

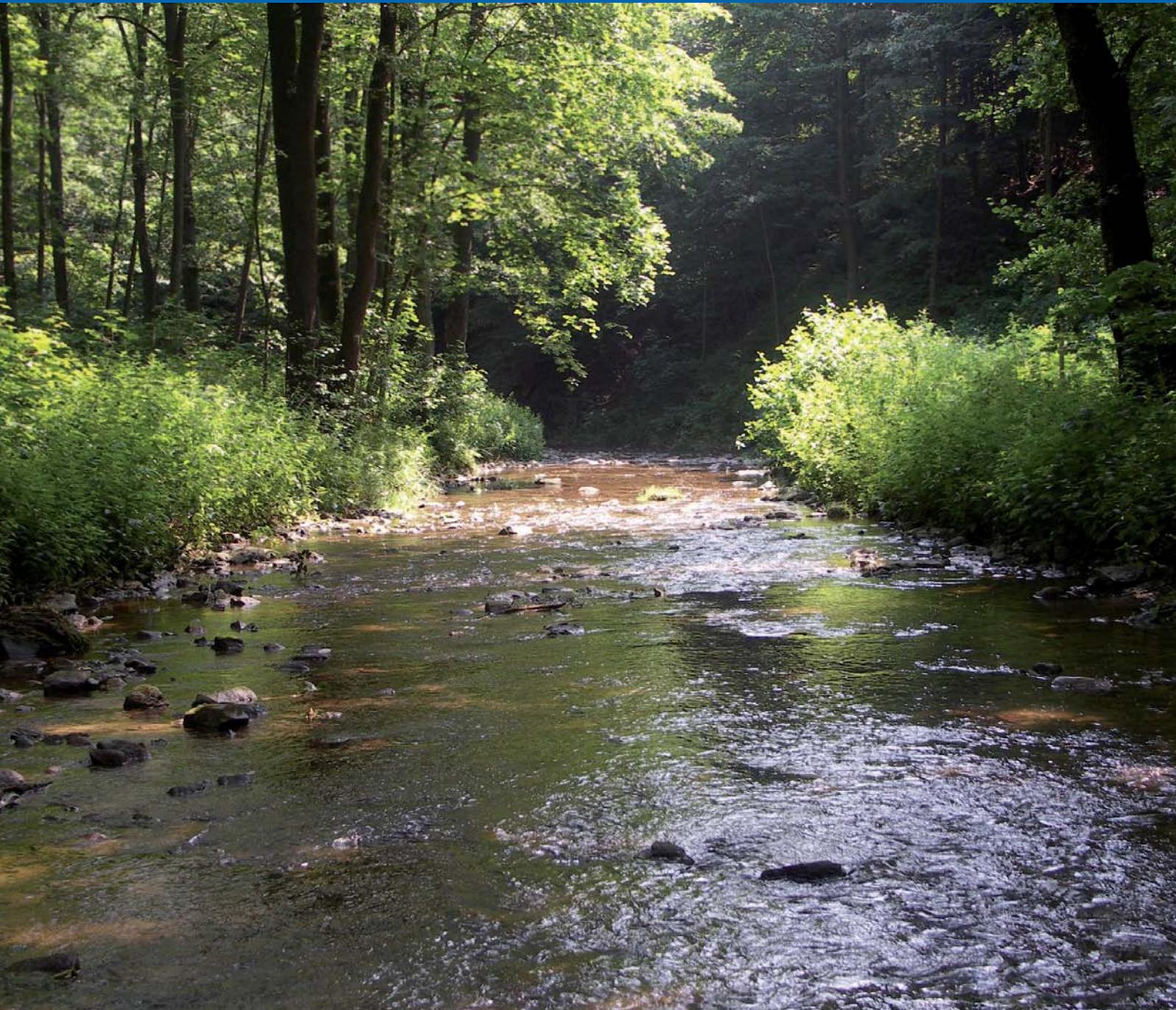


Federal Ministry for the
Environment, Nature Conservation
and Nuclear Safety

Umwelt
Bundes
Amt 
For our Environment

Water Framework Directive

The way towards healthy waters



IMPRINT

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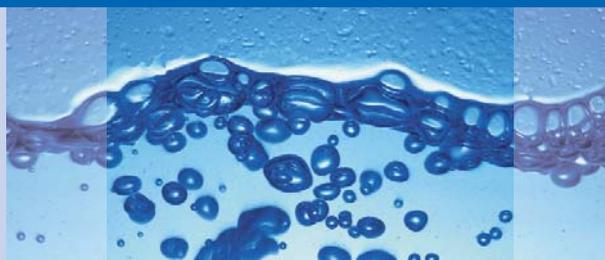
Water Framework Directive

The way towards healthy waters

Results of the German river basin management plans 2009



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Foreword



Dear Reader

The aim of the Water Framework Directive is to promote good water quality in all European water bodies by managing water bodies, i.e. lakes, rivers, groundwater bodies, transitional waters and coastal waters. Water body management poses a major challenge in densely populated countries such as Germany. Stewardship of water resources is of paramount importance throughout Europe and for all EU environmental policies now and in the future.

Official implementation of the Water Framework Directive on 22 December 2000 marked the beginning of a new era in the annals of water management. The Directive promulgates a unified water body protection framework. Unified in this context means that European water bodies have been consolidated into large river basins that are managed collaboratively by the state and national governments concerned. This mechanism is clearly evidenced by the large Elbe and Rhine river basin districts, the latter of which is managed jointly by nine nations and eight German states. Successful management of such river basin districts necessitates efficient collaboration in a spirit of partnership between all concerned. Hence the Water Framework Directive harmonizes water protection regulations within the steadily growing European Community.

The Water Framework Directive (WFD) stipulates that “good status” is to be achieved for all European water bodies by 2015, i.e. high water quality and adequate habitats for native flora and fauna. Although the Direc-

tive unequivocally emphasizes ecological quality and biodiversity improvement and maintenance for water bodies, it places no restrictions on core water body functions such as supplying drinking water, shipping and flood protection. Both ecological matters and water use will form the basis for river basin management planning in the coming years.

The 2004 characterization of water body pressures showed that without additional measures the vast majority of German water bodies will probably not achieve their objectives by 2015. This assessment has been borne out by the measures taken in connection with the river basin management planning work that has been done: substantial amounts of new data have been gathered and assessed; new assessment methods that meet Water Framework Directive requirements have been developed; research contracts have been awarded; and extensive programmes of measures have been established with a view to meeting WFD objectives.

Our state governments have also accomplished a great deal in this domain. Numerous pilot projects aimed at implementing the WFD have been set in motion, with a view to gathering experience and laying the groundwork for river basin management planning. In elaborating their plans and programmes, our state governments have devoted a great deal of effort to informing and conducting a dialogue with the general public, through measures such as Web sites, informational

brochures, water resource forums and roundtable discussions. Such programmes have been and remain a key instrument for transparency of the measures being taken and public acceptance thereof. My ministry and the Federal Environmental Agency were instrumental in elaborating the framework for a European implementation process whereby water quality assessments, deficit analyses and water river basin management planning are all based on reciprocally comparable standards. The elaboration of the relevant European guidelines, which in a number of cases Germany was instrumental in elaborating with the European Commission and other EU member states, have made a key contribution to implementation of the Water Framework Directive in Germany and Europe as a whole.

The present pamphlet describes the objectives and provisions of the Water Framework Directive and its role in the water management process. You will also find in these pages (a) the relevant facts and outcomes concerning river basin management planning in Germany; (b) the key planning steps of this process; and (c) the conclusions and results yielded by these activities. The pamphlet furthermore shows how our water bodies can be protected via implementation of unified and integrated river basin management. And finally, the pamphlet provides an overview of current water body status in Germany and in so doing answers the following questions: What exactly does “good status” entail and which requirements come into play for this classification? What is the status of German water bodies to-

day? How can we attain the mandated environmental objectives? Which measures are in the pipeline? Which actors will carry out these measures and how much will they cost?

Implementation of the Water Framework Directive related river basin management plans and programmes of measures will help our water bodies to attain a status that will durably safeguard our water resources.

I hope you enjoy reading this brochure.

A handwritten signature in black ink that reads "N. Röttgen". The signature is written in a cursive, slightly stylized font.

Dr. Norbert Röttgen

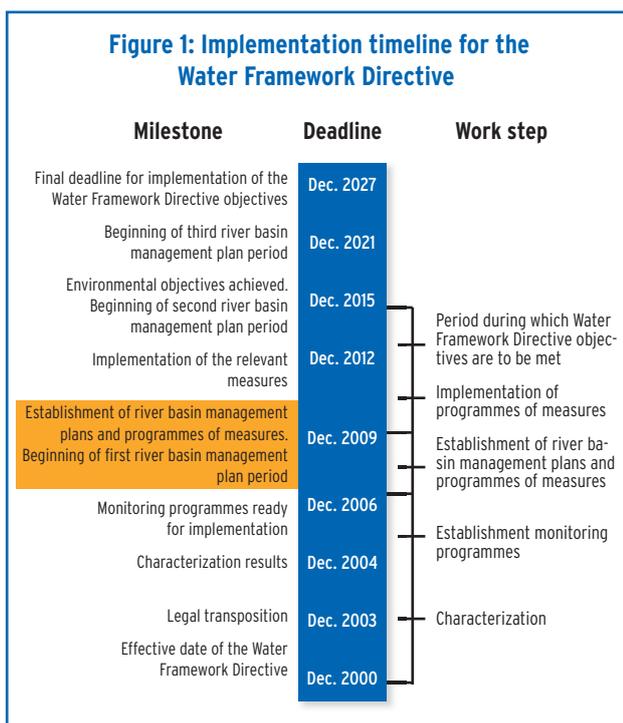
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1 INTRODUCTION: WATER BODY MANAGEMENT IN ACCORDANCE WITH THE WATER FRAMEWORK DIRECTIVE

The Water Framework Directive sets the ambitious goal of attaining “good status” for Europe’s rivers, lakes, groundwater bodies and coastal waters by 2015 in accordance with a clearly defined timeline (see Figure 1). The water body characterization process has been completed and the relevant monitoring programmes and programmes of measures have been elaborated. In March 2010 the various EU member states submitted their respective Water Framework Directive river basin management plans to the European Commission, which will now determine whether these plans and programmes meet Water Framework Directive requirements and will allow for achievement of the relevant environmental objectives. Completion of the river basin management plans marked the start of the initial river basin management plan period, which will extend from 2009 to 2015. The Directive’s objectives must be achieved by 2015, insofar as no exemptions are taken. Member states that avail themselves of a deadline extension beyond 2015 are required to achieve all Directive’s objectives by the end of the second and third river basin management plan periods, which extend from 2015 to 2021 and 2021 to 2027 respectively.

About the characterization process

The characterization process, which was completed in late 2004, involved the first-ever assessment of Europe’s water bodies based on Water Framework Directive requirements. In Germany, this process entailed the following activities on the part of our state governments: the various water bodies were described; water body types and reference water bodies were defined; anthropogenic pressures were measured and their ecological impact was classified; and the economic aspect of water use was analyzed. The characterization findings showed that in all probability only a fraction of Germany’s surface waters and only about half of its groundwater would be able to meet Water Framework Directive objectives by 2015 unless additional measures are taken. It was found, for example, that pressure reduction measures are needed for water bodies (a) whose morphology has been permanently altered by shipping, hydro power and other uses; and (b) that are subject to unduly high substance inputs, notably from farms.



River basin management planning

River basin management plans were elaborated for extensive river basin districts rather than for individual water bodies. Inasmuch as a river basin district comprises all of the water bodies in a river basin, in most cases two or more EU member states are in charge of protecting and managing the area. Of the ten river basins that have been defined in Germany (the Danube, Rhine, Maas, Ems, Weser, Oder, Elbe, Eider, Warnow-Peene and Schlei-Trave), eight extend across at least one international border, and only the Weser and Warnow-Peene river basins are confined to Germany and thus managed in Germany alone.

Annex VII of the Water Framework Directive stipulates that river basin management plans are to cover the following elements:

- a general description of the characteristics of the river basin district and a summary of significant anthropogenic pressures and their impact on the status of surface water and groundwater bodies,
- mapping of protected areas,
- a map of the relevant monitoring networks,
- a presentation in map form of the results of the monitoring programmes,
- a list of the relevant environmental objectives for water bodies, including in particular identification of instances where exemptions have been made,
- a summary of the economic analysis of water use,
- a summary of the programmes of measures, including the ways in which the mandated objectives are thereby to be achieved,
- a summary of the public information and consultation measures taken, their results, and the changes to the river basin management plan made as a consequence.

A programme of measures describes the actions that must be taken to bring water bodies into “good status”, for which the key measures are as follows: improving hydromorphology via restoration; removing or scaling back migratory obstacles and transverse structures such as weirs so as to restore river continuity; and sewage treatment plant optimization; implementation of good agricultural practice to reduce chemical inputs into water bodies. All such measures must be commensurate with (a) the nature and scope of the anthropogenic pressures involved; and (b) existing water usage modalities.

Inasmuch as water protection is a Community undertaking, in order to meet the Water Framework Directive objectives the EU member states will need to coordinate their river basin management plans and programmes of measures in a cross-border fashion. This is the only way to ensure that water management problems can be evaluated and managed based on uniform or comparable criteria. In Germany, federal and state government agencies will likewise need to coordinate their actions. And in the EU, neighbour states will need to engage in extensive cooperation when it comes to the following: elaborating cross-border monitoring programmes; developing and harmonizing comparable assessment procedures; and defining cross-border water management issues.

This chiefly managerial coordination process will necessitate a centralized body that can monitor the relevant efforts. To this end, existing national and international river basin associations are being used or established. For example, the ten states in the Elbe river basin formed a river basin association known as River Basin Community Elbe. The existing International Commission for Protection of the Elbe will be used as a logistics platform for international coordination of Elbe river protection efforts. Water authorities and other specialized bodies in Germany’s 16 states have already completed the necessary technical legwork and in so doing have exchanged information with each other. These agencies are also in charge of implementing the programmes of measures.

Role of the general public

Involvement of the general public has played a key role in implementing the Water Framework Directive. A three-stage consultation procedure from late 2006 to late 2008 enabled members of the general public to participate in the process of establishing the river basin management plans called for by the Water Framework Directive. This consultation entailed announcement of (a) the river basin management planning timeline and work programme; followed by (b) the key water management issues for each river basin district; and finally (on 22 December 2008) (c) the draft river basin management plans. Interested members of the general public then had until 22 June of the following year to indicate any changes or additions they felt were necessary in the plans. This feedback was then used as a basis for re-working the river basin management plans, which were completed on 22 December 2009.

In this consultation process, the German states exceeded the requirements of the Water Framework Directive by holding extensive discussions concerning water protection issues prior to the process per se.

There was tremendous public interest in the consultation. Feedback concerning the various documents mainly stemmed from municipalities, environmental organizations and the like, as well as the user groups affected.

The river basin management plans and the various programmes of measures will be updated during successive six year periods, during which implementation status, new evolutions and projected success – as well as any failures that occur – will be documented. In the event the mandated environmental objectives are not reached by 2015 and exemptions are needed, grounds

for their use will have to be provided. Hence the river basin management plans comprise a monitoring instrument for the European Commission and other river basin district management stakeholders.

2 SUMMARY OF THE OUTCOMES OF THE RIVER BASIN MANAGEMENT PLANNING PROCESS

The following issues are central to the river basin management planning process:

- What is the current status of the water bodies in the river basins?
- Which environmental objectives result from this status assessment and what are they based on?
- Which measures are planned with a view to achieving the WFD's environmental objectives?
In what time frame can the objectives be achieved and how will the measures be financed?

The key water management issues in all ten river basins in Germany are as follows:

- Reducing nutrient and pollutant input into surface waters and groundwater from diffuse and point sources.
- Improving surface-water hydromorphology (e.g. bed and bank characteristics, hydrological regime) and restoring free passage for fauna, particularly fish.

In addition to this, in a number of river basins other regional water management issues such as mining pollution will be identified.

Water body status

Status assessments of water bodies in Germany are based on extensive monitoring programmes. Studies have been carried out at numerous monitoring sites in surface waters and groundwater, looking, for example, at biota type and composition, chemical and chemico-physical quality elements, pollutants, and groundwater levels. German water bodies are subject to continuous monitoring with a view to assessing changes in water quality and the effectiveness of measures implemented, based on the following status classifications:

- The status of natural surface waters (rivers, lakes, transitional and coastal waters) is classified as “good” if the ecological and chemical status are both deemed “good.”
- The status of groundwater is classified as “good” if the quantitative and chemical status are both deemed “good.”

A distinction is made between natural water bodies and heavily modified and artificial water bodies. The latter are water bodies such as a canal that were artificially constructed, or whose hydromorphological characteristics have been modified to such an extent that “good ecological status” is not achievable without significantly compromising their long-term and economically significant use. For these water bodies, “good ecological potential” is an ambitious environmental objective that nevertheless permits the continued use of the water body. However, “good chemical status” applies

here exactly as it does to the defined environmental objective for natural water bodies. The following applies in such cases:

- The status of artificial or heavily modified water bodies is rated as “good” if both the ecological potential and the chemical status are deemed “good”.

The status of water bodies in Germany in 2009 can be summarized as follows:

Surface waters

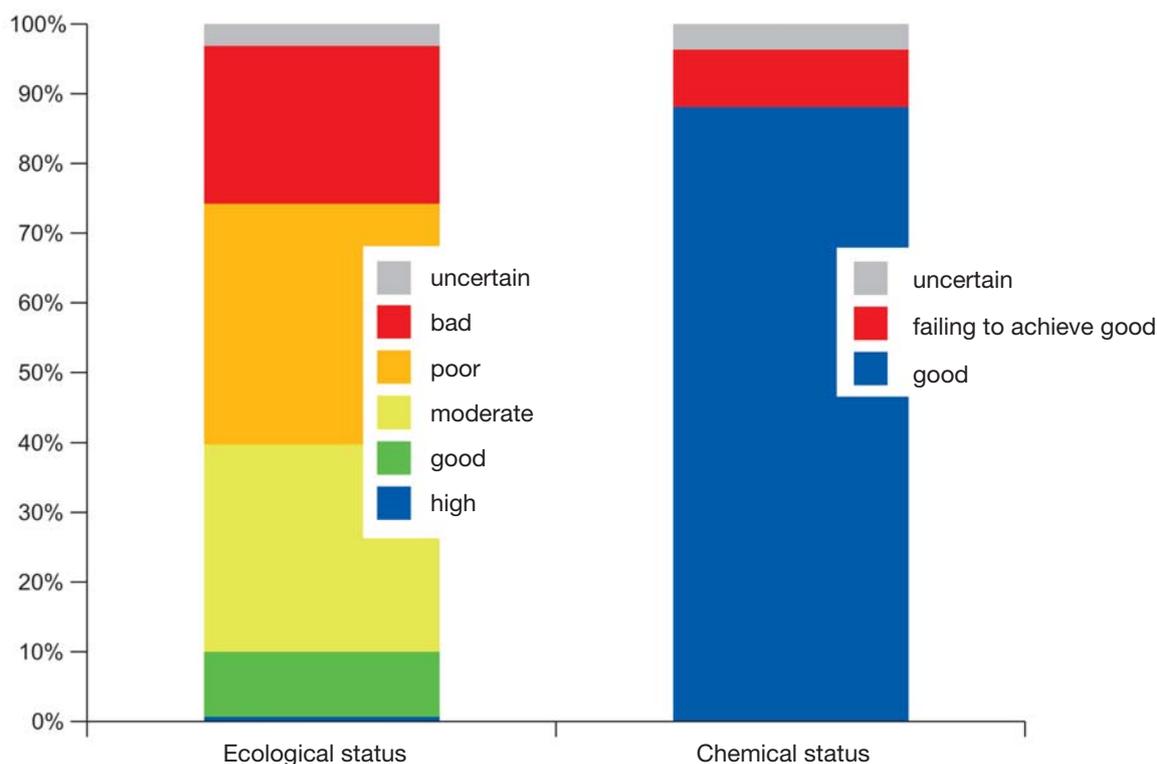
- In Germany there are about 9,900 surface water bodies, 10% of which have achieved “high” or “good” ecological status/potential¹. 87% of surface water bodies are distributed across the ecological status classes “moderate” (30%), “poor” (34%) and “bad” (23%). A small percentage of surface water bodies (3%) have not yet been assessed and are thus classified as “uncertain”.

- 88% of surface water bodies have achieved “good chemical status”. This classification will be less positive after mid-2010 when it becomes mandatory to implement the new daughter directive on Environmental Quality Standards (Directive 2008/105/EC) with its new and extended requirements for assessing chemical status.

- All told, 9.5% of water bodies have achieved a “good status”.

If a body of flowing water in Germany does not achieve “good ecological status” it is usually due to a radical change to its hydromorphology or excessively high nutrient load. In the case of lakes, as well as transitional and coastal waters, failing this objective is mainly attributable to high nutrient input.

Figure 2: Ecological and chemical status of surface water bodies in Germany.
Data source: Portal WasserBLICK/BfG, as at 22 March 2010.



1) The assessment of surface water bodies includes both ecological status and ecological potential. For the sake of simplicity, the two classifications are combined below under the heading of ecological status.

Groundwater

- There are about 1,000 groundwater bodies in Germany, 96% of which have achieved “good quantitative status”.
- By contrast, only 63% of groundwater bodies have achieved “good chemical status”.
- All told, 62% of groundwater bodies have achieved a “good status”.
- An upward trend in pollutant concentrations, in some cases going back over years and decades, has been identified in 58 groundwater bodies. In most bodies of groundwater (930) either no trend was identified or no assessment of this nature was made due to a lack of long time series data.

The few water bodies whose quantitative status is “poor” have mostly been compromised by mining activities. In these cases, continual extraction of water has often caused extensive groundwater recession.

In the case of groundwater bodies, with the exception of conurbations, “poor chemical status” is almost always due to the limit value for nitrates of 50 mg/l having been exceeded as a result of high nitrate input from intensively farmed land. Nitrates get into the groundwater through a leaching process.

Environmental objectives and exemptions

The environmental objectives for water bodies are clearly stated in Article 4 of the Water Framework Directive. In substantiated cases, deviation from the default environmental objectives (“good ecological status/potential, good chemical status, good quantitative status”) is permissible. Most of the cases where Germany has made use of the possibility of such exemptions take the form of extensions of deadlines (until 2021 or 2027). It is permissible to apply less stringent environmental objectives in exceptional circumstances if water bodies are so polluted or have been morphologically modified to such an extent that it is not possible to improve their condition in the foreseeable future (i.e. by 2027) using proportionate measures. Such water

bodies must be assessed at six year intervals. This possibility of exemption is relevant for groundwater in the mining areas in the Rhine, Maas, Elbe and Oder river basins; it is also relevant for surface waters in the Weser river basin, where heavy metals from mine dumps, mining pits and abandoned industrial sites enter smaller water bodies.

- Exemptions have been invoked for 82% of all surface water bodies. It is anticipated that 18% of Germany’s surface waters will have achieved their environmental objectives by 2015. It is on the whole not possible to respond within a short space of time to the

Figure 3: Quantitative and chemical status of groundwater bodies in Germany.

Data source: Portal WasserBLICK/BfG, as at 22 March 2010

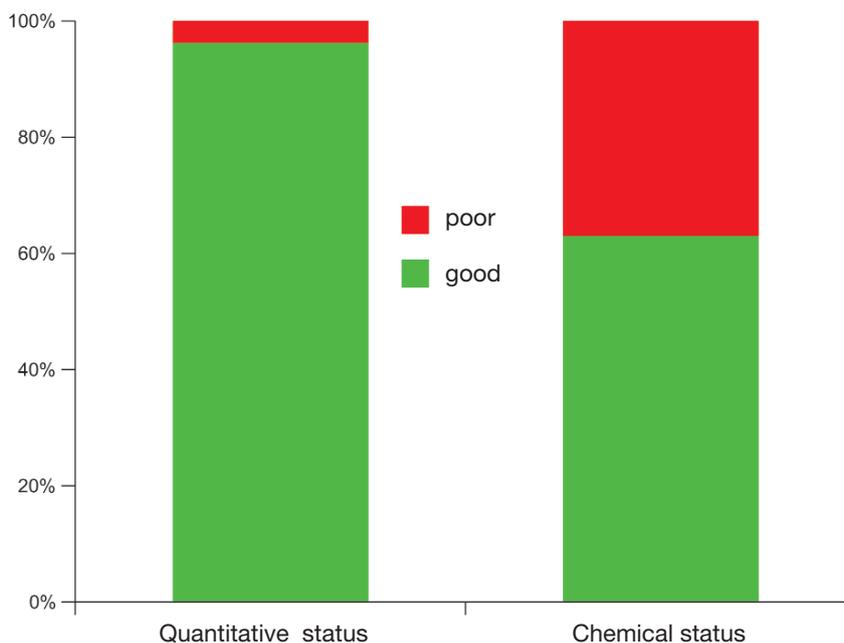
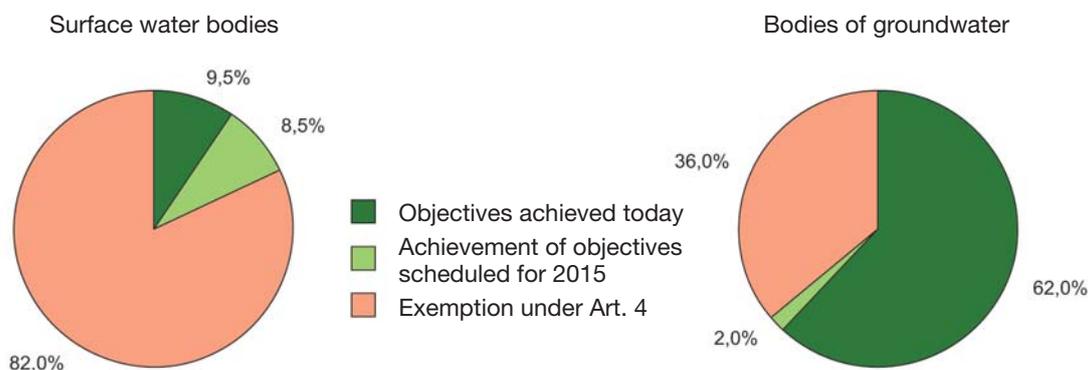


Figure 4: Achievement of objectives by 2015 and use of exemptions in Germany.

Data source: Portal WasserBLiCK/BfG, as at 22 March 2010.



modifications to water bodies in recent decades due to the way they have been used in such a densely populated industrial country as Germany.

- Exemptions have been invoked for 36% of all groundwater bodies. 62% of all water bodies have already achieved the designation of “good status”. Moreover, only 2% of groundwater bodies will achieve “good status” by 2015.

The use of exemptions has often been based on so called “natural conditions.” This means, for example, that it often takes longer for measures to have an effect in water bodies and on biota and for their success to be quantifiable. Another reason for invoking an exemption that is used just as frequently is lack of so called “technical feasibility.” This means that there is no “off the shelf” technical solution to the pollution problem, i.e. technical measures need to be carried out in a strict sequence, the procedures used are time-consuming, or further research is needed to optimise the measures. A third reason on which exemptions can be based is “disproportionate costs,” but this is seldom used to substantiate exemptions in river basins..

Measures and financing

Plans for envisaged measures have been drawn up at water body level. Due to the high number of water bodies involved, they have been combined to form larger units for reporting purposes, i.e. surface waters are organized into “planning units” and groundwater into “coordination areas.”

Surface waters

Reflecting the pollution and the water management issues they are facing, measures are planned in virtually all planning units for the following domains: municipalities/households; hydromorphology; agriculture; and continuity (free passage for aquatic fauna). Moreover, oftentimes administrative and economic measures are planned, as are informational programmes such as advisory services for farmers. Measures in the field of industry and mining (both areas include remediation of contaminated sites and abandoned industrial sites) and the fishing industry are mainly planned at the regional level only.

Groundwater

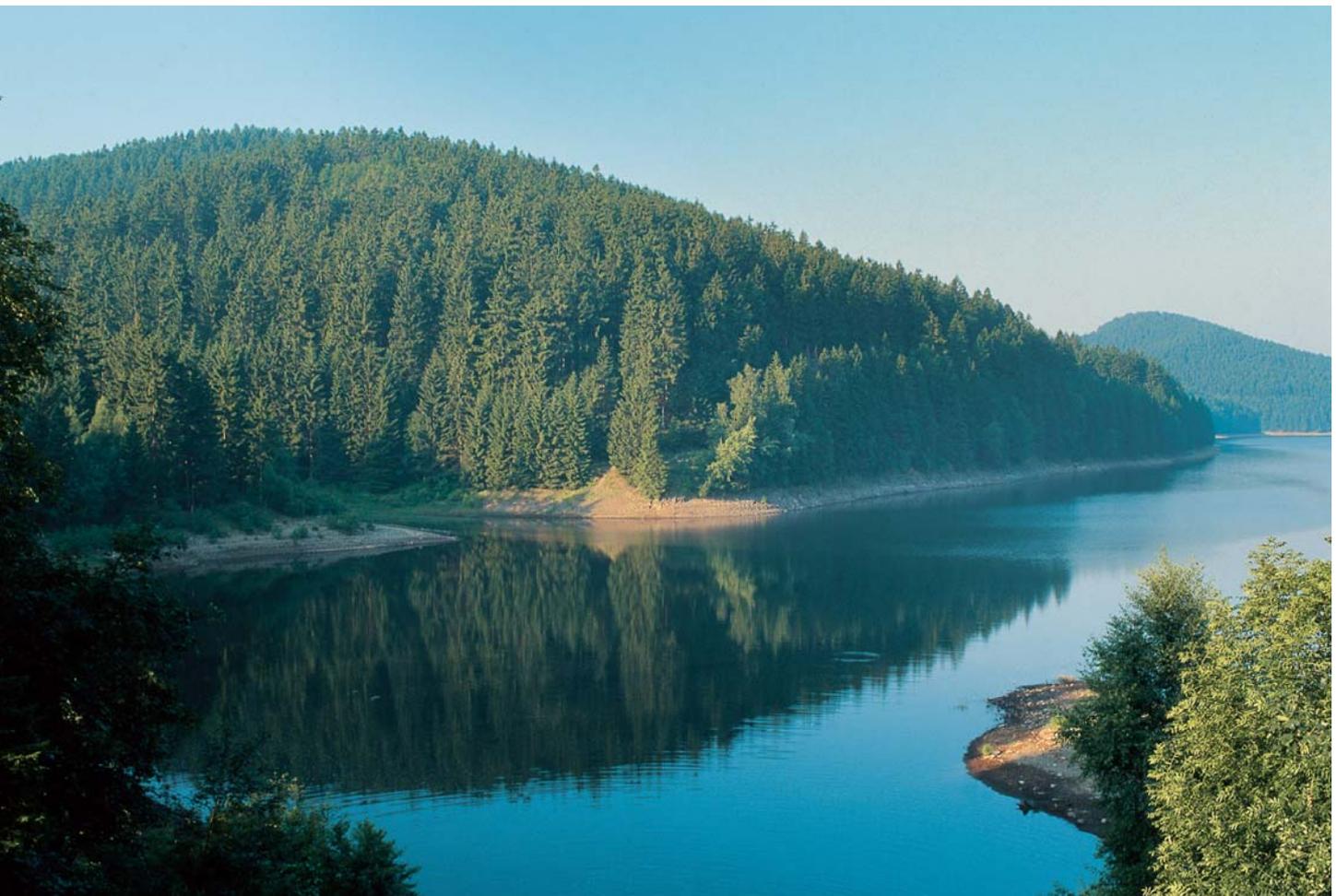
For groundwater, measures to reduce input from agriculture are planned in virtually all the coordination areas. This clearly underscores the fact that agriculture is one of the main causes of groundwater pollution.

Despite the measures that are planned in the areas mentioned, only a few additional surface water bodies and some groundwater bodies are likely to achieve “good status” by 2015. There are various reasons for this. For example, the long retention time of groundwater body water translates into a significant time lag before measures to reduce nutrient concentrations begin to have an effect. The same applies to returning species or introducing new ones to river segments that have been restored to a more natural state. The Directive’s “one out, all out” approach – according to which the poorest rating of all biological and chemical elements deter-

mines the overall classification – also has an effect in this regard.

Pollution reduction measures can only be implemented if sufficient funding is available. In Germany most costs are covered by tax revenues, fees and charges. The key sources of financing are the various funds available from the European Union, federal government, state governments, and local authorities, e.g. the European Agricultural Fund for Rural Development (EAFRD) and Germany’s Joint Task for the Improvement of Agricultural Structures and Coastal Protection (German abbreviation: GAK).

The costs of implementing the necessary measures in Germany by the end of the first management period in 2015 have been estimated at 9.4 billion euros, which equates to 20 euros annually per capita.



3 MONITORING OUR WATER BODIES

Strenuous efforts have been made in Germany to comprehensively characterize the status of our water bodies in accordance with the requirements of the Water Framework Directive, via a process involving the following activities: countless water samples were analyzed; thousands of kilometres of water bodies were mapped and evaluated; fish were caught, counted, and classified; and invertebrates from rocks, sand, wood and plants were collected and assessed.

In 2004, surface waters and groundwater bodies were characterized throughout Germany for the first time in accordance with the requirements of the Water Framework Directive. In this process, the environmental impact of anthropogenic pressures was assessed via numerous studies and measurements, with a view to evaluating the results of the water body characterizations and reaching conclusions concerning actual water body statuses. These activities were carried out within the framework of monitoring programmes that were elaborated for surface waters, ground water bodies, and water-dependent protected areas.

The results of these programmes, which formed the basis for the water body status classification process (see section 4) and are to be incorporated into the river basin management plans, largely confirmed the characterization findings – namely that a substantial proportion of Germany’s water bodies will not meet the Water Framework Directive goals unless specific measures are taken.

A concept was developed, by Bund/Länder-Arbeitsgemeinschaft Wasser (LAWA) for elaboration of the monitoring programmes, including determination of the number of monitoring sites for the various water body categories, as well as sampling methods and intervals. This concept also implemented the requirements of the Water Framework Directive and the daughter directives thereof, as well as the applicable European Commission guidelines, and formed the basis for a standardized nationwide monitoring programme.



Monitoring: the search for standardized assessment methods

The purpose of water body monitoring is to obtain a conclusive and comparable overview of anthropogenic pressures, whose assessment is complicated by the fact that suitable assessment methods must be developed and applied for each water body category and water type. In addition, biological quality elements (fish, invertebrates, and aquatic flora), physicochemical and chemical characteristics, river-basin specific pollutants, and priority substances must all be identified and differentiated from each other.

Methods for biological quality elements have been developed that allow for identification of various anthropogenic pressures based on biota composition. The research in this regard, which focused on which biological species are missing in the presence of which anthropogenic pressures and how specific biological group compositions are altered by specific anthropogenic pressure levels, allowed for the elaboration of standardized assessment methods such as MarBIT and PERLODES for invertebrates, FIBS for fish, and the PHYLIB, PHYTOFLUSS and PHYTOSEE index for aquatic flora. The results obtained using some of these methods

have already been intercalibrated (i.e. compared with the findings of other member states), thus allowing for EU-wide comparability. Physicochemical and chemical characteristics were also classified using existing guide values and environmental quality standards for river basin-specific pollutants and priority substances, as well as for certain other pollutants that determine chemical status (also see section 4.1).



Despite these methodological evolutions, numerous status assessment grey areas remain, and there is a particularly great need for research on biological elements. For example, no nationwide gold-standard method is available for benthic invertebrates and lake fish fauna. Moreover, the results of intercalibrating the various methods have yet to be transposed to German water body types.

Monitoring types

The Water Framework Directive differentiates between operational, surveillance and investigative monitoring for surface waters.

The results of *surveillance monitoring*, which chiefly allows for assessment of the overall status of a specific river basin area or sub-basin, supplement the result of characterizations and shed light on long term changes in a river basin. Our state governments have established a relatively wide-meshed measuring network comprising nearly 400 surface water monitoring sites; the river basin for each such site should not extend over

more than 2,500 square kilometres. Most of these sites were installed in the main flows of major river and at the mouths of major tributaries.

At surveillance monitoring sites, it is necessary to measure all quality elements: biological elements; hydro-morphological and physicochemical elements; river basin specific pollutants and substances that are relevant for chemical water body status classification (the latter two insofar as they constitute anthropogenic pressures in the water bodies being assessed). The biological quality elements are investigated at least once during each river basin management plan period.

Operational monitoring is used for status assessments of water bodies that are likely to fail Water Framework Directive objectives, and is thus also an instrument for verifying the success of the measures that have been taken. Our state governments have installed 7,280 surface water monitoring sites, which comprise a relatively fine-meshed monitoring network that is the lynchpin of surface water monitoring. River monitoring sites have been established at 20 kilometre intervals on average, which means that some of these water bodies have multiple monitoring sites. Whereas surveillance monitoring allows for the measurement of all characteristics and quality elements, operational monitoring normally focuses solely on those biological, chemical and physicochemical quality elements that indicate the presence of extensive anthropogenic pressures in the water bodies being assessed.

Investigative monitoring is used in cases where the sources of high water body loads are unknown, or to determine the scope and impact of adventitious water pollution such as that arising from accidental pollutant discharges or sudden fish death. Hence a relatively small number of surface water monitoring sites (375 at present) has been installed in the various river basins. These sites are located solely along rivers, with 315 in the state of Brandenburg alone, where mining has been highly detrimental to water quality.

A surveillance network and operational network have also been established for groundwater chemical status assessment purposes. As with surface waters, surveillance monitoring is realized at least once during each river basin management plan period, whereas operational monitoring is carried out at least once a year.

Table 1: Monitoring site counts for the various monitoring types and surface water categories in Germany.
 Source: Portal WasserBLiCK/BfG; last updated 22 March 2010.

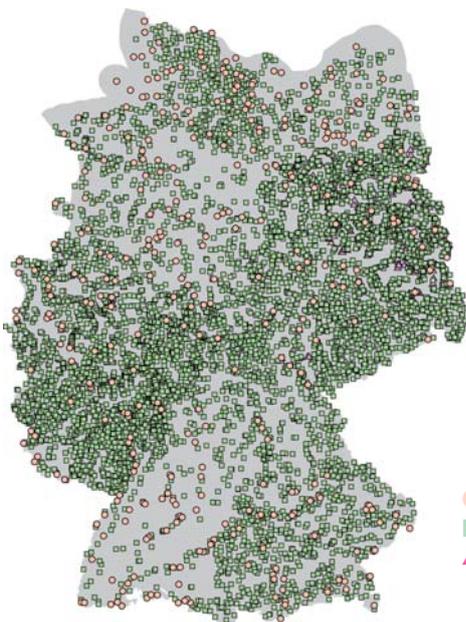
Monitoring type	Rivers	Lakes	Transitional waters	Coastal waters
Surveillance	290	67	5	32
Operational	7,252	449	20	100
Investigative	375	0	0	0

A monitoring network for groundwater quantity has also been implemented. This network, which integrates monitoring sites in each groundwater body, monitors groundwater bodies at intervals in such a way that both short and long term fluctuations occasioned by aquifer recharge, water abstraction and discharges are monitored. This network also allows for monitoring of natural and long term changes in water volume.

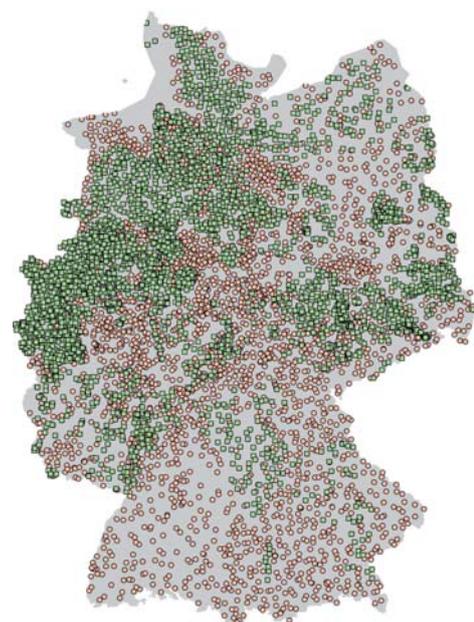
Our state governments have also installed numerous standalone monitoring sites to monitor the quantita-

tive and chemical status of groundwater bodies. 9,000 of these sites monitor quantitative groundwater status, 5,500 are used for the surveillance monitoring network, and 3,900 are used for the operational monitoring network. Some of these sites are “multipurpose”, i.e. they can be used for surveillance, operational and/or quantitative monitoring. Germany’s quantitative monitoring network contains an average of 25 monitoring sites per 1,000 square kilometres.

Map 1: Surveillance, operational and investigative monitoring sites in Germany’s surface waters.



Map 2: Surveillance and operational monitoring sites in Germany’s groundwaters.



- Surveillance monitoring
- Operational monitoring
- ▲ Investigative monitoring

Source: Portal WasserBLiCK/BfG; last updated 22 March 2010.

4 WATER BODY STATUS TODAY



Until the end of the 1980s, Germany's rivers discharged such a high nutrient load into the North Sea and Baltic Sea that their coastlines exhibited massive algae bloom. In addition, many of Germany's lakes were close to ecological disaster during the 1980s from elevated phosphorus and nitrogen levels. Many of Germany's surface waters remain eutrophic today, i.e. they exhibit elevated nutrient concentrations, which are mainly attributable to agricultural inputs.

Nationwide expansion of Germany's sewage treatment plant infrastructure in the 1980s and 1990s substantially reduced inputs resulting from nutrients, heavy metals and organic pollutants.

Although pollution-induced white foam on Germany's rivers has long since disappeared, have our water bodies really been cleaned up? Does their water quality adequately support the habitats of water dependent biota and enable these biota to survive and reproduce? And how about our groundwater bodies, which as the source of approximately 75% of Germany's drinking wa-

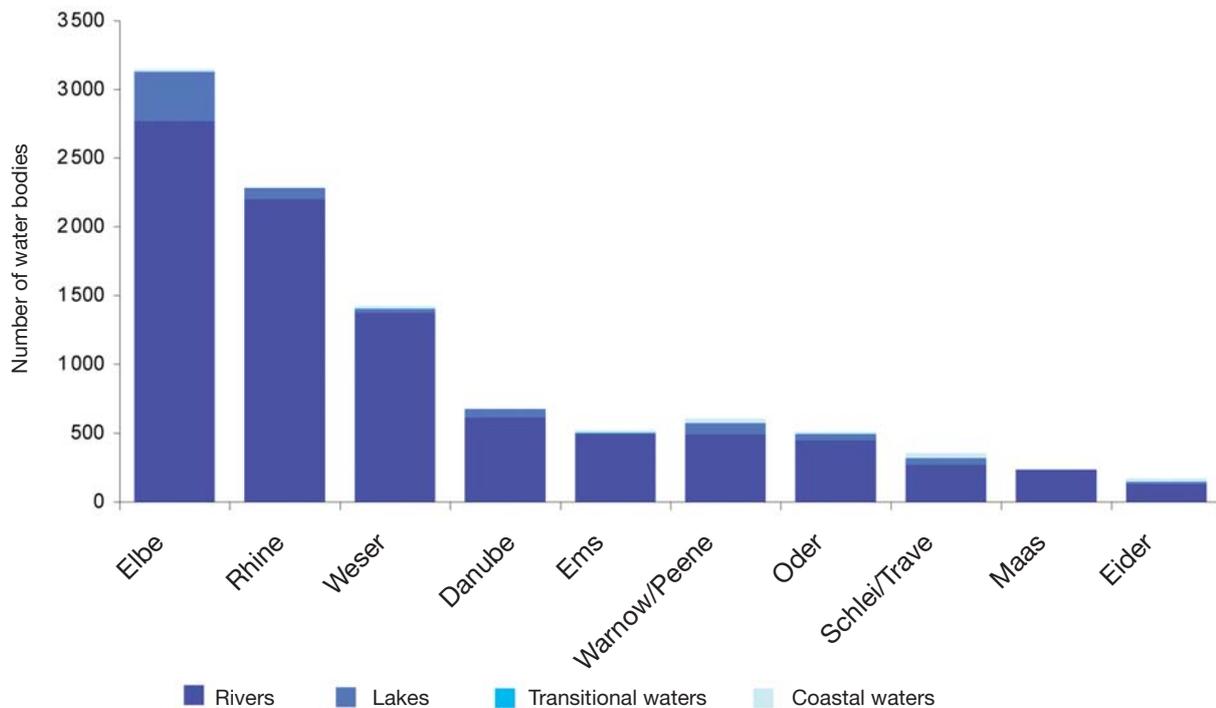
ter and an integral component of the water cycle, are particularly deserving of protection? What's more, groundwater plays a pivotal role in ecosystems; and groundwater quality has a major impact on river and lake characteristics, since in many areas groundwater feeds into surface waters.

4.1 Surface water status

Surface waters, meaning rivers, lakes, transitional waters, and coastal waters, are assessed as water bodies, which can be a river, river reach, lake, reservoir or portion of a canal. Germany has just under 9,900 surface water bodies. The flowing length of German rivers whose basins extend over more than 10 square kilometres is 127,000 kilometres. These rivers have been divided into approximately 9,070 water bodies, 710 of which are water bodies for lakes, five for transitional waters, and 74 for coastal waters (see Figure 5).

Figure 5: Number of surface water bodies in the ten river basins that are relevant for Germany.

Source: Portal WasserBLICK/BfG; last updated 22 March 2010.



The degree of ecological intactness of a surface water body is chiefly determined by its biological quality elements. In other words, the quality of the water body's chemical, physicochemical and hydromorphological elements must be such that its biota exhibit "good status". The water body's biota are only deemed to be intact insofar as its hydromorphological and chemical characteristics are favourable.

In addition, the water body must meet environmental quality standards for river basin specific pollutants. These standards promulgate maximum concentrations for specific water or sediment pollutants. If even one such concentration is exceeded, the water body will fail "good ecological status".

4.1.1 Ecological status assessments

According to the Water Framework Directive, the ecological status of surface waters is to be assessed in accordance with the following quality elements:

- Biological quality elements (fish, benthic invertebrates, aquatic flora)

in conjunction with the following elements that support the biological elements:

- Chemical quality elements (river basin specific pollutants) and physicochemical quality elements such as thermal, oxygenation and nutrient conditions
- Hydromorphological quality elements such as hydrological regime, morphological conditions or tidal regime

The role of biological quality elements in water quality assessments

Fish fauna are particularly susceptible to hydromorphological factors – that is, river bank constructions, inadequate root shelter, barriers, inadequately structured water beds – and pollutants. In addition, salmon and many other fish that migrate from the sea to river headwaters to spawn are dependent on river continuity.

Numerous in vivo studies going back decades have been realized on benthic invertebrates (fauna such as aquatic insects, crabs, snails and worms), using, inter alia, the saprobic index, which is probably the best known method for assessing water body deoxygenation. Benthic invertebrates are also used to assess the water body hydromorphology and acidification.

Water body flora are particularly susceptible to elevated water body nutrient concentrations, particularly phosphorus. Water body flora include free floating microscopic algae (phytoplankton); small algae that are visible with the naked eye and that grow upon rocks and other substrates (phytobenthos); and large aquatic plants (macrophytes, large algae, and angiosperms).

The requirements for achieving “good ecological status” are as follows:

- All biological quality elements must be rated “good”,
- conformity with the concentrations defined by environmental quality standards for river basin specific pollutants ,
- The values for general conditions must fall within a range that allows for good ecosystem functionality.



Heavily modified water bodies and artificial water bodies

Heavily modified water bodies oftentimes comprise shipping routes and impounded river reaches, whereas artificial water bodies can be, for example, canals or opencast mining lakes. In view of the extremely altered, usage-induced hydromorphology of these water bodies, the “good ecological potential” objective defined for them in the Water Framework Directive allows for such usage. This potential is based on a reference status known as “maximum ecological potential”, which is deemed to have been reached insofar as all morphology improvement measures have been completed without significantly interfering with water body use. The objective of “good chemical status” applies to natural, artificial, and heavily modified water bodies.

37 percent of Germany’s surface waters are classified as heavily modified and 15 percent are classified as artificial. Hence 52 percent of our surface waters need to attain “good ecological potential” in lieu of “good ecological status” (see Figure 6).

Map 3: Natural, artificial, and heavily modified water bodies in Germany.

Source: Portal WasserBLICK/BfG; last updated 22 March 2010.

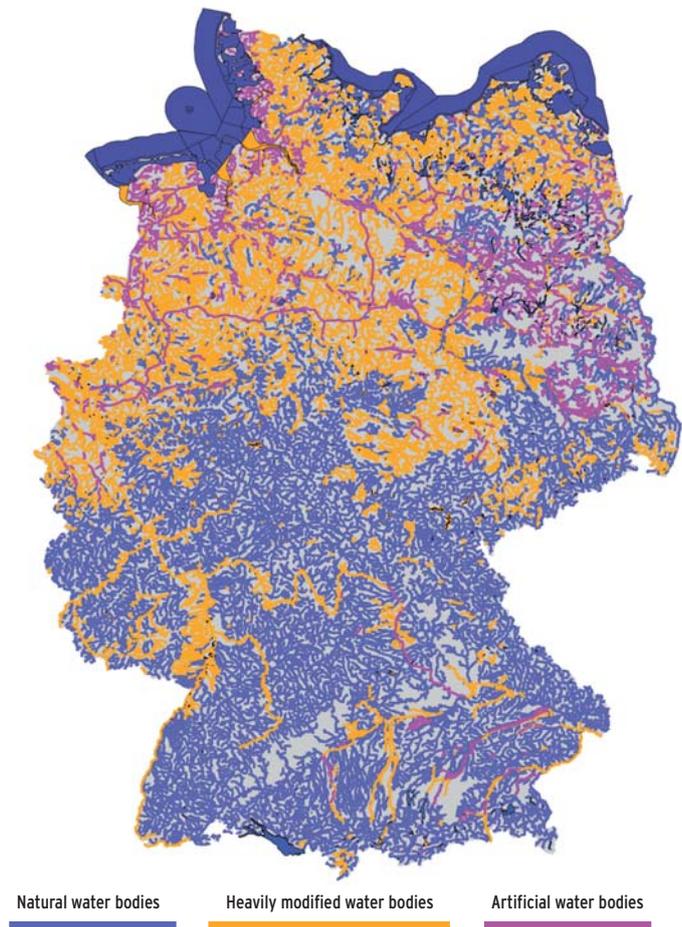


Figure 6: Ecological status of natural surface water bodies and ecological potential of heavily modified and artificial surface water bodies in Germany. Source: Portal WasserBLICK/BfG; last updated 22 March 2010.

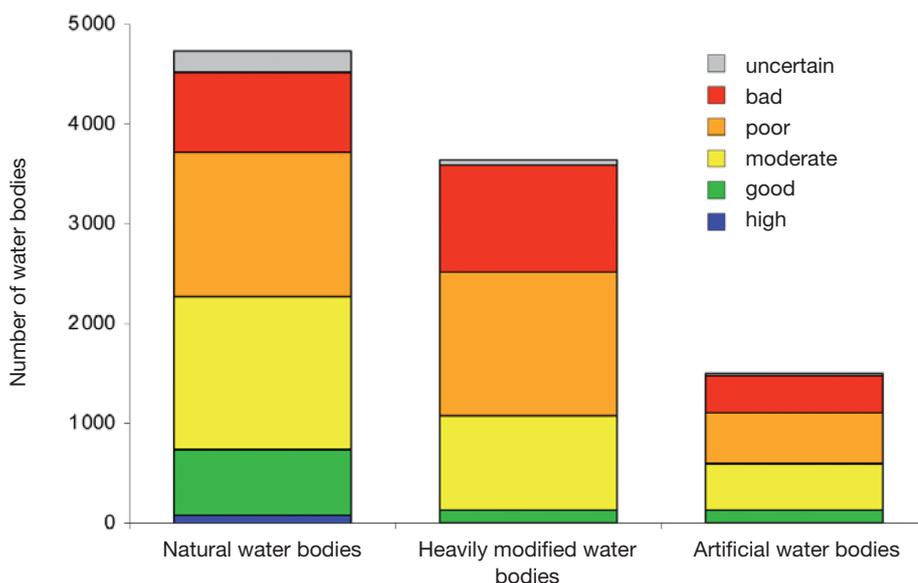
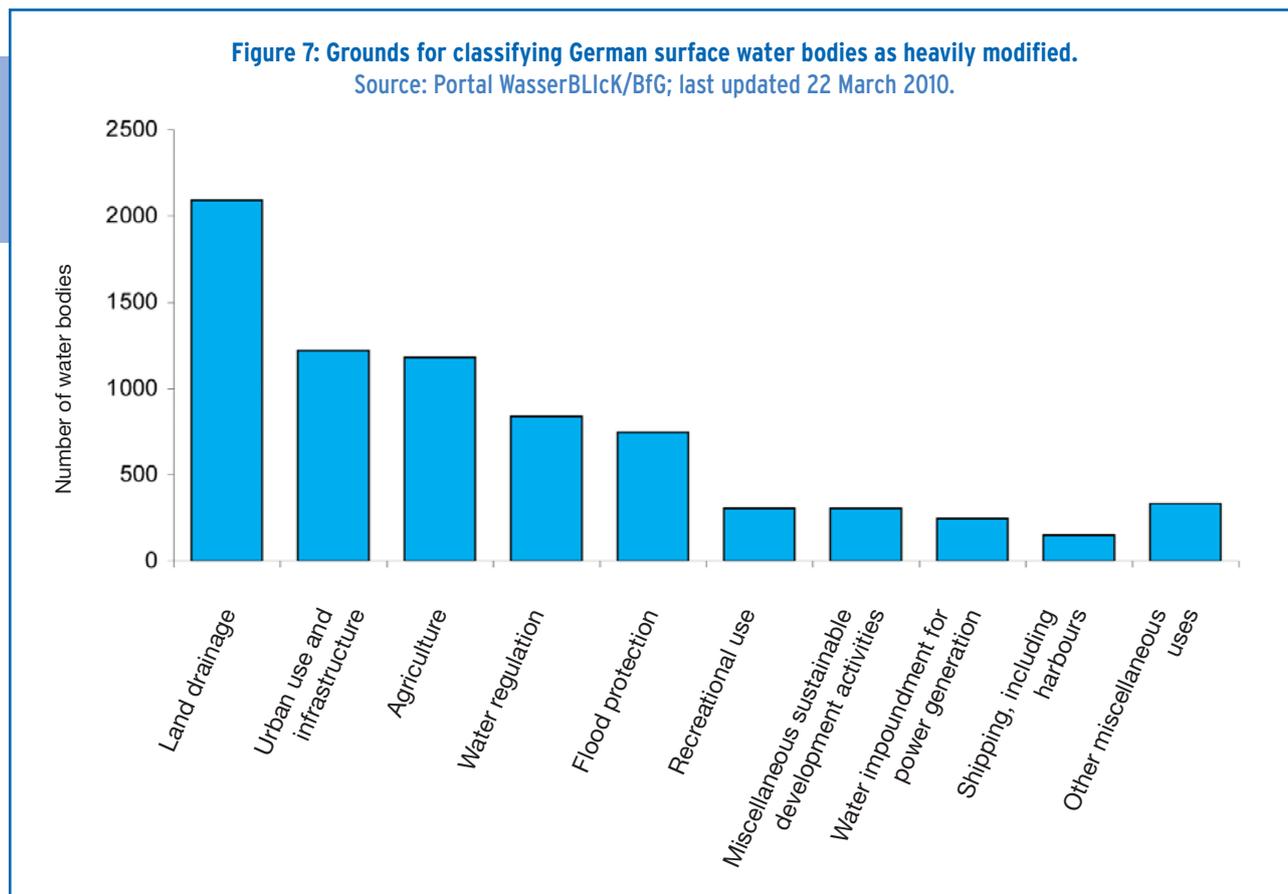


Figure 7 shows the main grounds for classifying German water bodies as “heavily modified”. For such water bodies, measures aimed at achieving “good ecological status” would have a highly detrimental effect on various water body uses, particularly land drainage, agriculture, residential areas, infrastructure elements, water regulation and flood protection. Such water bodies are also heavily used for leisure time activities, shipping and power generation.



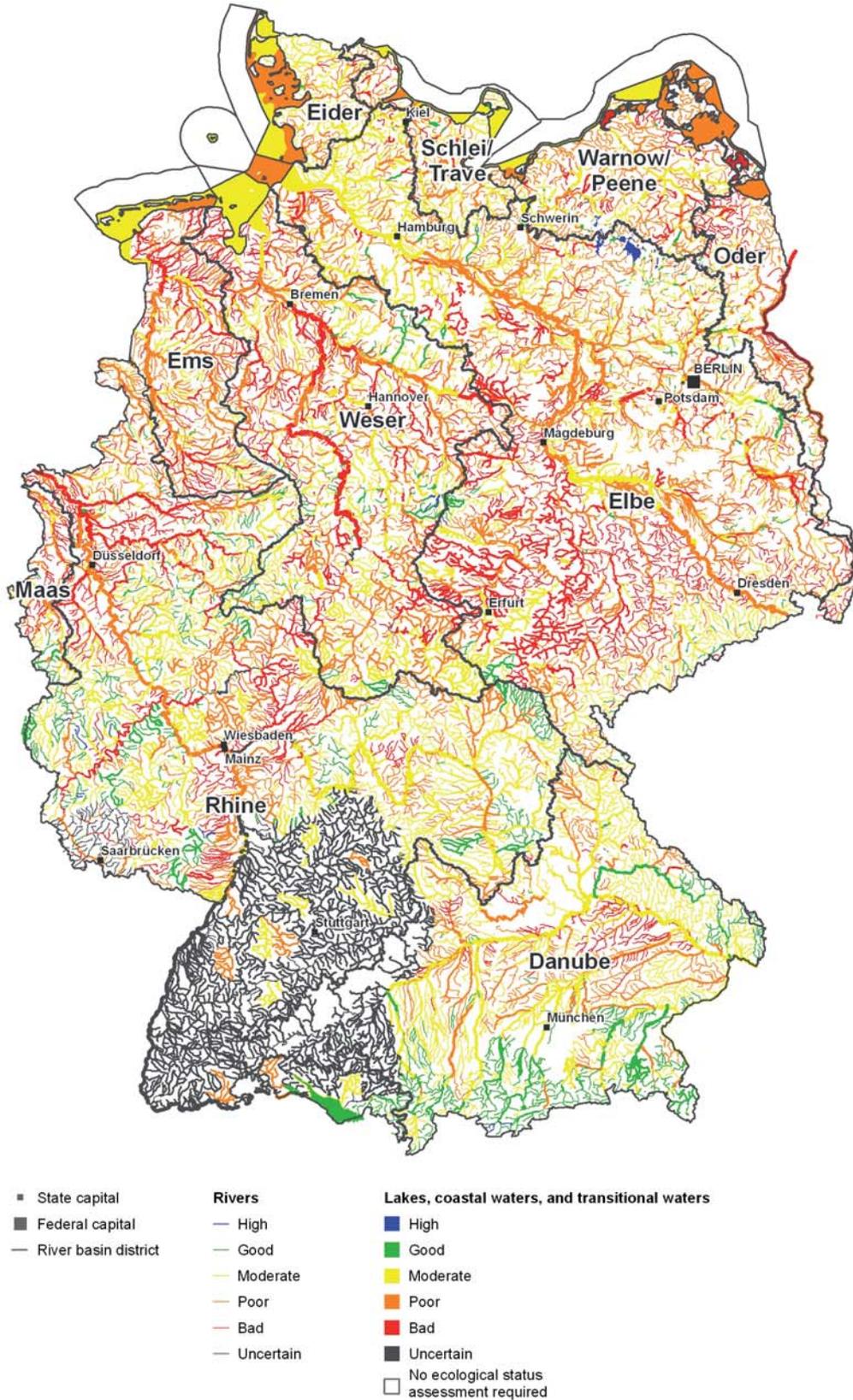
4.1.2 Ecological status of Germany’s surface waters

The ecological status of Germany’s surface waters is defined using the following classification system, whose main virtue is that it allows for a unified and transparent representation of water body status:

- Class 1: high
- Class 2: good
- Class 3: moderate (action needs to be taken for classes 3-5)
- Class 4: poor
- Class 5: bad

As can be seen in map 4, the ecological status of Germany’s water bodies varies, with classes 3-5 predominating – which means that the status of the biota in Germany’s water bodies is anything but good. Only 10 percent of all of Germany’s surface water bodies will meet the Water Framework Directive objective of “high” or “good ecological status” by the end of 2010.

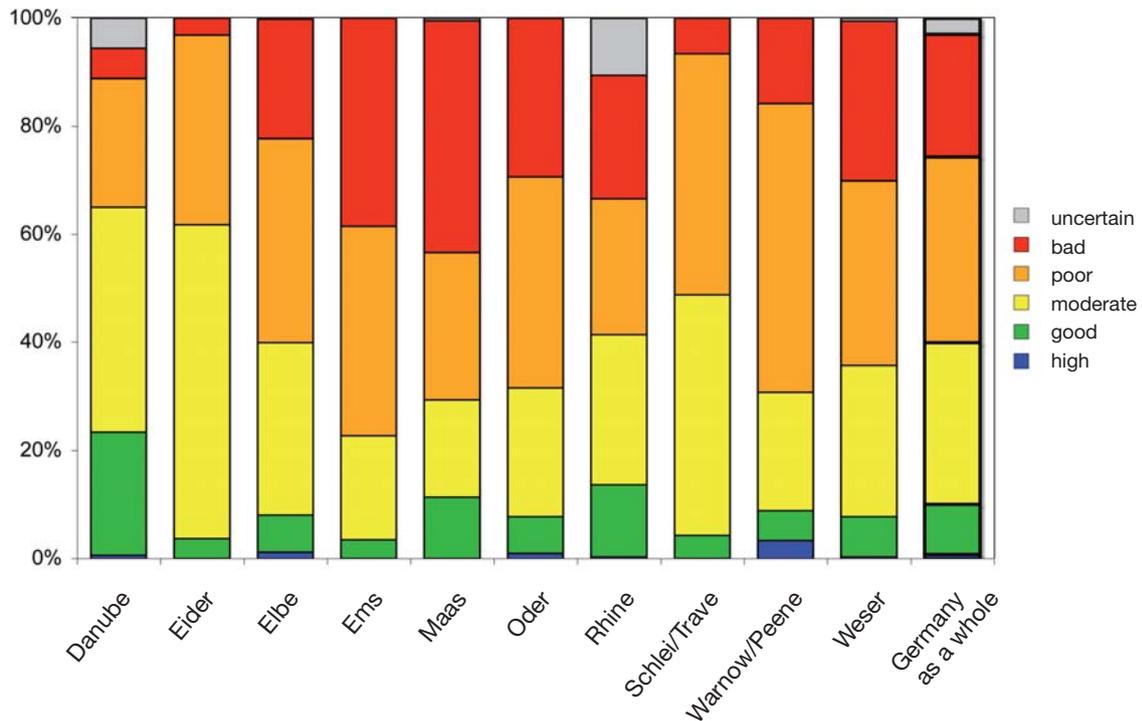
Map 4: Ecological status of Germany's surface water bodies



Source: Portal WasserBLick/BfG; last updated 22 March 2010

Figure 8: Surface water body ecological status in the ten river basins that are relevant for Germany.

Source: Portal WasserBLiCK/BfG; last updated 22 March 2010.



The overall ecological-status results are for the most part consistent with the characterization of German rivers, since the latter comprise the lion's share of our surface water bodies. The results for lakes are more positive in that 39 percent of these water bodies have achieved "high" or "good ecological status", whereas the situation is worse for coastal and notably transitional waters, most of which still fail "good ecological status" (see Figure 9).

Figures 10 and 11 show the strong correlation between biological elements and the quality elements that support them. River biota (fish fauna, benthic invertebrates, and aquatic flora) are mainly affected by general conditions* and by hydromorphology that is for the most part characterized as not good, whereas the pressure on lakes mainly arises from nutrient load.

* Nutrient load, oxygen deficiency, thermal stress from power plant discharges, and salt load from the Werra and Weser rivers.

Figure 9: Ecological status of rivers, lakes, transitional waters, and coastal waters in Germany.

Source: Portal WasserBLiCk/BfG; last updated 22 March 2010.

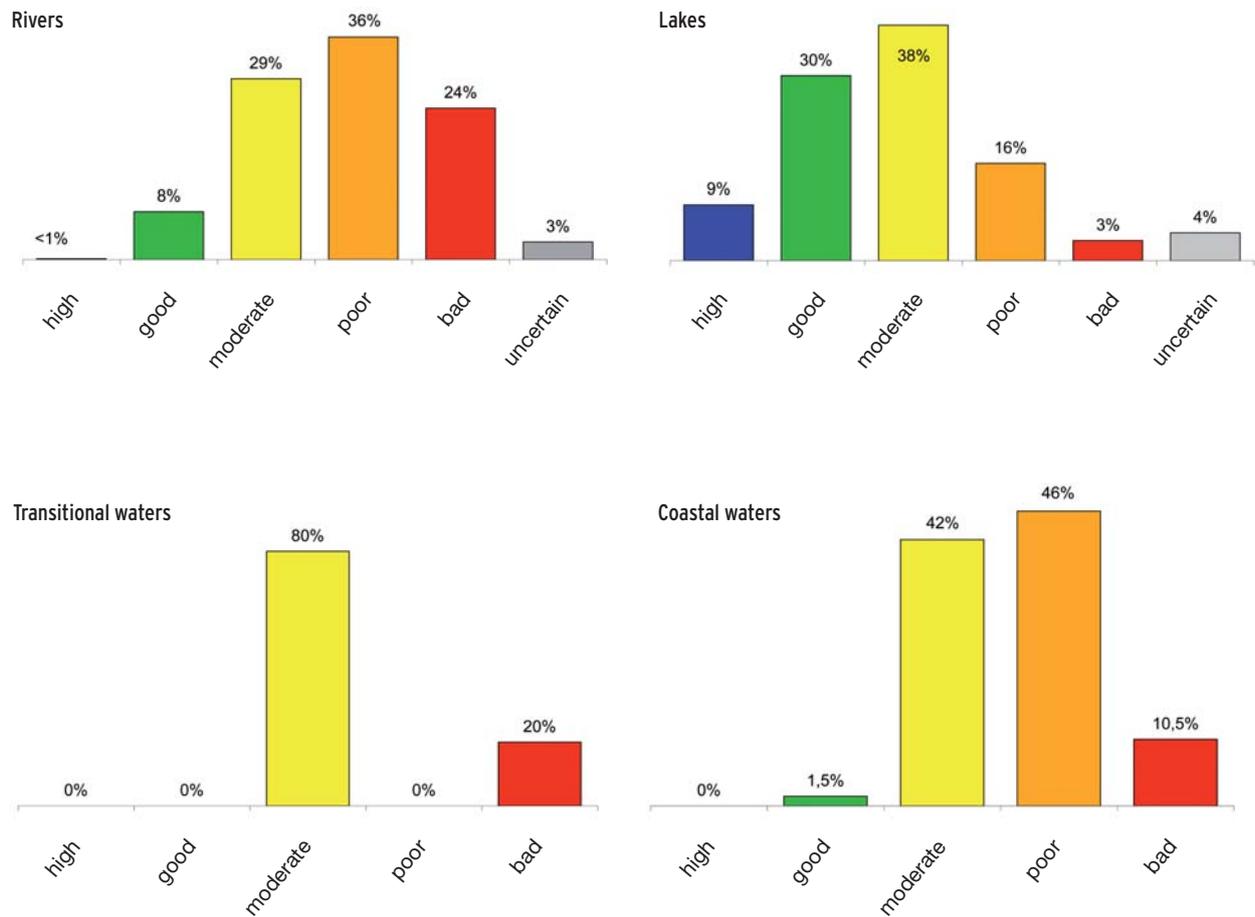
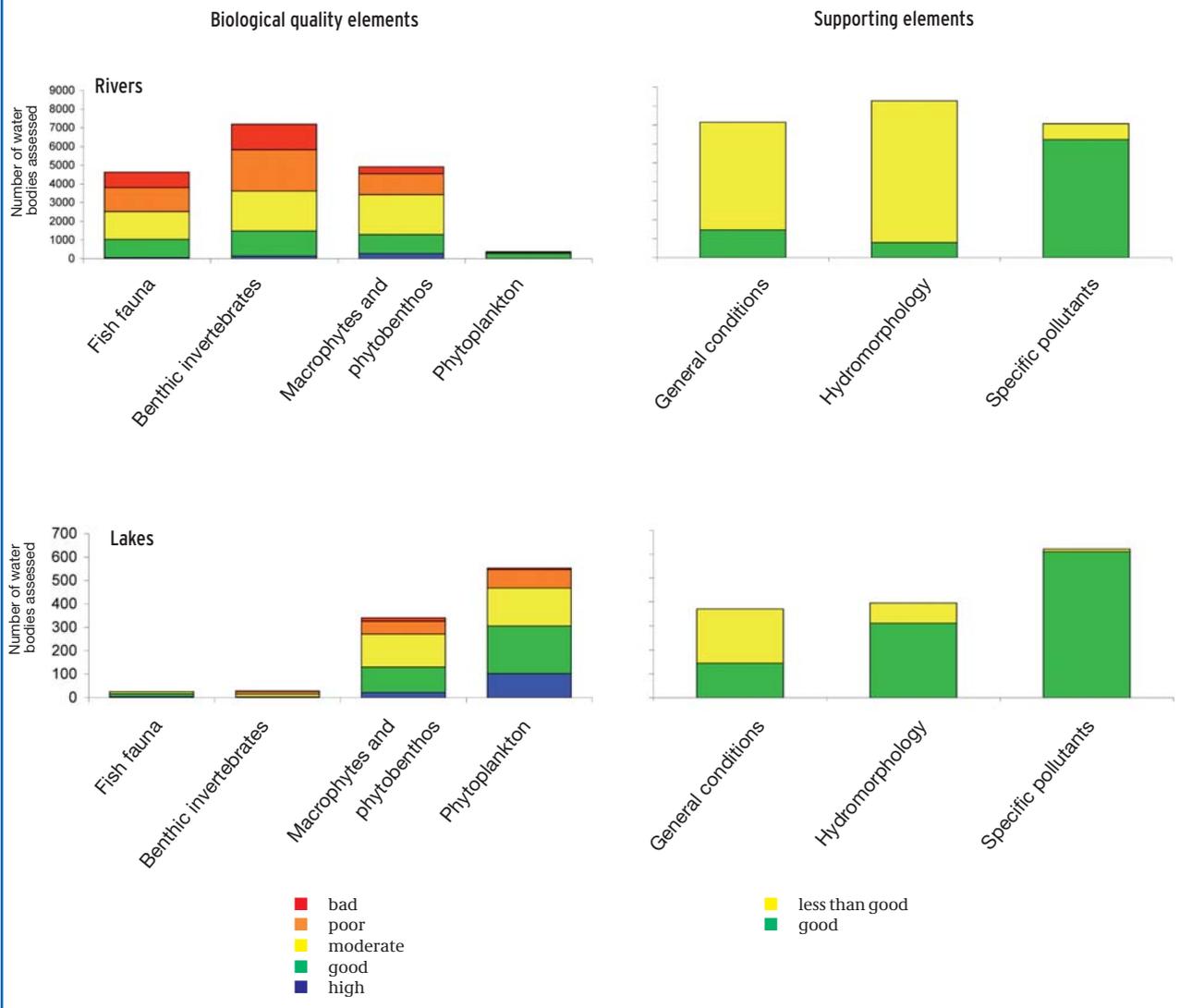


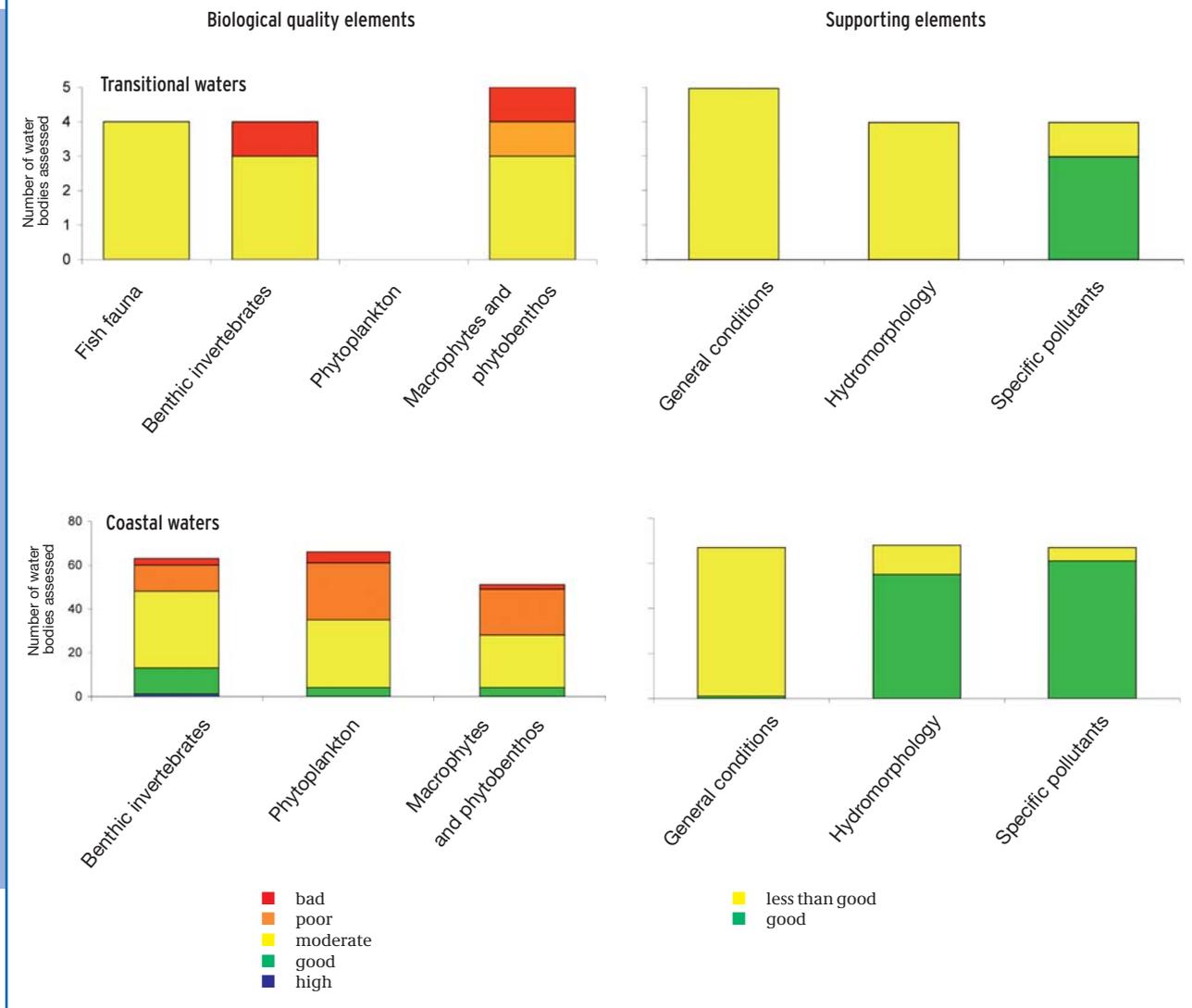
Figure 10: Quality-element statuses for lakes and rivers according to Annex V of the Water Framework Directive
 Source: Portal WasserBLICK/BfG; last updated 22 March



The predominant pressure on transitional and coastal waters (see Figure 11) is likewise exerted by nutrient load. Moreover, the hydromorphology of most transitional waters has been substantially degraded, a factor that contributes to the poor classification of aquatic fauna and flora in these water bodies.

Figures 10 and 11 also show that not all quality elements have been assessed in all water bodies. According to the Water Framework Directive, operational monitoring is to encompass solely those informative quality elements that best indicate the key sources of ecological pressures. Thus for example, benthic invertebrates and fish fauna in rivers were monitored most frequently, and phytoplankton in lakes.

Figure 11: Quality-element statuses for transitional and coastal waters in accordance with Annex V of the Water Framework Directive. Source: Portal WasserBLiCK/BfG; last updated 22 March 2010.



4.1.3 Assessment of chemical status

German water bodies contain numerous substances that stem from either point sources or diffuse sources. Keeping water bodies free of substances of concern and hazardous substances is a key goal of European water protection efforts. This also includes protection of the marine environment, since such substances are defined as extremely hazardous in international treaties as well.

Chemical status is assessed in accordance with EU quality standards for the following:

- 33 priority substances in accordance with Annex X of the Water Framework Directive
- The pollutants that fall within the scope of directive 2006/11/EC (in conjunction with Annex IX of the Water Framework Directive)
- Nitrates in accordance with Directive 91/676/EEC

New standards for hazardous substances

Annex X of the Water Framework Directive lists 33 priority substances, 13 of which are classified as priority hazardous substances, that fall into the following four groups:

1. Heavy metals
2. Pesticides
3. Industrial pollutants
4. Other pollutants

The Water Framework Directive stipulates that inputs of these substances into water bodies are to be reduced in stages (according to their hazardousness), and for priority hazardous substances are to be eliminated completely by 2028.

The substances listed in Annex X, which are subject to the environmental quality standards defined in the new daughter directive 2008/105/EC, comprise the benchmarks for “good chemical status”. German river basin management plans have not yet implemented this directive’s requirements across the board. However, this will be done during the current river basin management plan period (in July 2010).

4.1.4 Chemical status of Germany’s surface waters

The chemical status of Germany’s surface waters is classified as either ● “good” or ● “failing to achieve good”. Unlike ecological status, which is “moderate”, “unsatisfactory” or “poor” over wide stretches of these water bodies, 88 percent of these water bodies exhibit “good chemical status” in all river basins and for all water body types apart from transitional waters. However, only five water bodies were subject to assessment in this regard, and two of them (40 percent) have achieved “good chemical status”. 88 percent of all rivers, 92 percent of all lakes and 98 percent of all coastal waters have also achieved this status.

Map 5 shows the chemical status for all German surface waters. Figure 14 shows the percentage distribution for the various river basins.

Many water bodies exceed the mandated environmental quality standards owing to the presence of polycyclic aromatic hydrocarbons, tributyl tin compounds (biocides), cadmium and mercury. Some water bodies have also failed these standards owing to elevated levels of pesticides (e.g. isoproturon, diuron and lindane), fluoranthene (an intermediate product in the manufacture of pharmaceuticals), brominated diphenyl ethers (flame retardants), and DEHP (diethylhexylphthalate, a softener) in some water bodies of the Rhine, Ems, Elbe, Weser, Oder and Danube river basins.

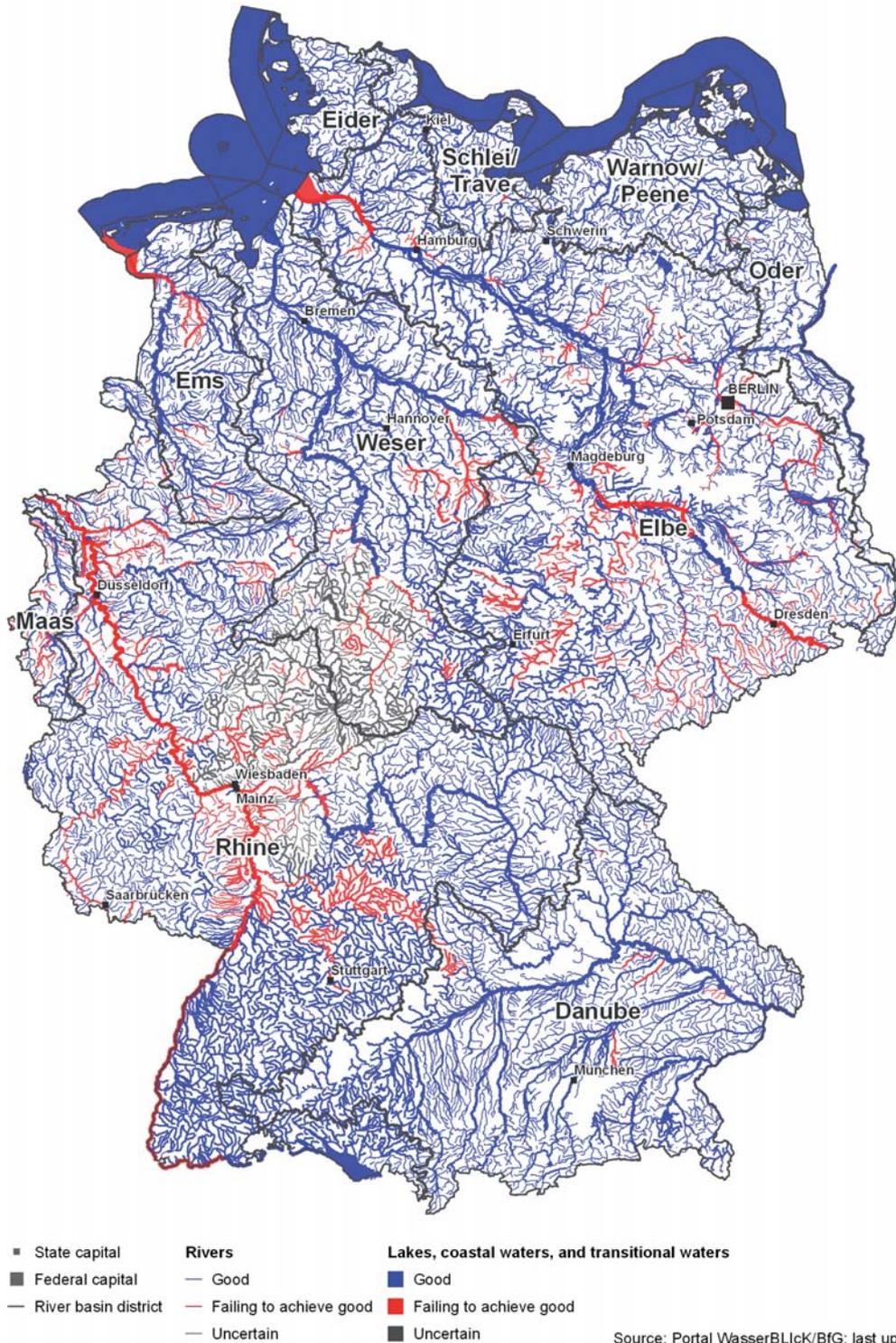
It should be noted in this regard, however, that suitable analytic methods are currently lacking for some chemical substances. Moreover, further methodological harmonization is needed to measure contaminants in aquatic biota, as called for in the Environmental Quality Standards Directive (2008/105/EC). Nonetheless, it now appears likely that environmental quality standards concerning factors such as mercury in fish (20 µg/kg) in both the ocean and in inland water bodies will be exceeded virtually everywhere in Germany.

Particle-bound pollutants play a crucial ecological role in any given water body system. They also have numerous effects in terms of the usability of water bodies and their adjoining floodplains and marshes. Hence pollution monitoring must also take account of pollutants that enrich in sediments and suspended solids.

Chemical-status requirements were modified in late 2008 by the Environmental Quality Standards Directive (2008/105/EC), which will come into effect on 13 July 2010. Some states have already applied the directive, some have classified the chemical status of numerous water bodies as uncertain, and some have compared the results obtained by applying the new and old directives. The present pamphlet indicates the statuses that have been reported to the European Commission. A comparison of the requirements of the new and old directives shows that application of the former translates into far fewer water bodies with a “good chemical status”. For example, under the old directive 9 percent of all assessed water bodies in the Elbe river basin fail “good chemical status”, whereas under the new directive the failure rate is 17 percent.

Map 5: Chemical status of German surface waters.

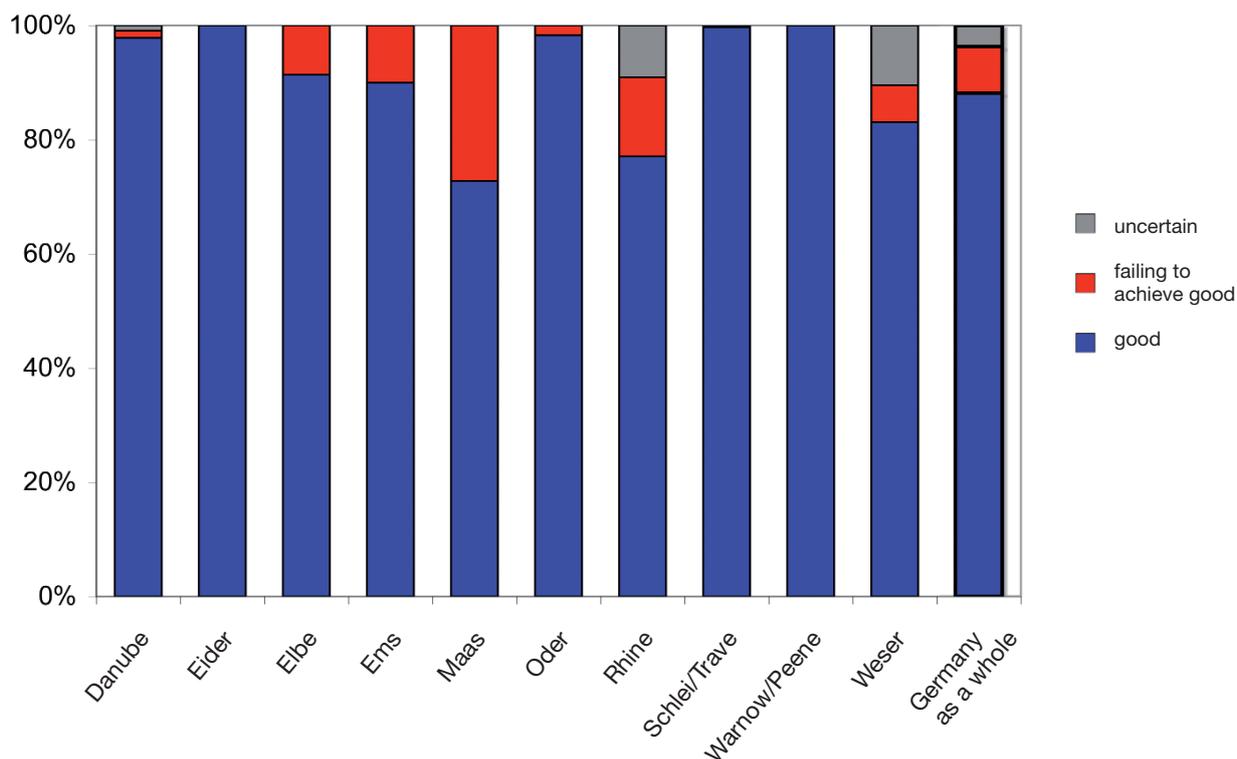
Some of our state governments have already determined this status in accordance with the environmental standards laid out in the Environmental Quality Standards Directive (2008/105/EC).



It is noteworthy that the chemical status of numerous water bodies in the state of Hesse is uncertain. This is attributable to the fact that quality standards were exceeded at surveillance monitoring sites owing to the fact that in Hesse, the considerably more stringent environmental quality standards for the polycyclic aromatic hydrocarbon isomers benzo(g,h,i)perylene and indeno(1,2,3-cd)-pyren (pursuant to Directive 2008/105/EC) were taken into account. Hence the chemical status of these water bodies was provisionally classified as uncertain inasmuch as measurements taken at other monitoring sites may reveal additional instances of noncompliance (the relevant investigations are slated for realization during the initial river basin management plan period).

Figure 12: Chemical status of German surface water bodies in the ten river basins that are relevant for Germany. Some of our state governments have already determined this status in accordance with the environmental standards laid out in the Environmental Quality Standards Directive (2008/105/EC).

Source: Portal WasserBLICK/BfG; last updated 22 March 2010.



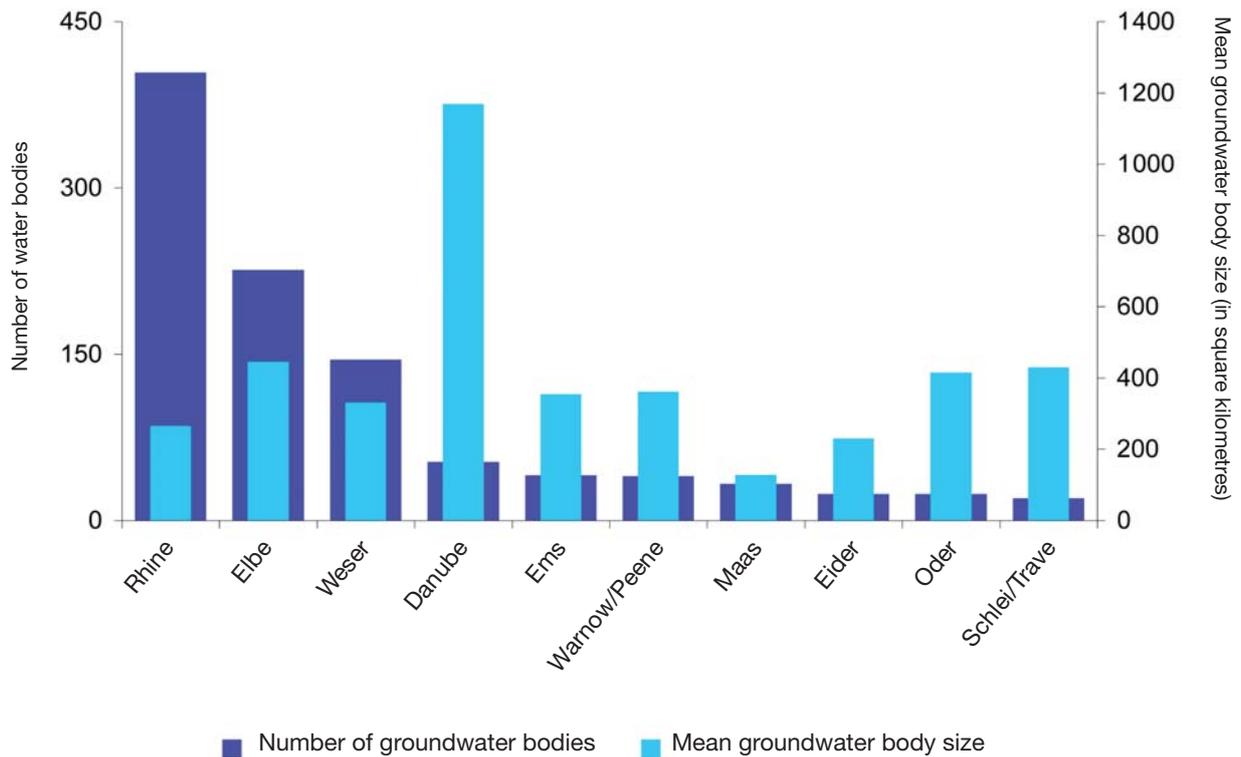
4.2 Groundwater status

Groundwater status is assessed in terms of groundwater bodies. A groundwater body describes a volume of groundwater with fixed boundaries within one or more aquifers. Germany has some 1,000 groundwater bodies averaging approximately 400 square kilometres in size (range: 200 to more than 1,000 square kilometres). The number and mean size of the groundwater bodies in Germany's river basins are shown in Figure 13.

The Water Framework Directive stipulates that groundwater must achieve "good quantitative status" and "good chemical status" by 2015. Groundwater bodies are classified as either ● "good" or ● "poor".

Figure 13: Number and mean size of the groundwater bodies in the ten river basins that are relevant for Germany.

Source: Portal WasserBLiCK/BfG; last updated 22 March 2010.



4.2.1 Assessment of quantitative status

“Good quantitative status” can only be achieved for groundwater if less water is abstracted than recharged. Wherever possible, the allowable groundwater abstrac-

tion should be substantially lower than the recharge rate. If the abstraction and recharge rates are the same, the consequent unavoidable natural outflow would reduce the groundwater quantity that flows into surface waters and wetlands.

The main criterion for assessment of “good quantitative status” is groundwater level, whereby the following requirements apply:

- Long-term mean annual abstraction is not to exceed the available groundwater resources,
- the groundwater level is not to be subject to anthropogenic changes that

- result in failure of the ecological quality objectives in Article 4 of the Water Framework Directive for the associated surface waters,
- significantly degrade the quality of these water bodies,
- significantly harm terrestrial ecosystems that are directly dependent on groundwater bodies.

- No saltwater or other intrusions are allowed.

4.2.2 Quantitative status of Germany's groundwater bodies

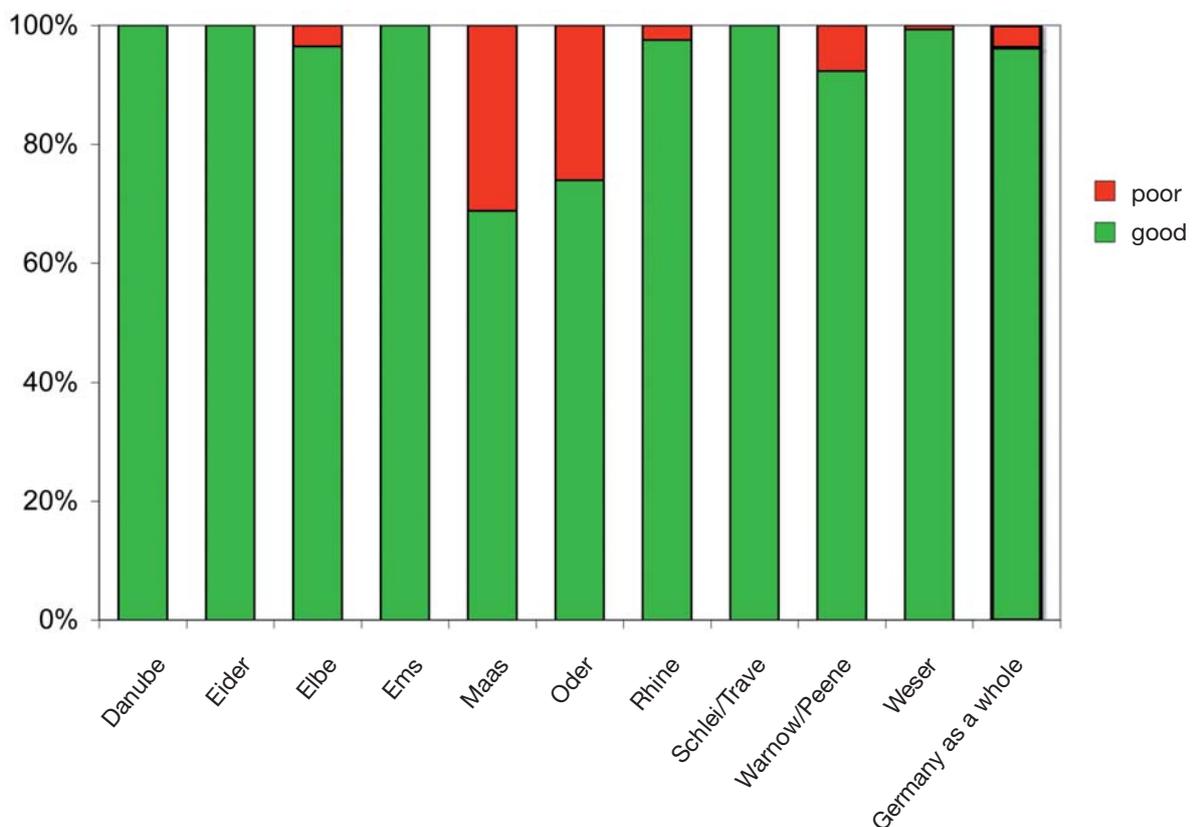
Map 6 shows the quantitative status of Germany's 1,000 groundwater bodies, relatively few of which are over-used and only 38 (4 percent) of which fail "good quantitative status".

Quantitative deficiencies occur, for example, in connection with mining activities, particularly in lignite and salt mining regions, whose groundwater levels had in many cases been subject to substantial reduction for decades. Moreover, even after mining comes to a halt,

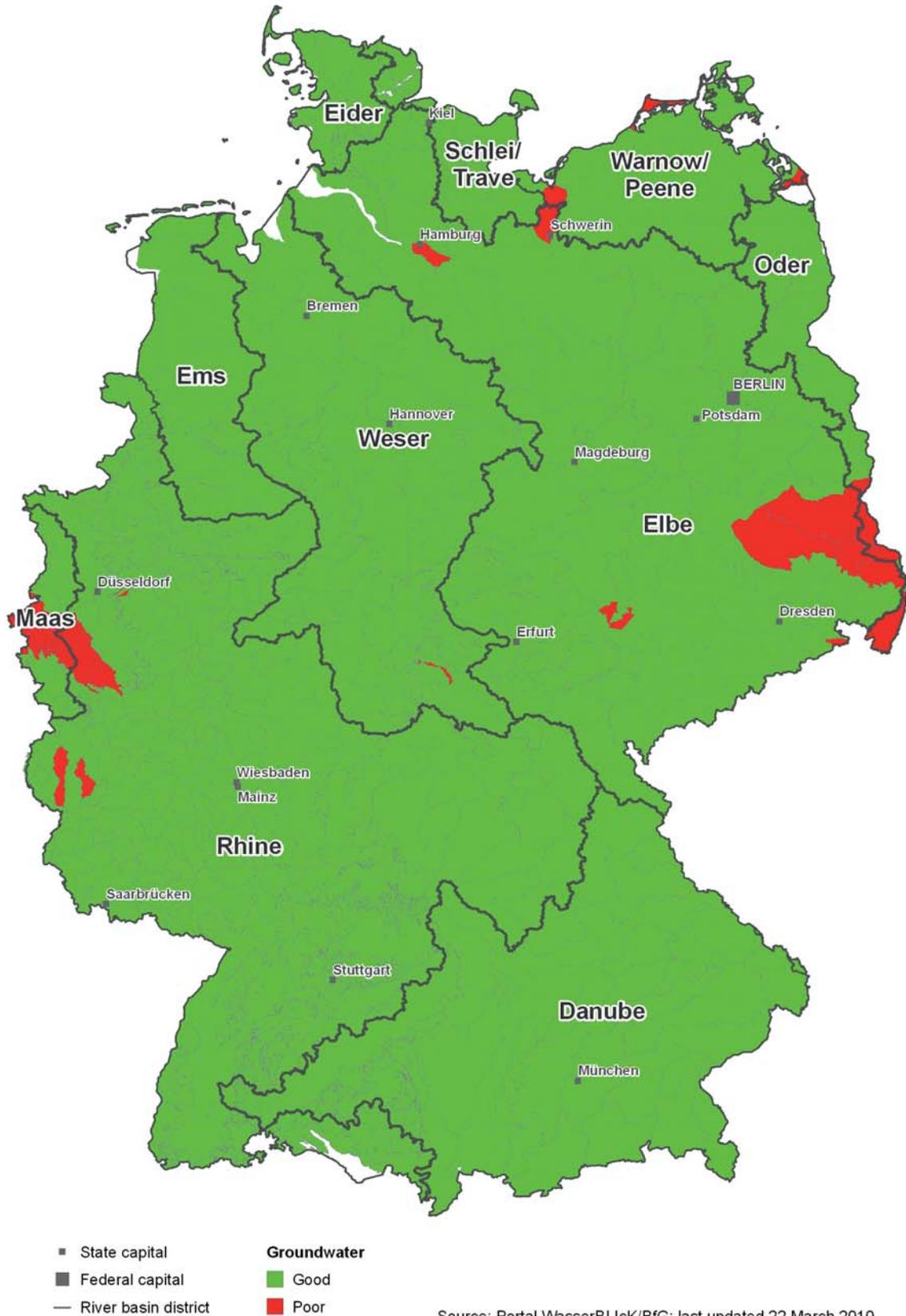
restoration of the natural groundwater level takes decades. The quantitative status of a groundwater body in the Tideelbe working area was classed as "poor" owing to the presence of saltwater, which had entered the water body owing to an increase in salty deep groundwater secondary to unduly high groundwater abstraction. Here too it will presumably take a long time for the natural water level of this groundwater body to be restored and for it to return to "good status".

Figure 14: Quantitative groundwater body status in the ten river basins that are relevant for Germany.

Source: Portal WasserBLICK/BfG; last updated 22 March 2010.



Map 6: Quantitative status of Germany's groundwater bodies



Source: Portal WasserBLICK/BFG; last updated 22 March 2010

4.2.3 Assessment of chemical status

The chemical status of groundwater is assessed on the basis of environmental quality standards and threshold values.

Groundwater must meet the following requirements in order to achieve “good chemical status”:

- No sign of salt or other intrusions.
- The environmental quality requirements and threshold values in accordance with the other applicable legislation listed in Article 17 of the Water Framework Directive are adhered to.

Pollutant concentrations do not exceed a threshold that would (a) fail the environmental objectives for groundwater bodies that feed into surface waters; (b) significantly reduce groundwater ecological or chemical quality; or (c) significantly damage terrestrial ecosystems that are dependent on groundwater.

Thus “good chemical status” of groundwater ensures that the groundwater itself exhibits good quality, and the quality of surface waters and terrestrial ecosystems that are dependent on groundwater is not degraded.

The Groundwater Directive (2006/118/EC) of the Water Framework Directive promulgates EU-wide environmental standards for nitrates, as well as pesticides, biocides and the relevant metabolites² thereof. The threshold value for nitrates is 50 mg/l; for pesticides, biocides and the relevant metabolites thereof the aggregate allowable amount is 0.1 µg/l and 0.5 µg/l respectively.

Apart from the EU-wide environmental quality standards promulgated by the Groundwater Directive the member states are also required to define threshold values for the additional substances listed in Annex II of the directive. These environmental quality standards and threshold values are the key assessment criteria for chemical groundwater status.

The Groundwater Directive specifies the core requirements for groundwater monitoring. For example, if the applicable environmental quality standards and thresholds are not exceeded at any monitoring site of a groundwater body, its chemical status is classified as “good”. But if, on the other hand, such a standard or threshold is exceeded at one or more monitoring sites, the size of the polluted area and the environmental impact of the anthropogenic pressures in question must be determined. If the impact is relevant, the entire groundwater body’s chemical status is classed as “poor”.

In view of the fact that once an aquifer has been polluted, it often takes a long time, as well as extensive and cost intensive technical measures, to restore it to “good chemical status”, the Groundwater Directive also requires that any “significant and sustained upward trend in the concentrations of any pollutant” be reversed. This key provision is intended to avert further accumulation of pollutants in groundwater, and to protect groundwater that has thus far been subject to little or no pollution.

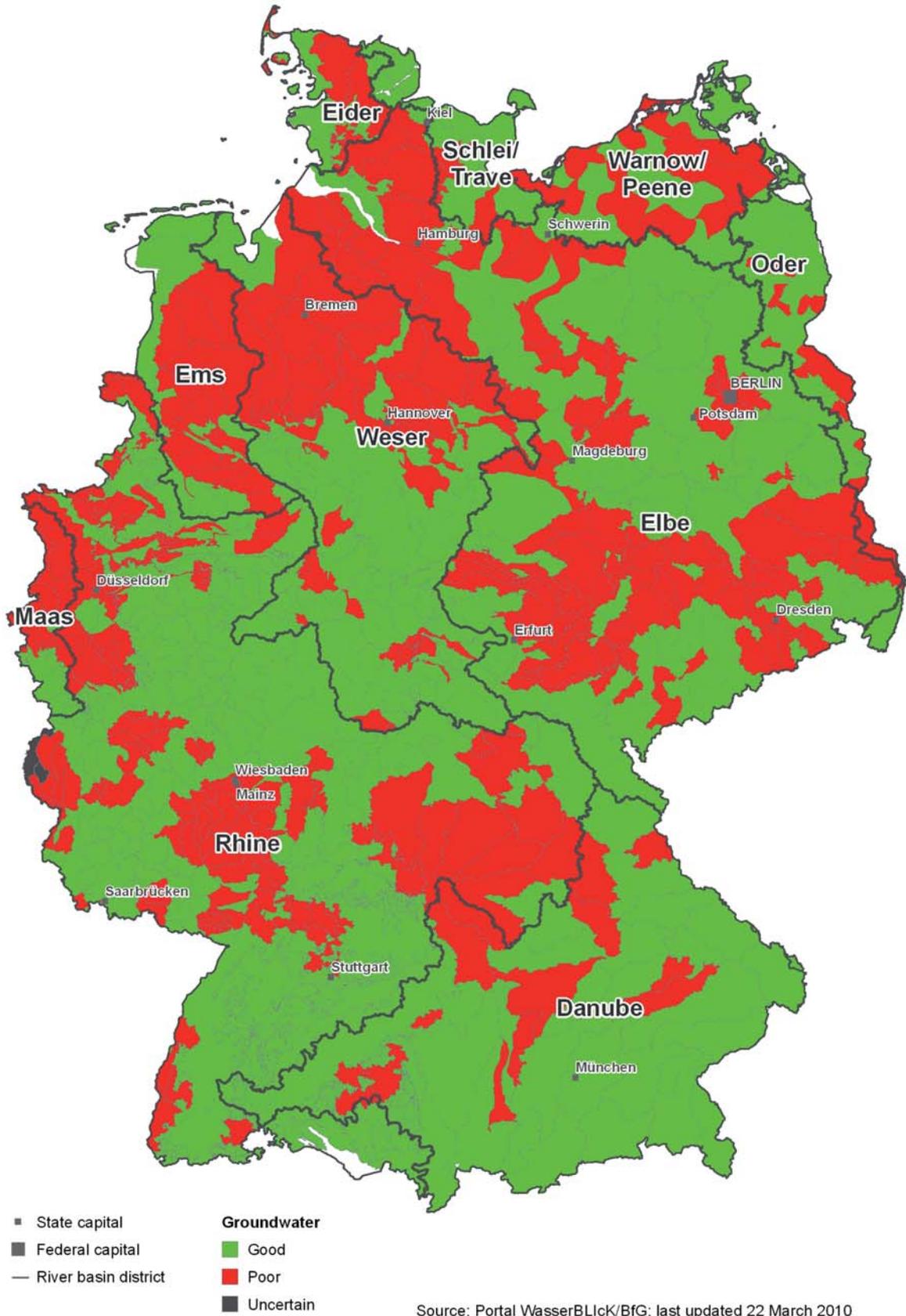
4.2.4 Chemical status of Germany’s groundwater bodies

The chemical status of Germany’s groundwater is shown in map 7. The percentage distribution of groundwater chemical status in the ten relevant river basins is shown in Figure 15.

63 percent of Germany’s groundwater bodies currently achieve “good chemical status”, whereas the remaining 37 percent do not (the status of only two groundwater bodies, i.e. less than 1 %, is classed as “uncertain”).

² Metabolites are the degradation products of pesticides and biocides; relevant here means that these metabolites are toxic.

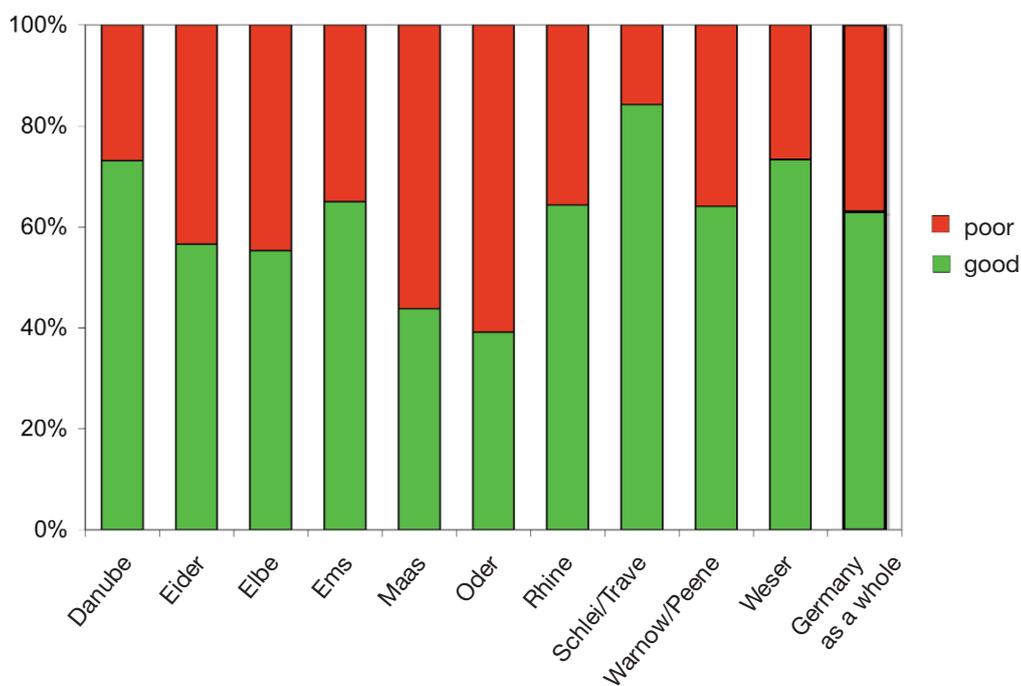
Map 7: Chemical status of Germany's groundwater bodies



Source: Portal WasserBLiCk/BfG; last updated 22 March 2010

Figure 15: Chemical groundwater body status in the ten river basins that are relevant for Germany.

Source: Portal WasserBLICK/BfG; last updated 22 March 2010.



Many German groundwater bodies are subject to pollution from nitrate (see Figure 16), which is highly water soluble and percolates into groundwater. The nitrate levels in many such groundwater bodies exceeds 50 mg/l. In addition, a substantial portion of nutrients in groundwater is input into surface waters, causing additional pollution there. Relative to these contaminants, pesticides and other pollutants play a lesser role in groundwater pollution.

Significant upward trends have been observed in 58 (6 percent) of Germany's 1,000 groundwater bodies (see Figure 17). A downward trend has been observed in ten groundwater bodies. During the present (initial) river basin management plan period, no trends, or only non-validated trends, have been identified for many groundwater bodies, due to the fact that sufficiently long time series concerning nutrient and pollutant concentrations are not available for all of the groundwater bodies in question.

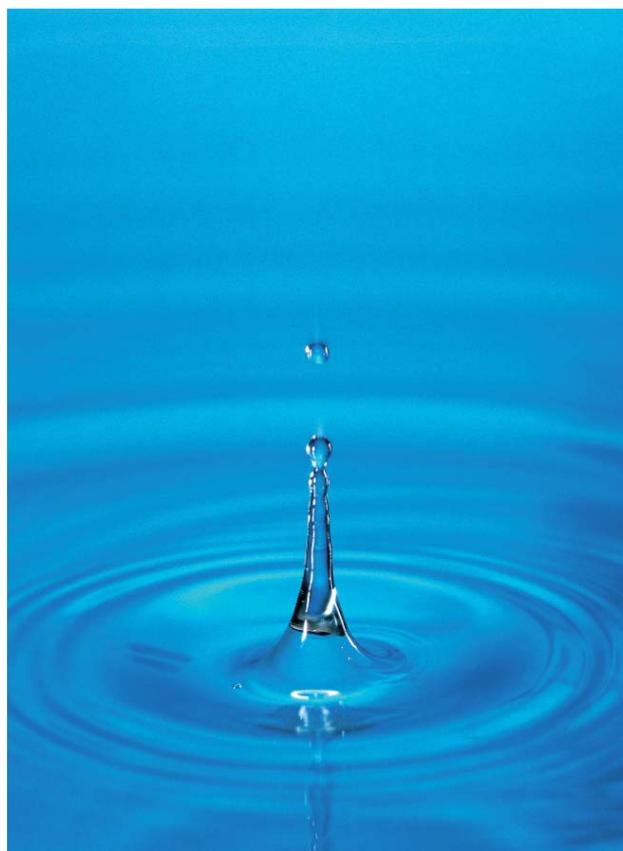


Figure 16: Assessment of the key substances for groundwater chemical status rankings in Germany.
 Source: Portal WasserBLiCK/BfG; last updated 22 March 2010.

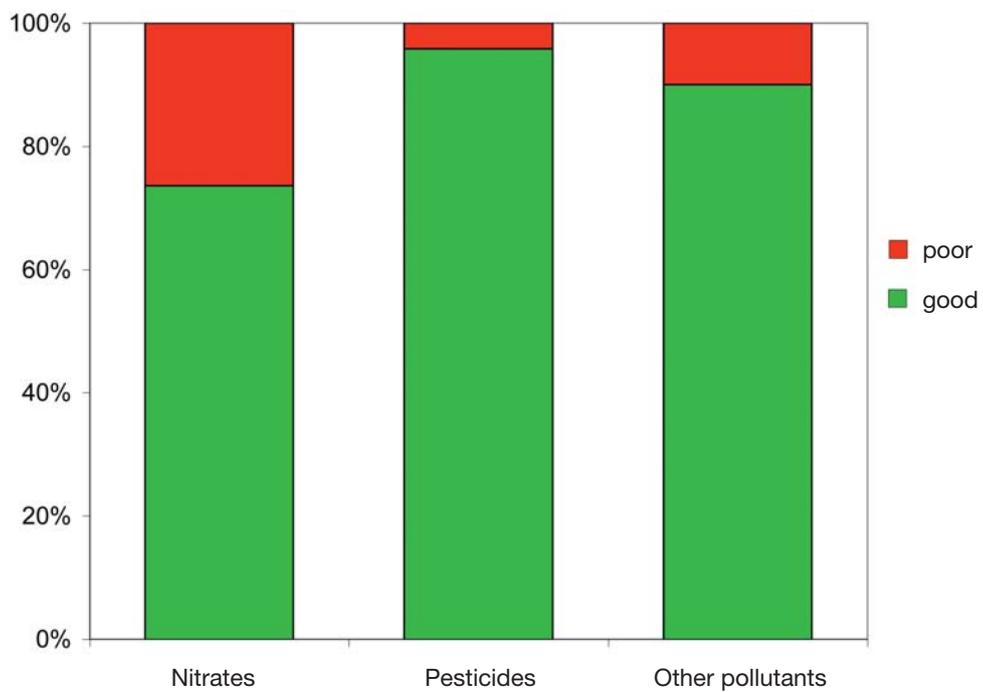
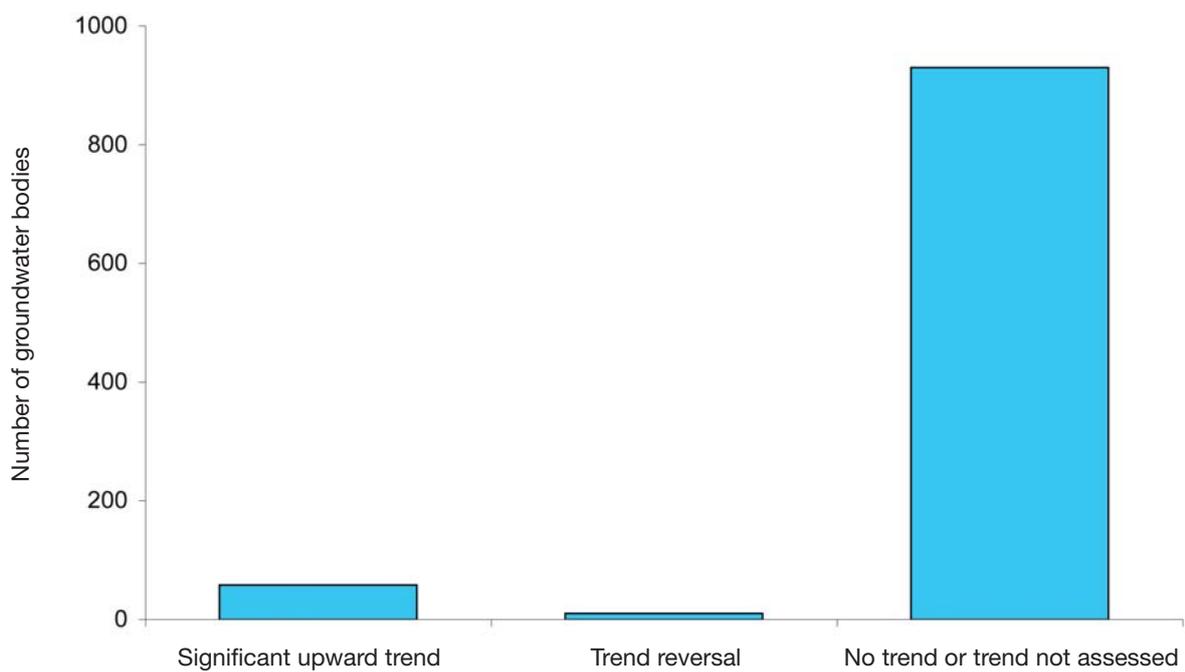


Figure 17: Trend assessment for pollutant concentrations in German groundwater bodies.
 Source: Portal WasserBLiCK/BfG; last updated 22 March 2010.



5 WATER FRAMEWORK DIRECTIVE ENVIRONMENTAL OBJECTIVES AND EXEMPTIONS

Germany's water protection accomplishments in recent decades are impressive. Sewage treatment plant expansion and construction have been particularly instrumental in improving our nation's water quality, and with it the bio-ecological characteristics of our surface waters. But despite these efforts, many of our water bodies still fail the "good status" required by the Water Framework Directive, whose requirements reveal our current shortcomings, particularly in respect to ecology, which in the past has not been given the water management the attention it deserves.

Article 4 of the Water Framework Directive defines the following objectives that are to be met during the three river basin management plan periods:

- By 2015 (and thereafter, under specific conditions during the two additional six-year periods) all surface waters and groundwaters are to achieve "good status".
- Any deterioration in water body status is to be avoided.
- Input of priority chemical substances is to be limited in stages, and input of priority hazardous substances is to be completely eliminated. Significant upward trends in groundwater pollution are to be reversed.
- The standards and objectives set by EU regulations for protected areas such as drinking water abstraction areas, bathing water, and flora-fauna habitat (FFH) areas are to be met.

Regional and trans-regional management objectives

Any given river basin management concept is driven by management objectives that relate to various geographical areas. For example, a trans-regional objective can in-

volve restoration of continuity in a major river or reducing anthropogenic nutrient input. On the other hand, the geographical scope of regional and local objectives is more limited, but may promote successful achievement of trans-regional water quality management objectives. Examples of regional water quality management issues include optimization of sewer overflow and rainwater drainage in urban areas; reducing substance input from municipal sewage treatment plants; and improving the hydromorphology of relatively short water body reaches.

The exemptions promulgated by Article 4 of the Water Framework Directive allow member states to extend the deadline for achieving Water Framework Directive objectives, so as to allow (a) a more realistic timeline for these objectives; or (b) for definition of less stringent objectives. Such exemptions are subject to strict requirements, must be described in detail in the relevant river basin management plans, and must be documented transparently. In addition, any less stringent environmental objectives are subject to review at six year intervals, likewise via the member states' river basin management plans.

The Water Framework Directive defines the following exemption related scenarios:

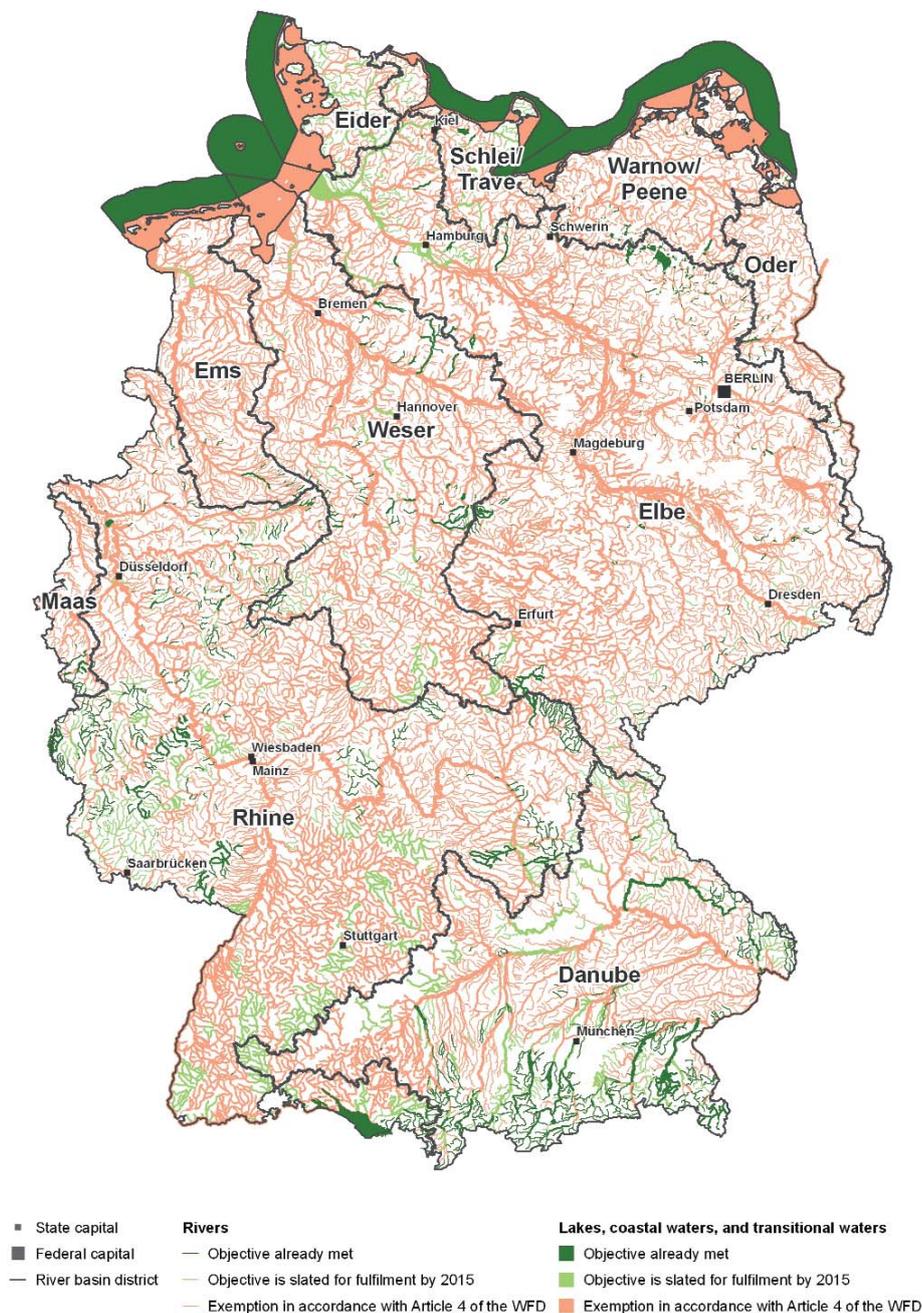
- Deadline extensions (achievement of environmental objectives by 2021 or 2027 in lieu of 2015).
- Defining less stringent environmental objectives.
- Temporary deterioration resulting from natural causes or force majeure (e.g. flooding or draught).
- New modifications in the physical characteristics of water bodies (e.g. groundwater levels; changes in hydromorphological characteristics resulting from water impoundment); new sustainable development activities that are realized for reasons of overriding public interest.

None of the above exemption scenarios are to interfere with achievement of the environmental objectives for any other water body, and are to be without prejudice to any other Community regulations.

5.1 Exemptions in Germany

In Germany, exemptions will be made for 82 percent of all surface water bodies (see map 8 and Figure 18), including heavily modified and artificial water bodies. Exemptions will be made for 36 percent of Germany's groundwater bodies (see map 9 and Figure 19).

Map 8: Objectives and exemptions for Germany's surface water bodies.



Source: Portal WasserBLick/BfG; last updated 22 March 2010

Figure 18: Objectives and exemptions for surface water bodies in the ten river basins that are relevant for Germany.

Source: Portal WasserBLiCK/BfG; last updated 22 March 2010.

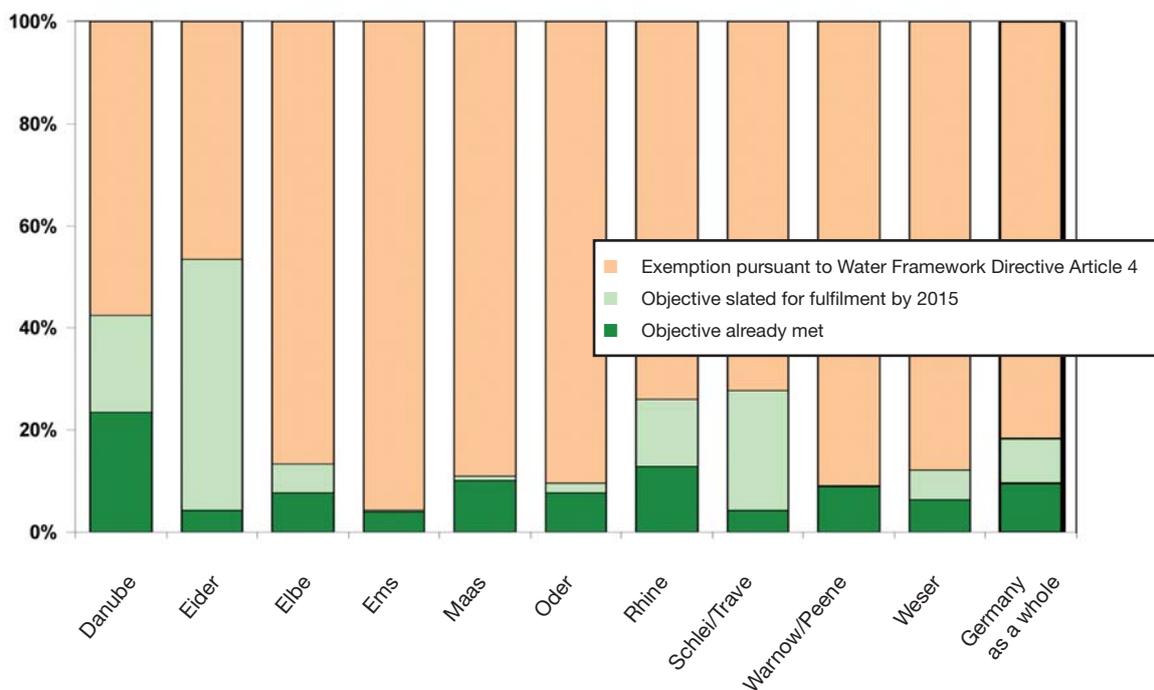
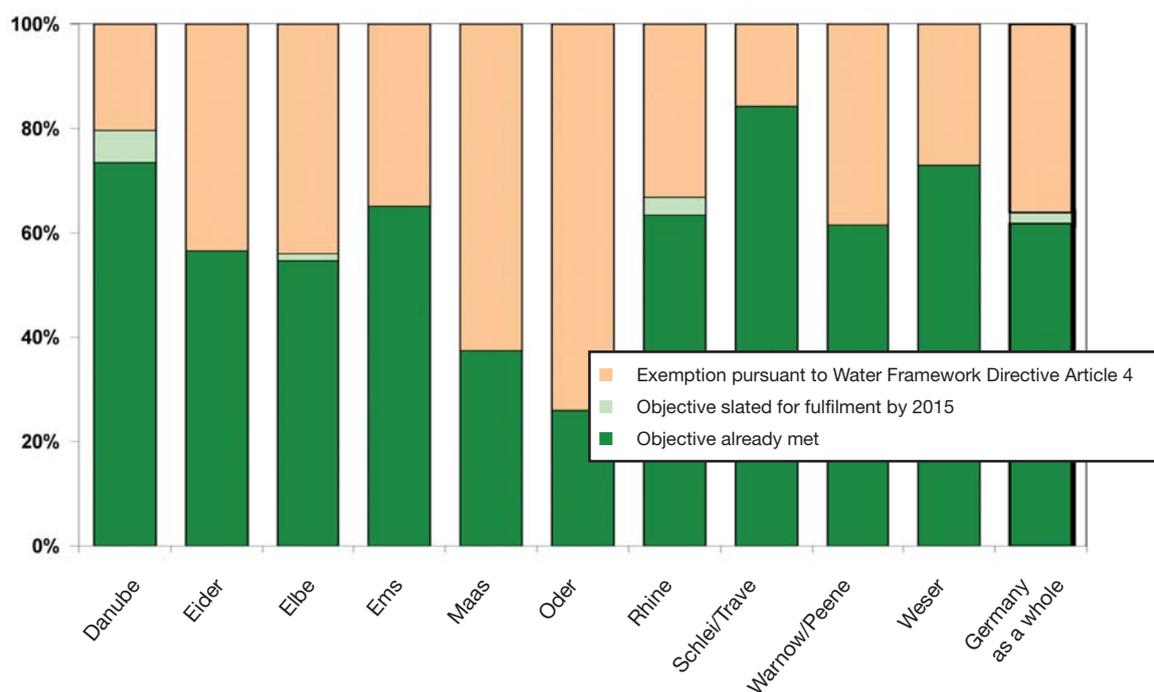
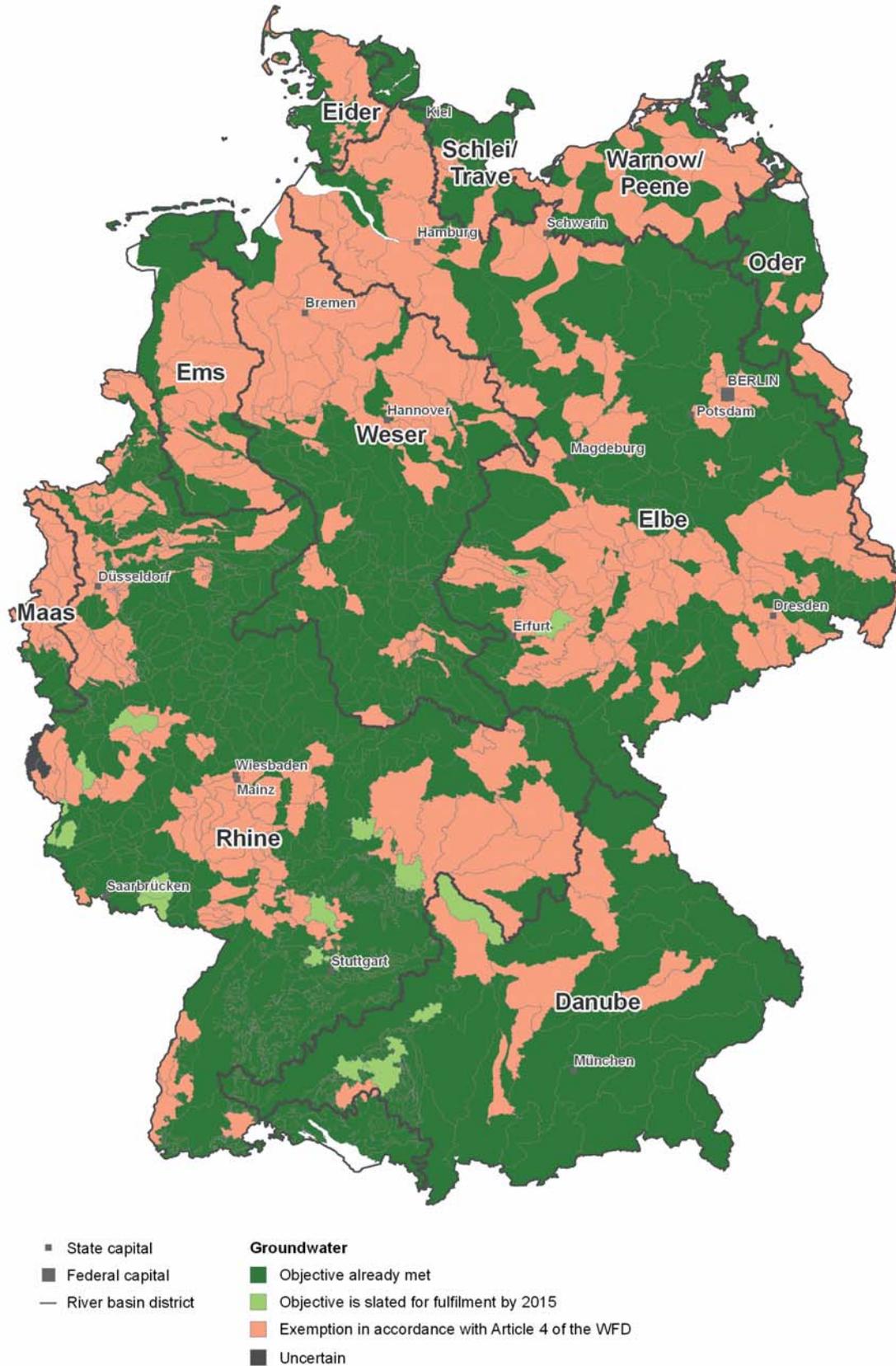


Figure 19: Objectives and exemptions for groundwater bodies in the ten river basins that are relevant for Germany.

Source: Portal WasserBLiCK/BfG; last updated 22 March 2010.



Map 9: Objectives and exemptions for Germany's groundwater bodies.



Source: Portal WasserBLiCk/BfG; last updated 22 March 2010

Most of the exemptions involve deadline extensions (see Figures 20 and 21). Less stringent environmental objectives will be defined only insofar as the relevant environmental objectives cannot be met by 2027 or if meeting them by that time would be unreasonably cost intensive. During the first river basin management plan period, no exemptions have been made for temporary water body status deterioration, changes in physical water body characteristics, or new sustainable human development activities.

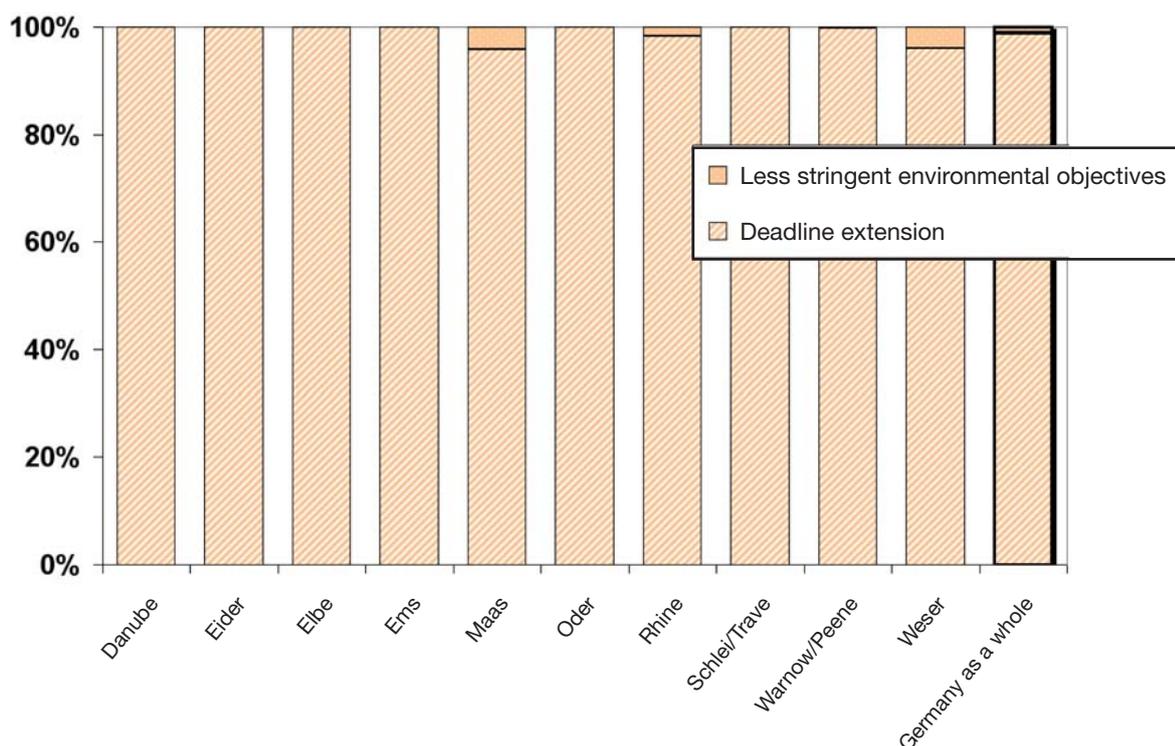
Deadline extensions do not mean that no measures will be taken, since oftentimes such extensions are at least partly attributable to uncertainties in respect to water body assessment. Such uncertainties can arise in the following situations, among others: the number of biological tests realized for a water body is not representative; the water body is not amenable to assessment due

to the absence of a reference water body or due to methodological uncertainties; the impact of measures cannot be forecast, particularly those involving hydro-morphology; the difficulty of prognosticating long term changes in precipitation patterns or the impact of natural disasters such as flooding or draught.

Less stringent environmental objectives for surface waters mainly result from unduly high chemical pollutant load, i.e. cases where “good chemical status” is failed. Heavy-metal pollution has been a particular problem in the Weser river basin district, including in some smaller Harz foothill rivers near the Aller and Oker rivers. Moreover, significant regional pollution is still engendered by heavy metals that are discharged diffusely into water bodies from mine dumps, mine pits, contaminated sites, and abandoned sites.

Figure 20: Surface water exemptions (in accordance with Article 14 of the Water Framework Directive) concerning ecological and chemical status.

Source: Portal WasserBLICK/BfG; last updated 22 March 2010.



Most groundwater exemptions – although relatively few have been made – likewise involve deadline extensions. Such extensions are particularly necessary for groundwater in many cases since it takes a long time for the chemical status of these water bodies to improve – as is also the case for groundwater quantity status.

In most cases, less stringent environmental objectives for groundwater are imposed for reasons related to mining or contaminated sites.

5.2 Grounds for exemptions

Exemptions, which are subject to review at six year intervals in the river basin management plans, can be made for the following reasons:

- The objectives in question cannot be met on the grounds that they are unfeasible from a technical standpoint, or can only be met in stages.
- Implementation of the objectives by 2015 would entail disproportionate costs.
- The existing natural conditions would not allow for timely improvement of the relevant status.

Figure 21: Groundwater exemptions (in accordance with Article 14 of the Water Framework Directive) concerning quantitative and chemical status.

Source: Portal WasserBLICK/BfG; last updated 22 March 2010.

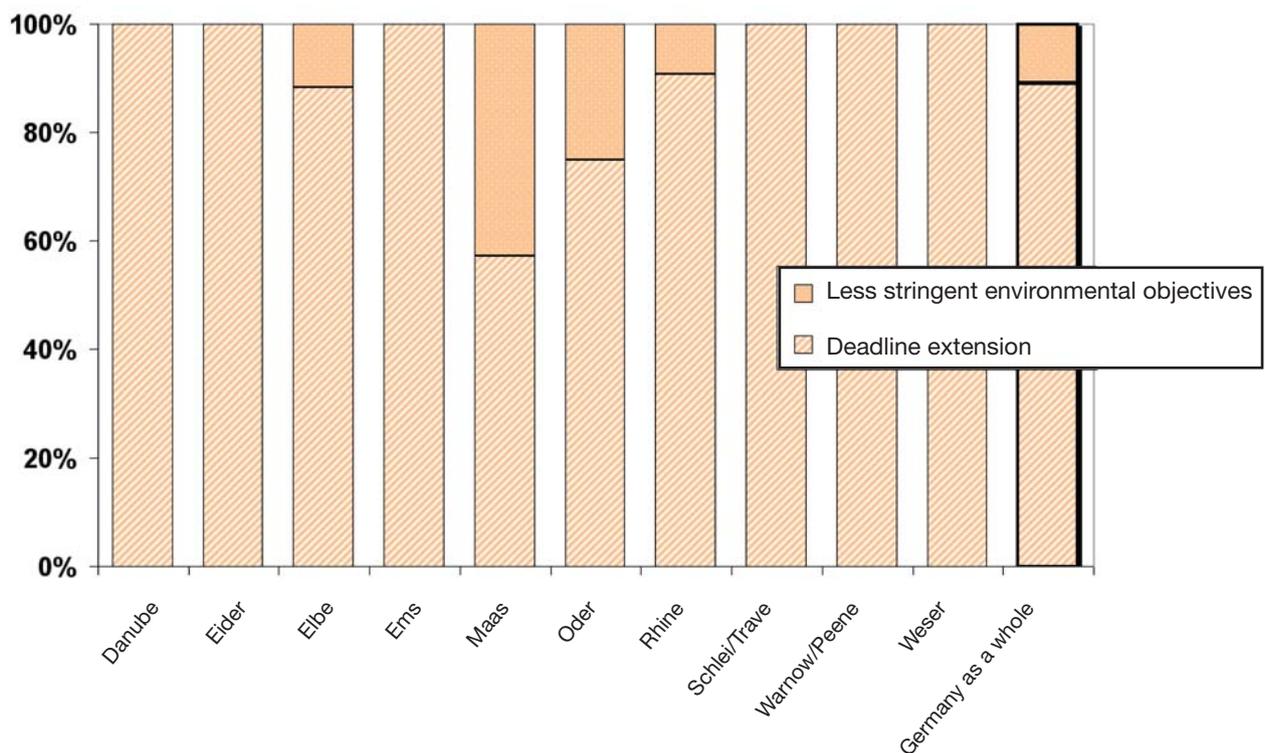
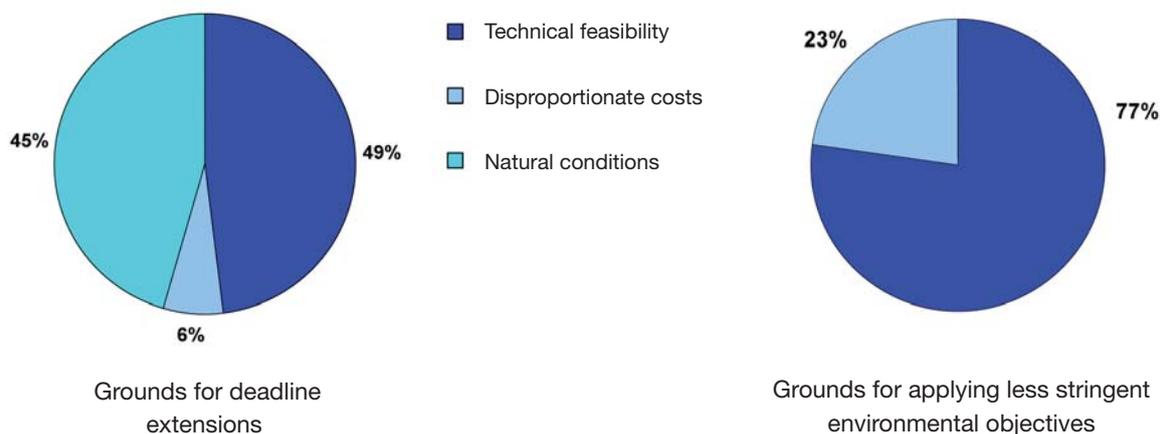


Figure 22: Grounds for deadline extensions and less stringent environmental objectives for surface and groundwater bodies.

Source: Portal WasserBLiCK/BfG; last updated 22 March 2010.



“Technical unfeasibility” refers to any of the following scenarios: no technical solution is available for the environmental problem in question; development of such a solution would be a lengthy process; lack of knowledge concerning the cause of the pressure in question; unresolved scientific issues.

“Disproportionate costs” refer to costs that would impose an unduly heavy financial burden on the party concerned, or costs that would entail a negative cost benefit ratio.

“Natural conditions” refers, for example, to measures where a lengthy period would elapse between implementation and the point at which positive impact of the measure concerned on water bodies and their biota would become measurable.

Exemptions in German river basins are often justified on the grounds of technical unfeasibility and natural conditions (see Figure 22).

However, most exemptions are made on a number of grounds.



6 PROGRAMMES OF MEASURES

Water body monitoring and status assessments revealed that numerous German water bodies currently fail the Water Framework Directive's environmental objectives. This raises the following questions: What should be done to promote the establishment of natural biota? How can nutrient and pollutant input be reduced? The programmes of measures address these issues.

Article 11 of the Water Framework Directive requires each member state to establish a program of measures "for each river basin district, or for the part of an international river basin district within its territory," and to implement such measures and the applicable laws and subsidy programmes by 2012. The effectiveness of each such program is subject to review at six year intervals beginning in 2015.

If it is found that the measures that have been taken are unlikely to allow for achievement of the Directive's environmental objectives, the program will have to be updated. All such measures must be incorporated into and legally binding for all future water use plans and permits.

The Water Framework Directive distinguishes between basic and supplementary measures (Annex VI Article 11(2) and (3) of the Water Framework Directive). In Germany, both types of measures are normally planned by state and federal water and shipping authorities, which define individual measures or constellations of measures for each water body and the pressures to which it is subject.

Basic measures and supplementary measures:

1. *Basic measures*, which comprise the minimum water body protection development requirements, are already defined in existing EU directives or serve to meet basic water management requirements (pursuant to Article 11(3) of the Water Framework Directive), including those laid out in Directive 91/271/EEC concerning urban wastewater treatment, Directive 91/676/EEC relating to nitrate pollution, and Directive 80/778/EEC concerning drinking water.
2. *Supplementary measures* are necessary in cases where the basic measures are not sufficient to allow the Water Framework Directive objectives to be reached. Such measures can include construction programmes, rehabilitation projects, legislative, administrative and fiscal instruments, and educational projects.

Germany's programmes of measures were established on the basis of a list of measures that was drawn up by Bund/Länder-Arbeitsgemeinschaft Wasser (LAWA) with a view to ensuring nationwide uniformity in this regard. Pursuant to Annex II of the Water Framework Directive, the LAWA list breaks down the various measures according to pressure type and cause (see Table 2).

Measures are selected based on the following criteria: Will the measure allow for achievement of the required environmental objective? How long will it take for the objective to be achieved? Is an individual measure sufficient, or would a constellation of measures be necessary and/or perhaps more ecologically efficient? Are the measures technically and financially feasible? Is the measure cost efficient?

Table 2: Representative excerpt from the LAWA list of measures, which formed the basis for planning the programmes of measures in accordance with the Water Framework Directive.

Type of pressure	Pressure source	Measure designation
Point source	Municipalities and households	Building and expanding municipal sewage treatment plants
Diffuse source	Agricultural sector	Installation of water body periphery strips to reduce nutrient input
Water abstraction	Mining	Reduction of mining related water abstraction
Morphological alterations	Morphology	Improvement of river bank habitats
Other anthropogenic pressures	Fishing sector	Fish stocking measures

Pursuant to Directive 2001/42/EC, each member state’s program of measures was also subject to realization of a strategic environmental assessment (SEA), whose purpose was to assess the environmental impact of the program on other environmental domains and to factor the assessment’s findings into the relevant decision making processes. The SEA also allowed for issuance of an environmental report on Germany’s program of measures.

6.1 Planning measures include...

According to the Water Framework Directive, measure planning should mainly revolve around nature protection, climate change, marine environment and flood protection. The attendant planning process necessitates extensive coordination between Germany’s states and municipalities, as well as hydro power plant operators, shipping authorities, and many other stakeholders.

6.1.1 Protected areas and nature conservation

Many endangered animal and plant species depend for their survival on habitats that cannot thrive without water and thus require special protection. Such areas are also an indispensable source of drinking water, and are also important for tourist and recreational activities.

Germany has approximately 21,600 protected areas, which break down as follows:

- 13,245 drinking water protection areas, which are used for drinking water abstraction pursuant to Article 7 of the Water Framework Directive.
- 294 areas designated for the protection of economically significant aquatic species (shellfish waters and fisheries).
- 2,178 lakes and coastal waters that are used for recreational purposes and bathing.
- Nutrient-sensitive areas and vulnerable zones, to both of which Germany applies the applicable EU directives (the Municipal Wastewater and Nitrate Directives) across the board.
- 5,892 nature conservation areas, namely 984 bird protection areas and 4,908 flora-fauna habitat areas that are subject to aquatic protection objectives.

Nature protection plays a role in implementation of the Water Framework Directive in that the purpose of the EU’s Bird Protection and Flora-Fauna Habitat Directives is to establish Natura 2000, a coherent ecological network of special protected areas in Europe. The aim of Natura 2000 is to protect or in some cases restore endangered Europe-wide habitats and ensure the survival of protected species. Water Framework Directive measures are harmonized with the applicable Natura 2000 conservation and development objectives in connection with the management of groundwater and surface

waters that are located in a Natura 2000 site, and are coordinated with nature conservation authorities.

Floodplains and bottomlands are also crucial for species conservation and flood protection. Although 50 percent of Germany's floodplains are located in Natura 2000 sites, many of them are extensively used as pastureland, for farming, as residential areas or for roads. Currently only about one third of former floodplains can be flooded when Germany's rivers overflow their banks, and in many reaches of the Rhine, Elbe, Danube and Oder the figure is only 10-20 percent.

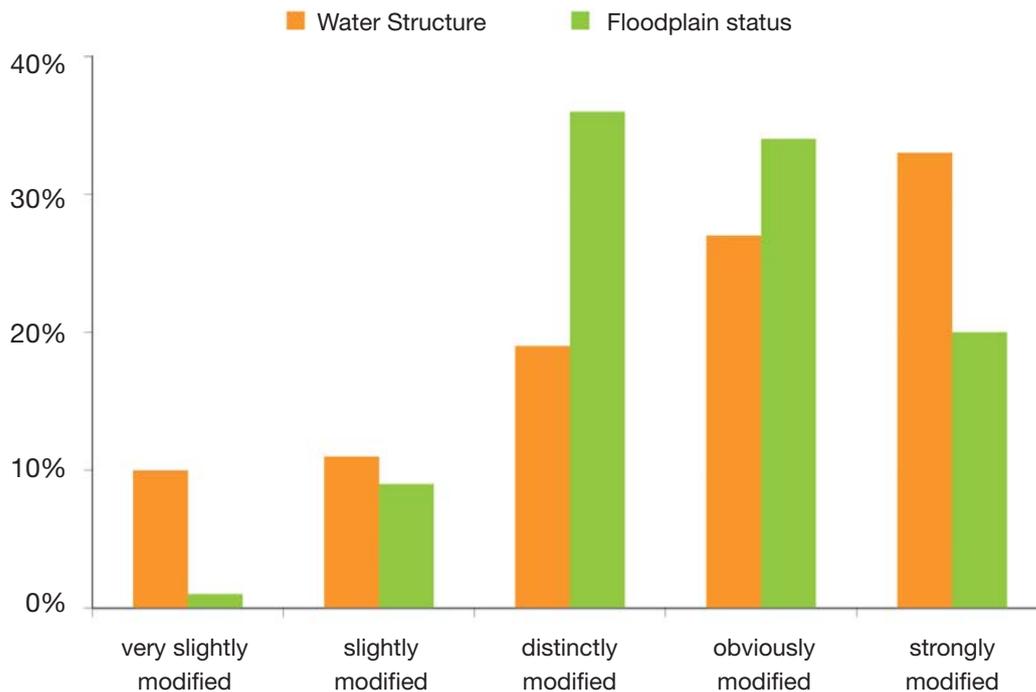
The status of Germany's river and floodplain areas is shown in Figure 23.

Water Framework Directive implementation measures can also support nature protection objectives – for



Figure 23: Morphological status of Germany's rivers and floodplain

(source: Bund-/Länder-Arbeitsgemeinschaft Wasser; Federal Agency for Nature Conservation. Morphological river status: 33,000 kilometres in size and selected rivers. Morphological floodplain status: rivers whose river basins extend over more than 1,000 square kilometres).



example if restoration programmes allow for restoration of a river's natural structures and habitats for species reintroduction purposes. However, some objectives may conflict with each other. For example, restoring river continuity by dismantling a barrage can have a negative impact on valuable floodplain biotopes that can only survive in deep water. Many such conflicts can be resolved through compromise solutions that are consistent with both water body and species protection objectives. In some such cases, it is necessary to determine which specific scenario's objectives have a higher priority or how disadvantages can be offset.

6.1.2 Climate change

Although no German river basin management plan has not yet designated climate change as a pressure, all such plans address the issue. Climate change can engender palpable seasonal and regional changes that make it necessary to alter water management modalities. The effects that come into play here and the consequent changes in water management modalities are described in a LAWA strategy white paper titled Klima-

wandel – Auswirkungen auf die Wasserwirtschaft (Impact of climate change on water management).

In the interest of determining the impact of climate change on water protection, the envisaged measures in selected river basins were analyzed prior to implementation. In addition, a series of research projects is investigating the possible effects of these measures on water resources and groundwater recharge. Regional effects and the necessary changes in water management modalities are currently being studied via various projects such as KliWa – Klimaveränderung und Konsequenzen für die Wasserwirtschaft (Climate change impact on water resource management; a joint state of Bavaria, Rheinland Palatinate, and Baden-Württemberg undertaking that is focusing on water resource management) or KLIWAS – Auswirkungen des Klimawandels auf Wasserstraßen und Schifffahrt, which is focusing on waterways and shipping. The findings of these and future studies will be factored over the long term into the decision making processes for establishment of programmes of measures as well as river basin management plans.





6.1.3 Protection of the marine environment

In view of the high ecological and economic importance of the Baltic Sea, North Sea and Wadden Sea, it is indispensable that we protect their marine habitats in implementing the Water Framework Directive. Section 21 of the Directive's preamble underscores member states' obligation to abide by "international agreements containing important obligations on the protection of marine waters from pollution." In addition, article 1 (e) promulgates the "ultimate aim of achieving concentrations in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances." Another core element of marine environmental protection is the EU's Marine Strategy Framework Directive (2008/56/EC), which came into force in 2008 and which calls for harmonization with the Water Framework Directive.

The most frequently cited reason for the failure of Germany's coastal waters to meet Water Framework Directive objectives* is elevated nutrient load from inflows. Hence, in defining environmental goals for inland areas the fact that a large portion of nutrients is discharged into the marine environment by rivers should be taken into account. In view of this fact, trans-regional river basin management objectives are often established for nutrients with a view to protecting the marine environment. In the Elbe, Eider and Schlei-Trave river basins, the 30 percent reduction in nutrient dis-

charge that is necessary to achieve "good coastal-water status" is slated for realization over the course of the three river basin management plan periods provided for by the Water Framework Directive.

Thirteen of the hazardous substances mentioned in the OSPAR treaty are also classified as priority hazardous substances in Annex X of the Water Framework Directive, which promulgates a ban on these substances beginning in 2028.

In 2007, the environmental ministers of the Baltic Sea riparian states concluded the HELCOM Baltic Sea Action Plan (BSAP), which calls for protection of the Baltic Sea. The BSAP's four main themes are reflective of the key pressures and causes thereof in the Baltic Sea ecosystem – namely eutrophication, biodiversity, hazardous substances and maritime activities. Inasmuch as the BSAP enumerates the actions that must be taken to improve Baltic Sea water quality and biodiversity, and defines the spheres of responsibility and timelines for these actions, the plan is also relevant for implementation of the Water Framework Directive.

River basin measures that aim to reduce pressures from diffuse sources also help to reduce coastal water loads. Such measures include the use of liquid manure and chemical fertilizer in accordance with crop needs; catch cropping; low-emission tilling methods; and wetland rewetting.

* 98.5 percent of these water bodies currently fail "good ecological status".



6.1.4 Flood risk management

Although the Water Framework Directive contains no flood risk management provisions, the Flood Risk Management Directive (2007/60/EC), which came into effect in 2007, stipulates that flood risk management programmes are to be coordinated with Water Framework Directive measures. The goal in this regard is to manage flooding inter-regionally with a view to reducing flood related risk in river basins. The implementation timeline for Directive 2007/60/EC has also been harmonized with that of the Water Framework Directive in that the member states are required to establish flood risk management plans by 2015.

Numerous river basin management plan measures also promote flood protection, examples being broader floodplains and maximally natural watercourses that retard water discharge and increase percolation. Moreover, improved retention resulting from restoration, as well as integrating oxbows into main watercourses, promotes both flood protection and ecology.

6.2 River basin measure planning

Water body measures are documented on the basis of larger agglomerations, which for surface waters are bundled into 225 so called planning units and for groundwater are grouped into 41 working areas, both of which are defined on the basis of hydrological boundaries. Thus many planning units and working areas extend across national and administrative boundaries.

The types of surface water measures that are slated for realization by 2015 and the numbers of planning units involved are shown in Figure 24.

Activities in the morphology, agriculture, continuity, municipality/household and rainwater drainage spheres are slated for realization in virtually all planning units, where measures such as advisory services, voluntary cooperation, and subsidy program establishment and modification will also be carried out. Measures aimed at reducing pressure from the fisheries sector are also envisaged in many planning units. However the mining and other industrial sectors, as well as abandoned sites, are only relevant at the regional level and thus are of lesser importance to the planning units (also see section 6.3).

The number of key envisaged constellations of measures in the groundwater working areas is shown in Figure 25.

Figure 24: Surface water measures and the attendant planning units.

Source: Portal WasserBLICK/BfG; last updated 22 March 2010.

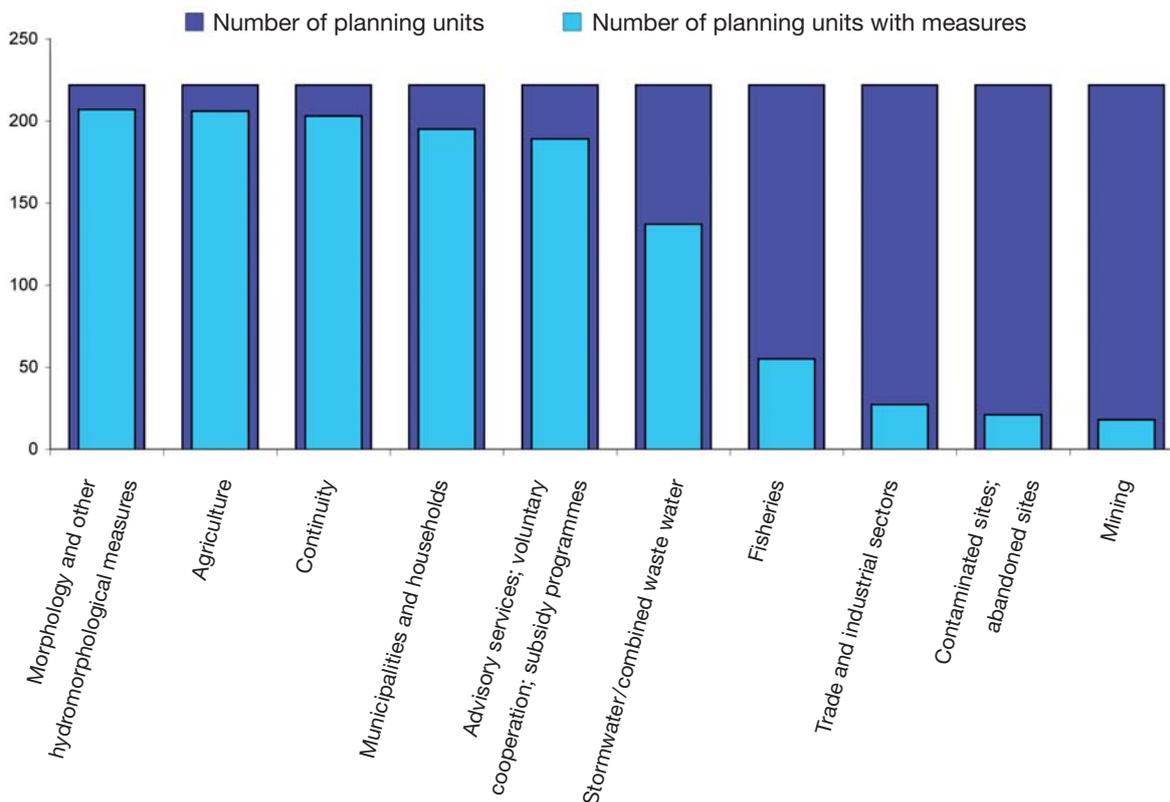
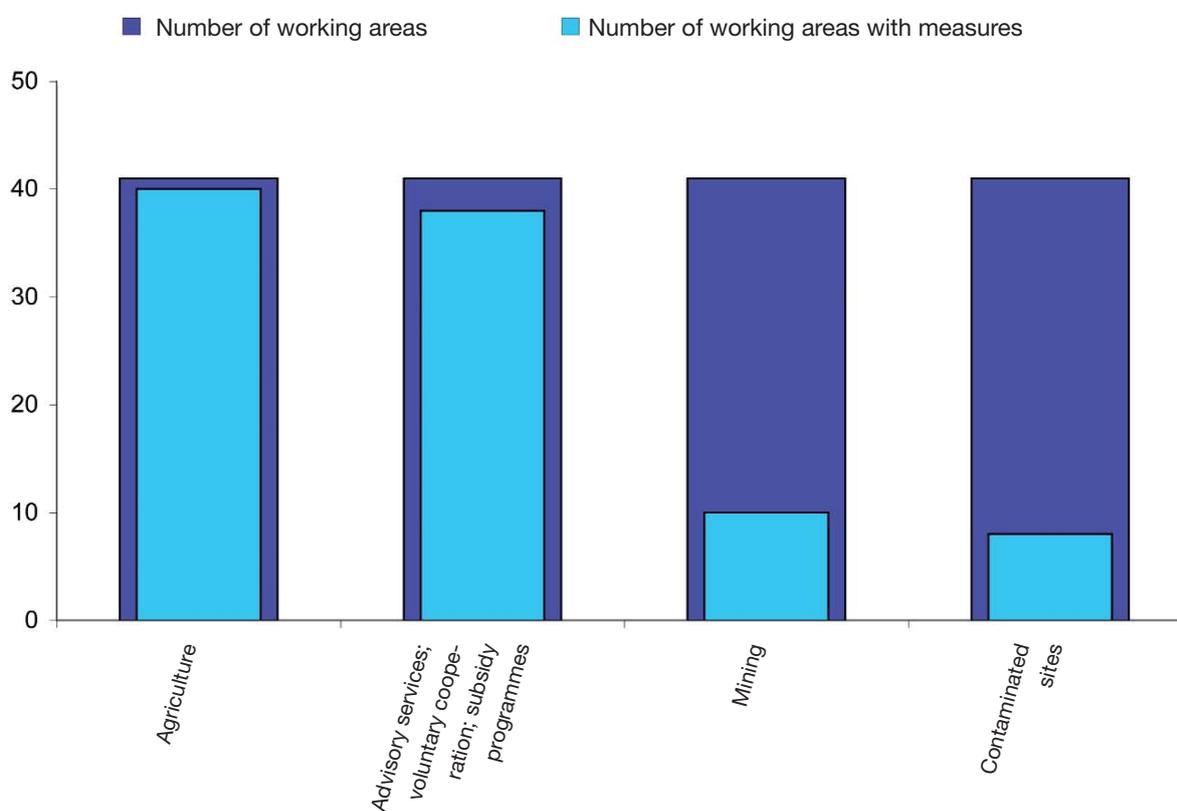


Figure 25: Groundwater measures in working areas.
 Source: Portal WasserBLICK/BfG; last updated 22 March 2010.



Measures have been planned in virtually all working areas with a view to reducing nutrient and pesticide input. Such measures are also necessary in view of the fact that agricultural activity is currently the main cause of groundwater pollution. However, the requirements relating to mining, as well as abandoned waste dumps and the like, apply solely to individual river basins.

6.3 It is up to the water users now

Anthropogenic pressures on water bodies are engendered by polluters in various sectors, including agriculture, commerce, industry, municipalities and households. The actors in all of these domains will need to do their share to sustainably reduce pressures on our water bodies over the long term. Such pressures cannot always be attributable to a specific user, but are in many cases the aggregate result of various types of use, partic-

ularly when it comes to hydromorphological damage. According to the Water Framework Directive, the polluter pays principle applies (also see section 7).

6.3.1 Agriculture

Agricultural water pollution arises from nutrient and pesticide input, as well as from hydromorphological damage, which mainly occurs in smaller water bodies.

Pressures

Centuries of farming have wrought substantial changes in our nation's flora and fauna habitats. As at 2007, Germany had approximately 349,000 farms with an aggregate workforce of 850,000 and comprising more than two hectares of arable land each. The agri-

cultural, forestry and fishery sector in 2007 accounted for 0.9 percent of Germany's gross value added (GVA) and 2.14 percent of our nation's workforce. The agricultural sector used 16.9 million hectares of land, which is approximately 48 percent of Germany's surface area. Of this land, just under 12 million hectares were used for crop production and just under 5 million hectares for permanent pasture.

A considerable amount of river, lake and groundwater pollution is attributable to conventional farming, which entails extensive use of fertilizer and pesticide. The consequent diffuse input, which is caused by erosion, percolation and other factors, is responsible for the lion's share of nutrient input into our groundwater and surface waters. Environmental quality thresholds are also exceeded in German water bodies owing to pesticide spray device cleaning, pesticide spraying accidents, and improper pesticide use. Diffuse inputs often times reach their maximum levels in cases where unduly high numbers of animals are pastured in areas that are susceptible to inputs.

Nutrient input remains as high as ever in Germany despite (a) the fact that our agricultural sector is subject to water protection regulations (e.g. the Nitrate and Pesticide Directive, as well as Germany's Fertilizer Regula-



tion and Pesticide Act); (b) voluntary implementation of additional water protection measures in accordance with our agricultural environmental protection program; and (c) the success of these measures. Of Germany's approximately 1,000 groundwater bodies, 370 fail "good status" – 350 of those due to inputs from diffuse sources. Moreover, some 7,400 of our 9,900 surface water bodies are subject to significant diffuse pressures. In addition, the fact that many German water bodies are classified as heavily modified is chiefly attributable to land drainage and agricultural activities.

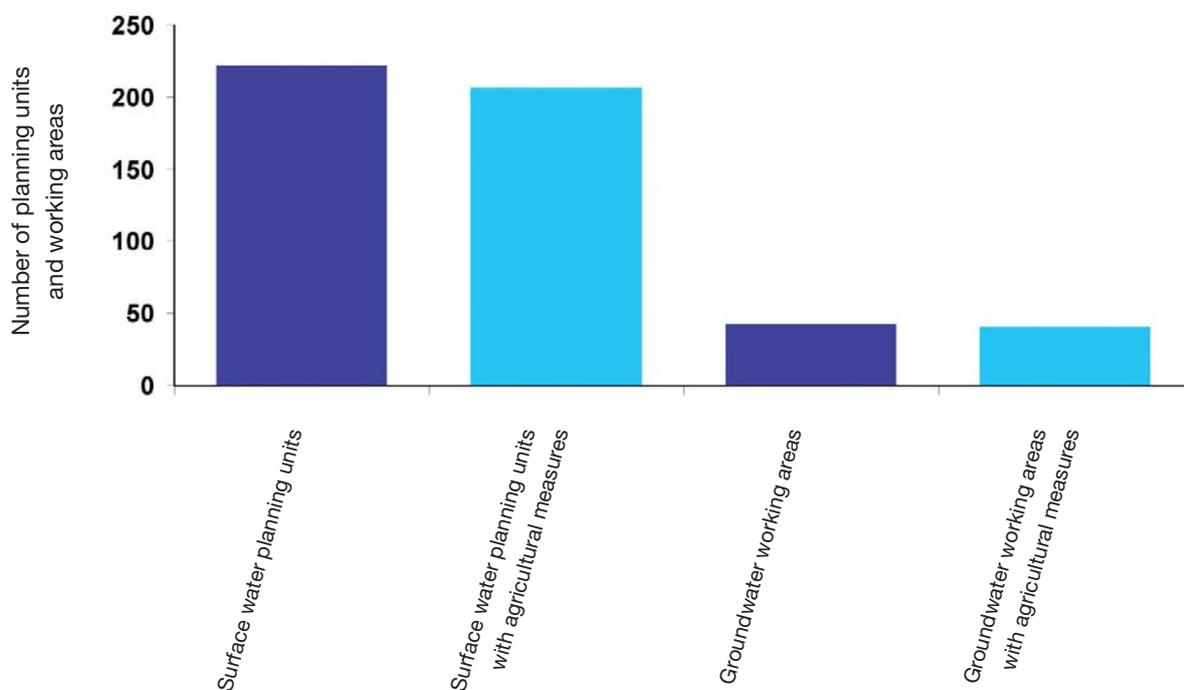
Envisaged measures

As Figure 26 shows, agricultural measures are slated for realization in virtually all German planning units and working areas.

Our nation's Water Framework Directive programmes of measures contain numerous actions aimed at substantially reducing agricultural pressures. Many of these actions were jointly elaborated by water management authorities and agricultural sector actors and exceed the minimum statutory requirements for

Figure 26: Planning units and working areas in which agricultural measures are to be carried out.

Source: Portal WasserBLICK/BfG; last updated 22 March 2010.



adherence to good professional practice. These actions are as follows:

- Imposing restrictions on the application conditions for mineral fertilizer
- Expanding the scope of catch cropping and undersowing
- Agricultural activities are to be extensified on a case by case only
- Increased use of ground coverings and of tillage methods that protect the soil
- Applying liquid manure in a water-protective manner, e.g. via modified application techniques, protected zones, reducing application timeframes, and increasing storage capacities
- Banning the use of pesticides
- Expanding the scope of organic farming
- Establishing buffer strips; inherently dynamic water body development
- Providing farmers with additional and more relevant information and advisory services

Organic farming is very promising from both an ecological and economic standpoint. Expanding the scope of organic farming will reduce the use of chemical pesticides and nitrogen input into groundwater. Moreover, consumer demand for organic products is rising steadily and the organic-food market has been growing for years.

The Groundwater protection through organic farming program that was started in 2008 for the Rhine and Danube river basins demonstrates how more environmentally compatible land management methods can be implemented. One of the core elements of this program is providing farmers with helpful advice and

enabling various actors to forge productive partnerships with each other. However, our main water management problems can only be solved if the water management methods used by conventional farmers are brought into line with water protection requirements.

In early 2001 the German government officially made strengthening the organic farming sector an agricultural policy objective – namely that 20 percent of Germany’s arable land should be used for organic farming by 2010. However, the current German administration has modified this objective to allow for the fact that the decision to switch to organic farming is up to each individual farmer. The new policy has put organic and conventional farming on an equal footing. Since 2003, organic farming in Germany has been growing steadily but at a very slow rate, in terms of arable land used and number of farms. Arable land use for organic farming increased at a rate of 2 to 5 percent per year between 2003 and 2007, accounting for 5.1 percent of all German farmland in 2007 (source: Fortschrittsbericht 2008 der Bundesregierung zur nationalen Nachhaltigkeitsstrategie [Federal Government 2008 progress report on the German sustainability strategy]).

More recent evolutions such as the rising demand for biomass for energy production are spurring intensive farming – a trend that undermines water protection.

Effectiveness of the measures

The vast number of the envisaged agricultural sector measures exceeded the scope of the legal requirements at the time the first river basin management plans were elaborated. These measures are being implemented voluntarily and have been granted the necessary funding. Many of our state governments have defined regional development areas for Water Framework Directive implementation purposes and are carrying out the mandated supplementary measures mainly in these highly polluted regions.



One of the keys to the success of Water Framework Directive measures is planning and implementing them locally in collaboration with the farmers concerned, as well as with any soil and nature protection organization representatives. However, the economic concerns of farmers whose main aim is to improve yields are oftentimes incompatible with ecological exigencies. Consequently, highly efficient albeit cost intensive measures such as scaling back livestock inventories are seldom incorporated into programmes of measures. And although many programmes call for the installation of buffer strips, the five meter minimum width of these strips called for by the Water Resources Act does not always allow for adequate ecological improvements (the law went into effect on 1 March 2010). Hence in order to meet the Water Framework Directive objectives, it will be necessary to make further efforts that exceed the scope of the envisaged measures.

Measure cost and implementation

The cost of implementing the aforementioned measures will be assumed by Germany’s farmers. However, Germany’s states have incorporated the vast majority of the measures into rural development subsidies (see Table 3).

Table 3: Overview of water body related rural development subsidy programmes in the German states

	BW	BY	BB/ BE	HH	HE	MV	NI/ HB	NR W	RP	SL	SN	ST	SH	TH	Subsidy range [€/ha]
Extensive pastureland use	X	X	X	X	X	X	X	X	X	X	X	X	X	X	70-200
Livestock inventory restrictions	X	X	X				X	X	X	X	X	X	X	X	
Ban on the use of pesticides	X	X	X	X		X	X	X	X		X	X	(X)	X	40-156
Ban on the use of fertilizer		X	X	X			X	X	X	X	X	X	(X)	X	
Ban on ploughing up	X	X	X		X		X	X			X		X		
Converting cropland to pastureland		X					X	X	X	X	X	X		X	124-491
Discontinuing use of liquid manure			X	X				X					(X)	X	
Extensive pasture use	X	X				X					X	X	X	X	108-200
Marshes and wet meadows			X			X					X			X	
Organic farming		X	X	X	X	X	X	X			X	X	X	X	
Fertilizing based on soil analyses	X					X			X					X	
Soil and erosion protection via undersowing, catch cropping and greening measures	X			X	X		X	X	X		X	X	X	X	45-90
Mulch sowing and/or direct sowing	X			X			X				X	X			40-120
Varied crop rotation	X	X	X					X	X					X	20-50
Ecologically safe pasture use in vulnerable areas		X	X		X				X						
Avoiding the use of sewage sludge and liquid manure on subsidized fields	X		X					X					X	X	
Limiting nitrate threshold level exceedance												X			
Set-aside of arable land		X	X				X		X		X			X	
Farming set-aside land in a manner that protects groundwater resources							X						X		
Buffer strips around fields and water bodies	X	X		X	X		X	X		X	X	X	X	X	55-740
Protection and development of fens and marshes			X			X	X				X	X	X		
Extensive aquaculture		X									X			X	
Development of semi-natural water bodies	X	X			X	X	X		X		X	X	X	X	
Extensive water retention in wet areas			X			X								X	
Providing advice and training	X										X		X		
Planning and conceptualization		X	X		X	X			X		X	X			
Publications and PR						X					X		x		
Financing model projects											X				

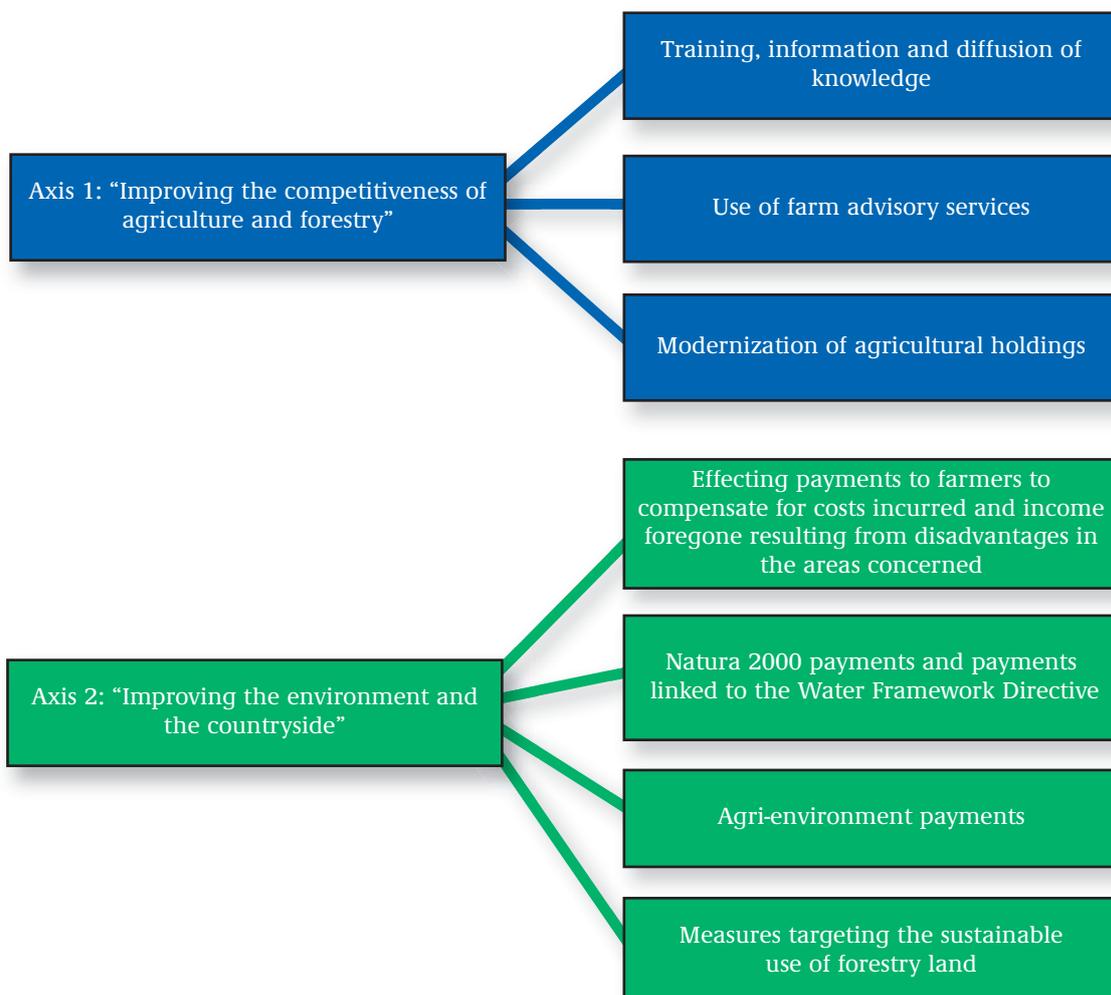
Although few river basin management plans or programmes of measures say anything about financing, it is safe to assume that the second pillar of the EU's common agricultural policy (CAP) will make a key contribution to financing the Water Framework Directive measures. The EAFRD (European Agricultural Fund for Rural Development) Regulation comprises the statutory framework for what is referred to as the second pillar of the CAP, for the years 2007 to 2013. Germany has at its disposal a total of 13.2 billion euros for this period – 8.1 billion from the EAFRD and the remainder from the federal budget. In addition, each state has the option to add funds from its own budget to this amount, which means that an additional 3.2 billion euros will be avail-

able for rural development subsidies. Thus a total of 16.4 billion euros will be available from 2007 to 2013 to subsidize agricultural measures and projects for all aspects of rural development that exceed the requirements prescribed by law. About one fifth to one third of these funds will be used for water protection measures, depending on the state concerned.

The payments entailed by the first two axes of the EAFRD Regulation are particularly important from a water protection standpoint (see Figure 27).

Of the aforementioned EAFRD funds, German states will collectively receive around 3.5 billion euros

Figure 27: The key water protection related measures called for by the EAFRD Regulation.



(26.5 percent) during axis 1 and 5.5 billion euros (41.8 percent) during axis 2. The allotted amounts vary considerably within the various states, however. Axis 3/Wider Rural Development (“Actions aiming to improve the quality of life in rural areas and the diversification of the rural economy”) and Axis 4/Leader (“a bottom-up approach aiming to build local capacity for employment and diversification of the rural economy”) could potentially strengthen water protection efforts in the coming years. For example Axis 3 concerns itself with cultural heritage conservation, which for some German states will also entail subsidies for water body restoration.

Axis 2 revolves around “measures aiming to improve the environment and the countryside including measures targeting the sustainable use of agricultural and forestry lands”, which in many cases make the most valuable contribution to water protection. 23.5 percent of Germany’s public EAFRD funds is earmarked for such measures, although here again the allotted amounts vary considerably within the various states.

In addition, Article 38 of the EAFRD Regulation stipulates that “compensation shall be granted (...) to farmers in order to compensate for costs incurred and income foregone resulting from disadvantages in the areas concerned related to the implementation of Directives 79/409/EEC, 92/43/EEC and 2000/60/EC.” This option has not been used in Germany to date owing to the fact that our initial program of measures centred around voluntary and cooperative measures. But now the programmes of measures have been submitted and the European Commission has hammered out the details for implementation of Article 38. Thus the German states now have the option to align their rural programmes with the exigencies of rural development. It remains to be seen, however, to what extent the Article 38 measures will be applied in Germany.

6.3.2 Municipalities, households, and the industrial sector

Household, municipal and industrial water pollution is mainly attributable to the input of nutrients, contaminants, and oxygen depleting substances.

Pressures

More than 10 billion cubic meters of sewage is generated in Germany each year, more than half of it sewage and the remainder external water and rainwater. This sewage is treated at nearly 10,000 sewage treatment plants before being discharged into water bodies. Despite progress in sewage treatment technology, the pollution loads from point sources remain unduly high in domains such as non-readily biodegradable industrial and household contaminants that cannot be satisfactorily filtered out by sewage treatment plants. Nutrient and heavy metal inputs from rainwater runoff also pose a problem in this domain.

According to Germany’s Federal Water Act (Wasserhaushaltsgesetz, WHG), the contaminant load in any given discharge must be reduced to the lowest level allowed by state of the art technology. Germany’s Waste Water Ordinance (Abwasserverordnung) stipulates which substances are to be filtered out of sewage, and which are not allowed to end up in it in the first place. Inasmuch as household and industrial wastewater contains widely differing contaminants, the Regulation differentiates between the various types of sewage sources. A substantial portion of Germany’s industrial sewage comes from slaughterhouses, breweries, distilleries and dairies, which are integrated into the public sewage grid since most of the substances in this sewage are readily biodegradable. But this is not the case with sewage from the chemical industry, mechanical engineering or automaking sectors, whose discharges contain substances that are not readily biodegradable and that thus are for most part treated in proprietary facilities using special procedures.

Pollutants also percolate into water bodies from abandoned industrial sites. For example in the Elbe river basin district, residual waste from abandoned industrial sites in the former East Germany has resulted in a situation where millions of tons of hazardous waste await removal, and groundwater extending over a considerable area needs to be decontaminated.

The hazardous-substance load in the state of Saxony-Anhalt’s groundwaters and surface waters is mainly attributable to chemical industry and mining inputs. Nearly 80 percent of the chemical plants in the former East Germany are located in the state.



Rainwater inputs can also cause water pollution. Many older stormwater tanks in hybrid systems are not state of the art, and some 40 percent of rainwater overflow tanks are unable to handle overflows properly. As a result, during heavy downpours in particular, a mixture of for the most part untreated rainwater and wastewater is discharged into rivers. This in turn engenders a situation where – apart from the consequent organic load on ponds, rivers and lakes – zinc, copper and the like from roofs, rain gutters and tire friction are carried by the water in both compartmentalized and hybrid systems. Thus rainwater treatment in urban areas needs to be improved.

Abrupt discharges can also induce a hydraulic load, particularly in water bodies that are located below urban areas with a high degree of soil sealing. Inasmuch as rainwater that accumulates on and is channelled by such surfaces alters the natural water balance, insofar

as possible such rainwater should be handled in a natural manner, particularly in densely populated areas, via percolation systems as well as using and increasing evaporation. If this is not possible, then rainwater runoff should be collected in sufficiently large retention basins.

Excessive land use and land development for households, industry, and traffic infrastructures has had and continues to have a serious impact on our natural environment and the countryside. In Germany, each day roughly 110 hectares of land is gobbled up by one kind of land development or another; the government's goal is to reduce this to 30 hectares. Unfortunately, continued extensive land use will tend to increase rather than decrease the volume of rainwater inputs into water bodies.

Envisaged measures

The envisaged remedial measures for municipalities, households and industry centre around building and expanding industrial and municipal wastewater treatment plants, including construction of numerous relatively small facilities. In addition, plans call for integrating additional households and factories into the public sewage grid, mainly in Eastern Germany (see Figure 28).

Such measures are envisaged for virtually all of Germany's planning units in the municipal and household sector, but for industrial facilities only in some areas that discharge large amounts of wastewater, that are subject to EU reporting requirements pursuant to the EPER and PRTR pollutant discharge registers, and whose heavy-metal or other emissions jeopardize achievement of environmental objectives.

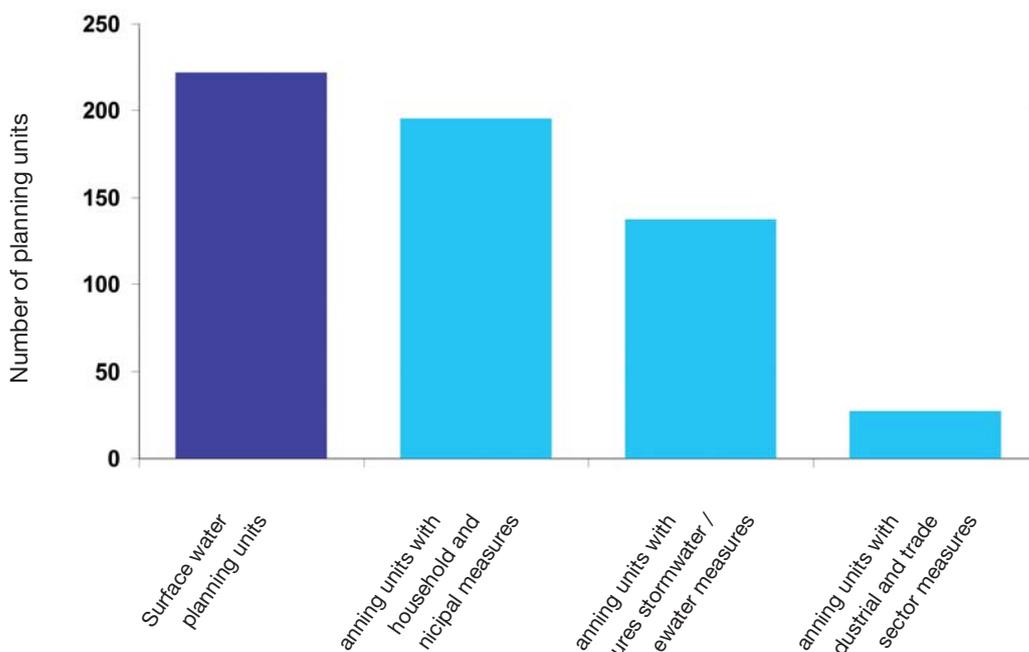
Measures aimed at reducing inputs from abandoned industrial sites will be carried out in selected river basins.

For historical reasons, the envisaged measures in Saxony-Anhalt (Elbe river basin) will centre around the Bitterfeld/Wolfen and Buna/Leuna locations in an area formerly known as the Chemistry Triangle, and will be implemented within the framework of large scale ecological projects for remediation of contaminated sites. Already approximately 70 million euros is being spent annually on preventing further spread of the pollutants involved, most of which are found in sediments extending over sizeable water body and floodplain areas. Hence a sediment management concept will be elaborated for the Elbe river basin and the Elbe river and its tributaries, with a view to developing solutions that will allow for ecologically and economically viable handling of contaminated sediments.

The rainwater drainage optimization activities slated for realization in 137 of 225 planning units will involve construction of new facilities such as rainwater retention systems and retention soil filters that will help reduce both hydraulic and pollutant loads. In addition, in the coming years it will be necessary throughout

Figure 28: Envisaged measures in planning units for the municipal, household and industrial sectors.

Source: Portal WasserBLiCK/BfG; last updated 22 March 2010.



Germany to upgrade or remediate defective sewage infrastructure elements such as sewage mains, with a view to reducing runoff that percolates through sewage system leaks. External water runoff in Germany currently amounts to 2 billion cubic meters annually.

Effectiveness of the measures

Contaminant loads will be reduced via the following measures: sewage treatment plant expansion and construction; use of new technologies; integrating additional households and factories into the public sewage grid; and decentralizing treatment of wastewater in small treatment plants. Also significant in this regard are envisaged measures aimed at optimized rainwater drainage, with a view to local rainwater retention, purification and percolation, insofar as possible.

Extensive soil sealing and the consequent high levels of rainwater discharge into water bodies can only be reduced through regional planning measures such as greater use of derelict urban land, installing rainwater percolation systems in new constructions, or requiring that rainwater runoff be channelled to a nearby location.

Measure cost and implementation

Inasmuch as responsibility for sewage treatment falls to municipalities in Germany, local and regional authorities are also responsible for financing construction and operation of their sewage treatment plants. The financing in this regard is based on the polluter pays principle, in that sewage treatment costs are funded via sewage charges imposed on dischargers that are connected to the sewage system. Private sector sewage treatment plants are financed and operated by the relevant property owners, who are also eligible for government subsidies in this regard. Industrial sewage treatment plants are likewise financed and operated by the company involved.

The state of Baden-Württemberg has earmarked approximately 400 million euros for sewage treatment measures in the Rhine and Danube river basins. The consequent costs will (as is now the case) be covered by sewage charges. Baden-Württemberg will also be providing approximately 40 million euros in funding for these projects, via the state water resource management directive titled *Förderrichtlinien Wasserwirtschaft*.

6.3.3 Shipping

Shipping is detrimental to hydromorphology via pressures such as the following: erosion; waterway straightening and deepening; cutting off meanders from their rivers; degrading river continuity via barrages; and possible backwater-induced eutrophication.

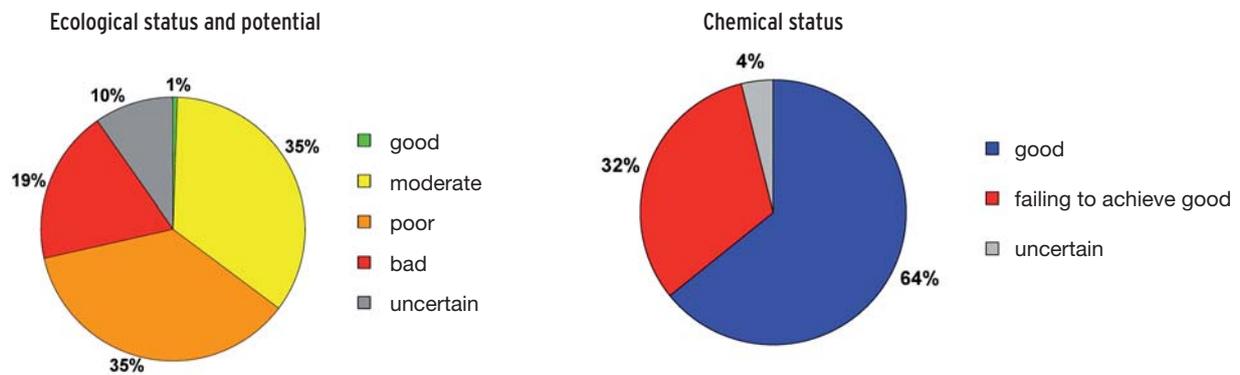
Pressures

Germany's federal waterways extend over nearly 7,300 kilometres; 75 percent of these waterways are rivers and the remaining 25 percent are canals. In view of the inherent safety and environmental friendliness of maritime and inland water transport, our waterways play a key role in our nation's economy and will remain an indispensable transportation modality in the coming years as well.

However, coastal regions and rivers are used for a broad range of in some cases competing uses, shipping lanes being only one of them. Using a river as a fairway inevitably has an impact on its waters and floodplains, including structural changes such as course shortening, embankments, straightening, and deepening – all of which can severely damage water body ecology and make it difficult to achieve “good



Figure 29: Ecological status and potential and chemical status of German waterways, in relation to water body length.
 Source: Portal WasserBLiCK/BfG; last updated 22 March 2010.



ecological status”. Such anthropogenic pressure have resulted in most of Germany’s waterways being classified as heavily modified. One exception in this regard is the German Binnemelbe, which despite the fairway deficiencies it exhibits will be able to achieve “good ecological status” via improvement measures.

The graphic below illustrates the current status of Germany’s waterways, in relation to water body length. 53 percent of our nation’s waterways have been classified as heavily modified and 23 percent as artificial; thus these water bodies are subject to the Water Framework Directive’s “good ecological potential” and “good chemical status” requirements.

The continuity of Germany’s waterways for fish and other aquatic organisms is disrupted by approximately 340 impoundments, which interfere with natural waterflow and sediment transport. Rivers that are deprived of sediment dig deeper into the substrate, and this in turn reduces groundwater levels in the areas near the river. Moreover, the river flows very slowly in weir backwater areas, which are also subject to nutrient input from farms and sewage treatment plants. The consequent elevated phosphate levels can spur algae growth and eutrophication. In any case, many weirs are used not only for shipping, but also for hydro power and other purposes.

Envisaged measures

Apart from hydromorphology optimization and continuity restoration measures, some state governments have elaborated specific hydromorphology improvement programmes for their waterways, and have harmonized them with the relevant federal programmes. Such measures will be implemented first and foremost in locations where they will not impede shipping, with a view to promoting (a) restoration of the relevant water bodies at a natural rhythm; and (b) the development of flora and fauna habitats. The following measures are envisaged in this regard, among others:

- Linking ox-bows and side channels to the main watercourse
- Dismantling embankments or replacing them with natural cospes to protect riverbanks and render bank lines more open
- Gravel and sand aggradation; installing structural elements composed of dredging material
- Installing spurs or rebuilding bankheads to create low-flow zones
- Conservation and development of natural floodplain forests

In view of the particular importance of river continuity, it is a key river basin management objective that must be implemented for German federal waterways as well. But inasmuch as commercial waterway continuity cannot be

restored by merely dismantling or constructing a weir, the envisaged measures centre around installing facilities that allow for unimpeded fish migration. The Federal Ministry of Transport, Building and Urban Development (Bundesministerium für Verkehr, Bau und Stadtentwicklung) is currently working closely with state governments and the Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit) on elaboration of a concept that will allow for achievement of river continuity at German waterway weirs, in accordance with the Water Framework Directive.

Effectiveness of the measures

Various research projects and federal-state initiatives are currently investigating the possibilities and limits entailed by eco-friendly management of Germany's waterways, with a view to developing measures that will create ecologically valuable habitats and that will not interfere with waterway use. Useful experience has already been acquired and regulations have been promulgated concerning the establishment of upstream river continuity, particularly for smaller water bodies. In addition, the downstream river continuity needed for fish protection needs to be coordinated with hydro power plants. However, owing to the high costs and numerous usage related restrictions involved, some reaches of German waterways are not amenable to immediate morphological optimization measures. In such cases, the so called stepping-stone principle is applied – which basically means that quality structural reaches (stepping stones) are established along a water body that provide sufficient habitats to keep a benthic community intact, and a platform from which fish and invertebrates can migrate to lower quality areas. In order for this concept to be implemented successfully, the various stepping stones must not be unduly small or too far apart.

Measure cost and implementation

Responsibility for Germany's waterways is shared by various actors, whereby primary responsibility lies with the Federal Waterways and Shipping Administration (Wasserstraßen- und Schifffahrtsverwaltung des Bundes, WSV), which until recently was responsible solely for water discharge and for ensuring that German waterways are kept open. However, the WSV's sphere of

responsibility now includes establishment of river continuity and water resource management, and thus now includes achievement of the Water Framework Directive's ecological river basin management goals. Our nation's state governments are responsible for water quality, flood protection, water resource and ecologically oriented construction measures for Germany's waterways.

There is no inherent contradiction between water protection and shipping - and without maritime and inland shipping Germany's transport policies can never hope to be environmentally and climate friendly. To achieve this goal, we need solutions that allow for sustainable use of our waterways and that strike a viable balance between ecological and economic concerns. The federal government's avowed goal is to achieve sustainable development of our waterways based on an integrated waterways policy, so that these waterways serve not only as transport arteries but also as habitats.

6.3.4 Hydro power

Hydro power use exerts environmental pressure via river flow impedance, hydromorphological changes, degrading river continuity, and backwater formation, which can provoke eutrophication.

Pressures

Hydro power use has a substantial impact on our water bodies and covers 3.4 percent of Germany's total energy demand. More than 90 percent of our hydro power is generated by some 400 large hydropower plants (i.e. facilities with more than 1 megawatt of installed output), with the rest originating from more than 7,300 smaller plants. The importance of hydro power varies from one river basin to another. A substantial portion of Germany's usable hydro power potential



is located in the southern states, thanks to their mountains, which provide the necessary slopes, and rivers, which provide sufficient water.

Hydro power is the second largest energy source in the state of Bavaria, where it met 16 percent of energy demand in 2004. Only 5 percent of the state's roughly 4,200 hydro power facilities have installed output exceeding 1 megawatt. However, these facilities produce more than 90 percent of the state's electricity.

Although hydro power is a virtually carbon-neutral resource, hydro power plant construction and operation have a highly deleterious effect on water body ecology, primarily owing to disrupted river continuity, as well as high fish mortality rates due to the absence or inadequacy of the requisite protective elements. This in turn makes it difficult for fish and benthic invertebrates to spawn, feed, and migrate. Moreover, hydro power facilities interfere with natural bed load transport.

Article 33 of Germany's Federal Water Act, that came into effect on 1 March 2010, stipulates that water impoundment, abstraction and drainage are only allowed insofar as sufficient minimum water passage is maintained. Article 34 of the Act stipulates that an impoundment facility may only be built, substantially altered, or operated insofar as water body continuity is maintained or restored to the point necessary to achieve the management objectives for the water body in question. Hence water body use is only admissible if suitable measures are taken to protect the fish populations affected, so as to ensure that migrating fish can pass through hydro power facilities without being harmed in any manner whatsoever.

Fish migrating upstream are prone to injury and death from hydro power turbines and screens, which in impoundment chains with successive facilities can jeopardize the existence of entire populations of fish. Moreover, water impoundment and inadequate minimum flows can provoke habitat loss. The aim of the European Eel Regulation (1100/2007/EC), which came into effect in 2007, is to reduce anthropogenic eel mortality to the point where at least 40 percent of eel can reach their spawning ground.

Envisaged measures

Numerous programmes and measures aimed at restoring impoundment continuity are slated for implementation in Germany's river basins (e.g., the state of Bavaria's river continuity concept), as are hydromorphological optimization measures (see Figure 24). These programmes and measures include the following:

- Establishment of continuity for fish fauna by constructing or upgrading fish ladders and by dismantling or installing weirs
- Implementation of minimum-flow regulation solutions for diverted streams
- Hydromorphology improvement
- Installation of fish protection elements, e.g. via screen system upgrading in conjunction with fish ladders, so as to create bypasses or the like

On renewal of hydro power facility permits or in cases where facility operators undertake voluntary measures, river continuity and minimum channel flow will be improved incrementally in diversion stretches. For newly built facilities, the relevant ecological criteria are provided for by the applicable regulations. In the event of any conflict with water dependent nature conservation areas or the monument protection requirements at old weirs, the relevant pros and cons must be carefully weighed. In addition, previously established rights to existing facilities oftentimes cause problems if upgrading or retrofitting is necessary.

Effectiveness of the measures

Engineering structures will only have the desired effect if they are monitored continuously. A fish ladder must be installed in such a way that it works properly and the fish can find it both in larger and smaller areas. Access to fish ladders is often obstructed by driftwood, thus necessitating regular maintenance of such facilities. Protective elements must be dimensioned in such a way that migrating fish do not end up in the turbines. Flow conditions and technical equipment should enable the fish to navigate the hydro power facility's tail water

safely and easily. In large hydro power plants, fish injury and death can be reduced via turbine management measures that, for example, prevent the fish from being harmed, in conjunction with a warning system that allows for visualization of migrating fish.

Measure cost and implementation

The technology that allows electricity to be generated via turbine driven hydro power plants has been in use for more than a century, as have most extant facilities and the franchises thereof. Although the currently applicable water protection requirements must be met for newly built hydro power facilities, it is often difficult to implement modern water protection solutions in old facilities before their franchises expire. Various instruments and subsidies are available that make such implementation easier for the operators concerned while still improving water body ecology.

In recent years, measures aimed at establishing river continuity have been implemented on the Lahn river using funds from the fisheries tax or via compensatory measures under Germany's nature conservation laws.

One of the main subsidy modalities in this domain is promulgated by Germany's Renewable Energy Act, which makes increased remuneration for hydro power electricity dependent on substantial ecological status improvement. If applied properly and steadfastly, this framework will make it possible for hydro power use and nature and water protection to be compatible with each other, particularly when it comes to modernization of large scale hydro power plants.

In view of the fact that water protection and climate protection go hand in hand, federal and state government agencies set a goal of increasing renewable-energy production while at the same time improving water body ecology.

6.3.5 Mining

The water resource problems engendered by mining mainly involve surface water and groundwater scarcity, point source and diffuse inputs, and hydromorphological damage.

Pressures

Most of the mining activities in Germany revolve around lignite, hard coal, rock salt and potash. From a water protection perspective, however, the impact of past ore mining activities in the Erzgebirge and Harz regions, and elsewhere in Germany is also a major factor. Germany's three largest lignite deposits are located in the Rhine, Lausitz and Middle German regions, whereas most of our hard coal is mined in the Ruhr and Saar regions. Economically important salt deposits comprise the largest mining areas in the states of Hesse and Thuringia.

Mining activities can have a serious effect on surface waters and groundwaters during the active life of a mine and for many years thereafter. Mining oftentimes entails major interventions in the natural water cycle, particularly in the case of open pit mining, which necessitates lowering of the groundwater level that can be deleterious for adjacent aquatic and terrestrial ecosystems. Restoration of natural groundwater levels in Germany's lignite mining regions will take decades due to the fact that such mining has been going on for more than a century in some areas. In addition, depressed groundwater levels provoked by lignite mining are the cause of the "poor quantitative status" of groundwater in certain portions of the Maas, Rhine, Elbe and Oder river basins.

Hard-coal mining in some parts of the Ruhr region have resulted in large scale mining subsidence that would in turn result in the inundation of large areas if groundwater levels returned to their natural state. Hence it is necessary to lower the groundwater level on an ongoing basis in order to keep it sufficiently below ground level. Other measures in this regard include (a) diverting watercourses or building levees for them;

and (b) flow regulation by building transverse structures such as weirs and installing pumping facilities.

In the Weser river basin district, where potash mining predominates, a portion of the saltwater generated by this activity is discharged into the ground, while the remainder is discharged directly into the Werra river. Studies have shown that naturally occurring rock water containing underground saltwater rises to the surface or to higher groundwater levels, whereupon some of this water is discharged into the Werra river as a diffuse input. There are also concerns that salt intrusions could contaminate aquifers. Another significant source of pollution in the Weser river basin district is diffuse heavy-metal input from abandoned ore mines in the Harz region.

When mining is discontinued, the question often arises as to what is to be done with the landscapes that to a great extent have been significantly altered by mining. The abandoned mining areas in the Lausitz and Middle German regions were turned into a recreational zone containing 46 artificial lakes that comprise a water body surface area amounting to 25,000 hectares. For this zone, it is necessary to keep the opencast mining pits filled with river water at all times, which abstracts large volumes of water from the nearby surface waters. Moreover, many of the mine dumps contain the mineral pyrite (an iron sulfide) which exhibits a strongly acid reaction on contact with water. The lakes thus formed are extremely acid (pH ranging from 2 to 4) and thus cannot be used at all. On the other hand, numerous recreational areas and excellent refuges for rare animal and plant species were created in former mining areas in the Elbe river basin.



Envisaged measures

The goal in river basins with mining activities is to reduce the negative impact of point and diffuse substance inputs on water bodies (see Figure 30) by reducing not only these inputs but also acidification and water abstraction, via the following measures:

- Treatment of mining related wastewater, mining pit water, and mine dump water with a view to reducing contaminant loads
- Construction of percolation water intake systems
- Construction of water retention systems or watertight walls
- Construction of retention basins or retention wells
- Covering or landscaping mine waste dumps; mine backfilling
- Supporting natural contaminant reduction processes; realization of wetlands, as well as impoundments
- In-depth investigations and conceptual studies

Groundwater level loss can be reduced using instruments such as impermeable walls of the type that were built in the Oder river basin district. Such walls prevent (among other things) groundwater outflow from the neighbouring Polish region to the Jänschwalde mining area.

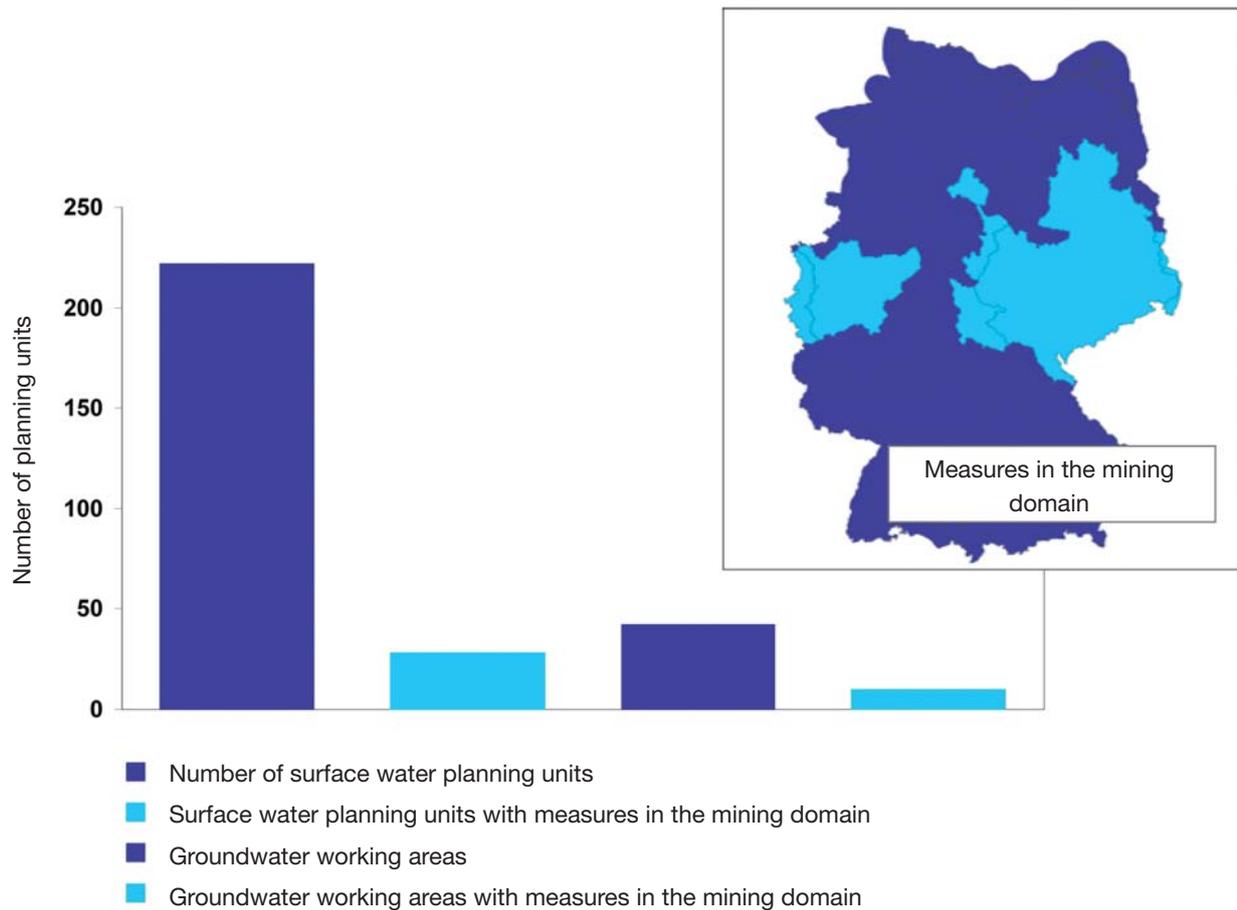
Effectiveness of the measures

Here too, the most effective measures are those that are realized on site, e.g. by reducing wastewater volumes, treating wastewater on site, or moving mine waste properly to empty pits. Minimizing diffuse water body inputs that in some cases occur decades after the mine has been shut down is a daunting task. In such cases, since diffuse sources cannot be measured reliably, the scope and origin of the load must first be clearly ascertained in order to ensure that effective countermeasures can be defined.

Oftentimes the water balance is severely disturbed to the point where timely improvement of the relevant status appears to be virtually impossible. And the cost of some measures is simply too high. Moreover, potentially risky measures such as mine lake flooding or mine waste removal may complicate the task of remediation.

Figure 30: Planning units and working areas in which measures in the mining domain are to be carried out.

Source: Portal WasserBLICK/BfG; last updated 22 March 2010.



Measure cost and implementation

Mine operators are required by law to assume the costs of measures aimed at minimizing the impact of mining activities on water bodies.

In the interest of reducing salty wastewater input from potash mining into the Werra river, a mining company (K+S) devised a 360 million euro package of measures that will substantially reduce the contaminant load. However, further action will be necessary in order to achieve the Water Framework Directive objectives.

Mining companies normally establish provisions to cover the costs of site cleanup that still incur even decades after the mines in question have been closed. However, these funds oftentimes do not cover the actual costs that are incurred, in which case other financing instruments must be found.

7 CLEAN WATER COMES AT A COST

The Water Framework Directive comprises an integrative and uniform approach that is predicated on the principle that ecological and economic concerns are not mutually exclusive. The Water Framework Directive is the first EU-wide regulation to establish explicit economic regulations for the implementation of environmental objectives.

The key pillars of this approach are as follows:

- Viable financing of the measures that will be used to achieve the mandated environmental objectives
- Implementation of the principle that the costs incurred by water utility and sewage treatment plant operators are to be fully recovered
- Taking account of the financial costs of environmental damage and the costs resulting from water resource overuse at the expense of future users
- Application of the polluter pays principle, i.e. water users are to make a reasonable financial contribution to water utility and sewage treatment costs
- Taking account of the commensurability of the costs of the measures

7.1 Where does the money come from?

Once the most cost efficient measures have been identified, paying for them is the lynchpin of Water Framework Directive implementation, since these measures can only be carried out and the mandated objectives achieved if the necessary funds are available. The capi-

Adequate financing of Water Framework Directive measures is crucial for achievement of the Directive's environmental objectives.



tal investment costs in the river basins that are relevant for Germany are expected to amount to approximately 9.4 billion euros, which works out to roughly 20 euros per capita and year for 2010-2015.

Most of Germany's Water Framework Directive measures will be financed from tax revenues, fees and charges. In cases where restrictions are imposed on user activities (e.g. via permit related limits), the users concerned will assume the cost of the measures. The key sources of financing for realization of our nation's programmes of measures are as follows:

- The following EU funds: European Agricultural Fund for Rural Development (EAFRD), the European Development Fund (EDF), and the European Regional Development Fund (ERDF)
- Federal subsidies, pursuant to the German Act on improvement of the agricultural infrastructure and

of coastal protection (GAK; Gesetz zur Verbesserung der Agrarstruktur und des Küstenschutzes)

- States and municipalities with funds from tax revenues, as well as revenue from fees and charges for water abstraction and discharge

7.2 The polluter pays principle – a key financing instrument

Implementation of the polluter pays principle will also generate considerable financing for Water Framework Directive measures. According to the polluter pays principle, water users must assume the cost of mitigating or eliminating the ecological damage engendered by their water use. This also promotes cost transparency. The general public is only called upon to pay in such cases if the polluter is unavailable or unknown.

The polluter pays principle is a basic tenet of EU environmental policy and of the Water Framework Directive.

The polluter pays principle and the consequent allocation of environmental and resource costs are mainly implemented in Germany via statutes and regulations that relate to products, manufacturing processes and methods and that promulgate requirements. By law, producers and manufacturers are obligated to limit their emissions or other water loads to a defined level that is based for example, on emission limit values for industry, minimum standards for hydro power plants, or the tenets of good professional practice in the agricultural sector.

7.3 Basic principles of the water pricing policies of tomorrow

The Water Framework Directive stipulates that by 2010 the member states “shall take account of the principle of the costs of water services, including environmental and resource costs, having regard to the economic analysis conducted according to Annex III, and in accordance in particular with the polluter pays principle.” This means two things. First, the operational costs for personnel,

installations, equipment, conduits, materials and operating resources must be covered by the rates charged for water. Second, these rates must include the environmental and resource costs entailed by water service provisioning. Moreover, in accordance with the polluter pays principle, the principle user groups – industry, agriculture and households – are required to make a reasonable contribution to the costs incurred by water utility operators. And finally, “water-pricing policies [are to] provide adequate incentives for users to use water resources efficiently, and thereby contribute to the environmental objectives of [the Water Framework Directive].”

Cost recovery and efficient resource use are the pillars of the water pricing policies of the future.

The cost-recovery principle is prescribed by state law throughout Germany and is documented in most German river basin management plans. During the first characterization in 2005, the level of cost recovery was found to be close to 100 percent on the basis of three representative regions (Middle Rhine, the Lippe sub-basin and Leipzig county). Other statistical data have become available in the interim based on some states’ supplementary empirical investigations, which confirm the earlier findings. The cost recovery levels were determined partly via government statistics, and partly by comparing the relevant operational figures.

Although only the operational costs were determined to the exclusion of environmental and resource costs, internalization instruments are now available in Germany that allow these costs to be factored into the equation. Environmental and resource costs are already being recovered from polluters via the following instruments: nationwide sewage fees; the water abstraction fees that are imposed in 11 states; and via the precautionary and compensatory measures resulting from restrictions imposed by operating permits.

8 THE WAY FORWARD

Germany's river basin management plans were submitted to the European Commission on 22 March 2010 following extensive consultation with water users, various interest groups, and interested members of the general public. The measures for the initial river basin management plan period must be implemented by 2012. The environmental objectives promulgated by the Water Framework Directive must be met by 2015; and by 2027 all such objectives must be met, including in cases where deadlines were extended.

The mandated Water Framework Directive deadlines are nothing if not ambitious, particularly in view of the uncertainty that remains concerning some of the assessment procedures and forecasts in connection with measure effectiveness. Monitoring will also be a major challenge, since questions such as the following have to be answered: To what extent is monitoring of agricultural measures necessary? How many investigations are needed to obtain representative data concerning water body status?

Moreover, we need to integrate more effective water protection instruments into the agri-environment. A decision needs to be made as to the point at which voluntary measures no longer suffice and thus usage restrictions need to be imposed and possibly compensated for. The EAFRD (European Agricultural Fund for Rural Development) Regulation calls for just such a procedure.

A major problem we face is a shortage of nature conservation and water protection areas. For example, sufficiently wide buffer strips along water bodies would promote the development of more natural habitats and would act as a retention platform for pollutant inputs. Land use pressures are being further intensified by biomass cultivation – for example in Northern Germany, where considerable tracts of erstwhile extensively farmed cropland are being used for energy crops.

Chemical status assessments should be based on the requirements laid out in the new Environmental Quality Standard daughter directive of the Water Framework Directive, which have yet to be implemented in all river basins. The threshold value for mercury in biota is probably being exceeded throughout Germany owing to elevated emissions from incineration plants, and the debate

as to whether further measures are needed for mercury and other toxins is already underway. Any minimization measures that are adopted in this regard would benefit not only rivers and lakes, but also oceans.

Water is a crucial economic factor. Economic programmes may make a growing contribution in the coming years to achieving sustainable water protection and should be incorporated more extensively into water resource management models. We need to build methods that allow for the identification and assessment of cost efficient measures, and simple and practical methods that factor in environmental and resource costs. The Water Framework Directive stipulates that the member states must develop efficient water pricing policies by 2010. This will entail implementation of water prices that allow for the recovery of all operational, environmental and resource costs, which in turn must be allocated to the main user groups in accordance with the polluter pays principle.

Climate change is set to take on increasing importance when it comes to implementing river basin management plans, which currently contain no indication to the effect that climate change is relevant for water resources. Nonetheless, the effects of climate change such as lengthy droughts, increased flooding, and the necessary adaptation strategies will inevitably become relevant for future action plans.

The water protection policies of tomorrow will centre around agriculture, energy generation, and transport policy (shipping). In order for us to achieve our ecological objectives, new ways must be found to reconcile the interests and concerns of the whole spectrum of water users. Classic methods alone will not suffice here because water protection necessitates the participation of all political actors, as well as constructive input from water users, state and federal water and agricultural authorities, municipalities, parties responsible for maintenance, and volunteers. If we can all pull together in this fashion, the Water Framework Directive offers us an opportunity to achieve outstanding water protection in an optimally efficient manner, and in so doing harmonize sustainable water management with other environmental protection objectives.

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LINKS TO THE RIVER BASIN MANAGEMENT PLANS AND PROGRAMMES OF MEASURES

International reports on river basins

Danube	http://www.icpdr.org/icpdr-pages/danube_rbm_plan_ready.htm
Elbe	http://www.ikse-mkol.org/index.php?id=513
Ems	http://www.ems-eems.de/7.0.html
Maas	http://www.meuse-maas.be/news.asp?idLayout=23&cid=68&lcid=39
Mosel-Saar	http://www.iksms.de/servlet/is/2873/
Oder	http://www.mkoo.pl/index.php?mid=17
Rhine	http://www.iksr.org/index.php?id=240

German river basin reports

Eider	http://www.wasser.sh/de/fachinformation/daten/aneider.html
Elbe	http://fgg-elbe.de/joomla/index.php?option=com_content&task=view&id=62
Maas	http://www.flussgebiete.nrw.de/Dokumente/NRW/Bewirtschaftungsplan_2010_2015/
Oder	http://www.luis.brandenburg.de/presse/WRRL_2009/BWP_Oder/National/BWP_Oder_2009.pdf
Schlei-Trave	http://www.wasser.sh/de/fachinformation/daten/anschlei.html
Warnow-Peene	http://www.luis.brandenburg.de/presse/WRRL_2009
Weser	http://www.fgg-weser.de/berichte_wrrl.html

Reports of states that share river basins

Baden Württemberg	http://www.uvm.baden-wuerttemberg.de/servlet/is/63467/
Bavaria	http://www.wasserrahmenrichtlinie.bayern.de/bewirtschaftungsplanung/bewirtschaftungsplaene/index.htm
Berlin	http://www.berlin.de/sen/umwelt/wasser/wrrl/index.shtml
Brandenburg	http://www.mugv.brandenburg.de/cms/detail.php/bb2.c.535758.de
Bremen	http://www.umwelt.bremen.de/de/detail.php?gsid=bremen179.c.9888.de
Hamburg	http://www.hamburg.de/wrrl-berichte/
Hessen	http://www2.hmuelv.hessen.de/umwelt/wasser/wrrl/umsetzung/BP/
Mecklenburg-West Pomerania	http://www.wrrl-mv.de/index_arb_2009.htm
Lower Saxony	http://www.nlwkn.niedersachsen.de/master/C5845107_N5507460_L20_D0_I5231158.html
North Rhine-Westphalia	http://www.flussgebiete.nrw.de/Dokumente/NRW/Bewirtschaftungsplan_2010_2015/
Rheinland- Palatinate	http://www.wrrl.rlp.de/servlet/is/8238/
Saarland	http://www.saarland.de/SID-3E724395-473D3B99/46834.htm
Saxony	http://www.umwelt.sachsen.de/de/wu/umwelt/lfug/lfug-internet/wasser_11703.html
Saxony-Anhalt	http://www.sachsen-anhalt.de/LPSA/index.php?id=38636
Schleswig-Holstein	http://www.wasser.sh/de/fachinformation/home/index.html
Thüringen	http://www.thueringen.de/de/tmlfun/themen/wasser/flussgebiete/oea/bewirtschaftung/daten/

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