



“NETWORK OF DANUBE WATERWAY ADMINISTRATIONS”
South-East European Transnational Cooperation Programme

**STATUS QUO REPORT ON WATERWAY MAINTENANCE
AUSTRIA**

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TABLE OF CONTENTS

1	LIST OF ABBREVIATIONS	3
2	SCOPE OF DOCUMENT.....	4
3	INTRODUCTION	5
3.1.	Responsibility for waterway administration, Institutions – manage the navigation conditions.....	5
3.1.1.	via donau – Österreichische Wasserstraße-Gesellschaft mbH.....	5
3.1.2.	Supreme Navigation Authority (“Oberste Schifffahrtsbehörde” – OSB)	6
3.1.3.	Navigation Surveillance	6
3.1.4.	VERBUND-Austrian Hydro Power AG (AHP)	6
3.1.5.	Private ports	7
4	CHARACTERISTIC OF WATERWAY	8
5	WATERWAY MAINTENANCE	11
5.1.	Main activities for waterway maintenance – hydrology, survey, signalization	11
5.1.1.	General information about Hydrology	11
5.1.2.	General information about river bed measurements	12
5.1.3.	Bottlenecks	13
5.1.4.	Signalization.....	15
5.2.	Report for river engineering constructions and execution	16
5.3.	Common sector, waterway maintenance	17
5.4.	Waterway maintenance in the ice period.....	18
5.5.	Waterway maintenance in the lowest level period	18
5.6.	Waterway maintenance in the highest level period	18
5.7.	Report about the prevention and restoration of flood damages	18
5.8.	Planning for lock maintenance and repairing	19
6	APPENDIX.....	20

1 LIST OF ABBREVIATIONS

ABBR.	Abbreviation
ADCP	Acoustic Doppler Current Profiler
AGN	European Agreement on Main Inland Waterways of International Importance
AHP	Austrian Hydro Power AG
AWL	Average Water Level
BC	Bottleneck capacity
DGPS	Differential Global Positioning System
DoRIS	Danube River Information Services
ECDIS	Electronic Chart Display and Information System
FGP	Integrated River Engineering Project on the Danube to the East of Vienna
GPS	Global Positioning System
GWh	Gigawatt-hour (= 1 million kilowatt-hours)
KV	Kilovolt
KWD 96	Significant water levels of the Danube 1996
LNWL	Low navigable water level
HNWL	Highest navigable water level
HWL	Highest water level
MW	Megawatt (= 1.000 kilowatts)
OSB	Oberste Schifffahrtsbehörde – Supreme Navigation Authority
RIS	River Information Services
TEN-T	Trans-European Transport network
UN/ECE	United Nations Economic Commission for Europe
VHF	Very high frequency

2 SCOPE OF DOCUMENT

Infrastructure is a fundamental element of the inland navigation system. The Austrian status quo report gives in three chapters an overview about the Austrian part of the Danube.

In the introducing chapter is the responsibility for the waterway administration described with an overview about the relevant institutions who manage the navigation conditions.

The second chapter of interest characterizes the Austrian waterway regarding e.g. locks, transported sediment, waterway parameters and water levels.

The main part of the report is described under the chapter waterway maintenance. Within this part information about hydrology, river bed measurements, bottlenecks, signalization, report for river engineering constructions and execution, common sector with Slovakia and Germany, waterway maintenance in the ice, lowest level and highest level period, a report about the prevention and restoration of flood damages and information about the planning for lock maintenance and repairing.

3 INTRODUCTION

3.1. Responsibility for waterway administration, Institutions – manage the navigation conditions

The Danube has its source in Germany and flows through a total of ten countries. On the right bank from River km 2223.15 till km 1872.70 and on the left bank from River km 1880.2 till River km 2201.7 the Danube crosses Austrian territory. In this part, including the mouth of the river Traun (1.7 km), the river Enns (2.5 km) and the river March (6.0 km), following institutions have responsibilities in waterway administration and maintenance:

3.1.1. *via donau – Österreichische Wasserstraßen-Gesellschaft mbH*

The purpose of *via donau – Österreichische Wasserstraßen-Gesellschaft mbH* is to meet the Austrian federal government's responsibilities pertaining to waterways, and in particular to carry out the responsibilities of federal waterway administration. The Federal Ministry for Transport, Innovation and Technology remains the competent authority for strategic planning, monitoring and supervising federal waterway administration. *Via donau* has been entrusted with carrying out the following responsibilities and rendering the following services:

- Regulating, maintaining and developing waterways
- Flood protection
- Protection of waters, monitoring the status of waters
- Hydrology, hydrography, measurement
- Strategic planning, construction and maintenance of towpaths
- Construction and maintenance of federal ports and site stages
- Management of waters and plots of land in public ownership and of movable and immovable assets of the federal government
- Federal agendas pursuant to the Federal Act on Creating a Danube Flood Control Agency (DHK)
- Landscaping and up keeping of riverbanks, improving the habitat for animal and plant life
- Ensures compliance with international commitments on Austria's waterways (e.g. TEN Trans-European Network and Transboundary Water Commission)
- Tasks according to the Hydraulic Engineering Assistance Act
- Responsibilities in Developing Inland Navigation
- Operating the navigation information systems (RIS-River Information Services, DoRIS, ECDIS)
- Sovereign lock management duties
- Sovereign weir management duties
- Sovereign waterway management duties

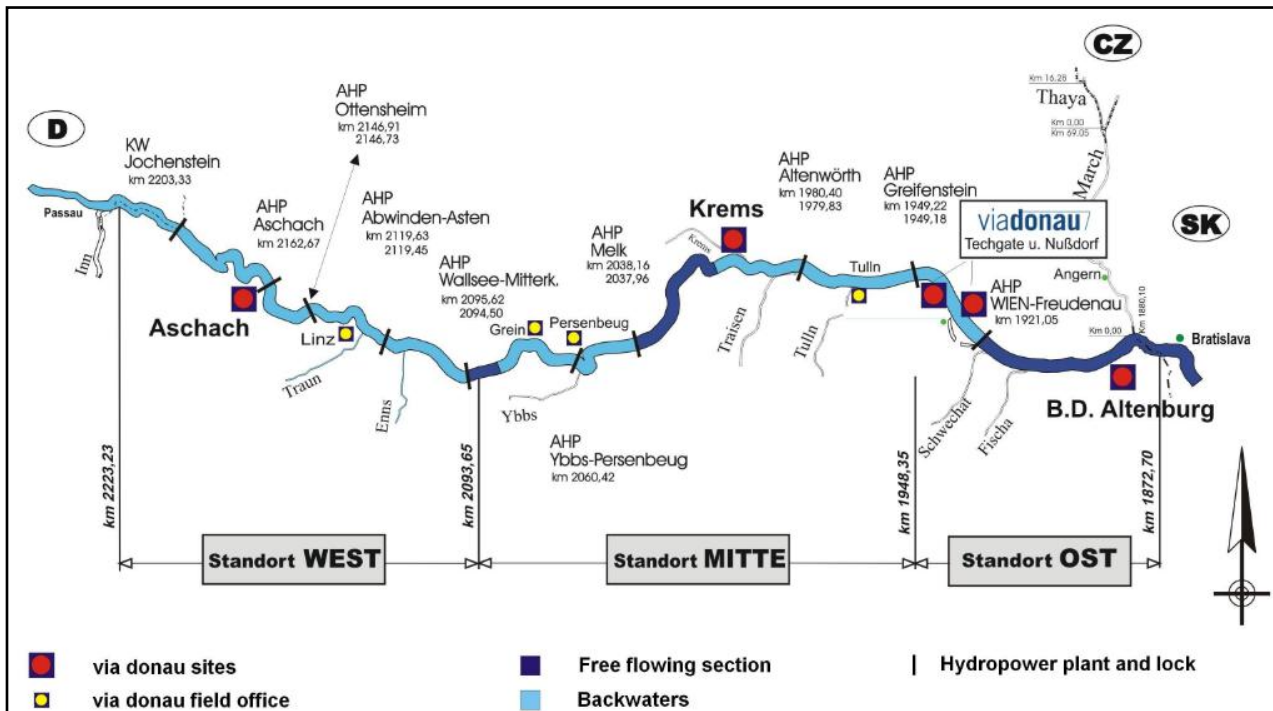


Figure 1: Overview about the Austrian part of the Danube

Via donau has its Headquarter in Vienna and three main sites along the Danube (Figure 1).

3.1.2. Supreme Navigation Authority (“Oberste Schifffahrtsbehörde” – OSB)

The Supreme Navigation Authority is the competent body for general, legal and international matters involving inland waterway transport in Austria, provided that these matters concern the surveillance and technology of inland waterway transport or nautical issues. The OSB is responsible for shipping facilities, shipping licences, gauging of ships, ship’s certificates, ship operations, navigation schools, surveilling inland waterway transport on the waterways (regulating traffic, setting up and operating navigation signal systems, buoys) and overseeing traffic telematics systems (River Information Services – RIS). By law, the OSB is also involved in waterway engineering, regulation and maintenance.

3.1.3. Navigation Surveillance

The Navigation Surveillance is an authority responsible for nautical matters and is subordinate to the Federal Ministry for Transport, Innovation and Technology. It ensures the uniform administration of the international waterway for the purpose of the Danube Convention. Its responsibilities primarily involve:

- Supervising compliance with all of the administrative provisions regarding inland waterway transport,
- Issuing instructions to those using the waterway,
- Regulating inland waterway transport, including monitoring the fairway and the use of the locks on the Danube

3.1.4. VERBUND-Austrian Hydro Power AG (AHP)

AHP operates and maintains the nine run-of-river power plants at the river area Danube. Furthermore, they are responsible for the lock and backwater maintenance. Following table shows basic data about the mentioned power plants.

Facility	River km	BC MW	SC GWh
Aschach	2162.67	287.4	1,617.4
Ottensheim	2146.91	179.0	1,134.9
Abwinden	2119.63	168.0	995.7
Wallsee	2095.62	210.0	1,318.8
Persenbeug	2060.42	236.5	1,335.9
Melk	2037.96	187.0	1,221.6
Altenwörth	1980.40	328.0	1,967.6
Greifenstein	1949.23	293.0	1,717.3
Freundenau	1921.05	172.0	1,052.0

BC Bottleneck capacity
SC Standard capacity (average annual output from natural inflows)
MW Megawatt (= 1,000 kilowatts)
GWh Gigawatt-hour (= 1 million kilowatt-hours)

Table 1: basic data about power plants on the Danube (source: AHP)

3.1.5. Private ports

Furthermore there are several private ports and port operators that are responsible for their area.

4 CHARACTERISTIC OF WATERWAY

There is a 21 km border section with Germany (rkm 2223,150 – 2201,770) and a 7.5 km border section with Slovakia (rkm 1880,260 – 1872,700) and the remaining 321.51 km (rkm 2201,770 – 1880,260) is the national section.

To characterize the Austrian part of the Danube the following data is needed:

Length	350 km
Width	about 300 m
Amount of power stations, locks, backwaters	10 (including lock Nußdorf)
Free flowing sections	Wachau km 2038 till km 1998 (=total of 40 km) East of Vienna – km 1921 till km 1873 (=total of 48 km)
Amount of fords / shallow sections	35

The table shows that there are 9 power stations with the corresponding locks and backwaters and 35 fords / shallow sections along the Austrian part of the Danube. The nine power stations (Figure 1) are located on the main stream, the lock Nußdorf on the Danube canal. The hydropower plant Jochenstein is within the border section to Germany and 50% belongs to VERBUND - Austrian Hydro Power AG and 50% to Rhein-Main-Donau AG in Germany.

There are only two free flowing sections left on the Austrian stretch of the Danube River.

Regarding the locks they can be divided in following groups regarding the geographic position (see also Figure 1 and Chapter 5.8):

- Locks group East (Freudenau, Greifenstein, Altenwörth)
- Locks group Middle (Melk, Persenbeug, Wallsee)
- Locks group West (Abwinden, Aschach, Ottensheim)
- Lock Nußdorf (Danube canal)

In terms of relevant sediments in the Austrian part of the Danube it is necessary to divide the Danube into following sections:

	Dominating transport	Material and diameter
Free-flowing sections	Bed load transport	Gravel (0 – 120 mm)
Backwater sections	Suspended load	Clay (21 – 31%), Silt (65 – 73%), Sand (2 – 7 %)

Regarding the waterway parameters for the Austrian Danube the Danube Commission recommends following parameters:

Depth recommendation (at LNWL)

In backwaters	27 dm gravel, 28 dm rock
Wachau (km 2038 till km 1998)	20 dm gravel, 21 dm rock
East of Vienna (km 1921 till km 1873)	25 dm gravel

Width recommendation

Mouth of Inn to Vienna (km 2225.32 till km 1920.30)	Free flowing	120 m
	Backwater	150 m

Vienna till Devin (km 1920.30 till km 1880.26)	Rock ground	75 m
	Gravel	120 m

Curvature recommendation

Jochenstein – Krems (km 2203.33 till km 2001.00)	Free flowing	350 m
	Backwater	350 m
Krems – Vienna (km 2001.00 till km 1920.30)	Free flowing	800 m
	Backwater	900 m
Vienna – Devin (km 1920.30 till km 1880.26)	Free flowing	800 m
	Backwater	1000 m

Headroom under Bridges

Upstream km 1920.30	8 m at HNWL
Downstream km 1920.30	10 m at HNWL

Headroom under power lines

16, 5 m at HNWL	
Up to 110 KV =	19 m at HNWL
Over 110 KV =	19 m + 1cm/KV at HNWL

To give an example the following table shows the water levels that are set in Vienna:

Facility	Danube	Danube canal	Total
Regulated low water level	830 m ³ /s	70 m ³ /s	900 m ³ /s
Average water level	1.700 m ³ /s	190 m ³ /s	1.890 m ³ /s
Highest navigable water level (HNWL)	5.070 m ³ /s	200 m ³ /s	5.270 m ³ /s
100 year flow	-	-	10,400 m ³ /s

Table 2: Water levels in Vienna (source: via donau)

Further relevant waterway parameters for the Danube are laid down in the AGN – the ‘European Agreement on Main Inland Waterways of International Importance’. The AGN has been published by the United Nations Economic Commission for Europe (UN/ECE) in 1996 and is periodically revised (last time in 2008). The AGN classified the Austrian stretch of the Danube as international waterway class VIb, following table gives an overview of the AGN waterway parameters:

















Type of inland waterway	Classes of navigable waterways	Motor vessels and barges					Pushed convoys					Minimum height under bridges ²	Graphical symbols on maps
		Type of vessel: General characteristics					Type of convoy: General characteristics						
		Designation	Maximum length L (m)	Maximum beam B (m)	Draught ² d (m)	Tonnage T (t)		Length L (m)	Beam B (m)	Draught ² d (m)	Tonnage T (t)		
1	2	3	4	5	6	7	8	9	10	11	12	13	14
OF INTERNATIONAL IMPORTANCE	IV	Johann Welker	80-85	9.5	2.50	1,000-1,500		85	9.5 ²	2.50-2.80	1,250-1,450	5.25 or 7.00 ²	
	Va	Large Rhine vessels	95-110	11.4	2.50-2.80	1,500-3,000		95-110 ²	11.4	2.50-4.50	1,600-3,000	5.25 or 7.00 or 9.10 ²	
	Vb							172-185 ²	11.4	2.50-4.50	3,200-6,000		
	Vla							95-110 ²	22.8	2.50-4.50	3,200-6,000	7.00 or 9.10 ²	
	Vlb	²	140	15.0	3.90			185-195 ²	22.8	2.50-4.50	6,400-12,000	7.00 or 9.10 ²	
	Vlc							270-280 ²	22.8	2.50-4.50	9,600-18,000	9.10 ²	
	Vlc							195-200 ²	33.0-34.2 ²	2.50-4.50	9,600-18,000		
VII								275-285 ²	33.0-34.2 ²	2.50-4.50	14,500-27,000	9.10 ²	

Table 3: Classification of European inland waterways of international importance

The AGN recommends for the Austrian Danube stretch a minimum draught of 2.5 meters on a minimum of 300 days per year.

5 WATERWAY MAINTENANCE

5.1. Main activities for waterway maintenance – hydrology, survey, signalization

5.1.1. General information about Hydrology

To describe the Hydrology it is essential to collect various parameters. The following table shows the number of monitoring stations and the unit of each parameter measured.

Measurement facilities:

Surface waters:

Parameter	number of monitoring stations
Water level [m.ü.A.]	70
Water temperature [°C]	20
Content of suspended matter [mg/l]	3
Additional: flexible discharge measurement devices [m ³ /s] (turbine meters and ADCP)	

Groundwater:

Parameter	number of monitoring stations
Groundwater level [m.ü.A.]	60
Groundwater temperature [°C]	20
Conductivity [µS/cm]	17

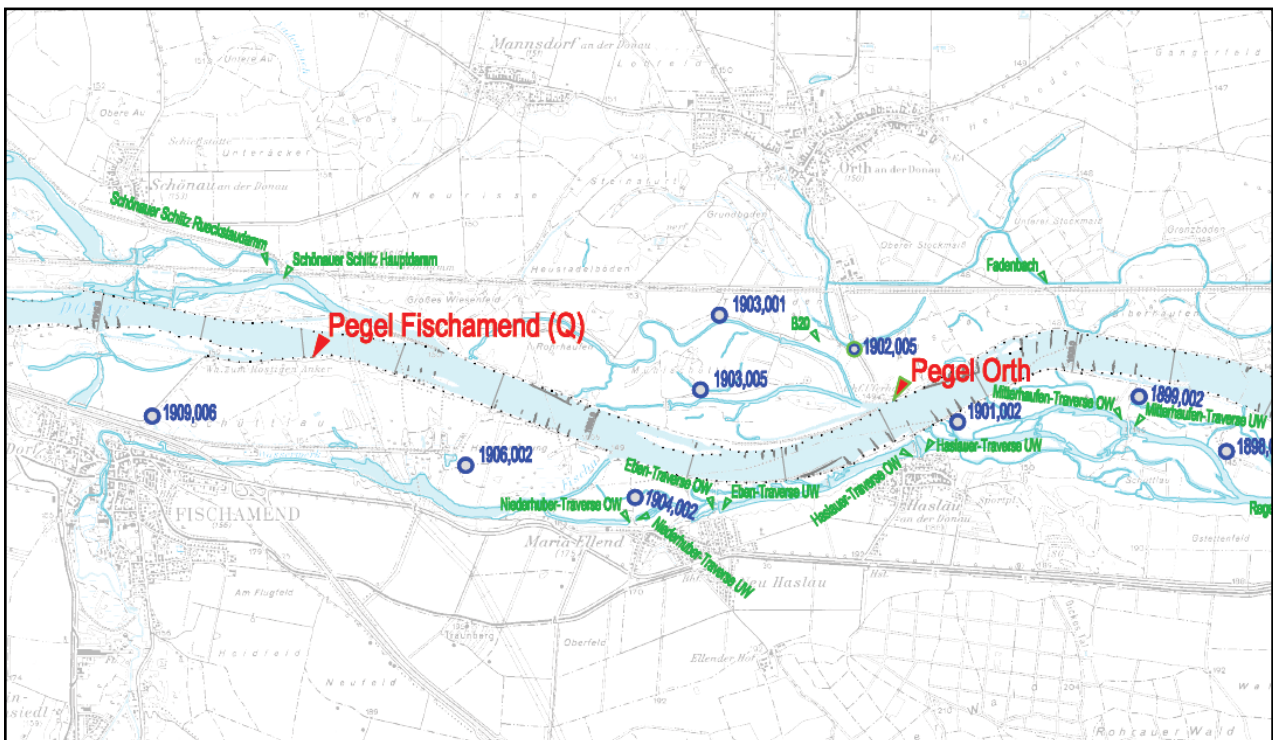


Figure 2: Overview about a part of the Danube east of Vienna with gauge stations

A detailed overview of the location of the gauge station is in the appendix.

The major part of the measuring systems is equipped with automatic data loggers. This data is public and it is transmitted to the hydrology department of via donau. Via donau is the owner of the monitoring stations and the collected data. The water levels of seven monitoring stations are published hourly on the website of via donau (<http://www.doris.bmvit.gv.at/>).

The focus of the measurements is certainly on the survey of water levels, which build the basis for the planning of flood prevention programmes and the calculation of recent and reference water levels (LNWL = Low navigable water level, AWL = Average water level, HNWL = Highest navigable water level, HWL = Highest water level).

At the Austrian part of the Danube reference water levels are set after bigger modifications on the river. At the moment the valid water levels refer to the year 1996 (KWD 96). In some sections there are updated ones after the flood in 2002. A revision of all numbers is done at the moment.

Furthermore, there exists the LNWL which has a standardised definition along the Danube. It is important for planning and describes the water level that corresponds to a long-term average water level reached or exceeded on all but 20 ice-free days per year (approximately between 5 and 6 percent of the ice-free period).

5.1.2. General information about river bed measurements

During the survey activities a so called Naufahrt is done monthly by via donau. Within the longitudinal movements they try to find out if there are shallow sections in the navigation fairway below 25 dm in the free flowing sections of the Wachau and east of Vienna and less than 27 dm in impounded sections and at the mouth of the river Enns. If that is the case cross-sectional profiles for the relevant section are created to discover the dimensions of the shallow section / ford. Afterwards they are transmitted immediately to Team DoRIS for publication.

At the same time the responsible Team for hydrography from via donau is instructed to do a record of the river basis. This record is the base for dredging projects and it is needed to start the dredging of the shallow section / ford. Furthermore, the received data should be integrated into ECDIS.

The measurements are usually conducted by vessels using standard single-beam echo sounders in the form of cross profiles with a distance of 50m between the profiles. The positioning of soundings is made by using DGPS or an automatic tacheometer in sections where the reception of GPS signals is not possible. The whole technical equipment is described in the following table:

Vessel	Echo sounding system	Software	Positioning System
Vessel Beta (mobile)	SB Reson Navisound 215 (210 KHz) ¹	Navisoft Survey (Navitronic)	Leica GPS530 Leica GPS1200+ (with Glonass)
Vessel Epsilon (mobile)	SB Kongsberg EA 400 (38 KHz, 200 KHz)	Navisoft Survey (Navitronic)	Tacheometer Leica TCA1100
Vessel Alpha ² (mobile)	SB Kongsberg EA 400 (38 KHz, 200 KHz)	Navisoft Survey (Navitronic)	
Vessel 4 ³	SB Reson Navisound 415 (15 KHz, 33 KHz and 210 KHz)	Navisoft Survey (Navitronic)	
Vessel Munin	MB Reson SeaBat 8101 (240 KHz); IXSEA Octans (gyrocompass motion sensor)	Navisoft Sweep (Navitronic)	

¹ Reson echo sounder will be replaced with Kongsberg EA 400, 200 KHz in 2010.

² Vessel Alpha can be equipped alternatively with a multi-beam echo sounding system. The acquisition of a second multi-beam echo sounder system is planned for 2010.

³ Vessel 4 can be equipped alternatively with a multi-beam echo sounder.

Table 4: Hydrographical survey equipment via donau (current status)

In principle the free-flowing sections are measured once in spring and once in autumn. In addition 4 – 5 impounded sections are measured per year, so the resultant interval of measurements is 2 – 3 years for the impounded sections.

The common free-flowing section with Slovakia is also monitored twice a year (rkm 1880.2 - 1872.7), in spring from the Austrian side and in autumn from Slovak side. The evaluated data will be exchanged within the cross border commission.

Further details about surveying and the corresponding procedures, technologies etc. are discussed in SWP 3.1 of the NEWADA project.

5.1.3. Bottlenecks

At the Austrian part of the Danube it can be distinguished between two major categories of shallow sections: shallow sections in free flowing sections and shallow sections in backwaters of the hydro power stations. The free flowing section to the east of Vienna consists of numerous fords / shallow section, the whole free flowing section is therefore addressed as bottleneck for navigation. Within the Trans-European Transport network (TEN-T) the elimination of this bottleneck is included in the TEN-T priority project number 18.

In the following part the shallow sections /fords on the Austrian Danube are characterised in more detail:

Free flowing sections:

Sediment: Gravel

Number of shallow sections: 35

Ford types: 20 lateral gravel bars, 15 mid-channel bars
 Dredging system: Dredging and building ecological structures upstream the dredging point at the river banks
 Bottleneck status: In the Wachau the main river engineering constructions are finished, in the east of Vienna an integrated river engineering project is in progress (FGP).

Backwater sections:

Sediment: Clay/silt/sand

Number of shallow sections: 78

Type: Clay bars in port mouths and lock entrances

Dredging system: Dredging and dumping the sediment downstream the dredging point in the middle of the river

A new survey of via donau and partners describes the ecological consequences for the macrozoobenthos and the fish population of dredging clay sediment in the riverbed of Harbour mouths and dumping the sediment downstream in the river.

The dredging cubatures from 1996 to 2006 including the flood 2002 amount to 360,000 m³/a gravel and 180,000 m³/a silt and clay. Private companies are engaged by via donau to do the dredging work. Most of the companies are using hydraulic excavators on stilt-pontoons, transport barges and vessels.

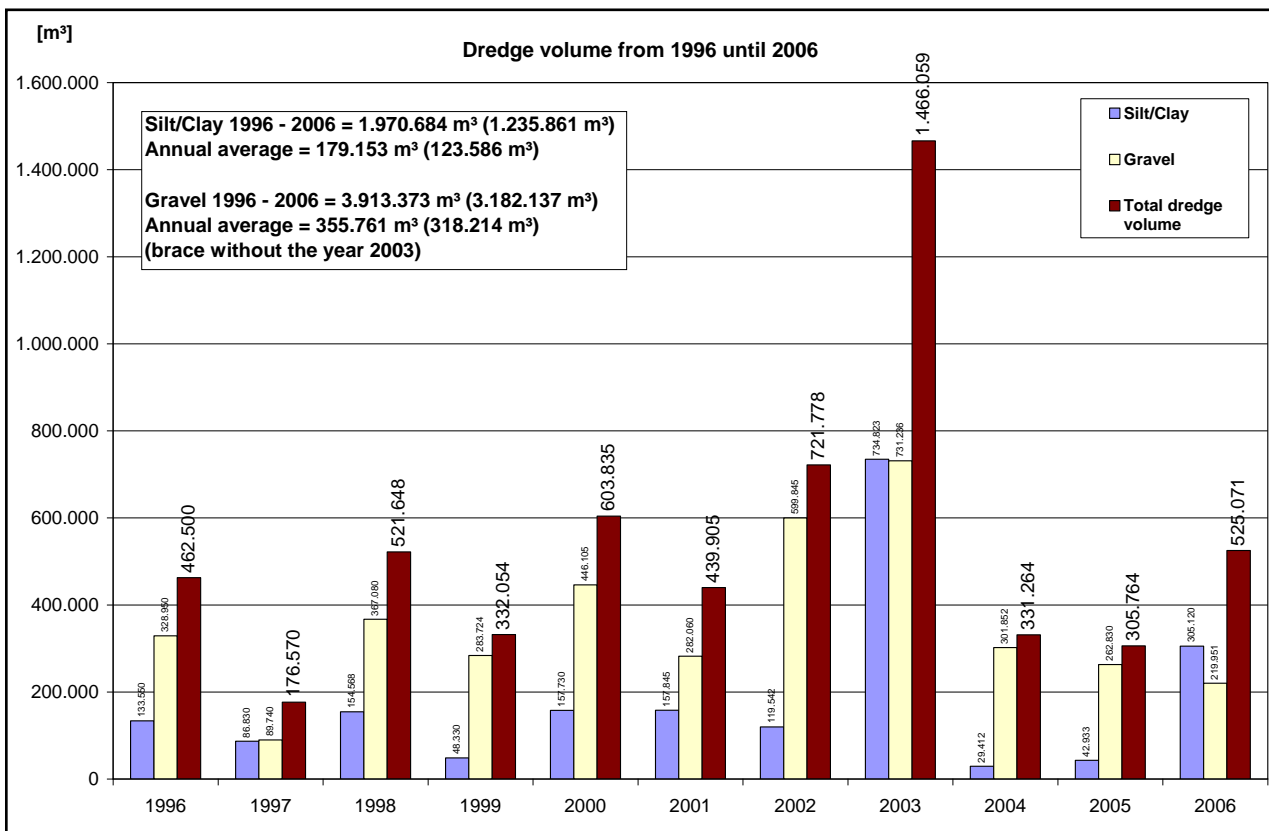


Figure 3: Total dredge volume from 1996 until 2006 (via donau)

In the figure above is the distribution of the material which was dredged. After the flood 2002 the dredging cubature was twice as high as normal.

The dredging works require an initial planning and a concluding success control of the works. This recurrent process can be described as fairway maintenance cycle and is illustrated by following chart:

The figure 4 displays the three recurrent and interdependent tasks with regard to the maintenance of the fairway:

- the continuous bathymetrical survey of the fairway
- the planning of the necessary dredging measures
- the execution of the dredging works including the monitoring of the works (success control)

In Austria exists a so called "grain manifest", which means that all dredged material remains in the river. With the obtained material via donau build within the last years a lot of ecological structures, as for example new gravel islands or bank restructuring with gravel structures.

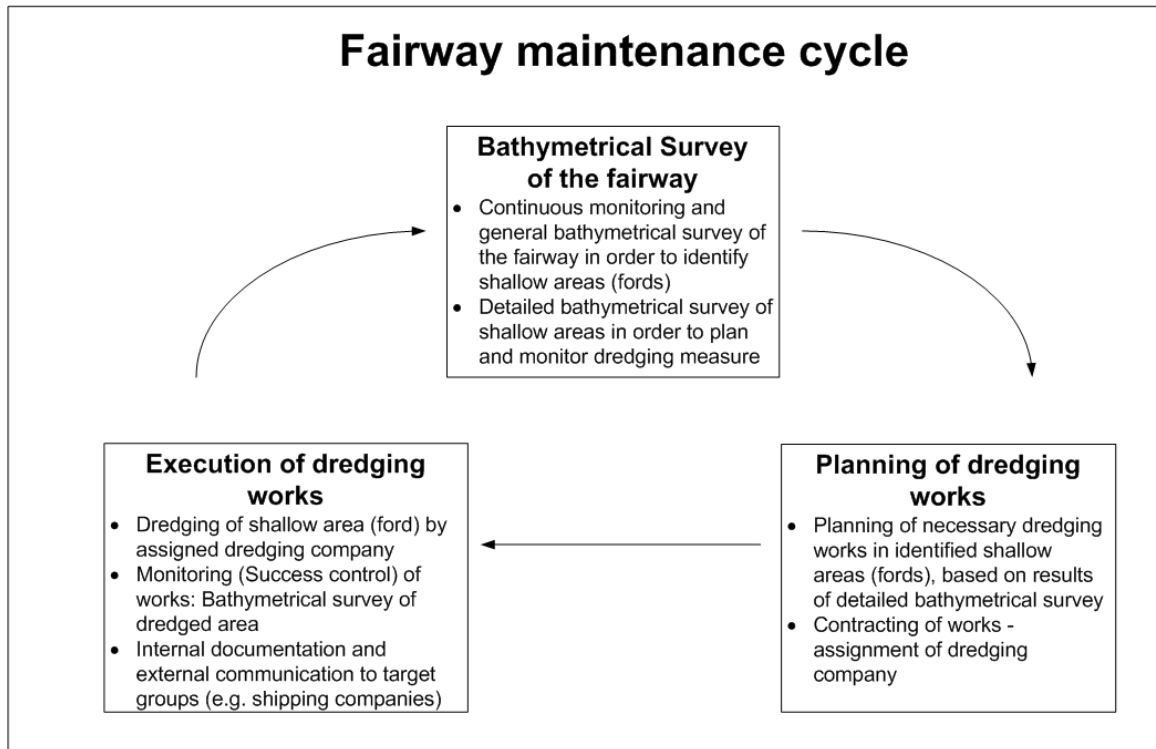


Figure 4: Fairway maintenance cycle (via donau)

5.1.4. Signalization

Signalization is basically standardised by the Danube Commission on the whole course of the Danube. The corresponding regulations in Austrian law are found in the Inland Waterway Regulation ("Wasserstraßenverkehrsordnung", WVO) and the Austrian Navigation Act ("Schiffahrtsgesetz", SchG). Amongst other things, there are regulations about vessel designation, night time markings, daytime markings, sound signals and waterway signs (e.g. buoys). The Navigation Surveillance is constantly maintaining the waterway signs at the Austrian Danube. The buoys are produced of iron sheet and the anchors are made of iron.

5.2. Report for river engineering constructions and execution

In the Wachau the main river engineering constructions are finished. Currently the free-flowing section of the Danube between Vienna (Freudenau power plant) and the Austrian-Slovakian border (river kilometres 1921.0 – 1872.7) constitutes a substantial weak point in inland waterway navigation and is characterised by a continued bed erosion rate of 2 to 3.5 cm per year.

Therefore, the Federal Ministry of Transport, Innovation and Technology (bmvit) and via donau – Österreichische Wasserstraßen-Gesellschaft mbH initiated the “Integrated River Engineering Project on the Danube to the East of Vienna” in order to improve fairway conditions and ecological deficits in this section of the Danube.

Measures:

It is planned to implement a combination of different river engineering and ecological hydro-engineering measures in this section of the Danube:

- Granulometric river bed stabilisation
- Low water regulation
- Riverbank renaturation
- Waterway linkage

Besides the lower water regulation one major goal of the project is the stabilisation of the river bed. The increasing bed erosion of the last few decades shall be reduced by means of a granulometric river bed stabilisation. It is planned to add coarse gravel with a grain diameter of approx. 40 to 70 mm, which is coarser than the major part of the Danube’s natural bed load in the project area, but finer than the maximum natural grain size. The thickness of the gravel layer and the exact grain size (grading curve) are the results of an optimisation task, whereby nautical and ecological requirements have been taken into account. The grain size distribution of the material to be added was determined in such a way that, with an appropriate safety distance, damage to ship propellers can be avoided and that the ecological exchange capacity of the river bed of the Danube is preserved.

The major project goal in terms of inland navigation is to secure adequate fairway conditions at low water levels. This will be accomplished by means of low water regulation measures (groynes and training walls). The distance between groynes, their heights and shapes were optimised from an ecological, nautical and material-efficient point of view in order to minimise the deposition of sediments in the groyne fields and the formation of scours near the groyne heads.

The major ecological goal of the project is to give the river greater freedom to move and thus to enhance the ecological functioning of the region. The landscape-forming power of the river is to be reinforced – primarily by riverbank renaturation. Protection structures on slip-off slopes are removed, undercut slopes are preserved. Furthermore, the waterway linkage is to increase the exchange of water between the Danube and the floodplains and will bring flowing water into the floodplains. Side arms will be linked to the main river at low water level.

Pilot Project Witzelsdorf

Near Witzelsdorf (river-km 1893,40 to 1891,70) a pilot project for the Integrated River Engineering Project Danube East of Vienna was implemented in the years 2007 to 2009.

On approx. 1,7 km length, the existing groyne field was optimised from an nautical, ecological and material-efficient point of view (see description above). This was the first time the new, downstream faced groyne type was implemented on the Austrian Danube.

In addition, an existing training wall was lowered to be effective only in low water conditions. On approx. 1,4 km length the riverbank was renaturated by the complete or partial removal of the stone protection.

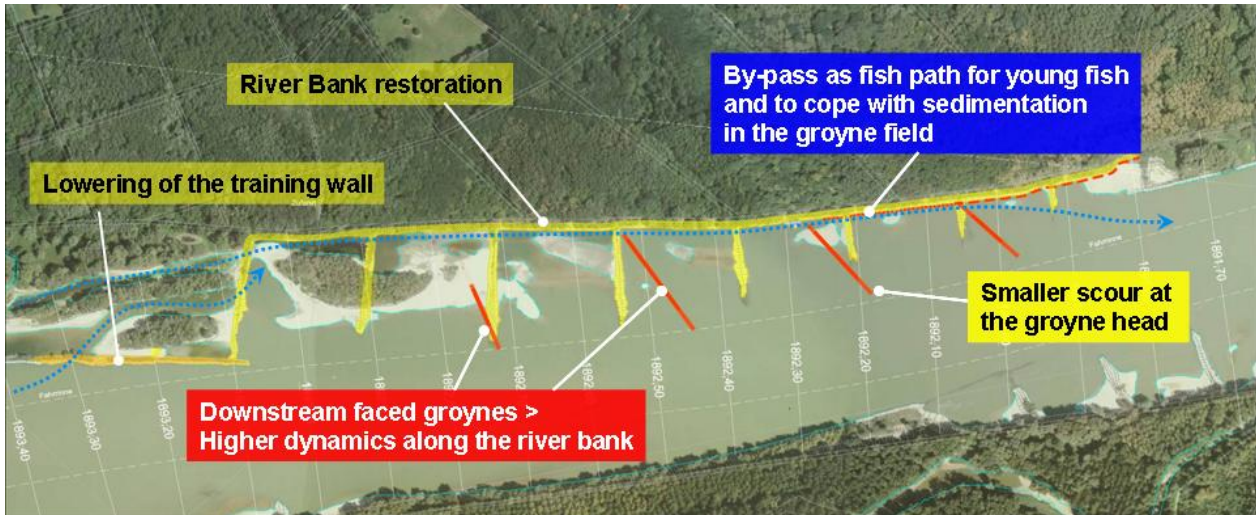


Figure 5: Measures within the Pilot Project Witzelsdorf (via donau)

Pilot Test Bad Deutsch-Altenburg

On an almost 3 km long section near Bad Deutsch-Altenburg (river-km 1887,5 to 1884,5) all measures, which are foreseen within the framework of the Integrated River Engineering Project Danube East of Vienna, will be implemented:

- Granulometric River Bed Improvement
- Low Water regulation: River bed adjustments, 19 groynes, which are not efficient will be removed, 10 downstream faced groynes will be constructed, 4 existing groynes will be lowered to be effective only at low water level
- Riverbank renaturation on approx. 1,2 km
- Reconnection of the Jöhler Side Arm

The pilot project is accompanied by a comprehensive evidence preservation programme designed to demonstrate that the project does not entail any unintentional side effects.

5.3. Common sector, waterway maintenance

For the common sector of Austria and its neighbouring countries there exists the Transboundary Waters Commission to regulate the waterway maintenance at the Danube. In Austria there are two institutions, one for each neighbouring country:

Slovakia – Austria: from Bratislava to the mouth of the river March, about 7 km cross border section

Austria – Germany: from Passau to Jochenstein, about 20 km cross border section

Every second month is a meeting within the cross border commission between Austria and Slovakia regarding the maintenance of the Danube and also the river March, which is the border between Austria and Slovakia.

The maintenance of these sections is executed on a rotational principle between the concerned states. Within this cooperation waterway signs are maintained and in addition projects with common financing and rotating execution are done.

5.4. Waterway maintenance in the ice period

In the ice period there are no special buoys used on the Austrian Danube. The conventional buoys are used the whole year. Measurement of fords is done every month all over the year in cooperation from via donau and the Navigation Surveillance. The frequencies of these measurements are independent of the existence of an ice period.

However, in the ice period a daily status report is published at the home page of via donau (www.via-donau.org) that gives an overview on the current situation (as e.g. the extension and the thickness of the ice). A potential stop of navigation due to ice is announced on this website too.

5.5. Waterway maintenance in the lowest level period

During LNWL surveying in the Wachau and in the east of Vienna is done weekly. The results are published for the customers at the home page of via donau and on the DoRIS website. Further information can be found in the report SWP 3.1.1 on hydrographical activities.

There are no special modifications in the hydrologic measurement of water levels because of the already short intervals (hourly).

In terms of waterway maintenance is the lowest level period the time when dredging works take place as described under chapter 5.1.3.

To reduce dredging works and to secure adequate fairway conditions at low water levels measures as characterized under 5.2 will be implemented.

5.6. Waterway maintenance in the highest level period

The information about the highest water level is brought to the costumers with several water level gauges, and several gauges at the bridges and locks. A potential stop of navigation at high water level is decreed by the navigation authority in the Federal Ministry for Transport, Innovation and Technology. Immediately after a flooding the bottlenecks are surveyed to initiate the necessary dredging works of the gravel and clay bars as soon as possible.

In the highest level period there are no special modifications in the hydrologic measurement of water levels because of the already short intervals (hourly).

5.7. Report about the prevention and restoration of flood damages

There are three different ways how skippers get informed about the suspension of navigation in the flood period:

- the service "notices to skippers" from the Supreme Navigation Authority (if requested additionally sent by E-Mail)
- information from the information system DoRIS (reaching HNWL + 90 cm)
- radio communication with the lock staff via VHF radio

The resumption of navigation is broadcasted on the same channels of information.

In a flood period monitoring of the water level and surveying stay the same. However, measurement of discharge is done at different bridges at the peak of the high water. Usually there are two or three measurements each high water.

5.8. Planning for lock maintenance and repairing

There are nine two-chamber locks on the Austrian section of the Danube, situated in conjunction with power plants (Aschach, Ottensheim-Wilhering, Abwinden-Asten, Wallsee-Mitterkirchen, Ybbs-Persenbeug, Melk, Altenwörth, Greifenstein und Freudenau). In addition there is a (smaller) one-chamber lock in Vienna on the entrance from the Danube to the Viennese Danube canal.

Responsibilities:

The operation of the nine Danube locks for passing and supervision of vessels is performed by personnel of via donau (so called "Schleusenaufsicht"), whereas the operator of the power plants, the company „VERBUND – Austrian Hydro Power AG (AHP)“ is in charge of the technical operation of the locks. For this purpose either own personnel or subcontracted external parties are used.

The duties for AHP are defined by specific contracts with the Federal Ministry for Transport, Innovation and Technology and via donau, defining the responsibilities for technical maintenance and repair, hydrographic measurements and dredging within the lock areas as well as service levels and cost sharing. The cooperation and relationship between via donau, the Federal Ministry for Transport, Innovation and Technology and AHP takes place on several levels and can be judged as very positive and constructive.

For solving daily problems (e.g. handling of failures during operation) there is direct contact between the responsible persons on-site, in case of more complex failures, which may e.g. cause blocking of lock chambers or if there is a need to solve special issues middle management of both parties becomes involved. Beside meetings on demand also regular quarterly meetings on management levels are scheduled to review past performance and co-ordinate future planning for revisions and extensive constructions.

The operation of the Danube canal lock is fully under the responsibility of personnel of via donau, including passing and supervision of vessels as well as technical maintenance and repair.

Regular maintenance and revisions:

The periodic revisions for the nine Danube locks are performed by AHP according to a specific planning (which was recently put in place, regulated in one of the mentioned contracts): For each of the 18 lock chambers a revision (with a dammed up and drained chamber) is performed each sixth year, so that each year a total number of three locks are under revision. The time interval of approximately 10 weeks for the revision is solely during winter period between begin of November and end of March, so that the obstacles for vessel traffic can be minimized (there is much less traffic of passenger vessels during winter period).

For better preparation of these revisions so-called "intermediate" revisions without a drained chamber are scheduled in advance in order to optimize planning, work preparation and spare parts provisioning.

Revisions for the Danube canal lock are also done during the peak-off season between November and March.

Ad-hoc repairs:

In case of unexpected repairs caused by technical problems, vessel or flood damages specific organizational measures (e.g. personnel scheduling, overtime, shift time) are put in place, in order to minimize the length of lock blockage. For this purpose specific regulation are also defined by the mentioned contracts.

Information to skippers:

The information of planned or ad-hoc changes in lock status is provided by several communication tools (E-Mail, Web-Site) as part of the River Information Services implemented according to several EU-regulations and standards, such as "Notices to Skippers" (http://www.doris.bmvit.gv.at/en/notices_to_skippers).

6 APPENDIX

Water gauge stations	river km	side
Achleiten	2223,05	right
Engelhartszell	2200,66	right
Ronthal	2197,52	right
Kager-Niederranna	2194,03	right
Vornwald	2189,97	right
Schlögen	2186,8	right
Obermühl	2178,03	left
Untermühl	2169,24	left
Schmiedelsau	2166,49	right
Aschach-Strombauleitung	2161,27	right
Aschach-Agentie	2159,73	right
Überströmstrecke Brandstatt	2158,20	right
Überströmstrecke Feldkirchen	2157,00	left
Christl	2156,02	right
Wilhering	2144,31	right
Kürnberg	2139,36	right
Linz	2135,17	right
Linz Handelshafen	2130,60	right
Überströmstrecke Steyregg	2129,00	left
Linz VÖEST-Hafen	2126,95	right
Marauer	2116,79	right
Mauthausen	2110,98	left
Schwarzholz	2108,38	right
Au/OÖ	2106,85	left
Überströmstrecke Wallsee 2106 LI	2106,00	left
Überströmstrecke Wallsee 2106 RE	2106,00	right
Überströmstrecke Wallsee 2105 LI	2105,00	left
Überströmstrecke Wallsee 2105 RE	2105,00	right
Wallsee	2092,87	right
Dornach	2084,36	left
Grein	2079,10	left
Sarmingstein	2072,71	left
Ybbs	2058,79	right
Säusenstein	2054,19	right
Krummnußbaum	2049,60	right
Melk	2035,98	right
Aggstein	2024,97	right
Spitz	2018,89	left
Kienstock (10m, Hydrosens)	2015,21	right
Kienstock redundant (20m, Logo)	2015,21	right
Dürnstein	2009,15	left
Loiben	2006,02	left

Stein-Krems	2002,70	left
Thallern	1998,00	right
Angern an der Donau	1996,30	right
Hollenburg	1994,32	right
Preuwitz	1985,50	right
Bärndorf	1975,97	right
Donauchemie	1971,95	right
Tulln	1963,09	right
Greifenstein	1947,79	right
Korneuburg	1941,46	left
Wien Nußdorf	1934,05	right
Wien Floridsdorferbrücke	1931,70	right
Wien Reichsbrücke	1929,09	right
Jedleseer Steig (Neue Donau)		
Donaukanalmündung	1919,43	right
Fischamend	1907,90	right
Orth	1901,83	left
Wildungsmauer	1894,72	right
Bad Deutsch-Altenburg (Rollfähre)	1887,19	right
Bad Deutsch-Altenburg	1886,86	right
Hainburg Straßenbrücke	1886,24	right
Hainburg	1883,92	right
Thebnerstraßl	1879,25	right
Wolfsthal	1874,84	right
<i>Donaukanal (Vienna):</i>		
Wehr Nußdorf Unterwasser	0,58	left
Wien-Brigittenau	1,10	left
Wien-Heiligenstädterbrücke	2,16	right
Wien-Schwedenbrücke	6,28	right
Wien-Rotundenbrücke	8,24	right
<i>Alte Donau (Vienna):</i>		
Kagranerbrücke		-
<i>Side-arm connections:</i>		
Mitterhaufentraverse OW	n/a	right
Mitterhaufentraverse UW	n/a	right
Ebentraverse OW	n/a	right
Ebentraverse UW	n/a	right
Niederhubertraverse OW	n/a	right
Niederhubertraverse UW	n/a	right
Regelsbrunner Traverse OW	n/a	right
Regelsbrunner Traverse UW	n/a	right
Haslauer Traverse OW	n/a	right
Haslauer Traverse UW	n/a	right
B20	n/a	left

Entenhaufentraverse OW	n/a	left
Entenhaufentraverse UW	n/a	left
Fadenbach	n/a	left
Grossau Traverse	n/a	left
Pioniertraverse OW	n/a	left
Pioniertraverse UW	n/a	left
Schönauer Schlitz Hauptdamm	n/a	left
Schönauer Schlitz Rückstaudamm	n/a	left
Spittelauer Traverse OW	n/a	left
Spittelauer Traverse UW	n/a	left
Uferhausstraße	n/a	left
Ground water gauge stations	river km	side
Fischamend, BI 1909.006	1909,600	right
Maria Ellend, BI 1906.002	1906,200	right
Maria Ellend, BI 1904.002	1904,200	right
Orth, BI 1903.005	1903,500	left
Orth, BI 1903.001	1903,100	left
Orth a.d.D., BI. 1902.005	1902,500	left
Haslau, BI 1901.002	1901,200	right
Haslau, BI 1899.002	1899,200	right
Regelsbrunn, BI 1898.002	1898,200	right
Eckartsau, BI 1897.003	1897,300	left
Eckartsau, BI 1895.003	1895,300	left
Eckartsau, BI 1894,053	1894,530	left
Eckartsau, BI 1894.005	1894,500	left
Eckartsau, BI 1894.023	1894,230	left
Eckartsau, BI 1892.003	1892,003	left
Witzelsdorf, BI 1891.001	1891,100	left
Petronell, BI 1890.006	1890,600	right
Petronell, B. 1889.007	1889,700	left
Petronell, BI 1889.004	1889,400	right
Petronell, BI 1889.002	1889,200	right
Petronell, BI 1888.002	1888,200	right
Untere Badschwelle, BI 1887.602	1887,500	right
Stopfenreuth, BI 1887.001	1887,100	left
Stopfenreuth, BI 1885.001	1885,100	left
Hainburg a.d.D., BI. 1884.005	1884,500	left
Markthof, BI. 1884.001	1884,100	left
Hainburg, BI. 1883,015	1883,015	left
Markthof, BI 1881.005	1881,500	left
Markthof, BI. 1880.001	1880,100	left
Wolfsthal, BI 1877.004	1877,400	right
Wolfsthal, BI 1873.002	1873,200	right
Wolfsthal, BI 1873.012	1873,120	right
Wolfsthal, BI 1873.010	1873,100	left

Temporary studies (pilot project "Naturversuch" - East of Vienna):		
Stopfenreuth, BI 1887.005	1887,000	left
Engelhartsstetten, BI 1886.001	1886,100	left
Engelhartsstetten, BI 1886.023	1886,200	left
Markthof, BI 1884.007	1884,700	left
Stopfenreuth, BI 1887.032	1887,000	right
Bad Deutsch Altenburg, BI 1887.004	1887,400	right
Stopfenreuth, BI 1887.003	1887,300	left
Englhartsstetten, BI 1886.003 (LD)	1886,000	left
Stopfenreuth, BI. 1887.013 (LD)	1887,500	left
Stopfenreuth, BI 123	1885,300	left
Stopfenreuth BI. 1886.005	1886,500	left
Petronell, BI 1888.004	1888,400	left
Bad Deutsch Altenburg, BI 1886.022	1886,220	right
Bad Deutsch Altenburg, BI 1886.040	1886,700	right
Bad Deutsch Altenburg, BI 1887.106	1887,106	right

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