Ruhrverband
KNOW-HOW, VALUES, WATER

Water Resources Management at Ruhrverband

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KNOW-HOW, VALUES, WATER

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At Ruhrverband, we preserve water for the people in our region.

With our eight reservoirs and 69 sewage treatment plants, we work to make sure that there's enough water of high quality.

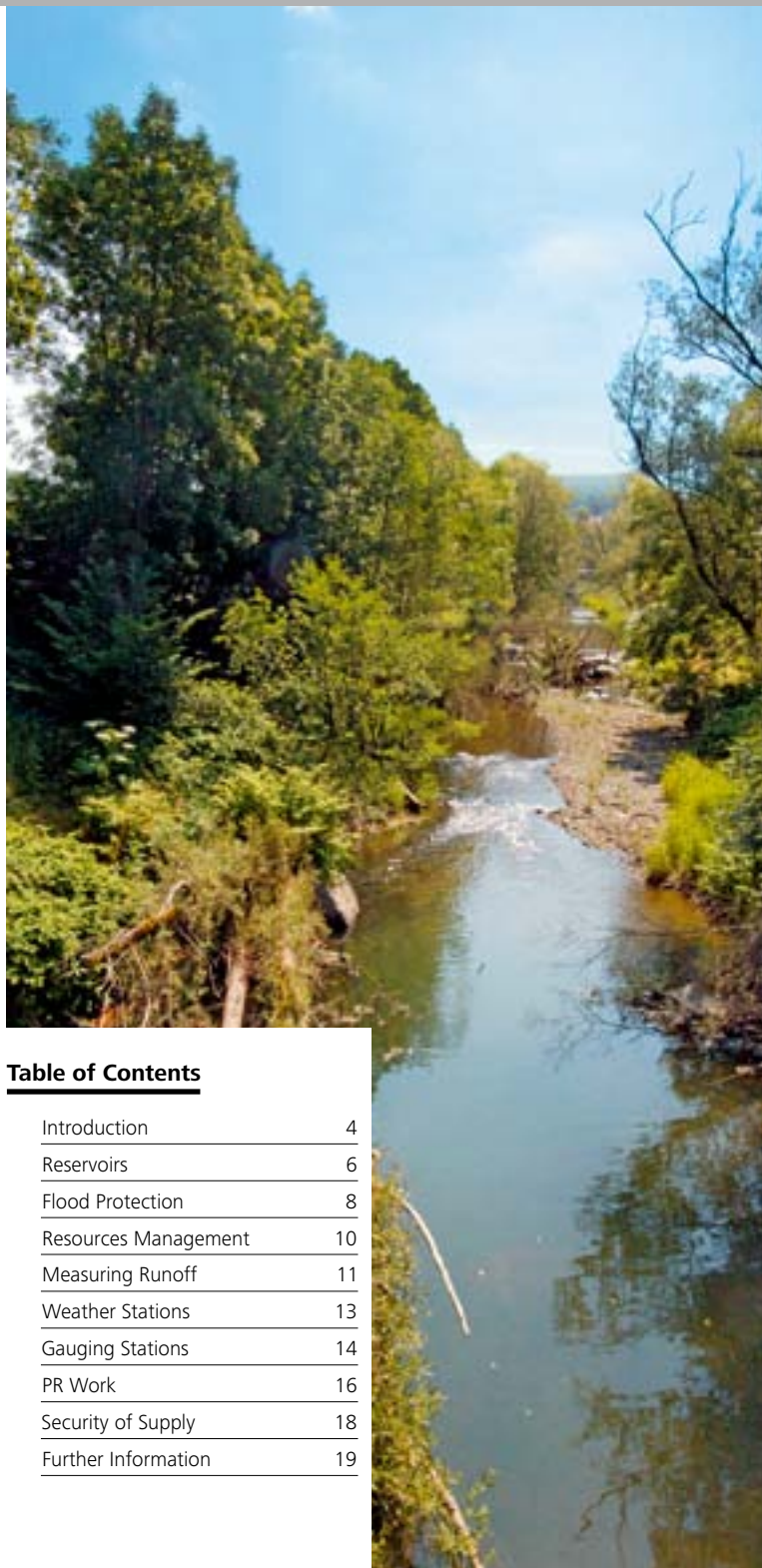
With our knowledge about water, we safeguard the basis of human life and the protection of nature.

To ensure quality, we continuously monitor the condition of our rivers and lakes.

We try to reach our goals in the most economical manner possible. Our work is about the well-being of people and not about striving for profit.

We use innovative and modern methods and develop new ideas.

Leisure and recreation along our rivers and lakes and in our forests are a real source of enjoyment for many people.



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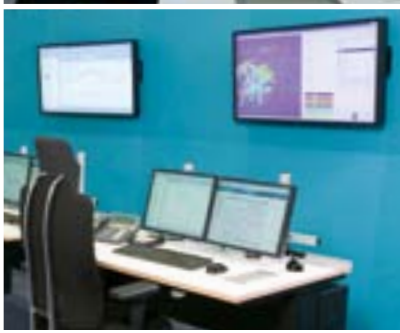
A Small River with a Large Task

The densely populated region north of the Ruhr River in Germany – known as the "Ruhr area" – is today one of the largest urban conglomerations in Europe. The Ruhr River and its tributaries supply industrial water for the region's industries and drinking water for its 4.6 million inhabitants. These are impressive accomplishments for a relatively small river – only 219 kilometers long and reaching a mean runoff of 80 cubic meters per second when it enters the Rhine River. By way of comparison: the Rhine River is 1,233 kilometers long and has an average runoff of over 2,000 cubic meters at its mouth.

The task of ensuring that the "puny" Ruhr can provide a water supply for an entire region falls to Ruhrverband. Thanks to the extensive infrastructure maintained by Ruhrverband for water resource management, it is today inconceivable that the lower reaches of the Ruhr River could run dry during hot summers and that the resulting lack of clean water could cause a typhoid epidemic in the "Ruhr area" – as happened at the beginning of the 20th century. At the heart of Ruhrverband's water quantity management is a network of eight reservoirs which store water during rainy periods and release it into the river system when needed during dry periods. Decisions on when to release water from the reservoirs – and in what amounts – are made at the Reservoir Control Center at Ruhrverband in Essen.

The Ruhr River supplies water for an entire region.



View into Ruhrverband's Reservoir Control Center in Essen.

Guardians of Water

Ruhrverband has been running a Reservoir Control Center at its headquarters in Essen since 1995. At this center up-to-date hydrological and meteorological data such as water levels, flow rate, reservoir storage volumes and precipitation are processed. In conjunction with operational framework conditions and forecasts made by various weather services, these data constitute the basis for decisions concerning the release of water from the reservoirs.

By having a team of water management experts on call 24/7, Ruhrverband maintains the capability to react to weather developments as they happen. This is especially important during floods and phases of sustained drought since it enables the water managers to adjust the volumes of water released by the reservoirs – several times daily if need be – in response to the actual situation.

Water abstraction and production of drinking water in the Ruhr Valley.

Securing Our Water Supply ...

The *Ruhrverbandgesetz* (Ruhr River Association Act) constitutes the legal basis for the control of Ruhrverband's reservoir system. This law stipulates that runoff must not be allowed to fall below certain minimum values at selected cross-sections – in particular, at the Villigst gauging station and between the Hattingen gauging station and the point where the Ruhr River enters the Rhine River at Duisburg. These locations have not been chosen arbitrarily; rather, they were selected to ensure that the Ruhr River carries enough water at all locations – even at cities (such as Mülheim) situated on the lower reaches of the Ruhr – so that the waterworks can extract enough water from the river for the drinking water supply. When the data available to the Reservoir Control Center indicate that actual runoff could fall below the minimum values prescribed by law, it must increase the additional volumes of water provided by the reservoirs in time to remedy this deficit.

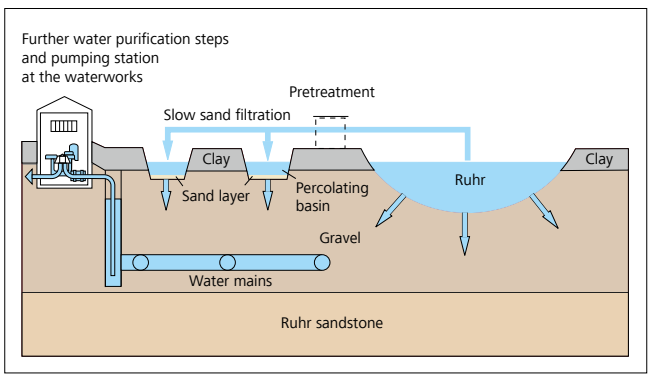


Diagram of water abstraction and drinking water production in the Ruhr Valley.

Reservoirs cannot prevent floods like the flood in Altena shown in this photo. However, they can reduce the flood peaks.

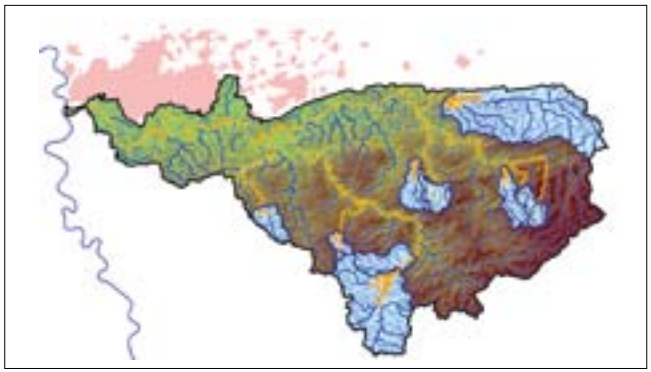
... and Reducing Flood Peaks

You might think this is a simple matter: all you have to do to ensure that the water supply is not depleted even during hot summers is to keep the reservoirs full of water. Exactly this is not possible, however, since Ruhrverband also employs its reservoirs as part of the flood protection infrastructure in the region – a task which precludes keeping the reservoirs full up to their design water levels. During the winter months Ruhrverband is even obligated to reserve part of the storage capacity of individual reservoirs as flood-protection capacity which can be called upon to lower water levels in downstream sections of the river if necessary. However, the reservoirs have an impact only on the water from one-quarter of the Ruhr catchment area: rain falling outside the catchment area of the reservoirs cannot be retained. The reservoirs can therefore not prevent floods; however, in a flood emergency they can help to prevent a worsening of the situation by decreasing the flood peaks.

How Does Flood Protection Work?

The year 2007 will not soon be forgotten by the water management specialists at Ruhrverband. An unusually warm and sunny April was followed by a totally rainy summer. In August the measured precipitation was nearly two-and-a-half times the average values and the Ruhr catchment area was struck by no fewer than two flood events. Apart from being totally untypical for the time of year, these flood events were of a magnitude surpassing even that of most winter floods. These examples constitute impressive testimony to the extent of the protective effect exerted by the reservoir system during floods.

The values measured at the Hattingen gauging station, for example, demonstrate this clearly. On August 23 more than 770 cubic meters rushed past per second and the water level rose to 616 centimeters, the highest water mark since the commissioning of the Biggetal Dam in 1965. At the same time Ruhrverband's reservoirs retained up to 270 cubic meters of water per second. Without this retention the flood would have occurred much earlier and been much larger. As it was, the inhabitants of the Ruhr Valley had more time to react to the situation. Ruhrverband is obligated to provide flood protection capacity in selected reservoirs only in the winter, when floods occur more frequently. However, the reservoirs can also make a decisive contribution during unusual events like those in August 2007.



The catchment area of the Ruhr River. The catchment areas of the reservoirs are colored blue. River sections affected by the reservoirs are colored orange.

→ A RESERVOIR FLOWS OVER THE DAM

The first of the two floods occurring in August 2007 had the unexpected effect of making the Möhne Dam a star. In the early morning hours of August 2007 the impounded water volume in the reservoir reached the design water level. As a result, water started to flow through the 105 overflow outlets in the dam crest. This form of flood discharge was already provided for in the dam design to protect the dam against damage caused by high water pressure. However, "overflowing" of the Möhne Dam is an extremely rare event. The reservoir therefore attracted a correspondingly large crowd of spectators eager to catch a glimpse of this unusual drama on the following sunny weekend. On the afternoon of August 13, the Möhne Reservoir stopped overflowing. The water volumes retained during the flood were subsequently released via the service outlets. During these procedures the most important consideration was to avoid exacerbating the flood situation in the areas downstream of the dam.

Flood discharge via the spillway of the Möhne Dam in August 2007.

Reservoir water is also used to drive power plant turbines – as here at the Sorpe Reservoir.

A Balancing Act Between Many Tasks

At times the tasks of securing the water supply for 4.6 million people and of providing flood protection require contradictory measures. Whereas one would like to use the entire storage capacity available in the reservoirs to secure the water supply, it is also necessary to keep some flood-protection capacity in reserve so that it can be flooded if necessary. Repeatedly finding a reasonable compromise between these two sometimes conflicting goals is a fine art.

Many climate experts expect there will even be an increase in extreme weather events such as long dry periods and severe floods in the future as a result of climate change. In addition to their two main roles, moreover, the reservoirs in the Sauerland are also sources of water power, a renewable energy source, and an important factor for tourism in the region. Despite the use of more and more advanced technology and increasingly sophisticated forecasting models, there will still be a need for people with sensitivity and many years of experience to control the reservoirs in such a way that they can perform the wide range of tasks assigned to them.

Manual work is still required when measuring streamflow.

Streamflow Measurement Does Not Just Happen

The hydrological data required by the Reservoir Control Center for water quantity management are supplied, among other sources, by nearly 50 gauging stations. These stations record the actual water levels round the clock and convey the data to the Control Center via long-distance data transmission. The discharge, i.e. the volume of water that flows through a river cross-section at a certain point in time, can then be determined for the particular water level on the basis of a stage-discharge relation. To draw up a stage-discharge relation, the discharge is required as a second reference quantity in addition to the water level. In contrast to the water level, the flow rate is still determined manually at the measuring station for the most part. At some locations, however, permanently installed streamflow measuring units are in operation. These are continuously recording the flow velocities of the cross-section.

Since the hydraulic conditions change frequently in rivers (for example, as a result of erosion, overgrowth of aquatic plants, or sedimentation following a flood), the streamflow must be measured repeatedly at every gauging station several times a year to keep the stage-discharge relation up to date at all times and to check the accuracy of the permanently installed runoff gauging stations. The employees entrusted with reservoir control perform around 400 streamflow measurements annually along the Ruhr River and its tributaries.

Ruhrverband currently uses mainly three types of instruments for streamflow measurement: current meters, electromagnetic probes and Acoustic Doppler Current Profilers (ADCP). With the current meters and the electromagnetic probes, the measuring devices (current meters or sensors) are placed at various points in a runoff cross-section. Depending on the water depth and discharge, measurements can be made from a measuring pier, for example; smaller bodies of water with lower streamflow can be waded into. At measuring stations with large cross-sections there are also stationary cableways in service; at these locations the measuring devices (hydrometric current meters or ADCP boats) are moved over the water from the measuring station hut and positioned at the corresponding measuring points.

Since the water has a different discharge at each measuring point, a large number of single values are needed to precisely determine the average flow velocity. A measurement made with a current meter or electromagnetic probe can thus take up to six hours depending on the width and depth of the river! Distinctly faster results are obtained with ADCP; however, this method has only been used to measure the streamflow for about a few years. Furthermore, ADCP does not yield results until a certain water depth is reached. For this reason, current meters or electromagnetic sensors will more likely be used in the future to measure streamflow in smaller rivers.

A minimum depth is a prerequisite for the use of the ADCP measuring device mounted on a boat.

Employees working in reservoir control performing water equivalent measurements.

Weather Is Also a Source of Information

In addition to a large number of water-level gauges at reservoirs, impounded lakes and other bodies of water – as well as storage level meters in the reservoirs – Ruhrverband operates weather stations supplying information on air temperature, precipitation, air humidity and – depending on the time of year – depth of snow cover. These measuring data are supplemented by the forecasts of various weather services. In the winter manual measurements of the water equivalent of the snow cover provide valuable insights on topics such as the volumes of water stored in the form of snow. On the basis of this information, Ruhrverband can draw conclusions as to how the runoff situation will develop when the snow starts to melt.

How a Gauging Station Operates

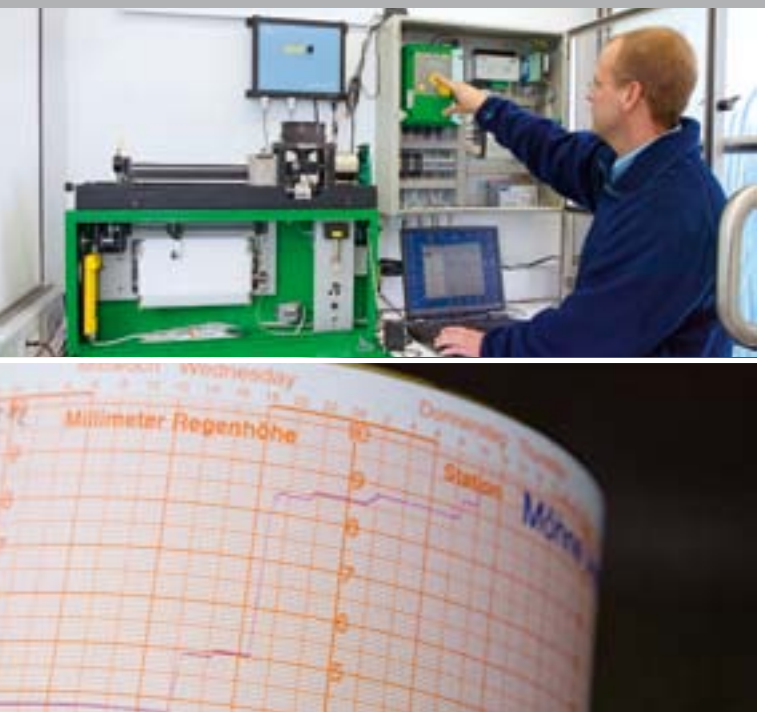
What is hidden inside a gauging station house? In principle the operation of a modern gauging station is based on century-old principles that were developed when people living in areas subject to flooding began to observe and document water levels regularly. The main instrument used here is still a staff gauge fastened to the wall of the gauging station house or to the riverbank or placed in a vertical position in the river. The actual water level can be read off this staff gauge. During their regular rounds of the gauging stations, the members of the measuring team can then check whether the automatic recording of the water level on the instruments in the shelter house is still accurate or has to be recalibrated using the values read off the staff gauge. For this reason – and since other measuring devices could fail entirely (during extreme flood events, for example) – every water-level gauging station in Germany must be equipped with a staff gauge.

The Ruhrverband gauging stations use several complementary measurement systems to continuously record and transmit water-level and flow-velocity data. The analogue mechanical recorder continuously registers the water-level data on a paper strip chart fixed to a rotating drum which is moved forward by a clockwork. Thus, a continuous line is recorded on paper. The values registered on the paper strip are delivered e.g. by a float which is located in a stilling well to protect it against waves, current and floating material and whose movements are converted into pen movements. To record water-level data electronically the measured values, e.g. the height of a float or the hydrostatic pressure, which are converted into electrical analogue or digital signals which can be stored on a data logger. The electronic recording is normally carried out by two independently operating systems (redundancy principle): in the first recording path the water level is recorded, for example, with the aid of a radar sensor or an shaft encoder which stores the particular 15-minute mean values on a data logger and from there transmits them over the Ruhrverband Intranet to a database at the Reservoir Control Center. Parallel to this, the water level is recorded using a pressure sensor in the water. This sensor also stores 15-minute mean values on a second data logger and sends them to the database at the Reservoir Control Center via the cellular phone network.

→ GAUGING STATION INSTRUMENT HOUSE – DO NOT DAMAGE ANYTHING, PLEASE!

"This facility is used for the purpose of environmental protection and water resource management. Please do not damage or alter anything!" With signs of this kind on the gauging station instrument house, Ruhrverband attempts to protect its gauging stations from vandalism. These efforts are not always successful: gauging stations on frequently used paths or in the direct vicinity of popular gathering points are regularly the targets of vandalism. The destruction ranges from soiling or defacing of the gauging station houses with spray paint or other substances over the act of throwing objects into the water that change the hydraulic conditions of the river to staff gauges misused as boat slides or willfully torn from their fastenings. The application of artistic motifs to the houses as a way of preventing soiling and defacing – a method that has been used successfully in Essen-Werden for several years – is unfortunately not feasible at all locations. Each year Ruhrverband spends large sums of money to repair damage to its gauging stations and to maintain an orderly measurement operation. In the interests of the 4.6 million people who obtain their drinking water from the catchment area of the Ruhr, the basic motto for all gauging stations operated by Ruhrverband is: do not destroy anything, please!

Gauging station instrument house decorated with an artistic motif in Essen-Werden.



Many measuring results can be called up in the Internet.

Working under Public Scrutiny

The water resource management activities carried out by Ruhrverband do not take place in secret by any means. On the website **www.talsperrenleitzentrale-ruhr.de** Internet users can see how much water flows into each reservoir and how much flows out again practically in real time. The data on water levels and streamflow conveyed to the Reservoir Control Center by long-distance data transmission can be called up in the Internet. Further information can also be found here such as the current situation report, webcam pictures of reservoirs and gauging stations and, as a special service for weekend skippers, the navigational situation on the Ruhr River and the impounded lakes. The river is navigable for engine-driven craft from the junction with the Rhine in Duisburg to the restaurant "Zornige Ameise" ["the angry ant"] in Essen-Rellinghausen; further upstream navigation by boats and other craft without engines is permitted. When the water level reaches a certain value at the gauging stations at Hattingen or Wetter, however, restrictions – ranging up to a total prohibition on boating – are placed on boat traffic in the Ruhr River.

For this reason, it is advisable to check out the navigational situation at the website of the Reservoir Control Center when planning a boat trip on the Ruhr or the impounded lakes along the Ruhr. In addition to the daily reports issued by the Reservoir Control Center, Internet users can find information on long-term water management in the Ruhrwassermengenbericht (Annual Ruhrverband Water Quantity Report) on this site. Each report contains detailed information – based on the so-called water year from November 1 to October 31 – on weather conditions, runoff, water abstractions, changes in the impounded volumes, and the volumes of additional water discharged by the reservoirs to satisfy the statutory regulations concerning minimum runoff in the Ruhr River.

The website of the Reservoir Control Center has been a huge success: during floods, in particular, the number of visitors rises. Furthermore, various official bodies, such as police and firefighting departments, rely on data supplied by Ruhrverband to stay constantly abreast of the current flood situation. As an additional service to the population, Ruhrverband has installed water-level and discharge indicators at various locations highly frequented by the public. In addition, the gauging stations at Hattingen and Wetter are furnished with webcams.

The website is also a valuable source of information for people interested in aquatic sports.

Preparing for Climate Change

Is the capacity of the reservoirs sufficient to provide a water supply for the people living in the catchment area of the Ruhr River in the context of possible climate change? Ruhrverband explores questions of this kind, questions with long-term implications, and commissioned a climate impact report for this reason in 2006. The results of this analysis showed that, viewed statistically, the water reserves in the Ruhrverband reservoirs will fall short of requirements once every 200 years. Today this occurrence probability is once in 500 years. The research institute engaged by Ruhrverband based its analysis on two regional climate models predicting a temperature rise of about three degrees by the year 2100. The annual precipitation will remain about the same but the dry periods in summer will be more extreme and there will be more precipitation in the winter.

Another research project, sponsored by the Ministry of the Environment of the German state of North-Rhine Westphalia, investigated the flood protection effect of the reservoirs in the Ruhr catchment area expected in the future; this analysis was also carried out against the background of changing climatic conditions. The results of both climate studies are available on the website of the Reservoir Control Center. Ruhrverband is using the insights gained from these two analyses to optimize its strategies for reservoir management early enough to ensure there will be enough water for human beings, agriculture and industry along the Ruhr in the future as well.

Extreme weather events such a floods (right) could increase in the future.

Would You Like to Learn More?

Comprehensive online data and information on reservoir control are available at **www.talsperrenleitzentrale-ruhr.de**. General information on our water association and the other main activities of Ruhrverband can be found at **www.ruhrverband.de**

To reach us even faster and more directly, simply scan the QR code for Ruhrverband (left) or the Reservoir Control Center (right) with your smart phone.

If you have any questions or would like to tell us something, please contact us via the phone number or e-mail address shown below:

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