set by the UKTAG in the assessments[17]. Additional information on groundwater assessments is provided on our website[18].

The principal objective of the Directive is for member states to aim to achieve good status, and to comply with protected area standards and objectives, by 2015. Because of the difficulty of predicting changes in pressures between now and 2015 we have made the general assumption that if a water body is at risk in 2004 it will be at risk in 2015. There are a few exceptions to this where we have accurate trend data to suggest otherwise and where planned investment is already funded.

The Directive requires us to report on water bodies as either at risk or not at risk of failing their objectives by 2015. In order to help prioritise future action, results are reported using the agreed UK categories shown in Table 2. This will enable us to concentrate our efforts first on the most significant risks[19].

Table 2: Agreed UK reporting categories and subsequent action

Directive reporting category	UK reporting category	Action
At risk	(1a) Water bodies at significant risk	Consideration of appropriate measures can start as soon as practicable
	(1b) Water bodies probably at significant risk but further information is needed to make sure this view is correct	Focus for more detailed risk assessments to determine whether or not the water bodies in this category are at significant risk in time for the interim overview of significant water management issues in 2007
Not at risk	(2a) Water bodies probably not at significant risk	Focus on improving quality of information in time for second pressure and impact analysis report in 2013
	(2b) Water bodies not at significant risk	Review for next pressure and impact analysis report in 2013 to identify any significant changes in the situation

The pressure and impact analysis in these first assessments has used a variety of methods and data sets reflecting differences in availability and quality of data. Some assessments have used data on environmental impacts, such as water quality and fish populations. Others have been based on pressures on the environment, such as water abstraction points and location of physical structures (such as barrages and weirs) which themselves may lead to an environmental impact.

The extent and quality of available data and information will improve in future cycles making later assessments more comprehensive and robust. Nevertheless, we believe that this first analysis provides a sound basis from which to develop monitoring programmes, improve the risk assessment and progress river basin management planning.

6.2 Point source pollution and assessment of impact

What is the issue?

Discharges from sewage works and industrial processes can contain substances that damage the ecology of waters. Authorised point sources are all those sites that have consents to discharge at a specific place, like sewage works or industrial discharges.

[17]Detailed information on these is available from http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5332/view
[18]See www.sepa.org.uk/groundwater/wfd
[19]More detailed guidance on the general principles for the pressure and impact analysis can be found at http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5332/view.

SEPA uses consents to control the amounts of substances discharged from point sources. Operators of sewage works and industrial sites commonly discharge effluent at a quality that is much better than their consent allows. This gives them a safety margin to guard against failure of the consent conditions. Therefore most of the sites we have looked at currently pass the targets we have used.

The European Commission has identified a list of 33 priority substances based on their toxicity, persistence and liability to bioaccumulate. European environmental quality standards (EQS) for these substances have not yet been set. However, any failures of existing UK standards are assumed to indicate a risk of not achieving good chemical status.

How did we do the assessment?

For surface waters we used water quality information obtained from our monitoring programmes. Our current monitoring network is geared towards assessing the impact from point source pollution. There is less information available on groundwaters. The methods of groundwater assessment are therefore more predictive and use simple models to indicate where impacts on groundwater are likely to occur.

Surface water bodies are considered as being at risk of not achieving good status if there is a risk that environmental quality standards are exceeded for any of the priority substances. Assessments are mainly based on existing SEPA data but a research project to identify possible point sources based on types of use has also been undertaken. There is little discharge or environmental data available in Scotland for many of the EC list of priority substances. This is because these substances have not been identified as being used in significant quantities.

We have carried out an assessment to identify water bodies at risk from radioactive substances[20]. This work shows that no water bodies are at risk from radioactive substances.

What do the maps show?

Map 13 shows examples of the pressures considered in carrying out the risk assessments. Many of these point sources are already subject to existing controls and are not causing any damage to the water environment. Water bodies affected by point source pollution pressures are shown in Map 14 (surface waters) and Map 15 (groundwater).

For each water body considered to be at risk, we have recorded the nature of the pressure and the general industry sector[21] responsible for this pressure. The assessments have also recorded whether a particular pressure is considered to be a primary or contributory one and figures presented in this report include both (see Box 3). Summary information is provided in the following tables and bar charts. This information can be viewed in detail for individual water bodies via the website at http://www.sepa.org.uk/wfd/characterisation.htm.

Tables 3 to 7 show the numbers, length and area of water bodies affected by point source pollution for rivers, lochs, transitional waters, coastal waters and groundwaters, respectively.

Figures 1 to 5 show the general industry sectors affecting water bodies in categories 1a and 1b for rivers, lochs, transitional waters, coastal waters and groundwaters, respectively. A water body is often affected by more than one sector and can therefore be counted more than once in the bar chart.

Box 3

Primary and contributory pressures

For each water body at risk, we have recorded the nature of the pressure and whether a pressure is considered to be a primary or contributory one. A primary pressure is one that on its own is likely to cause the water body to fail the environmental objectives. A water body can have more than one primary pressure. We have used expert judgement to determine whether a pressure is a primary or contributory one. This information will be useful when we come to establish the programme of measures. All maps, tables and bar charts include both primary and contributory pressures. This is because in some cases a water body does not have any primary pressures and is at risk from several contributory pressures.

[20]A copy of the full report can be found at http://www.sepa.org.uk/pdf/publications/technical/wfd_Assessment_pressures_impacts.pdf
[21]For a list of sectors used see http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5332/TAG2003%20WP%207a%20%2802%29/view

Table 3: River water bodies affected by point source pollution

	Reporting category	Number of water bodies	% of number	Length (km)	% of length
Rivers	1a	156	7.8	1682	8.1
	1b	129	6.4	1818	8.7
	2a	23	1.2	360	1.7
	2b	1697	84.6	16963	81.5
Total		2005	100	20822	100
Total at risk	1a + 1b	285	14.2	3499	16.8

Figure 1: General industry sectors affecting 1a and 1b river water bodies (point source pollution)

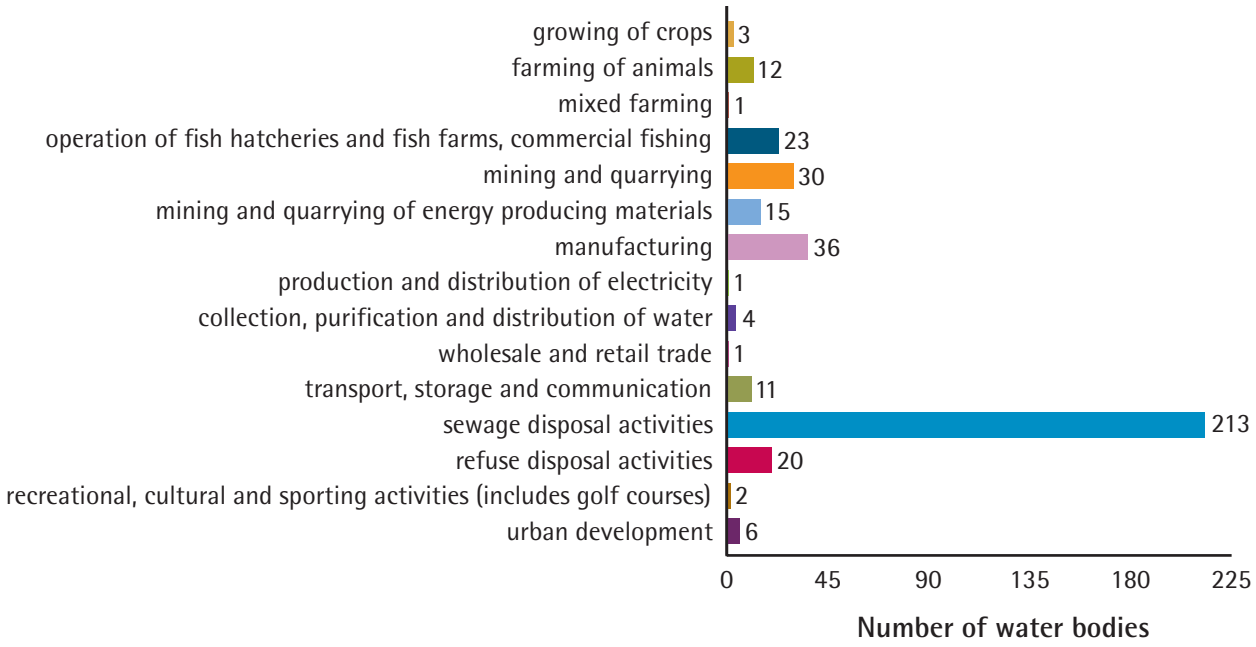


Table 4: Loch water bodies affected by point source pollution

	Reporting category	Number of water bodies	% of number	Area (km^2)	% of area
Lochs	1a	24	7.8	109	11.4
	1b	14	4.5	111	11.6
	2a	1	0.3	2	0.2
	2b	270	87.4	738	76.8
Total		309	100	961	100
Total at risk	1a + 1b	38	12.3	220	22.9

Figure 2: General industry sectors affecting 1a and 1b loch water bodies (point source pollution)

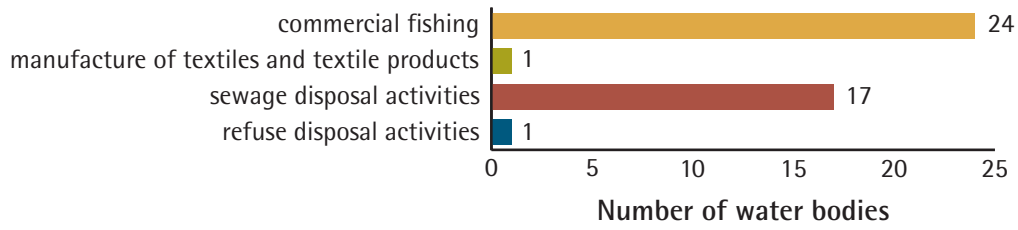


Table 5: Transitional water bodies affected by point source pollution

	Reporting category	Number of water bodies	% of number	Area (km^2)	% of area
Transitional	1a	15	37.5	356	58.8
	1b	3	7.5	145	23.9
	2a	3	7.5	60	9.9
	2b	19	47.5	45	7.4
Total		40	100	605	100
Total at risk	1a + 1b	18	45	500	82.7

Figure 3: General industry sectors affecting 1a and 1b transitional water bodies (point source pollution)

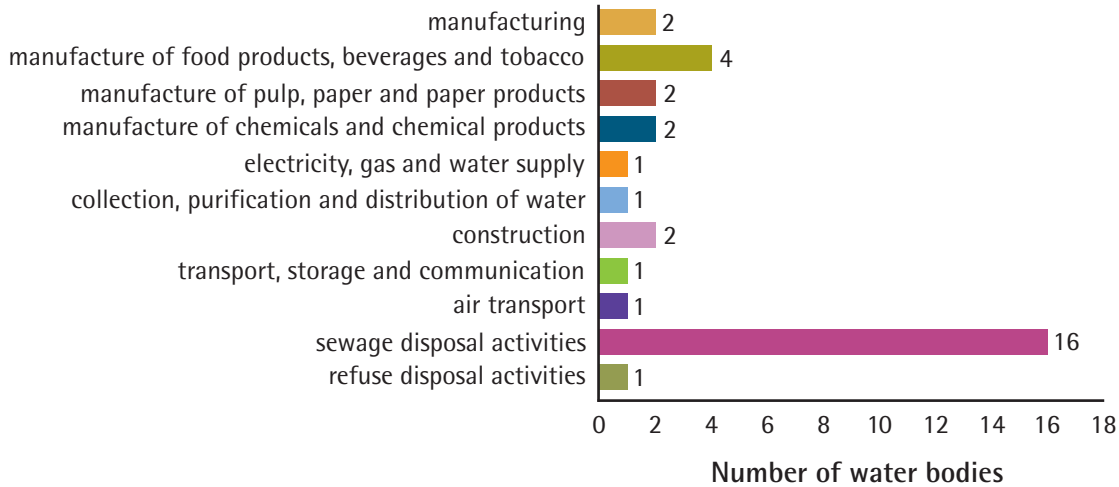


Table 6: Coastal water bodies affected by point source pollution

	Reporting category	Number of water bodies	% of number	Area (km²)	% of area
Coastal	1a	39	8.7	2337	5.1
	1b	71	15.8	4039	8.8
	2a	11	2.5	501	1.1
	2b	328	73.1	38918	85.0
Total		449	100	45796	100
Total at risk	1a + 1b	110	24.5	6376	13.9

Figure 4: General industry sectors affecting 1a and 1b coastal water bodies (point source pollution)

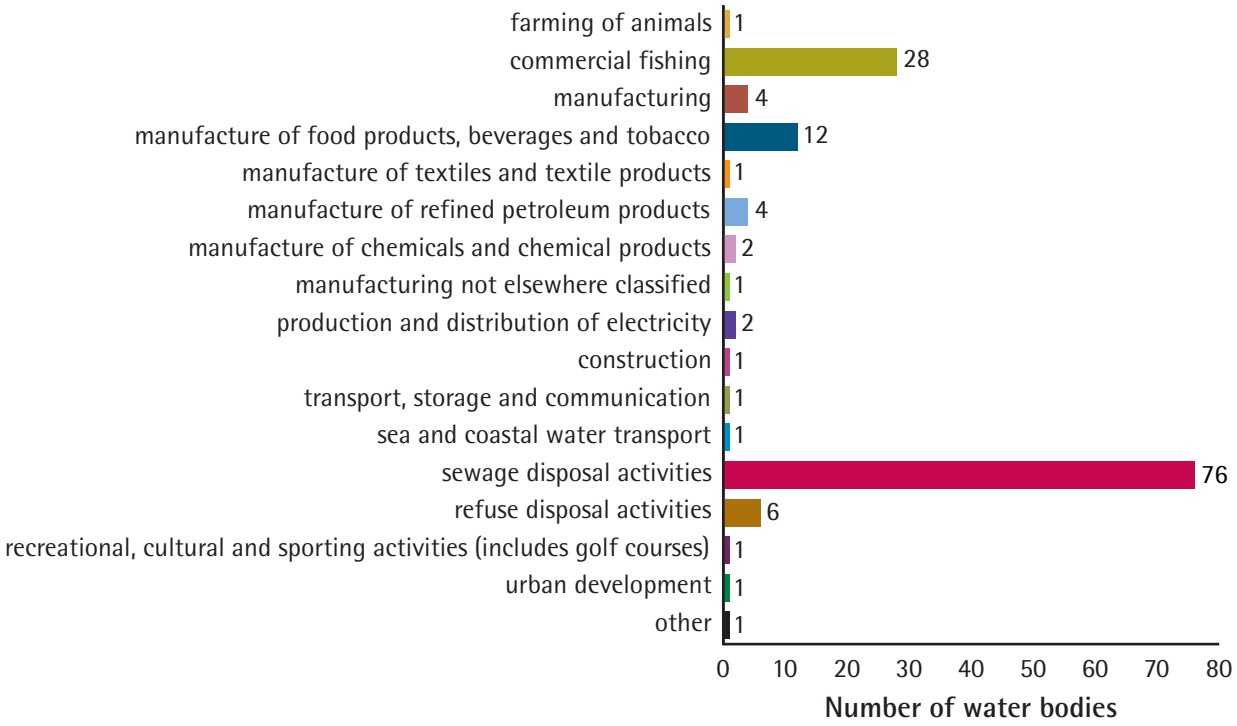
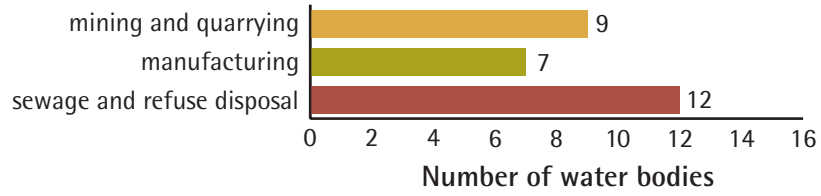


Table 7: Groundwater water bodies affected by point source pollution

	Reporting category	Number of water bodies	% of number	Area (km²)	% of area
Groundwater	1a	12	11.3	13765	20.8
	1b	5	4.7	6895	10.4
	2a	18	17.0	19525	29.5
	2b	71	67.0	26065	39.3
Total		106	100	66250	100
Total at risk	1a + 1b	17	16	20660	31.2

Figure 5: General industry sectors affecting 1a and 1b groundwater bodies (point source pollution)



6.3 Diffuse source pollution and assessment of impact

What is the issue?

Diffuse pollution comes from a variety of activities. It can arise from land use activities, both rural and urban, that are dispersed across a catchment and may have an individually minor, but collectively significant environmental impact. Examples of diffuse pollution to groundwater and/or surface waters include the transport of nutrients and sediment from farmland or the run-off of water contaminated with pollutants from vehicle emissions from hard surfaces in towns. Diffuse pollution is often associated with heavy rainfall when pollutants are flushed into watercourses.

Atmospheric pollution also causes diffuse water pollution. Acidification is truly diffuse in nature. It occurs when gases such as ammonia, oxides of nitrogen and sulphur dioxide, emitted from transport and industry, react in the atmosphere to form nitric and sulphuric acids. When acid rain falls on catchments, particularly upland ones where there are thin soils and little to buffer or neutralise the acid, the rivers and lochs become affected by acidification. Fish populations, particularly salmon, sea trout and brown trout, and the invertebrates that these species feed on, can often be severely affected. Although emissions have dropped substantially during the 1990s,[22] acidification continues to be a problem particularly in the west and north of Scotland where underlying rocks have little capacity to neutralise acidic rainfall.

Transitional and coastal waters are not affected by acidification. Groundwaters have not been considered in their own right but consideration of subsurface buffering conditions has formed the core of the surface water assessment. In this sense the groundwaters and surface waters have been considered together.

Enrichment of surface waters by nutrients, particularly compounds of phosphorus and nitrogen, may give rise to eutrophication. This is the process by which nutrients cause excessive growths of algae (some of which may be toxic) and other plants. This can lead to adverse effects on biodiversity and water quality, and reduces the value of the water body for amenity, recreation and water supply. Nutrients enter water bodies from point sources and deposition from the atmosphere, as well as from land use activities.

Unless carefully managed, some mines can contaminate the water environment whether they are working or closed. Poor quality water can be discharged to streams and rivers from pumping to de-water working mines or from rising minewaters in closed sites where pumping has stopped. Rivers can also be polluted by contaminated water running off mine wastes such as spoil heaps. The main problems are acidity, heavy metals (such as iron, manganese, aluminium, copper, nickel, zinc), high salinity and high chemical oxygen demand, which reduces concentrations of dissolved oxygen. Impacts arising from mines can be point or diffuse in nature.

How did we do the assessment?

SEPA's current surface water monitoring is predominantly designed to assess the impacts on water bodies from point sources. As a result, we have less knowledge about diffuse source pressures at a national scale than for point sources. The groundwater monitoring regime focuses on nitrate and pesticide issues. Nevertheless, water quality and fish monitoring data do indicate where pollution pressures are affecting water quality, regardless of whether the pressures are from point or diffuse sources. These data, in combination with expert judgement and land use maps, have been used in the risk assessments presented here.

We recognise that this approach has limitations; therefore we have developed a screening method using a suite of models to assess the risks from diffuse pollution based on pollutant inputs to the land surface and outputs to water bodies. We have compiled a database of landscape factors, such as land use, climate, topography, geology and soils, which affect the source and location of potential pollutants. This information is used alongside land management practice data such as pesticide usage surveys, numbers of livestock, maps of atmospheric deposition and population density. We have used the model results in addition to water quality monitoring data. The suite of models will provide a very useful tool for future use in river basin management planning.

[22]http://themes.eea.eu.int/Environmental_issues/acidification

Where possible, we have estimated the pressure trend to 2015 for nutrients in rivers and groundwater.

What do the maps show?

Diffuse pollution is strongly linked to land use activity and Map 16 shows a land use map for the Scotland river basin district. Water bodies affected by diffuse source pollution pressures are shown in Map 17 (surface waters) and Map 18 (groundwater). For each water body considered to be at risk, we have recorded the nature of the pressure and the general industry sector[23] responsible for this pressure. The assessments have also recorded whether a particular pressure is considered to be a primary or contributory one and figures presented in this report include both (see Box 3). Summary information is provided in the following tables and bar charts. This information can be viewed in detail for individual water bodies via the website at http://www.sepa.org.uk/wfd/characterisation.htm.

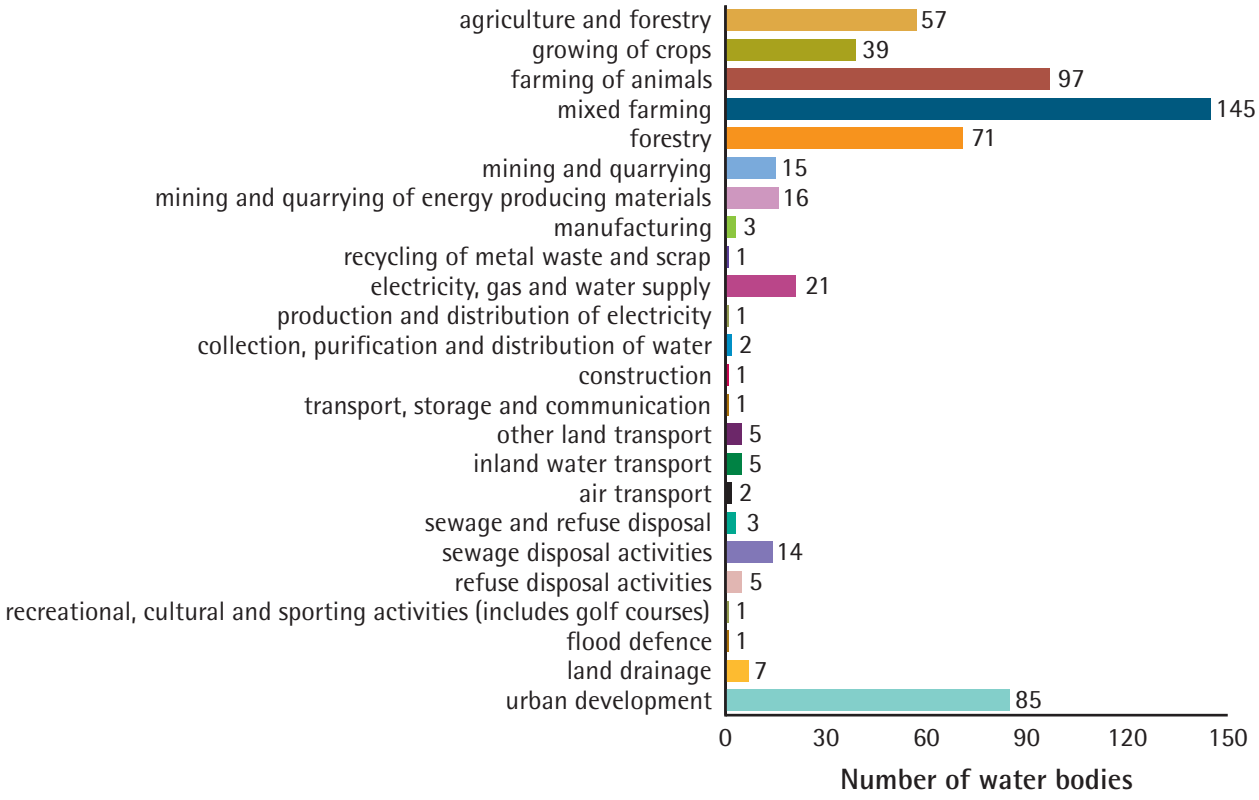
Tables 8 to 12 show the numbers, length and area of water bodies affected by diffuse source pollution for rivers, lochs, transitional waters, coastal waters and groundwaters, respectively.

Figures 6 to 10 show the general industry sectors affecting water bodies in categories 1a and 1b for rivers, lochs, transitional waters, coastal waters and groundwaters, respectively. A water body is often affected by more than one sector and can therefore be counted more than once in the bar chart.

Table 8: River water bodies affected by diffuse source pollution

	Reporting category	Number of water bodies	% of number	Length (km)	% of length
Rivers	1a	201	10.0	2192	10.5
	1b	287	14.3	3562	17.1
	2a	113	5.6	1250	6.0
	2b	1404	70.0	13818	66.4
Total		2005	100	20822	100
Total at risk	1a + 1b	488	24.3	5755	27.6

Figure 6: General industry sectors affecting 1a and 1b river water bodies (diffuse source pollution)



[23]For a list of sectors used see http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5332/TAG2003%20WP%207a%20%2802%29/view

Table 9: Loch water bodies affected by diffuse source pollution

	Reporting category	Number of water bodies	% of number	Area (km²)	% of area
Lochs	1a	40	12.9	158	16.5
	1b	17	5.5	101	10.5
	2a	32	10.4	36	3.8
	2b	220	71.2	665	69.2
Total		309	100	961	100
Total at risk	1a + 1b	57	18.4	259	27

Figure 7: General industry sectors affecting 1a and 1b loch water bodies (diffuse source pollution)

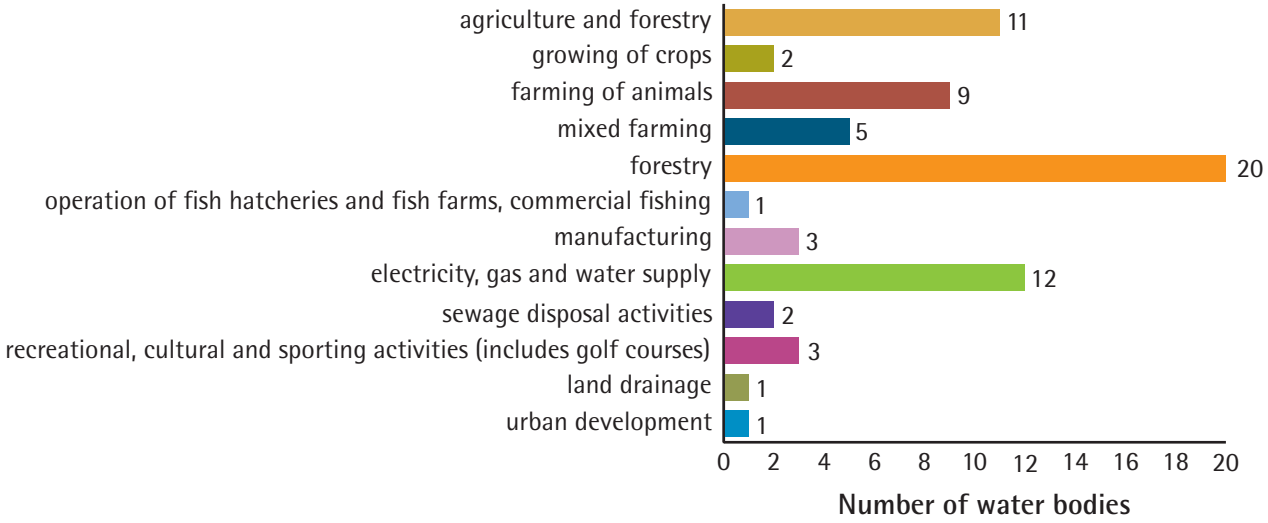


Table 10: Transitional water bodies affected by diffuse source pollution

	Reporting category	Number of water bodies	% of number	Area (km²)	% of area
Transitional	1a	14	35.0	269	44.4
	1b	4	10.0	150	24.8
	2a	1	2.5	0	0
	2b	21	52.5	186	30.8
Total		40	100	605	100
Total at risk	1a + 1b	18	45	419	69.2

Figure 8: General industry sectors affecting 1a and 1b transitional water bodies (diffuse source pollution)

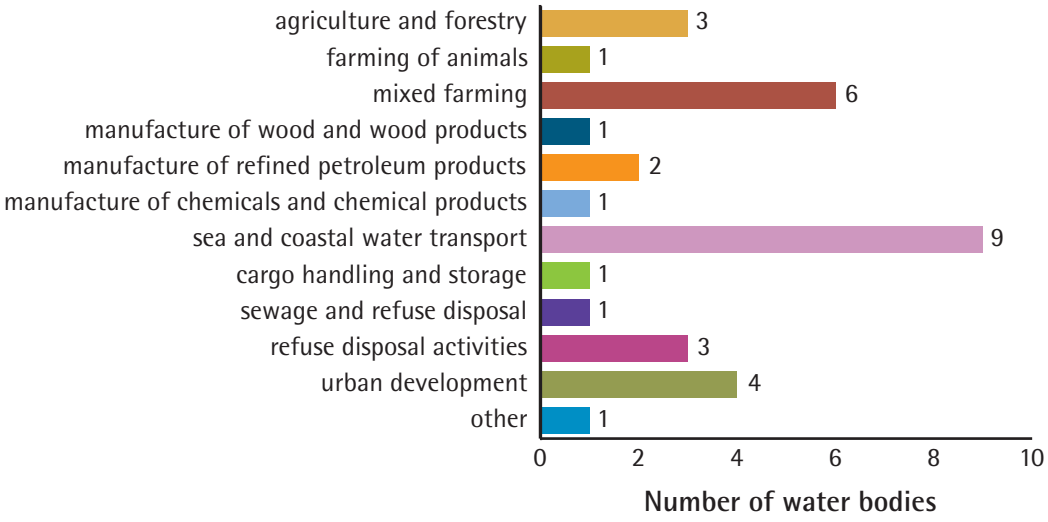


Table 11: Coastal water bodies affected by diffuse source pollution

	Reporting category	Number of water bodies	% of number	Area (km^2)	% of area
Coastal	1a	26	5.8	1667	3.6
	1b	33	7.4	1977	4.3
	2a	7	1.6	872	1.9
	2b	383	85.3	41281	90.1
Total		449	100	45796	100
Total at risk	1a + 1b	59	13.1	3643	8

Figure 9: General industry sectors affecting 1a and 1b coastal water bodies (diffuse source pollution)

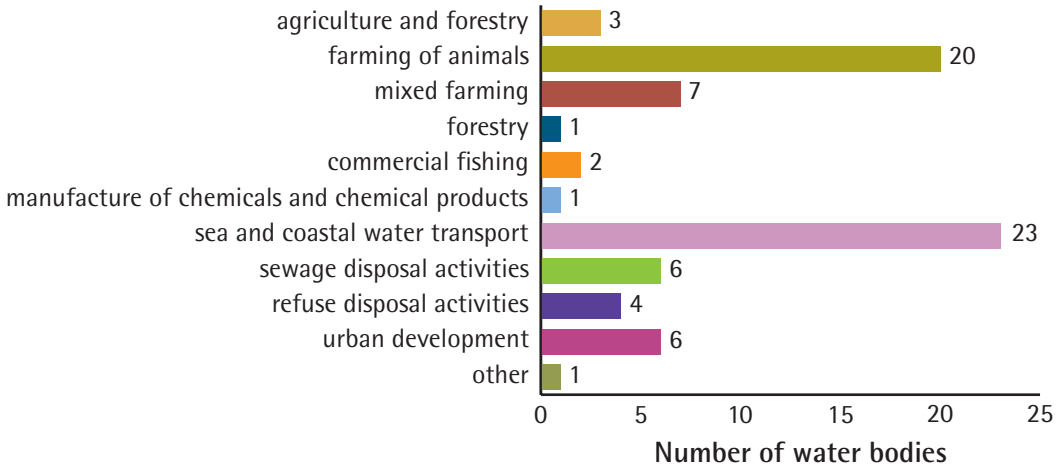
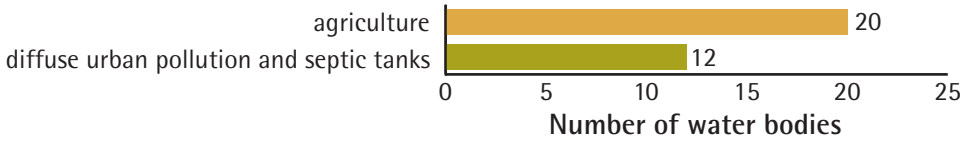


Table 12: Groundwater water bodies affected by diffuse source pollution

	Reporting category	Number of water bodies	% of number	Area (km^2)	% of area
Groundwater	1a	13	12.3	13610	20.5
	1b	8	7.5	11290	17.0
	2a	30	28.3	27409	41.4
	2b	55	51.9	13941	21.1
Total		106	100	66250	100
Total at risk	1a + 1b	21	19.8	24900	37.5

Figure 10: General industry sectors affecting 1a and 1b groundwater bodies (diffuse source pollution)



6.4 Abstraction and flow regulation and assessment of impact

What is the issue?

Water is abstracted from rivers, canals, reservoirs, lochs or underground rocks (aquifers) to provide public water supplies and serve industry and agriculture. The main challenge in managing abstraction is to meet the reasonable needs of water users, while leaving enough water in the environment to conserve river, loch and wetland habitats and species.

Abnormally low river flows can damage river and estuarine ecology, which may take years to recover. Low river flows may be caused by periods of low rainfall, but the effects can be prolonged or made worse by abstraction at critical periods. Unsustainable abstraction from groundwater can lower groundwater levels and have knock-on impacts on river flows or wetlands.

How did we do the assessment?

Compared with many other European countries Scotland generally has sufficient supplies of water but the demand on our water supplies continues to increase. Unlike point source pollution pressures, pressures arising from abstraction and flow regulation have not been comprehensively regulated in Scotland before now. As a result, limited quantitative information is available and the risk assessment has relied to a large extent on predicted impacts. Much effort went into establishing a national database of abstraction and flow regulation pressures. Information came largely from:

- existing legislation, including those acts with a direct control on the management of water resources (for example electricity and water orders, reservoirs acts) and those which may provide some control (planning conditions and legislation targeting other pressures such as discharges);
- request to key water users either directly or through industry associations;
- British Geological Survey database;
- local and expert knowledge.

The risk assessment for surface waters is based on the premise that the habitats and organisms are able to tolerate a certain amount of change in the flow (or level) regimes that would normally be expected for that water body. This boundary is defined as the ecological flow (or level) objective and is quantified in the guidance given by UKTAG[24]. For groundwaters the overall water balance within the groundwater body is considered. We also look at the potential for more localised groundwater abstraction to affect dependent surface ecosystems or to cause an intrusion of saline water.

[24]See http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5332/TAG2003%20WP%207b%20%2802%29/view

What do the maps show?

Map 19 shows examples of the pressures that have been considered in carrying out the risk assessments. Water bodies affected by abstraction and flow regulation pressures are shown in Map 20 (surface waters) and Map 21 (groundwater). The map for surface waters also shows water bodies that have been provisionally identified as being heavily modified or artificial. We will be doing more work in future to assess the risk of not achieving good ecological potential for heavily modified and artificial water bodies (see Section 3.3 for further detail on artificial and heavily modified water bodies).

For each water body considered to be at risk, we have recorded the nature of the pressure and the general industry sector[25] responsible for this pressure. The assessments have also recorded whether a particular pressure is considered to be a primary or contributory one and figures presented in this report include both (see Box 3). Summary information is provided in the following tables and bar charts. This information can be viewed in detail for individual water bodies via the website at http://www.sepa.org.uk/wfd/characterisation.htm.

Tables 13 to 15 show the numbers, length and area of water bodies affected by abstraction and flow regulation for rivers, lochs and transitional waters, respectively. Table 16 shows the number and area of water bodies affected by abstraction for groundwaters. There are no coastal water bodies at risk from abstraction and flow regulation.

Figures 11 to 13 show the general industry sectors affecting water bodies in categories 1a and 1b for rivers, lochs and groundwaters, respectively. A water body is often affected by more than one sector and can therefore be counted more than once in the bar chart.

Table 13: River water bodies affected by abstraction and flow regulation

	Reporting category	Number of water bodies	% of number	Length (km)	% of length
Rivers	1a	189	9.4	2017	9.7
	1b	305	15.2	3636	17.5
	2a	73	3.6	852	4.1
	2b	1438	71.7	14318	68.8
Total		2005	100	20822	100
Total at risk	1a + 1b	494*	24.6	5653	27.2

* A total of 227 and 29 river water bodies have been provisionally identified as HMWB and AWB, respectively. Canals are AWB.

[25] For a list of sectors used see http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5332/TAG2003%20WP%207a%20%2802%29/view

Figure 11: General industry sectors affecting 1a and 1b river water bodies (abstraction and flow regulation)

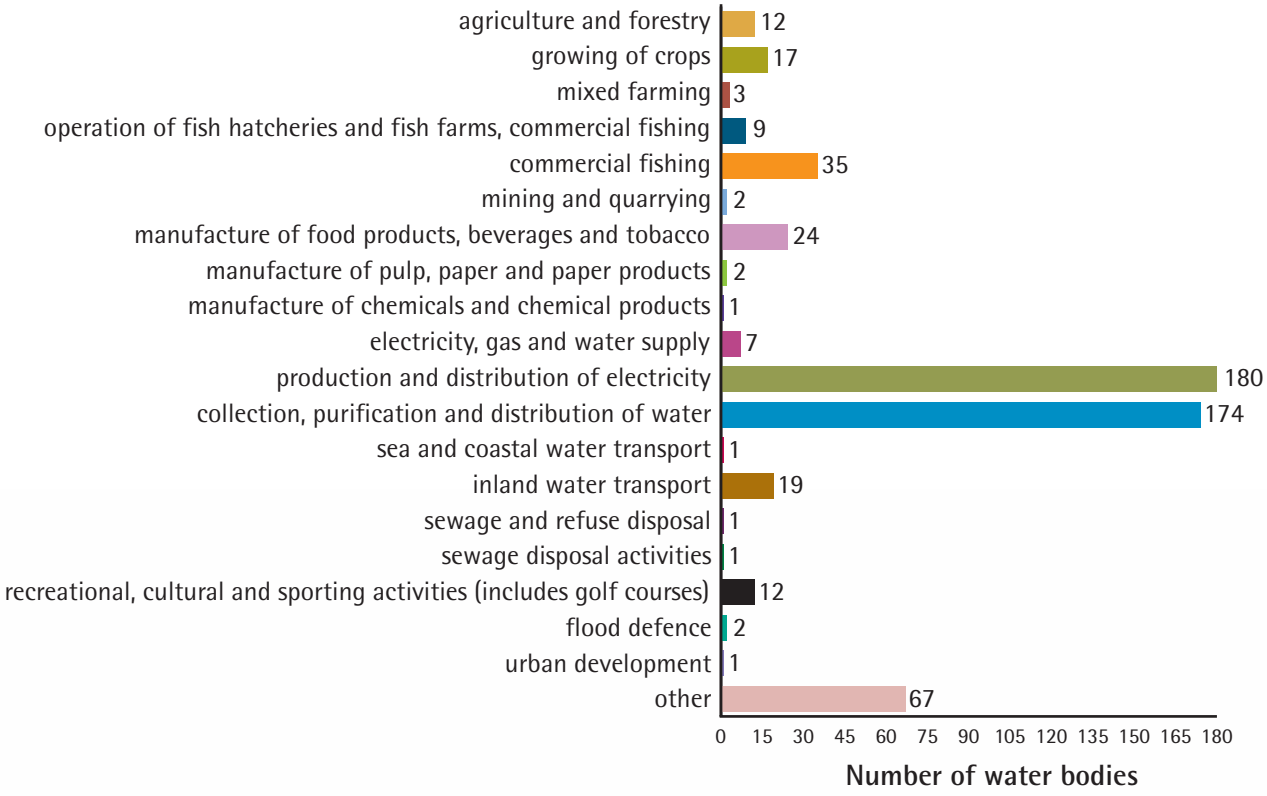
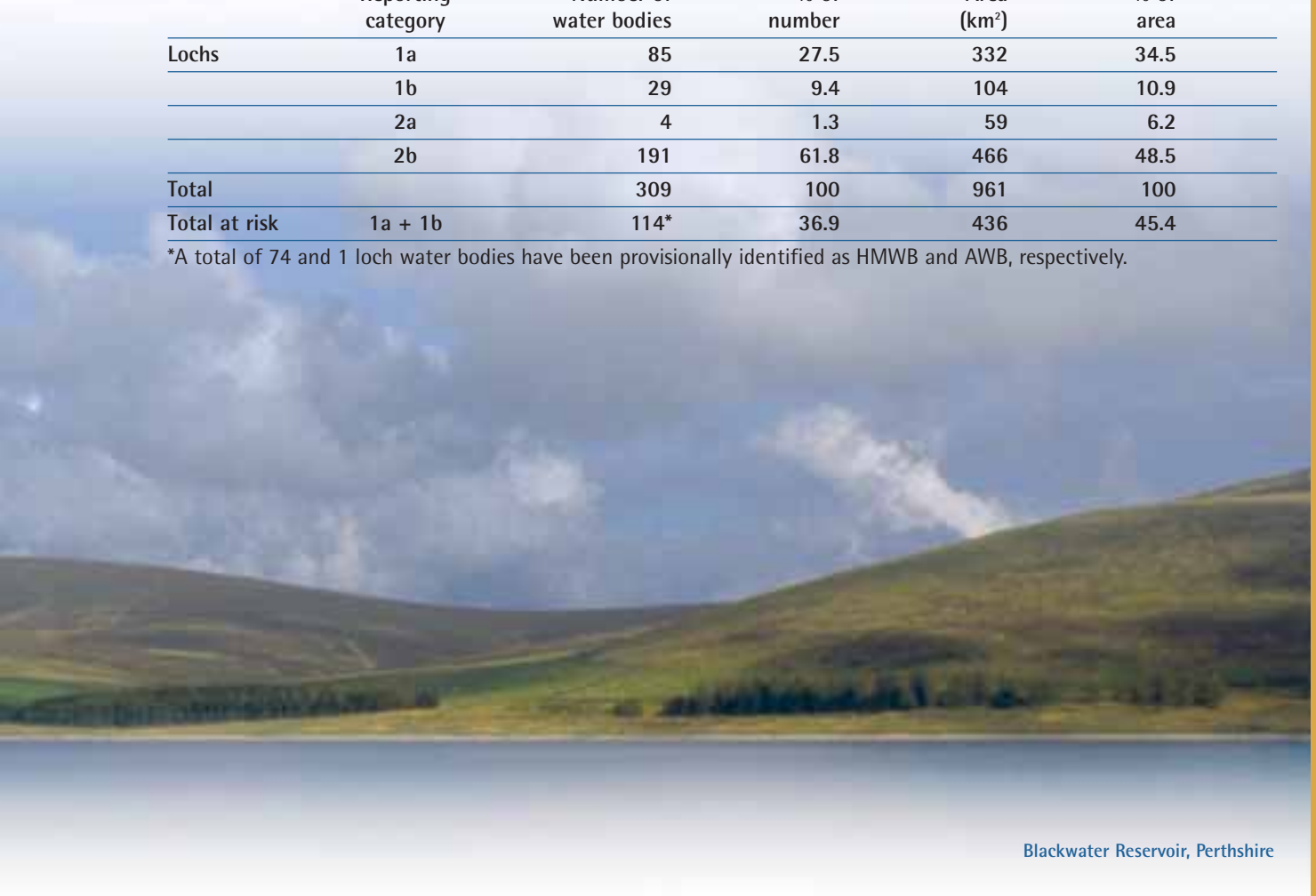


Table 14: Loch water bodies affected by abstraction and flow regulation

	Reporting category	Number of water bodies	% of number	Area (km^2)	% of area
Lochs	1a	85	27.5	332	34.5
	1b	29	9.4	104	10.9
	2a	4	1.3	59	6.2
	2b	191	61.8	466	48.5
Total		309	100	961	100
Total at risk	1a + 1b	114*	36.9	436	45.4

*A total of 74 and 1 loch water bodies have been provisionally identified as HMWB and AWB, respectively.



Blackwater Reservoir, Perthshire

Figure 12: General industry sectors affecting 1a and 1b loch water bodies (abstraction and flow regulation)

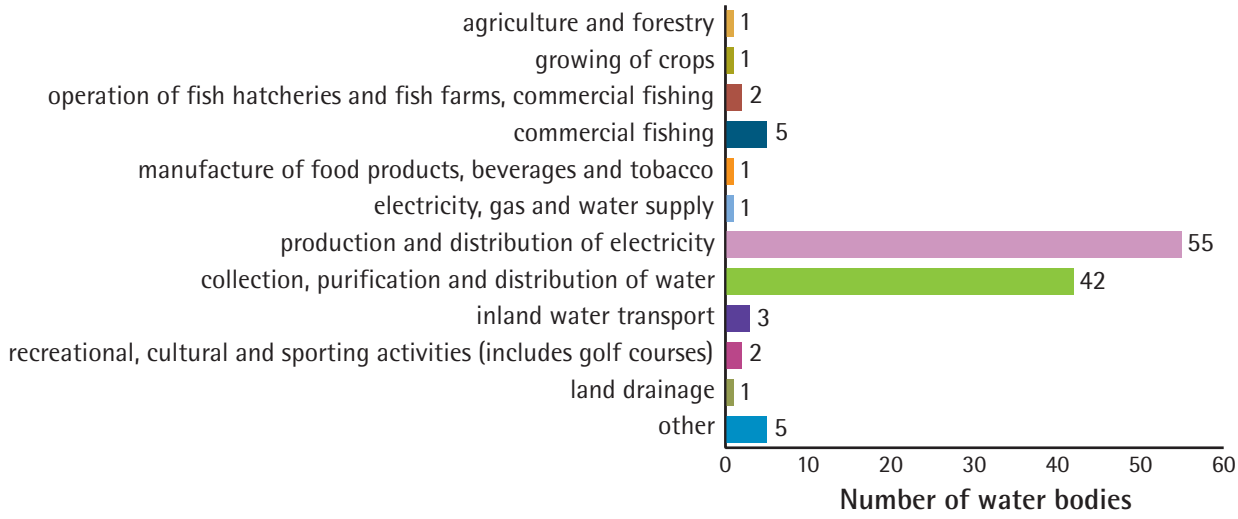


Table 15: Transitional water bodies affected by abstraction and flow regulation

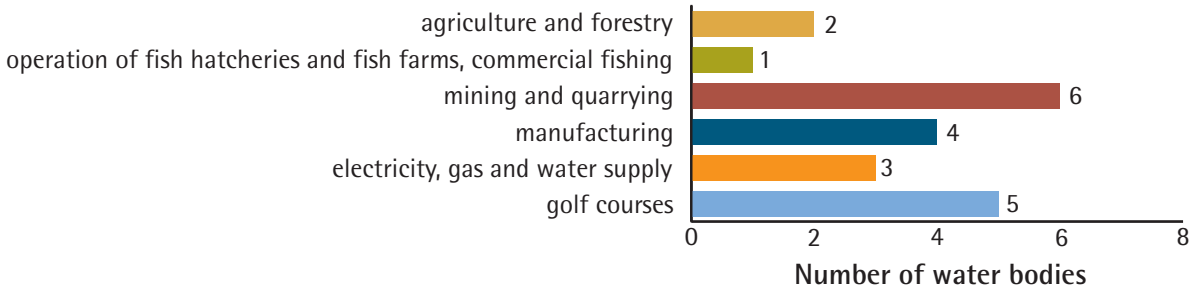
	Reporting category	Number of water bodies	% of number	Area (km²)	% of area
Transitional	1a	1*	2.5	2	0.3
	1b	0	0.0	0	0.0
	2a	0	0.0	0	0.0
	2b	39	97.5	603	99.7
Total		40	100	605	100
Total at risk	1a + 1b	1	2.5	2	0.3

* At risk from manufacturing processes.

Table 16: Groundwater water bodies affected by abstraction

	Reporting category	Number of water bodies	% of number	Area (km²)	% of area
Groundwater	1a	5	4.7	7604	11.5
	1b	6	5.7	4836	7.3
	2a	15	14.2	9804	14.8
	2b	80	75.4	44006	66.4
Total		106	100	66250	100
Total at risk	1a + 1b	11	10.4	12440	18.8

Figure 13: General industry sectors affecting 1a and 1b groundwater bodies (abstraction)



6.5 Morphological alterations and assessment of impact

What is the issue?

Physical alterations to a river, loch, transitional or coastal water can cause habitat damage or loss that results in a loss or decline of species.

Land claim, shoreline reinforcement or physical barriers (such as flood defences, barrages and sluices) can affect all categories of surface waters. Weirs, dams and barrages can alter water and sediment movements, and may impede the passage of migratory fish such as salmon. Activities such as maintenance and aggregate dredging, placement of dredged material and commercial fishing using towed bottom-fishing gear can also damage physical habitats. Using water for transport and recreation often requires physical alteration to habitats and affects the flow of water.

How did we do the assessment?

The risk assessments have been carried out using a variety of information. Some information is available from River Habitat Survey (RHS) and System for Evaluating Rivers for Conservation (SERCON) monitoring, however these sites only cover a proportion of rivers. In order to identify any further pressures, we used a map based approach to identify morphological alterations. By examining maps for features such as river straightening, land claim, and presence of ports and harbours, we were able to identify additional water bodies at risk. Local knowledge and, where possible, a site visit confirmed this assessment. In transitional and coastal waters the physical pressures assessed included land claim, shoreline reinforcement and commercial fishing using towed bottom-fishing gear. In future years with additional monitoring and regulation aimed at morphological pressures we will be able to carry out more robust assessments.

As part of the risk assessment process we have identified provisional HMWB and AWB (see Section 3.3) for Ministerial consideration. However, the final designations are not required until 2009 as part of the river basin management plan. A European guidance paper gives more detailed information on HMWB[26]. Since separate classification schemes need to be developed for HMWBs and AWBs, European guidance recommends that the assessment of the risk of failing to achieve good ecological potential is extended beyond 2004; therefore this assessment has not been included here. The European guidance splits the assessment process into provisional identification (for 2004) and formal designation (for 2009 or before). Initially as part of this process water bodies are assessed against good ecological status (not potential). A large proportion of HMWB and AWB that are at risk of failing good ecological status may meet good ecological potential in future assessments and will therefore no longer be considered at risk.

What do the maps show?

Map 22 shows examples of the pressures that have been considered in carrying out the risk assessments as well as the RHS monitoring sites. Water bodies affected by morphological alterations are shown in Map 23. The map also shows water bodies that have been provisionally identified as being heavily modified or artificial. For each water body considered to be at risk, we have recorded the nature of the pressure and the general industry sector[27] responsible for this pressure. The assessments have also recorded whether a particular pressure is considered to be a primary or contributory one and figures presented in this report include both (see Box 3). Summary information is provided in the following tables and bar charts. This information can be viewed in detail for individual water bodies via the website at http://www.sepa.org.uk/wfd/characterisation.htm.

Tables 17 to 20 show the numbers, length and area of water bodies affected by morphological alterations for rivers, lochs, transitional and coastal waters, respectively.

[26]See http://forum.europa.eu.int/Public/irc/env/wfd/library?l=/framework_directive/guidance_documents/modified_guidance&vm=detailed&sb=Title
[27]For a list of sectors used see http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5332/TAG2003%20WP%207a%20%2802%29/view

Figures 14 to 17 show the general industry sectors affecting water bodies in categories 1a and 1b for rivers, lochs, transitional and coastal waters, respectively. A water body is often affected by more than one sector and can therefore be counted more than once in the bar chart.

Table 17: River water bodies affected by morphological alterations

	Reporting category	Number of water bodies	% of number	Length (km)	% of length
Rivers	1a	275	13.7	2712	13.0
	1b	392	19.6	4427	21.3
	2a	146	7.3	1638	7.9
	2b	1192	59.5	12045	57.9
Total		2005	100	20822	100
Total at risk	1a + 1b	667*	33.3	7139	34.3

*A total of 227 and 29 river water bodies have been provisionally identified as HMWB and AWB, respectively. Canals are AWB.

Figure 14: General industry sectors affecting 1a and 1b river water bodies (morphological alterations)

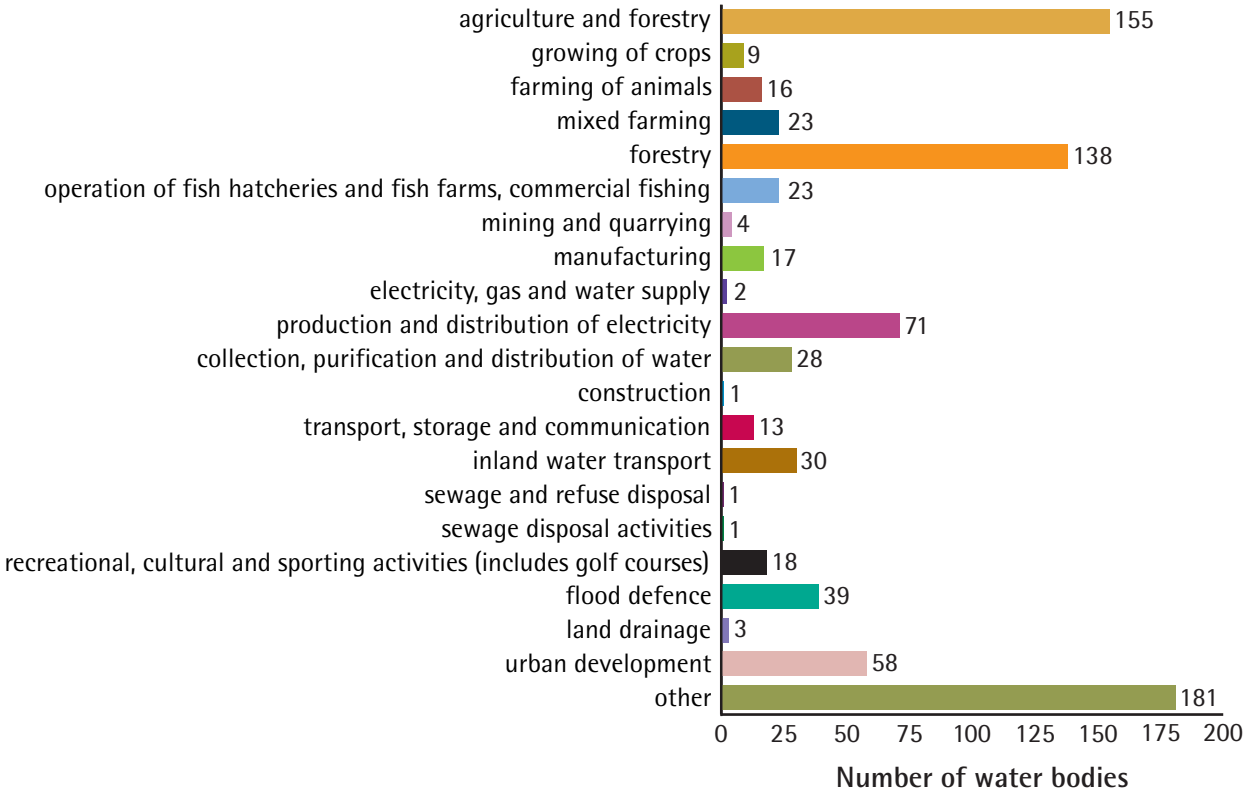


Table 18: Loch water bodies affected by morphological alterations

	Reporting category	Number of water bodies	% of number	Area (km²)	% of area
Lochs	1a	86	27.8	326	33.9
	1b	34	11.0	110	11.4
	2a	6	1.9	13	1.3
	2b	183	59.2	513	53.4
Total		309	100	961	100
Total at risk	1a + 1b	120*	38.8	435	45.3

*A total of 74 and 1 loch water bodies have been provisionally identified as HMWB and AWB, respectively.

Figure 15: General industry sectors affecting 1a and 1b loch water bodies (morphological alterations)

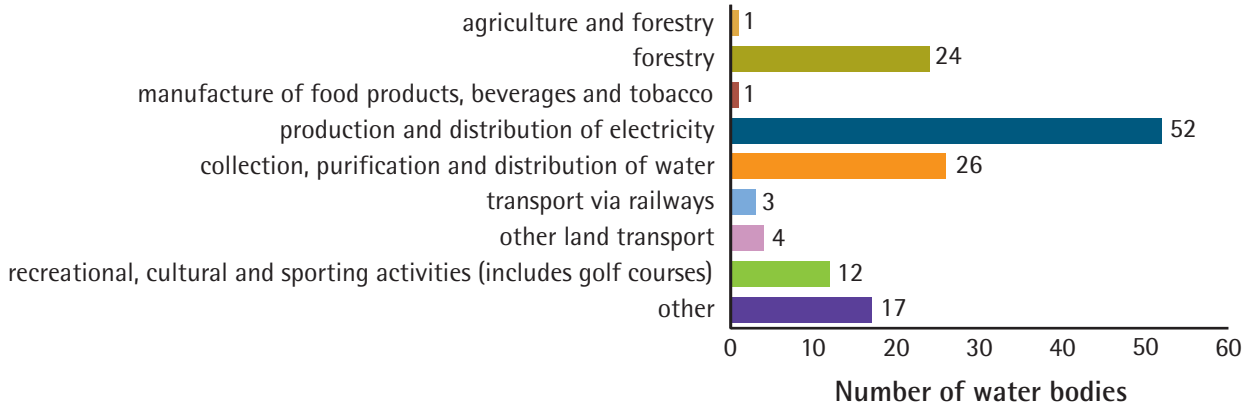


Table 19: Transitional water bodies affected by morphological alterations

	Reporting category	Number of water bodies	% of number	Area (km²)	% of area
Transitional	1a	13	32.5	252	41.6
	1b	3	7.5	43	7.2
	2a	3	7.5	60	9.9
	2b	21	52.5	250	41.3
Total		40	100	605	100
Total at risk	1a + 1b	16*	40	295	48.8

*A total of 8 and 1 transitional water bodies have been provisionally identified as HMWB and AWB, respectively.

Figure 16: General industry sectors affecting 1a and 1b transitional water bodies (morphological alterations)

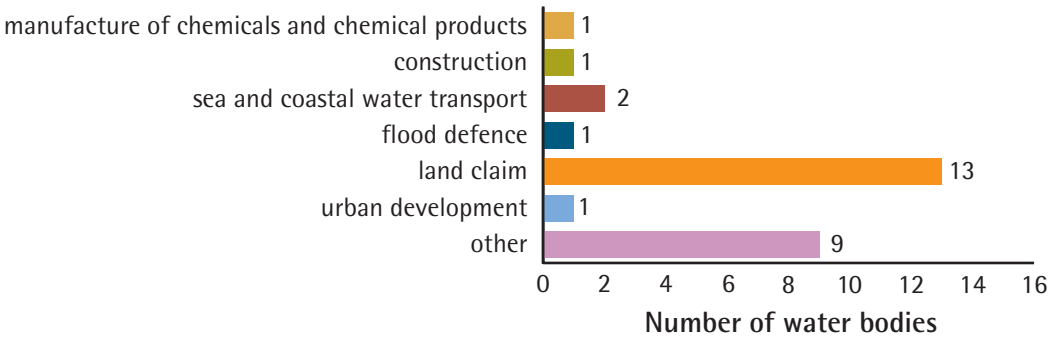
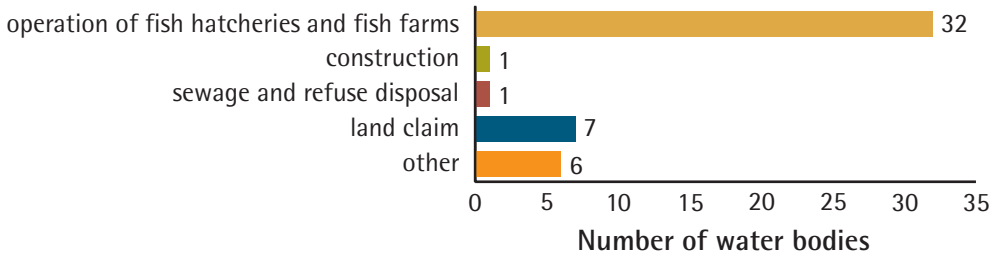


Table 20: Coastal water bodies affected by morphological alterations

	Reporting category	Number of water bodies	% of number	Area (km²)	% of area
Coastal	1a	16	3.6	1231	2.7
	1b	27	6.0	2424	5.3
	2a	39	8.7	20618	45.0
	2b	367	81.7	21523	47.0
Total		449	100	45796	100
Total at risk	1a + 1b	43*	9.6	3655	8.0

*A total of 2 and 8 coastal water bodies have been provisionally identified as HMWB and AWB, respectively.

Figure 17: General industry sectors affecting 1a and 1b coastal water bodies (morphological alterations)



6.6 Other human pressures and assessment of impact

What is the issue?

Alien species are non-native organisms that establish themselves in, and may disrupt, native ecosystems. Alien species have been deliberately or accidentally introduced by humans and there is growing evidence that they can cause a major threat to native flora and fauna. They can result in loss of natural biodiversity and may have significant economic impacts.

How have we done the assessment?

The assessment[28] carried out for this report has focused on 10 species in rivers, lochs, transitional and coastal waters that have been selected because of data availability and the severity of their impact.

The species assessed are:

Australian swamp stonecrop	*Crassula helmsii*
Floating pennywort	*Hydrocotyle ranunculoides*
Water fern	*Azolla filiculoides*
Parrot's feather	*Myriophyllum aquaticum*
Common cord-grass	*Spartina anglica*
Japanese weed	*Sargassum muticum*
North American signal crayfish	*Pacifastacus leniusculus*
Zebra mussel	*Dreissena polymorpha*
Chinese mitten crab	*Eriocheir sinensis*
Slipper limpet	*Crepidula fornicata*

Scottish Natural Heritage identified records of known locations of alien species. Their presence indicates a risk that the water body will not achieve Directive objectives. The analysis is not a comprehensive assessment of all alien species but indicates the potential extent of the problem in the Scotland river basin district.

What does the map show?

Map 24 shows known occurrences of the alien species considered along with those water bodies affected. For each water body considered to be at risk, we have recorded the nature of the pressure and the general industry sector[29] responsible for this pressure. This information can be viewed in detail for individual water bodies via the website at http://www.sepa.org.uk/wfd/characterisation.htm.

Due to the nature of the information provided, it has not always been possible to identify a water body. Some of the grid references are not accurate enough to allow us to identify a specific water body. Further work will be required to correct this in future. At this stage a total of 18 river, 4 loch, 5 transitional and 1 coastal water bodies have been identified as being at risk from alien species.

6.7 Summary of water bodies affected by all pressures

Sections 6.2 to 6.6 present information on the different types of impacts and pressures on water bodies and the resulting risk of not achieving the Directive's objectives in the Scotland river basin district. Many water bodies are affected by more than one type of pressure and this section provides an overall summary of the main issues in this district.

Analysis of results

Map 25 (surface waters) and Map 26 (groundwater) show all water bodies at risk of failing the Directive's environmental objectives.

Tables 21 to 25 show the numbers, length, area and percentages of surface and groundwater bodies at risk from all pressures in the Scotland river basin district.

Figures 18 to 22 show the relative causes of all water bodies at risk.

Scotland's estuaries are subject to the highest levels of risk of failing the environmental objectives (about 84% of the total surface area). This is not surprising as our largest population centres are close to large estuaries and include some of Scotland's most important industrial sites.

Approximately 45% of our rivers and 54% of our lochs are at risk of failing the environmental objectives. While many of the areas affected occur near larger population centres, some of the more remote areas of Scotland are also at risk from pressures such as acid deposition and hydropower schemes.

About 24% of our groundwaters are at risk of failing the environmental objectives and the main areas are situated around Scotland's population centres and more intensively farmed areas.

[28]For more detailed background information and the method used for assessment see the UKTAG paper at http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5332/TAG%202004%20%28PR1-16-03-04%29/view

[29]For a list of sectors used see http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5332/TAG2003%20WP%207a%20%2802%29/view

Coastal water bodies have the lowest proportion of area at risk of failing the environmental objectives (about 17% of the surface area). The Scotland river basin district has a long coastline and the majority of our coastal waters are not considered to be at risk.

It is important to remember that this is a risk screening assessment and not the result of a classification scheme. This assessment is only the first step in an ongoing process to improve our understanding of impacts on the water environment. Over the next two years further characterisation and the application of new regulations will help us to improve our understanding of pressures and impacts.

Table 21: River water bodies affected by all pressures

	Reporting category	Number of water bodies	% of number	Length (km)	% of length
Rivers	1a	343	17.1	3453	16.6
	1b	570	28.4	6523	31.3
	2a	291	14.5	3288	15.8
	2b	801	40.0	7559	36.3
Total		2005	100	20822	100
Total at risk	1a + 1b	913	45.5	9976	47.9

Table 22: Loch water bodies affected by all pressures

	Reporting category	Number of water bodies	% of number	Area (km^2)	% of area
Lochs	1a	113	36.6	404	42.1
	1b	54	17.5	182	19.0
	2a	37	12.0	103	10.8
	2b	105	34.0	271	28.2
Total		309	100	961	100
Total at risk	1a + 1b	167	54.1	587	61.1

Table 23: Transitional water bodies affected by all pressures

	Reporting category	Number of water bodies	% of number	Area (km^2)	% of area
Transitional	1a	17	42.5	357	59.1
	1b	6	15.0	150	24.8
	2a	5	12.5	60	9.9
	2b	12	30.0	38	6.3
Total		40	100	605	100
Total at risk	1a + 1b	23	57.5	507	83.8

Table 24: Coastal water bodies affected by all pressures

	Reporting category	Number of water bodies	% of number	Area (km^2)	% of area
Coastal	1a	46	10.2	2650	5.8
	1b	82	18.3	5071	11.1
	2a	53	11.8	21493	46.9
	2b	268	59.7	16582	36.2
Total		449	100	45796	100
Total at risk	1a + 1b	128	28.5	7720	16.9

Table 25: Groundwater water bodies affected by all pressures

	Reporting category	Number of water bodies	% of number	Area (km^2)	% of area
Groundwater	1a	19	17.9	21072	31.8
	1b	6	5.7	6413	9.7
	2a	34	32.1	29084	43.9
	2b	47	44.3	9682	14.6
Total		106	100	66250	100
Total at risk	1a + 1b	25	23.6	27484	41.5

Figure 18: Relative cause of river water bodies at risk

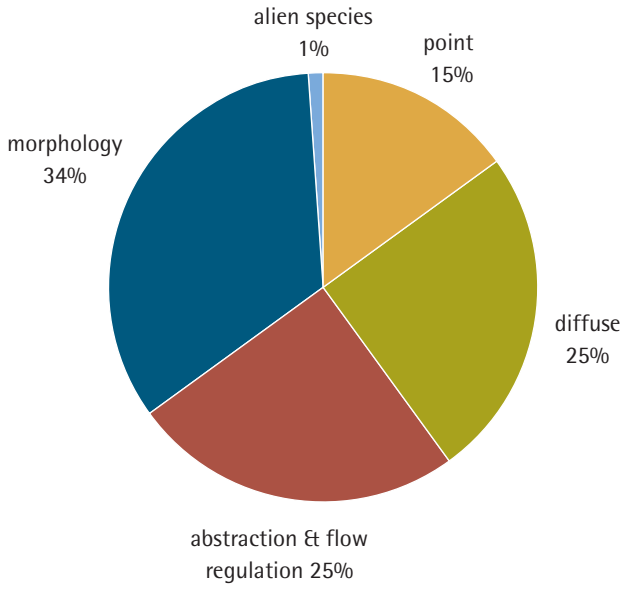


Figure 19: Relative cause of loch water bodies at risk

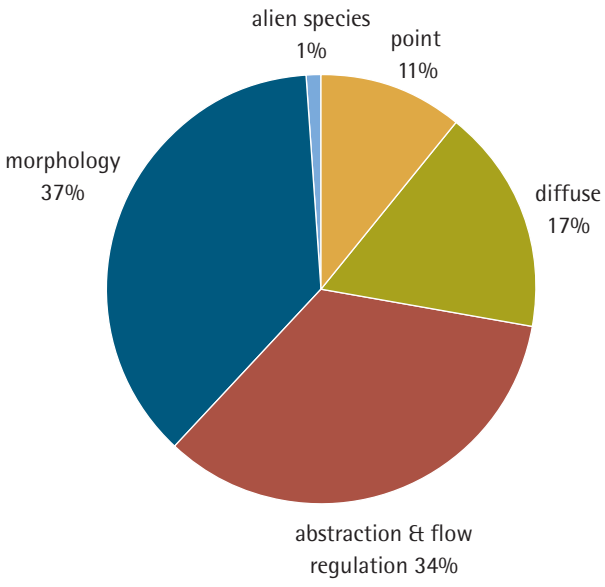


Figure 20: Relative cause of transitional water bodies at risk

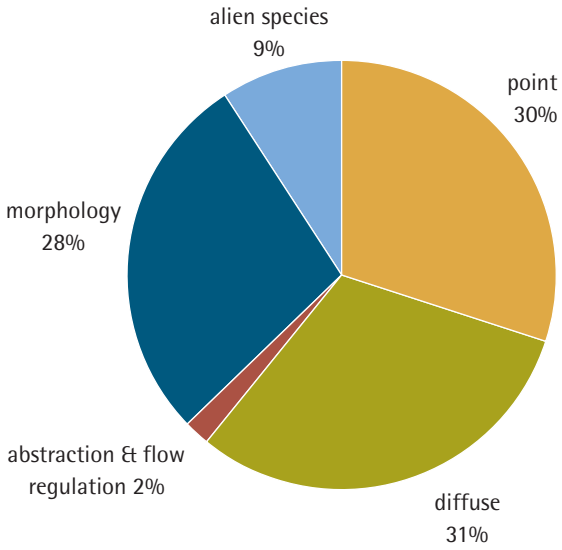


Figure 21: Relative cause of coastal water bodies at risk

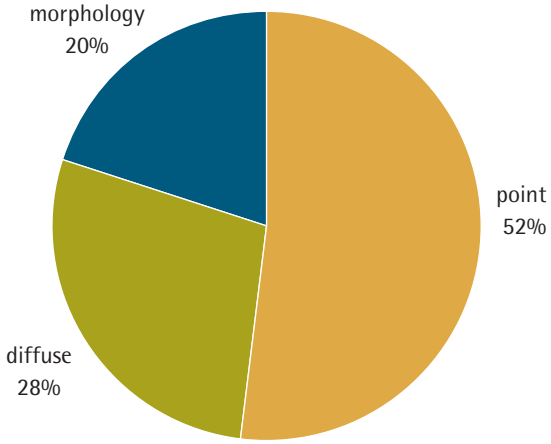
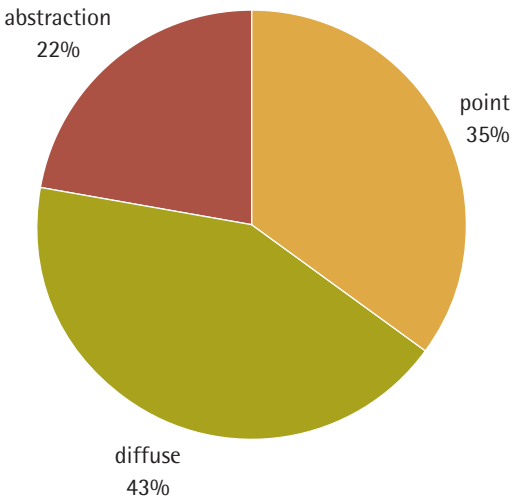


Figure 22: Relative cause of groundwater bodies at risk



6.8 Groundwater bodies for which lower objectives may be specified

Sections 2.4 and 2.5 of Annex II of the Directive require member states to identify those bodies of groundwater for which lower objectives are to be specified under Article 4 including where achieving good groundwater chemical and quantitative status is infeasible or disproportionately expensive.

Such groundwater bodies are provisionally identified within this river basin district in Map 27.

This provisional identification is based on a hydrogeological expert judgement assessment of whether remedial action will be sufficiently effective by 2027 and the likelihood of remedial action being disproportionately expensive[30].

The identification of such bodies of groundwater should be regarded as preliminary. It is based on the best available information at the present time. However, the gaps in current information and the uncertainties include:

- a daughter directive on groundwater, which will clarify the approach to 'good status' has yet to be agreed;
- standards to be applied in setting 'good status' have yet to be established;
- uncertainties remain on the meaning of ecological and chemical status for surface waters, on which the definition of good groundwater status is dependent;
- consideration (at EU and UK level) of how exemptions including lower objectives should operate in accordance with Article 4 are at an early stage. The identification of bodies of groundwater likely to require such exemptions at this stage pre-empts much of this ongoing work;
- no consideration of socio-economics has yet been undertaken.

Further characterisation will provide more information about groundwater characteristics and pressures and impacts. This work, together with progress establishing the approaches to good status, setting lower objectives and considering socio-economic factors, should address uncertainties listed above. Consequently revisions are likely to be made to the number of bodies of groundwater likely to require lower objectives included in this report, when the time comes to identify such groundwater bodies in river basin management plans in 2009.

6.9 General trends and future pressures

While there is no direct relationship between economic activity and pressures, considering trends in activity may help us to understand and respond to future pressures. Specific trends and pressures are considered in turn below.

Land cover changes

A study by SNH[31] examining land cover change between 1947 and 1988 found that considerable changes took place within Scotland's towns and countryside during this period. Urban expansion, road development and afforestation were among the more striking. Changes in the structure of farmland, or in the extent and condition of moorland, may have been less obvious but still relevant to the visual appearance of the countryside, to its wildlife and to the water environment. The report also summarises changes in lowland and blanket mires which include wetland habitats.

A further study was conducted focusing on 'broad habitat' changes between 1990 and 1998. Following the Biodiversity Convention at the Earth Summit in Rio de Janeiro in 1992, the UK Biodiversity Action Plan set out a programme of action to conserve and enhance biological diversity throughout the UK. A classification of 'broad habitats' was defined to allow consistent reporting and to set the context for 'priority' habitats and species requiring conservation action. The extent of fen, marsh and swamp increased significantly as did the area of broadleaved, mixed and yew woodland. There was no clear evidence of change in the extent of arable and horticultural land in Scotland, nor was there clear evidence of change in the extent of developed land in rural areas.

The common agricultural policy[32] (CAP) has led to land use changes over the last 30 years. Agricultural intensification, such as increased stocking, fertiliser and pesticide use, has resulted in increased pressures and impacts on the water environment. Intensification has slowed in recent years and the reform of CAP, which will become effective from 2005, may provide water quality, landscape and biodiversity benefits. While CAP reform is expected to lead to an overall de-intensification, some farmers are likely to expand and intensify production.

A further major land use change is in forestry; the Scottish Forestry Strategy aims for 25% forestation. In addition economics will determine when the areas of mature timber will be felled.

Although the changes in urban expansion and increased farmland have slowed somewhat in more recent years, the land cover changes described have had an effect on Scotland's water environment. Water quality can be affected by land use decisions and management practices. Diffuse pollution can result from urban areas, roads, forestry and agricultural land. Many of these problems are currently being addressed (for example through sustainable urban drainage systems and agricultural best management practices) but in areas where these types of land use change continue, measures will need to be put in place to ensure that no deterioration in status occurs.

[30]For further details see http://www.sepa.org/groundwater/wfd
[31]For more detailed information visit A-Z index 'land cover change in Scotland' at http://www.snh.org.uk/
[32]For further information on the common agricultural policy see http://europa.eu.int/comm/agriculture/publi/capleaflet/cap_en.htm

Future development pressures

A research project was commissioned to identify potential pressures and impacts on water bodies as a consequence of land use proposals within the current suite of Scottish development plans and other published strategy documents. Development plans from 1998 onwards were reviewed and 691 strategic development sites, representing about 0.35% of Scotland's land area, were identified as being relevant to the study. Sites are mainly concentrated in the central belt with a lower density in the borders and lower lying areas of north east Scotland. Residential (39%), industrial (22%) and mixed use (15%) make up most of the strategic development site allocations identified. These future development pressures will need to be borne in mind when programmes of measures are established. Map 28 shows the future development pressures[33].

Increased renewable energy sources

The UK government has set a target to increase the amount of energy produced from renewable sources. The target set is that generation from renewable sources should supply 10% of the UK electricity by 2010, rising to 20% by 2020. The development of renewable energy is vital to meeting government targets for reducing carbon dioxide emissions. For the Scotland river basin district this is likely to mean an increase in hydropower schemes, wind power schemes and schemes harnessing wave power. These schemes may have an impact on the water environment as a result of abstraction and flow regulation pressures or morphological alterations. Northwest Scotland and coastal areas are likely to be the main areas for such renewable energy schemes.

Climate change

Climate change will affect all aspects of the water environment but we are still unsure what the impacts will be and where they will occur. For example, increased rainfall may dilute the pollutants present in water bodies but will also flush more of them into receiving waters, such as nitrates in winter, or cause more frequent sewer overflows in the summer, both resulting in deteriorating water quality.

The Directive states that temporary deterioration in the status of water bodies is allowable if this arises from exceptional circumstances such as extreme floods and prolonged droughts, but less severe weather changes will also have an indirect impact on the water environment. The increasing variability of weather patterns will make it more difficult to assess the risks and pressures, the long-term effectiveness of the programmes of measures and the efficacy of sampling and monitoring regimes. We expect to see changes in land use and water consumption because of climate change, and these may prove to be significant in achieving the overall objective of good status. Surveillance monitoring will be designed to assess the impact of climate change.

[33]For a full copy of the report see http://www.sepa.org.uk/pdf/publications/reports4sepa/national_planning_policy_dev.pdf

7. Conclusions and next steps

This report summarises the results of the characterisation and pressures and impacts analyses of the Scotland river basin district's water environment. The Water Framework Directive requires a much wider range of pressures to be considered, in contrast to our historic focus on point source pollution. This will start to allow SEPA and other interested groups in the Scotland river basin district to take a more integrated approach to water management in the future.

This assessment is the first step in the overall process of improving our aquatic environment through river basin management planning. The next stages include:

- Review of water bodies probably at risk of failing the environmental objectives before 2007 (reporting category 1b). This will be done using additional information that will become available from regulated and non-regulated sectors, new environmental monitoring and modelling data and the application of new regulations.
- Design of a new monitoring programme by 2006 taking into account the wider range of pressures that need to be considered. The results from the pressure and impact assessment and further characterisation will be used to define the network. We are making progress with a Scottish Aquatic Environment Monitoring Strategy in partnership with other organisations.
- Preparation of data presentation for use in river basin management planning. We will form a network of Area Advisory Groups to support RBMP production. Pressure and impact information will be used by these groups to help identify risk management measures and establish a programme of measures.

The process of river basin management is cyclical. Information will continually be improved making the next cycle of characterisation easier and more robust than this first assessment. This process will improve our water environment and support the sustainable uses of our water resources bringing economic and social benefit to the people of Scotland.

Loch Meadie, Sutherland

Glossary

AWB	artificial water body
CAP	Common Agricultural Policy
EC	European Community
EQS	environmental quality standards
EU	European Union
GWDTE	groundwater dependent terrestrial ecosystem
HMWB	heavily modified water body
RBD	river basin district
RBM	river basin management
RBMP	river basin management plan
RHS	river habitat survey
SEPA	Scottish Environment Protection Agency
SSSI	Site of Special Scientific Interest
UKTAG	United Kingdom Technical Advisory Group
WEWS Act	Water Environment and Water Services (Scotland) Act 2003

River Nith, Quarry diversion

Annex 1: Summary of environmental objectives and issues surrounding their assessment

Objectives

The environmental objectives that need to be achieved under the Directive are summarised as:

	Environmental objectives
For surface waters	• achievement of good ecological status and good surface water chemical status by 2015 • achievement of good ecological potential and good surface water chemical status for heavily modified water bodies (HMWB) and artificial water bodies (AWB) • prevention of deterioration from one status class to another • achievement of water related objectives and standards for protected areas
For groundwater	• achievement of good groundwater quantitative and chemical status by 2015 • prevention of deterioration from one status class to another • reversal of any significant and sustained upward trends in pollutant concentrations and prevent or limit input of pollutants to groundwater • achievement of water related objectives and standards for protected areas

Water bodies are identified as being at risk if they are likely to fail any of these environmental objectives.

Prediction of risk to 2015

The risk assessment is generally based on the current situation and does not take into account future scenarios or planned improvements. Therefore we assume that if a water body is currently at risk, it will also be at risk in 2015. There are exceptions to this:

- Improvements that are assumed to occur under Scottish Water improvement plans which are already financed under the Quality & Standards 2 programme and are due for completion by the end of 2005.
- Where we have accurate trend data these are used to predict the situation in 2015, for example nitrate trends to 2015 in groundwaters.

Relative scale of water bodies and assessment

Groundwater bodies and some transitional and coastal water bodies are typically very large and may be identified as being at risk from localised pressures that affect only small portions of a water body. This scale issue is relevant to all water bodies to some extent, although particularly in the larger bodies, and any monitoring strategy and programme of measures established will take this into account.

Pressure and impact assessment issues

A number of difficulties surround the assessments. Below we highlight the main issues encountered and how we have dealt with them.

Difficulty	Solution	Outcome
Good ecological status has not yet been defined across Europe.	A European process of intercalibration is currently addressing this matter and in the meantime we have used preliminary criteria established by UKTAG.	A water body 'at risk' cannot automatically be interpreted as meaning the water body is not of 'good ecological status'.
Good chemical status has not yet been defined as EQSs for the priority substances have not yet been agreed. The approach to dealing with other specific pollutants has not yet been determined in detail, and it is not clear whether standards will be set for sediments or biota.	As an initial indication of the risk of not achieving good chemical status, existing UK standards, where they exist, have been used in the assessments.	A water body 'at risk' cannot automatically be interpreted as meaning the water body is not of good chemical status.

Difficulty (continued)	**Solution** (continued)	**Outcome** (continued)
The alternative objective of good ecological potential has not yet been defined. This standard applies to heavily modified and artificial water bodies. Related to this, heavily modified and artificial water bodies don't need to be designated until 2009.	Heavily modified and artificial water bodies have been provisionally identified and have been assessed in relation to good status (as recommended by European guidance).	A large proportion of heavily modified and artificial water bodies identified as at risk may in fact meet good ecological potential in future.
Exceptions (e.g. extended deadlines or lower objectives) and disproportionate costs have not been taken into account at this stage, apart from provisional proposals for lower objectives for groundwater bodies.	Groundwater bodies which may require lower objectives have been provisionally identified. This will be considered for other water bodies at a later stage, as recommended by European guidance. At present we have assessed water bodies in relation to good status by 2015.	Some water bodies identified as at risk may later be exempted from achieving good status by 2015.
The aim is to achieve the environmental objectives (Annex 1) by 2015. It is difficult to predict changes between now and 2015 in relation to good status and other objectives, especially since good status or the other objectives have not yet been defined.	We have made the general assumption that if a water body is at risk in 2004 it will be at risk in 2015. There are a few exceptions to this where we have accurate trend data to suggest otherwise and where planned investment is already funded.	Water bodies at risk will be taken forward into the first river basin management process to determine appropriate programmes of measures.
Drinking water protected areas have only recently been identified so we have not assessed specific objectives for these areas.	This will be considered at a later stage and reported in the next characterisation report in 2013. At present we have assessed water bodies in relation to an estimation of good status.	Water bodies at risk will be taken forward into the first river basin management process to determine appropriate programmes of measures.
Lack of nationally consistent data or absence of data.	We have used the best information available. In the absence of data we have used alternative methods such as modelling or expert judgement.	Many of the water bodies affected by these difficulties have been identified as 'probably at risk' or 'probably not at risk'. Water bodies probably at risk will be reviewed before 2007 and water bodies probably not at risk will be reviewed before 2013 (see Section 6.1).
Protected area objectives for water dependent Natura 2000 sites have been assessed by Scottish Natural Heritage to determine if there is a risk of failure of objectives.	This work pre-empts reporting under the Habitats and the Birds Directives due in 2006.	These assessments should be seen as provisional until reported under the Habitats and the Birds Directives.

Annex 2: Sources of information

Europa: European guidance on heavily modified water bodies:
http://forum.europa.eu.int/Public/irc/env/wfd/library?l=/framework_directive/guidance_documents/modified_guidance&vm=detailed&tsb=Title

Europa: European guidance on identification of surface water bodies:
http://forum.europa.eu.int/Public/irc/env/wfd/library?l=/framework_directive/guidance_documents/identification_bodies&vm=detailed&tsb=Title

Europa: European information on common agricultural policy:
http://europa.eu.int/comm/agriculture/publi/capleaflet/cap_en.htm

Europa: Water Framework Directive text:
http://europa.eu.int/eur-lex/pri/en/oj/dat/2000/l_327/l_32720001222en00010072.pdf

European Environment Agency information on acidification:
http://themes.eea.eu.int/Environmental_issues/acidification

Scottish Environment Protection Agency consultation, May 2002, 'The Future for Scotland's Waters' provides a general introduction to technical requirements of the Water Framework Directive:
http://www.sepa.org.uk/publications/wfd/

Scottish Environment Protection Agency, guidance on groundwater assessments:
www.sepa.org.uk/groundwater/wfd

Scottish Environment Protection Agency, research project on future development pressures:
http://www.sepa.org.uk/pdf/publications/reports4sepa/national_planning_policy_dev.pdf

Scottish Natural Heritage, A-Z index, land cover change in Scotland:
http://www.snh.org.uk/

UKTAG guidance on groundwater body delineation:
http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5420/view

UKTAG guidance on groundwater-dependent terrestrial ecosystems (identification):
http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5332/TAG2003%20WP%205a-b%20%2801%29/view

UKTAG guidance on pressure and impact analysis (various papers):
http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5332/view

UKTAG guidance on protected areas (identification):
http://www.wfduk.org/tag_guidance/Article_06-07/view

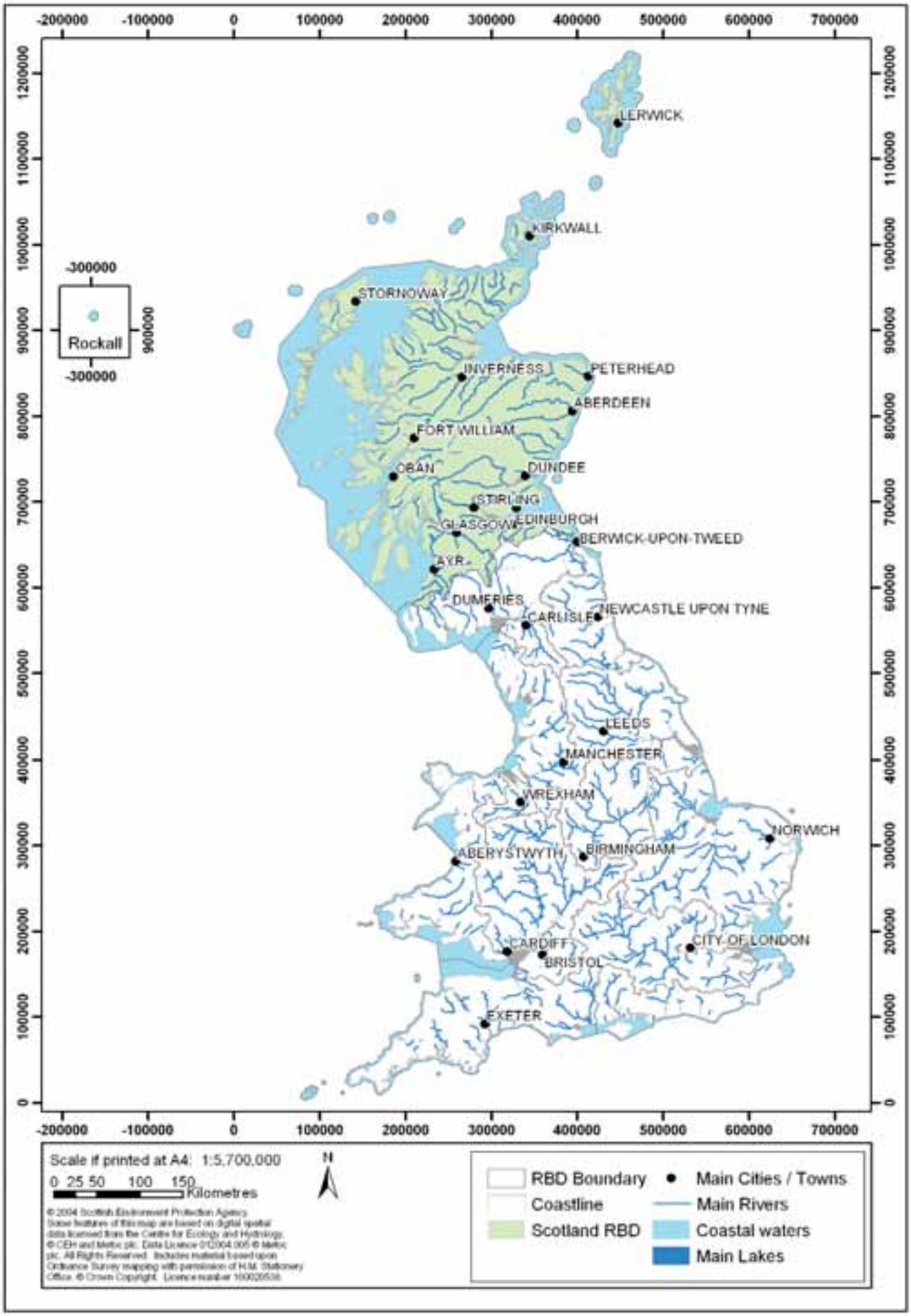
UKTAG guidance on small waters:
http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5420/view

UKTAG guidance typology (rivers, lakes, transitional and coastal waters):
http://www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5312/view

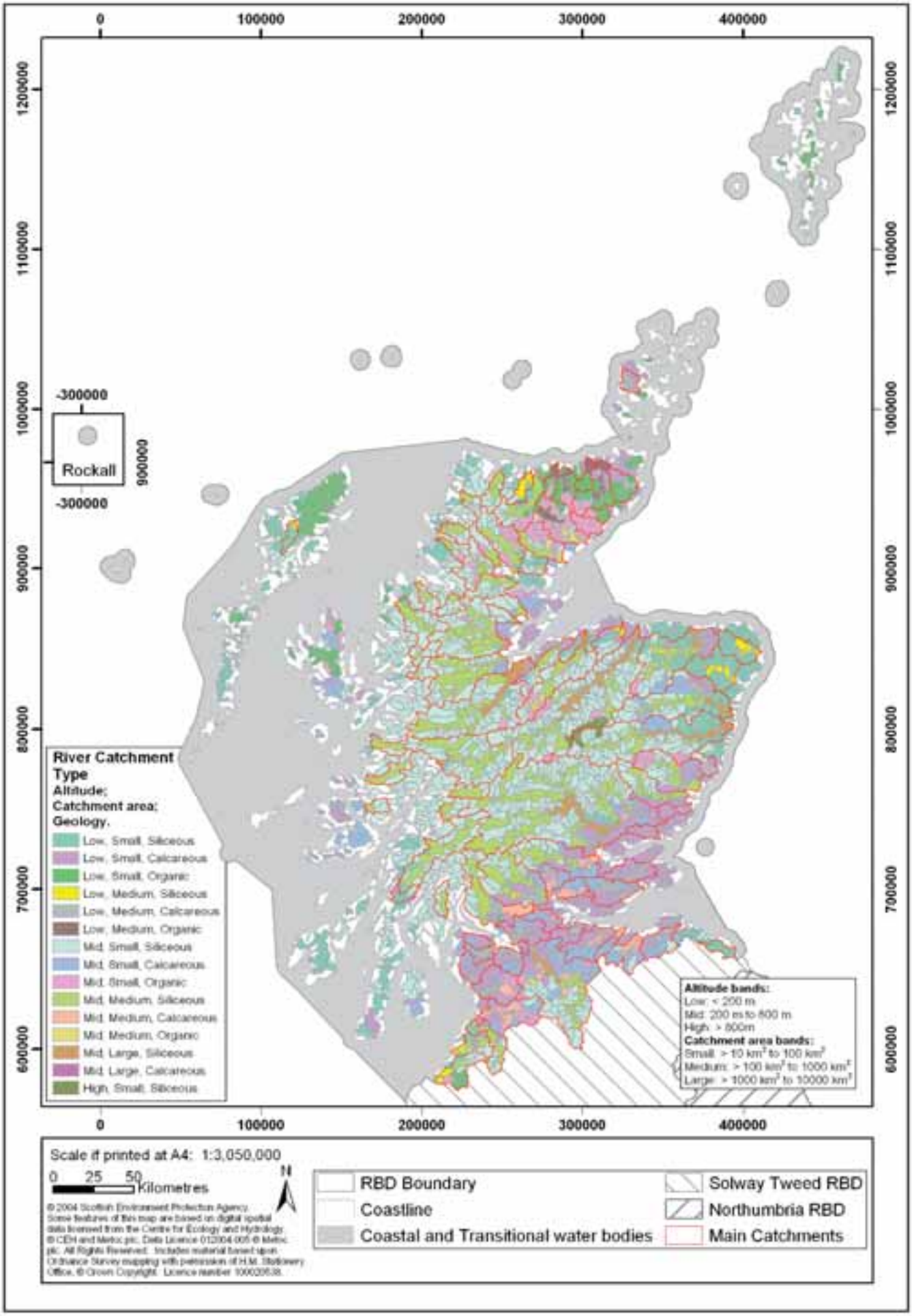
UKTAG reference condition descriptions:
http://www.wfduk.org/tag_guidance/Article_05/Type%20specific%20reference%20conditions/view

Annex 3: List of characterisation maps

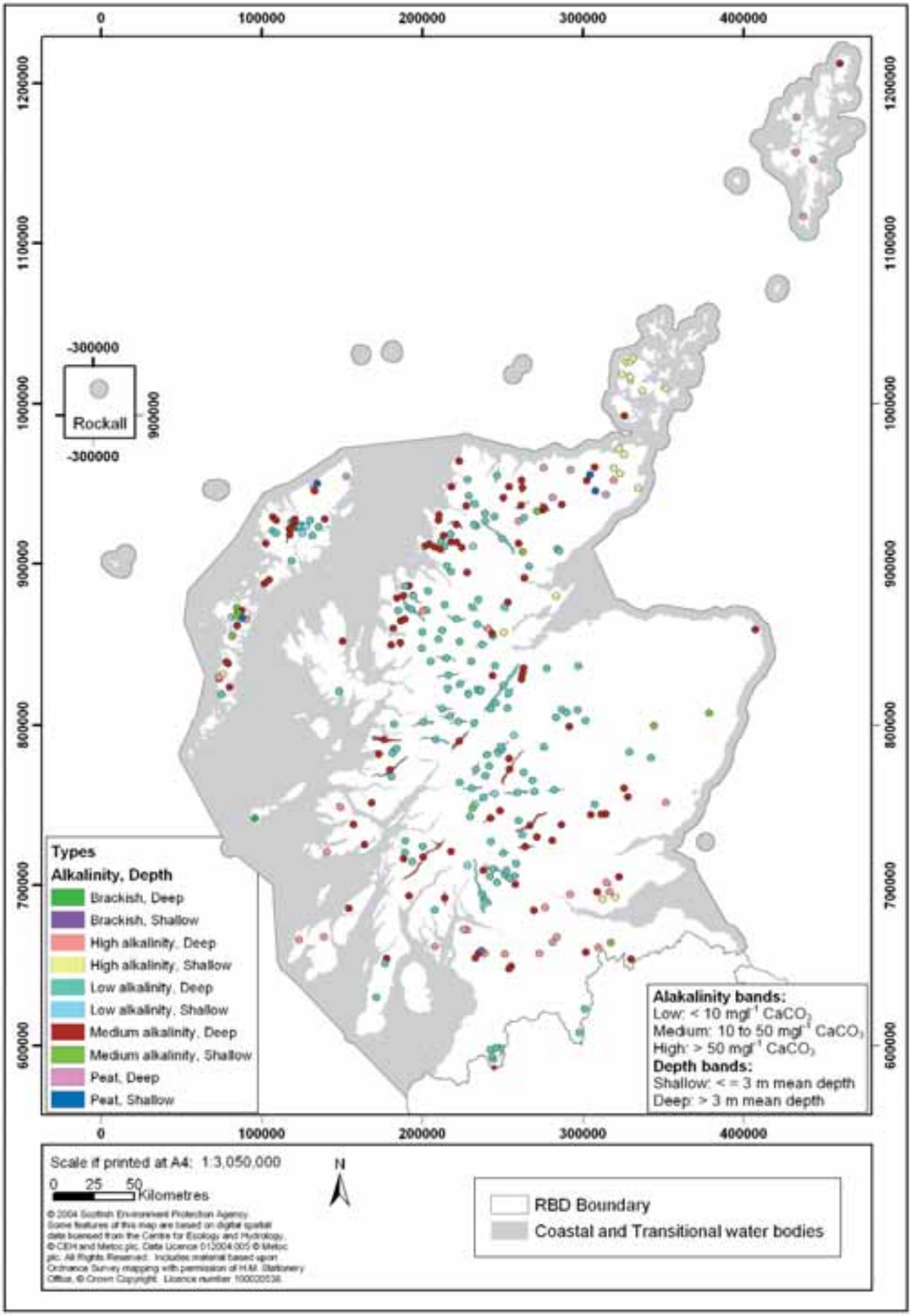
Map 1: River basin districts in mainland UK



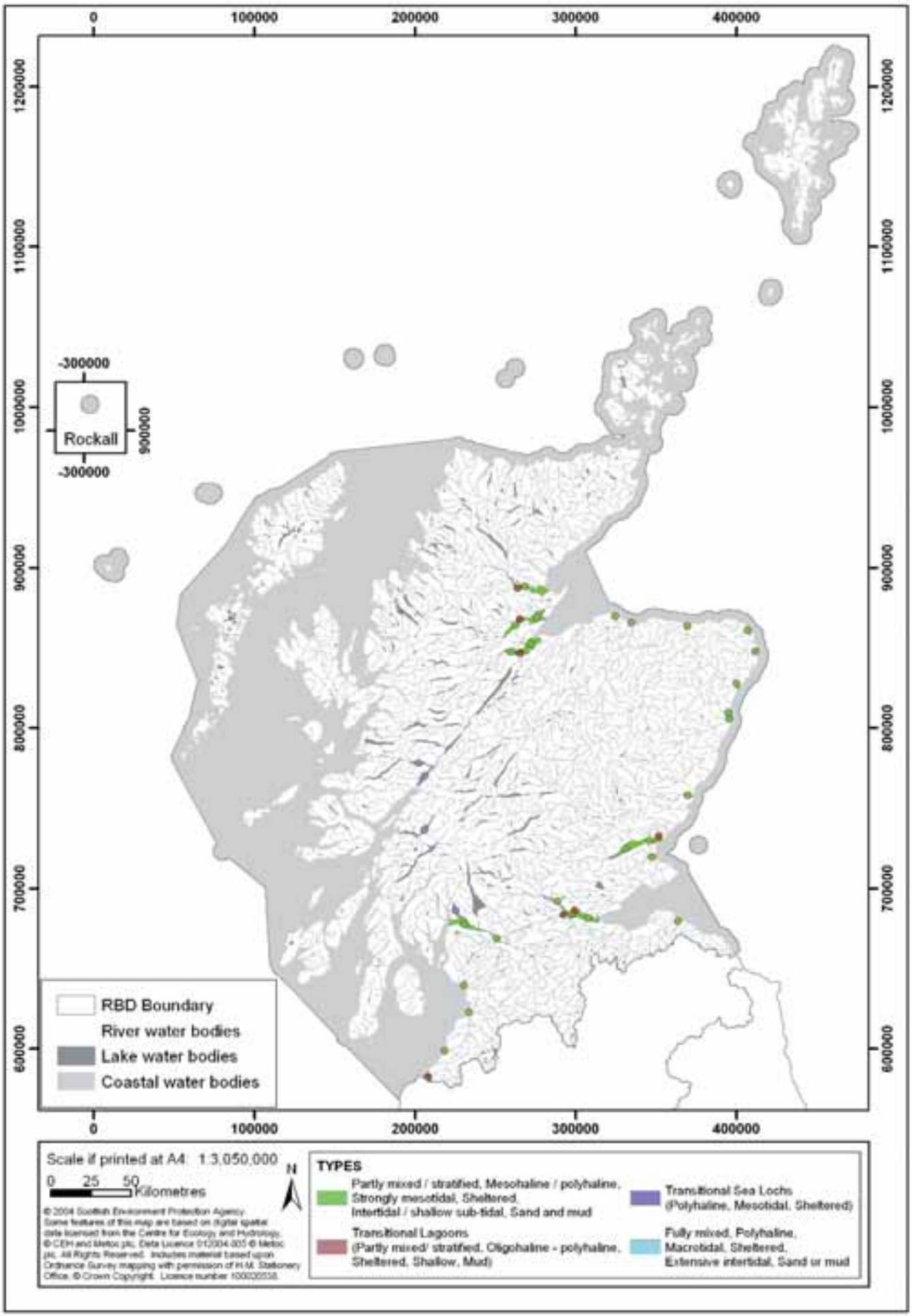
Map 2: Main river catchments and types



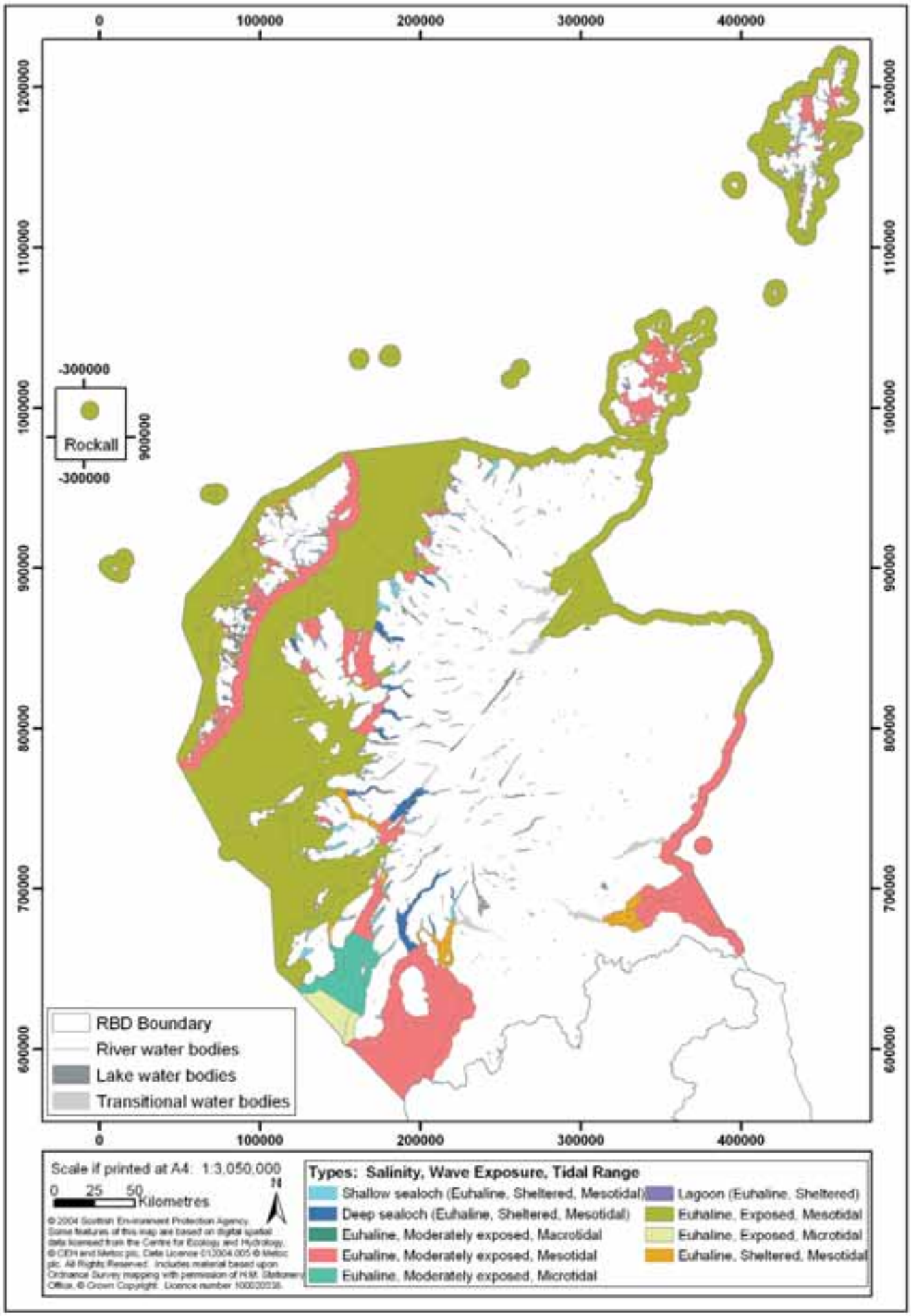
Map 3: Lake types



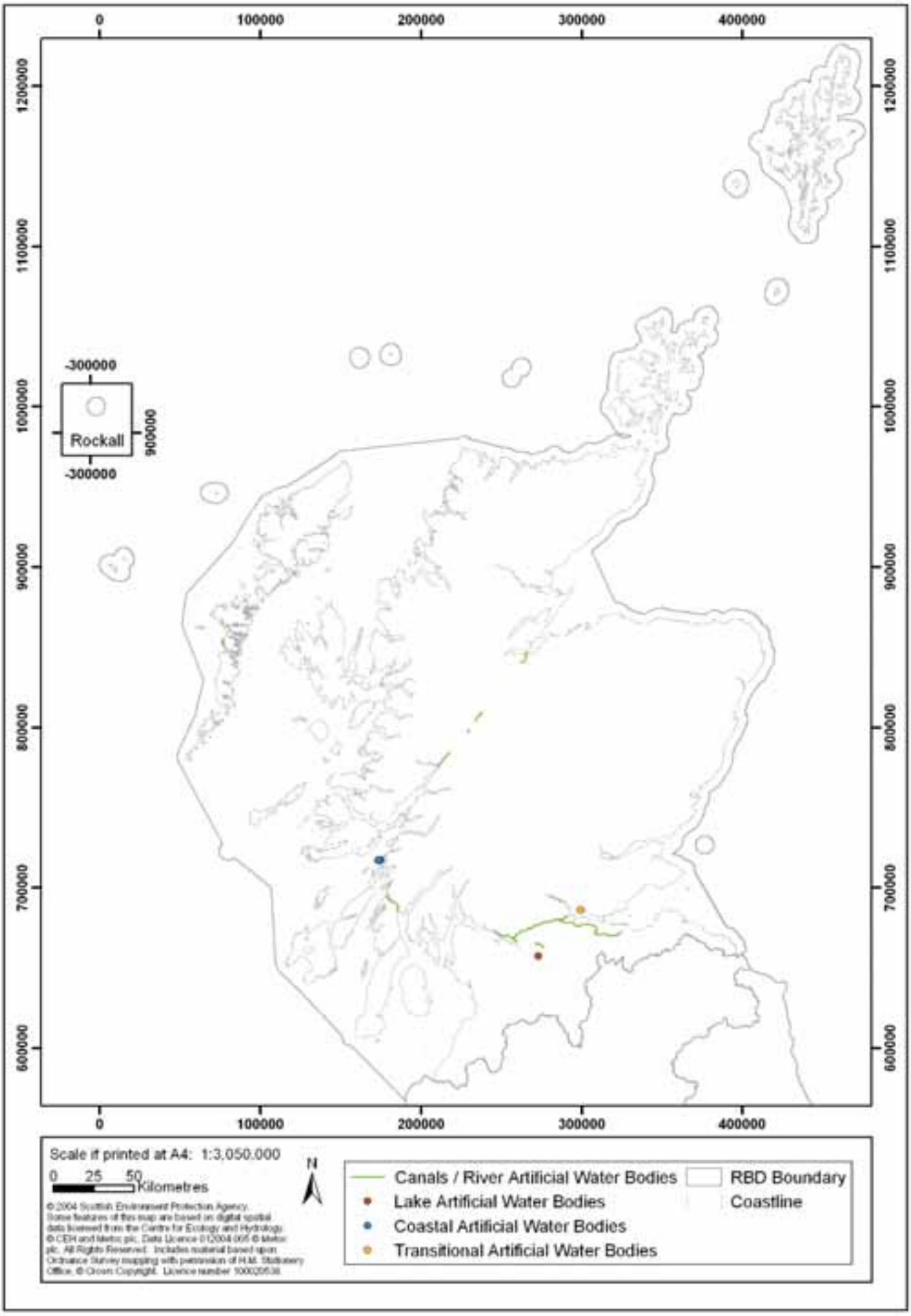
Map 4: Transitional waters types



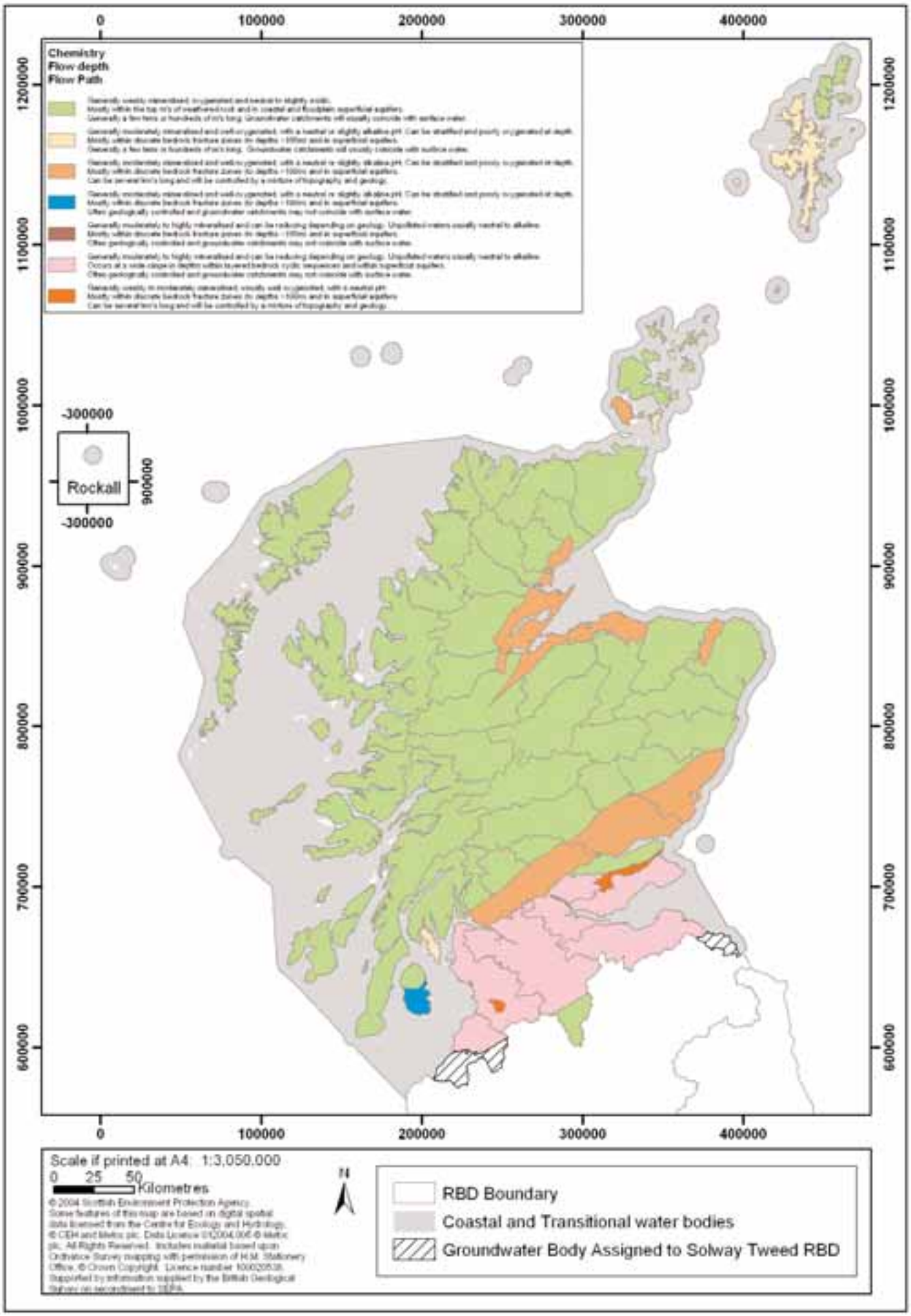
Map 5: Coastal waters types



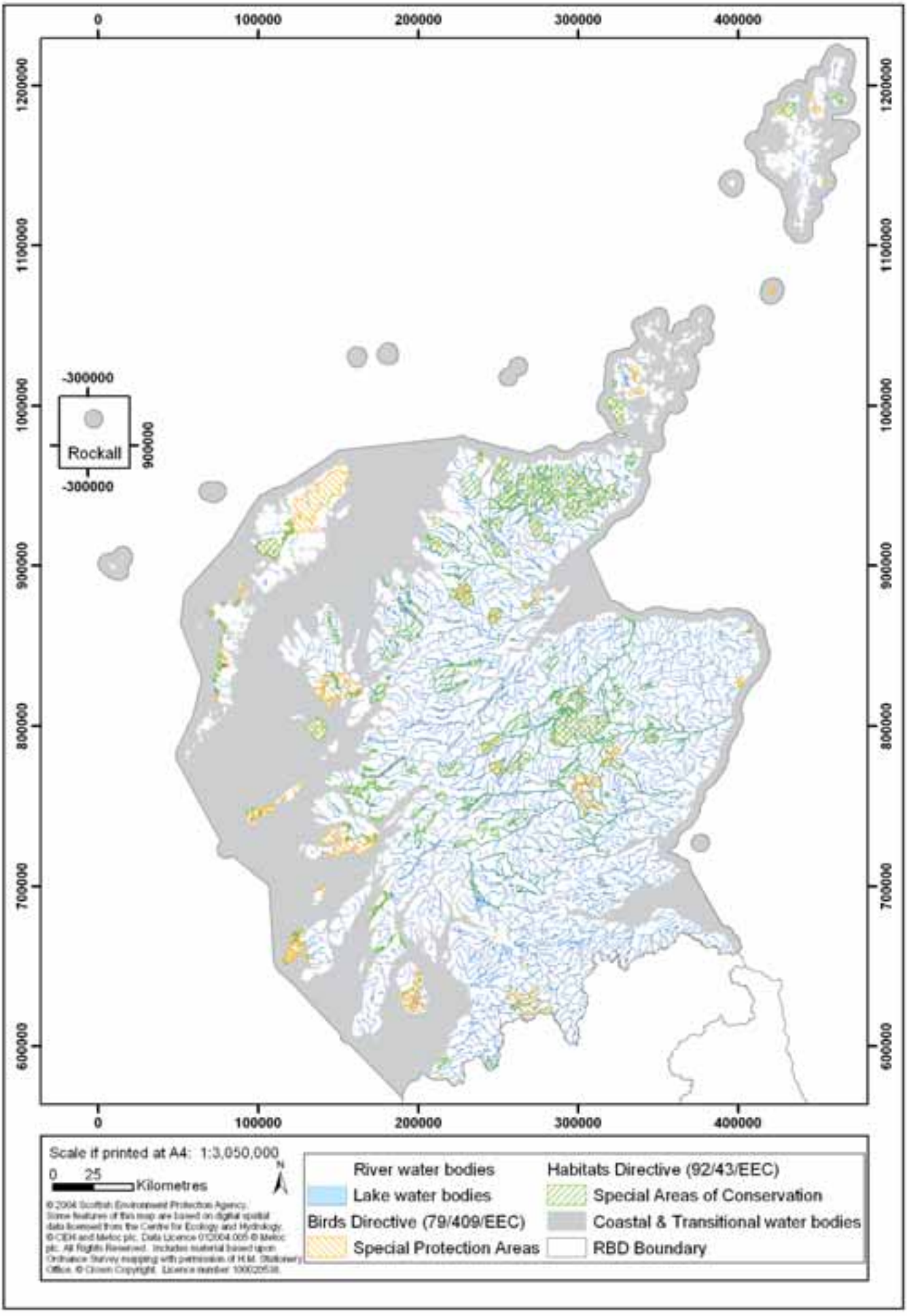
Map 6: Artificial water bodies and canals



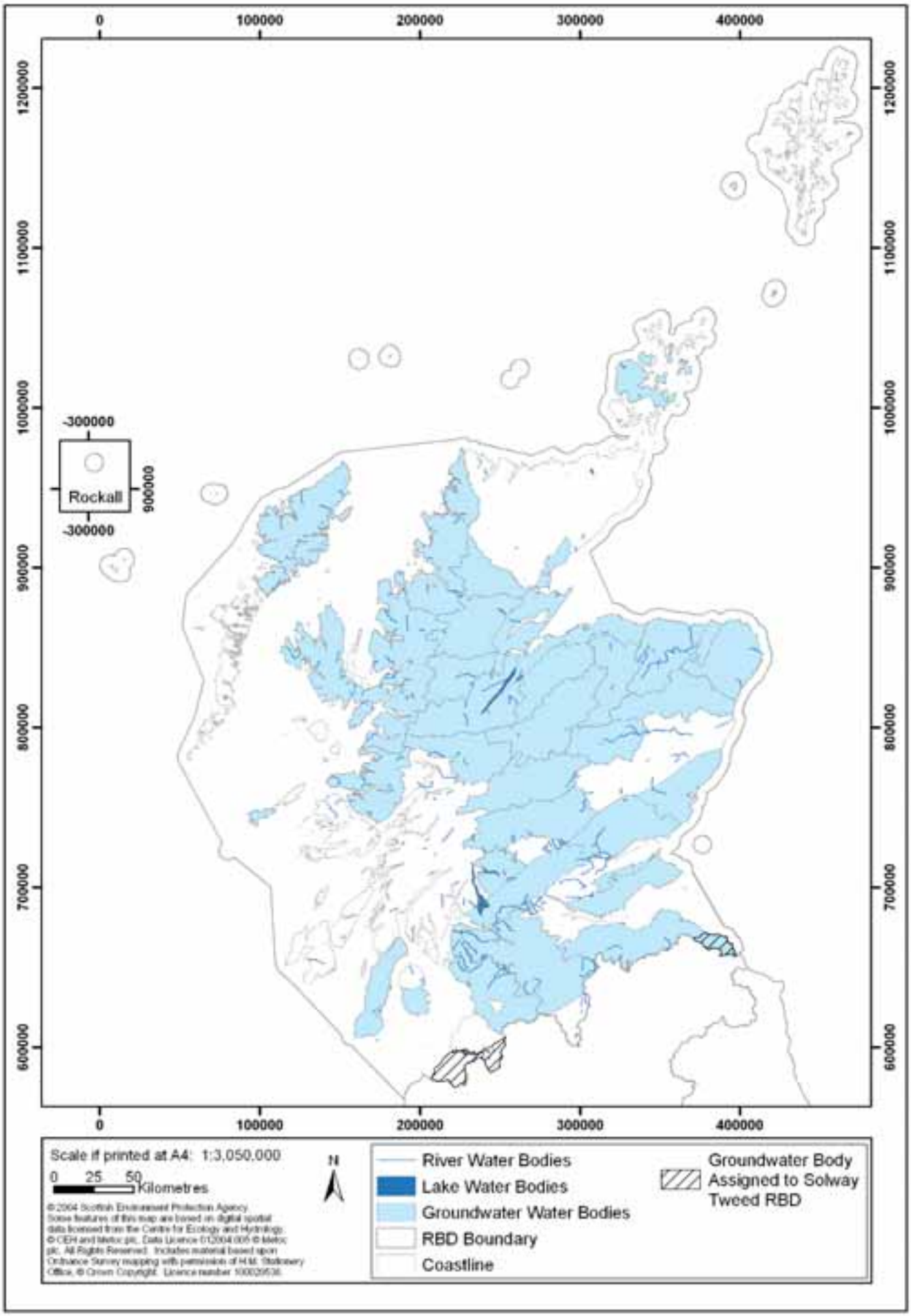
Map 7: Groundwater body types



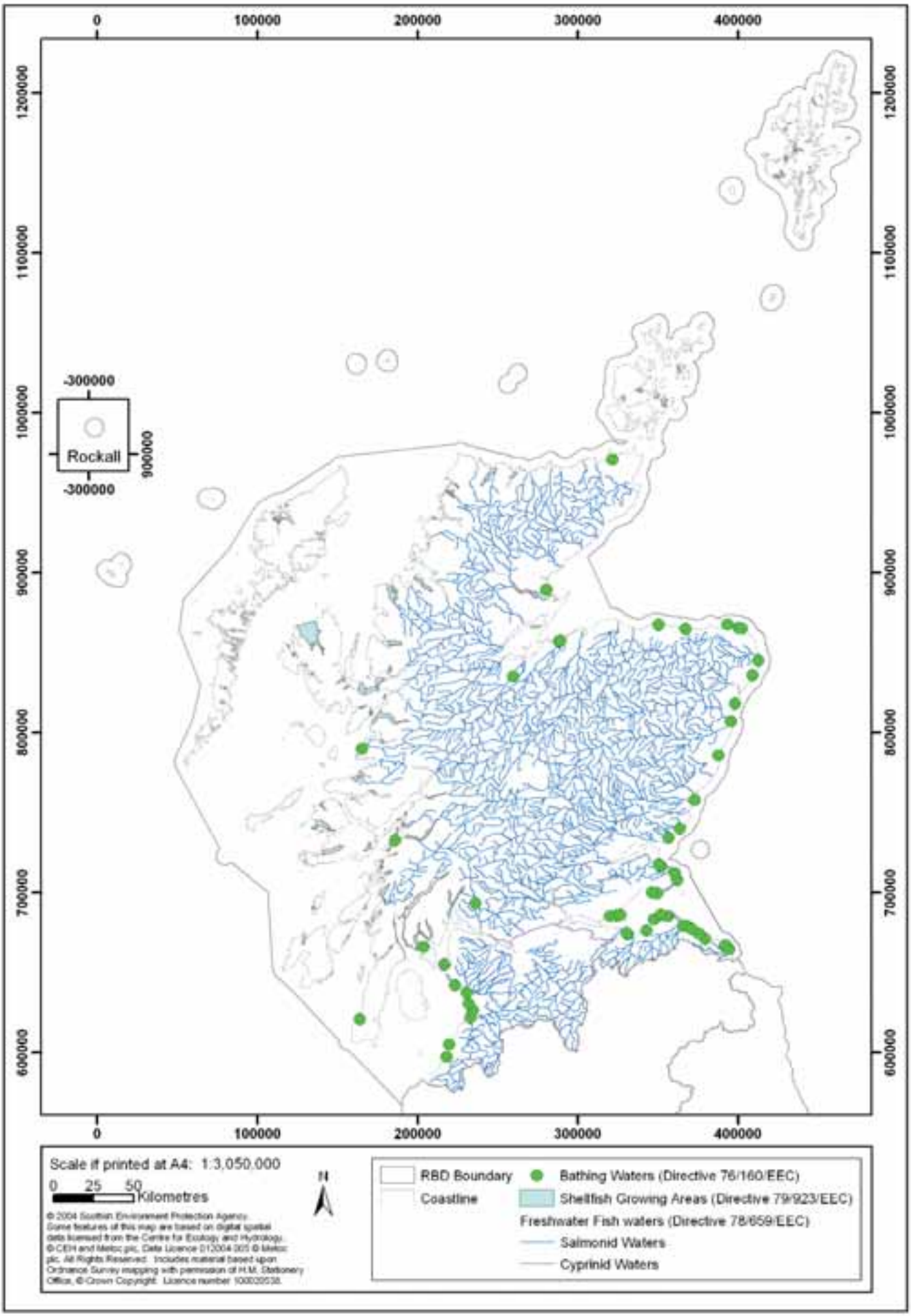
Map 8: Groundwater dependent surface water bodies and terrestrial ecosystems



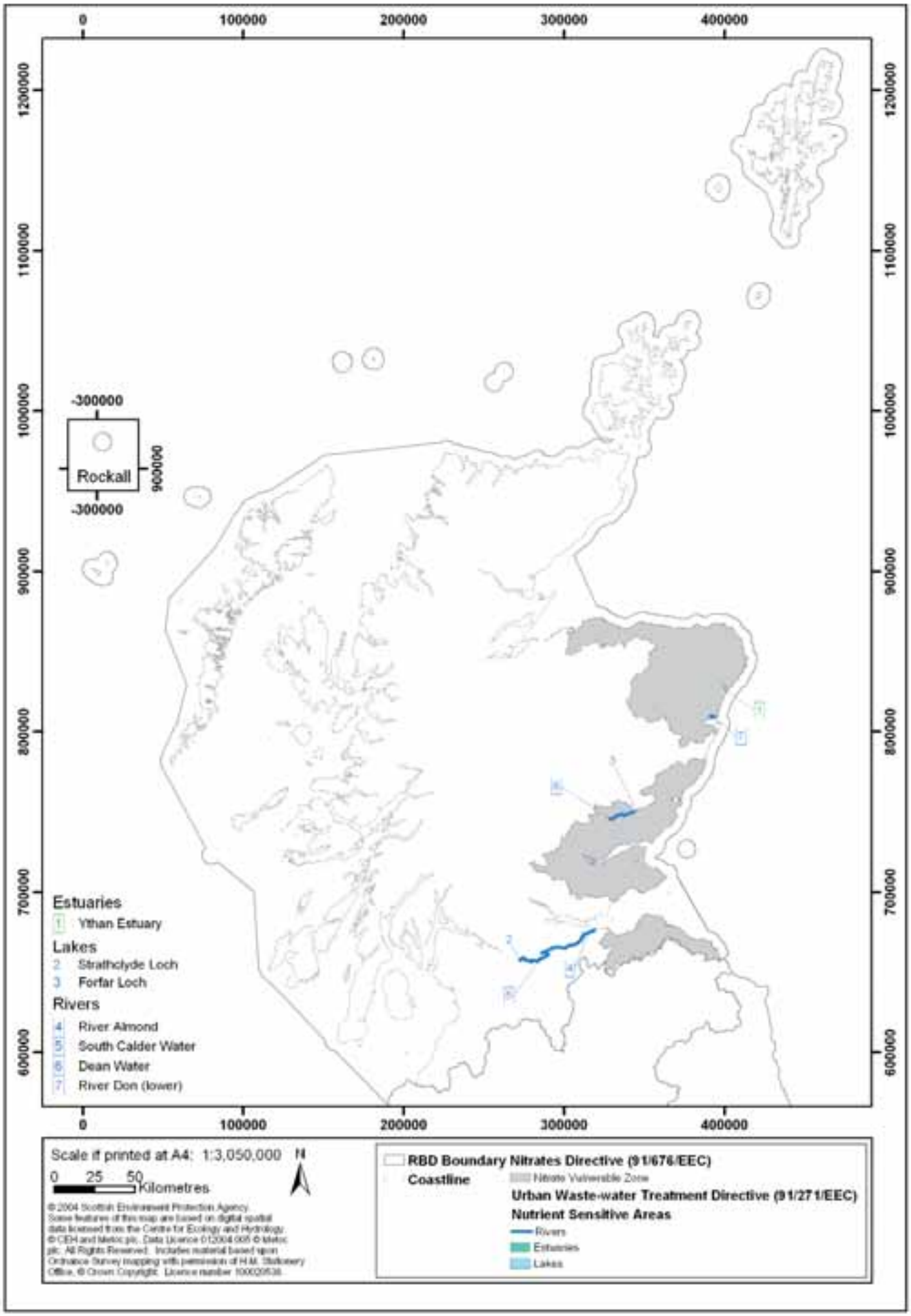
Map 9: Waters used for the abstraction of drinking water (proposed)



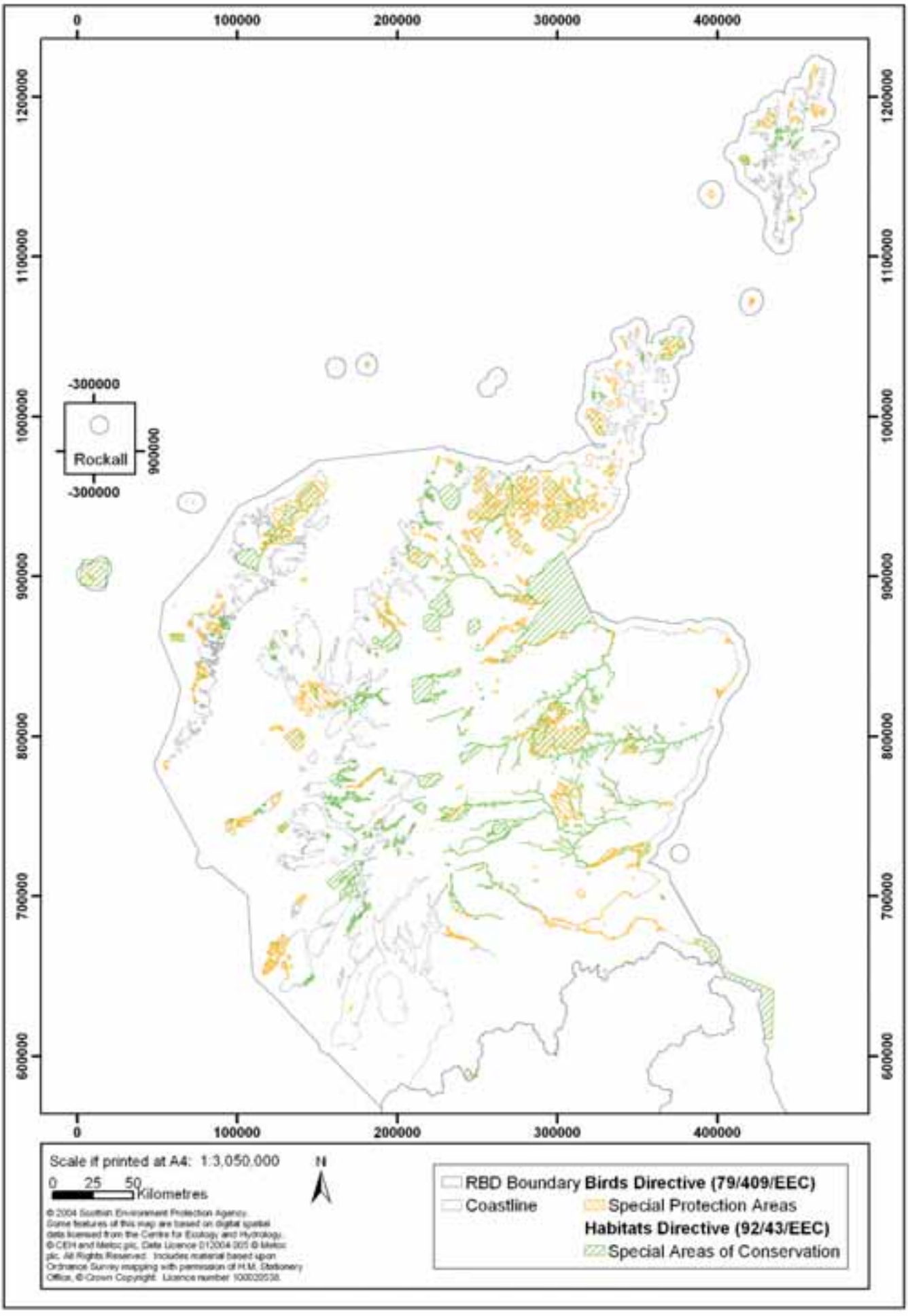
Map 10: Areas designated to protect economically significant aquatic species and Bathing Water Directive beaches



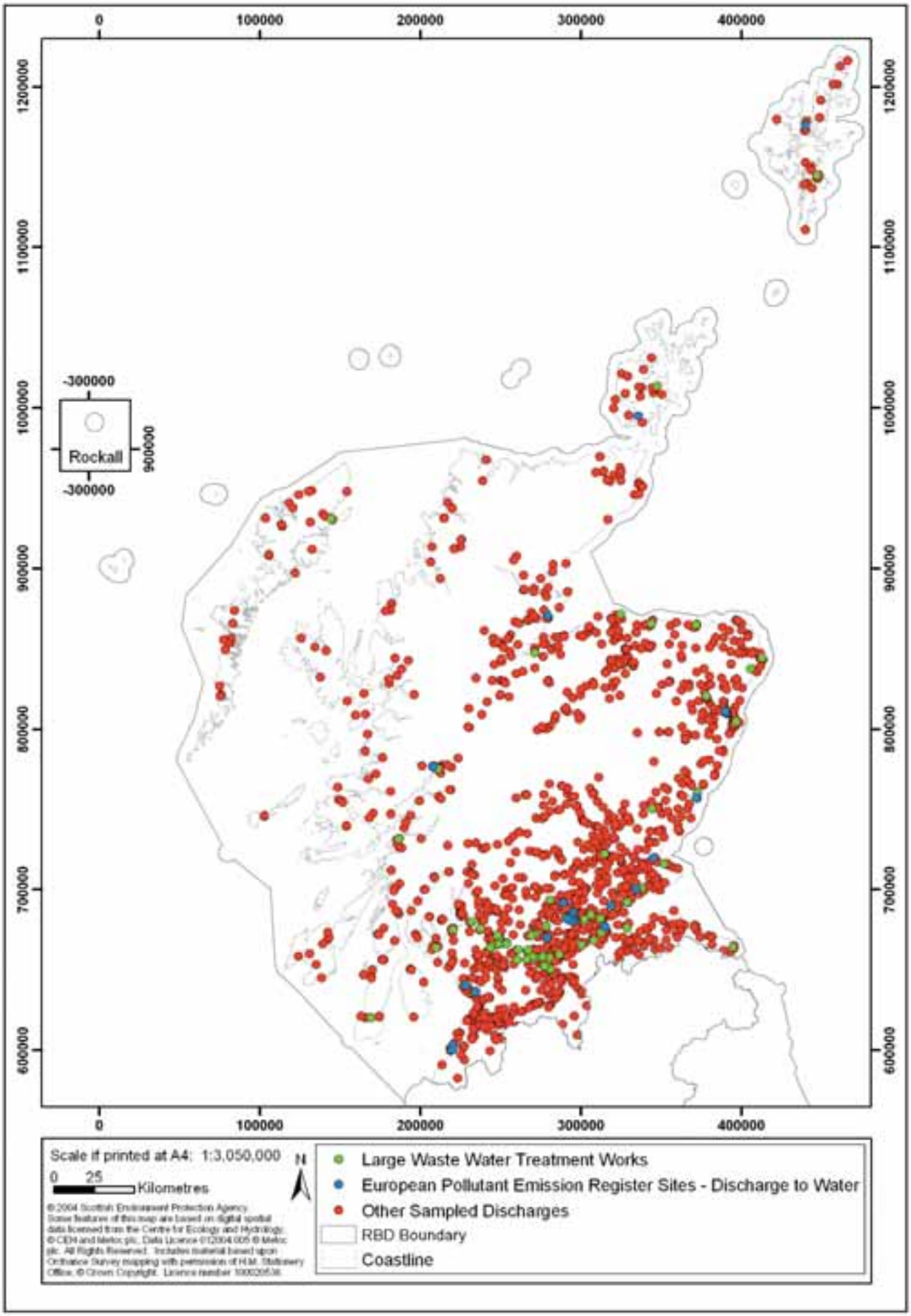
Map 11: Nutrient sensitive areas



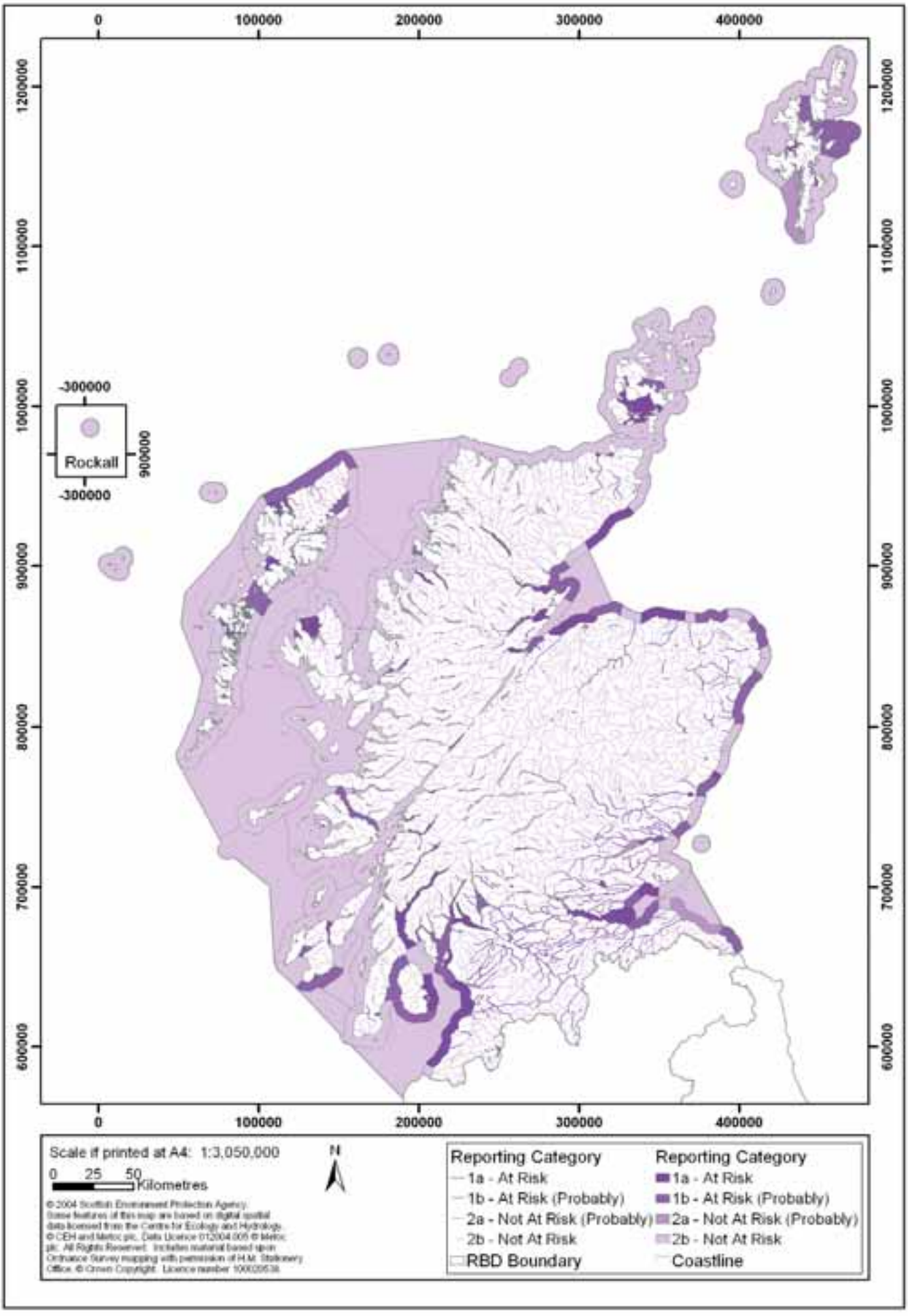
Map 12: Water dependent conservation areas



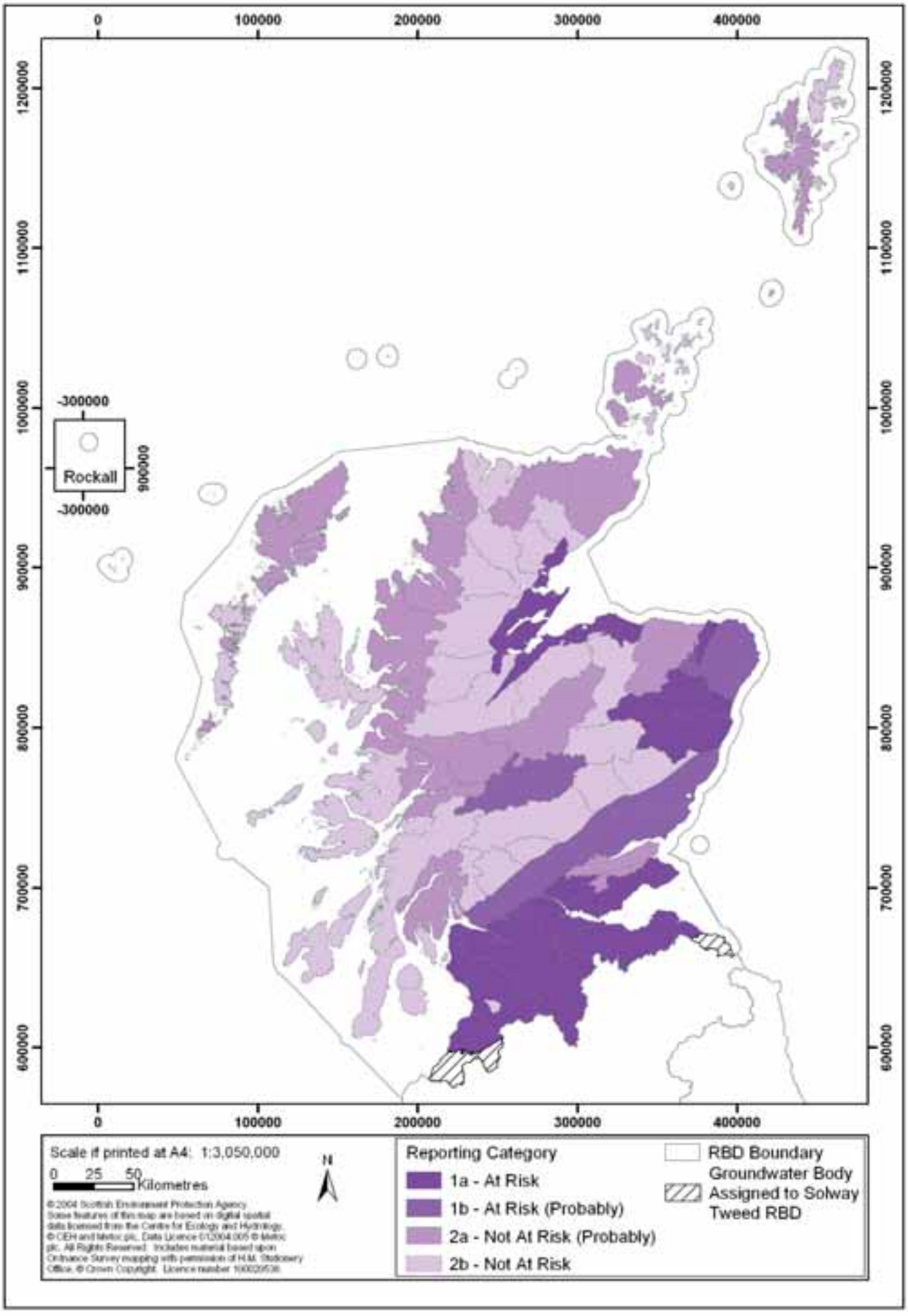
Map 13: Point source pressures



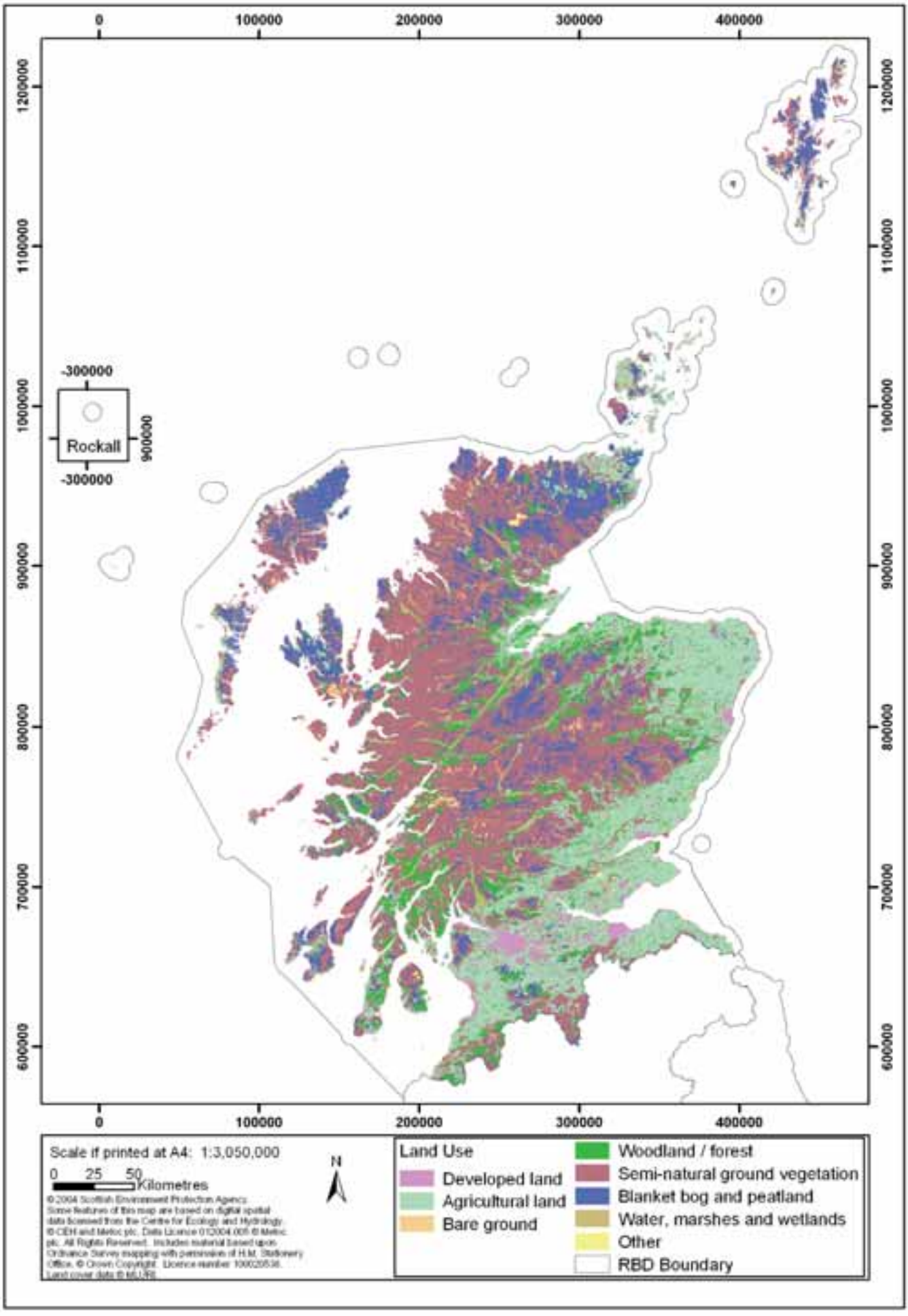
Map 14: Surface water bodies affected by point source pollution pressures



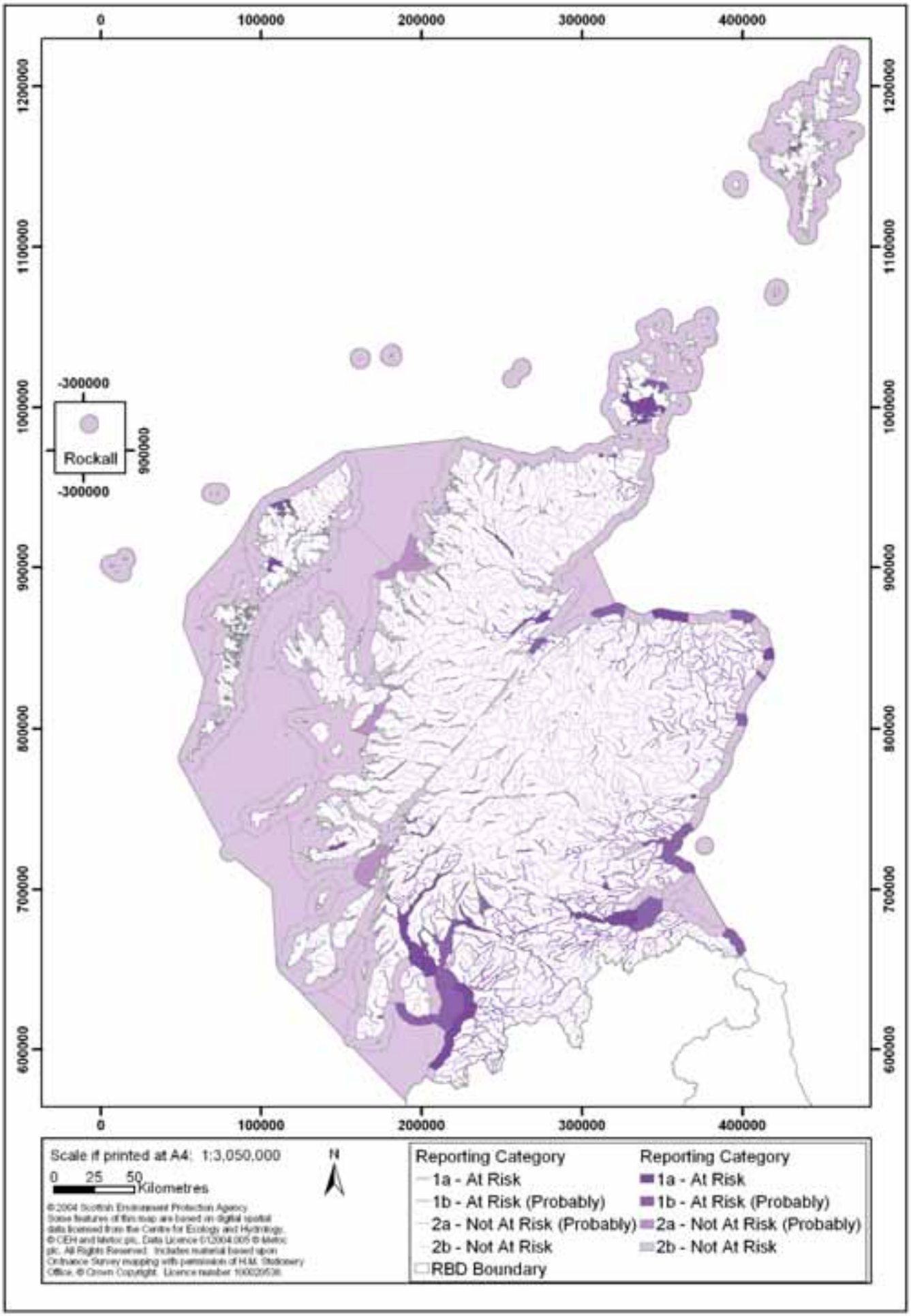
Map 15: Groundwater water bodies affected by point source pollution pressures



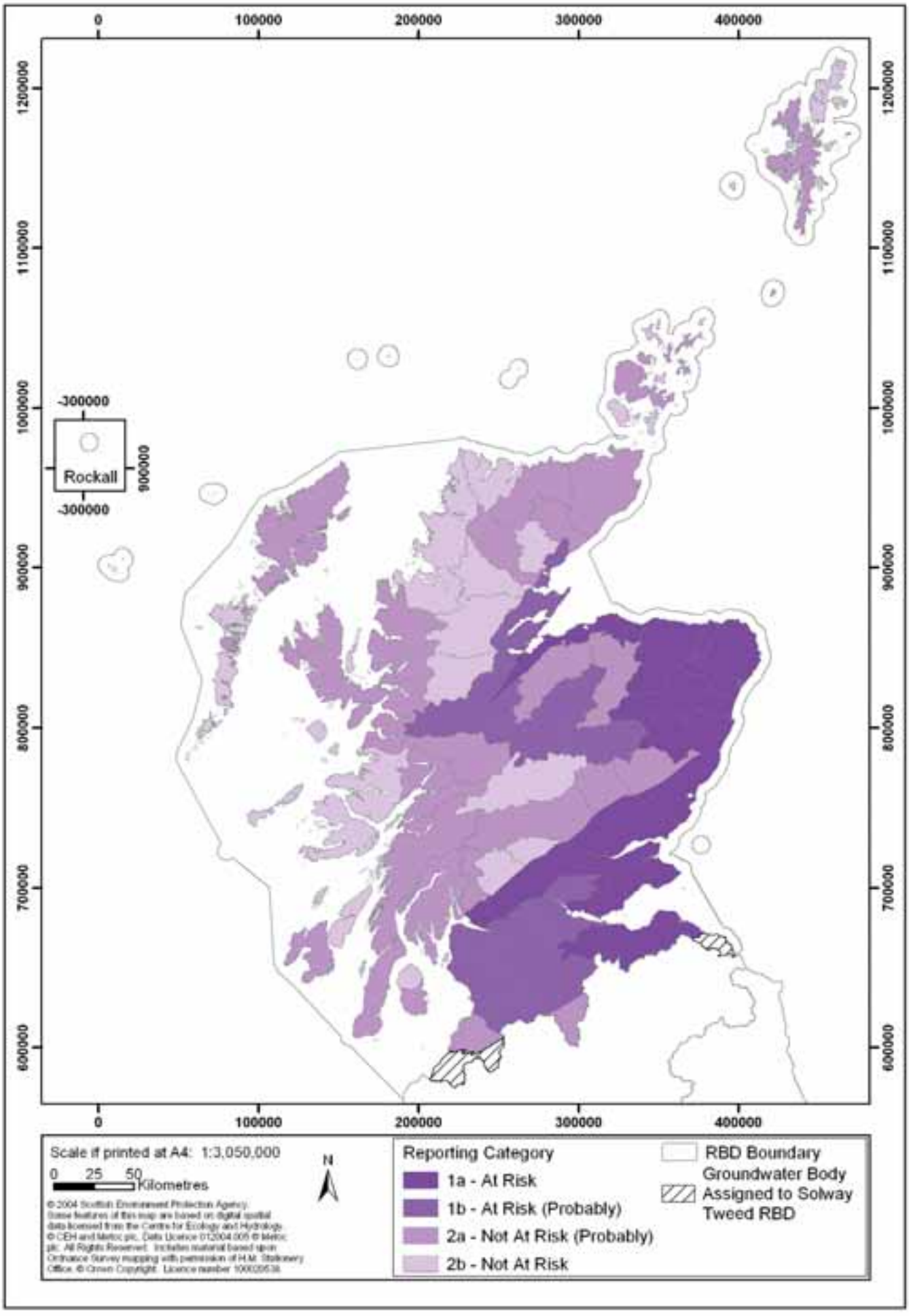
Map 16: Land use in the Scotland river basin district



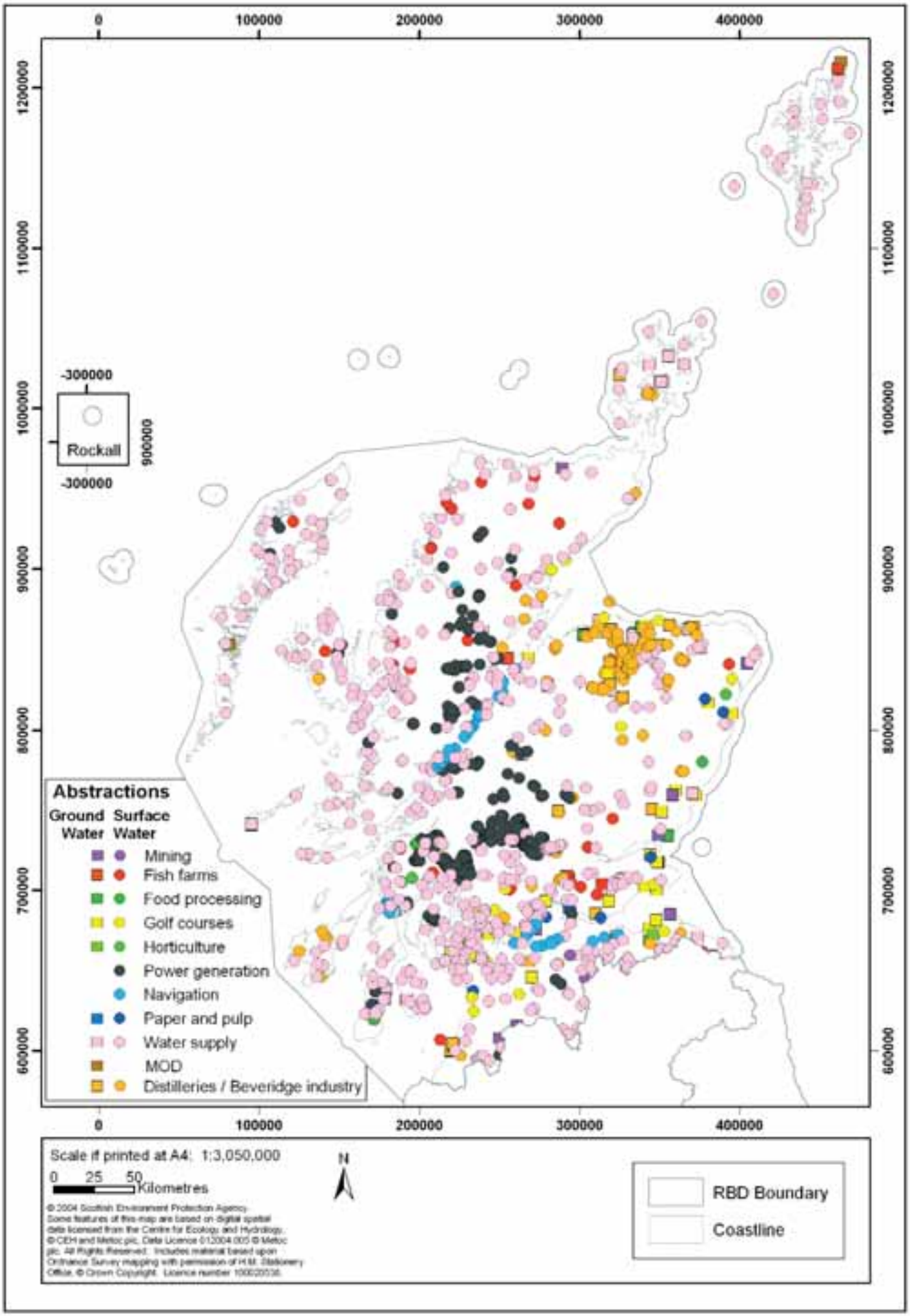
Map 17: Surface water bodies affected by diffuse source pollution pressures



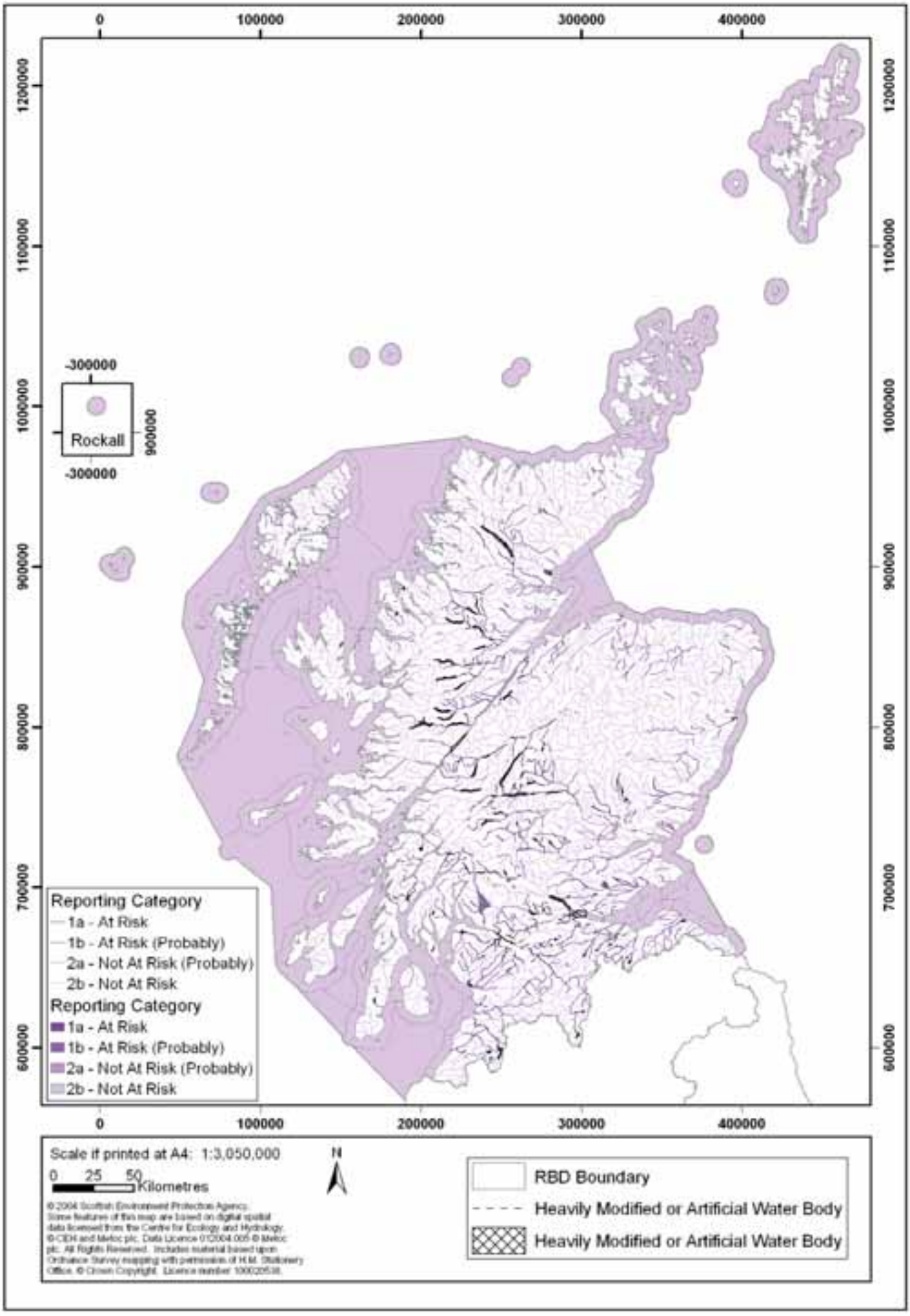
Map 18: Groundwater water bodies affected by diffuse source pollution pressures



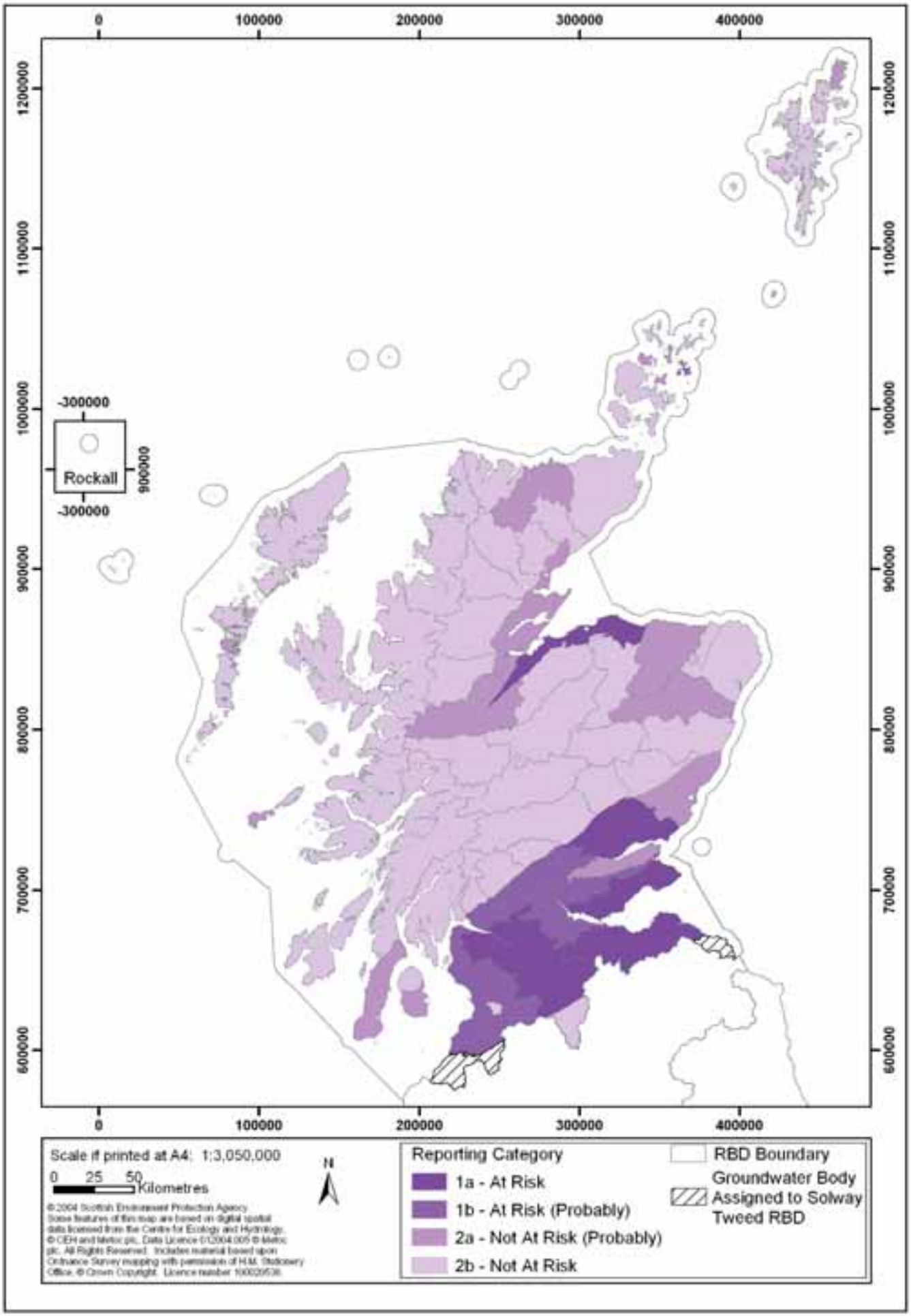
Map 19: Abstraction and flow regulation pressures



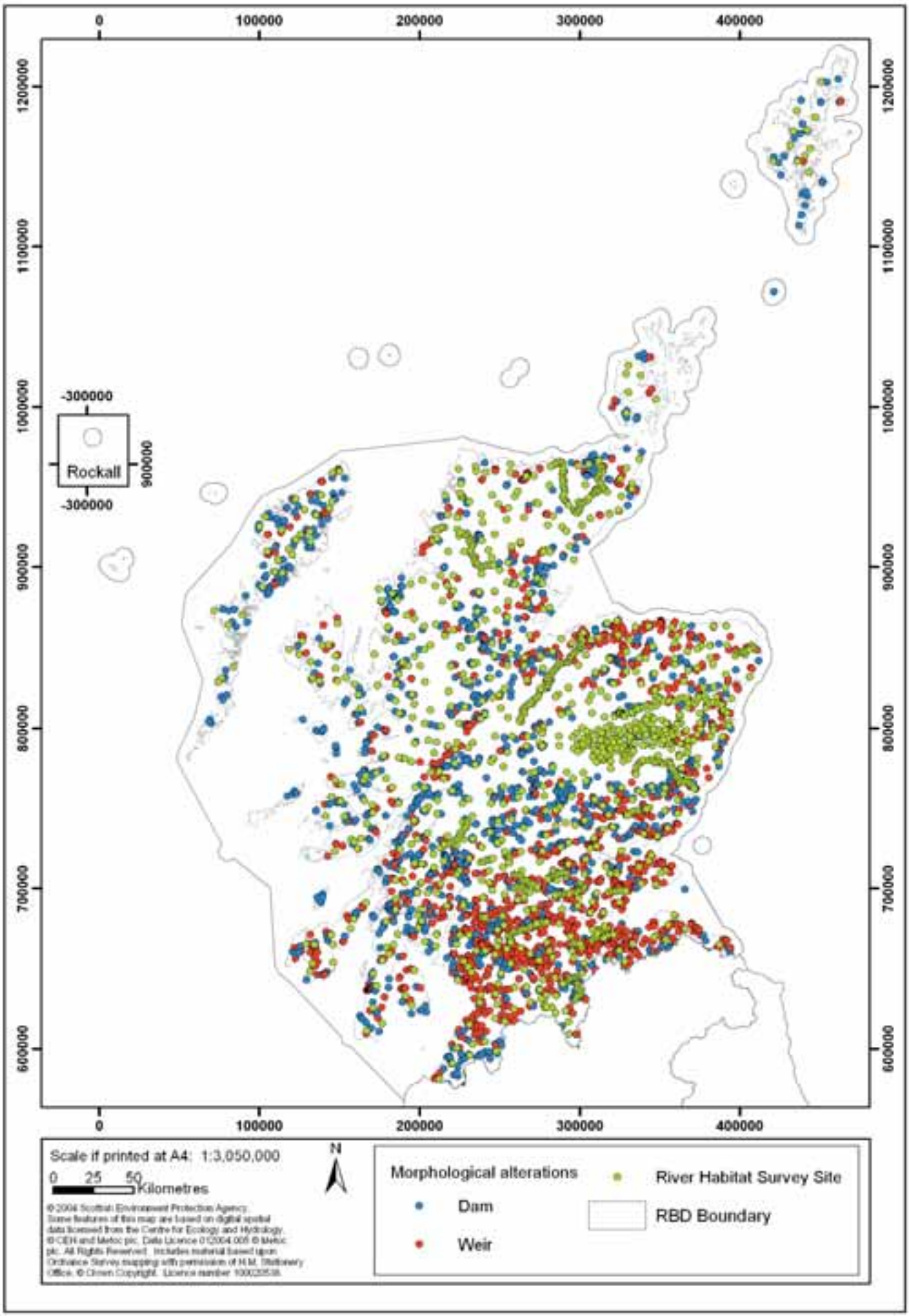
Map 20: Surface water bodies affected by abstraction and flow regulation pressures



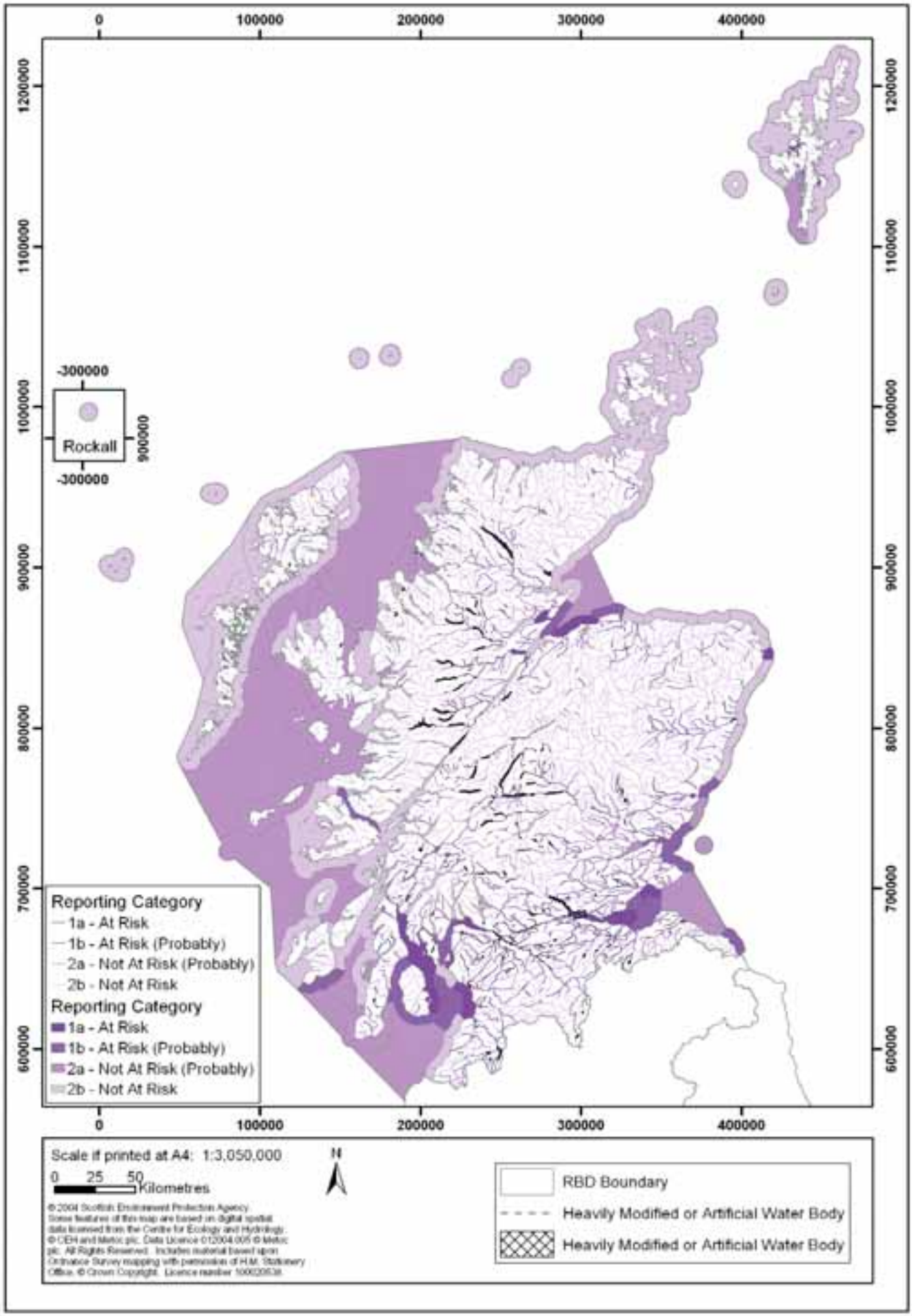
Map 21: Groundwater water bodies affected by abstraction pressures



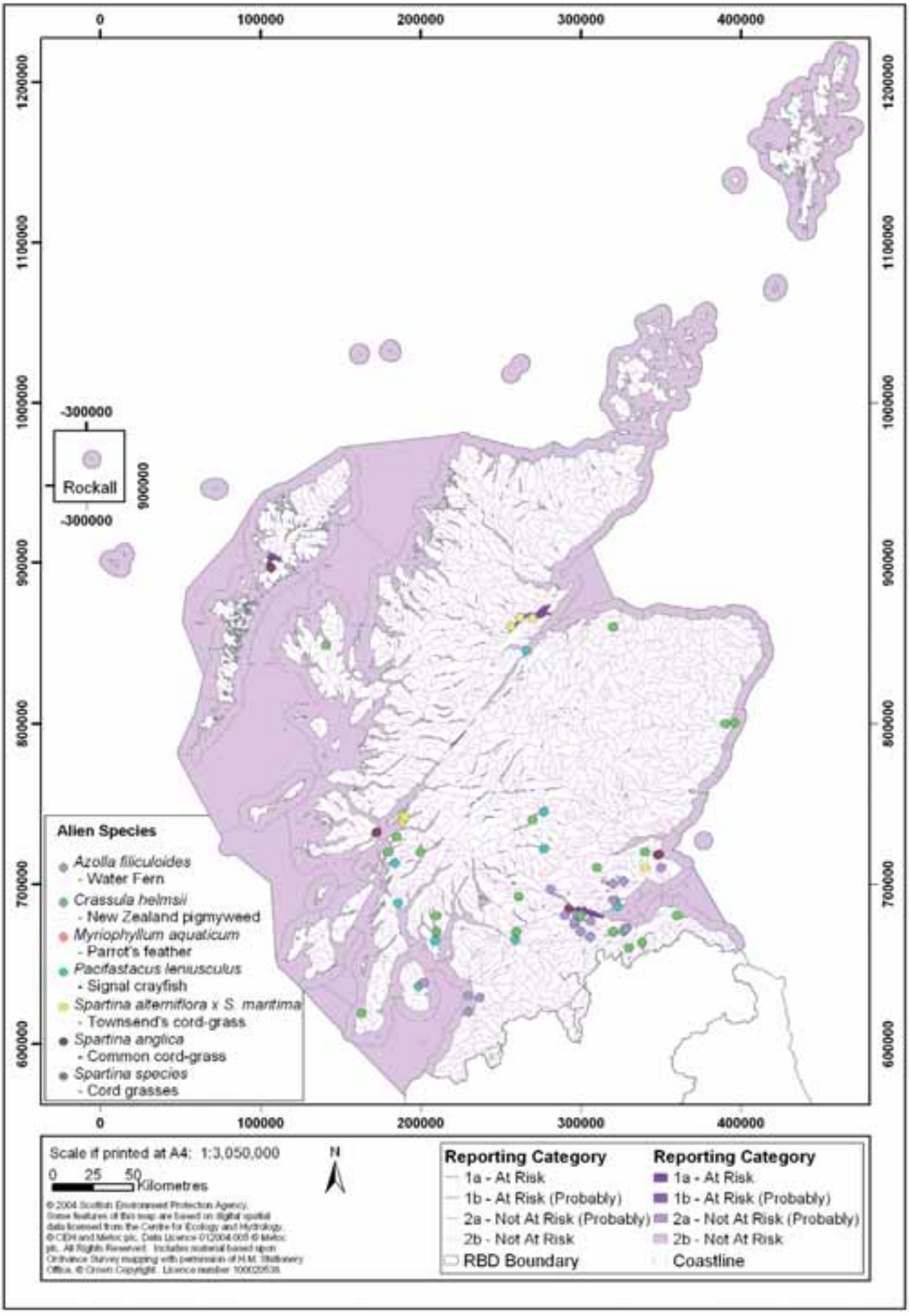
Map 22: Morphology pressures and river habitat survey sites



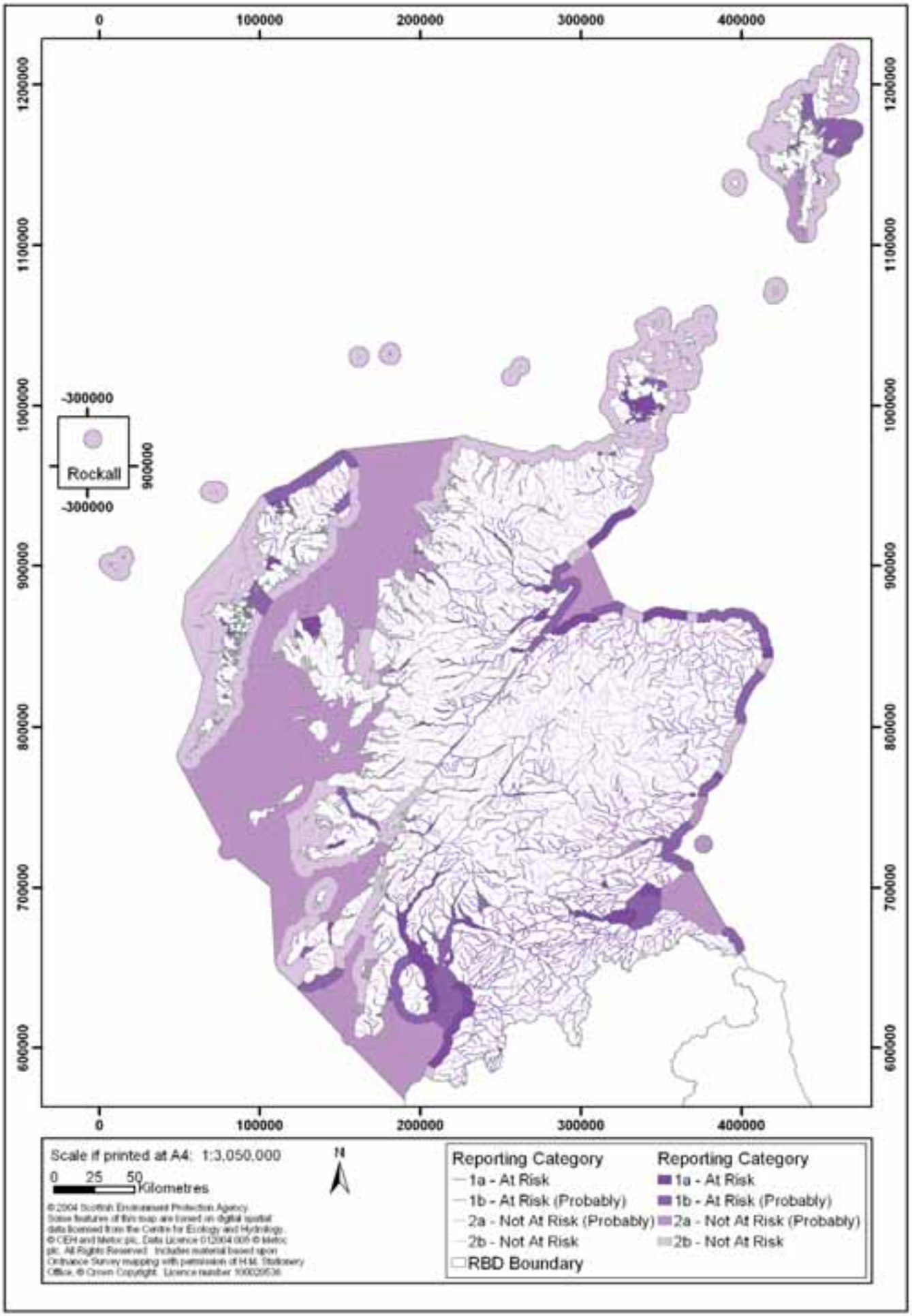
Map 23: Surface water bodies affected by morphological pressures



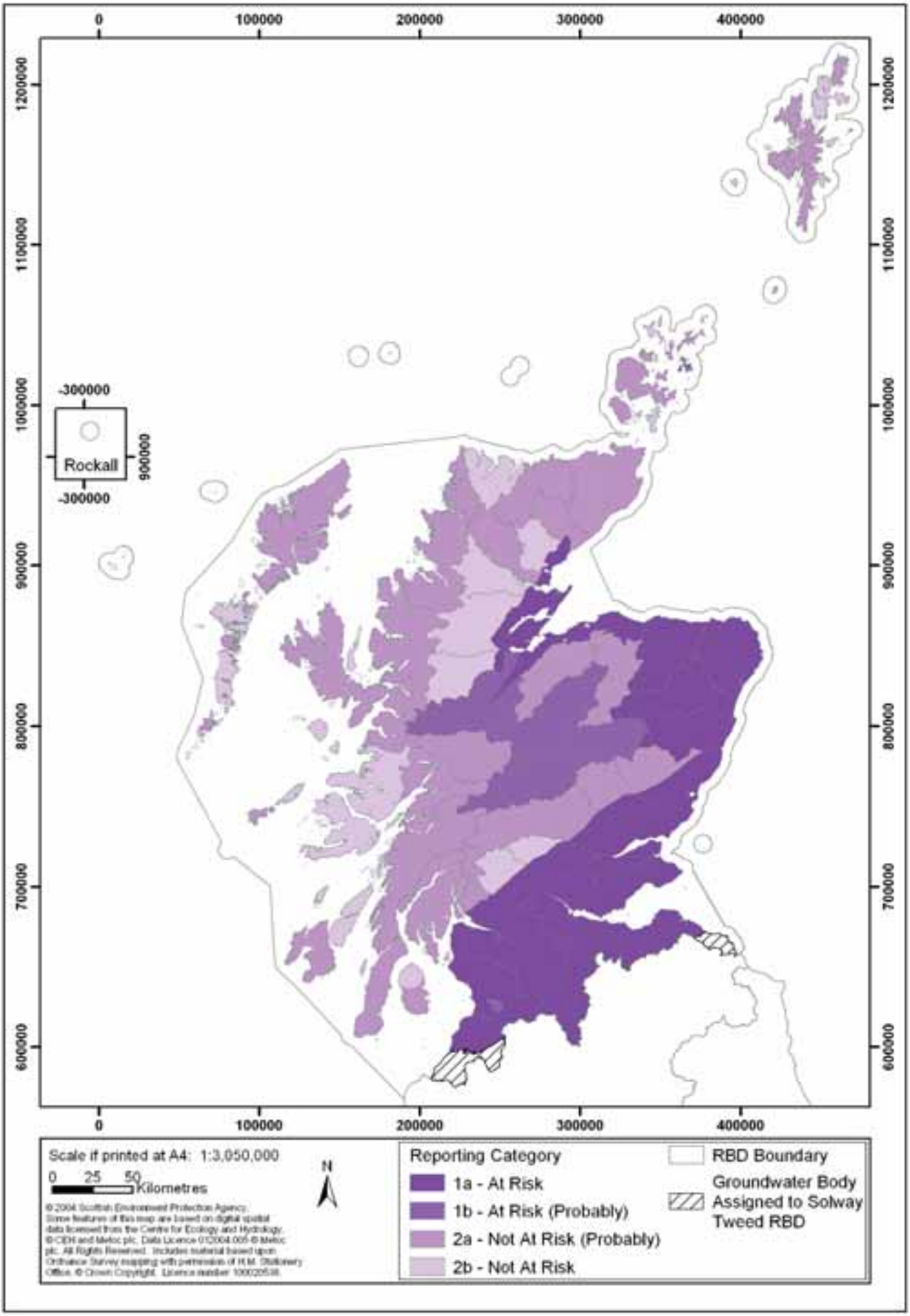
Map 24: Surface water bodies affected by alien species pressures



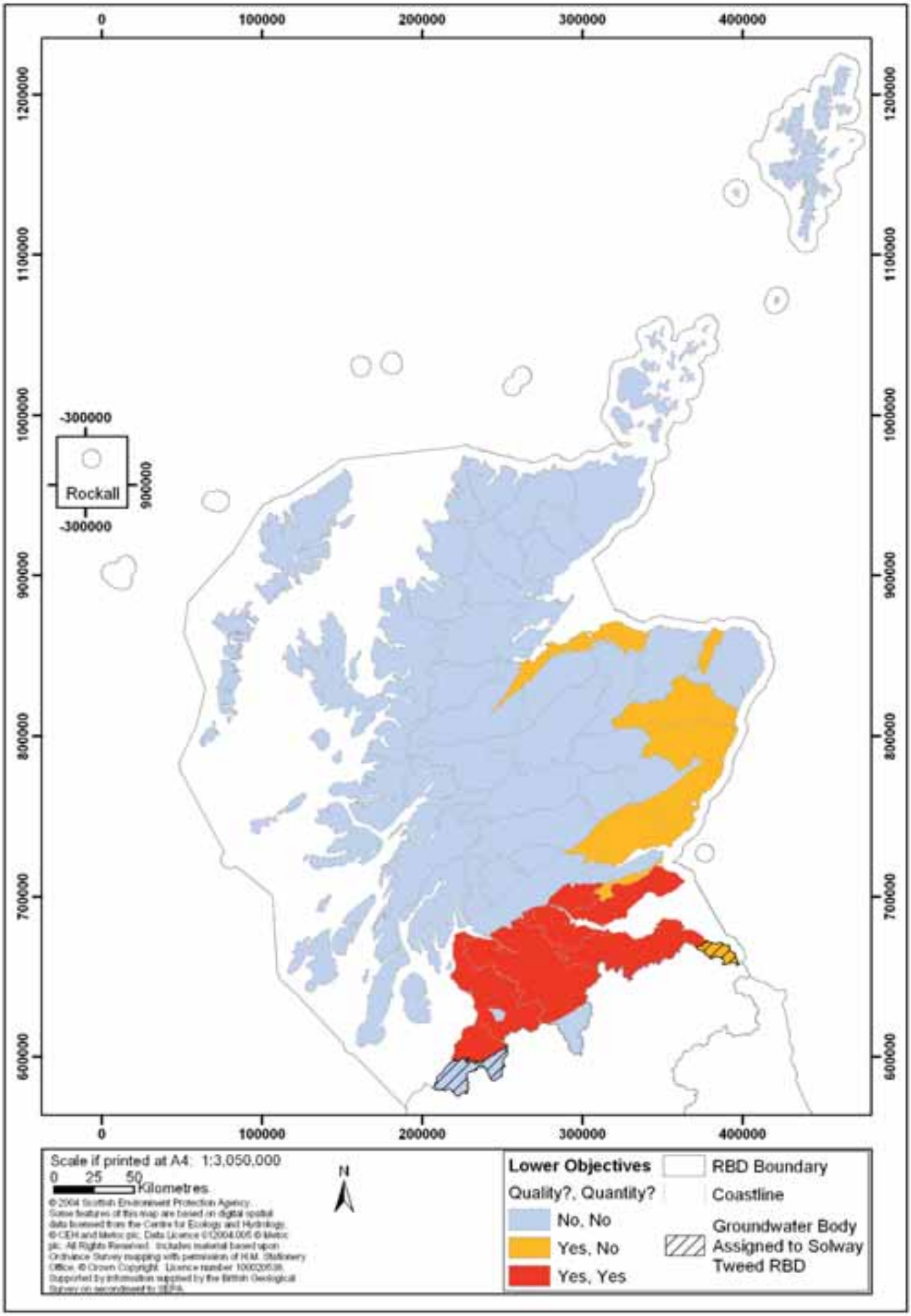
Map 25: Surface water bodies affected by all pressure types



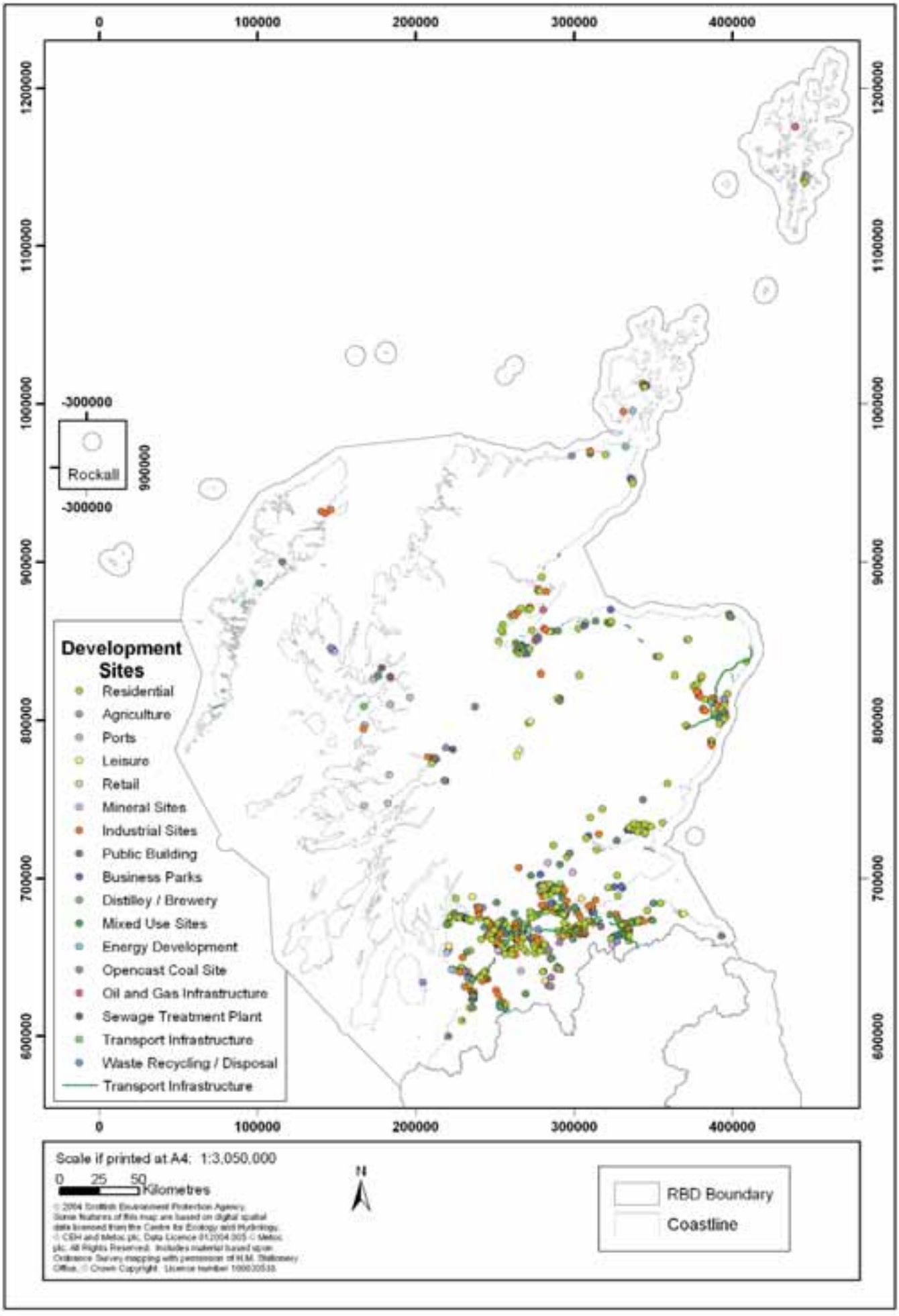
Map 26: Groundwater water bodies affected by all pressure types



Map 27: Groundwater bodies for which lower objectives may be specified



Map 28: Future development pressures



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