Groundwater – the river's invisible twin

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International Commission for the Protection of the Danube River

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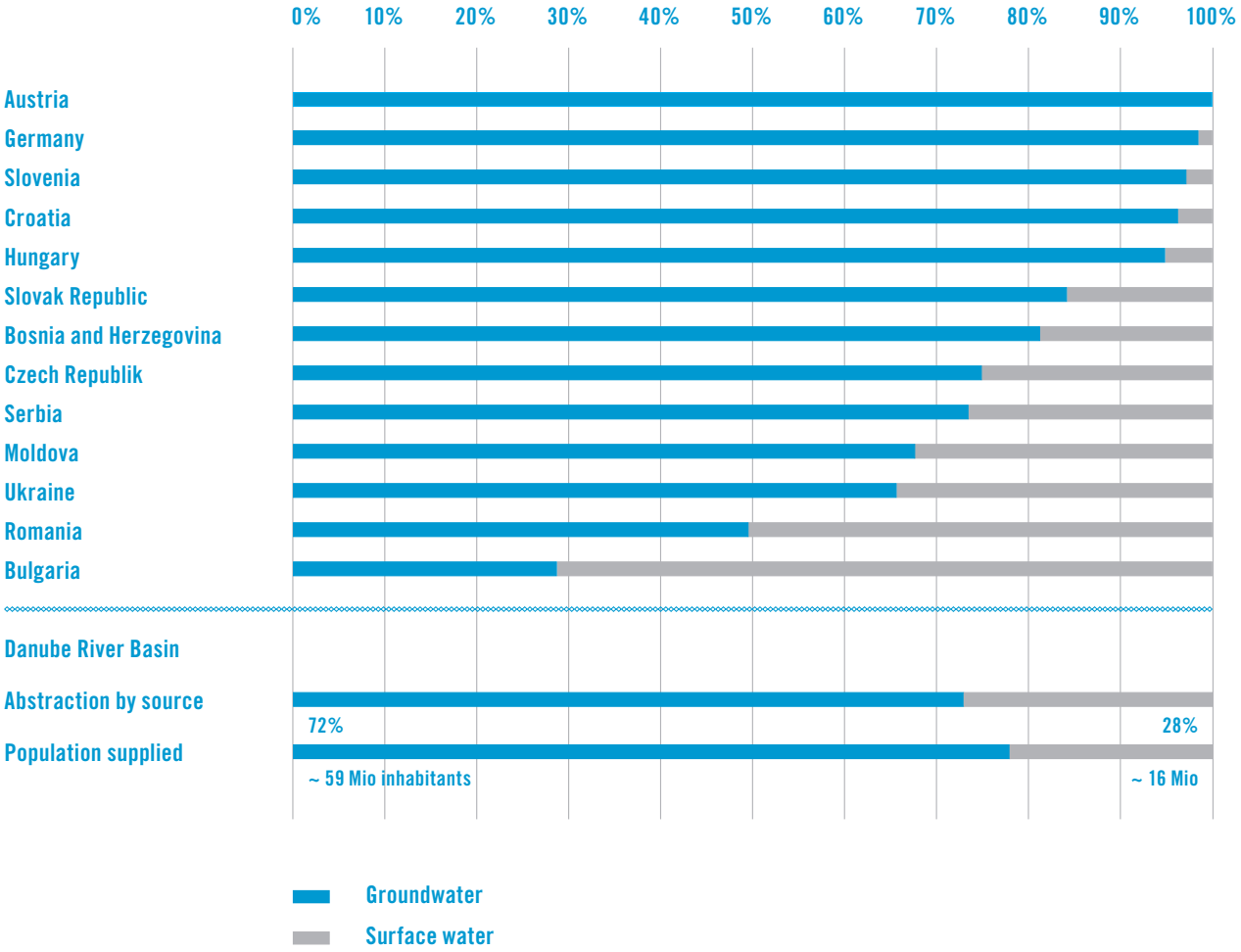
Groundwater's essential role in the Danube River Basin

Groundwater is underground and largely invisible. We often ignore it. Or we take it for granted. But the truth is that groundwater has incredibly important values for people, industry and the environment throughout the Danube River Basin (DRB). And to maintain those values, it desperately needs our constant protection.

Nearly 72% of all drinking water consumed in the DRB is produced from groundwater sources, serving an overall population of some 59 million people. The rest, around 28% for about 16 million people, is abstracted (removed) from surface water.

Drinking water abstraction by source in the Danube River Basin



Among countries sharing the Danube basin, the shares of groundwater and surface water used for drinking water is not uniform. This is due to the wide diversity of conditions – hydrogeological, topographic, climatic, pressure and pollution – found throughout the basin. The share for groundwater ranges from 30% in the part of Bulgaria belonging to the DRB to 100% in Austria.

Data coverage: 99% of the Danube River Basin;
Source: ICPDR, GW TG 2014

Groundwater provides much-needed water for agricultural irrigation. It is used for the production of beverages and food and it is an important resource for other industrial activities. Applications for cooling and heating also often depend on groundwater sources. And not to forget the recreational amenities of thermal spas.

Alongside its multiple benefits for people, it has become increasingly clear that groundwater should be protected for its environmental values. Its essential role in the basin's hydrological cycle brings numerous environmental goods and services, such as providing livelihood for wildlife species. And during dry periods, groundwater can help recharge wetlands and even river flows, acting as a buffer and thereby helping to prevent drought. In other words, it provides base flow, or the water which feeds rivers all year round.

What is groundwater?

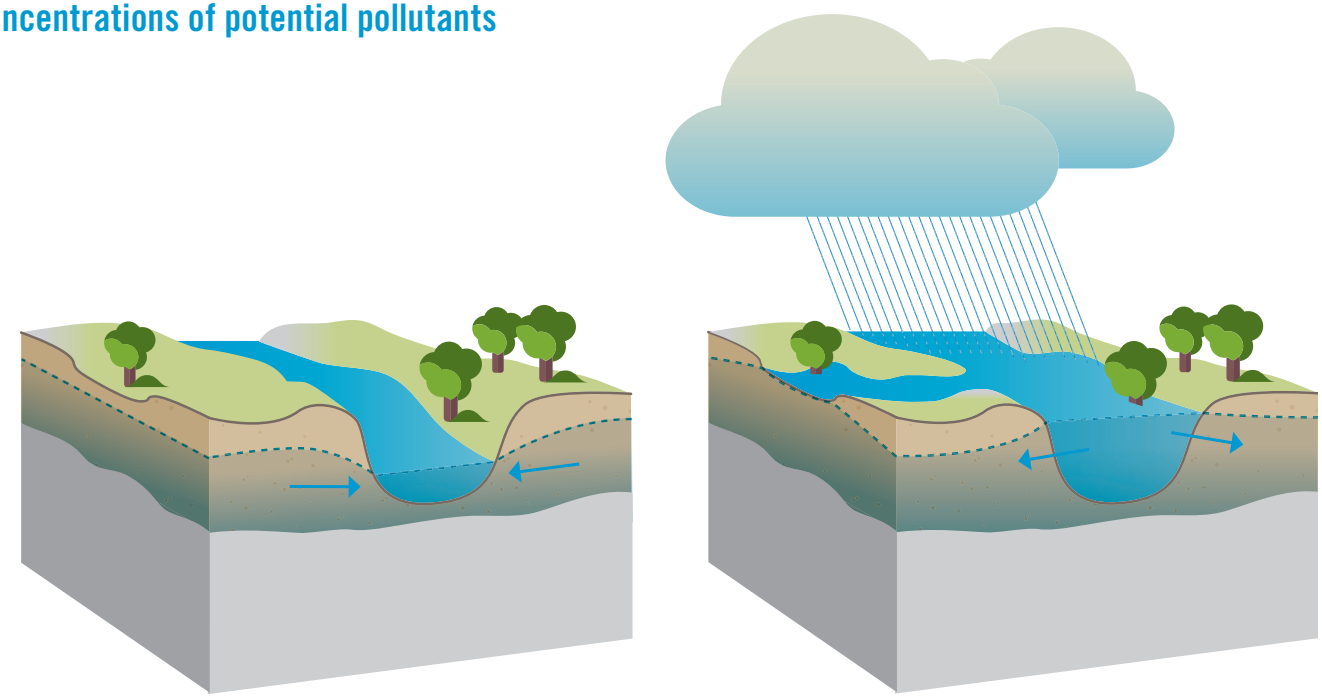
'Groundwater' refers to all water which is below the surface of the ground in the so-called "saturation zone" and in direct contact with the ground or subsoil. It is all of the water that is stored in spaces – pores, fissures, cracks and cavities – in soil, rock, gravel and sand. Being 'stored' does not mean that groundwater always stays in one place; in fact, it rises and falls with the water level of rivers, and flows at variable rates through 'aquifers' – any underground formation which can contain groundwater.

Groundwater: Europe and the globe

Groundwater constitutes over 97% of all freshwater available on earth, excluding glaciers and ice caps. In Europe, groundwater is by far the most important source of drinking water, either as tap water from central water suppliers or abstracted from private wells.

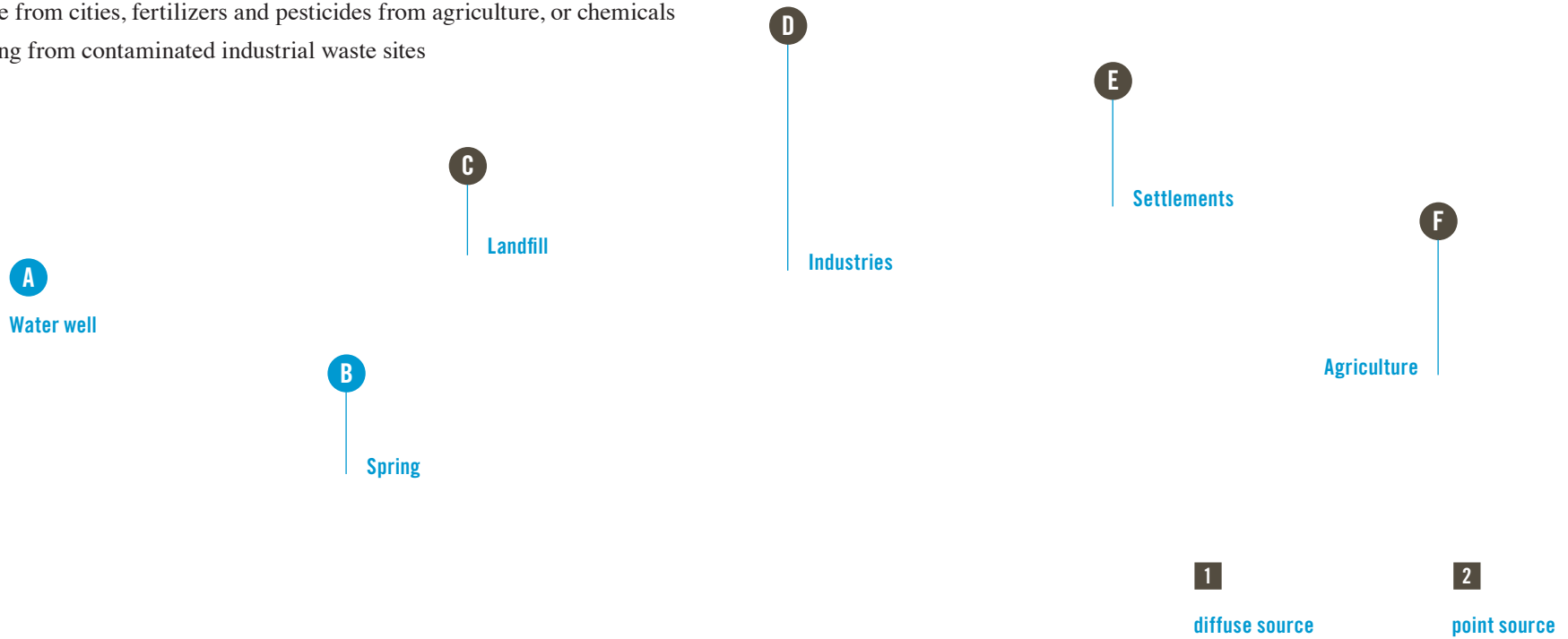
The river's invisible twin

Surface water and groundwater tend to be highly interconnected. When the river surface water level is high, river water infiltrates into the groundwater system. This is especially true during high flows, when both the river and adjoining floodplains and meadows can become flooded. In drier periods, groundwater flows back into the river. This exchange includes quantities of water as well as concentrations of potential pollutants in the water that might be transferred.

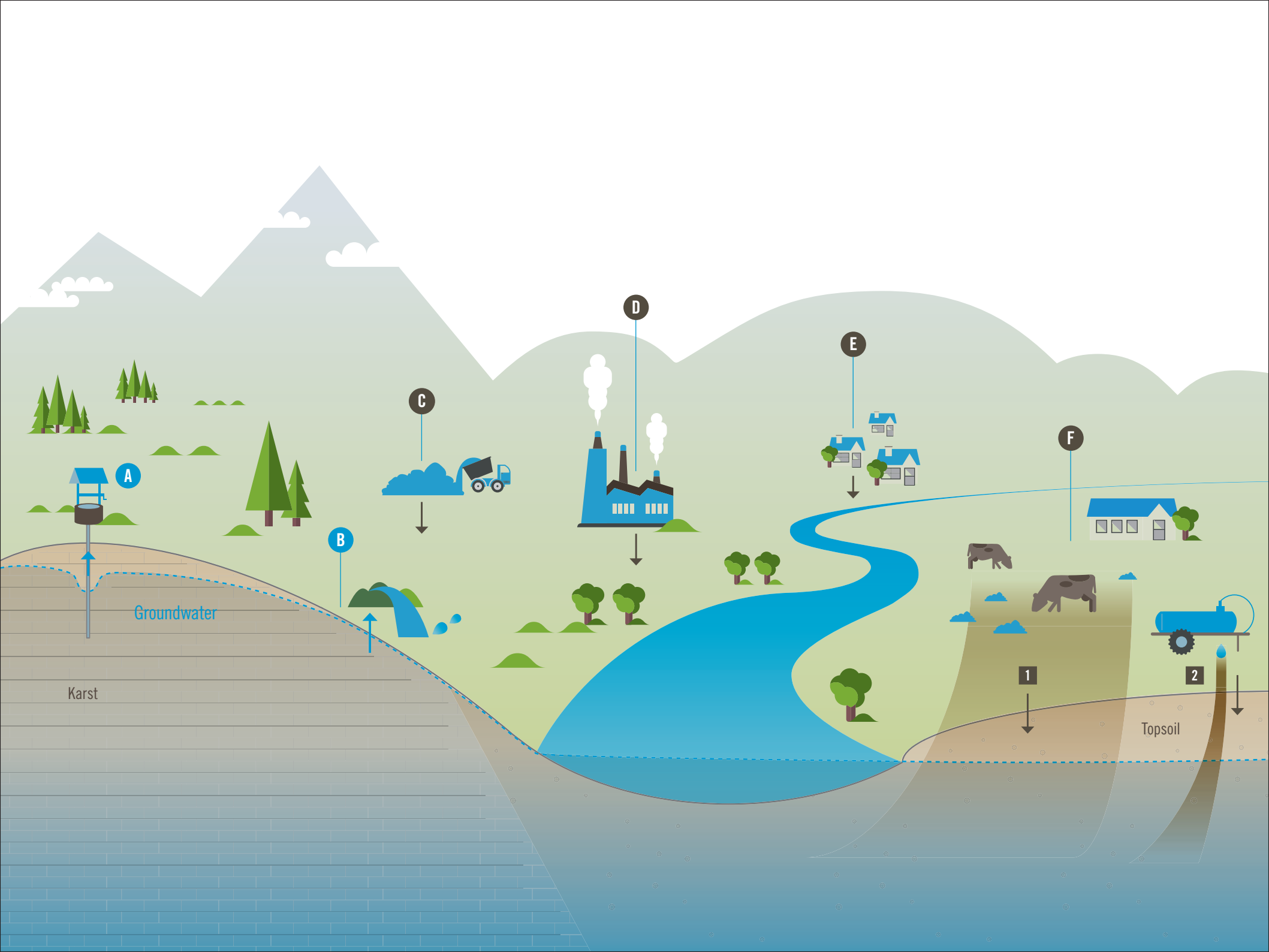


Groundwater faces many threats

At the same time, groundwater faces many threats. The main risk related to groundwater quality comes from pollution – for example, untreated sewage from cities, fertilizers and pesticides from agriculture, or chemicals leaching from contaminated industrial waste sites



Pollution can reach groundwater reserves in many ways, such as through direct discharge from a point-source to a water body, or indirect discharge through soil infiltration. As a result, in some cases, groundwater sources cannot be used without prior treatment. As for groundwater quantity, the main pressure is excessive abstraction by users, such as for drinking water or agriculture.


A
B
C
D
E
F
Groundwater
Karst
1
2
Topsoil

The international response

Ensuring that groundwater in the DRB is monitored and protected has always been an important goal of the Convention on Cooperation for the Protection and Sustainable use of the Danube River (or Danube River Protection Convention) which has been signed by 11 Danube basin countries. As such, it has been one of the main issues managed by the International Commission for the Protection of the Danube River (ICPDR) which has the mandate to implement the convention. Within the ICPDR, the important task falls under the responsibility of the Groundwater Task Group. Danube countries which are EU Member States, as well as those which are not, are fully involved, demonstrating the joint interest of all countries in the DRB to deal with the protection and proper management of groundwater. Over the years, the ICPDR and Danube countries have successfully identified 11 transboundary groundwater bodies of basin-wide importance. They have also formulated basin-wide visions regarding the pollution of groundwater and its sustainable use.

Meeting EU water legislation

The ICPDR and Danube countries have been actively taking steps to achieve the objectives of the EU's Water Framework Directive (WFD) and the more specific Groundwater Directive. The WFD requires Member States to achieve a 'good status' for all waters in the EU by 2015. This includes a good status for all Danube basin groundwaters – in terms of chemicals (i.e. the water should be clean) and in terms of quantity (i.e. there should be no groundwater overexploitation). Furthermore, achieving good status is not only relevant from the perspective of human uses, but also for the health of aquatic and terrestrial ecosystems that depend on groundwater.

Broadly speaking, the comprehensive WFD aims at preventing deterioration, and enhancing, restoring and protecting Europe's surface and groundwater bodies through a challenging set of actions. It requires the identification, characterization and review of the impacts of human activities. In order to achieve the demanding WFD objectives, a comprehensive programme of measures is essential to address existing and expected groundwater problems. Overall, transboundary and integrated and river basin management (IRBM) is needed, as water does not respect administrative or political boundaries and moves continuously above and below the surface within the hydrological cycle, from one reservoir to another (e.g. from air to rivers, lakes, oceans, wetlands, soil and aquifers). Continuous monitoring and periodic reviews and reporting, including public participation, are required to achieve the overall goals in due time.

In the Danube River Basin Management Plan the ICPDR developed such a programme which will ensure that the water use is appropriately balanced and does not exceed the available groundwater resource, considering future impacts of climate change and that the emissions of polluting substances would not cause any deterioration of groundwater quality.

Slow movers and fast movers

Groundwater usually moves quite slowly in underground aquifers which consist of porous media, such as gravel, or fractured rocks. Due to its generally low renewal rate (the rate at which an aquifer becomes – theoretically – refilled), the groundwater in such areas can be quite old – even decades or centuries old. Coverage by layers of soil can offer a certain level of protection against pollution. However, once polluted, this may last for a long time. This means that pollution which happened many years or even decades ago can still show effects today. It also means that measures which were implemented recently or in the past, to stop or remediate pollution, might only yield effects in years or decades to come.

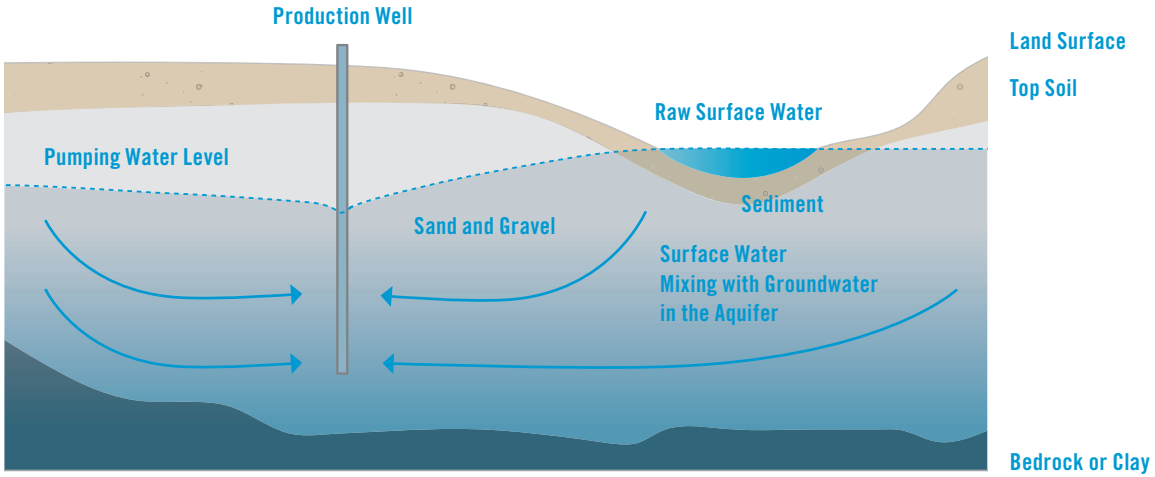
In contrast, karstic groundwater, such as in Europe's Alpine and Balkan regions, often moves rapidly underground. It is also often barely protected against polluting activities on the surface by soil layers. This means increased vulnerability and the potential for polluting activities to cause immediate and unbuffered effects for groundwater. At the same time, karstic recharge areas, where rain and surface water infiltrates underground, can be very large and distant. As a result, protection areas may also need to be large and distant from groundwater springs. Identifying the location of recharge areas as well as the travel time of groundwater can make the task of delineating protection areas quite challenging.

Bank-filtered groundwater

A considerable amount of drinking water is abstracted from groundwater sources close to rivers. When 'water production wells' abstract groundwater that significantly originates from surface water, such abstractions are referred to as 'bank-filtered'. This technique makes use of the natural purification and filtration processes taking place while water moves underground between the river and the production well. This approach also often benefits from the mixing of cleaner and colder groundwater with surface water that is streaming from the river to the well.

The ICPDR has compiled an inventory of the most important and largest bank filtration abstraction sites along the Danube River, covering eight countries. It demonstrates that more than four million people are served and that an additional five million people could be supplied with drinking water from these abstractions. These figures considerably raise the significance of the Danube for drinking water supply. They also shed light on the importance of raising awareness of how polluted surface water could affect the health of human populations living in the basin.

Schematic sketch of a river bank filtration abstraction



Learn more about groundwater in the Danube River Basin

You will find more information on groundwater in the Danube River Basin and references to relevant websites from your Danube Basin country at http://icpdr.org/main/issues/groundwater

Contact

ICPDR Secretariat
Vienna International Centre / D0412
P.O. Box 500 / 1400 Vienna / Austria
T: +43 (1) 26060-5738 / F: +43 (1) 26060-5895
icpdr@unvienna.org / www.icpdr.org

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