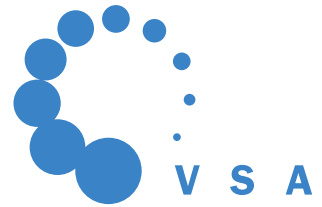


Verband Schweizer
Abwasser- und
Gewässerschutz-
fachleute

Association suisse
des professionnels
de la protection
des eaux

Associazione Svizzera
dei professionisti
della protezione
delle acque

Swiss Water
Association

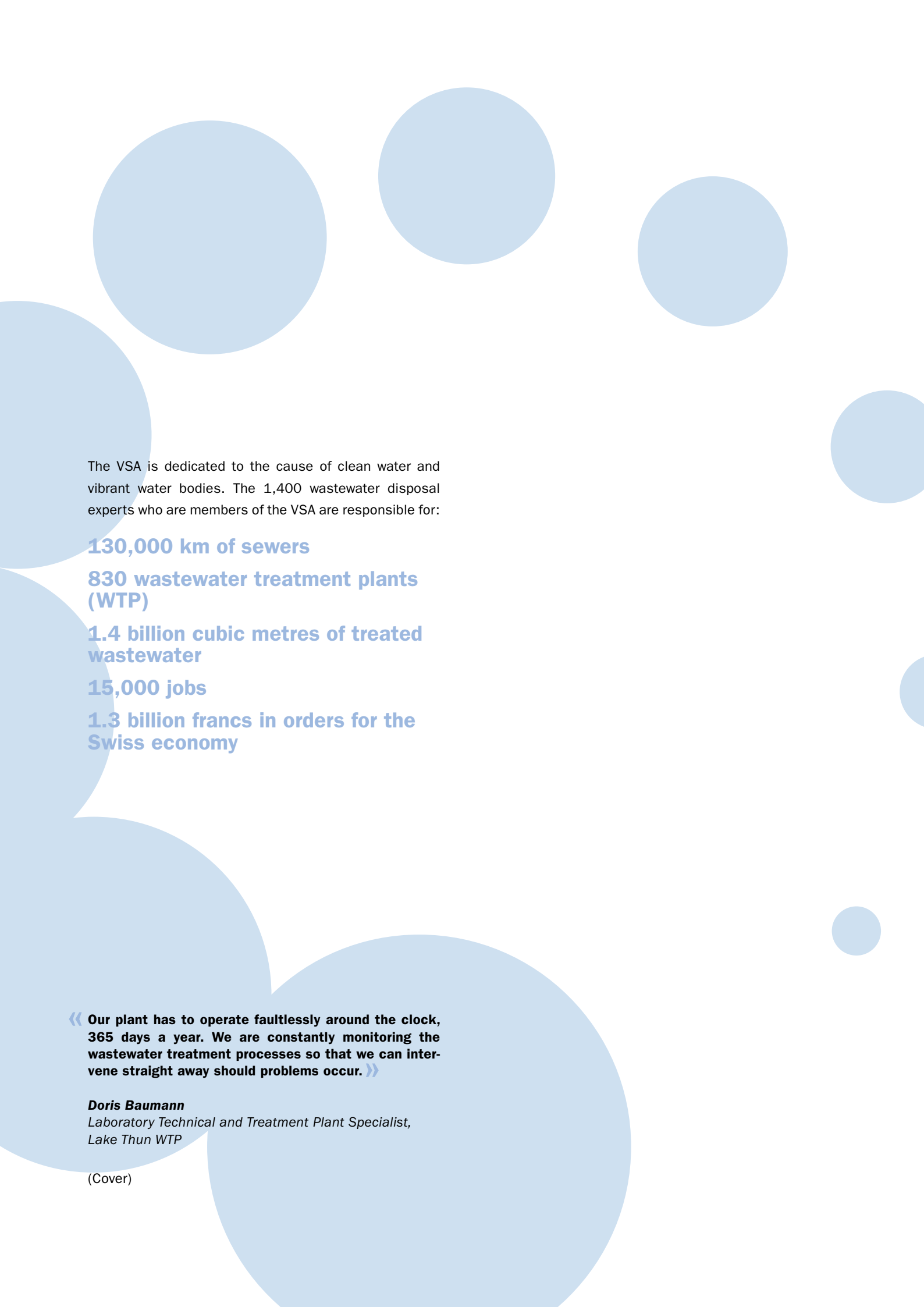


SAFEGUARDING QUALITY OF LIFE IN SWITZERLAND.

Your Swiss wastewater disposal service.

**Topic report 2015
on urban drainage
and wastewater treatment**





The VSA is dedicated to the cause of clean water and vibrant water bodies. The 1,400 wastewater disposal experts who are members of the VSA are responsible for:

130,000 km of sewers

830 wastewater treatment plants (WTP)

1.4 billion cubic metres of treated wastewater

15,000 jobs

1.3 billion francs in orders for the Swiss economy

« Our plant has to operate faultlessly around the clock, 365 days a year. We are constantly monitoring the wastewater treatment processes so that we can intervene straight away should problems occur. »

Doris Baumann

*Laboratory Technical and Treatment Plant Specialist,
Lake Thun WTP*

(Cover)

Major economic benefits and much more

Dear Reader,

Beneath our feet in Switzerland lies a sewer network that is 130,000 kilometres long. Its combined length would circle the planet three times. The sewer network accomplishes amazing things. Together with over 800 treatment plants, it is the reason that epidemics and diseases caused by poor urban hygiene and polluted bodies of water are a thing of the distant past. Sewer networks and water treatment plants make a major contribution to the high quality of life we enjoy in our country, not least by ensuring that our wastewater is collected and treated. This results in clean surface waters and first-rate drinking water resources. As well as its major advantages to society, wastewater disposal also provides significant economic benefits: more than 3,000 people in public authorities and operations are involved in the maintenance and continual development of wastewater disposal in Switzerland. Moreover, contracts worth 1.3 billion francs are issued annually to the construction industry, energy service providers, engineering firms, researchers and others. The Swiss wastewater industry thus secures around 15,000 permanent jobs.



Our association will continue to be involved in Switzerland's wastewater treatment in the future in order to maintain the high standards that we have achieved in this sphere. However, an increasingly important issue that also needs our dedicated involvement is the protection of surface waters, and all that this entails.

I would like to thank everyone who works to contribute to the smooth operation of wastewater disposal in Switzerland. This report provides an overview of the broad spectrum of duties and professions in the field of wastewater disposal, as well as outlining what the future challenges will be and how the VSA intends to help tackle them.

I hope you find it a stimulating read.

Kind regards,

Heinz Habegger
VSA President

OUTSTANDING BENEFITS FOR SWITZERLAND



Wastewater disposal protects drinking water resources

Water means life. Our drinking water is an irreplaceable commodity that we need on a daily basis – and we need it to be clean and in sufficient quantity. Even today, diarrhoeal diseases caused by polluted water are responsible for more deaths than AIDS or tuberculosis. According to the UN, in 2015, there are over 700 million people without access to clean drinking water.

Switzerland's modern wastewater disposal system makes a significant contribution to the impeccable quality of our drinking water. That was not always the case. Even in Switzerland, untreated wastewater was once discharged into open bodies of water. This polluted lakes, springs and ground water, all of which are sources of drinking water. Polluted drinking water has a significant impact on quality of life. It is the cause of numerous diseases, all of which spread rapidly. Such epidemics have long since disappeared in Switzerland.

Today, wastewater is treated with state-of-the-art processes throughout Switzerland. Ground and spring water is often so clean that a third of the water obtained for drinking can be fed directly into the drinking water supply.

« We bear a great responsibility for the local population. A prolonged outage of the WTP would threaten the drinking water supply of thousands of people, because drinking water sources along the Rhone would have to be closed. »

Christian Durand

Plant Manager, WTP Bois-de-Bay, Geneva

Rainwater flows safely away from our villages and cities

When rain falls on natural surfaces, the water evaporates, seeps into the ground or flows away via natural water courses. In Swiss villages and cities, rain is often no longer able to flow away naturally. Roofs, driveways and streets seal off the ground. Without well-functioning urban drainage, there would be floods and backed-up basements, followed by traffic disruption and damage to buildings and public infrastructure. In Switzerland, however, rainwater is collected in an impressive 130,000 km long sewer network and channelled safely away from urban areas. Modern drainage concepts ensure that rainwater is drained off as naturally as possible and if conditions permit can seep into the ground.



« Several times a week, we monitor the quality of the treated wastewater that we release into the Vedeggio and Lake Lugano. The data obtained is used to optimise our treatment processes. »

Armando Foletti

Laboratory Technician, WTP Lugano



Surface waters remain first-class habitats and recreational spaces

Many plants and animals live in Swiss rivers and lakes. These surface waters are also important living and recreational spaces for people. As well as our mountain landscapes, clean surface waters are an important factor in attracting tourism, Switzerland's fourth largest economic sector.

This has not always been the case. As a comprehensive sewage system was installed throughout almost every part of Switzerland over the past hundred years, living conditions improved in the villages and cities, but new problems such as odours or algae blooms began to occur in the surface waters. Organic pollutants, nitrogen and phosphorus were only filtered out in wastewater treatment plants (WTP) once the infrastructure was established in the middle of the last century. Before this, such contaminants severely taxed the water resources. Today, rivers and lakes are protected from such pollution and are thus able to perform their natural function.

« When it rains, up to 20 times the amount of water flows through this sewer than when the weather is fine. That amounts to up to 3,000 litres of wastewater and rainwater per second. »

Edi Hinnen

*Sewer Network Employee,
Altenrhein Wastewater Association*

Indispensable for economic performance

Clean drinking water resources, flood protection and clean water bodies are crucial for Switzerland's economic development and performance. They are also essential to the success of the leisure, recreation, tourism, agriculture and fishery industries. Although its contribution to GDP is less than 1%, without a well-functioning wastewater disposal system the costs would be unthinkable in terms of the resulting damage, disease and drinking water treatment requirements. The loss of Switzerland's attractiveness would also have immense implications.

Wastewater disposal is a major provider of jobs and contracts. It offers interesting career opportunities for electrical, mechanical, civil and environmental engineers as well as mechanics, electricians, metalworkers and laboratory technicians. In addition, 1.3 billion francs' worth of orders are placed annually for operations, renovations and upgrades with the construction industry, engineers and others.



« By burning sewage gas in three thermal power stations we generate more electricity and heat than we need for our own operation. We supply a sports centre and a school with the waste heat. »

André Gilomen

Head of Operations and Maintenance, Lake Thun WTP

IMPRESSIVE PERFORMANCE

Urban drainage is one of Switzerland's largest transport operations

A total of 1.4 billion cubic metres of wastewater are transported to the treatment plants each year in Switzerland. If this amount were loaded onto freight wagons, the train would be long enough to circle the globe six times. That corresponds to a haulage capacity of around 10 billion tonne-kilometres per year. The entire Swiss cargo transportation system achieved the same haulage capacity on the rails in 2012. The wastewater collected in Switzerland is routed through around 50,000 kilometres of public and 80,000 kilometres of private sewers to one of the 830 wastewater treatment plants.

Whilst in 1965 only around 14% of Swiss residents were connected to a WTP with modern process technology, the figure exceeds 97% today. This makes Switzerland a world leader.

High standards, international obligations

The conditions under which treated wastewater may be discharged into rivers or lakes are subject to strict ecological criteria. They are incorporated into law and the cantonal authorities constantly monitor their adherence. In this way, more than 90% of the 500,000 tonnes of organic pollutants that reach the WTP each year are completely removed. A similarly high amount of phosphorous is also removed to hinder the growth of algae in lakes.

As the «water tower of Europe», Switzerland also assumes responsibility for those countries situated downstream from the major watercourses. Around 16,000 tonnes of nitrogen are removed from wastewater today in the Swiss catchment area of the Rhine River in accordance with international agreements intended to protect the North Sea. These efforts are steadily being expanded.

Significant energy production

It takes a lot of energy to treat wastewater. A total of 460 gigawatt-hours of electricity are needed annually to operate the Swiss WTPs. This equates to the electricity consumption of 130,000 households. However, a great deal of energy can also be recovered in the process of wastewater treatment. From sewage gas that is generated in the WTPs in Switzerland, around 123 gigawatt-hours of renewable electricity is produced each year. This represents an excellent ecological balance sheet, with the result that it can be certified with the «naturemade star» quality label, and the electricity produced can be fed into the electrical grid. Swiss WTPs produce approximately twice as much

electricity today as industrial and agricultural biogas plants. Some WTPs have optimised their process technology to the point that they produce more electricity than they need themselves. Some WTPs provide district heating from the waste heat generated during electricity production. Others process sewage gas and supply it as an alternative to natural gas. Such processing facilities are in operation at eight Swiss WTPs, with further projects planned. The public transport companies of the City of Berne (Bernmobil) have been operating around 30 buses fuelled with biogas from the Berne WTP since 2007. This reduces Bernmobil's CO₂ emissions by around 2,300 tonnes annually.

WASTEWATER DISPOSAL HAS ITS PRICE

Public wastewater disposal costs ½ franc per person, per day

All the Swiss WTPs, public sewers and special facilities such as pump stations or retention basins are together worth around 80 billion francs. This equates to 10,000 francs per resident.

The operation and maintenance of these facilities costs less than 200 francs per year per person, or 50 centimes per day. The costs are relatively low in comparison to other expenses in the household budget. According to the Swiss Federal Statistical Office, the average annual expenditure for telecommunications amounts to 1,000 francs per person, while mandatory health insurance costs 3,000 francs, and transportation expenditure amounts to 4,000 francs annually. However, not all residents pay the same amount: Those connected to a very small WTP pay up to twice as much as someone who is connected to a large plant. Small plants have comparatively high fixed costs. Most residents these days, however, are connected to large plants. A total of 80% of Swiss wastewater is treated in 20% of the plants (170 plants).

Treatment performance is increasing, while costs remain the same

The cleaning performance of the WTPs has been continually improved in recent years. The amount of pollutants reaching open water bodies after being discharged from WTPs is constantly decreasing. The total costs for wastewater treatment from households and industry amounts to 2.2 billion francs annually. This is less than what is expended throughout Switzerland for municipal roads (2.9 billion) or the police (2.8 billion).

The annual cost for wastewater disposal remains stable despite enhanced performance. This is possible because existing plants are being modernised. Continued development is enabling wastewater treatment to be concentrated in fewer but larger plants. In the past five years, 40 plants were decommissioned and connected to larger, better-performing plants in the vicinity. If smaller, more expensive plants are decommissioned in favour of larger plants, then costs are lowered and performance rises.

The process of consolidating to large WTPs is ongoing. Of the 830 existing WTPs, there are still 550 plants today serving fewer than 10,000 residents. Some of these plants will also sooner or later be connected to neighbouring larger and higher-capacity plants.



« We clean out around 7,000 collector drains every year. These collect sand, gravel and other contaminants so that they do not end up in the sewers. »

Werner Kaufmann
Vacuum tanker, Driver and Assistant
Civil Engineering Office of the City of Berne

« Over 500 suppliers provide us with a whole range of services that contribute to the reliable operation of the plant. Many of these are local to our region. »

Dr Christoph Egli

*Managing Director of the Altenrhein
Wastewater Association*



AN IMPORTANT EMPLOYER AND CONTRACTING ENTITY

Public responsibility

A major part of the government's public remit is to provide, monitor and safeguard the sustainability of wastewater disposal – a service which is vital for water protection, urban sanitation and flood prevention.

Wastewater disposal is a natural monopoly. There is no reasonable justification for privatisation, as it does not increase competition nor result in lower costs. The requisite plants are therefore publicly owned. Wastewater disposal is financed through consumption-based charges. Politicians, the commercial sector and the general public have a right to transparency of information, so national key figures relating to the services provided and their associated costs are recorded, evaluated and published once every five years. Comparisons show that Swiss wastewater disposal performs very well in the European context.

1.3 billion francs annually in contracts and investments

The average lifespan of sewers is 80 years. Many were built in the middle of the last century and will need to be renovated in the near future. The WTPs themselves must also be periodically upgraded. Annual investments to the tune of 800 million francs go into the renovation and upgrading of WTPs and sewers, while a further 500 million francs' worth of goods and services are needed for plant operation. These contracts benefit the construction industry, suppliers of measurement instruments, controls and control devices, energy providers as well as engineering firms. Such contracts are generally put out to tender, and a large proportion of the services are awarded to Swiss contractors and performed in Switzerland.

Interesting professional fields

More than 3,000 people who work in public sector companies and organisations are involved in wastewater disposal, and the field accounts for a further 10,000 jobs in the private sector. In addition to electrical, mechanical, construction and environmental engineers, there is often a demand for specialists, such as mechanics, electricians, laboratory technicians and automation technicians. The latter are becoming increasingly important due to the ever more complex processes with their sophisticated measurement and control concepts. Analogue and digital signalers transmit information to the process control

system; pumps, vents and valves carry out control instructions. This equipment must be constantly maintained and kept up to date. Control of the biological processes also requires staff with in-depth knowledge of chemical and microbiological processes.

The VSA is also actively engaged in education and further training to ensure that the demand for specialists can continue to be met in the future. An aspiring operations manager of a large WTP needs to undertake a challenging training programme in order to become a federally certified treatment plant specialist. A three-year professional training course in drainage technology is also now offered.

NEW CHALLENGES

The need to renovate private sewers

The approximately 50,000 kilometres of public sewers in Switzerland are regularly inspected, and renovated whenever necessary.

In addition to these, there are private property connections totalling over 80,000 kilometres in length. Investigations have shown that a third of the private sewers need renovation either urgently or in the medium term. The necessary measures are often only reluctantly undertaken by private homeowners.

The precautionary principle in the Water Protection Act and the legal requirement that sewers must be watertight apply to all property owners. This means that investments are also necessary in the privately owned sections of the sewerage network. The requisite inspection and renovation technologies have been available for several years.

Recovering raw materials from wastewater

Significant amounts of nutrients such as phosphorus and nitrogen are found in wastewater, and thanks to new technologies, these can now be recovered and reused. Both chemicals are essential fertilisers and play a central role in food production. Switzerland is dependent on imports for both these materials. The price of phosphorus has increased by 300% in recent years.

«Urban mining», or the recovery of raw materials from solid urban waste, represents an alternative to importing. Switzerland's wastewater contains the equivalent of around 75% of all the nitrogen fertiliser we import, and the equivalent of 100% of the phosphorus fertiliser used in agriculture. These nutrients are laboriously removed today in wastewater treatment plants, but are not processed for reuse. The sector is working on technical solutions in order to recover these resources and make them reusable.



« We use this robot to regularly inspect our sewer network for damage. That way, we can prevent pollution of the soil or groundwater and plan longer-term maintenance measures. »

Michael Mitter
Camera operator, Civil Engineering Office
of the City of Berne

« We have new processes that enable us to remove a large proportion of the micropollutants from wastewater. We are researching these in our testing facility in Dübendorf. »

Dr Adriano Joss

Research Associate, EAWAG Swiss Federal Institute of Aquatic Science and Technology



Halving surface water contamination by micropollutants

Micropollutants originate from countless products used in the modern consumer society. More than 30,000 materials from washing and cleaning products, fertiliser, pesticides, paint, and even our urine, end up in wastewater or in rainwater. Wastewater mirrors society. Traces of cosmetic particles, medications or drugs such as cocaine or ecstasy can be found. Many of these chemicals are already eliminated in the wastewater treatment plants today. Some cannot be removed in WTPs, however, and end up in our surface waters. Even in low concentrations they can have a harmful effect on aquatic life and compromise our drinking water.

In 2014, the Swiss Parliament decided that micropollutants must be systematically removed from wastewater. Additional processing steps are now needed in order to achieve this. Activated carbon powder adsorption facilities are operated successfully abroad, while in Switzerland good results have been attained with initial pilot ozonation facilities. Therefore, in the next 20 years around 100 of the 830 WTPs in Switzerland will either be expanded to accommodate the removal of micropollutants, or connected to larger plants. This will cut surface water contamination by micropollutants in half. The total investment is estimated to be 1.2 billion francs, which will be financed through a temporary wastewater levy amounting to a maximum of nine francs per resident per year.

Greater cooperation

When the first WTPs were built in the middle of the last century, they often connected numerous municipalities. These days, an average of three municipalities are connected to one WTP. In some areas, a WTP treats the wastewater from just 1 km² of urban settlement area. The organisation of the sewer networks operates on an even smaller scale. With just a few exceptions, these are owned by the individual municipalities.

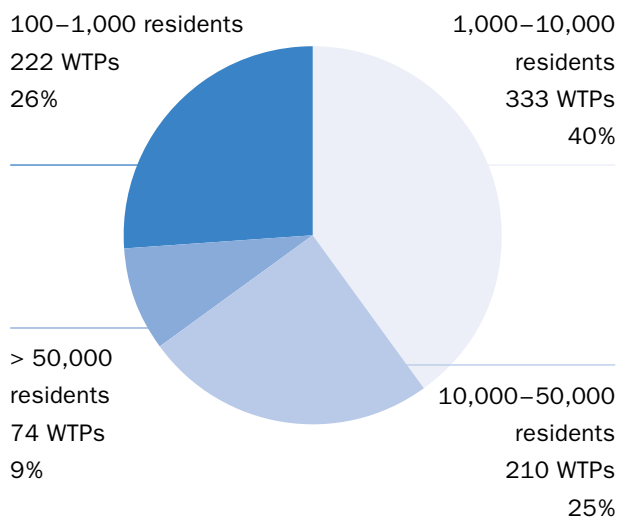
Some tasks are better suited to regional rather than local-scale operations. For example, larger plants are created through merging, and specific surface water related priorities can be established for water treatment operations. As well as being more economical, a high level of coordination between the municipalities and with cantonal authorities improves water protection, and allows issues such as the reduction of micropollutants to be effectively tackled.

FACTS AND FIGURES

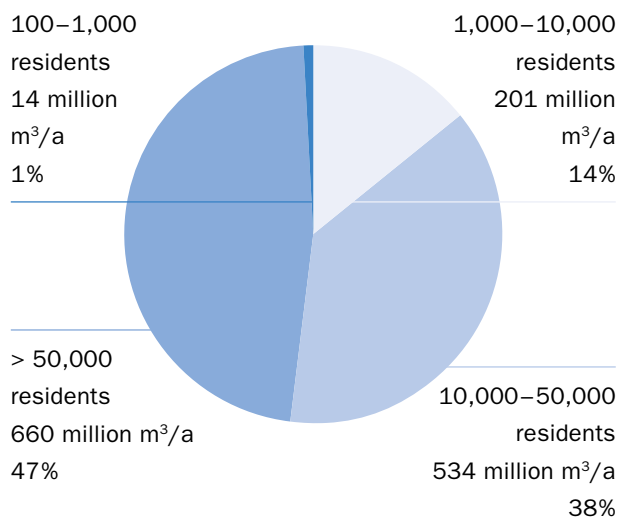
Wastewater disposal structure in Switzerland

Structural data	2005	2010	Change 2005–2010
Residents in Switzerland as of 31.12 (in millions) ⁽¹⁾	7.46	7.87	
Connected residents (in millions) ⁽²⁾	7.21	7.63	+5.8%
Number of wastewater treatment plants (WTP) (Treatment capacity > 100 connected residents)	875 ⁽³⁾	839 ⁽⁴⁾	–4.1
Maximum treatment capacity (per million residents)		15.5 ⁽⁴⁾	
Connected population equivalents ^(A) (per million residents)		11.2 ⁽⁴⁾	
Public sewer length (km), estimate	47,000 ⁽³⁾	49,110 ⁽⁴⁾	+4.5%
Length of sewer per resident (m)	6.52	6.44	
Annual wastewater volume (billion m ³)	1.44 ⁽³⁾	1.41 ⁽⁴⁾	
Wastewater volume per resident, per day (litres)	547	505	–7.7%
Private property connections (km), estimate	80,000 ⁽⁵⁾		

Distribution of plants by WTP treatment capacity^{(4), (A)}

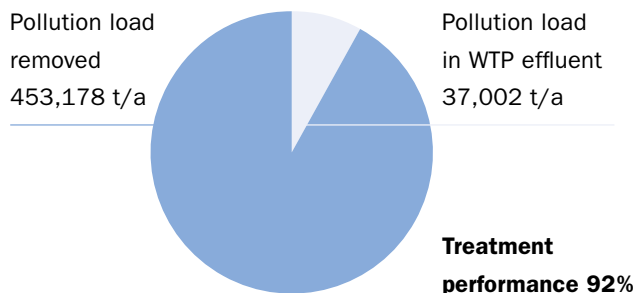


Distribution of wastewater volume by WTP treatment capacity⁽⁴⁾

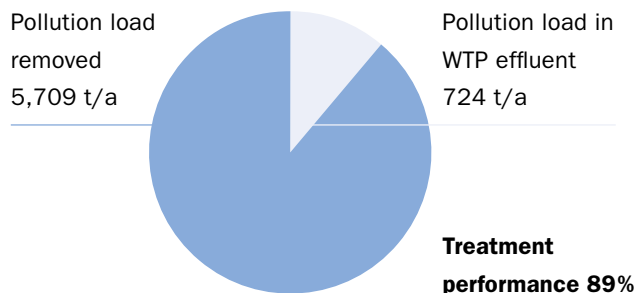


Treatment performance

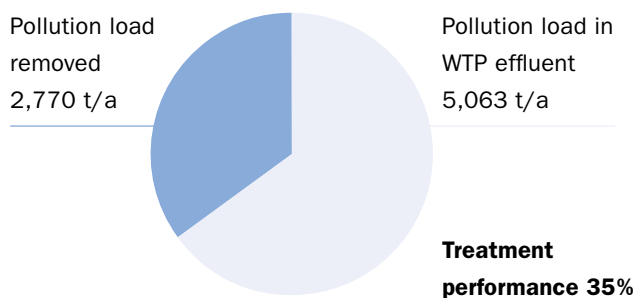
Organic pollutants ⁽⁴⁾



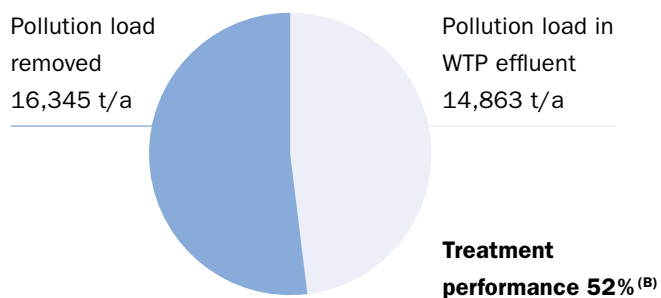
Phosphorus ⁽⁴⁾



Nitrogen in the Rhone catchment area ⁽⁴⁾



Nitrogen in the Rhine catchment area ⁽⁴⁾



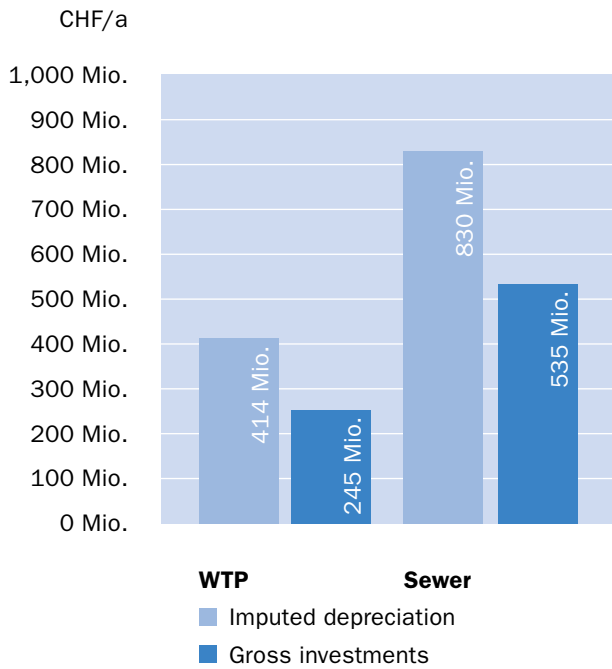
Wastewater disposal costs in Switzerland ⁽⁴⁾

	WTP (CHF/a)	Sewers (CHF/a)
Personnel costs	170 million	115 million
Materials costs	317 million	199 million
Operating costs	487 million (22%)	314 million (14%)
Calculated amortisation costs	414 million	830 million
Interest costs	68 million	64 million
Capital costs	482 million (22%)	893 million (42%)
Total	1.0 billion (44%)	1.2 billion (56%)
Total annual costs 2010	2.2 billion (100%)	
Total annual costs 2005 ⁽³⁾	2.2 billion	

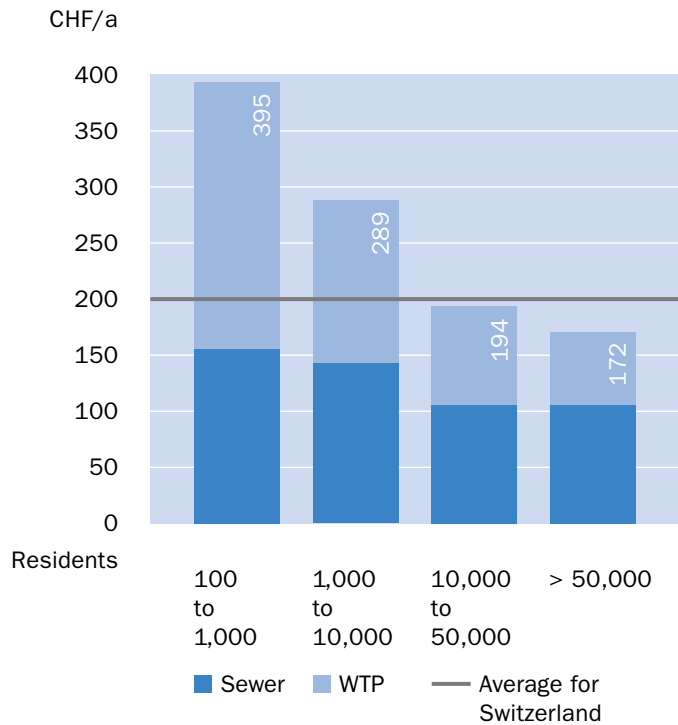
Replacement values ⁽⁴⁾

Sewer network (in CHF billion)	66.4
Wastewater disposal plants (in CHF billion)	13.6
Wastewater disposal total (in CHF billion)	80.0
Sewer network per resident (CHF)	8,800
WTP per resident (CHF)	1,700
Total per resident (CHF)	10,500

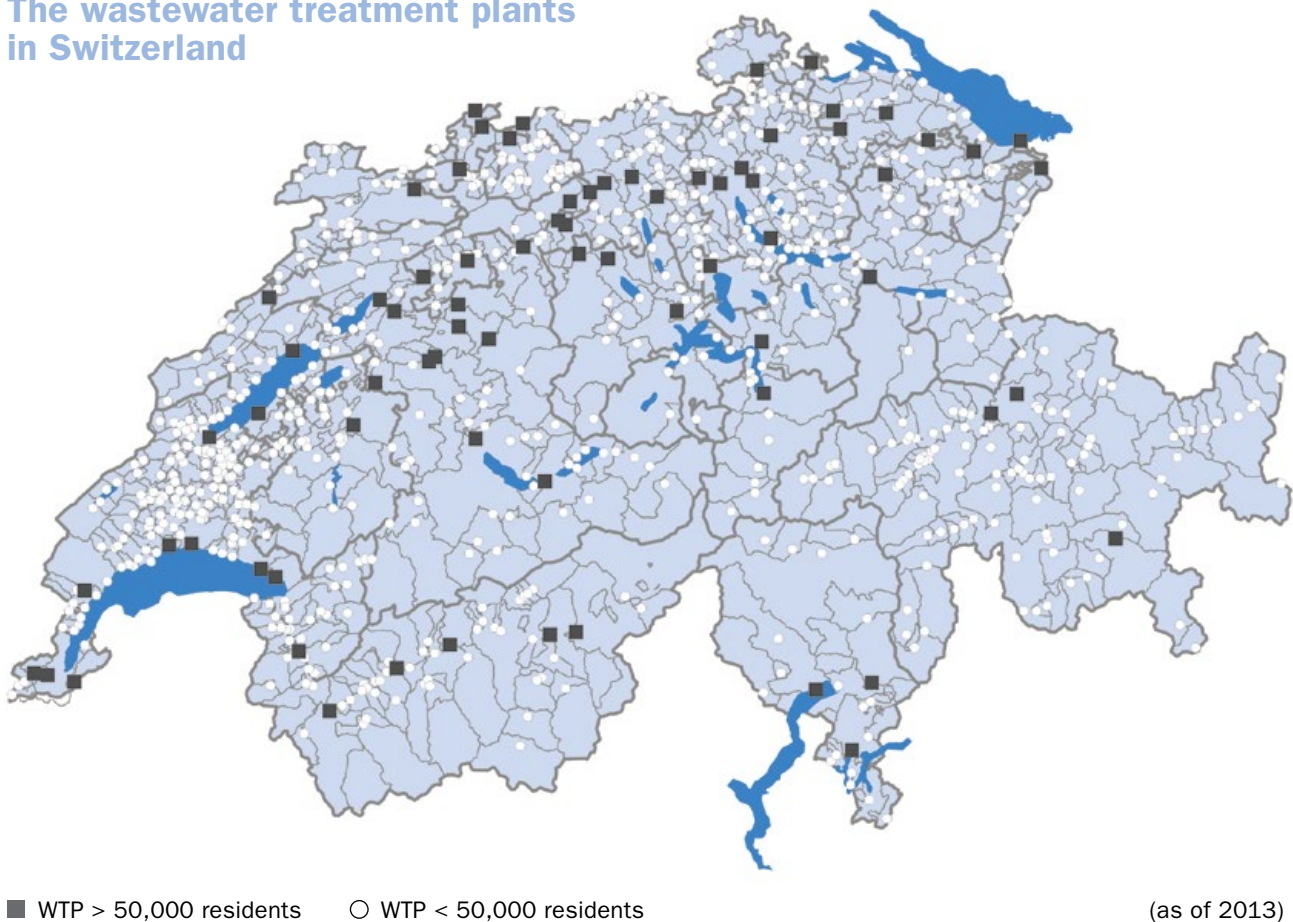
Gross investment and amortisation costs ⁽⁴⁾



Total annual costs per resident, broken down by the size of the connected WTP ^{(4), (A)}



The wastewater treatment plants in Switzerland



« It makes me proud to be able to contribute to the protection of Lake Lugano. The consistently high performance and the complexity of the processes never cease to impress me. »

Miguelangel Pintos

Plant Electrician, WTP Lugano

Sources/Comments:

- ⁽¹⁾ Swiss Federal Statistical Office
- ⁽²⁾ Federal Office for the Environment
- ⁽³⁾ Kosten der Abwasserentsorgung: Resultate aus dem Pilotprojekt (Wastewater disposal costs: Results from the pilot project), text VSA/FES 2006
- ⁽⁴⁾ Kosten und Leistungen der Abwasserentsorgung (Wastewater disposal costs and performance), VSA/KI 2011
- ⁽⁵⁾ Rough estimate, basis: Baulicher Zustand der Grundstücksentwässerung (Structural condition of property drainage), AWEL, Canton of Zurich, 2014
- ^(A) This is a resident value. These are a measurement of the pollution and, in addition to wastewater generated by people, also take wastewater from industry and commerce into account.
- ^(B) Due to agreements regarding protection of the Rhine and the North Sea, stricter regulations pertaining to the elimination of nitrogen apply for plants in the Rhine catchment area.

More detailed data and facts can be found in the following publication: *Kosten und Leistungen der Abwasserentsorgung (Wastewater Costs and Performance)*, Swiss Water Association and Municipal Infrastructure, 2011

Publishing details

Publisher: Swiss Water Association

Concept, research, text: INFRAconcept

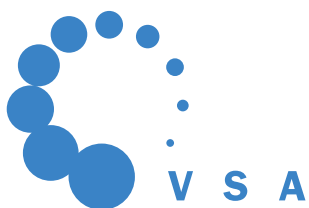
Design, editing: Weissgrund

English version: Zieltext AG

Photos: Romeo Polcan

April 2015





Swiss Water Association (VSA)
Europastrasse 3
P.O. Box, 8152 Glattbrugg
sekretariat@vsa.ch
www.vsa.ch
Phone: 043 343 70 70
Fax: 043 343 70 71