

02.11 Water Conservation Districts (Edition 2006)

Overview

The drinking water needs of Berlin are met primarily by groundwater. The drinking water supply is managed by the Berlin Public Water Companies. Water supplies are partially obtained as bank filtered water: surface waters filter through the soil and are withdrawn by extraction wells near the banks). Some surface water is diverted into groundwater recharge plants to percolate into groundwater, which will then be withdrawn for use.

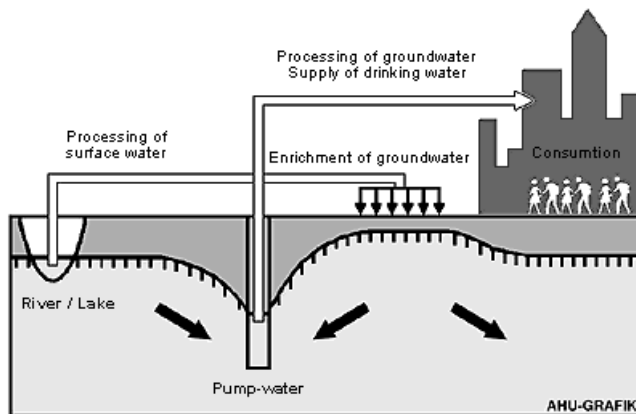


Fig. 1: Principles of Groundwater Production (AHU 1991)

There are also a number of smaller production plants, the **private sector water supply plants**, which withdraw groundwater for private sector purposes, mostly industrial, or withdraw groundwater for public facilities.

Construction increased considerably after the unification of Berlin in 1990. **Groundwater retention** is practiced during construction when groundwater is withdrawn. This occurs according to construction activity at various locations and in variable amounts. Especially deep and/or large construction projects use the trough construction method which spares groundwater. This method requires the withdrawal of only small amounts of water.

However, in May 2005, the phreatic surface, which has been lowered in Berlin by drinking-water discharge over the past hundred years, was, all in all, compared to 1989 at a relatively high level, as it had been during the previous eight years. The reason for this is the **reduced raw-water** discharge by the Berlin Water Utility. Five smaller Berlin waterworks (Altglienicke, Friedrichsfelde, Köpenick, Riemeisfenn und Buch) discontinued their production altogether during the period between 1991 and 1997 were closed during the period between 1991 and 1997: Altglienicke, Friedrichsfelde, Köpenick, Riemeisfenn und Buch. In addition, drinking water production at the two waterworks Johannisthal and Jungfernheide was discontinued temporarily since September 2001; at the latter, the same was true for artificial groundwater recharging. In the context of groundwater management by the Senate Department for Urban Development, groundwater is, however still discharged at both locations, so as not to endanger current local waste disposal and construction measures.

The overall discharge of the waterworks for drinking water purposes has dropped by over 40 % in Berlin during the past 16 years (Fig. 2). In 1989, 378 million m³ were discharged, as opposed to 219 million m³ in 2002. In 2003 the discharge increased lightly to 226 million m³ because of the dry summer, to fall again in 2005 to 212 million m³.

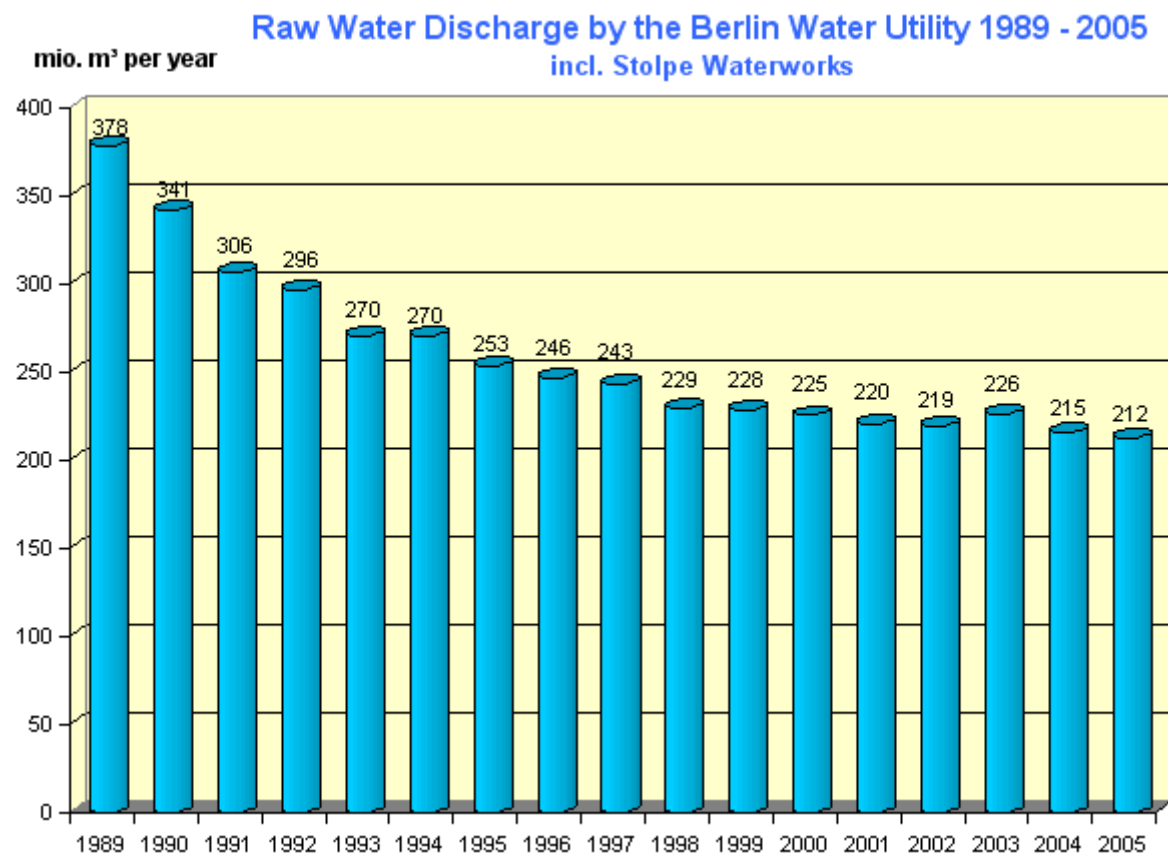


Fig 2: Drop in Raw-Water Discharge by the Berlin Water Utility during the past 16 Years

Legal Principles

As a framework for regional legislation, the Federal legislature have provided the "Gesetz zur Ordnung des Wasserhaushalts (Wasserhaushaltsgesetz - WHG) - water supply regulations. §19 The WHG forms a basis for the regional authorization of water conservation areas.

§ 19 Water Conservation Areas

- (1) as far as circumstances permit, Water Conservation Areas can be established,
 1. to protect the present and future public water supply from disadvantageous effects or
 2. to enrich the groundwater or
 3. to prevent groundwater damage resulting from precipitation and the loss of nutrients or the absorption of impurities from pesticides or fertilizers.
- (2) In the Water Conservation Areas
 1. damaging actions can be prohibited or severely restricted and
 2. special measures can be taken to prevent damage resulting from the actions or rights of property owners and users. The observation and protection of soil and groundwater is an integral part of these measures.

Other regulations of the legislature have only an indirect effect on the procedures. Of note here are the "Gesetz über Abgaben für das Einleiten von Abwässer in Gewässer (Abwasserabgabengesetz - AbwAG)" and the "Verordnung über Trinkwasser und über Wasser für Lebensmittelbetriebe (Trinkwasserverordnung - TrinkWV).

Together with the Federal legislature, the Berlin Water Rights policy which summarises the laws, legal ordinances and administration regulations, forms the basis for the establishment of water conservation areas (WSG).

In conjunction with the partial privatisation of the Berlin water companies (BWB) in the year 2000, the new (Berliner Wassergesetz -BWG) § 37 was established, and proposes that all waters needed for Berlin's public water supply should be taken from the Berlin region.

To assist in the implementation of the WSG proposals for

§ 22 Wasserschutzgebiete (Water Conservation Areas)

- (1) Water conservation areas are fixed by regulation of the senate. The protection regulations are to be marked in the ordinance. Zones with different protection regulations can be fixed. (...)
- (2) In the establishment of water conservation areas, the local authorities and local public bodies should be involved.
- (3) A hearing procedure is a necessary part in the establishment of a water conservation area. Decisions and plans are to be publicized in the official Berlin "Amtsblatt". The following must be observed,
 1. Plans, (drawings, proofs and descriptions) showing the full scope of the water conservation zones and the proposed protection regulations should be available for one month and
 2. Objections to the proposed measures can be raised up to two weeks (at the latest) from the end of the publication period... (...)

In addition, the laws regulate the division of standing waters and rights pertaining to property ownership, use of water and official responsibility. Furthermore, the maintenance and building of embankments and constructions at or in standing waters.

Water Conservation Areas

The Berlin water law distinguishes two legal qualitative definitions of protected areas:

For water conservation areas situated in west parts of the city §22 Abs. 5 the "Anordnung über die hygienische Überwachung der Berliner Wasserwerke und die Bildung von Schutzzonen" vom 08.10.1946 (ie. 1946 Allied Ordinances) is relevant.

This ordinance determine still only one following protected area:

- Waterwork Riemeisterfenn

From §22 Abs.1 the BWG were remitted the following protection ordinances by the Senate Department for City Development :

- Ordinance for the water conservation area **Kladow** Waterworks
(Water Conservation Area Ordinance Kladow) from 07.01.1975
- Ordinance for the water conservation area **Tiefwerder** Waterworks
(Water Conservation Area Ordinance Tiefwerder) from 01.09.1978
- Ordinance for the water conservation area **Beelitzhof** Waterworks
(Water Conservation Area Ordinance Beelitzhof) from 13.11.1987
- Ordinance for the water conservation area **Jungfernheide** Waterworks
(Water Conservation Area Ordinance Jungfernheide) from 31.08.1995
- Ordinance for the water conservation area **Tegel** Waterworks
(Water Conservation Area Ordinance Tegel) from 31.08.1995
- Ordinance for the water conservation area **Buch** Waterworks
(Water Conservation Area Ordinance Buch) from 31.08.1999
- Ordinance for the water conservation area **Friedrichshagen** Waterworks
(Water Conservation Area Ordinance Friedrichshagen) from 31.08.1995
- Ordinance for the water conservation area **Johannisthal** and **Altglienicke** Waterworks
(Water Conservation Area Ordinance Johannisthal / Altglienicke) from 31.08.1999
- Ordinance for the water conservation area Wasserwerke **Wuhlheide** and **Kaulsdorf** Waterworks
(Water Conservation Area Ordinance Wuhlheide / Kaulsdorf) from 11.10.1999
- Ordinance for the water conservation area **Erkner** Waterworks
(Water Conservation Area Ordinance Erkner) from 12.10.2000
- Ordinance for the water conservation area **Staaken** Waterworks
(Water Conservation Area Ordinance Staaken) from 16.10.2001

- Ordinance for the water conservation area **Eichwalde** Waterworks (Water Conservation Area Ordinance Eichwalde) from 16.10.2001
- Ordinance for the water conservation area **Spandau** Waterworks (Water Conservation Area Ordinance Spandau) from 22.06.2005

You will find the text of the ordinances under Wasserrecht (only in German).

No.*	Waterwork	Founded	Legal grounds for WSG
01.	Tegel	1877	Ordinance Tegel
02.	Beelitzhof	1894	Ordinance Beelitzhof
03.	Jungfernheide	1896	Ordinance Jungfernheide
04.	Tiefwerder	1914	Ordinance Tiefwerder
05.	Spandau	1897	Ordinance Spandau
06.	Grunewald		closed
07.	Kladow	1932	Ordinance Kladow
08.	Riemeisterfenn	1955	1946 Allied Ordinance
09.	Glienicke		closed
10.	Johannisthal	1901	Ordinance Johannisthal/Altglienicke
11.	Friedrichshagen	1893	Ordinance Friedrichshagen
12.	Wuhlheide	1914	Ordinance Wuhlheide/Kaulsdorf
13.	Kaulsdorf	1916	Ordinance Wuhlheide/Kaulsdorf
14.	Buch	1906	Ordinance Buch
15.	Altglienicke	1906	Ordinance Johannisthal/Altglienicke
16.	Friedrichsfelde	1912	-
17.	Köpenick	1907	-
18.	Stolpe	1911	in the Brandenburg region
19.	Staaken		Ordinance Staaken
20.	Eichwalde	1913	Ordinance Eichwalde
21.	Erkner	1914	Ordinance Erkner

* No. of the water conservation zone as documented in the SenStadt report VIII E

Tab. 1: Overview of waterworks and Water Conservation Districts in Berlin

Criteria for the scope of Water Conservation Districts

Conservation zones are set on observing the relationship between protection regulations and the distance from the water source. Taking the increased interest in conservation and protection of groundwater into account, drinking water wells are covered by zones with stronger protection regulations. For the individual WSGs, different criteria for the demarcation was assessed on the basis of the heterogeneous legal status (hydrology, geology, local conditions, settlement).

1946 Allied Ordinance

Water conservation zones in areas regulated by Section 4 of the Magistral Ordinances of 8 October 1946 were determined use limitations. This ordinance proceeded from an order of the Allied Commandant of Berlin, valid for all Berlin. The conservation zones are divided into a narrow conservation zone(zone II) with a radius of 100 m around extraction wells, and into a wider conservation zone (zone III) with a radius of 500 m. The captation area (zone I) is defined by the water conservation area ordinance with a radius of 10 m around the wells. In case of well galleries the areas will be connected.

Water conservation area ordinance

The regulations enacted until further notice are divided into two groups.

Under the **old Regulations** the differentiation of the wider protection zone III was not determined. (Beelitzhof, Kladow, Tiefwerder (issued between 1975 and 1987)). After 1988, protection zone III was re-defined into IIIa and IIIb.

Under the **new Regulations**, the **Isochronic concept** (comp. fig. 3) is the measuring principle used.

The isochronic concept determines the size of water conservation districts and their geometric forms of zone II, IIIa and IIIb in hydraulic terms: from the flow time of water to the removal site. To get a clear fixing of the areas the real scope follows existing site or land borders or clear visible terrain marks.

Flow times at the removal sites for determining the conservation district borders:

- conservation zone II: 50 days
- conservation zone IIIa: 500 days
- conservation zone IIIb: 2.500-3.500 days

The determination of the isochrons, and thus the conservation district borders, proceed from hydrogeologic examinations of a given area. A regional groundwater flow model is developed for this area. The goal of the concept is to have sufficient time for damage control should soil (and/or groundwater) be contaminated.

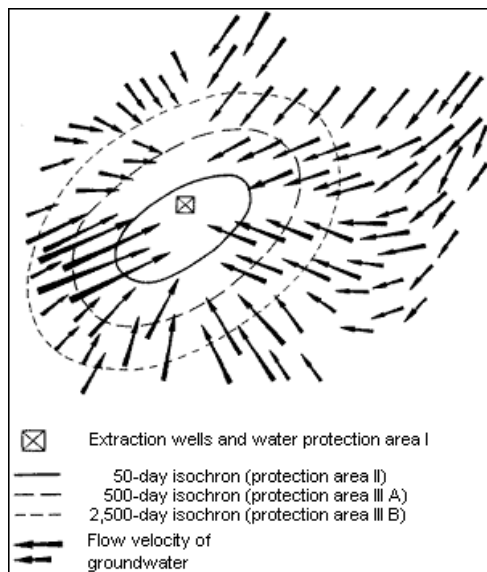


Fig. 3: Example for Definition of a Water Protection Area According to the Isochronic Concept
The flow velocity of groundwater is indicated by the length of the arrows. The longer the arrow, the higher the flow velocity.

Use limitations within conservation districts were supplemented and extended in the course of revising the Water Conservation District Regulations according to the isochronic concept.

Statistical Base and Methodology

For the statistical documentation of the regions, no uniform basis was available. As far as water conservation area ordinances were concerned, atlas supplements in the scale 1:5000 were available. Information concerning wells was recorded and documented with reference to the demarcation from iso-distances, (instigated after the 1946 allied ordinance). Ordinance information for other areas was taken from the Berlin map 1:5000 and then digitalized. The precision given for the Berlin region is due to the availability of the map in scale 1:5000. In contrast, information for the conservation zones in the Brandenburg region had to be taken from smaller scale maps, an exact statement for single sites is not possible.

This map gives an overview. For judicial binding information use the original maps from the ordinances

The project essentially used the graphic software "Mercury" of the Fa. CGM. Basis was the "Map of Berlin 1:5000 - screen data (K5 RD) - " the Ministry of Urban Development, Dept. III.

The selected map scale of 1 : 50,000 does not allow Berlin Public Water Companies wells to be depicted individually, but only as **well galleries**. The depiction of Conservation Zone II in the former West Berlin and the captation zone (Zone I) are also missing.

Map Description

100% of the drinking-water supply for Berlin (approx. 212 million m³ in 2005) is obtained from groundwater. Moreover, groundwater reserves are tapped for in-house and industrial use, as well as for major construction projects and heating-related purposes.

Excepting Buch, the nine waterworks of the Berlin Public Water Companies Spandau, Tegel, Tiefwerder, Beelitzhof, Kladow, Wuhlheide, Kaulsdorf and Friedrichshagen are located in the Warsaw-Berlin pleistocene watercourse or the Havel channel.

The Stolpe Waterwork is located in Brandenburg. It is operated by the Berlin Public Water Companies and serves the drinking water supply of Berlin to 10 % and a few nearby communities in the state of Brandenburg. The conservation districts of the Staaken, Eichwalde and Erkner Waterworks, which serve communities in the vicinity of Berlin, are located both inside and outside the city boundaries.



Fig. 4: Location of the nine waterworks supplying Berlin with drinking-water in Mai 2005

Due to the large number of waterworks both in the city area and on the outskirts, a considerable proportion of urban areas are under protection. Berlin's has a total surface area of approx. 890 km², with water conservation zones accounting for approx. 28 %.

Zone	area in ha	% of WSG	% of total area
I	117,3	0.5	0.1
II	2662,4	10.6	2.9
III	1509,5	6.0	1.7
IIIa	9048,3	36.1	10.1
IIIb	11631,8	46.4	13.0
1946 Allied ordinance	879,0	0.3	0.1
	<u>25051,2</u>	<u>100.00</u>	<u>27.9</u>

Tab.2: Total surface area of the Water Conservation Zones (WSG)

Groundwater Management

The dramatic **reduction in demands on groundwater** especially in the neighbourhood of the recently de-commissioned Waterworks, has resulted in groundwater levels rising by up to 3m. This is

especially so in the pleistocene watercourse region of southeast Berlin where areas have a high level water table. This has resulted in residential estates being plagued by water-logged cellars, eg. Rudow in the 1990's. In July 2001, in order to achieve groundwater states which allows settlement areas without water damages and as a reaction to the spatial unequal development of water demand inside Berlins, the Berlin senate made the following decisions:

In the long term, 50 percent **more groundwater** should be available for the public water supply in the eastern half of the city, to be taken from the regional network where consumption allows. The groundwater supply to southeast Berlin should be increased to a future 90 Mio. m³ per year from the present 60 Mio. m³ per year. After repair and renovation, the Berlin water-pipe network should supply drinking water to the west of the city.

Through the additional groundwater withdrawal for drinking water production in the neighbourhood of the waterworks in southeast Berlin, the increase of the groundwater level can be stopped and consistent groundwater states for residential areas can be guaranteed.

As a consequence of the **increased drinking waters production in southeast Berlin** and in order to safeguard public drinking water supplies, the Berlin water companies must cut production in the western half of the city by 30 Mio. m³ per year. Thus increasing groundwater reserves in the proximity of the waterworks where production is reduced, but also spreading the problems of water-logging from east to west. In order to counteract this, the levels of **groundwater concentration** (through the infusion of purified surface water into the subsoil) should be controlled to **reduce** the problem and achieve an approximate levelling of groundwater states throughout the city.

The momentarily de-commissioned **Jungfernheide** waterworks offers the BWB an immediate reduction of drinking water production in the western half of the city. To achieve a long term increase in production levels in the eastern half of the city, the local waterworks must be restored and modernised accordingly. Re-development is due to start shortly at the currently de-commissioned **Johannisthal** waterworks. These measures are scheduled for completion by 2009 at the latest.

In the meantime, work should be intensified to eliminate subsoil pollution in the catchment areas of the Johannisthal and Wuhlheide waterworks. Through the controlled increase of groundwater reserves, redevelopment can be accelerated on the large-scale **Spree** project (contaminated waste disposal sites in Niederschöneweide, Johannisthal und Adlershof).

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Maps

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