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National Water Strategy

Draft of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety




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Foreword to the draft of the National Water Strategy

Water is the basis for all life. Springs, streams, rivers, lakes, wetlands, seas and oceans provide habitats for a wide variety of plants and animals. Water is not a typical commercial product, but a resource that has to be protected and treated with care. We rely on water for our food supply and our daily hygiene, we use it as a source of energy and a means of transport, for industry and agriculture.

We are accustomed to having enough high-quality water available whenever we need it. But water is increasingly coming under pressure as a resource. One reason for this is climate change. Summers are becoming hotter and drier. The groundwater level is receding, and there is less moisture in the soil. Crops and forests are suffering as a result. At the same time, however, heavy rainfall is occurring more frequently and snow less frequently. Cities, water reservoirs and sewage systems have to be adapted to the changing conditions.

A second environmental policy challenge compounds the issue, namely, water pollution caused by nitrate, phosphorous and various other substances*. This threatens the ecological status of water bodies and makes the abstraction and supply of drinking water increasingly complex and expensive.

Developments such as digitalisation, changes in lifestyle and the relationship between urban and rural areas, as well as in land use as a whole, also impact water management*.

It is time to develop a strategy to address the challenges we will face in the next few decades. That is why I am presenting the draft for a National Water Strategy.

Precautionary measures are at the core of this draft:

- Precautionary measures as a public service: in the future, too, everyone should be able to rely on a safe, affordable and efficient water supply and wastewater disposal – at all times and throughout Germany. Everyone should also be able to rely on effective risk* management in the event of extreme events such as heavy rainfall or water shortages.
- Precautionary measures for future generations: they, too, should be able to make sustainable use of water bodies and groundwater.
- And finally precautionary measures for plants and animals: healthy water and a functioning water balance* are key requirements for preserving the diversity of our flora and fauna.

The National Water Strategy is intended to help us better adapt to the upcoming changes – for example, when regions with high rainfall become regions with low rainfall. It also aims to raise society's awareness of the special value of water.

It also addresses how we in Germany can contribute to the sustainable use of water and water bodies in other countries and to making the human right to clean water and sanitation a reality.

My draft for a National Water Strategy incorporates many of the results of the national water dialogue and the national citizens' dialogue on water. I would like to thank everyone who actively participated in these two processes.

The water sector*, like the economy and society as a whole, is on the brink of a transformation. This will require considerable investment, e.g. to adapt the infrastructure. In the future, the impact on water should be taken into account in all areas of life, the economy and policy. This can only be accomplished if all stakeholders work together.

The draft of the National Water Strategy and its programme of measures is the Federal Environment Ministry's proposal for a roadmap outlining our common path.

This draft is ambitious and is intended as a basis for further discussions and consultations. My hope and aim is to turn this draft into a coordinated National Water Strategy as quickly as possible, with many people involved in implementation in their respective areas of responsibility.

I want to ensure that we have sufficient quantities of high-quality drinking water readily available, even 30 years from now. And that our wastewater disposal continues to function at a high level and the costs are distributed fairly, taking into account polluter responsibility and social justice. I am committed to further improving the status of water bodies and adapting water management to the consequences of climate change. And it is important not to leave the federal states, districts and municipalities to perform these tasks on their own, but to offer them guidance and support. This is why we need a National Water Strategy.

Federal Environment Minister Svenja Schulze

The Draft of the German National Water Strategy is a living document. As such, the document is subject to ongoing consultations with relevant state and non-state actors in an aim to leverage synergies to German efforts in other relevant sectors and to facilitate the implementation of the strategy and the fulfillment of its vision. Results of consultations that took place after the publication of the original Draft version are already taken up in the English translation of the draft. Both the German draft version and the English translation will be updated after this comprehensive consultation process has been completed.

List of abbreviations

BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit)
BREF	Best Available Techniques reference documents
CO_2	Carbon dioxide
DART 2020 and 2030	German Antibiotics Resistance Strategy (Deutsche Antibiotika-Resistenzstrategie)
EU	European Union
GHG	Greenhouse gas emissions
HELCOM	Helsinki Convention
LULUCF	Land use, land-use change and forestry
MSFD	Marine Strategy Framework Directive
OECD	Organisation for Economic Cooperation and Development
OGewV	German Surface Waters Regulation (Oberflächengewässerverordnung)
OZG	Online Access Act (Onlinezugangsgesetz)
OSPAR	OSPAR Convention
RCP8.5 scenario	Representative Concentration Pathway Scenario 8.5
SDG	Sustainable Development Goal
TN	Total nitrogen
TP	Total phosphorus
GHG	Greenhouse gases
UBA	Federal Environmental Agency (Umweltbundesamt)
UNEP	United Nations Environment Programme
UNICEF	United Nations Children's Fund
UNOPS	United Nations Office for Project Services
UNRWA	United Nations Relief and Works Agency for Palestine Refugees in the Near East
UNHCR	United Nations High Commissioner for Refugees
UN	United Nations
WASH	Water, Sanitation and Hygiene Network
WHG	Federal Water Act (Wasserhaushaltsgesetz)
WFD	Water Framework Directive

The facts provided in the baseline sections can be found with all sources in the scientific background on the strategy (see UBA texts 86/2021).

I. Motivation for and foundations of the National Water Strategy

I. 1. Why do we need a National Water Strategy?

Water management* faces enormous current and future challenges. Climate change, globalisation, demographic change, biodiversity loss and the ongoing use of surface waters and groundwater require resolute and strategic action to prevent the overuse of water resources and to ensure that the services provided by these ecosystems, which are also important for humans, are preserved in the long term under changing conditions.

In the National Water Dialogue, which the Federal Environment Ministry (BMU) and UBA conducted from October 2018 to October 2020, the wide range of water management* challenges were discussed with experts from the relevant sectors, strategic goals were formulated and initial ideas for solutions developed.[1] The dialogue process highlighted the need for a National Water Strategy and provided key input for the development of the strategy. This is the BMU's proposal for a National Water Strategy, which will be further discussed and finalised in the coming months. The aim is to produce a joint Federal National Water Strategy that has broad public support and is implemented by the German government, federal states, municipalities and all relevant water management* stakeholders.

A citizens' council made up of randomly selected citizens from different regions of Germany formulated their requests and recommendations for Federal policy, which are to be addressed and implemented as part of the National Water Strategy. From February to June 2021, the contributors engaged voluntarily in learning about this complex issue, participated in digital event formats and provided their input for citizens' recommendations. In various fields including awareness-raising, climate change, water quality and financing, they identified action areas, proposed measures and drafted the relevant texts together by consensus at an editorial meeting. Many of their requests and recommendations were incorporated in the process of strategy development and can also be found in the programme of measures.[2]

The National Water Strategy is not a stand-alone instrument, but must be seen in a European and global context. It will support implementation of EU water law and relevant multilateral conventions as well as the achievement of the Sustainable Development Goals of the United Nations 2030 Agenda.

This strategy addresses measures for marine conservation to the extent that the catchments of inland waters drain into the seas, e.g. measures to reduce nutrients discharged into marine waters. This strategy does not address marine conservation in the context of its economic use (shipping, fishing, raw material extraction, etc.) and the resulting pressures.

The National Water Strategy is addressed not only to the authorities at Federal, federal state and local level, but is deliberately aimed at all stakeholders in society. The aim of the strategy is to mobilise and combine all forces to take the crucial steps necessary to meet the long-term challenges facing water management* and water resources.

The National Water Strategy defines a clear vision for the future, sets goals for action and measures for key strategic issues. Equal consideration was given to environmental, economic and social aspects, in keeping with the guiding principle of sustainability*.

The National Water Strategy is interlinked with a number of other national strategies of the German government, including the Climate Action Plan 2045, the Climate Action Programme 2030, the German

[1] The documentation of this process (in German) can be found at https://www.bmu.de/wasserdialog.
[2] The documentation of this process (in German) can be found at https://dialog.bmu.de/bmu/de/process/54586.

Strategy for Adaptation to Climate Change, the peatland conservation strategy, the preliminary work on a trace substances strategy, the Biodiversity Strategy (NBS) and the government's Blue Belt programme.

Implementation of the National Water Strategy will not always be free of conflict with other public interests and goals. The strategy acknowledges these conflicts and shows different ways and means to deal with them constructively or to resolve them.

I. 2. Timeline and evaluation

The timeline for achieving the vision (see I. 4.) and strategic goals outlined in the strategy ranges from 2030 to 2050. However, it is clear that some first steps are now needed to achieve the goals. An initial programme of measures will therefore identify a number of specific steps to be taken gradually over the next few years up to the year 2030.

Monitoring success is part of the change process. It makes a significant contribution to evaluating the effectiveness of the strategy and the supporting measures. The extent to which the strategy is accepted and implemented in the social, political and economic context also provides an indication of its success. The first step will therefore be to evaluate the Water Strategy by regularly reporting on the activities in progress.

In the future, the BMU will publish a report on the implementation of the National Water Strategy every six years (similar to the Water Framework Directive). This will provide information in condensed form on the implementation status of the activities contained in the programme of measures.

I. 3. Basic principles of the strategy

The strategy is guided by the following basic principles:

- The precautionary principle* and the polluter pays principle*, as enshrined in Article 191(2) of the Treaty on the Functioning of the European Union, which says: "Union policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay." According to the **precautionary principle***, environmental damage must be prevented wherever possible, i.e. it should not occur in the first place. The **polluter pays principle*** has punitive character (by allocating environmental responsibility), but also has general and special preventive effects: the polluter pays principle* means that the party responsible for producing pollution is also responsible for remedying or paying for the damage done to the natural environment.[3] The opposite of the polluter pays principle* is the **community pays principle**, which is inherent in any regulation where external costs are not fully internalised.[4]
- The **principle of shared responsibility** completes the traditional triad of principles in environmental law. It reflects the realisation that environmental protection efforts made solely by the government are doomed to fail and that only the closest possible cooperation between the government and society, i.e. with the entities of its legal system, can bring about effective environmental protection. Protection of the environment is therefore also the

[3] Kloepfer, Umweltrecht in Deutschland, https://www.kas.de/c/document_library/get_file?uuid=45c5f490-f212-96fb-8894-84c2fee510dd&groupId=252038.

[4] UBA texts 73/2015, (p. 97), "Gerechtigkeit im Umweltrecht", https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/texte_73_2015_gerechtigkeit_im_umweltrecht.pdf.

responsibility of society. The principle of shared responsibility seeks to involve the members of the public affected and the business community through information and participation and thus strives for empowerment and equal opportunities. A consensus-based approach, involving balanced cooperation, increases the acceptance of decisions and improves the level of information among all parties, especially in terms of the knowledge contributed. The principle of shared responsibility is applied, for example, in the legislative process in the form of consultation procedures and in environmental agreements.[5]

- Several years ago, a fourth principle was added to the traditional triad of principles: the **principle of integration**. This requires the environment to be protected in its entirety – over and above German environmental law, which is traditionally still largely based on media or sectors.[6]
- The **principle of sustainability*** aims to align the three pillars of environmental, economic and social goals. The aim is to harmonise the goals of the current members of a society (intragenerational justice), of the current and future members of a society (intergenerational justice) and of countries (international justice).[7]
- According to the **principle of subsidiarity**, a government function should only be performed by a higher administrative and decision-making level if a lower level cannot be expected to perform the task and achieve the objective effectively.
- In accordance with the principle of **local public services***, it is the responsibility and right of the municipalities and districts to provide basic economic, social and cultural services necessary for human existence and to regulate these services within the framework of the local laws. Local public services* in the water sector* mean supplying people with safe drinking water and properly disposing of wastewater. An intact environment with functioning ecosystems and services is a basic prerequisite; safeguarding this environment is becoming an increasingly urgent issue as pressures on the environment increase.

I. 4. What is our vision and mission for 2050?

Within the scope of the two-year National Water Dialogue, the participants developed proposals for a common vision for water management* in 2050 and a mission for making it a reality. Thanks to the broad approval of these proposals in the National Water Dialogue, this vision and mission are to be included as guiding principles in the National Water Strategy, with only a few editorial changes.

The vision for 2050

The protection of natural water resources and the sustainable use of water in times of global transformation are implemented in all areas of life and the economy in Germany for the benefit of people and the environment.

The mission for 2050

A sufficient supply of high-quality water is essential for humans and nature, and for people's social and economic activities. This valuable resource must be preserved for current and future

[5] UBA texts 73/2015, (p. 84), "Gerechtigkeit im Umweltrecht", https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/texte_73_2015_gerechtigkeit_im_umweltrecht.pdf.

[6] Kloepfer, Umweltrecht in Deutschland, https://www.kas.de/c/document_library/get_file?uuid=45c5f490-f212-96fb-8894-84c2fee510dd&groupId=252038.

[7] UBA texts 73/2015, (p. 98), "Gerechtigkeit im Umweltrecht", https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/texte_73_2015_gerechtigkeit_im_umweltrecht.pdf.

generations. Protecting water as a habitat and as a central element in many ecosystems over the long term is therefore an important mission for our society. This is especially true in view of advancing climate change, dwindling water resources worldwide and the need to preserve the carbon storage function of wetlands.

Water bodies must therefore be managed to improve, restore and safeguard their functional capacity and resilience in the long term. This involves, among other things, a semi-natural* water balance* and more natural structures. The impacts of climate change and the need to conserve biodiversity must be taken into account accordingly. This requires an increasingly integrated and systemic approach to water body management*. This approach must reconcile habitat functions with the various water uses* humans want and need, under dynamically changing overall conditions. The aim of this approach is to ensure that:

- future public water services (drinking water supply, wastewater disposal) are guaranteed for people living in urban and rural areas, i.e. that a sustainable, adapted water infrastructure* is available;
- efficient technologies can be used to reduce water pollution caused by humans to a negligible level;
- the precautionary principle* and the polluter pays principle* are rigorously implemented in all sectors dependent on water;
- energy and resources are used sustainably;
- water bodies are developed and preserved as diverse habitats in a semi-natural* state and disruptions to the water balance* are kept to a minimum;
- the overuse of water resources is prevented, also taking into account the impacts of climate change; and
- precautions are taken to protect people and the environment, including the prevention of damage caused by extreme events.

A systemic approach of this kind extends beyond the current scope of water management* and must include stakeholders from other areas (such as agriculture, shipping, industry, commerce, tourism/recreation, nature conservation and research) and their interests and scope for action. It is important to keep in mind that Germany's landscape is essentially human-made, and it would be impossible to completely restore the natural state due to the historical, current and future uses of its water bodies.

The National Water Strategy addresses the expectations resulting from this approach for society as a whole as well as for the water sector* and other affected sectors. It outlines options and opportunities for sustainable development over the long term. In addition, it provides the framework for precautionary* and polluter pays* solutions as well as for necessary regulatory, legal and structural adjustments.

I. 5. The National Water Strategy in the context of European and international goals, developments and processes

It is not possible to achieve the vision and mission of sustainable water management* formulated above without considering developments at EU and international level. The way we deal with water as a resource and with water bodies is largely determined by an EU regulatory framework that must not

only be taken into account, but also further developed and shaped. Our international river basins must be managed in close cooperation with neighbouring countries.

The National Water Strategy builds on the existing EU legal framework and seeks to contribute to achieving the goals it defines. However, it also aims to provide guidance on where the EU legal framework needs to be further developed – also over and above water law – to ensure that the visions formulated in the following sections on selected strategic issues can be achieved. In many cases, the necessary measures can only be effectively implemented at European level or do not lie within the (sole) regulatory powers of the individual member states. The presentation of the National Water Strategy comes at a time when proposals for strategic direction in key policy and regulatory areas (agriculture, biodiversity, chemicals legislation and zero pollution action plan, circular economy and resource conservation, adaptation* to climate change, implementation of the EU climate change law incl. the 55% reduction target for greenhouse gas emissions by 2030 and greenhouse gas neutrality by 2045) are also being intensively discussed at EU level and are of great importance for sustainable water management*.

The water footprint* associated with our economies and consumption patterns is an expression of an increasingly interconnected world, in which decisions made at home have an impact on water resources and water bodies in other countries and regions that must be taken into account. Principles agreed at international level, such as the human right to safe drinking water and adequate sanitation, and the global water objectives, as formulated in particular in the United Nations 2030 Agenda for Sustainable Development, are central points of reference for the National Water Strategy.

The water goals set forth in the 2030 Agenda for Sustainable Development, which were adopted by the member states of the United Nations in 2015, have been achieved in Germany in many respects. However, despite undeniable progress, shortcomings still exist in Germany, e.g. in the protection and improvement of aquatic ecosystems or the further reduction of water pollution caused by substance* discharge. This is where the National Water Strategy comes into play.

In addition, the National Water Strategy is intended to contribute to global implementation of the goals of the 2030 Agenda by identifying ways to reduce Germany's water footprint* and by outlining the steps necessary to improve multilateral structures to support accelerated implementation of the global water sustainability* goals. An overarching approach that addresses and leverages the interdependencies between the 17 global Sustainable Development Goals (SDGs) is particularly important in this context. For example, the implementation of the Sustainable Development Goal on water and sanitation (SDG 6) will help to achieve many other SDGs, such as SDG 2 (zero hunger), SDG 3 (good health and well-being) and SDG 11 (sustainable cities and communities), but is also highly dependent on progress made on SDG 7 (affordable and clean energy) and SDG 12 (sustainable consumption and production). SDG 13 (climate action) is closely linked to water.

II. What needs to be done – Ten strategic issues: Challenges, vision and transformation to sustainable water management

The challenges for water management* are diverse and complex. The solutions and options for transitioning to viable water management* in the future are similarly complex and interlinked. The National Water Strategy is not intended to fully reflect and resolve this complexity. It focuses on ten strategic issues (see figure) that address the key challenges and needs for action that were also addressed in the National Water Dialogue. The challenges, the vision for 2050 and the main steps towards achieving this vision are outlined below for each of these ten issues. Specific measures will be identified in an initial programme of measures.

Figure 1: The ten strategic issues of the National Water Strategy

II. 1. Raise awareness of water as a resource

Baseline

- 46% of people surveyed in Germany say that water quality in water bodies (pollution and hydromorphological modifications) is a fairly serious to very serious problem.
- 70% would like more information on the ecological impacts of water consumption and consider adequate information about water consumption to be the most effective measure to reduce these problems.
- Germany's water footprint* is largely determined by the production of goods and imports from abroad: external water use accounts for just under 70% of the footprint.
- 62% of people surveyed in Germany say that changes in ecosystems are particularly alarming for them; 58% of respondents say that climate change is particularly alarming.
- 85% of people in Germany are happy with the quality and price of drinking water.
- 90% of the population say they have no information at all about river basin management* plans, which have to be drawn up regularly under the EU Water Framework Directive.
- In 2012-2013, the European Right2Water initiative (officially called "Water and sanitation are a human right! Water is not a commodity but a public good!") collected more than 1.6 million signatures (with more than 1.2 million from Germany) to ensure that the supply of drinking water and the management* of water resources are not subject to internal market regulations and that the water sector* does not appear on the agenda for deregulation.

What are the challenges?

The forward-looking development and reorganisation of the water sector* and the sustainable protection of water resources and water bodies will require changes in many areas. These change processes require broad social acceptance, which must be earned.

It is important to know that aquatic ecosystems – springs, streams, rivers, lakes, seas and groundwater – provide a wide range of services to people and society. They are recreational areas, habitats for flora and fauna and carbon sinks, they can provide natural protection against floods, contribute to

improving water quality, help to ensure a healthy climate in cities, serve as transport routes and, last but not least, form the basis for the supply of water.

This view requires a general appreciation of the natural functioning of the water balance* and the important role healthy water bodies play in the natural balance, human well-being, health and economic and social development as a whole. The use of the ecosystem services* mentioned above is something many people take for granted.

A sufficient supply of clean tap water at any time of the day or night is also perceived in Germany as an integral component of public services* and thus as something that is self-evident. However, many people are not aware of the natural resources involved in these uses and the effort required to provide drinking water. They never ask themselves where the water from the tap comes from and why the quality is always good.

Many people are not aware of the impact of their own behaviour and consumption on water pollution – e.g. through the use and disposal of products containing pollutants (e.g. medicines, PPPs, biocides, treated materials) and the use of available water resources, e.g. through the consumption of water-intensive manufactured goods. However, the increasing pressure on water requires a more conscientious approach to this resource in all areas of use – not least of all to prevent possible conflicts of use and to promote the sustainable use of water resources. This presupposes that transparent information is available about the effects of individual behaviour and consumption.

The full value of water must therefore become more prominent in the minds of the public and policymakers. It is important that water ecosystem services* – such as the supply of drinking water, wastewater disposal and water's function as a habitat – are made transparent for society, valued and appreciated.

The challenge is thus to highlight the importance of water in all its facets and to actively raise public awareness to gain the necessary support for the required changes in how this resource is managed.

Vision – Considerably increase appreciation for the value of water by 2050

The value of water and its importance as a public good (as food, habitat and economic factor) are firmly rooted in all areas of society. The right to water and free access to it are an integral component of public services* at all levels. The government ensures that water is protected and is responsible for the necessary public infrastructure.

Awareness of the value of water is embedded in all social groups and is evident in many facets of everyday life. Companies identify and account for their water footprint* in the production of goods and services; they report this information and take their responsibility seriously – also in production countries outside Germany. The right information enables consumers to take the water footprint* into account in their consumer choices. Consumers give preference to regional and seasonal food and products that are produced in ways that conserve and sustainably manage the available local water resources. They do not buy products produced under conditions that lead to high water consumption in areas suffering from water scarcity. Retail, as a key sector, sells products that are produced in line with water conservation principles in most of its product range, and consumers can quickly identify and select these products with the help of labels or information displayed on the packaging. Additional costs are reflected in consumer decisions and possibly through higher prices as a collective contribution to water conservation.

Consumers also refrain from participating in recreational activities that lead to excessive water consumption in water-scarce locations.

To avoid or resolve conflicts of use, there is an awareness of the need for balanced management* of water resources among users, i.e. also among the general public. The public is aware of the various user interests, the goals of water body development* and the requirements of a semi-natural* water balance*. The resulting decisions are presented transparently.

What needs to be done?

Educational and information programmes on water appreciation and management* for people of different ages and professional groups will be created, interlinked and value added. This will also include creating and linking learning centres where the importance of water can be experienced first-hand, and education and training is possible (e.g. experiential learning sites, research and demonstration fields). This is associated with appreciation for the value of the public services* provided by the water sector*.

A long-term water education and communication campaign must raise awareness among the general population and specific professional groups of the following:

a. Knowledge about water infrastructure*
b. Knowledge about pollutants discharged into water bodies, e.g. through improper disposal of chemicals and pharmaceuticals
c. Water bodies as habitats
d. Water use, water bodies and climate change and climate action
e. Opportunities for participation in water management* planning
f. Concept of the water footprint* and ways it can be taken into account in the production and consumption of products
g. Labels that include criteria on quantitative and qualitative impacts of a product on water resources
h. Preference for regional and seasonal products
i. Precautionary measures for buildings in the event of extreme events (e.g. protection against flooding during heavy rainfall)
j. Economical use of water at home and in the garden
k. Sustainable, water-friendly tourism

Target group-specific formats are used in the process.

Participatory processes, such as citizen science instruments, will motivate the public to engage with water-related issues.

In the domestic production sector, guidelines, incentives* and benchmarks will be created for production practices that use water sparingly and protect water bodies (e.g. with a Sustainable Water Award). Companies need to monitor their global production sites and supply and production chains for sustainability* criteria, their water footprint* and water risks* and to review and publish the findings. In addition, within the scope of their responsibility, they will be expected to contribute to efficient water use, reducing pollutant discharge and preventing conflicts of use. Consumers must be informed, e.g. by means of information materials or product labels (e.g. for food, textiles, medicines, cleaning agents, etc.), about how a product measures up in terms of water and water-relevant criteria, such as the water footprint*. The German government's sustainable finance strategy also aims to improve the transparency of water risks* for investment decisions. Livestock production accounts for a large share of the water footprint* due to feed production. When consumers eat fewer animal products, they make an important contribution to protecting water bodies and reducing water consumption. This should be encouraged by providing appropriate information.

II. 2. Further develop water infrastructure

Baseline

- Over 95% of the population in Germany, public institutions and businesses are connected to the water infrastructure* (water supply and wastewater disposal).
- The length of the sewer system network is 594,335 km and the drinking water network spans approx. 540,000 km. Many of the sewers are in need of rehabilitation due to their advanced age.
- The German inland waterway network currently covers about 7,350 km.
- Every year, roughly 5 billion m³ of water is removed for public water supply and about 19 billion m³ for non-public water abstraction for industry, commerce and energy production. In Germany, nearly 10 billion m³ of wastewater is treated annually by the public wastewater disposal system (of which approx. 5 billion m³ is rainwater and infiltration water).
- The Organisation for Economic Cooperation and Development (OECD) estimates per capita annual expenditure in Germany in recent years on water supply and sanitation at just under 300 euros, and predicts that Germany will have to spend around 25% more annually by 2030 to comply with the Drinking Water and Wastewater Directives.
- The increase in extreme events (e.g. heavy rainfall, drought) as a result of climate change and a decline in ecosystem services* (e.g. self-purification of water bodies, water retention, groundwater recharge, sink function) increases the stress and risks* for much of the water infrastructure* and the water uses* and services that depend on this infrastructure.
- The number of transverse structures in German rivers is estimated at more than 190,000; slightly more than 2 per river kilometre.
- In Germany, there are currently about 8,300 hydropower plants in operation, of which about 7,300 supply the public grid. More than 80% of hydropower electricity is generated in Bavaria and Baden-Württemberg. These plants feed about 20,000 gigawatt hours of electricity into the public grid every year. Although small hydropower plants account for about 90% of the total number of existing plants, they generate only around 10% of the electricity of the entire hydropower sector. 57% of large hydropower plants are over 60 years old. Some of the operating licences were granted on a permanent basis (known as legacy rights) or for long periods (100 years).
- Within the scope of implementation of the Water Framework Directive (WFD), hydropower generation is classified as a significant pressure by the federal states in 33% of rivers or 45,000 km of flowing waterways. The lower the electricity output of a hydropower plant, the less favourable the relationship between the costs of the hydroecological measures (in particular Sections 33-35 of the Federal Water Act (WHG)) and the output of the plant.
- Along the German North and Baltic Sea coasts, there are 12,000 km^2 of coastal lowlands with roughly 2.5 million inhabitants. Germany has a total of 1,471 km of sea dikes. The sea level has risen about 0.15 to 0.20 m along the German coast within the last 100 years. In the southern German Bight, the average sea level rise over the past 100 years was 1.1 to 1.9 mm per year – without accounting for land subsidence. It is currently assumed that the mean sea level rise in the future on the German North and Baltic Sea coasts at the end of this century will range between 0.61 and 1.10 m (median value: 0.84 m). Storm surge water levels along German coasts will therefore be significantly higher in the future.

What are the challenges?

The supporting pillars of public services* in the water sector* are a reliable supply of water in a quality and quantity sufficient for the various water uses* as well as effective wastewater and rainwater management. Precautions to counter the impacts of extreme events and disasters such as floods and

droughts as well as measures to prevent ecosystems and their services from further decline are other key elements.

Germany has water management* and coastal protection infrastructure that has been evolving for decades and essentially functions well; its basic design has stood the test of time and has hardly changed in a very long time. Preserving the value of this infrastructure and modernising and adapting it to changing conditions pose major challenges for society, not least from the perspective of financing. In addition, there are fluctuating overall conditions due to the impacts of climate change (e.g. increased heavy rainfall events, long periods of heat and drought, sea level rise) and the requirements of a circular economy geared towards resource conservation and efficiency* as well as changes in demographic trends and economic structure.

These changes expand the range of tasks to be performed by the water infrastructure*. It must make greater contributions to climate change mitigation and the energy transition, climate adaptation*, resource conservation and nature conservation, as well as biodiversity conservation. This makes it even more important to consider interfaces with other infrastructure sectors, such as energy supply, environmental protection and nature conservation or urban infrastructure (transport routes, public squares, green spaces, buildings) and cross-sector urban and infrastructure planning. If possible, infrastructure should not only be developed with a single goal in mind, but should serve several multifunctional goals. For example, river courses as well as flood and infiltration areas can provide various ecosystem services* (e.g. flood protection, groundwater recharge, nutrient, pesticide and sediment retention) or water areas and green spaces can be used for recreation, biodiversity, climate resilience, rainwater retention and groundwater recharge.

This is why one of the main challenges is to increasingly use semi-natural* or natural “green” and “blue” infrastructure and combine it with technical infrastructure in addition to the technically based “grey” water infrastructure*, such as sewer systems, retention basins, dams, wells, waterways, flood and coastal protection dikes.

At the same time, the water infrastructure* is also facing new challenges in its core area of responsibility. This applies, for example, to how pollutants are dealt with in drinking water treatment and wastewater management, including pathogens*. Adaptation* to changing settlement structures (differences in adaptation needs between urban and rural areas) and the digitalisation of systems and processes are other examples.

In this context, the different challenges can sometimes conflict with one another, as higher demands on the purification capability of wastewater treatment and drinking water purification plants can be associated with increased energy consumption.

To meet these challenges, it is necessary to counteract the obsolescence and decline in value of the existing infrastructure through continuous investment in the water infrastructure* and, at the same time, to harness the potential of available smart, new infrastructure concepts for the further development and gradual restructuring of the water infrastructure*.

Forward-looking and long-term infrastructure planning must be flexible and bring together the different temporal, spatial and systemic boundaries of infrastructure, such as by increasingly combining green infrastructure with technical infrastructure. This can also lead to improvements in ecology (e.g. through water body maintenance* and regulations for water abstraction).

For some types of infrastructure, the requirements of the EU Water Framework Directive and the Habitats Directive have so far only been implemented in part. One example is legacy rights to hydropower plants. The operation of hydropower plants is one of the reasons why the management*

goals set out in the EU Water Framework Directive have not yet been reached in Germany. Particularly problematic in this context is the large number of small hydropower plants, which, however, account for only a minimal share of gross electricity generation in Germany, but which can certainly be regionally relevant. Since legacy rights were granted on the basis of the legal regulations in force at the time, discrepancies exist at hydropower plants between the hydroecological requirements under water law in force today (Sections 33-35 of the WHG) and how they are implemented.

Vision – Water infrastructure in 2050

The technical, semi-natural* and natural infrastructure play an essential role in providing water uses* and services such as (drinking) water supply and wastewater disposal and treatment for households, public buildings, manufacturing, agriculture, industry and mining, as well as energy production, flood and coastal protection, biotope connectivity, shipping and urban and rural sports and recreation. Natural and semi-natural* infrastructure, with its multifunctionality, has a much greater significance in this context than is currently the case with technical infrastructure. Drinking water will continue to be treated using semi-natural* measures.

Water supply and wastewater management continue to be a public function and will be carried out with public infrastructure.[8] This infrastructure features a high level of technology, which is continuously developed by putting these innovations into practice. The water infrastructure* is designed so that it can be adapted with minimal effort to evolving conditions such as climate change, new demands from the public for higher “ecological standards” or the changing water needs of users. It facilitates regional, local and district- or neighbourhood-specific solutions with smart management systems and modules. Wherever possible, the infrastructure is designed to be nature-based* and networked* at a suitable intermunicipal level.

The water supply infrastructure is networked* on a regional and, if necessary, supraregional level (long-distance supply networks, waterways) and thus guarantees a nationwide water supply in line with demand, even in areas with low local water supply and during dry periods. Overuse of local water resources is prevented. Potential for multiple use of reservoirs for energy supply and high and low water management is taken advantage of.

Water infrastructure* meets the requirements of the Water Framework Directive and the Habitats Directive.

Coastal regions are adapted to the climate and protected. Various measures have increased the resilience of coastal, marine and inland water ecosystems.

What needs to be done?

The existing water infrastructure* must be continuously maintained and adapted. To this end, uniform national guidelines need to be developed and the technical regulations reviewed on an ongoing basis. This is because they are important not only for the water sector*, but often also for transport, energy, coastal protection and other economic sectors, as well as nature conservation and urban planning. Adaptation* must also include, where appropriate, the dismantling of infrastructure that is no longer needed and the promotion of semi-natural* and natural elements in infrastructure planning and implementation.

To proactively address the challenges of the future, the federal states are developing regional water supply plans in cooperation with water suppliers, local authorities and other water users

[8] However, there is also private infrastructure, e.g., owned by industrial and agricultural enterprises that is self-sufficient on the basis of permits.

(manufacturing, industry, agriculture, nature conservation, etc.). These plans prevent overuse as well as a deterioration in the quality of water resources and form the basis for the planning of regional water supply infrastructure (interconnected supply areas, long-distance water supplies, reservoirs). They take into account potential synergies* with energy supply (shared use of reservoir infrastructure), groundwater recharge, water retention and flood protection plans and runoff management for surface waters, as well as the potential for water reuse.

As these are mostly long-term investments, administrations and infrastructure operators need to design and implement more cross-sector framework plans and support systems and take even more advantage of opportunities to adapt obsolete infrastructure or create new infrastructure. This must also take into account cost structures and distribute costs equitably across generations. Similarly, cooperation between different users must be encouraged e.g. by providing domestic water of suitable quality or for groundwater recharge.

Legal regulations are used and – if necessary – adapted to create the best possible conditions for the development and widespread implementation of efficient and sustainable water infrastructure* (e.g. mandatory drainage plans for local authorities). Existing regulatory loopholes, such as in rainwater management (including hazard and risk* maps for heavy rainfall), are eliminated. Research structures (known as living laboratories) must be developed that make it possible to implement innovative approaches – such as water-smart cities (e.g. sponge cities, multifunctional land use with heavy rainfall) and the use of new types of sanitation systems – in practice and on a large scale, and to create broad social and economic acceptance for them. Research in this area needs to take into account water quantities and different water qualities with a view to reducing risks* for everyone (including for the environment and human health) and thus paving the way for implementation in the long term.

The recommendation to deregulate the water supply, which comes up at regular intervals, cannot help solve the challenges described above. On the contrary, a water supply system subject to competition would suggest that public welfare and water conservation concerns are being scaled back further. This option is therefore not viable.

As part of urban development assistance for 2020, which has been further developed and coordinated between the German government and the federal states, climate action measures and measures for adaptation* to climate change, in particular for improving the green infrastructure (e.g. urban green spaces and sponge cities), will become a mandatory funding requirement.

The continuation of the National Flood Protection Programme – including dike relocation to reclaim natural retention areas (e.g. floodplains) – is necessary for precautionary flood control measures. This gives rise not only to synergies* with nature conservation, but also with activities involving climate adaptation*, which is also embedded in the framework of the German Adaptation Strategy.

To adapt to climate change and the resulting sea level rise, a precautionary measurement* of at least 1.0 m (in relation to climate change) will be used in the future on the German North and Baltic Sea coasts when designing reinforcement measures for coastal protection structures. This precautionary measurement* covers a period of 100 years in relation to the year 2020. Depending on the local conditions and the specific structure, the precautionary measurement* can be carried out using different measures. The precautionary measurement* is reviewed regularly or as required on the basis of new scientific findings and adjusted if necessary.

Finally, all infrastructure planning and measures must take into account the EU Water Framework Directive and the Habitats Directive, which require good status of groundwater and surface water and favourable conservation status for species and habitats in standing waterbodies and water courses. To

improve the required coherence of the Natura 2000 network, the interstate biotope network in particular must be expanded (especially streams, rivers, floodplains). When granting new permits, modifying and adapting permits for water infrastructure* or their uses – such as hydropower – the applicable water law must therefore be applied with greater consistency and the necessary measures taken to mitigate the ecological impacts of hydropower plants pursuant to Sections 33-35 of the WHG. When permits expire, it must not be possible to simply extend them; rather, the permit must depend on a case-by-case assessment and only be reissued if the ecological requirements are met.

II. 3. Link water, energy and substance cycles

Baseline

- Energy generation and reduction in wastewater treatment is expected to reduce electricity from other sources by 10-20% (and the associated costs). Energy production from wastewater (sewage gas) is experiencing an upward trend of 1-2% per year.
- The phosphorus contained in wastewater could reduce the annual phosphorus mineral imports in agriculture by about half.
- The installation of a fourth purification stage increases energy requirements by an average of 5-30%.
- The energy supply currently accounts for more than half of the water withdrawals in Germany, mainly for cooling purposes. The restructuring of the energy system (phase-out of coal, promotion of renewables in the electricity and heat sectors, phase-out of nuclear energy) is expected to lead to a significant 50-60% reduction in cooling water withdrawals by 2030 and a 70-85% reduction by 2050.

What are the challenges?

Using water and its components with an awareness of circularity leads to greater sustainability* in the water sector*. This applies both to water reuse if the quality is suitable for use and the environment, but also to the generation and consumption of energy in the water supply and wastewater disposal systems and the use of substances* contained in wastewater, such as phosphorus and nitrogen.

Economical and efficient water use can be promoted by water recirculation, such as in various industrial uses (e.g. cooling and process water in steel production, industrial parks or mining). The use of treated (municipal) wastewater, e.g. for irrigation, can help conserve scarce freshwater resources and prevent potential conflicts of use. High environmental and health standards as well as additional costs and energy requirements for treatment and distribution must be taken into account.

Unlike recirculating cooling and process water in the manufacturing industry, the recirculation of used drinking water or the management of rainwater in buildings, cities and municipalities is only just in its infancy. Smart systems that combine, for example, cooling for buildings, the provision of domestic water, irrigation of gardens and green roofs and façades are feasible and useful, but have so far only been used in individual cases. However, they are becoming increasingly important in the context of climate change. To roll out model projects on a large scale, there is a need for stronger guidance from the public sector as well as changes to existing formal hurdles, such as the strict interpretation of the compulsory connection and use of central infrastructure systems.

The wastewater sector can contribute to climate change mitigation by harnessing other technical opportunities for energy-saving measures and potential energy recovery. The use of sewage gas to produce electricity is already established practice in many plants. In many cases, however, operators complain about legal and financial barriers (surcharge for renewable energy, electricity duty and privileged status for combined heat and power generation), which call into question the economic

viability of broader implementation. There is still potential in supplying heat to buildings or using sewage gas to generate process heat.

Closing substance* cycles by introducing suitable technologies and management strategies consistent with the circular economy is another challenge for wastewater management. Currently, the nutrients phosphorus and nitrogen present in wastewater go largely unused. These nutrients could be used, for example, to produce fertiliser. In Germany, phosphorus recovery from sewage sludge and sewage sludge ash will become mandatory from 2029 as a result of the amendment to the Sewage Sludge Ordinance (Klärschlammverordnung) that came into force in 2017. This will require considerable investment in recovery technologies over the next few years, which in many cases will require the formation of new regional cooperation structures. The recovered phosphorus could then replace phosphorus from natural sources.

Vision – Water, energy and substance cycles in 2050

The water sector* of the future is efficient, resource-saving and is sustainable in its use of nature and the environment, energy, raw materials and recyclables. The sustainable use of raw materials and the efficient recovery or production/abstraction of energy, water and recyclables is implemented in stronger cooperation with other sectors such as the waste, secondary raw materials and energy industries, fertiliser production and agriculture.

The water systems reduce their energy consumption and produce the energy they need themselves by making use of the heat generated by the cleaning processes and supraregional network solutions. The water and substance* cycles in industrial production are largely closed.

The EU Circular Economy Action Plan is implemented: wastewater and wastewater components are used as a resource. Closed cycles are guaranteed and socially accepted along with the sale and reuse of raw materials. Innovative energy forms such as hydrogen are produced without interfering with other water uses*. The sustainable use of water resources reduces the impact to a level compatible with nature. Substance* cycles are guided as much as possible by natural processes and integrate these natural processes into their overall approach to sustainable and environmentally compatible business practices.

What needs to be done?

There are currently a large number of research projects and initiatives on technical alternatives and legal foundations for the recovery of energy, water and recyclable materials, especially for wastewater systems. The first step now is a comparative assessment of the current situation to create a strategically appropriate legal, economic and technical basis for further measures (e.g. help with sector coupling). This also includes rules on sharing data and information on pollutant loads and operational data.

The wastewater treatment plants must be planned or upgraded together with the energy sector to optimise energy consumption and to tap potential for energy production, so that it is easier to adapt to the conditions of future energy systems.

The hygienically safe and environmentally compatible use of treated wastewater must be made possible for irrigation in agriculture as well as in cities and regions during prolonged periods of drought if this makes ecological sense – also to optimise nutrient cycles. To this end, the requirements in the EU Directive on minimum requirements for water reuse are being adapted to German water law and supplemented. In addition, legal requirements and guidelines for the use of treated wastewater are being drafted.

For the production of energy sources such as hydrogen, general strategies are being developed that minimise the impact on the water balance* and prevent competition with other water uses*. Strategies for thermal management of groundwater are being used for underground storage technologies, especially in urban areas, for shifting more to renewables for the supply of heating and cooling. Underground storage of heat and cold can be used where temperature changes do not have a significant adverse impact on other water uses* such as the quality of groundwater as a source of drinking water or as a habitat. To this end, thermal and ecological quality targets are being developed for groundwater.

The greenhouse gas emissions of the water infrastructure* are recorded in the national emissions inventories. They are minimised to ensure that the water infrastructure* makes the necessary contribution to greenhouse gas neutrality by 2045.

II. 4. Mitigate risks caused by substances inputs

Baseline

- The level of anthropogenic substances discharged into water bodies has decreased in Germany in recent decades.
- However, the level is still high enough that the “good chemical status” and the “good ecological status” of surface waters in Germany as defined in the EU’s WFD are not being achieved on a large scale, especially due to ubiquitously occurring substances* such as mercury or brominated diphenyl ethers (found in flame retardants) as well as fertilisers and pesticides.
- Especially during periods when water is low, significant pollution is caused when treated wastewater is discharged into low-flow water bodies or in densely populated urban areas. Pollution also occurs during heavy rainfall when combined waste and stormwater systems overflow before the water can be treated.
- Trace substances*, e.g. pharmaceuticals and their residues, are being detected in surface waters. Similarly, antibiotic-resistant pathogens* and plastic particles* can be found in water bodies.
- In recent years, there has been an increase in the use of pharmaceuticals, partly due to demographic change. Studies show that this increase could be as much as 70% by 2045.
- 36% of groundwater bodies fail to achieve “good chemical status” as defined by the WFD due to excessive nitrate concentrations and other pollutants.
- 23% of groundwater bodies that do not meet “good chemical status” show increasing trends in pollutant concentrations.
- In the North and Baltic Seas, good environmental status according to the EU Marine Strategy Framework Directive (MSFD) is likewise not being achieved everywhere. Nutrients discharged into the seas through rivers cause eutrophication in coastal waters. Pollutants from rivers accumulate in marine waters.
- In more than 70% of small water bodies on agricultural land, residues of plant protection products exceed the concentrations deemed acceptable when granting approval for their use.
- Less than 40% of water bodies adjacent to agricultural land had permanently vegetated margins in 2016.
- According to a survey, 63% of those surveyed considered environmental pollution by pesticides and 56% pollution of water bodies and drinking water by “overfertilisation/slurry” to be a very serious problem.

What are the challenges?

The discharge of substances*, pathogens* and antibiotic-resistant pathogens* as well as particles* into water bodies poses a risk* to human health and the environment.

Despite considerable progress in a number of substances* and substance groups* where water quality standards exist, the pollution of water bodies by pollutants discharged from various sources such as agriculture, industry and municipalities is still too high. In addition, new analysis and assessment methods have identified previously undetected pollutant loads in water bodies. There is often a considerable lack of knowledge and information about the hydroecological impacts of many substances* and their combined effects. Many substances* only degrade very slowly in water bodies and can therefore have long-term negative effects on ecosystems and the usability of polluted water bodies. Valid methods for the detection of pathogens* and plastic particles* and their effects on humans and ecosystems are lacking.

Already today, there is an extensive and complex set of rules to regulate substances*. EU regulations play a key role here. They regulate, among other things, registration and authorisation requirements (which vary for chemicals, pesticides, biocides, pharmaceuticals, detergents and cleaning agents), emissions for wastewater discharge and quality standards for water bodies. However, the interaction of the different regulatory areas needs to be improved, also in the assessment of the European Commission.

The input paths* are varied and even where point sources (e.g. municipal or industrial wastewater treatment plants) can be identified, it is only in specific cases that measures and process combinations can be implemented to sufficiently reduce inputs to water bodies. In view of the large number of substances* of concern – from the perspective of water pollution control – which are already in circulation, it therefore remains a challenge to further improve wastewater treatment processes and to establish a best-available-technology standard in the existing regulations.

In addition to point inputs, pollutant loads from diffuse sources also play a significant role. This includes, for example, the discharge of nutrients and pollutants (PPPs, biocides, veterinary medicinal products) from agriculture leached from soils into the groundwater or caused by erosion of land into surface waters. To date, the comprehensive implementation of suitable risk* mitigation measures, such as the establishment of vegetated margins along bodies of water, has failed in part due to formal obstacles such as the threat of sanctions in the event of violations of the requirements of European subsidy law (greening measures) or a threatened loss of arable land status. Monitoring the success of the adopted measures also calls for suitable monitoring strategies. In addition, pollutants such as mercury and PAHs from fossil fuel combustion are widely dispersed by atmospheric deposition and find their way into water bodies.

Another challenge is to significantly reduce the pollutant load of wastewater through measures along the entire value chain*, i.e. from development to the production and use of substances* and products all the way to prevention. This kind of integrated multi-barrier* approach requires responsible cooperation among all stakeholders along the value chain*, including producers and consumers.

Municipal wastewater and sewage sludge are considered hotspots for the spread of antibiotic-resistant pathogens*. On the one hand, these are directly discharged into the environment together with wastewater and sewage sludge; on the other hand, the active substances* contained in the antibiotics can facilitate the emergence of resistance in the environment or promote its selection. Pollutants also contained in wastewater, such as heavy metals, can additionally contribute to the selection of antibiotic-resistant strains. In order to bridge existing knowledge gaps, it is necessary to establish screening and monitoring capacities in wastewater, sewage sludge and water bodies. Other

preventive and cross-sector measures are set out in the German Antibiotic Resistance Strategy (DART 2020 and 2030).

Plastics discharged into soils accumulate over the long term. The persistence of the substances*, coupled with mechanical fragmentation, causes ever smaller plastic particles* to accumulate, which can ultimately also be mobilised and enter the groundwater. Plastics contained in the soil can also enter surface waters through surface runoff and erosion.

Vision – Zero pollutants in 2050

The goal of the EU's zero pollution action plan is to ensure that concentrations of pollutants no longer pose a risk* to human health and water bodies in the future. The discharge of substances*, substance groups*, pathogens* and particles* is minimised to such an extent that no impairment of ecosystem functions is expected (even over time).

Knowledge and understanding of the behaviour and effects of substances* in the water cycle have vastly improved. Information on the risks* to water bodies and their uses is available along the entire value and use chain, along with information on how to safely handle products containing risky substances* or possible alternatives to them. Transparent risk* communication has improved general understanding and knowledge of the effects and their relevance (including combined impacts) of point and diffuse source pollutants discharged into water bodies and seas, and makes it possible to assess and act independently. Consumers base their choices and consumption habits on water conservation as well as other aspects.

Measurement and analysis methods that enable new types of pollutants in water bodies to be systematically and efficiently identified and traced back to their sources are well established in water monitoring. Substances*, substance groups*, pathogens* and particles* are transparently assessed and prioritised with regard to their relevance for water bodies and their uses as well as their impact on nature and the environment. At the same time, the currently predominant focus on individual substances* has largely been replaced by a view that is based on substance groups*.

The input paths* of relevant substances*, substance groups*, pathogens* and particles* into water bodies are known along the entire value and use chain, and the risk* of inputs is minimised by appropriate measures at the various stages of the value and use chains. Manufacturers and users take their responsibility for reducing and preventing relevant pollutant discharge seriously. Producer and product responsibility for water conservation is achieved through a combination of regulatory and market-based solutions at both EU and national level. In the area of agriculture and municipal wastewater management, measures have been implemented to reduce and prevent the discharge of relevant substances*/substance groups* into particularly polluted or sensitive waters and to protect the seas.

Broad consensus exists on how to appropriately distribute the costs of the measures along the value and use chain and among the consumers of the services and the public sector. In addition, it is an established part of the financing system that manufacturers share in the costs.

When developing, registering and authorising new substances*, the risks* to water bodies and their uses by humans are fully identified and taken into account in the overall assessment. Newly developed substances* are required to be "safe by design*". Registration or authorisation is not permitted of substances* or substance groups* that individually or in combination have toxic effects on humans or aquatic ecosystems, do not degrade or degrade only very slowly, accumulate in the environment or

have significant other unwanted effects on humans and the environment. Relevant existing substances* or substance groups* are largely replaced by safe alternatives or banned. Exceptions are strictly limited to absolutely essential uses regulated by strict safety requirements.

Nutrient pollution in groundwater and surface waters, including coastal waters, is reduced to such an extent that the requirements for good status of groundwater and surface water are reliably met and e.g. eutrophication processes in lakes and coastal waters are prevented.

What needs to be done?

Germany supports the European Commission's zero pollution action plan included in the Green Deal. This, together with the Chemicals Strategy for Sustainability as a central element of the action plan, is at the core of pollution prevention. This is supplemented by other regulations, e.g. for emissions from industrial plants and agriculture, as well as strategies such as the Plastics Strategy, the Pharmaceuticals Strategy, the Strategic Approach to Pharmaceuticals in the Environment, the Farm-to-Fork Strategy and the Biodiversity Strategy. The last two aim to reduce the use and risk* of agricultural pesticides and antimicrobials by 50% and to achieve a reduction in nutrient losses of at least 50%. Likewise, a reduction in fertiliser use of at least 20% by 2030 is envisaged.

These activities and their implementation in Germany will help to reduce the exposure of humans and the environment to substances*, substance groups*, pathogens* and particles* with a more integrated approach across the different environmental media and existing areas of environmental law.

A wide range of measures in all sectors responsible will be developed, which will interact coherently and focus on the assessment and management of the risk* of substances* along the entire chain – from production and use to recovery and reuse or disposal. Appropriate instruments coupled with innovative methods to avoid and minimise relevant and unwanted discharges will help to establish and implement these measures in line with the multi-barrier principle* at source, during use or in wastewater treatment. Examples include recommendations for low-pollution construction, the expansion of wastewater infrastructure*, but also the establishment of reduction targets for pollutants discharged into individual river basins, such as the 30% reduction target for micropollutants by 2040 for the Rhine agreed in 2020. Quality standards for protected assets, emission standards adapted to best-available technology, substance*- and product-related regulations as well as requirements for the reduction of pollutants prior to reuse or disposal must interlink and complement one other.

Further action is needed to define the quality requirements for protecting and monitoring surface waters, groundwater and the seas, in order, on the one hand, to continue to provide sufficient quantities of high-quality drinking water with semi-natural* treatment processes and, on the other hand, to achieve the objectives of the Water Framework Directive (WFD). The goal is also to reduce the number of incidents in industrial plants to zero and thus eliminate pollutants discharged as a result of incidents.

At legal level, it will be necessary to fill existing regulatory loopholes and establish better interaction between the different regulatory areas in order to achieve the conditions for effective and efficient implementation of the regulatory framework. Soil protection laws will also be reviewed in this context, particularly with regard to plastics and potentially environmentally hazardous, new substance groups*.

With regard to water protection, this applies, for example, to the interaction between the EU Environmental Quality Standards Directive, the requirements for best available techniques under the

EU Industrial Emissions Directive and the Urban Waste Water Directive, as well as EU legislation on chemicals, biocides, plant protection products and medicinal products. In addition, the existing discrepancies with other areas of law, such as agricultural funding law/agricultural and environmental measures, must be reconciled.

An important aspect here is sharing and linking information and data on substance* properties and assessments (e.g. national substances database). To this end, models for mapping pollutants are an important tool, as is the transparent provision of data for precise information on input paths*. Newly designed monitoring systems (e.g. success monitoring for nitrate, pandemic prevention) and analytical procedures for wastewater and water monitoring should be used to improve knowledge of substances* and substance groups* and their impacts. In order to increase knowledge about antibiotic resistance and plastic particles*, appropriate monitoring capacities should be developed and established in each case.

A milestone in this overall process is the discussion revolving around the Federal Trace Substance Strategy, which has been developed in a dialogue process since 2016. The recommendations from this process and other expert reports on the subject contain a variety of indications for the implementation and (further) development of measures to reduce trace substances*. These will also be incorporated into the discussion at EU level. The future Federal Trace Substance Centre, which is part of the Environment Agency, supports these processes and provides technical advice. The measures from the trace substances dialogue with stakeholders must be continued and further developed.

As also envisioned in the Green Deal, Germany supports a European approach of enhanced product stewardship. Producers or distributors of a product (or active substance*) that harms the environment are expected to contribute to the avoidance and elimination of the substances* and the damage they cause to water bodies, e.g. through fund solutions. Other instruments that more closely involve the producers and distributors of products containing trace substances* are also expected to create opportunities for reducing trace substances*.

The wastewater charge, which continues to be regulated and revised at national level, provides an important incentive* to reduce pollutants, including trace substances*, and helps finance the reduction of pollutant discharge*. This is also intended to support all measures to reduce trace substances*, such as adding a fourth purification stage to wastewater treatment plants, but also to reduce pollutants that enter the water cycle through rain or are discharged as a result of combined wastewater in urban areas.

II. 5. Manage and restore the semi-natural water balance– prevent conflicting objectives

Baseline

- The long-term average of renewable water resources in Germany is 188 billion m³. In recent years, however, they have been significantly lower in some cases, e.g. 119 billion m³ in the drought year of 2018.
- In Germany, most water is withdrawn by the energy supply and mining sectors, the manufacturing industry, the public water supply and agriculture. In total, these user groups have withdrawn around 24 billion m³ of water from groundwater and surface waters (as at 2016).
- Germany has so far not experienced any widespread water scarcity (“water stress”). Despite the generally adequate water supply, there are significant regional differences in water

availability and soil moisture in the spring and summer months, with major implications for agriculture and forestry.

- In the six warm months of the year, there has been a significant decrease in the average discharge at 80 monitoring sites distributed across the river basins in Germany since 1961. This suggests a change in summer water availability.
- Prolonged periods of low water have significant negative impacts on the energy sector, water supply, water quality and quantity management*, inland shipping, aquatic ecology and fisheries. This is why low water has such an important impact on the national economy.
- According to the Intergovernmental Panel on Climate Change (IPCC) report, emissions from inland waters account for almost one third of greenhouse gases released from natural sources. Global warming and eutrophication promote the formation of methane in water bodies. Microbial processes can partially degrade the methane in bodies of water. Methane emissions are many times more potent than CO_2 in terms of the greenhouse effect.
- Water withdrawals, drainage, hydromorphological modifications, soil compaction and the extensive sealing of land affect and impair the natural water balance*; river engineering leads to higher and faster flows, increases the risk* of flooding, impedes water retention and impairs the ecology and natural dynamics of watercourse systems.
- Along many sections of the major rivers in Germany, only 10-20% of the former floodplains still exist.
- A semi-natural* landscape water balance is essential for all water bodies, wetlands and peatlands; here this has direct links to climate change (e.g. CO_2 and methane emissions if they dry up) as well as to biodiversity and the nutrient balance.
- Around 45% of land used for human settlements and transport infrastructure in Germany is sealed. This impairs important soil functions, infiltration capacity and groundwater recharge. Currently, 56 ha of undeveloped land is developed or converted to land for other uses every day in Germany. According to Germany's National Sustainable Development Strategy, the Federal government's goal is to reduce land take for human settlements and transport infrastructure to well below 30 ha per day by 2030.
- The land needed for groundwater recharge, water retention and flood protection, for water body development* and drinking water abstraction often have great potential for synergies* with nature conservation and for leisure and recreation, while at the same time competing in part with what is needed for other uses such as agriculture, settlement, energy, industry and transport.

What are the challenges?

Since the drought events in the summer months of 2018, 2019 and 2020, water supply, water uses* and possible conflicts over the water resources have become the focus of public attention in Germany as well.

The water balance* spans precipitation, evaporation, storage and runoff. Soil condition and groundwater recharge play an important role here. The water balance* in a semi-natural* form supplies soils, wetlands and water bodies with water even in prolonged dry periods. It is profoundly influenced and changed by land use and the use of water resources, e.g. water withdrawals, hydromorphological modifications or flood protection measures such as dikes, as well as by the drainage of mineral soils and peatlands (e.g. by drainages or drainage ditches). In addition, climate change affects the water balance* and leads to changes in precipitation, evaporation, storage and runoff. The extent of climate change impacts varies greatly from region to region, e.g. with regard to groundwater supply. Permanently receding groundwater levels particularly affect regions where

(seasonally) low and possibly further declining groundwater recharge due to climate change goes hand in hand with an increase in water demand and a relatively low level of groundwater resources.

The impairment of groundwater recharge, e.g. due to drainage of wetlands and peatlands, changes in use, soil degradation (loss of humus, compaction, erosion by water and wind, loss of biodiversity) and sealing, also have a negative impact on the water balance*.

How important it is for the water balance* to be as semi-natural* as possible is reflected in its inclusion as a target value in the Federal Water Act (WHG).

A semi-natural* water balance* for all habitat types dependent on water is also essential for ensuring or achieving a favourable conservation status under the Habitats Directive; significant impairments are not permitted (prohibition of deterioration).

The dry soil and low water levels in the rivers in recent summers had a significant ecological impact and directly affected various economic sectors such as agriculture, forestry, energy production, transport shipping and industry. Regionally, conflicts arose in individual cases between agricultural irrigation in competition with drinking water supply, or increased water withdrawal from rivers and lakes led to negative impacts on ecology. As a result of climate change, an increase in extreme events such as heavy rainfall in the summer months and a potential increase in prolonged dry periods can be expected. This is why we are seeing an increase in competing uses and conflicting objectives as a result of the ever-diminishing amount of water available.

Conflicting objectives in the area of water quality arise, for example, for drinking water suppliers when groundwater and surface waters are contaminated by pesticides and fertilisers used in agriculture, making water treatment more expensive.

To maintain or restore a semi-natural* landscape water balance (e.g. of water bodies or large wetlands/peatlands), the water management* of the entire catchment area must be considered and emissions prevented. It must be kept in mind that there are conflicting interests when it comes to land use, e.g. in floodplains that are used for agriculture and flood retention. Finally, uses such as recreation, leisure, sport or tourism in the vicinity of and directly on water bodies may also compete with other uses and in practice be prohibited or restricted.

Due to the current overall conditions, especially the effects of climate change on the quantity and quality of water, it will be urgently necessary in the future to develop joint solutions to prevent competing uses and conflicting objectives for water resources in the medium and long term. A regional water balance* that is as semi-natural* as possible will be an important prerequisite for a stable water supply and will protect ecological interests in the long term.

According to the Federal Soil Protection Act (Bundesbodenschutzgesetz), the functions of the soil, also with regard to the water balance*, must be protected or restored. The legal framework should be reviewed to see how enforcement can be improved.

Vision – Semi-natural water balance in 2050

The semi-natural* water balance* is established to the extent possible, while preserving the soil functions, improving water retention over a large area and minimising land consumption and sealing.

To this end, models exist for a semi-natural*, area-specific water balance* at sub-basin level that take climate change and the goal of greenhouse gas neutrality in 2045 into account and adequately reflect use requirements. Those responsible at regional level continuously monitor water withdrawals and water supply, thereby creating the basis for preventing overuse of water resources (risk*-based

approach). The agricultural sector is aware of its role as a water user, it lowers its need for irrigation and contributes to increasing the infiltration capacity and water storage capacity of soils. This is done with suitable farming methods and crops, as well as appropriate crop rotations. Any remaining irrigation needs are met with water-saving, efficient irrigation technology (e.g. drip irrigation).

Potential and existing synergies* and conflicts of use are shown transparently and clearly. Conflicting objectives in the use of water resources are confronted proactively. In the event of prolonged periods of drought, regional water use priorities are defined (water hierarchies), which are coordinated between those responsible at the various levels and also with the users on the basis of defined criteria and are communicated transparently to everyone.

Integrating all interests at an early stage and a joint negotiation process prior to deciding on possible measures are common practise in regional management of the water supply. A strong and competent water management* administration is established, which makes decisions on quantitative withdrawals, taking into account all stakeholders and interests. The public water supply system continues to be very important in providing public water services to ensure the supply of water for human consumption to the population. For long phases of drought with a shortage of usable water resources, however, areas of use are also prioritised within the public water supply system, if necessary, according to defined transparent standards for the supply areas affected. Alternative water resources – e.g. treated municipal wastewater – are included in regional water use plans to preserve scarce freshwater resources, taking into account human health and environmental protection aspects.

The water needs of ecosystems are known and taken into account, as are industrial and agricultural needs, when balancing water withdrawals. Requirements for efficient water use in all sectors are established to ensure that scarce water resources are used wisely and economically and to prevent conflicts of use in advance. Efficient water use is the prerequisite for withdrawal permits.

Sustainable land use (LULUCF) and the responsible use of water resources take into account the goal of greenhouse gas neutrality by 2045, the impacts of climate change on the water balance*, such as high and low water levels, but also changing groundwater levels. It is an integral part of the management* plans and programmes of measures. Water quality in streams, rivers, lakes and groundwater is continuously improved. This significantly reduces conflicting objectives for water resources due to water quality.

The considerable potential for synergies* with nature conservation strategies and objectives, especially in flood and floodplain protection and in the biotope network (e.g. Germany’s Blue Belt programme), is tapped whenever possible. Floodplains, wetlands and semi-natural* peatland areas are conserved, restored and protected. They stabilise the water balance* and meet the requirements of the Habitats Directive with regard to the conservation of peatland habitats and species. The prerequisites for sustainable peatland protection are fulfilled.

Spatial and land development planning are provided with comprehensive information about water management* planning at an early stage to secure areas for groundwater recharge, water body development*, flood protection, drinking water abstraction and other water management* uses. This is intended to prevent these priorities from being outweighed by the claims of other users.

The regional demand for water supply is ensured by sufficient groundwater resources, water management* measures and designating the required priority and retention areas for water abstraction in spatial planning instruments and measures (e.g. development plans). Areas and routes

for water infrastructure* (e.g. if necessary as long-distance water supply, also supraregional) are balanced against competing interests and designated in spatial plans as binding spatial planning objectives vis-à-vis other public planning authorities.

Spatial planning instruments (e.g. development plans) also ensure large-scale flood protection, nature conservation, infiltration and retention areas, which are binding for local authorities. Regional plans secure areas for the protection and development of water bodies and wetlands, for the management of heavy rainfall and for the infrastructure required for this purpose, as well as priority areas for future water protection areas.

The water balance* of all surface waters is aligned with natural conditions as far as possible; the maintenance* of water courses is semi-natural* and supports the water retention function of floodplains (retention areas).

The soils in the different land uses are in a healthy state and are able to perform their natural soil functions. Soil degradation is reduced through locally adapted management*, and soil erosion into surface waters is thus reduced as far as possible. High humus content and high soil biodiversity contribute to high water storage capacity. Soil compaction is largely minimised through the use of locally adapted technology.

Land use for human settlements and transport infrastructure is significantly decreased. The transition to a circular land economy (net-zero land consumption) is complete.

What needs to be done?

Foresighted management of water use conflicts requires a comprehensive data foundation. National water balance* modelling (including hydrogeological modelling) is initially necessary as a basis. This will enable creation of medium to long-term water supply and demand analyses at regional level. The semi-natural*, regional water balance* will be analysed, and projections based on expert methods will be made with inclusion of water requirements of the ecosystems calculated in advance. Existing instruments such as water use concepts will be examined with regard to their application and success factors for water management* planning and further developed as needed, e.g. in the direction of risk* management in case of drought. For precautionary water management* and for the reduction of flood hazards, the water retention function in the entire catchment including the floodplains is improved (in particular through semi-natural* water body maintenance*, restoration of a semi-natural* watercourse morphology, expansion of retention areas, integrated protection schemes for watercourses and their floodplains)[9] and measures for sustainable water quantity use will be implemented. This will be accomplished within the framework of structures that allow for participation of and mediation among the stakeholders affected.

Guidance on rules and criteria for water distribution in case of regional water scarcity and dry soil will be developed. More priority will be given to semi-natural* rainwater management* measures in municipal urban land use planning. The legal permits for groundwater and surface water withdrawals as well as for dams will be reviewed on the basis of the improved data and adjusted if necessary.

The water management* administrations will be provided with the necessary human and technical capacities as well as access to the required information and data. The latter enable them to make decisions on the management* of the usable water supply independently, taking into account all

[9] See also section II. 6. Pursue land use in urban and rural areas that is compatible with water and the climate and section II. 7. Further develop sustainable management of water bodies.

relevant aspects, in a reasonable timeframe and after consultation with all stakeholders. The decision-making powers will be defined and the authorities responsible provided with technical support, e.g. in the form of decision-making support systems. The (Federal, federal state and local) administrations responsible and other affected stakeholders develop mechanisms to implement water use priorities, taking into account the following issues, among others: i) enforcement (formation of crisis teams, if necessary) and monitoring; ii) dealing with resistance; iii) compensation; iv) transparency; v) evaluation.

The extensive water supply and demand analyses form the basis for water management* planning and low water and drought management. Furthermore, these analyses support the integration of water management* aspects in the federal state and regional plans. Existing and future conflicting objectives in land use are acknowledged and described at municipal and regional level, and appropriate areas and sites are identified. All relevant land requirements for water management* are taken into account, e.g. for groundwater recharge, water retention over a large area, nature conservation, water body development*, drinking water abstraction, etc.

The German government is developing a strategy to reduce supraregional land use conflicts and to support higher-level spatial management planning. This strategy facilitates coherence between water management* planning and overall spatial planning by proposing how to provide spatial and land development planners with information and consultation regarding water management* planning at an early stage. This will also be encouraged with improved coordination of municipal urban land use planning and regional planning and achieved through intermunicipal cooperation. The long-distance water supply can play a decisive role in individual cases. This strategy also includes options for financing measures to improve the ecosystem services* of water bodies, nature conservation areas and forests.

Soil protection legislation must be supplemented and specified in more detail with the aim of giving greater consideration to the precautionary approach* to preventing harmful changes to the soil. In particular, the aim is to strengthen enforcement at federal state level and give greater consideration to natural soil functions when balancing spatial planning concerns (see also section II. 6.). Peatlands are extensively rewetted as part of the peatland protection strategy.

All the recommendations for measures mentioned in section II. 4. to reduce the risks* of pollutant discharge* and improve water quality also work to prevent conflicting objectives arising due to poor water quality.

II. 6. Pursue land use in urban and rural areas that is compatible with water and the climate

Baseline

- Agriculture is mainly responsible for the diffuse pollution of groundwater and surface waters with fertilisers and pesticides.
- Currently, around 11.4 million ha are covered with forest. This represents just under a third of Germany's total area.
- Agricultural land in Germany amounts to around 16.7 million ha. Most agricultural land is used for farming, followed by grassland (e.g. pasture farming) and permanent crops (e.g. viticulture). In 2019, organic farmland accounted for 7.8% of the total agricultural area.
- About 45% of the land used for human settlements and transport infrastructure in Germany is currently sealed, i.e. buildings have been built on the land or it is covered by concrete, asphalt, paving, etc.
- The impacts of climate change intensify the already existing pressure on land use systems, ecosystems and water resources.

- The frequent occurrence of extreme events (dry soil and heavy rainfall) due to climate change pose a serious problem for agriculture. As a result of the associated erosion (drifting or runoff) of fertile soil, nutrients and pesticides, they also increasingly cause damage and pollution in surface waters.
- Sustainable agriculture and forestry are beneficial to water and soil quality when fewer nutrients and pesticides are used and more crop rotation strengthens the natural nutrient cycle.
- A wide range of nature-based solutions*, but also technical processes for evaporation, infiltration and storage of rainwater are already available in urban areas.
- Extensive experience has been gained in the use of proven forms of rainwater management* in an urban context. It is important to further develop existing solutions. However, conflicts of use and conflicting objectives as well as other obstacles arise when it comes to practical implementation of water-smart urban development solutions.

What are the challenges?

Agriculture and forestry produce renewable raw materials in the form of biomass for food and animal feed as well as products for materials and energy. Biomass is therefore important for our society today and in the future. The impacts of climate change and a shrinking water supply, especially in the summer months, will affect agriculture and forestry in particular. Adapting agriculture and forestry to these new climate conditions will thus have an impact on nature and the environment, including water bodies.

The economic and regulatory conditions (set by EU agricultural policy, other government subsidies, the food retail sector, etc.) and our consumption habits in agricultural products shape the way we treat nature in agricultural production. Only nature-compatible, sustainable agricultural production can ensure a semi-natural* water balance* and functional water bodies in the long term.

Semi-natural* forest ecosystems rich in structure and species are of immense importance in terms of their ecosystem services*, e.g. as water reservoirs, habitats, CO_2 sinks, climate and heat regulators, recreational areas and raw material suppliers. Sustainable, semi-natural* forestry supports the long-term preservation of these services. The principle of forest conservation is compatible with the interests of sustainable water conservation.

In German cities, the degree of soil sealing is still on the rise. Most of the rainwater is discharged into the sewage system. This impairs rainfall infiltration and leads to high surface runoff at certain points during heavy rainfall. Groundwater recharge is low as a result. Making the concept of the sponge city a reality is still a challenge. The aim of sponge cities is to keep the changes to the natural water balance* caused by residential activities as low as is technically, ecologically and economically acceptable in terms of quantity and pollutants.

The problems in the practical implementation of water-smart urban development can essentially be divided into five areas:

1) Remove obstacles in the planning process
2) Advance semi-natural* and technical planning and design of measures
3) Review the legal framework
4) Create funding and financing opportunities
5) Eliminate other barriers to implementation, e.g. by empowering stakeholder groups

In all five areas, solutions are available and systematic transfer is generally possible. However, widespread implementation often fails due to individual objectives or political and practical constraints such as financing issues.

These obstacles to implementation are particularly relevant in existing buildings. In contrast, the chances of implementing water-smart urban development measures in newly planned areas are significantly higher. Since existing built up areas cover considerably more area than new ones, they have significantly greater basic potential for improvements in terms of water-smart cities. Planning processes and solutions for existing and new developments must be approached in different ways.

When and under what circumstances the use of rainwater not only for irrigation but also in the household makes sense from an economic, hygienic and ecological point of view can only be decided on a case-by-case basis. This assessment must also take into account the quantities of materials to be used (e.g. a second pipeline network).

The interconnections and interdependencies between cities and rural areas are often functional and not always free of conflict. They can lead to competition for water resources, for example between different water users such as farmers, public water suppliers or even tourism and irrigation in urban areas. This mainly affects land use because competing needs for space and land can arise between cities and the surrounding areas in food or energy production, flood risk* management (retention areas) and the protection of water protection areas. Land is also needed for wastewater treatment and recycling of urban waste. The surroundings of cities are also often popular recreational areas. Due to these interdependencies, closer cooperation and coordination between regional administrations pose a challenge for the future (see also section II. 9.).

The sustainable management* of water as a natural resource is a central element in responsible land use and conforms to the guiding principles of a semi-natural* water balance*. Forward-looking land use is increasingly becoming the focus of society, also with a view to the goal of greenhouse gas neutrality in 2045, to the preservation of cultural and natural landscapes and to balanced and locally adapted spatial development, especially in rural regions.

Vision– Land use in urban and rural areas that is compatible with water and the climate in 2050

The semi-natural* water balance* is restored in terms of quantity, quality and dynamics (see section II. 5.). Conflicts of use are prevented with established management* and use concepts for the landscape hydrology. The needs-based and efficient irrigation of crops, animal feed and special crops as well as the preservation of water-dependent habitats and species is ensured.

Drains from agricultural land are, as far as possible, dismantled or redesigned to ensure that they can contribute to stabilising the soil hydrology and the landscape hydrology (balance between precipitation and dry periods).

The possibilities offered by digitalisation in land management are used to determine the need for irrigation, fertiliser and plant protection products tailored to the location and correctly implemented. This means that there is hardly any excess nutrient and pollutant discharge* from agriculture.

Regionally aligned, environmentally responsible agriculture is guided by location factors, integrates water reservoirs and ensures groundwater recharge. Agricultural land is managed such that it supports the goals of water and nature conservation and flood protection as well as climate change mitigation and greenhouse gas neutrality. This includes the most extensive possible management* of floodplains and riparian zones with the use of a combination of instruments including support for ecosystem services* and regulatory requirements.

Structurally rich, ecologically high-quality and thus climate-resilient forest ecosystems also serve to protect water bodies by i) counteracting erosion caused by water and wind, landslides and humus loss, ii) mitigating floods through evaporation and infiltration as well as by delaying peak runoff, e.g. during snowmelt, and iii) binding nutrients in the biomass and soil.

Water-smart urban development is well established. It pursues the goal of unsealing as many surfaces as possible and promoting the storage, infiltration, evaporation and use of rainwater in urban areas. An intact urban water balance* is thus characterised by good water availability for urban vegetation, enhanced evaporative cooling and reduced risks* from flooding. Urban bodies of water are important habitats for animal and plant species and provide opportunities for local recreation as a space for experiencing nature.

Local authorities in cities and rural areas work closely together at all levels and in all sectors, ensuring that water policy objectives are incorporated into other policies and, in particular, that land requirements for water body development*, drinking water protection and green infrastructure are highly prioritised in land use planning.

What needs to be done?

On the basis of a framework strategy jointly developed by representatives of agriculture, forestry, water management* and water conservation, measures and pathways will be identified with the aim of permanently maintaining a semi-natural* and functional water balance*. The agricultural and forestry management practices derived from this strategy enable long-term water use that maintains the water supply for humans and provides enough water to preserve ecosystems and biodiversity. This water-friendly approach to agriculture and forestry enables regionally and locally differentiated management* measures in terms of the water balance* to achieve a high level of ecological effectiveness with economic efficiency*. Monitoring and evaluation help to respond to changing conditions, in particular climate change and the scarcity of water resources, at an early stage and over the long term.

Regional models for water-friendly agriculture and forestry practices make possible regionally and locally differentiated management* measures to achieve a high level of ecological effectiveness with economic efficiency*. A national practical handbook for water-efficient land use is being created to support these efforts.

It is imperative to develop regional or national water use plans that take into account the prioritisation of water withdrawals and future planning. They include the irrigation needs of agriculture as well as the requirements of water-dependent habitats for sufficient groundwater levels. They promote the implementation of water-saving measures in agriculture and appropriate quality standards for irrigation.

Sustainable agriculture that is compatible with soil and water bodies is supported by education, training and support programmes as well as incentive* schemes that minimise the impact of climate change and land management on the regional water balance* and the risks* posed by more frequent and more intense extreme events.

Dialogue between representatives of agriculture and the water sector* will be initiated to achieve the vision/objective of farming practices adapted to water bodies and the climate. This dialogue will pursue an integrated approach to regional water management* with the aim of jointly developing solutions. This is necessary to resolve land use conflicts between water body development*, the regional water balance* and agricultural use.

Important measures in land use are promoted, such as the adaptation* of irrigation and drainage of agricultural land, the protection of water body margins (or conditional sustainable extensive use), the creation of rainfall storage reservoirs (ponds of different sizes, fire water ponds) and the rewetting of peatland soils and wetlands. These measures improve groundwater recharge, water retention over a large area and the regional water balance*. Pure coniferous tree stands are consistently converted

into semi-natural*, species-rich and thus climate-stable mixed forests, thus contributing to groundwater protection and recharge, but also to forest resilience.

To implement these measures, the stakeholders should be well connected via cooperative regional approaches, e.g. through legally legitimised regional water networks with equal representation, or water councils[10] that advise authorities and land users on measures and monitor and evaluate their implementation.

Achieving greenhouse gas neutrality by 2045 presupposes growing demand for renewable resources and must be consistent with water policy goals. For example, management* with native tree species can contribute to erosion reduction and at the same time to nutrient retention on water body margins. This serves to protect water bodies, but at the same time produces material for generating energy from wood and insulation, while not impairing the natural habitats and species of the water bodies and their banks/floodplains. These forms of use, as well as extensive grassland use, which combine water conservation and economic production, should be promoted.

Forest ecosystems are managed to ensure that they are protected from erosion and soil compaction and the discharge of unwanted substances* into surface waters and groundwater is prevented as much as possible. This is achieved particularly by semi-natural*, structurally rich and thus climate-resilient mixed forests. Groundwater recharge and groundwater quality can be further improved by selectively planting deciduous forests.

To prevent soil erosion caused by water, a wide range of practical measures is formulated in detail in the soil protection and agricultural recommendations. These technical recommendations for measures must be actively implemented in practice. Agricultural practices designed to reduce erosion must be effectively supported by agricultural structural measures involving land development and land consolidation. In this context, greater account must be taken of the dangers posed by water runoff and soil erosion.

Water-smart urban development is a key component of climate-friendly urban design and an important part of integrated planning. To achieve this goal, a broad, inter-ministerial and interdisciplinary discussion of the need for action as well as specific measures to be taken in the various action areas addressed is needed. The technical, planning and enforcement levels should be involved in the process from the outset. In addition, the German government supports municipalities that promote water-smart urban development.

Water-efficient and sustainable farms are integrated into local or regional processing systems and sales networks. They have special priority in public procurement. Financial incentives* for regional sales channels are available.

Structures and support programmes must be created that promote the regional circular economy, the quality of land management* and better reconciliation of interests between urban, suburban and rural areas.

II. 7. Further develop sustainable management of water bodies

Baseline

- Over 91.8% of all surface waters currently fall short of good ecological status and/or good ecological potential as defined in the WFD, mainly due to lack of habitat for flora and fauna.

[10] In this case, similar to hunting councils or water associations.

- Over 80% of Germany's running waters, more than 60,000 km, are "significantly" to "completely modified". Many transverse structures in watercourses prevent the linear passage of fish fauna.
- 80% of the Habitats Directive standing and running water habitats and 65% of the listed fish species have yet to reach the required favourable conservation status. 43% of the habitat types are in poor conservation status.[11]
- Floodplains are natural inundation areas that can ease floodwaters and prevent or mitigate damage when flooding occurs. They are also hotspots for biodiversity. In the past, rivers were largely cut off from these floodplains. Now during major flooding events only around a third of former floodplains are available for inundation by rivers with catchments larger than 1,000 km^2.

What are the challenges?

Intact river landscapes and floodplains are among the most biodiverse habitats in Central Europe. Natural water bodies are an important component of species and biotope conservation.

Water body development* and nature conservation have many areas of synergy*, for instance in flood protection and widespread water retention areas. Using these synergies* can facilitate the preservation and restoration of many ecosystem services*. This includes making water-based ecosystems more resilient to changes, for example caused by climate change, and also to the human use requirements including recreation and leisure, flood protection and shipping. The protection and conservation of ecosystems on the one hand and the use of water bodies and their adjacent flood plains by people on the other require a high level of cooperation and effective strategies for integrated water body management*.

The Water Framework Directive is the main instrument at European level for water body development* and management*. The Habitats Directive is the key instrument for water body and floodplain conservation. There are numerous Federal and federal states' programmes in these areas as well. The aim of the Water Framework Directive is the good status of all water bodies, also beyond the general 2027 target year of the directive. The Habitats Directive aims to promote favourable conservation status for species and habitat types. The sustainable management* of water bodies and their floodplains is a decisive factor in successfully implementing the WFD and the Habitats Directive.

The protection of these valuable river-and-floodplain ecosystems is also a component of the new EU Biodiversity Strategy in the framework of the EU Commission's European Green Deal. The important goals here are increasing the number of protected area designations, restoring intact ecosystems using efficient measures, restoring continuity (target: 25,000 km² of freely running water in Europe) and strictly implementing the existing legal provisions.

Despite the many efforts of the Federal, federal state and local authorities, good status of water bodies and favourable conservation status of water-dependent habitat types and species under the Habitats Directive have largely not been achieved. It has become clear that, in our complex industrial and service-based economy with diverse use requirements, the status of water bodies and floodplains can only be improved using interlocking measures at all levels of management*. Examples include nature-based solutions* and measures sensitive to environmental, social and economic concerns.

[11]The reference value for the percentages is the sum of the assessments of the freshwater habitats and fish species in the specific biogeographic regions (Atlantic, Continental, Alpine) as there is no overall evaluation for Germany as a whole.

Currently, for a variety of reasons, the implementation of necessary measures is not possible or only possible with delay. This is often due to unavailability of land, e.g. for necessary restoration measures, but often also due to lack of personnel and financial resources. For example, for these reasons, 60% of the planned measures to improve the structure of water bodies by 2018 have not started yet.

Successful implementation of the WFD also depends on measures in other sectors. Water policy lacks integration with other policy and regulatory areas such as agriculture, spatial planning and regional planning. This is a hindrance to coherent, enforceable water conservation policy. The great potential for synergies* with the strategies and goals of nature conservation, particularly with regard to flood protection, protection of floodplains and creation of a biotope network, should be leveraged wherever possible. The Floods Directive refers explicitly to its synergies* with the WFD. Germany's Blue Belt programme can also play a role here.

The objectives of the WFD, the Habitats Directive and the European Green Deal are ambitious; the challenge lies in balancing these objectives with the range of uses. Progress was made, for example, in restoring the continuity of watercourses. It is time to build on this progress; the sustainable management* of water remains an ambitious ongoing endeavour.

Vision – Sustainable management of water bodies in 2050

All watercourses and water bodies are in good ecological status or have good ecological potential as defined in the WFD; the Habitats Directive freshwater habitat types and species have favourable conservation status. Where this is not yet the case due to natural circumstances, for example in ecosystems with lengthier regeneration phases, a clear trend towards improvement is apparent.

Habitats are quantitatively and qualitatively adequate for the flora and fauna in surface waters and adjacent floodplains. Habitats, fauna, flora and the groundwater are protected by networked* biotope structures. The protection of these ecosystems is balanced with water uses*.

Appropriate structural, technical and conservation measures have been taken in response to climate change and biodiversity loss to enable sustainable, integrated water body management*. This includes restoring and revitalising straightened and sealed watercourses, reconnecting former floodplains and linking them to groundwater reserves, and creating areas for inundation. A semi-natural* landscape hydrology and adequate groundwater levels are permanently ensured for all peatlands, wetlands and water-dependent habitats. The water balance* is in harmony with water uses*.

The objectives of Germany's Blue Belt programme are achieved in all areas (modification and dismantling, continuity, maintenance*, biotope network and floodplain development).

The development of the legal framework in Germany has fostered tighter links between management* planning (in accordance with the WFD and the Habitats Directive) and spatial planning, nature conservation and land management.

What needs to be done?

Implementation of the WFD and the Habitats Directive must be steadily continued. The WFD's level of ambition must be upheld in view of the still existing inadequacies in water quality and increasing pressure due to various uses and the challenges of climate change. The evaluation principles of the directives ensure that all pressures are taken into account, including human uses of the landscape developed over decades. These form the basis for integrated water body management*.

The plans for conservation and management* of the ecosystems must be structured so that ecosystems retain their functions despite climate change, i.e. so that they are resilient. Climate

resilience requirements are also in harmony with the Marine Strategy Framework Directive, the Floods Directive and the goals of the European Green Deal.

The nature conservation and water management* requirements of the implementation of the Habitats Directive and the WFD need to be examined together at an early stage and formulated in the management plans with goal-oriented, detailed measures. The hydraulic infrastructure and the maintenance* measures on and around water courses must facilitate their continuity and semi-natural* morphology and dynamics.

Efforts to create a coherent, interstate biotope network must be stepped up; watercourses and their floodplains are ideal for this as natural network structures. This supports the implementation of the goals of the Habitats Directive and the WFD, Germany's Blue Belt programme and the EU Biodiversity Strategy for 2030.

The financial and human resources necessary for sustainable management* of water bodies will be discussed and requested in the framework of broad public discussions. In addition, binding administrative responsibilities for the implementation of measures must be defined. The consequences of inadequate water management* must be made clear to policymakers and private individuals. Acceptance for carrying out measures needs to be strengthened by involving stakeholders and the public at an early stage, holding consultations, providing recommendations for planning, financing and implementing measures and by supporting best-practice examples. The environmental, economic and social benefits linked to the necessary measures must be communicated in a targeted way.

Another reason that water conservation goals remain unfulfilled is their lack of integration in legal areas outside of water law. For example, the funding eligibility of hydroelectric power plants under the Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz) and their licensing should be linked to the current requirements of the WFD and the Habitats Directive. Water body development* should be incorporated in the guiding principles of spatial planning.

The synergies* between watercourse and floodplain development and conservation, promotion of biodiversity, climate adaptation*, recreation, flood protection and low water management should be rigorously exploited and more space should be allocated for water body development*. This development space needs to be examined and defined in terms of target land area in order to arrive at a spatial allocation for restoration measures embedded in spatial planning and building law and to explore options for procuring and securing land. The aim is planning that secures the land needed for watercourse corridors and floodplains for the stringent, ecologically efficient implementation of structural measures for water bodies.

II. 8. Intensify protection of marine areas (the North and Baltic Seas) from pollutants from land

Baseline

- The watercourses that drain into the coastal and marine waters of the North and Baltic Seas are the main input path* for nutrients coming from diffuse and point sources such as agriculture and wastewater treatment plants, pollutants from industry, trade and households and plastic waste (including microplastics).
- The federal states and the river basin communities use regular monitoring to track riverine inputs. The data is used in the work under the regional marine protection conventions and the international river basin commissions. Similar monitoring is not yet in place for plastic pollution.

- Germany has fulfilled the targets of the OSPAR and HELCOM strategies. The nitrogen inputs in surface waters in the German Baltic Sea catchment area (Warnow/Peene, Schlei/Trave and Oder river basins) were reduced between 1983 and 1987 and 2021 and 2014 by 65% from 63,000 t/year to 22,200 t/year. Phosphorous inputs were reduced in the same time period by 78%, from 3,600 t/year to 800 t/year. The nutrient inputs in the surface waters in the German North Sea catchment area (Elbe, Weser, Ems and Eider river basins) were reduced between 1983 and 1987 and 2021 and 2014 by 50% for nitrogen (from 804,038 t/year to 353,400 t/year) and by more than 70% for phosphorous (from 67,164 t/year to 17,540 t/year).
- These reductions were not nearly enough to achieve good environmental status of marine waters as set out in the current provisions of OSPAR, HELCOM, the Marine Strategy Framework Directive (MSFD) and the Habitats Directive. Moreover, the input of substances continues to take place. The environmental targets set by Germany to implement the MSFD include further reduction of inputs of nutrients, pollutants and waste (with a focus on plastics) in particular via rivers, but also via the atmosphere.
- The Baltic Sea coastal states have determined the maximum allowable anthropogenic inputs of nitrogen and phosphorous in the Baltic Sea basin to achieve good environmental status of these waters with regard to eutrophication. Building on this, they have formulated a future reduction target in the form of a maximum allowable input ceiling in tonnes/year. These target calculations take into account inputs via rivers and the air as well as inputs transported over long distances from other marine areas. The countries bordering the North Sea are working under OSPAR to establish similar targets.
- The Ordinance for the Protection of Surface Waters (Oberflächengewässerverordnung, OGewV) sets nitrogen concentrations at the limnic-marine transition point at 2.8 mg/l TN for rivers flowing into the North Sea and 2.6 mg/l TN for rivers flowing into the Baltic Sea as the basis for management* of the river basin districts. Currently, it is assumed that future compliance with these values can facilitate achievement of good status for the marine waters with regard to eutrophication. There are also current river type-specific orientation values for phosphorous (0.10-0.15 mg/l TP for rivers flowing into the Baltic Sea and 0.10-0.30 mg/l TP for rivers flowing into the North Sea).
- Of the 24 rivers flowing into the Baltic Sea, five attain the management target value for total nitrogen; three attain the river type-specific orientation value for total phosphorous. Of the nine rivers flowing into the North Sea examined in the evaluation period 2015-2019, only the Rhine attained the target value for total nitrogen. The river type-specific orientation value for total phosphorous concentration was reached in the Rhine, the Eider, Treene, Arlau, Miele and the Bongsieler Canal.
- There are currently no specific input target values or limit values at the limnic-marine transition point nationally or at EU level for pollutants making their way into the seas via rivers. There is a lack of quantitative estimates of the reductions and related measures needed in river basins to help achieve good status for marine waters.
- Inputs of cadmium, lead and mercury via the rivers flowing into the North and Baltic Seas have sharply declined since the 1980s. Although the quality objectives in the aqueous phase laid out in the EU Water Framework Directive (WFD) are met for all three substances*, this is not the case for the German marine waters, where these substances* accumulate in sediments and marine wildlife.
- Three quarters of the waste in the sea consists of plastic products from production on land and their applications. Plastics degrade into tiny pieces, sometimes over centuries, and become what is known as secondary microplastics, which accumulate in sediments and in the

water column and have harmful effects on marine biota. Primary microplastics, which are intentionally produced for a specific use, for example as an additive in products, also reach the sea via rivers because they cannot be completely removed by wastewater treatment plants. They can also find their way from production plants directly into water bodies through the air, e.g. as pellets. The current status assessment of Germany's North and Baltic Sea waters under the MSFD from 2018 found microplastics on the surface of marine waters, in the water column, in sediments and in marine wildlife.

What are the challenges?

Marine waters are intensively utilised by people in a variety of ways, e.g. for shipping, by fisheries, for water sports and beach tourism. The seas also play a major role in various forms of energy generation and are a source of both food and resources. As a consequence of these uses, the status of much of the North and Baltic Seas unfortunately remains concerning.

The aim of the MSFD is good status for the seas, a goal Germany is actively working to achieve. Marine conservation requirements in the MSFD and the Habitats Directive must be integrated in other policy areas, particularly the forms of use. Conservation and use must be brought into balance. With regard to pollutants, this applies primarily to the Common Agricultural Policy (CAP) of the EU, but also to other areas such as marine shipping and industrial discharge.

Coastal zones are ecologically valuable and sensitive areas that are coming under increasing pressure from human use. Addressing this calls for a coordinated approach on land and at sea.

Vision – Onshore marine conservation in 2050

The many pollutants affecting the North and Baltic Seas, also coming from the rivers that flow into them, are reduced to a minimum. The requirements of the MSFD and the Habitats Directive as well as the OSPAR and HELCOM provisions for good status of marine waters are met.

What needs to be done?

Numerous onshore measures to protect water, especially running waters, are necessary to give the seas comprehensive protection. In particular, cooperation between onshore and marine conservation actors should be strengthened. In addition to this cooperation, clear targets that enable gradual reduction of pollutant discharge* from land are needed. The target values set for nitrogen at the limnic-marine transition point to date have proven to be a good tool for assessing the implementation and impact of inland measures to reduce nitrogen inputs. Additional target values at the limnic-marine transition point should be determined for total phosphorous, selected pollutants and plastic waste (including microplastics). These values are intended as a basis for determining onshore reduction requirements to achieve targets and facilitate appropriate measures in the river basin districts. A transparent, participatory process involving all inland and coastal states is planned. The BMU and UBA will support this work with a broad-based research project. The target values identified in the research project should be included in future in the Ordinance for the Protection of Surface Waters to lay out requirements for river management* beneficial to marine conservation.

In the context of the infringement procedure regarding the Nitrates Directive, a combined Federal and federal state monitoring programme related to the Fertiliser Application Ordinance is being set up that will monitor phosphorous inputs in watercourses, among other things. This should simultaneously be used to determine the phosphorous discharged into the seas on an ongoing basis and to adapt the provisions of the Ordinance for the Protection of Surface Waters and the Fertiliser Application Ordinance so that the phosphorous load requirements of the MSFD and the WFD are met.

Similarly, target values should be defined for plastics in other research projects focused on marine waters.

Pollutants discharged into the sea need to be discussed more intensively in the international river basin commissions in order to make the approach of the different countries as uniform as possible. Discharges from upstream countries and the need to reduce them must also be taken into account. In the medium term, the establishment of target values at the limnic-marine transition point should be regulated at EU level for all member states as limiting values defined in Germany are not mandatory for other countries.

II. 9. Strengthen efficient administration, improve data flow, optimise legal frameworks and secure financing

Baseline

- The water sector* in Germany has a many-layered organisational structure. Public water responsibilities are divided among the Federal government, the federal states, districts and local authorities. The functions of the water sector* are also carried out by various companies and association structures (e.g. special purpose associations, special law associations, water and soil associations).
- The enforcement of water regulations is the responsibility of the federal states and is carried out by state, district or local authorities. The management* of the federal waterways including the associated enforcement is the responsibility of the Federal government. The conventional enforcement tasks, which are highly dependent on certain conditions, often require very specialised technical and legal expertise and the ability to effectively integrate environmental aspects.
- Environmental administrations are facing pressure to reduce their spending and eliminate bureaucracy on the one hand; on the other, the range of tasks they are handling and the difficulty of the tasks are growing. Today's environmental problems are extremely complex and require ambitious solutions and adequate personnel.
- The range of instruments in national and European legislation is constantly expanding, leading to new administrative duties.
- The growth in data volume and the resulting requirements for collecting, processing, sharing and analysing data are also major challenges for water administrations. Technical and legal barriers are often a hindrance to seamless data and information exchange.
- The Federal government's administrative data strategy is critical of the fact that data exchange between the Federal, federal state and local levels only takes place sporadically and sometimes only on request. All Federal ministries are required to make ongoing progress on linking and expanding efficient data infrastructure systems in goal-oriented cooperation that includes the federal states. The establishment of data partnerships to fulfil the government's mandate to provide services, also with offices outside the administration, complements this approach.
- Technical, content and organisational improvement to data exchange is also in line with the 2020 Council conclusions "Shaping Europe's Digital Future" and "Digitalisation for the Benefit of the Environment". Data exchange serves the establishment of a European environmental data space as defined in the European Strategy for Data and responds to the call in the European Commission's Green Deal to create and broaden access to interoperable data. At the same time, it is also a prerequisite for efficient, effective monitoring of the targets in the EU's 8th Environment Action Programme.
- Financing is not guaranteed for the measures to achieve water objectives at the various levels involved; in addition, numerous new responsibilities are falling to the water sector*, for

instance due to climate change and biodiversity loss. It is also unclear how these activities will be funded.

- Most recently, annual investments of 7.5 billion euros went to wastewater treatment and drinking water supply.
- To achieve the WFD management* targets in all water bodies, the LAWA estimates necessary additional costs of approx. 35 billion euros.

What are the challenges?

Various administrative bodies implement water management* objectives. Implementation thus primarily depends on how well the administrative or organisational structures in question function. In many cases, the environmental administrations are now working at the limits of their capacity, as the German Advisory Council on the Environment (Sachverständigenrat für Umweltfragen, SRU) was able to document in many expert interviews. These administrations also acknowledge that they lack the capacity to rigorously fulfil all of their legally prescribed responsibilities. In future, it must be ensured that the administrations are equipped with sufficient qualified personnel, technology and organisational structures that match their current needs, and adequate financial resources.

The conventional enforcement duties increasingly include tasks oriented towards environmental quality objectives. These require highly qualified administrations with the capacity for interdisciplinary work. Furthermore, administrations must have the authority and capability to develop strategic plans. Cooperative intermunicipal and multi-association projects are already common practice due to the overarching nature of the tasks handled by the water sector*.

Workflows and communication processes will be fundamentally changed by digitalisation across administrations. The digital transformation is bringing about profound change in the economy and society, in work, consumption, cooperation and communication. A number of important plans and measures have already been implemented by the Federal government as part of the 2020 agenda for digital government (Digitale Verwaltung 2020). Key strategic challenges for water data and environmental information include:

a. development of data management at Federal and federal state levels with better technical, organisational and content coordination
b. harmonisation of the existing data/technical information systems at Federal and federal state levels, e.g. of the environmental data reporting apparatus within the specialised networks (EU, European Environment Agency), and the provision of environmental data and information
c. reduction of technical, organisational and legal barriers to exchanging data and information in Germany and Europe while meeting data protection requirements
d. development of data on how smart devices or the use of the internet/digital services by private users (also data generated by private users in the hands of private companies) influences nature and the environment

The Directive on open data and the reuse of public sector information (Directive (EU) 2019/1024) is a first step in the right direction. The data relevant to the water sector* (or even water management*) must be incorporated into regulations on high-quality data sets as defined in this directive The European Data Governance Act, currently in progress, and the planned Data Act represent further steps towards tapping into water data outside of the public sector or within the public sector but excluded from reuse, for example due to business secrecy, copyright standards or statistical confidentiality.

Water is the link between the various sectors, for example health, agriculture, manufacturing, energy, environmental protection and nature conservation, spatial planning, regional development and between the respective responsible authorities. These act at different levels (local, regional, federal

state, Federal). Administrative structures must ensure that authorities outside of the area of environmental protection, for example administrations in energy, transport and agriculture, accept and are able to handle water conservation responsibilities.

Currently, the existing governance structures do not always make targeted and active use of the potential synergies* arising from common goals in water conservation. This means financial and human resources are not used to their full potential.

The increasing complexity of water planning processes due to quality requirements may overtax the capacities of some authorities in future. Certain future problems will no longer be solvable, e.g. within the scope of responsibility of individual local authorities. In fulfilling certain public service functions in practice, there is already a division of labour and cooperation between municipalities with the aim of greater efficiency*. These intermunicipal cooperation platforms should be expanded and strengthened. The legal and structural frameworks should be reviewed and adapted where necessary.

Further development of the legal framework is required in order to meet the challenges in the water sector*, at national level and to some extent at European level.

Due to increasing demands on and complexity within the water sector*, it is likely that the legally defined participatory processes will no longer be adequate or will start too late to serve the stakeholders and the general public. These groups must be included earlier on and as actively as possible in policy-making, planning and project decisions and must be able to monitor project implementation. Ensuring this is a challenge, also in light of current requirements coming from the European Court of Justice.

As the German Advisory Council on the Environment [12] has found, fees and charges currently contribute a relatively small amount to financing environmental protection measures. In light of tight budgets and the increasing public service responsibilities in environmental protection, requiring users and polluters to pay for administrative costs can help relieve the financial burden and ensure that the government fulfils its duties adequately in the long term. It is possible and advantageous to charge the costs incurred to users particularly where the costs of environmental protection services can be directly allocated to the party responsible. At the same time, charging users for environmental protection creates an incentive* to change behaviour that should not be underestimated, whether in the context of providing public goods or helping prevent negative environmental effects. The existing potential in fees for financing and changing behaviour has yet to be fully tapped.

Vision – Administration, data flows, legal frameworks and financing in 2050

The decision-making levels and administrative structures at national, state, district and local level in the German water sector* are set up from an organisational, technical, staffing and financial perspective so that they can handle new challenges, for example climate change and the loss of biodiversity, but also demographic change and the balance between urban and rural areas. There is extensive cooperation within the administrative levels of the water sector* and networked cooperation with other administrations whose activities can give rise to synergies* and/or conflicts with the water sector*. This includes effective intermunicipal cooperation in the area of public water services.

A **networked system of applications and databases** is established to support complex processes in environmental protection documentation, notification and reporting obligations. This takes into account national obligations to the European Commission, the European Environment Agency and

[12] See SRU (2007): Umweltverwaltungen unter Reformdruck: Herausforderungen, Strategien, Perspektiven.

monitoring requirements under intergovernmental cooperation platforms (HELCOM, OSPAR, etc.). The interconnected system of applications and databases has the aim of permanently reducing the administrative burden on companies and public authorities at all levels and ensuring a high level of protection for water in Germany.

Integrated work methods are adapted to the changed overall conditions and requirements. There is also intensive dialogue among the federal states on appropriate governance structures in joint working groups; this enables mutual learning.

The water sector* and water authorities offer attractive professions, prestigious jobs and various career opportunities. Job openings in the sector are adequately filled. Professionals in the sector have qualifications that keep pace with ongoing developments in technology, digitalisation and new environmental requirements. Salaries are appropriate to the work. The selection of personnel is adapted to the new challenges.

The legal framework specific to water is optimally coordinated with other relevant areas of law. Conflicting objectives are minimised and tailored to the new challenges.

Synergies* in legislation, planning, building and operation of water infrastructure* enable effective administrative activities involving all relevant stakeholders and using modern forms of management and work organisation.

Financing that covers costs is secured for water services (water supply and wastewater management) for the long term through adjusted charges, fees and pricing schemes that include the funding required for maintaining and updating installations and infrastructure. The services performed by public water sector* companies to protect water resources and water bodies are appropriately accounted for. The possibilities offered by the digital transformation are used to differentiate tariffs based on demand.

In order to tackle the transformation of the water sector*, sufficient funds are available in joint federal-state financing instruments to finance water management* measures to be implemented by public agencies (water protection, flood protection and low water management). Charges linked to pressures put on water resources that create incentives* to reduce pollution contribute to funding for programmes of measures, for water-related climate adaptation*, for preservation of ecosystem services*, for conservation of species and habitats and for water body development*. Charges for associated services and goods, for example tourism fees, can also help finance work in the water sector*.

What needs to be done?

Active cooperation in and support for change processes in the water sector* led by administrations require that they be sufficiently equipped with qualified personnel and, if needed, specially adapted administrative structures. Administrations must continue to be able to work with their “customers” (the public, businesses, engineers, planning agencies, etc.) with technical expertise and adequate resources. At national, state and local level, the water administrations should cooperate to develop and implement plans to strengthen and train their personnel. Taking stock of the existing training capacities by carrying out a personnel needs analysis with short, medium and long-term timelines is the next step. This will be regularly updated, and the qualification and training requirements will be reviewed and adapted.

Strengthening the administrations also means improving digital skills and taking advantage of the opportunities offered by digitalisation. The government’s 2020 agenda on digital government programme, the Digital Strategy 2025 and the acts on e-government and online access (OZG) have laid

the foundation for streamlining and optimising administrative processes and creating seamless services for the public and companies. At the same time, cooperation among all government levels needs to be improved. Intermunicipal cooperation must be strengthened by stepping up advice and support to local authorities on how to initiate and carry out cooperative projects.

For enforcement, this means, for example, making more personnel available for water-related legal processes (i.e. licensing) in the future where reasonable and possible or (further) developing publicly accessible environmental information systems.

When it comes to collecting, managing and sharing water data, further harmonisation and standardisation processes need to be initiated in order to minimise, for example, incomplete data transfer caused by different data standards at the various administrative levels. Drawing up a plan to create a uniform legal basis for collecting and using water data in cooperation with the federal states and other water stakeholders can guide and provide a framework for this process.

People in adjacent interest areas and disciplines (especially in spatial planning and nature conservation) need to be kept informed about hydraulic plans and projects (e.g. Germany's Blue Belt programme, river basin protection, flood protection, interstate biotope network) and involved in planning. In the framework of implementing European and national law, for example the Water Framework Directive, the Habitats Directive, the Floods Directive, the Federal Nature Conservation Act, the coordination and cooperation between the various professional disciplines should be made more robust at all levels. Regional participatory formats are an appropriate instrument to support the transformation of the water sector* and to ensure the acceptance and success of implementation processes. These formats allow participants including landowners, water suppliers, local authorities and lower-level water, nature conservation and agricultural administrations to discuss the necessary regional duties in the water sector*. Transferring decision-making powers to these bodies needs to be reviewed. These regional formats help ensure that spatial planning takes better account of water management* aspects and issues. It can also help with the development of binding land use planning for transparent, flexible and sustainable water management* and serves to head off use conflicts at an early stage.

An independent peer review of the responsibility, cooperation and decision-making structures in the water sector* should be conducted to serve as a guide for this transformation process. Cooperation with the OECD is an option here, as the organisation supports its member states in these kinds of processes. Additionally, the Federal, federal state and local levels conduct ongoing reviews of the compatibility and the need for adaptation of existing structures in their areas of responsibility.

Current water law will be examined to see whether it matches future challenges and developments at European Union-level with the Green Deal and the Biodiversity Strategy for 2030. In this context, the aim is to minimise conflicting objectives identified in the legal provisions as much as possible by adapting the legislation in question in all relevant areas (nationally and at EU level).

Public procurement entities are required to prioritise products that have no adverse impacts on water resources.

The existing financing instruments will be evaluated to determine their future viability in order to ensure the needed financial resources in all areas of the water sector*. Current and imminent financing gaps need to be identified, and proposals developed for future sufficient financing of water sector* activities, e.g. in the framework of a new Joint Task, a targeted funding programme. The Federal and federal state governments will coordinate with the relevant stakeholders to ensure that suitable financing mechanisms are developed and implemented. The Federal government should participate in

financing via an immediate action programme for urgent water conservation measures required to implement EU law, water development measures and adaptation* measures.

II. 10. Working together to sustainably protect global water resources

Baseline

- According to United Nations projections, the world's population will grow to 9.7 billion by 2050 (and to 10.9 billion by 2100). At the same time, the lifestyles of many people are changing. Both of these trends will lead to a significant rise in water demands.
- Already today, around 2 billion people live in regions under water stress. Experts believe that this figure will increase sharply in the coming decades. Estimates suggest that by 2030, 700 million people around the world could be displaced by extreme water scarcity.
- In 2050, approximately 70% of the world's population will live in cities. According to estimates made by the United Nations, over 80% of wastewater is being discharged into the environment without adequate treatment.
- Goal 6 of the 2030 Agenda for Sustainable Development (SDG 6) is to ensure the availability and sustainable management of water and sanitation for all.
- United Nations surveys show that currently every third person globally (around 2.2 billion people) has no access to safe drinking water, and more than half of the world's population (around 4.2 billion people) live without adequate sanitation.
- At the end of 2019, UN-Water reported that the Sustainable Development Goal for water (SDG 6) of the 2030 Agenda will not be attainable unless the international community and UN organisations significantly step up their efforts. A considerable improvement of cooperation among UN organisations is pivotal.
- Since 2011, the World Economic Forum has yearly identified the global water crisis as one of the biggest risks* for the economy, the environment and peace on earth.
- Goal 14 of the 2030 Agenda (SDG 14) is to conserve and sustainably use the oceans, seas and marine resources. Currently, these are in considerable danger due to human activity.
- The United Nations institutional landscape for water is highly fragmented. Interventions and responsibilities for the support to SDG 6 are distributed across 32 UN organisations, programmes and funds.
- Germany's water footprint* is largely determined by foreign production of goods and imports from abroad. Almost 70% of the footprint can be attributed to external water use.

What are the challenges?

The global water cycle is a closed system. Overall, the planet's water resources remain the same. However, only a very small share of global water resources (3.5%) can be used as fresh water resource.

Sustainable water management* is essential for combating global poverty, ensuring worldwide food security and sustainable economic and industrial development. In agriculture and industry (including energy production), water demand will increase sharply in the coming decades due to population growth, the impacts of climate change, increasing electrification, changing lifestyles and consumption patterns and the associated economic development.

Experts believe that the number of people living in regions under water stress will rise sharply in the next few decades. The number of people displaced by extreme water scarcity will also increase dramatically.

At the same time, available freshwater resources will be strained by increasing pollution of surface water and groundwater, which will limit exploitable water resources and increase the effort and expense needed to supply safe drinking and domestic water. The declining status of water bodies hits

developing countries and emerging economies particularly hard. Since the 1990s, water pollution has increased in almost all rivers in Africa, Asia and Latin America.

Already today, many cities lack adequate infrastructure and resources to ensure efficient and sustainable wastewater management. In many places, the expansion of infrastructure is not keeping pace with increasing urbanisation. Globally, wastewater is still mostly discharged into the environment without appropriate treatment. This leads to water and ecosystems degradation, health risks* and increased emissions of the greenhouse gas methane. It also means that valuable resources contained in wastewater go unused. Still, every third person worldwide has to drink contaminated water that poses a health risk*. More than half of the world's population lives without adequate sanitation. Water, sanitation and hygiene are closely linked, as noted by the concept of WASH.

Due to global economic integration, well-being in Germany depends on the availability and quality of water resources in other countries. At the same time, industrialised countries share through their water footprint*, i.e. their production and consumption patterns and lifestyles, responsibility for the overuse of water resources worldwide and the pollution of water bodies.

Sustainable water use and healthy water bodies are a prerequisite for functioning ecosystems, which are also of high economic importance. The annual value of the ecosystem services* they provide exceeds the annual global gross domestic product.

In 2010, the UN General Assembly and the Human Rights C first recognised clean drinking water as a human right. In 2015, sanitation as a human right followed. Both rights are legally binding to all signing parties. The same year, 193 member states of the United Nations committed to the goals of the 2030 Agenda for Sustainable Development, including Goal 6: ensure access to water and sanitation for all.

In 2017, the member states of the United Nations adopted a resolution addressing water pollution to protect and restore water-related ecosystems at the third session of the UN Environment Assembly.

According to UN analyses, SDG 6 of the 2030 Agenda is not achievable with the current international efforts. To date, the UN development system efforts to deliver on the 2030 Agenda are insufficient to reverse this prognosis. According to a 2017 report commissioned by the UN Secretary-General, the majority of the UN budget available for water issues is allocated to emergency and humanitarian aid (UNICEF, UNOPS, UNRWA, UNHCR). Only an extremely small amount of funds are used for assistance on issues such as integrated water resource management*, improvement of water use efficiency* and sustainable increase in access to drinking water and sanitation.

The UN's institutional landscape on water is extremely fragmented, with very little overarching coordination and strategic orientation to deliver on the goals of the 2030 Agenda. The existing internal coordination mechanism of UN-Water only has a weak mandate and cannot intervene in the programme approach of the individual UN organisations.

Vision – Global water resources in 2050

The conservation of water resources and the quality of surface waters and groundwater worldwide is improved.

The water security and the protection of groundwater and surface waters is ensured.

Water bodies are protected from harmful pollution, adverse changes and overuse. The conservation and restoration of ecosystems worldwide, which are essential for sustainable water availability and healthy water bodies, are guaranteed through multilateral, regional and bilateral agreements, national legislation and efficient implementation structures.

The quality of groundwater and surface waters of the world is ecologically safe compared to an international evaluation baseline. Where this is not yet the case, the required political, institutional and financial framework conditions are established in order to achieve good status within an appropriate timeline.

Water management* and water infrastructure* are climate resilient. Water-using sectors anticipate and adapt to the impacts of climate change. The water sector* takes full advantage of its options for reducing greenhouse gas emissions . Sustainable water resource management* thus also contributes to the implementation of the Paris Agreement.

There is a better understanding of the economic and social impacts that unfold in the wake of climate change due to variations in regional water availability and the frequency and intensity of extreme events such as droughts and flooding and their significance for political conflicts and waves of migration. This understanding is integrated as a cross-cutting issue into the development of policy strategies to prevent internal conflicts and conflicts between countries.

The targets of SDG 6, SDG 14 and other water-related targets of the 2030 Agenda for Sustainable Development are achieved. Compliance with the targets is ensured for the long term, e.g. via sustainable financing mechanisms, integrated and sustainable resource management* and protected rights for local communities, vulnerable groups and minorities.

Water pollution is in sharp decline thanks to regulation of water-relevant pollutants * and the safe use of chemical substances under international agreements, among other things. The cross-sector character of water is reflected by the worldwide application of integrated sustainable water management*. This involves close, efficient cooperation between ministries and specialist authorities in the various policy areas, the scientific community, the private sector and civil society at local, national and basin levels. There are established mechanisms to handle and reconcile use conflicts. Governments, businesses and consumers make decisions taking into account the water footprint* of the entire value-chain of a product or service. This is supported by internationally agreed criteria and standards as well as transparency rules in individual countries.

Locally appropriate and tailored mechanisms for the sustainable financing of construction, maintenance and operation of grey and green infrastructure and of water services as well as for management and conservation measures are established around the globe. These take into account the polluter-pays principle and the particular needs and rights of vulnerable groups. This is complemented by fair, sustainable international financing mechanisms to support particularly least-developed countries in ensuring water security and the supply of water services.

Multilateral structures to achieve the 2030 Agenda and handle future challenges are strengthened.

Agreements under international law and their implementation mechanisms exist for cooperation among countries that share transboundary waters; these are based on the Convention on the Law of Non-Navigational Uses of International Watercourses or the Convention on the Protection and Use of Transboundary Watercourses and International Lakes.

At multilateral level, mechanisms for cooperation are developed that are able to respond promptly, efficiently and as needed to international water and policy challenges. These mechanisms also support their member states as effectively as possible in handling these challenges.

At the level of the United Nations, there is effective and efficient coordination of the (global, regional and country-specific) interventions of the various organisations and programmes active in the water sector*. Their areas of responsibility are clearly defined and distinct from one another. They are geared

to the goals of the relevant multilateral agreements (e.g. 2030 Agenda, Paris Agreement, Convention on Biological Diversity, Sendai Framework, New Urban Agenda for Sustainable Urban Development). At the level of the United Nations, an intergovernmental mechanism is established that enables the member states to regularly review the overall progress made on water targets and how the UN system contributes to these targets, formulating political guidance in response.

What needs to be done?

Holistic approaches and strong international cooperation are required in order to realise the vision of worldwide good water quality, resilient water infrastructure* and the sustainable use of the world's freshwater resources.

The availability of reliable data on the pressures water faces, the status of water bodies and the impacts of climate change is a pre-requisite for targeted decision-making and measures. This requires appropriate capacities for data collection, management and analysis as well as robust cooperation among international organisations, at bilateral and multilateral levels and with the involvement of national authorities and research institutes. A status description of global freshwater resources must be drawn up and regularly updated. The availability of targeted data products and evidence-based water and climate data services and early warning systems to support decision-making in UN member states needs to be improved. Multi-stakeholder initiatives like the World Water Quality Alliance are particularly suitable for this.

Decisions about the use of water resources are not taken solely by the authorities and bodies responsible for their conservation and management*, but by stakeholders in all sectors making use of these water resources (in particular agriculture, industry, mining, urban development). Decisions in other environmental policy areas (air quality control, waste management, climate action, climate adaptation*, nature conservation) can also have impacts on water resources. Water policy targets can only be achieved through cooperation and coordination across sectors and policy fields at national, basin and multilateral levels. The appropriate mechanisms, structures and legal bases need to be created, further developed and strengthened. It is important here to ensure that these have a foundation in human rights, include the interests of local communities in a non-discriminatory way, promote social justice and curb future potential for conflict. Germany has an active role to play in the relevant multilateral organisations and processes here and must tailor its bilateral cooperation to support the establishment and application of efficient regulation and governance systems in the context of integrated water resource management*.

The creation of transboundary cooperation mechanisms in river basin districts and at regional level needs to be promoted, for example by promoting the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention).

Co-benefits in greenhouse gas mitigation and climate adaptation*, for example ecosystem-based solutions, water reuse and increased water use efficiency* in water-using sectors, should be more effectively leveraged, while trade-offs should be mitigated. These developments should be flanked and fostered by the establishment of targeted instruments and services for Member States within the framework of multilateral mechanisms and conventions, by the formation of cross-sector alliances.

Partner governments and the operators of local water and wastewater services should be supported in cutting GHG emissions in drinking water supply and wastewater management, for example by increasing energy efficiency*, optimising the operation of water and wastewater plants and developing targeted regulation. The implementation of technical innovations and the application of nature-based solutions and traditional knowledge should receive targeted support.

Support for the expansion of urban and industrial wastewater management in developing countries and emerging economies and the promotion of best available technologies and suitable legal frameworks must be continued and stepped up. Related cooperation between stakeholders from Government, industry and science to support the practical application of technologies needs to be promoted.

In cooperation with the EU countries and other UN member states, decisions must be pursued to strengthen the multilateral mechanisms for achieving the water Goals and targets of the 2030 Agenda and future objectives. On the one hand, improved horizontal coordination between the various water-related organisations and programmes of the United Nations is the goal. This requires a strong mandate for an internal coordination mechanism within the UN system that is able to evaluate the sum of activities of UN actors and their impacts and develop a basis for decision-making. On the other hand, greater coherence in the decisions of the UN member states within the governing bodies of the various organisations and programmes is required to ensure a more coherent, more efficient and better aligned delivery of the UN development system on the water-related Goals and targets of the 2030 Agenda. This requires the establishment of regular, joint follow-up and assessment, by UN Member States, of the progress on SDG 6 achievement and SDG 6-related UN system intervention. This joint follow-up could be organized, for example, under the umbrella of the UN General Assembly or in the form of regular high-level meetings presided by the UN Secretary-General. Work with partner countries, civil society and other non-governmental organisations is needed to take account of the important role of water in the consultation and decision-making processes of multilateral agreements in other policy fields. This primarily applies to multilateral environmental conventions, but also to agreements in agriculture, mining, transport and trade. The aim is to agree on internationally comparable requirements to reduce water demands, to ensure sustainable use of water resources in all sectors, to create transparency around the water footprint* of goods and services along the entire value-chain and to mitigate and adapt to climate change.

III. Programme of measures – Water

The proposed measures summarised in this programme are intended to operationalise the National Water Strategy. The programme of measures focuses on the time period up to 2030 and is broken down into measures that will begin in the next five years (short term) and follow-on measures that are more likely to be initiated in the second half of the decade (medium term). Like the overall proposal for the National Water Strategy, these proposed measures are intended to be the foundation for further discussion and coordination with the aim of achieving a National Water Strategy drawn up by the Federal government that will then be further developed with the federal states and have broad support from stakeholders. The programme of measures therefore contains measures that address various stakeholder levels. Close coordination, discussion and agreement on priorities, responsibilities and financing will be necessary.

The programme of measures draws on ideas from the national dialogue on water and the citizens' dialogue on water carried out by the BMU. During the National Water Strategy drafting process, numerous existing strategies related to water were analysed. The content of measures that were relevant to the strategic issues of the National Water Strategy have been included in this programme of measures.

III. 1. Raise awareness of water as a resource

Number	Measure	Links	Start date
1	**Water communication strategy** Plan and implement long-term water communication strategy in the framework of the UN Water Action Decade. The strategy must address various target groups (e.g. children, adults, farmers, businesses). It needs to touch on the following topics: water pollution (particularly nitrates, microplastics and pharmaceuticals), the value of ecosystems, the value of clean drinking water (health), the value of functioning water supply, the importance of wastewater management, climate adaptation* (water use), consumption and water requirements, nature conservation and rainwater infiltration. The communication strategy will be implemented through media partnerships and advertising campaigns over a period of at least ten years.	Measure III.1.2, Sustainable Water Award competition, should be included in the communication efforts.	Short term
2	**Sustainable Water Award competition**		Short term

	An annual water prize will be awarded to companies and farms that manage water particularly efficiently. The award will be based on a competition.		
3	**Training programme for local policy-makers** Establish training and continuing education opportunities for local decision-makers. The training should cover planning aspects as well as ecological and technical issues. Since many water management* and conservation decisions are made at the level of local authorities, local politicians and decision-makers should gain comprehensive awareness and understanding of the interdependencies of water management*. Policy-makers who understand their own scope for action are better able to leverage it in decision-making.	Can link to measure III.1.5, Network of experiential learning and educational sites; training can be held at these sites.	Short term
4	**Education and training for farmers** Joint planning and execution of education and training programmes on water topics by the water, agriculture, forestry and nature conservation sectors with the aim of reducing farming and forestry's negative impacts on water bodies.	Should include results from measure III.6.41,National practical handbook for water-optimised land use.	Medium term
5	**Network of experiential learning and educational sites** Create a national network of educational institutions, experiential learning and educational sites focused on water. This network will address pre-school age children through to adults, providing general education on water and promoting the appeal of sector-specific professions (cultivating future professionals). At these sites, stakeholders involved in implementation can also receive information about the latest knowledge and best available techniques. The network will also provide advice on creating educational offerings. The aim is to create new programmes or materials wherever the existing network has gaps in content or geographic coverage.		Short term

6	**Use of citizen science** Develop citizen science instruments as a new option for the public to participate in water conservation and monitoring (e.g. pollution apps).	Can be an element of measure III.1.1, Water communication strategy.	Short term
7	**Create a research and demonstration field for innovative water and wastewater technologies** Create a permanent demonstration site for innovative water and wastewater technologies under real-life conditions and with intensive scientific involvement, in combination with a centre for education and training. The research and demonstration field will establish a platform for start-ups and scientific cooperation aimed at helping innovative developments make the transition to practical application. The education and training component, also for experts from other countries, is intended to help new concepts spread internationally, which is also an important prerequisite for future cooperation and exports.		Short term
8	**Operationalise water footprints** Further develop the water footprint* concept with the aim of identifying national resource indicators on the water footprint*, developing options for water-related product labelling and providing individual water footprint* calculations (similar to carbon footprint calculators).		Short term
9	**Water footprints in education and for consumers** Make the methodology and standard of the water footprint* known to the general public as a uniform labelling system to be used as a guide. This also serves to reduce Germany's world water footprint*.	Requires completion of measure III.1.8, Operationalise water footprints.	Medium term
10	**Corporate reports**	Requires completion of measure III.1.8, Operationalise water footprints.	Short term

	Include water aspects in the sustainability* reporting of businesses following the revision of the EU provisions on sustainability* reporting. Develop methods for estimating water risks* for businesses and for measuring the impacts of business activities, including on water bodies. The aim is to improve the information financial market actors have for their investment decisions (German Sustainable Finance Strategy).		

III. 2. Further develop water infrastructure

Number	Measure	Links	Start
11	**Develop uniform national guidelines for future design of water infrastructure** Develop uniform national guidelines to support administrations and infrastructure operators in the long-term, cross-sector design of infrastructure. These guidelines must provide orientation that prioritises nature-based solutions* as much as possible to promote multifunctionality (e.g. unsealing, climate adaptation*, local recreation, etc.) and the resilience of future investments. The guidelines also need to contain information on variant analysis and practical examples. In terms of efficient use of funds, these guidelines are intended as the basis for directing existing and/or new funding programmes and investment planning.	Should be planned together with measure III.2.12, Adapt (technical) water regulations to climate change.	Short term
12	**Adapt (technical) water regulations to climate change** Innovative and forward-looking solutions will receive funding. The regulatory institutions will receive support to establish good examples as the recognised best available technologies. The impacts of climate change are taken into account in the existing sub-legislative codes, standards, guidelines and provisions for water infrastructure*, e.g. the climate label in the German Association for Water, Wastewater and Waste (DWA) guidance documents. The bodies in the water sector* will review the standards and technical regulations as part of the regular revision cycle and adapt them to the requirements of climate change.	Should be planned together with measure III.2.11, Develop uniform national guidelines for future design of water infrastructure.	Short term
13	**Minimise hydropower impacts on water bodies**		Short term

	The operation of hydroelectric power installations is a major factor in why the management objectives set out in the EU water Framework Directive have not yet been reached in Germany. Particularly problematic in this context is the large number of small hydropower plants, which, however, account for only a minimal share of gross electricity generation in Germany. The legal framework for hydropower needs to be reviewed and adapted in specific cases to improve the hydro-ecological conditions in running watercourses in Germany. • The provisions in the Renewable Energy Sources Act (EEG) that incentivise new small hydroelectric power plants and capacity increases must be reviewed with an eye to their environmental impacts and be adapted if necessary. • For larger new plants and capacity increases in larger existing plants, support in future needs to be linked across the board to proven compliance with water law requirements (in particular minimum water flow, river continuity, fish conservation). The support that has been granted to date solely for increasing capacity by at least 10% will no longer be granted in future. • Support needs to be discontinued if the responsible authority determines that the requirements for licensing under water law are not or are no longer met. • Adaptation of the regulatory requirements for the use of hydropower with regard to improving fish conservation and fish downstream migration is also feasible.		
14	**Create nationally uniform framework for regional water supply plans** Develop a nationally uniform framework (national blueprint) to support the federal states in drawing up comprehensive regional water supply plans. These plans aim to prevent overuse of local water resources and form the basis for planning regional grey and green water infrastructure* systems (water retention, groundwater recharge, interconnected supply areas, long-	Requires measure III.5.30, Improve forecasting in water balance analysis as a basis.	Short term

	distance water supplies, reservoirs). Water supply plans will take into account how demographic changes and climate will impact the regional water management* and supraregional interfaces. The plans will also include potential for synergies* with energy supply (shared use of reservoir infrastructure) and effects on the flow of surface waters and options for water reuse.		
15	**Supraregional infrastructure** The water use plans will provide a basis for determining national needs for supraregional infrastructure. Beyond this, it will also be reviewed whether the necessary space for supraregional infrastructure – for example corridors for long-distance water lines or land for water body development* – can be included in Federal spatial planning.	Requires measure III.2.14, Create nationally uniform framework concept for regional water supply plans, and is supported by III.5.30, Improve forecasting in water balance analysis.	Medium term
16	**Permanently strengthen inland and coastal flood protection** The aim of the national flood protection programme is to accelerate the planning and implementation of large-scale cross-regional flood control measures at federal state level. This is intended to mitigate the damage caused by future floods. Further, the national flood protection programme needs to be secured beyond the currently planned ten years with long-term support and multi-year financial planning. In light of the expected rise in sea level, protecting the coast from storm surges must also be continually supported and ensured for the long term.	Plan with measure III.7.46, Strengthen Germany's Blue Belt programme.	Medium term
17	**Support for creating hazard and risk maps for local heavy rainfall events** A guideline needs to provide minimum standards for creating hazard and risk* maps for local heavy rainfall events. Uniformity should be the aim, as these maps are the basis for local planning. They provide data on risks* to planners, property owners and workers and therefore contribute to better precautions to handle climate change impacts. Compatibility with the Joint Water		Short term

	Commission of the States (LAWA) strategy for effective heavy rainfall management must be ensured.		

III. 3. Link water, energy and substance cycles

Number	Measure	Link	Start
18	**Review existing legal frameworks/remove barriers to investment** The legal frameworks in energy and taxes need to be reviewed and adapted if necessary in order to increase the investment options for local water supply and wastewater management companies when it comes to energy efficiency* and regenerative energy production.		Short term
19	**Draw up a guide on sector coupling with water** On the basis of existing research and pilot projects, a guide will be developed for infrastructure operators (showing what is feasible) to support the creation of water and wastewater systems that are sector coupled, climate neutral and resource efficient. It will cover technical, legal, financial and organisational aspects.	Must be linked to measure III.3.18, Review existing legal frameworks/remove barriers to investment.	Medium term
20	**Increase water reuse** Water reuse will become relevant as a climate adaptation* measure, particularly in cities and regions with long summer dry periods. Joint guidelines and technical instructions for the use of treated wastewater will be developed (in addition to implementation of Regulation (EU) 2020/741 for agricultural irrigation). Further, guidelines will be developed for water reuse and multiple use (e.g. of rainwater) in local development planning and in the water supply plans for city districts and industrial installations.		Short term Medium term
21	**Design water sector frameworks for new energy sources**		Medium term

	Requirements, technical instructions and evaluation processes will be drawn up for the production of innovative energy sources like hydrogen or geothermal use of groundwater (for heating/cooling). These will assess and minimise potential impacts on the water balance* and hydroecology and prevent competitive situations with other water uses*.		

III. 4. Mitigate risks caused by pollutants

Number	Measure	Link	Start
22	**Continue trace substances dialogue and further develop content** The newly established Federal Trace Substances Centre at the Federal Environment Agency (UBA) will continue its scientific follow-up on the work done in the trace substances dialogue (e.g. identifying reduction measures along the value and use chains, raising awareness and setting expert priorities) and will advise stakeholders.		Short term
23	**Support and implement zero pollution action plan** At EU level, Germany will work to achieve coherence between the European framework provisions for water and marine conservation (WFD, MSFD) and the air quality and substance*-related regulations (e.g. Directive 2010/75/EU on industrial emissions, Directive 91/271/EEC concerning urban waste-water treatment, the EU Biocide Directive 528/2012, Regulation (EC) No. 726/2004 on medicinal products, Regulation (EC) No. 1107/2009 on plant protection products, Regulation (EC) No. 850/2004 on persistent organic pollutants, and the REACH Regulation (EC) No. 1907/2006).		Short term
24	**National substances database** On the basis of standardised methods for monitoring substances*, substance groups*, pathogens* and particles* and taking into account existing databases, a national database will be established in order to create a better		Medium term

	knowledge base for scientists, practitioners and the public and to support enforcement of pollutant law.		
25	**Develop BREFs on the law governing major accidents** The laws governing major accidents must require the use of the best available techniques to avoid water pollution due to major accidents. The corresponding BREFs (Best Available Techniques reference documents) need to be developed.		Medium term
26	**Fourth purification stage** More water purification plants will be retrofitted with a fourth purification stage using the guidance on setting priorities developed in the trace substances dialogue. Federal financing instruments (e.g. further developed wastewater fees) need to be set up.	Implementation of measure III.4.27, Regulate manufacturer responsibility, can be used for financing.	Short term
27	**Regulate manufacturer responsibility** The manufacturers of products that can cause water pollution must be involved in preventing and removing harmful trace substances* from the water (and also in financing for the fourth purification stages in purification plants). Extended manufacturer responsibility needs to be regulated in water conservation law.		Short term
28	**Further develop measures in fertiliser law to implement the Nitrates Directive on the basis of impact monitoring** The impact of the measures taken in fertiliser law to implement the Nitrates Directive need to be reviewed as part of full-coverage monitoring to be set up nationally. Further measures to protect groundwater and water bodies will then be developed together with the agriculture sector on the basis of the monitoring results.		Short term

29	**Identify microbiological threats to human health (pandemic prevention)** Establish wastewater monitoring that will enable early detection of health risks* due to pathogens* (bacteria, viruses).		Short term

III. 5. Manage and restore the semi-natural water balance – prevent conflicting objectives

Number	Measure	Link	Start
30	**Improve forecasting in water balance analysis** Far-sighted management of water use conflicts requires a comprehensive data foundation. National water balance* modelling (including hydrogeological modelling) is necessary as a basis. Medium to long-term water supply and demand analyses can then be created at regional level and over the course of the year. The semi-natural*, regional water balance* will be analysed and projections made based on technical methods. These must include water requirements of the ecosystem, which will be determined in advance. For water management* planning, existing instruments such as water use plans will be examined to determine deployment possibilities and success factors and, if necessary, further developed, e.g. with a view to risk* management in case of drought.	Results from measure III.5.31, Develop groundwater withdrawal monitoring, and III.5.33, Guiding principles for regional, semi-natural water balance, need to be taken into account here.	Short term
31	**Develop groundwater withdrawal monitoring** Representative, quantitative real-time groundwater monitoring of actual amounts withdrawn will be developed. This, together with evaluation of the quantitative status of groundwater bodies, will form a basis for the future structure of withdrawal rights and risk*-informed groundwater management*. In addition, de minimis limits need to be reviewed.		Medium term

32	**Develop recommendations for handling water scarcity** Rules and criteria for water use priorities for expected future regional water shortages (water use hierarchies) will be drawn up. The particular importance of the public supply of drinking water and ecological water requirements will be taken into account.	This measure must also look at the results from measures III.2.14, Create nationally uniform framework for regional water supply plans; III.5.30, Improve forecasting in water balance analysis; and III.3.20, Increase water reuse. Equally, the structures of measure III.5.36, Create participation and mediation structures for handling water conflicts, should be used to support regional planning.	Short term
33	**Guiding principles for regional, semi-natural water balance** Guiding principles will be developed for rural and urban areas for achieving a regional, semi-natural* water balance*. These will take into account climate change and the 2045 greenhouse gas neutrality goal. They will also appropriately reflect use requirements.		Short term
34	**Incorporate public water supply better in planning processes** In order to give water supply planning appropriate consideration in the designation of building sites, building, planning and water laws will be reviewed for coherence and adapted if necessary.		Short term

35	**Measures for sustainable use of water quantities** Precautionary measures for ensuring sustainable water supply and a semi-natural* water balance* will be developed. These could include e.g. minimum standards for efficient water use in accordance with an established best available technique, national introduction and development of water	This measure is supported by the results of measures III.5.33, Guiding principles for regional, semi-natural water balance, and III.5.31, Develop groundwater withdrawal monitoring.	Short term

	withdrawal fees or the review of water tariffs for drinking and domestic water.		
36	**Create participation and mediation structures for handling water conflicts** Participation and mediation structures (e.g. water councils, water networks) will be created that support the implementation of national provisions on water use via consultation and above all work for the acceptance and success of these provisions. These structures will focus on achieving a fair balance between water interests and the needs of agriculture, forestry, landowners, fisheries, inland shipping and nature conservation for the common good. The involvement of these structures in creating and establishing regional land use and local plans, water protection areas and management* standards for the conservation of local water resources needs to be explicitly stipulated and embedded in the water laws of the federal states.		Medium term
37	**Improve soil conservation, the soil hydrology and groundwater recharge** The Federal Soil Protection Act will be amended to better meet the challenges of climate change and to ensure soil function, also with regard to soil hydrology, large-scale water retention and groundwater recharge. In addition, soil erosion and pollution are to be minimised and the precautionary principle* made a stronger part of soil conservation.		Short term
38	**Semi-natural rainwater management** Semi-natural* measures for rainwater management (e.g. infiltration and evaporation) must be prioritised in local development planning. With regard to infiltration, pollution in precipitation should be taken into account to protect the groundwater from contamination. This is a part of implementing water-smart urban development.	Link to measure III.6.43, Develop and implement model for the water-smart city.	Short term

39	**Strengthen protection of peatlands** The conservation measures outlined in the peatland protection strategy are intended to ensure comprehensive rewetting of peatland soils. To improve the hydrological basis for rewetting these soils, climate-neutral plans for removing drainage systems, drainage ditches or dismantling flood protection infrastructure (creation of retention areas) need to be drawn up using the results of the state finance programme (Länderfinanzierunsprogramm) project “Channels, irrigation and drainage”.	This must be coordinated with measure III.7.44, Incorporate areas for river basin development and water body development corridors in planning, and III.7.45, Improve integration of water planning in overall spatial planning.	Short term

III. 6. Pursue land use in urban and rural areas that is compatible with water and the climate

Number	Measure	Link	Start
40	**Agriculture and water sector practitioners’ dialogue** A dialogue project involving practitioners from agriculture, forestry and the water sector* as well as water conservation will draw up joint guiding principles for water-smart agriculture to protect water resources, also with an eye to climate adaptation*. Water-saving and water-efficient agricultural use and management will also focus on regional factors such as soil quality, water supply, topography and climate.	The dialogue can also support the activities of measure III.1.4, Education and training for farmers, and measure III.6.41, National practical handbook for water-optimised land use.	Short term
41	**National practical handbook for water-optimised land use** A national practical handbook on legal and sublegal rules and practical examples of management* methods needs to be drawn up with the goal of ensuring water-optimised land use. It can also be used as part of education and training in agriculture.		Medium term

42	**Add water criteria to funding instruments for climate-stable forest conversion** Aspects of compatibility with the water sector* (e.g. groundwater recharge as an ecosystem service) need to be components of the funding instruments for climate-stable forest conversion.		Short term
43	**Develop and implement model for the water-smart city** A practice-based, feasible model for the water-smart city (sponge city) will be developed to improve sustainable management* of precipitation in cities (infiltration, evaporation, storage and heavy rainfall management) and create opportunities for adapting to drought and heat in urban areas (e.g. prioritising decentralised rainwater management in new residential and commercial areas over channelling rainwater into sewers, giving special consideration to heavy rainfall events, flood prevention, reduction of heat stress). Aspects of water ecology and opportunities for people to experience their natural surroundings also need to be integrated. Technical approaches, social acceptance and possible risks* to the environment and health must be further clarified and model recommendations drawn up. The various areas such as local land management, building and water law, financing and liability issues and existing technical rules need to be compiled and adaptation needs identified.	Must take into account the results of measures III.2.14, Create nationally uniform framework for regional water supply plans; III.2.17, Support for creating hazard and risk maps for local heavy rainfall events; III.3.20, Increase water reuse; and III.5.38, Semi-natural rainwater management.	Short term

III. 7. Further develop sustainable management of water bodies

Number	Measure	Link	Start
44	**Incorporate areas for river basin development and water body development corridors in planning**	Plan with measure III.7.46, Strengthen Germany's Blue Belt programme.	Short term

	To supply land for water body development*, corridors that provide planning security for spatial needs on all sides of water bodies must be enshrined in spatial planning law. This enables carrying out hydromorphological measures and restoring links to adjacent river basins. Suitable space requirements for these must be determined. Synergies* between nature conservation and flood protection need to be considered.		
45	**Improve integration of water planning in overall spatial planning** The BMU will initiate development of the relevant scientific bases to improve the integration (compatibility) of water planning in overall spatial planning (regional and development planning) and thus its actual ability to be enforced when assessing all spatial concerns.		Short term
46	**Strengthen Germany's Blue Belt programme** Activities under Germany's Blue Belt programme must be strengthened and linked to water conservation measures in order to build up a biotope network of national significance along the Federal waterways and their floodplains.		Short term

III. 8. Intensify protection of marine areas (the North and Baltic Seas) from pollutants from land

Number	Measure	Links	Start
47	**Create a basis for more sharply reducing onshore pollution discharged into marine waters** Reference values must be determined for total phosphorous, selected pollutants and plastic waste including microplastics at the interface between inland and marine waters (the limnic-marine transition point). These form the basis for measures to reduce discharge into marine waters from river basins and aimed at achieving good environmental status for marine waters. The		Short term

	reference values determined in the research will then be legally implemented at a later date in the Surface Waters Ordinance.		

III. 9. Strengthen efficient administration, improve data flow, optimise legal frameworks and secure financing

Number	Measure	Links	Start
48	**Carry out OECD assessment** In cooperation with the OECD, an independent peer review of the water structures with the aim of identifying room for improvement needs to be carried out. The basis for the review will be the OECD Water Governance Principles and the indicator system developed by the OECD for these principles. The federal states and local authorities will have in-depth involvement in design and execution of the assessment.		Short term
49	**Further develop water law** In order to address the challenges identified in the Water Strategy (in particular the impacts of climate change and loss of biodiversity), the WHG and other relevant provisions need to be reviewed and adapted as required.		Short term
50	**Further develop intermunicipal cooperation** Intermunicipal cooperation must be further developed in order to increase the effectiveness of water supply and wastewater management. This should include improving the framework conditions for cooperation, e.g. by strengthening advisory services and support to local authorities, fully taking advantage of EU legal scope and making efforts to expand this scope.		Short term
51	**Make administration more robust in terms of staffing and organisation** A national systematic survey of personnel needs in administrations and specialised offices of the water sector*, including necessary qualifications, needs to be the basis for personnel recruitment and development planning. This work should also take into account the requirements and possibilities of digitalising water technology (Water 4.0) and water administration. Further, it		Short term

	needs to be reviewed whether pooling technical expertise by, for example, creating administration-internal competence centres could reduce the workload.		
52	**Set up a national immediate action programme for measures in water body development and climate adaptation* in water management*** Beyond the existing finance options, a national immediate action programme for measures in water body development* and climate adaptation* in water management* needs to be set up. Funding volume should be at least one billion euros over ten years. One aim is transfer to a newly designed Joint Task programme.		Short term
53	**Draw up a water data strategy** Create a strategy for collecting, storing and using water data. The aim of this strategy is to establish modern digital transformation processes, legal frameworks and administrative processes nationwide for the implementation of Water 4.0 in practice (e.g. an act on water data, uniform data standards, interoperable process chains).		Short term Medium term
54	**Public procurement** Public procurement at Federal level will be geared to sustainable water use and water conservation (e.g. water footprint*, Blue Angel).	Requires completion of measure III.1.8, Operationalise water footprints.	Medium term

II. 10. Working together to sustainably protect global water resources

Number	Measure	Link	Start

55	**Cooperate internationally to promote sustainable and integrated water resource management*** Germany will support the establishment of structures and capacities for continuously collecting and using hydrological and meteorological data in partner countries. Germany will support partner countries in transboundary river basin cooperation and on cooperative use of planning and financing mechanisms across sectors and scales. Germany will support partner Governments, local stakeholders and non-state actors in establishing enabling environments for resource-efficient water use, for sustainable water service for all, leaving no one behind, and for integrated water management practices that take into account the challenges of climate change mitigation and adaptation as well as conflicting water uses. Germany will also support related multilateral initiatives.		Short term
56	**Strengthen multilateral mechanisms to achieve the water goals of the 2030 Agenda** Germany is engaged in strategic dialogue with the EU and UN member states on the creation of an intergovernmental mechanism under the United Nations that will enable regular exchange on the implementation of the water goals of the 2030 Agenda and future global targets. Germany will also advocate strengthening the mandate and efficiency of UN-Water as a mechanism for coordinating the UN organisations and programmes active in water-related areas in view of Member States needs to achieve the 2030 Agenda and other water-relevant international agreements such as the Convention on Biological Diversity and the Paris Agreement.		Short term
57	**Support prevention of water pollution and protection and restoration of water-based ecosystems**		Short term

	Germany is actively involved in bilateral and multilateral initiatives for regular assessments of the quality of global freshwater resources (Global Water Quality Assessment) and for the establishment of water quality data products and services for UN member states. Partner governments in developing countries and emerging economies will receive support in creating and implementing regulations to protect water resources from degradation and overuse and in using the best available technologies (BATs) for urban and industrial wastewater management*. International cooperation between administrations, industry and science in the use of new environmental and climate-friendly technologies will be promoted.		

Glossary

Term	Definition
Adaptation	Initiatives and measures with the aim of reducing the sensitivity of natural and human systems to actual or expected impacts (due to change in legislative frameworks, society or the climate, obsolete structures or technologies). Various types of adaptation exist, e.g. anticipatory and reactive, private and public, and autonomous and planned.[13]
Cross-media	Perspective that integrates various media, for example, examining the environmental media of water, climate, air and soil.
Ecosystem services	Services, benefits or advantages supplied by ecological systems. Examples of ecosystem services include the supply of water usable for irrigation and drinking via natural filtering of rainwater, the supply of medicinal and mineral water, the reproduction of fish stock as a source of food and the provision of an appealing environment for recreation, leisure and aesthetic enrichment. In contrast to the term ecosystem function, the term ecosystem services takes an anthropocentric perspective and refers to the benefits of the ecosystem for people.[14] Ecosystem functions are the ecosystem processes behind the ecosystem services [15]
Efficiency	Rational use of resources with an integrated and cross-media approach that does not focus on a single resource.
Incentives	The link between motive (in the sense of needs) and motivation that conditions behaviour. Public financial incentives to promote sustainable water uses can include fees, taxes and funding programmes; there are also other non-financial incentives such as public recognition of activities, for example awards.[16]
Input path	There are both point source and diffuse input paths. Point source input path: wastewater treatment plants, direct industrial discharge and other types of direct discharge (e.g. mining). Diffuse input paths: erosion, surface run-off from paved and unpaved surfaces, drainage channels, overflow of combined waste and stormwater, rainwater channels, off-grid households, groundwater, atmospheric deposition.[17]
Landscape features	Characteristics of natural space or landscape, for example topography, climate, geology, soil composition or land use.
Management	Sustainable and value-creating administration and use of resources following the principle of economy. Significance in relation to water: the management of all artificial and natural water cycles and subprocesses respecting three essential goals: the long-term conservation of water as a habitat and as a key element of habitats; the preservation of water in its various facets as a resource for current generation and future generations; the identification of options for long-term economic and social development that is compatible with nature.[18]
Multi-barrier principle	Also called the multiple barrier system or the multi-barrier approach. It is a principle applied in environmental technologies with multiple successively tiered safety barriers for the defined assets.[19]
Nature-based solutions	Nature-based solutions are measures that are inspired and supported by nature. They are cost-effective and have environmental, social and economic advantages. They also help strengthen

[13] Based on: IPCC (2007): Klimaänderung 2007. Synthesebericht, https://www.umweltbundesamt.de/service/glossar/a (27 April 2021).
[14] BfN (2015): Gewässer und Auen – Nutzen für die Gesellschaft, https://www.bfn.de/fileadmin/BfN/wasser/Dokumente/BR-gepr-Gesell_Nutz_Gewaes_Auen_barrierefre.pdf (2 June 2020).
[15] Based on: Biologie-Seite (2020): Ökosystemdienstleistung, https://www.biologie-seite.de/Biologie/%C3%96kosystemdienstleistung (27 April 2021).
[16] https://wirtschaftslexikon.gabler.de/definition/anreiz-29046.
[17] https://www.umweltbundesamt.de/themen/wasser/fluesse/nutzung-belastungen/stoffeintraege-in-gewaesser#stoffeintrage-deutschlandweit-quantifizieren-modellieren.
[18] Compiled from the following: UBA (2018): Nachhaltige Wasserwirtschaft, https://www.umweltbundesamt.de/themen/wasser/wasser-bewirtschaften/nachhaltige-wasserwirtschaft#textpart-1 (02 June 2020); and Educalingo: Bewirtschaftung, https://educalingo.com/de/dic-de/bewirtschaftung (27 April2021).
[19] https://www.dvgw.de/medien/dvgw/wasser/management/1011castell_multibarriere.pdf (27 April 2021).

	the resilience of ecosystems. Nature-based solutions benefit biodiversity and support the provision of a range of ecosystem services.[20]
Networked infrastructure	Structurally or functionally linked facilities and installations of a material nature. Linkage can mitigate certain risks or weaknesses of the various parts of the infrastructure system (e.g. digital controls, combined drinking water supply systems) but can also give rise to additional risks (e.g. in the event of power outage or spread of pathogens or invasive species in ecosystems).
Particles	Substances in water that can be separated or filtered out of the water using partially standardised analysis processes. Depending on the analysis process, these particles can be differentiated by origin and size (e.g. soil particles, macroplastic particles, microplastic particles, nanoparticles).
Pathogens	General overarching term used for disease agents that can cause infections or infectious diseases in humans. These can be cellular or subcellular vectors such as viruses, viroids, bacteria, parasites, fungi, protists or other infectious organisms.[21]
Pollutant discharge	Discharge of nutrients, harmful substances and trace substances via various input paths or transport paths into surface waters, groundwater and the oceans.
Polluter pays principle	In environmental law, the polluter pays principle is a basic concept of environmental protection which requires the polluter to bear the costs for preventing, eliminating or offsetting environmental damage.[22]
Precautionary measurement	The precautionary measurement plays a role in the height of coastal protection infrastructure relative to average high tide levels. In light of climate change and the associated rise in sea level, a higher precautionary measurement will ensure adequate coastal protection along the German North and Baltic Sea coasts.[23]
Precautionary principle	The precautionary principles goes beyond simply averting negative impacts and focuses on mitigating risks to people and the environment, keeping pace with scientific findings and technical progress. The two dimensions of the precautionary principle are risk prevention and resource conservation. Risk prevention means taking precautions when there is incomplete knowledge or uncertainty about the type, extent, probability and/or causality of environmental damage and dangers in order to avoid these from the outset. Resource conservation means using natural resources like water, soil and air carefully in order to ensure their long-term availability for the benefit of future generations.[24]
Public services	Ensuring general public access to essential goods and services in accordance with the needs of the public, guided by defined qualitative standards at socially acceptable prices. The goods and services defined as essential vary over time and are determined by policymakers.[25]
Risk	Risk describes the combination of the likelihood that something will occur and the extent of damage it could cause.[26]
Safe by design	Safe by design refers to the safe development of products, materials and processes so that they pose no risks to people and the environment. This is achieved by considering safety in the development of every product and process.
Semi-natural (state)	According to the definition in Section 6 of the WHG, a semi-natural state is not the equivalent of natural state. It is differentiated as follows in Section 6(2): “Water bodies in a natural or semi-

[20] European Commission (2021): Nature-based solutions, https://ec.europa.eu/info/research-and-innovation/research-area/environment/nature-based-solutions_en (27 April 2021).
[21] Based on: Infektionsschutzgesetz Bundesrepublik Deutschland, vertreten durch die Bundesministerin der Justiz und für Verbraucherschutz (ed.): Gesetze im Internet, https://www.gesetze-im-internet.de/ifsg (27 April 2021); and: Lexikon der Biologie (Spektrum: Keim. Lexikon der Biologie, https://www.spektrum.de/lexikon/biologie/keim/35714 (2 June 2020)).
[22] Compiled from the following: Glossar Spurenstoffdialog des Bundes; Ergebnispapier Phase 2 (2019); and: Emde & Emde (1996): Umweltorientiertes Handeln in Kreditinstituten. ed. Dt. Sparkassenverband. Wissenschaft für die Praxis, vol. 10, p. 24.
[23] Bundesministerium des Innern, für Bau und Heimat (2018): Hochwasserschutzfibel: Objektschutz und bauliche Vorsorge.
[24] Compiled from the following: Glossar Spurenstoffdialog des Bundes; Ergebnispapier Phase 2 (2019); and: Emde & Emde (1996): Umweltorientiertes Handeln in Kreditinstituten. ed. Dt. Sparkassenverband. Wissenschaft für die Praxis, vol. 10, p. 24.
[25] Gabler Wirtschaftslexikon: Daseinsvorsorge, https://wirtschaftslexikon.gabler.de/definition/daseinsvorsorge-28469 (27 April .2021).
[26] Based on: Glossar Spurenstoffdialog des Bundes; Ergebnispapier Phase 2 (2019).

	natural condition should be preserved in this status...” It further stipulates that natural water bodies that have been artificially developed should be returned to a semi-natural state, except where this runs counter to overriding public interests. In addition to public welfare, high value is attached to the conservation of water bodies as an integral part of the natural environment, which is cited as the first principle of management.[27]
Semi-natural processes (for drinking water purification)	These are treatment methods that use natural processes (physical, biological and chemical) for purifying drinking water and work without added chemicals. Some examples include bank filtration, artificial groundwater recharge and slow sand filtration.
Substance	A chemical element and its compounds as found in nature or obtained via a production process, including active decomposition products (relevant metabolites), the additives necessary to maintain its stability (attendant and carrier substances) and the contaminants (with the exception of solvents) generated by the process used and by combined and repeated application that can be separated from the substance or material without impairing its stability or changing its composition.[28]
Substance groups	Substance groups contain substances with similar material or structural properties: • groups of substances with similar properties, for example persistent, toxic, bio-accumulative or endocrine substances; • groups of substances with material similarities (having similar molecular structures). These have certain similar substructures, e.g. what are called functional groups. An example of a group of similar substances is polycyclic aromatic hydrocarbons.[29]
Sustainable development, sustainability	Sustainability means that each generation solves its own problems and does not impose them on future generations.[30] This means that • the use of renewable resources such as water, forests and fish stocks does not exceed what can be regenerated; • non-renewable resources like minerals and petroleum are only used on a scale corresponding to what can be replaced (for example by renewable alternatives); • the air, waters and soils are not polluted with more harmful substances than can be processed by their natural capacity for self-purification.[31] Building on the Brundtland Report of the World Commission on Environment and Development, the German Bundestag’s Study Commission on the Protection of Humanity and the Environment described sustainable development as the concept of long-term, future-proof development of the economic, environmental and social dimensions of human existence.[32] Since 2016, the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda have been the policy focus of the United Nations, intended to safeguard sustainable development at economic, social and environmental levels.[33]
Synergy	The interplay of various forces (sectors) achieving a combined output. The combined achievement is often expected to exceed the sum of the separate efforts. Synergy emerges, for example, in complex issues or problems when multiple people (from various disciplines) in possession of different information work together on the issue.

[27] SZDK/Schenk (2019): 53. EL August 2019, WHG Section 6 No. 9, 10.
[28] Sonderforschungsgruppe Institutionenanalyse – sofia (2007): Glossar – Zusammenstellung der wesentlichen Begriffe im REACh-System, https://www.reach-helpdesk.info/fileadmin/reach/dokumente/REACHGlossar.pdf (27 April 2021).
[29] UBA (2015): Stoffgruppen,https://www.umweltbundesamt.de/themen/chemikalien/chemikalien-reach/stoffgruppen (27 April 2021).
[30] Based on: Bundesregierung (2013): Die nationale Nachhaltigkeitsstrategie, https://www.umweltbundesamt.de/service/glossar/n (27 April 2021).
[31] Wissenschaftsförderung der Sparkassenorganisation e. V. (1996): Wissenschaft für die Praxis. Abteilung 3, vol. 10, p.. 25.
[32] Wikipedia (2020): Drei-Säulen-Modell (Nachhaltigkeit), https://de.wikipedia.org/wiki/Drei-S%C3%A4ulen-Modell_(Nachhaltigkeit) (2 June .2020); quoting: Abschlussbericht der Enquete-Kommission „Schutz des Menschen und der Umwelt – Ziele und Rahmenbedingungen einer nachhaltig zukunftsverträglichen Entwicklung“, Deutscher Bundestag: Drucksache 13/11200 of 26 June 1998, p. 218.
[33] Wikipedia (2020): Ziele für nachhaltige Entwicklung, https://de.wikipedia.org/wiki/Ziele_f%C3%BCr_nachhaltige_Entwicklung (02.06.2020); quoting: Rio+20 Ergebnisdokument „The future we want“ (A/RES/66/288).

	Barriers to synergy include tense relationships between group members, conformity and too many group members.[34]
Value chain	All activities (value creation and resource consumption) necessary to bring a product from design to the various production and processing phases to the end consumer and finally to disposal after use.[35]
Water body development	The semi-natural restoration of water bodies as functional, intact ecosystems, allowing for floodplains as natural retention areas with associated implementation of forward-looking flood protection. Also includes the integration of additional needs for the public good like various uses, nature conservation, recreation, leisure time and the aesthetics of the water landscape.[36]
Water body maintenance	Cultivation and development of water bodies with the aim of preserving and improving their function for water management and the natural environment as well as their navigability. This is regulated by the Federal Water Act and state-level water acts. Water body maintenance must be in line with the management targets of the EU WFD (see Sections 27 to 31 of the Federal Water Act) and must not endanger achievement of these targets.[37]
Water footprint	In contrast to direct water consumption, the water footprint also includes indirectly used water. The amount of water "hidden" in products is often termed virtual water. The water footprint is the entire amount of water used by countries, companies or consumers.[38]
Water infrastructure	All long-lived facilities and installations of a material nature that enable any type of use of water or other resources connected to water (e.g. energy, fishery) or ecosystem services or facilities and installations dependent on or heavily impacted by water. In the context of the water dialogue, the term is used very broadly and includes, for example, human infrastructure (sometimes termed "grey" infrastructure, e.g. dams, canals and drainage networks, wastewater treatment plants, irrigation facilities, dikes, measurement systems, digital infrastructure such as networks and data centres) and natural infrastructure (sometimes termed "green" or "blue" infrastructure, e.g. rivers, lakes, wetlands, flood zones, groundwater bodies, groundwater filtration areas).
Water balance	A part of the natural system focused on quantities of water in its various states and spaces. Water balance describes the interplay of individual water cycle variables and their amounts. It is influenced by the energy cycle. According to the general water balance equation, the main components of the water balance are: precipitation, evaporation, flow and change in storage. Important specifications of the water balance include: a) landscape hydrology: this means that the water balance components correspond regionally to semi-natural landscape features; b) soil hydrology; and c) local hydrology.[39] Sustainable use of water resources protects the services of the water balance that are required for people, the environment, nature and the landscape. In regards to the water balance, the Federal Water Act stipulates that water is to be used economically, the functionality of the water balance is to be preserved and an increase in or acceleration of water run-off must be prevented, as must be impairments of onshore water-dependent ecosystems and wetlands..[40]

[34] Gabler Wirtschaftslexikon: Synergie, https://wirtschaftslexikon.gabler.de/definition/synergie-47512 (2 June 2020), adapted.
[35] Wuppertal Institut für Klima, Umwelt, Energie GmbH (ed.) (2009): Kaskadennutzung von nachwachsenden Rohstoffen: Ein Konzept zur Verbesserung der Rohstoffeffizienz und Optimierung der Landnutzung, https://epub.wupperinst.org/frontdoor/deliver/index/docId/3303/file/WP180.pdf (27 April 2021).
[36] LAWA (2006). Leitlinien zur Gewässerentwicklung – Ziele und Strategien, https://www.umweltministerkonferenz.de/umlbeschluesse/umlaufBericht2006_30.pdf (27 April 2021).
[37] Based on: Section 39 of the WHG.
[38] Umweltbundesamt (2018): Wasserfußabdruck, https://www.umweltbundesamt.de/themen/wasser/wasser-bewirtschaften/wasserfussabdruck#was-ist-der-wasserfussabdruck
[39] Based on: Spektrum: Wasserhaushalt. Lexikon der Geowissenschaften, https://www.spektrum.de/lexikon/geowissenschaften/wasserhaushalt/17995 (27 April 2021).
[40] Wasserhaushaltsgesetz of 31 July 2009 (Federal Law Gazette I p. 2585), last amended in Article 2 of the Act of 4 December 2018 (Federal Law Gazette I p. 2254); Sections 5 und 6.

Water sector	The entirety of the institutions and activities for water supply[41], for wastewater management and regulation of the water balance.[42]
Water uses	Services for households, public facilities or economic activities such as withdrawal, impoundment, storage, treatment and distribution of water from a body of water; collection and treatment of wastewater in treatment plants that is subsequently channelled into surface waters, shipping, fisheries, flood protection, hydropower, the energy sector, industrial and commercial use including bottling, tourism, sports and recreation, etc., and other activities with an impact on the status of a water body, to include uses beyond the definition in the WHG. The WHG defines water uses as all water services and other activities with impacts on the status of a water body that are significant in terms of the management objectives of Sections 27 to 31, 44 and 47 of the WHG. Water services are the following services for households, public facilities or economic activities of every kind: • withdrawal, impoundment, storage, treatment and distribution of water from a body of water; • collection and treatment of wastewater in treatment plants that is subsequently channelled into surface waters.

[41] E.g. UBA (2020): Wasserwirtschaft, https://www.umweltbundesamt.de/daten/wasser/wasserwirtschaft (27 April 2021).
[42] Based on: Duden: Wasserwirtschaft, https://www.duden.de/rechtschreibung/Wasserwirtschaft (27 April 2021).