Münchner
Stadtentwässerung

Wastewater Treatment Plant
Gut Großlappen

Out of sight, out of mind:
Who thinks about the water that disappears down the drain after washing up, doing the dishes or the laundry? Only a few. And only a minority of these few ask for technical details on how to prevent the wastewater of Munich from polluting the environment. This is a pity, because the answers would give them reason to be proud of their city and its exemplary concept for wastewater management. Let's consider the Wastewater Treatment Plants Gut Großlappen and Gut Marienhof, in which this concept comes to life.

Munich's First Wastewater Treatment Plant

2400 Kilometres of Sewer Network

Two Wastewater Treatment Plants Working Together

Operating Since 1926

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What Defines Clean Waters?

Wastewater Treatment

Sludge Digester Construction

Combined Denitrification and Primary Settling Tanks

Sand Filtration

Waste Sludge Incineration

Waste Sludge Incineration Plant

Flowchart of the Wastewater Treatment Plant

Munich's First Wastewater Treatment Plant

The Münchner Stadtentwässerung, a self-supporting wastewater management enterprise (Eigenbetrieb) since 1993, is responsible for the construction, operation and administration of Munich's sewer system and wastewater treatment plants. In the roughly 100 previous years, these tasks were performed by a subdivision of the municipal construction department. The Münchner Stadtentwässerung is one of the largest municipal facility owners, financing its construction projects soley by collecting wastewater fees. These user fees have been consistently low for years now.

Around the clock, roughly 850 employees of various backgrounds ensure a smooth operation.

The most important objectives of the Münchner Stadtentwässerung are:

- high-level environmental protection
- sustainability
- efficiency and user fee stability
- customer service
- best possible occupational safety and plant reliability

To prove the implementation of these objectives, the Münchner Stadtentwässerung underwent external inspection. After a one-year preparation phase, certification according to the current quality, environment and occupational safety standards succeeded in April 2005 (DIN EN ISO 9001, DIN EN ISO 14001, DIN EN ISO 18001).

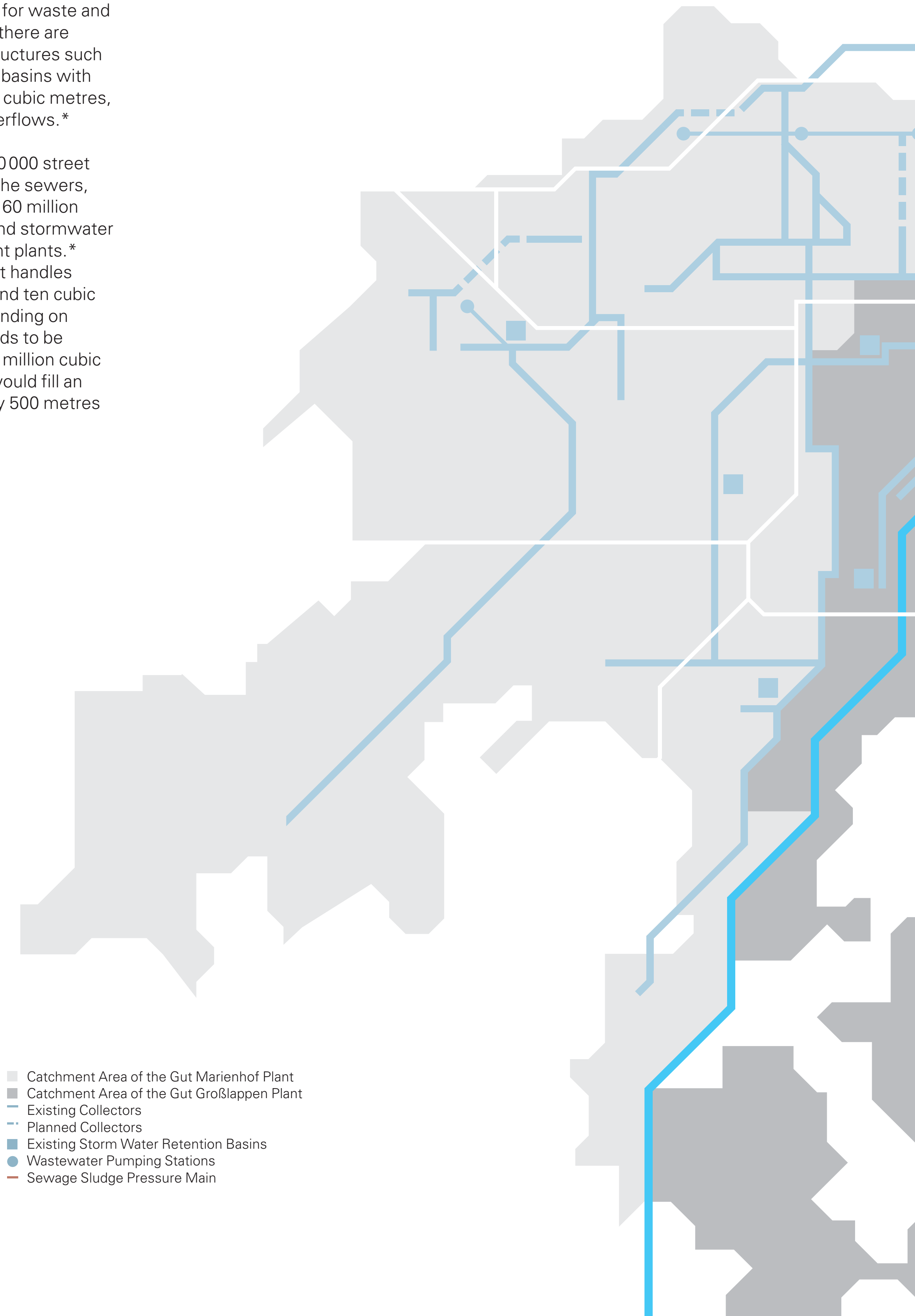
Complex technology: The Wastewater Treatment Plant Gut Großlappen is one of the two Munich plants, in which about 160 million cubic metres are treated annually.

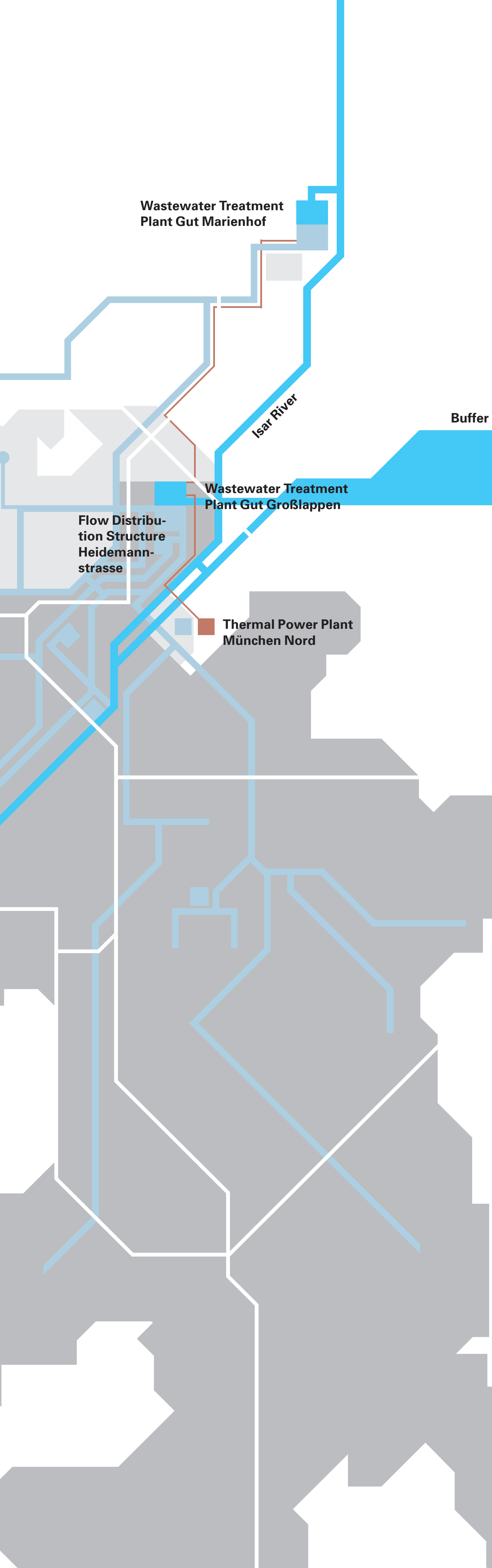
2400 Kilometres of Sewer Network

For sewage collection there is a network of 2 400 kilometres in length, of which 1 250 are large enough to walk through. Most of it is designed as a combined sewer system for waste and storm water. In addition, there are numerous specialised structures such as storm water retention basins with a total volume of 70 0000 cubic metres, pumping stations and overflows.*

140 000 properties and 70 000 street gullies are connected to the sewers, delivering an average of 160 million cubic metres of waste- and stormwater annually to both treatment plants.* The Gut Großlappen Plant handles an influent between six and ten cubic metres per second, depending on whether stormwater needs to be treated. It adds up to 100 million cubic metres annually, which would fill an imaginary cube of roughly 500 metres per side.

* All figures are rounded.





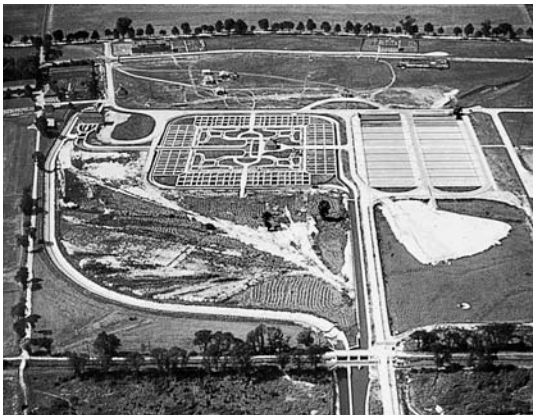
Wastewater Treatment
Plant Gut Großlappen

Wastewater Treatment
Plant Gut Marienhof

Two Wastewater Treatment Plants Working Together

The Gut Großlappen Plant shares its workload with Munich's other large-scale plant, Gut Marienhof. Together they have a treatment capacity of 3 million population equivalents, which accounts for domestic, commercial and industrial wastewater from Munich and 22 neighbouring communities. The treatment processes in the plants remove 99 percent of the organic pollutants and a major part of the nutrients nitrogen and phosphorus. These would otherwise enhance eutrophication in receiving waters.

Operating Since 1926



1926: Construction of the Wastewater Treatment Plant Gut Großlappen. The wastewater was treated mechanically by Imhoff tanks and biologically by fish ponds.

The Wastewater Treatment Plant Gut Großlappen, located at Munich's north-eastern city limit, has been in operation since 1926. However, it has undergone continuous state of the art modernisation and extension ever since.
After the introduction of a water-borne sewage system in 1890, the wastewater coming from the small collection network was easily biodegraded by the Isar River itself, as predicted by chemist and hygienist Max von Pettenkofer. However, the city kept expanding and with it its sewer network.
The pollution of the Isar River became more and more evident until 1912, when the Bavarian Government demanded the construction of a wastewater treatment plant for at least 60 percent of Munich's population. Hence the city council members inspected wastewater treatment plants in other cities, which initiated building a pilot plant.

By 1915, preparations for construction of a large scale plant near Großlappen were well under way when World War I postponed the project indefinitely.
The discussion was resumed only in connection with hydroelectric power generation from the Isar River. Finally, the construction of a mechanical treatment plant followed by a fish pond as biological stage took place between 1922 and 1926. Primary treatment consisted of a coarse screen and two-storey digesters, the so-called Imhoff tanks, which remained in operation until 1989. The waste sludge was transported to agricultural fields located up to 10 kilometres north of the plant via a small railway system.
Increasing environmental consciousness led to stricter requirements concerning treatment performance, which made further upgrading of the Gut Großlappen Plant inevitable.
Adding another influent channel with mechanical treatment in 1960 and a biological treatment stage in 1973 were big steps towards improving the Isar River water quality. In 1994, the second biological stage, which oxidates harmful ammonia, went into operation.
Over the last decades, countless modifications, extensions and upgrades in building structures as well as technical and electrical equipment have made routine plant operation virtually impossible.

A further obstacle was that the plant grounds had become increasingly confined by new settlements, roads and a sanitary landfill. Often old structures had to be demolished to make room for new ones.

After five years of construction and an investment of 300 million Euros, Munich's second wastewater treatment plant Gut Marienhof, went into operation in 1989.

1973: Adding a biological treatment stage was a big step towards improving the Isar River water quality.

2006: Construction of new sludge digesters and an effluent sand filter

Learning from The Best

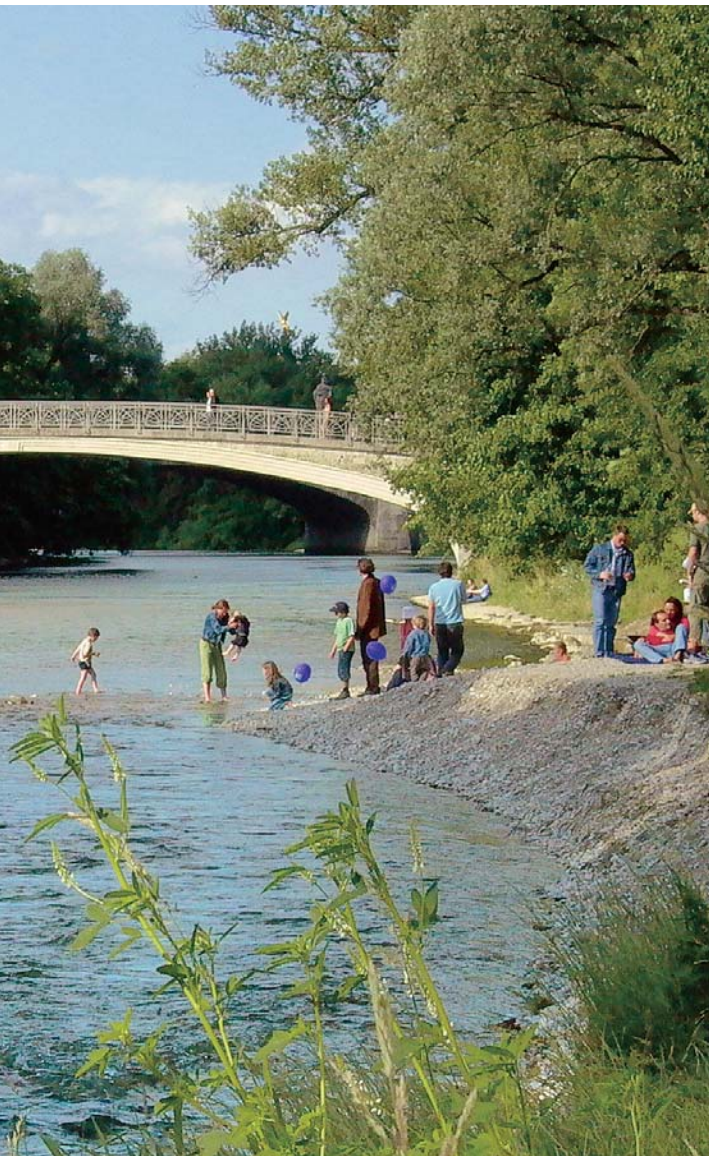
Operating and maintaining such a large wastewater treatment plant is costly. To avoid burdening the citizens unnecessarily, it is essential to work efficiently. The best way to judge this efficiency is to compare yourself with others. For this reason, the Münchner Stadtentwässerung is an active associate of the Aquabench GmbH, which is a benchmarking platform for leading water and wastewater management enterprises in Germany. Here standardised indices for all types of consumption, expenses and performances are determined and then compared with those of other plant operators. Especially favourable solutions are presented and can be adopted at other wastewater treatment plants. Practising this method regularly and consequentially guarantees a cost-efficient operation.

What Defines Clean Waters?

To what degree a water body is organically polluted, can be described by its water quality class. It is determined by the existence of indicator organisms such as bacteria, fungi or insects. This classification system uses the so-called Saprobic Index and was developed back in 1902.

After pollutant discharges into a flowing water body, biodegradation occurs step by step, until the pollutants are no longer detectable. In addition, the water quality is further impacted by feeder streams and surface runoff, so that the lower river sections are usually more contaminated than their upper reaches. The natural self-cleaning capacity of a river can also be limited by toxic substances or artificial barriers. A continuous development of treatment plant performances and the reduction of industrial and agricultural pollution have significantly improved the water body qualities in Germany. The large investments in Munich's wastewater treatment plants have paid off. The Isar River has reached the desired water quality class, which represents a flowing water body rich in dissolved oxygen and in microorganisms, insect larvae and fish.

Bathing in the middle of a metropolis: The installation of wastewater disinfection units within the project »Restoring Bathing Water Quality in the Isar River« has improved the water quality immensely.



Wastewater Treatment

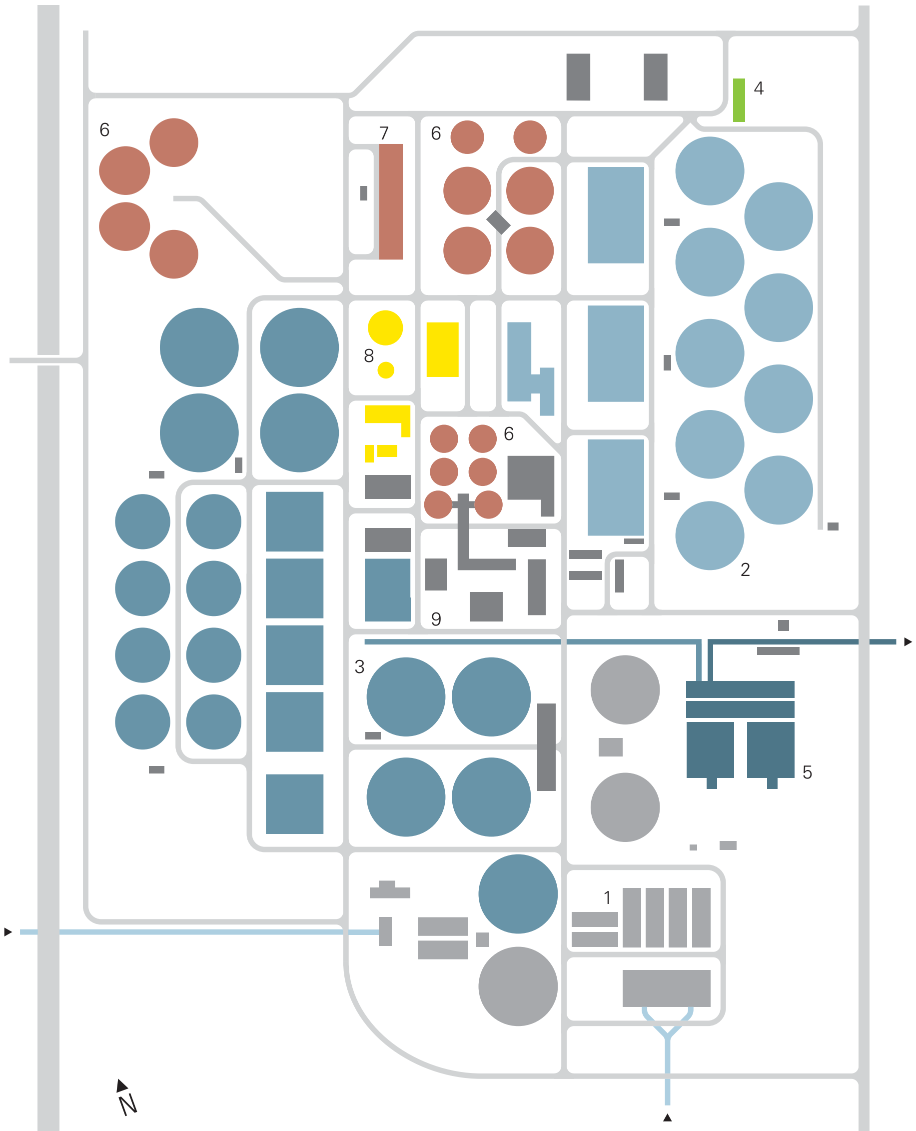
The Wastewater Treatment Plant Gut Großlappen is equipped with a mechanical and two biological treatment stages. Samples are taken systematically from all treatment stages and analysed in the plant's own laboratory.

The goal of wastewater treatment is to retain solid and dissolved pollutants. After the removal of coarse and mineral substances, carbon-, nitrogen- and phosphorus- containing compounds are degradated. The final products of the treatment processes are screenings, sand, sewage sludge and treated wastewater. Principally the self-cleaning action of natural waters are imitated, only in less time and space. Pumps, aerators, thickeners and other technical equipment increase the biological purification capacity significantly without neglecting economic aspects.
The Wastewater Treatment Plant Gut Großlappen has been designed with a mechanical and two biological treatment stages. Removing the nutrient nitrate by a unique three-step process is worth special mention.
Another special feature is the waste sludge incineration plant, which serves not only the Gut Großlappen Plant, but also the Gut Marienhof Plant.

The second biological treatment stage: The new sludge digesters (here still pictured as a simulation).

Wastewater Treatment Plant Gut Großlappen

- 1 Mechanical Treatment
- 2 Biological Treatment - First Stage
- 3 Biological Treatment - Second Stage
- 4 Phosphate Precipitation
- 5 Sand Filtration
- 6 Sludge Treatment
- 7 Sludge Incineration
- 8 Biogas Storage and Power Station
- 9 Operational and Social Buildings



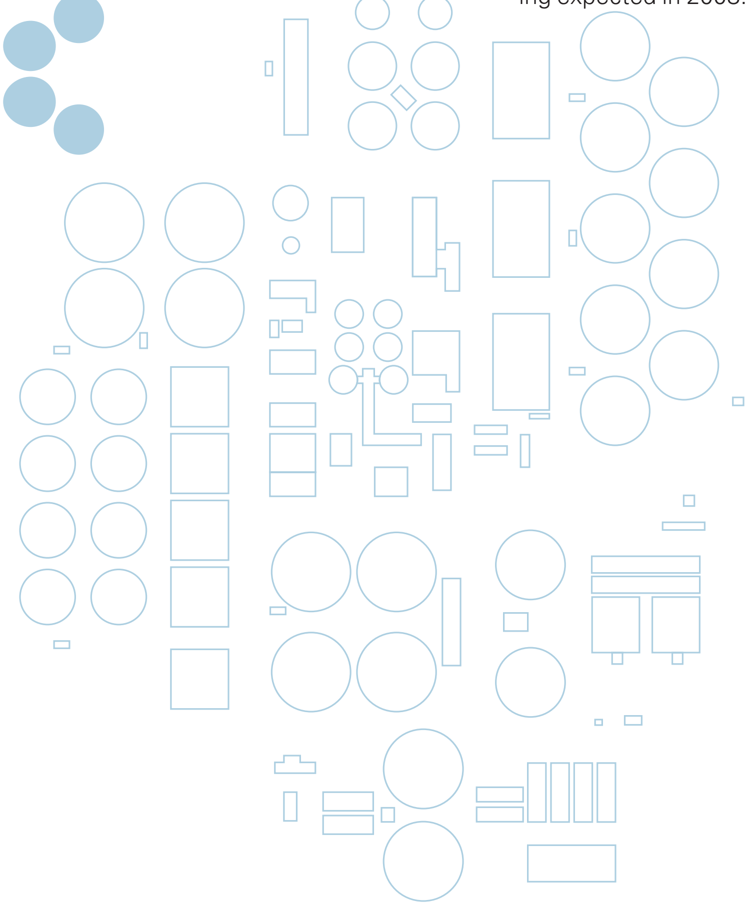
Sludge Digester Construction

Erecting the sludge digesters is a unique challenge in construction technology. In this project, four cone-shaped tanks, an operation building and a 155 metre long installation tunnel are to be realised.

When finished, the digesters will extend 31.5 metres above and 13.5 metres below ground level.

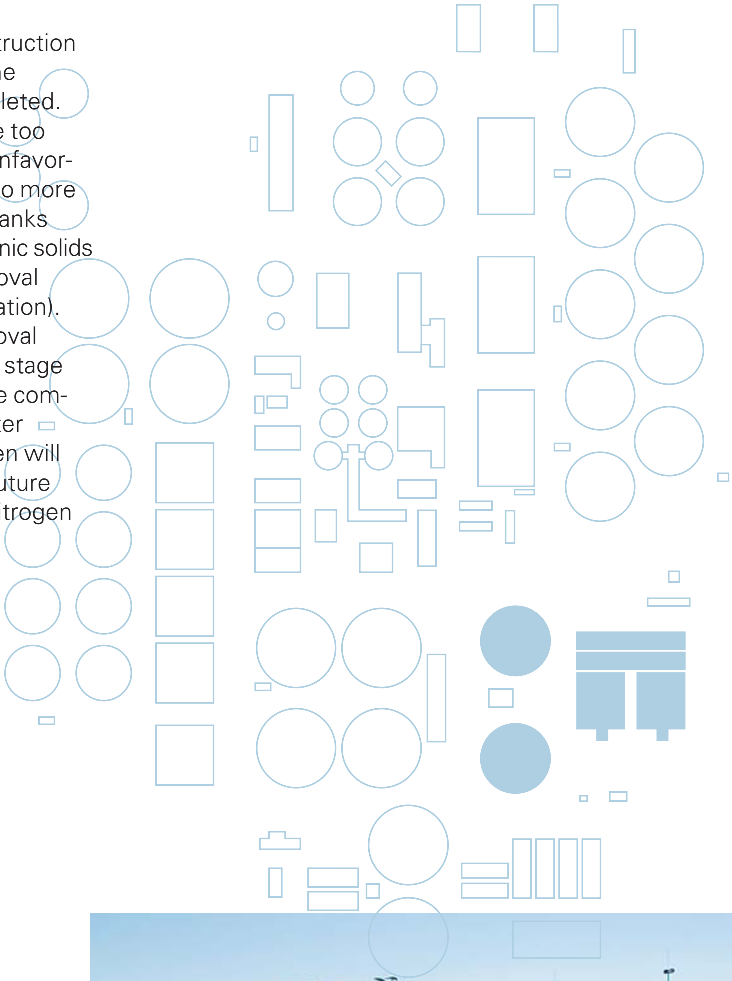
A distinguished project of the Münchner Stadtentwässerung is replacing the almost 50 year old sludge digesting units. Four cone-shaped tanks with 14 500 cubic metres of volume each are arranged in a semicircle around a stair and elevator tower. The corresponding operations building is located completely under grade and is connected to the remaining treatment plant by a 155 metre long installation tunnel. The total construction budget is estimated at 63 million Euro. This project, which stands out because of its exceptional architecture, was approved by the Munich City Council in November 2001.

An urban planning controversy during the approval phase arose due to the close proximity of the tanks to the new football stadium, in which the opening game of the 2006 World Cup was to take place. After a great deal of discussion and numerous presentations the design proposal of the Münchner Stadtentwässerung was finally confirmed by the urban planning commission. Hence construction was commenced in the spring of 2003 with commissioning expected in 2008.



Combined Denitrification and Primary Settling Tanks

In autumn of 2005, the reconstruction of the primary clarification at the eastern plant inflow was completed. As the four existing tanks were too voluminous and hydraulically unfavorable, they were replaced by two more suitable tanks. These special tanks combine the settlement of organic solids (primary settling) with the removal of dissolved nitrates (denitrification). In connection with nitrate removal in the first biological treatment stage and in the new sand filter (to be completed by 2008), the Wastewater Treatment Plant Gut Großlappen will easily be able to comply with future requirements regarding total nitrogen effluent concentrations.



These specially designed tanks combine the settlement of organic solids with the removal of dissolved nitrates.

The new sand filter consists of 24 filter cells arranged in four streams. Each cell is filled with a two metre layer of silica sand. In addition to the main filter structure, a pumping station, a metering unit and a visitor centre are also being built.

Sand Filtration

Similar to the combined denitrification and primary settling tanks, the new sand filter will also fullfill multiple functions. It retains floating residuals from the treated wastewater including adsorbed phosphorus, which would otherwise unnecessarily fertilise the receiving water. Additionally, denitrification is performed by microorganisms living in the sand by utilizing methanol, which is added to each filter cell with the treated wastewater.
This project includes a filter influent pumping station, a new plant effluent metering unit and a newly designed visitor centre with a viewing area of the outflowing treated water.

Waste Sludge Incineration

As opposed to solid waste, sewage sludge cannot be prevented. On the contrary, the more effective the wastewater treatment processes are, the more sewage sludge accumulates. After extensive studies of sludge disposal possibilities, the Münchner Stadtentwässerung constructed a sludge incineration plant at the Wastewater Treatment Plant Gut Großlappen between 1994 and 1998.
70 million Euros were invested in the project, whereas half of this was required for the very complex exhaust air treatment. This effort paid off, as the air pollutant concentrations are well below their respective federal standards.The facility incinerates sewage sludge from both of Munich's wastewater treatment plants, conveying the sludge from the Gut Marienhof Plant to the incineration facilities through a pressure pipe.

Incineration plant control room: From here the burning process of waste sludge from the two treatment plants is controlled and monitored.

The boiler room of the incineration plant. In the two boiler lines, exhaust air with 860°C from the sludge burning process heats up water-filled tubes thusly generating a high pressure steam with 400°C and 40 bars. The steam first propels a power turbine and is then used for heating the sludge driers.

The sludge incineration plant together with the completed sludge digesters (composite photo).

Waste Sludge Incineration Plant

Dewatering and Drying (2+3)

Before the digested sludge reaches the inciner-ation unit, it is required to the raise the solids content from 3 to roughly 40 percent in order to incinerate the sludge without external energy sources. To attain this, the wet sludge is preheated, dewatered in centrifuges and then desiccated in contact disc driers. The required heat is delivered by downstream heat recovery boilers.

Incineration (5)

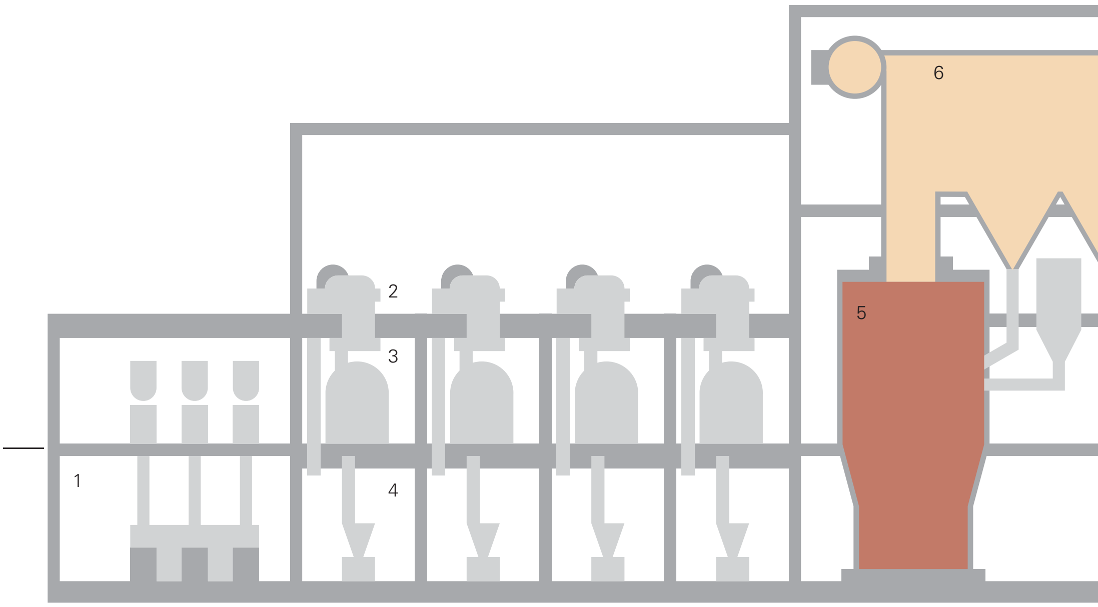
The dried sludge is then pumped into the two floating bed furnaces. Preheated fresh air is blown in to keep a bed of hot sand afloat. The sludge is thusly pulverized, enabling the remaining moisture to evaporate. With temperatures over 850°C, the organic matter combusts cleanly and completely.

Exhaust Air Treatment (6–9)

Nearly half of the plant's construction budget was spent for exhaust air treatment. The technology installed guarantees emissions well below legal limits.

Waste Sludge Incineration
Gut Großlappen

1 Flocculant Station
2 Digested Sludge Dewatering Centrifuges
3 Contact Disc Sludge Driers
4 Thickened Sludge Pumps
5 Floating Bed Furnace
6 Boilers
7 Electrostatic Filters
8 Fabric Filters
9 Exhaust Air Washers
10 Suction Unit
11 Chimney
12 Adsorbent Silo
13 Lime Silo



Steam and Power Generation (6)

In the heat recovery boilers, combustion gases generate steam which propels a power turbine, providing a portion of the plant´s electrical energy demand. Then the steam heats up iron contact discs in the driers to further dewater the sludge.

Dust Removal in the Electrostatic Filter (7)

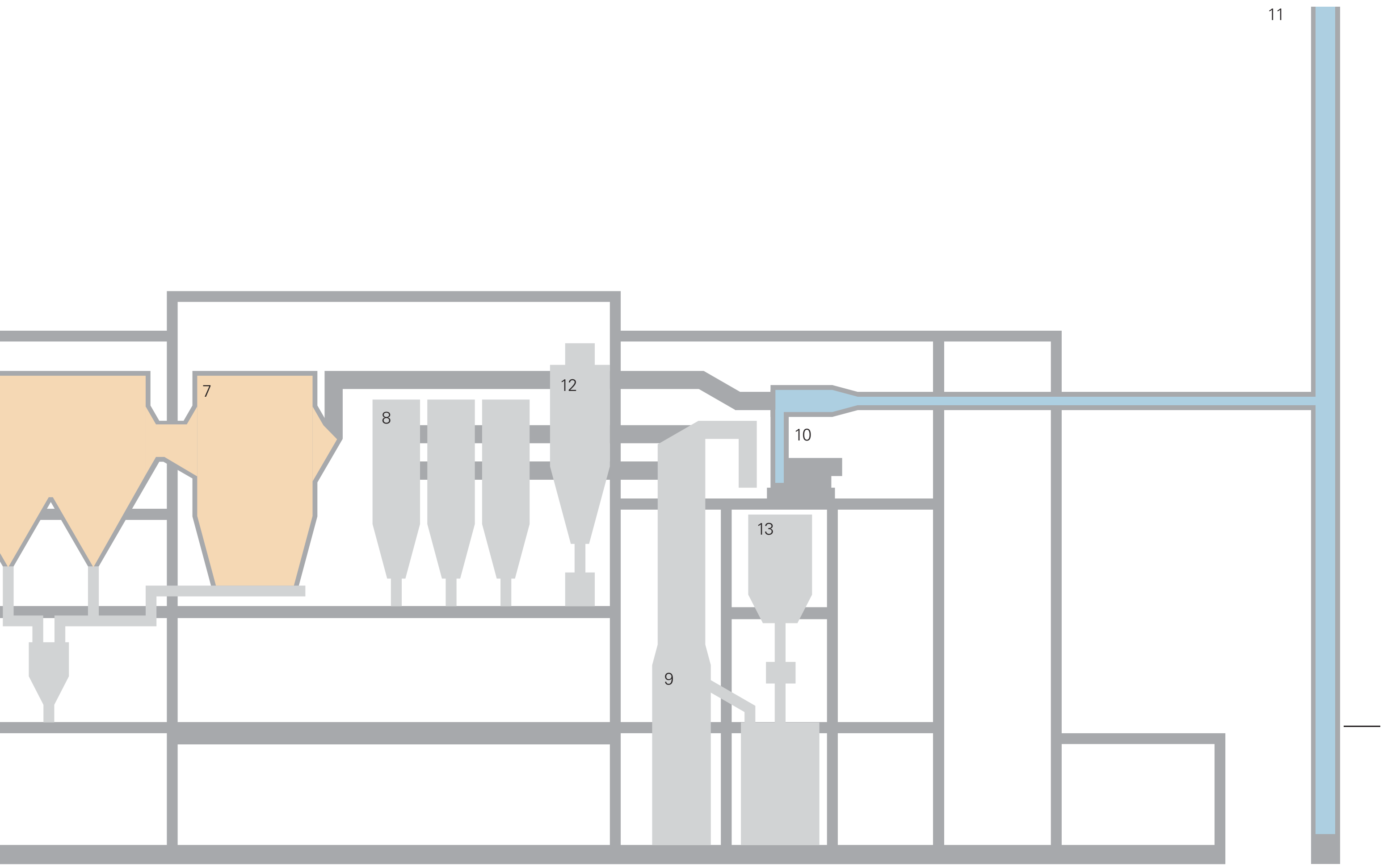
Electrostatic attraction removes most of the ashes from the exhaust air. Up to 15 000 tons of mineral ashes need to be disposed of annually.

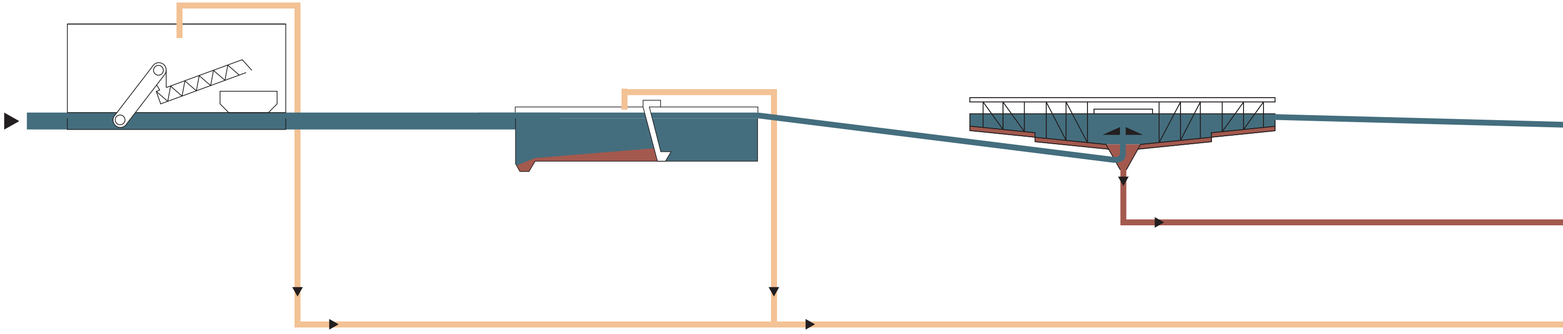
Dry Exhaust Air Purification in the Fabric Filter (8)

Lime and activated carbon are added to the cooled exhaust air, which absorbs pollutants, particularly heavy metals and chlorides. Residual pollutants are retained in a downstream fabric filter.
Every year 450 tons of heavily contaminated lime-carbon-mixture have to be properly disposed of in underground waste sites.

Wet Exhaust Air Purification (9)

In the next step, the exhaust air is cleaned in a two-stage purification process. Gaseous sulphur dioxide initially reacts with water and then with added limestone to form pure gypsum. Annually 1 000 tons are produced, which are used by construction industry. In a last step the exhaust air is cooled down and fed through a wet electrostatic filter, which removes the remaining trace pollutants and moisture. Finally, it needs to be warmed up by a heat exchanger in order to escape into the atmosphere.





Mechanical Treatment

Screening Building

Wastewater arrives at the plant via an eastern and a western collector. In the eastern inflow, coarse matter is removed in four parallel lines, each equipped with a filter band screen with 6 mm holes. The western plant inflow, which normally serves as a backup system, is equipped with 50 mm and 20 mm spaced bar screens. Annually, approximately 4 000 tons of screenings are removed and properly disposed.

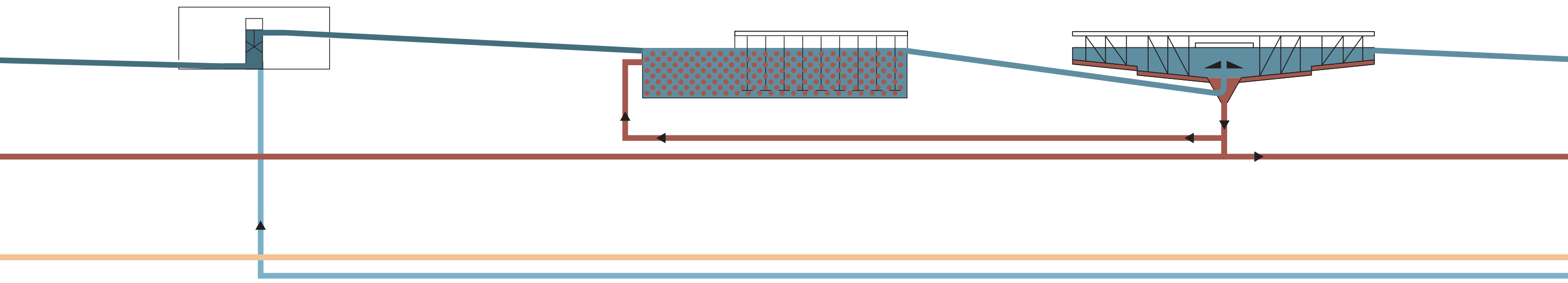
Aerated Grit Chambers

The flow rate is reduced in the grit chambers allowing sand to settle, which would otherwise disturb plant operation. The settled material is pushed into hoppers with scraper shields. Air-lift pumps take out more than 550 tons of mineral substances annually, which are also properly disposed.
Floating grease and oil are also removed here in parallel separation chambers.

Primary Sedimentation Tank

In these round tanks most of the suspended organic solids are removed by gravity by further flow speed reduction. The so-called primary sludge is scraped into a centre hopper and pumped to the sludge treatment stages.
The two eastern primary sedimentation tanks, each measuring 53 metres in diameter, can also convert dissolved nitrates into gaseous nitrogen by recirculation. The units were thusly named combined denitrification and primary settling tanks.

Flow Chart of the Wastewater Treatment Plant



Biological Treatment, First Stage

Wastewater Pumping Station I

Six propeller pumps, each with a capacity of 3.3 cubic metres per second and 160 kilowatt power requirement, lift the wastewater to the first biological stage.

Activated Sludge Tank I

The two biological stages are the most important part in the wastewater treatment process. Principally, they imitate the natural self-cleaning process of natural waters, only in less time and space.

In these tanks bacteria and other microorganisms feed on suspended and dissolved organic pollutants. This process requires a permanent supply of oxygen provided by intense aeration. In order to maintain a high biomass concentration, the activated sludge must be recirculated, hence the name return sludge.

A total of 27 lines serve for the degradation of carbon compounds (fats, proteins and carbohydrates). Finely dispersed air is provided through special ceramic aeration tubes at the bottom of the tanks and is constantly controlled by online oxygen metres.
There is no aeration in the influent area of the tanks, as the chemically-bound oxygen in the nitrates is used for bacteria respiration instead. The remaining nitrogen becomes gaseous and escapes into the atmosphere. This process is called denitrification.

Intermediate Sedimentation Tank

Since the activated sludge is heavier than water, it settles in the slowly moving water of these tanks. As in primary sedimentation, the activated sludge is collected in a centre hopper, but most of this secondary sludge it is pumped back into the aerated tanks. The surplus sludge is removed and transported to further treatment stages.

Technical Specifications

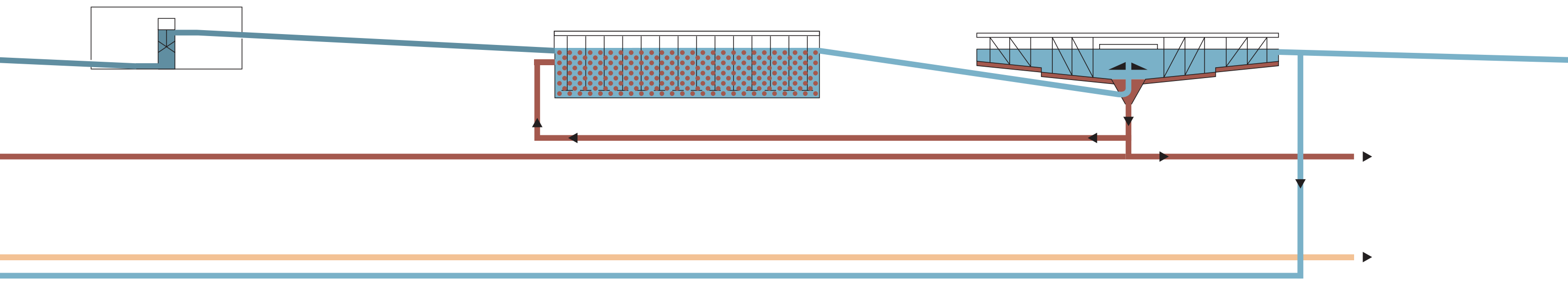
Treatment Plant Capacity
2 000 000 PE*

Maximum Dry Weather Influent
6.6 cubic metres per second
Maximum Combined Sewer Influent
10.0 cubic metres per second

Average Wastewater Retention Time
in the Plant during Dry Weather
17 hours

* PE (population equivalent)

is a parameter for designing wastewater treatment installations. Each living inhabitant is represented by 1 PE, which corresponds to 60 g of BOD per day. BOD (biological oxygen demand) is a cumulative parameter for biologically degradable organic pollution. Population equivalents are also used to quantify commercial and industrial organic water pollution.



Biological Treatment, Second Stage

Wastewater Pumping Station II

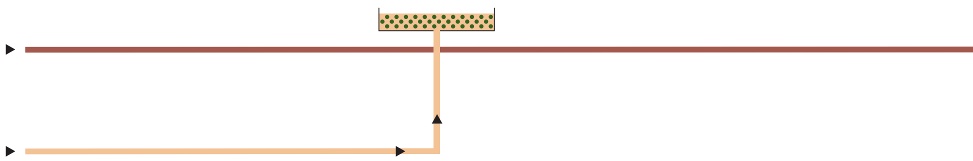
Six propeller pumps lift the wastewater four metres, enabling it to flow through the second biological stage by gravity.

Aerated Sludge Tank II

Here specialised nitrifying bacteria oxidate the ammonia in the wastewater to form nitrates. This takes place in 10 tanks arranged in parallel lines, which are technically equipped similarly to the first biological stage. Since these nitrifiers grow more slowly, they have to be kept separate from the organisms of the first biological stage.

Final Sedimentation Tank

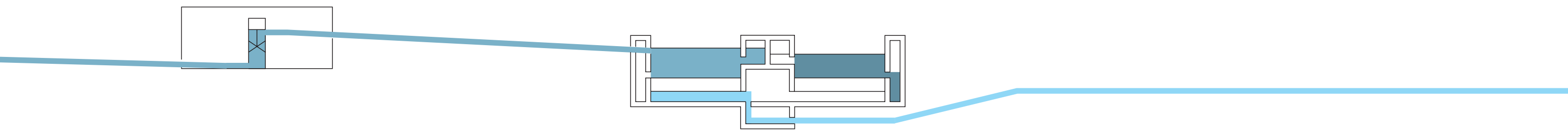
To improve the plant´s treatment efficiency, phosphorus is removed by adding aluminium and iron salt solutions. They form floc-like compounds, which settle to the tank bottom and can then be removed with the waste sludge.
A portion of the clear tank effluent, which contains dissolved nitrates, is recirculated to the first biological stage so that the nitrates can be converted to gaseous nitrogen in the influent zone.



Exhaust Air Treatment

Odour Elimination

At certain treatment stages unpleasant odours may be emitted, which are collected by encapsulation and air extraction units. The odours are removed by blowing them through specially designed biofilters, where they are degradated by microorganisms.



Filtration

Wastewater Pumping Station III (to be commissioned in 2008)

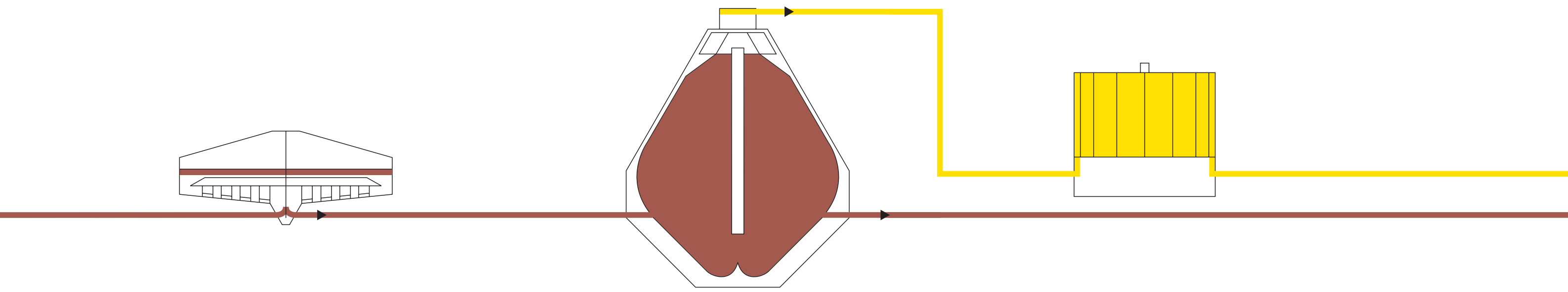
In order for the new sand filter to operate, the treated wastewater must be lifted 3.5 metres by another set of six propeller pumps, each having a capacity of 2 cubic metres per second.

Sand Filter (to be commissioned in 2008)

After passing through both biological treatment stages, most of the organic substances have been converted to solids. Most of them have been removed by the sedimentation tanks, but some of the very fine material still remains suspended. Therefore, the treated wastewater must pass through 24 filter cells, each consisting of a 2 metre thick silica sand bed. Additionally, denitrifying bacteria living in the sand feed on externally added methanol, simultaneously converting nitrates to gaseous nitrogen.

Nitrogen Removal

In the second biological stage nitrates are formed from ammonia (nitrification). If left untreated, these nitrates enhance eutrophication in the receiving waters. Because of this, the nitrates are converted to gaseous nitrogen (denitrification). Through removal in the combined denitrification and primary settling tanks, the first biological stage and the sand filter, nitrate discharge into the Isar River is reduced to a minimum.



Sludge Treatment

Sludge Thickener

The sludge coming from primary sedimentation and biological treatment stages contains only 0.5 to 1 percent solids; the rest being water. In order to reduce the volume for the following digestion stage, it is thickened by gravity here. The four covered thickener tanks, each having a volume of 2 500 cubic metres, increase the solids content to 6 percent, which in turn reduces the volume by 90 percent. The excess water is routed back into the biological treatment process.

Digestion Tank

In the digestion tanks the previously thickened waste sludge ferments in absence of oxygen for approximately 20 days at 38 °C, hereby producing 1 600 cubic metres of methan-containing, combustible biogas per hour.
Presently, this takes place in 6 egg-shaped tanks, each with a volume of 6 500 cubic metres, a height of 37 metres and a diameter of 21 metres. According to plan, the new digester facility goes into operation in 2008, which consists of 4 cone-shaped tanks with a volume of 14 500 cubic metres each.

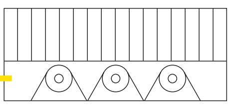
Biogas Storage

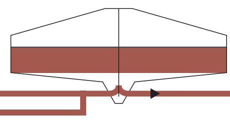
After purification the biogas is temporarily stored in a membrane bladder with a volume of 5 000 cubic metres, which is weighted down to keep the gas permanently under pressure.

Discharge into the Isar River Canal

Effluent Discharge

The treated effluent leaves the plant to enter the Isar River Canal and is later introduced into the natural Isar River east of the City of Moosburg.





Power Generation

In a centralised power station, the biogas is utilized for 5 Gas-Otto Engines, which run electrical generators rated at 1600 kilowatts each. Approximately one half of the Gut Großlappen Plant's electricity demands are met through this source. The waste heat of the engines' cooling system is utilised for pre-warming the digester sludge, heating the digester itself as well as other operation buildings in the plant.

Sludge Storage

The digested sludge is stored intermediately in two covered tanks with a total volume of 6400 cubic metres.
Digested sludge from the Gut Marienhof Plant is also added here, which has been pumped through a 13 kilometre long pressure main.
This pipe is kept free of deposits by periodical »pigging«. The »pig« is an elastic body with steel brushes that fits tightly into the pipe and is pumped together with the sludge.

Plant Operation and Supervision

Personnel
Approximately 190 persons are employed at the Wastewater Treatment Plant Gut Großlappen, of which 50 work in shifts.The different operational challenges in the plant require a staff having a broad variety of backgrounds, ranging from labourers, craftsmen and clerks to engineers. They are all needed to ensure smooth plant operation 24 hours a day and 365 days a year.

Process Control
The treatment plant is controlled by a central process control system in connection with numerous subsystems, online instruments and measurement transmitters. Experienced employees supervise the processes in the central control room around the clock.

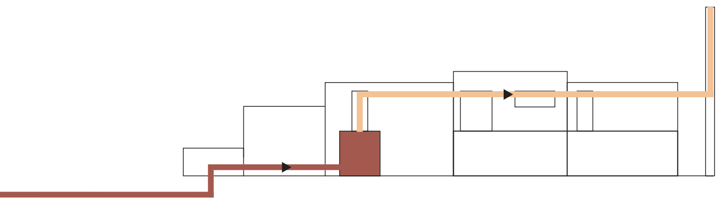
Laboratory
Samples are taken regularly from every process stage and analysed at the in-house laboratory, thus allowing a continuous surveillance of the plant's performance. The treated effluent is also monitored continuously for all relevant parameters using online equipment. This is conducted in close cooperation with the supervising authorities.

Service Water

Instead of wasting valuable drinking water for cleaning and cooling purposes, filtered and disinfected water from the plant effluent is used.

Compressed Air Production

In two separate machine buildings turbo compressors, which work according to the jet engine principle, produce pressurized air for the two biological treatment stages. In total there are 9 aggregates, each requiring 1.6 megawatts electrical power to deliver beteween 65 000 and 80 000 cubic metres of compressed air per hour.



Exhaust Air
Wastewater Flow
Sludge Flow
Biogas

Sewage Sludge Disposal

Sewage Sludge Incineration Plant

As opposed to solid waste, sewage sludge cannot be prevented.
Approximately 22 000 net tons of sewage sludge from both plants are thermally utilized in the incineration plant annually.

Techncal Specifications

Plant Size

Design Capacity		2 000 000 Population Equivalents
Design Influent Quantity	Dry Weather Combined Flow	6.6 m^3/s 10.0 m^3/s

Measured Values 2004

Influent Quantity (85%-Percentile)	Dry Weather	3.63 m^3/s
Concentrations (Annual Averages)		
Raw Water Influent	BOD COD Suspended Solids NH4-N Total-N Total-P	183 mg/l 381 mg/l 182 mg/l 28 mg/l 40 mg/l 6.4 mg/l
Plant Effluent	BOD COD Suspended Solids NH4-N Total-N Total-P	4 mg/l 29 mg/l 6 mg/l 0.1 mg/l 19 mg/l 0.8 mg/l
Annual Loads	Influent BOD Effluent BOD	18 756 t/a 415 t/a
Required Legal Limits (4 out of 5 flow-proportional, homogenized samples over a 2-hour period)	BOD COD Suspended Solids NH4-N Total-N Total-P	15 mg/l 50 mg/l 15 mg/l 5 mg/l 21 mg/l (May – October) 1.0 mg/l

Mechanical Treatment Stage

Eastern Inflow **Screen System**		4 Filter Band Screens with 6 mm Holes
Grit Chamber		8 Aerated Chambers
Primary Sedimentation	Total Volume Total Surface	2 Round Tanks 53 m in Diameter V = 12 500 m^3 A = 4 400 m^2
	Dry Weather Retention Time (Design)	0.75 h
Western Inflow **Screen System**		2 Coarse Screens with 50 mm Bar Spacing 2 Fine Screens with 20 mm Bar Spacing
Grit Chamber		4 Aerated Chambers
Primary Sedimentation	Total Volume Total Surface	2 Round Tanks, 61 m in Diameter V = 15 600 m^3 A = 5 842 m^2
	Dry Weather Retention Time (Design)	0.87 h

1st Biological Treatment Stage

Intermediate Pumping Station I		6 Propeller Pumps with 3.3 m^3/s each
Activated Sludge Tanks		3 Rectangular Tanks with 9 Cascades each (Partial Upstream Denitrification, Fine-Bubble Aeration)
	Total Volume	V = 39 000 m^3
	Dry Weather Design Values: Volume Load Sludge Load BOD Reduction	 1.2 kg BOD/m^3 per day 0.42 kg BOD/kg per day 66%
Intermediate Sedimentation	Total Volume Total Surface	9 Round Tanks, 53 m in Diameter V = 93 600 m^3 A = 19 500 m^2

2nd Biological Treatment Stage

Intermediate Pumping Station II		2 Propeller Pumps with 2.5 m³/s each 4 Propeller Pumps with 2.0 m³/s each
Activated Sludge Tanks		10 Rectangular Tanks with 3 Cascades each (Fine-Bubble Aeration)
	Total Volume	V = 47 100 m³
	Dry Weather Design Values: Volume Load	 0.13 kg BOD/m³ per day 0.22 kg NH4-N/m³ per day
	Sludge Load	0.041 kg BOD/kg per day 0.049 kg NH4-N/kg per day
Final Sedimentation	 Total Volume Total Surface	15 Round Tanks 42/61 m in Diameter V = 100 200 m³ A = 31 200 m²

Advanced Treatment

Intermediate Pumping Station III (under Construction)		6 Propeller Pumps with 2.0 m³/s each
Sand Filter (under Construction)	 Total Surface	24 Downward Flow Filter Cells (Partial Denitrification) A = 2 000 m²

Technical Installations

Machine Building 1	Pressurised Air Production	4 Turbo Blowers 80 000 Nm³/h each
Machine Building 2	Pressurised Air Production	5 Turbo Blowers 80 000 Nm³/h each
Energy Control Unit	Power Generation	5 Gas-Otto Engines 1.6 MW Electrical Power each
Service Water Plant	Filtration and Disinfection of Treated Plant Effluent	1 200 m³/h Peak Flow

Sludge Treatment

Primary and Final Sludge Thickeners	 Total Volume	4 Covered Round Tanks V = 16 800 m³
Existing Anaerobic Digesters	Total Volume Retention Time	6 Closed Conical Tanks V = 39 000 m³ Approx. 15 Days
Anaerobic Digesters (under Construction)	Total Volume Retention Time	4 Closed Conical Tanks V = 58 000 m³ Approx. 20 Days
Biogas Storage Tank	Total Volume	Cylinder Shaped V = 5 000 m³
Digested Sludge Storage Tanks	Total Volume	2 Covered Round Tanks V = 6 400 m³

Sludge Discharge

Waste Sludge Incineration	Dewatering	4 Centrifuges with 50 m³/h followed by 4 Disc Dryers
	Incineration	2 Floating Bed Furnaces with 3 t/h Dried Solids each
	Steam Turbine	1.15 MW Power Generation
Thermal Power Plant Munich Nord	Dewatering	3 Centrifuges with 70 m³/h
	Incineration	Together with Solid Waste (2 Units with 3 t/h and 1 Unit with 6 t/h Dried Solids)

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