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NEWADA

"NETWORK OF DANUBE WATERWAY ADMINISTRATIONS"

South-East European Transnational Cooperation Programme

STATUS QUO REPORT FOR WATERWAY MAINTENANCE IN SERBIA

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1 LIST OF ABBREVIATIONS

ABBR.	Abbreviation
NEWADA	Network of Danube Waterway Administrations
DK	Danube Commission
UNECE	United Nations Economic Commission for Europe
AGN	European Agreement on Main Inland Waterways of International Importance
GPS	Global Positioning System Global Positioning System
DGPS	Differential GPS

2 SCOPE OF DOCUMENT

This report gives an overview of the basic network of internal waterways in the Republic of Serbia, particularly the Danube, the institutions responsible for maintaining its navigability, as well as the basic activities that constitute on its technical maintenance, both in normal and in exceptional hydrological and meteorological conditions.

In addition, this report contains a list of all significant engineering construction in the riverbed and banks of the Danube River on the part of its course through Serbia in length of 588km (km 1433 - km 845).

3 INTRODUCTION

3.1. Responsibility for waterway administration - Institutions managing navigation conditions

The Danube enters Serbia from Hungary close to Bezdan at km 1433 and flows for 588 km before it leaves the country at km 845 where the river continues along the Rumanian – Bulgarian Border. Within Serbia several smaller rivers and the major tributaries Drava, Tisa, Sava and Morava join the Danube River at km 1382.5, 1215, 1170 and 1104.5, respectively.

The most important man-made features on the river within Serbia are the HEPP Djerdap I (km 943) and Djerdap II (km 863) which were both designed to produce hydroelectric power and to improve navigation on the Danube. Both dams are equipped with navigation locks at both Romanian and Serbian side, to enable the passage of ships at these locations. Locks are constructed aside the dam with dimensions of 310 x 34 x 5 m.

The organizations in Serbia involved in IWT concerns organizations on the international level and national level and includes ministries, authorities and companies. Not all organizations, in particular on national level have only IWT activities. These vary from flood control, water supply, irrigation, drainage to environmental issues.

Presently, besides the Ministry of Infrastructure and dependent Port Master Offices, two Ministry-independent organizations exists: Plovput and Jugoregistar. One organization (Djerdap) resorts under the Ministry of Mines and Energy Resources. Srbija Vode is resorting under the Ministry of Agriculture and Water Resources and Forest; Vode Vojvodine is under the Autonomous Province of Vojvodina. In addition, there are port organization (most of these completely private) and shipping organizations (both in the public- and private sector).

Directorate for Inland waterways - 'Plovput' is the institution in charge for maintenance of inland navigable waterways established by the "Law on Ministries" for the maintenance and development of inland navigable waterways of international importance. The head office is in Belgrade.

4 CHARACTERISTIC OF WATERWAY

4.1. River stretch characterisation

Within Serbia the following sections are distinguished:

from the Hungarian border (km 1433) to Belgrade km (km 1170), which is classed as VIc, permits the transit of six pushed barges up to 9,600 tones. In practice, due to water depth restrictions in the upper and lower reaches of the Danube, barges and vessels do not load to its maximum draft and sail at a reduced draft, usually less in a range of 2.0 to 2.2 m. to allow a safety margin;

from Belgrade (km 1170) downstream towards the Djerdap II dam (km 863), the river attains the maximum class rating of Class VII, allowing transit of nine pushed barges up to 14,500 tones dead weight.

from Djerdap II (km 863) till the Bulgarian border (km 845), the river is classed as VIc. Barges and vessels transiting the Serbian section of the Danube may have a reduced draft when low water levels occur downstream of Djerdap II and in Romania.

Another classification could be made by dividing the river into 'geo-political' sections where the river is the state border, being:

from the Hungarian border at km 1433 to Bačka Palanka at km 1295 where the river forms the border between Serbia and Croatia;

from Bačka Palanka (km 1295) to the Romanian border at km 1075, where the river is entirely in Serbian territory;

from km 1075 through the Djerdap Gorge, where the two Djerdap hydro electric dams are located, till the Bulgarian border at km 845, and forms the border between Serbia and Romania.

Thus, only over a length of 220 km both sides of the Danube are in Serbian territory, while over 328 km only one side of the Danube is Serbian territory.

The water level on the Danube is influenced by the backwater of the HEPP Djerdap I and HEPP Djerdap II. During low flow the backwater zone extents up to Novi Sad almost 300 km upstream of the Djerdap I dam. During high flows, the backwater zone extents about 100 km. Djerdap I is operated in such a way to obtain a constant water level for flows up to 7000 m3/s at Nera, 133 km upstream Djerdap I. This means that the water level at Djerdap I is reduced when the discharge increases in the Danube. There is ample depth for navigation downstream of km 1170 (the confluence with the Sava River) due to the backwater effect from Djerdap I.

The backwater zone of Djerdap II stretches till the Djerdap I dam. Within the backwater zone sufficient navigation depth is available. Outside the backwater zone, the water level and consequently the available width and depth for navigation depend on the discharge of the river. During low flow conditions, certain river stretches may not dispose of sufficient navigation depth or width.

The majority of the bottlenecks occur on the stretch between km 1430 and 1250 (free flow). Most of them are related to sharp bends or narrow cross-sectional profiles. In addition to above mentioned bottlenecks, also the railway bridge in Novi Sad must be considered as a severe bottleneck due to the limited navigable width in combination with the limited clearance. Downstream of km 1250 less problems are encountered, and after km 1198 till the beginning of the Djerdap Gorges bottlenecks have not been identified. Downstream of the Djerdap II dam there are no bottlenecks with regard to available width and depth of the fairway, except during extreme low water levels. In that case a large amount of sunken German WWII warships create hazardous situations for navigation as these narrow the fairway width substantially.

4.1.1. Waterway parameters

Fairway is a part of the waterway. As such, it is defined through its depth H, width B and radius of curvature R. Values and variations of these parameters directly reflect the conditions in the fairway. Their required values are defined by the Danube Commission (Recommendations Relatives A L'Etablissement Des Gabarits Du Chenal, Des Ouvrages Hydrotechniques Et Autres Sur Le Danube) upon which are determined criteria for the analysis of the waterway parameters.

Fairway Parameters` values in accordance with the Danube Commission conditions are:

Minimal depth in the fairway H

- Sections with free flow H ≥ 2.5 m
- Sections under the influence of the backwater H ≥ 3.5 m

Minimal width of the fairway B

- Sections with free flow
  - Sections with easily scouring bottom B ≥ 180 m
  - Sections with easily scouring bottom in meander B ≥ 200 m
  - Sections with rock bottom B ≥ 100 m
  - Shoals with easily scouring bottom B ≥ 150 m
- Sections under the influence of the backwater B ≥ 200 m

Minimal radius of curvature (along the fairway axis) R

- R ≥ 1000 m
- Sections with unfavorable geomorphologic conditions R ≥ 750 m

Fairway with B, with regard to the radius of curvature, in accordance to the Danube Commission recommendations is:

- B = 180.0 m for R > 4000 m (straight section)
- B = 200.0 m for R < 4000 m (curvature - meander)

Section classification (Adopted criteria for analysis of morphological parameters)

According to the conditions defined by the Danube Commission, basic parameter, as well as the criterion, for the evaluation of the fairway condition and section classification is fairway width B for the set fairway depth H=2.5 m (sections with free flow), i.e. H=3.5 m (sections under the influence of break water) in regard to the low navigation level (EN).

Considering the values of the fairway width, river can be classified into the following section classes:

a. B > 180.0 (200.0) m

b. B < 180.0 (200.0) m

All stretches of the river course, for which the condition B > 180.0 (200.0) m have been met can be considered favorable with a view to navigation, especially if the fairway axis is constant.

Stretches that do not fulfill conditions (B < 180.0 m) are deemed unfavorable with regard to the safe navigation. Stretches that currently fulfill such conditions, but their width in the past used to be less than required, which points out to the deformability of the channel, are also considered unfavorable.

Curvature of the fairway axis

Besides two basic parameters of the fairway (width B=180.0 m i.e. B=200.0 m and depth H=2.5 m with a reference to the low navigation level EN) there is another condition – minimal radius of curvature of the fairway R = 1000 m.

According to this condition, all stretches where R < 1000, are deemed unfavorable with regard to the safe navigation and regulation works are proposed as a measure for solution to this problem i.e. to attain required radius.

At certain stretches this condition is hard to meet due to urban zone or other difficulties where regulation works would be far too expensive and unjustifiable with regard to economical-technical reasons.

5 WATERWAY MAINTENANCE

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

5.1.1. General information about Hydrology

Republic Hydro meteorological Service of Serbia (www.hidmet.gov.rs) transmits hydrological warnings to: Ministry of Agriculture, Forestry and Water Management of Serbia – Directorate for Water, Public Water Companies ''Srbijavode'' and ''Vode Vojvodine'' (which distribute them to responsible personnel), and to the State centre for observation and information, which distributes these information to endangered communities. Data, forecasts and warnings are presented in special bulletins and transmitted via e-mail to Ministry, and all other participants in flood defense activities.

The Hydro meteorological Service of Serbia – Forecast Office is responsible for the collection and distribution of hydrological and meteorological data. Hydrological data are collected from 56 stations and reported in real time, via radio, telephone and automatically via GSM. Meteorological data are collected from 28 stations via radio. The data available on the territory of Serbia are not sufficient for the delivery of warnings and forecasts. Namely, floods on major rivers, such as the Danube, Sava, Tisza, Tamis etc., originate beyond Serbian borders, that is why information from upstream countries is indispensable. Data from neighboring countries (2 stations in Austria, 2 in

Slovakia, 18 in Hungary, 15 in Romania, and 8 in Croatia) are collected via GTS (Global Telecommunications System) and by e-mail. Also data for 5 stations in Republic of Srpska are collected by phone.

Various methods are used for hydrological forecasting, ranging from the simplest graphical correlations to the most sophisticated models which describe the physical processes that take place within the river basin and the river network. For all of these methods and models, it is important to have access to accurate data on the initial conditions of forecasted parameters, and the fundamental impacts. Such data are provided by hydrologic and meteorological measurements and observations, while precipitation can be the result of meteorological forecasts. For the time being, only now casts and short-term meteorological forecasts can be used successfully.

5.1.2. General information about river bed measurements

Hydrographic (bathymetric) survey is the process of gathering information about navigable waterways for various purposes such as: safe navigation of vessels, dredging, planning the engineering works and alike. It applies to survey of any navigable waters, including rivers, lakes and sea.

Directorate for Inland waterways - 'Plovput', established by the "Law on Ministries" is the institution in charge of hydrographic surveys of inland navigable waterways of international importance in Serbia.

The Plovput's typical cross section surveying equipment includes the following:

- Survey Echo Sounder E-SEA SOUND 103 / 200 KHz sound (Depth measurement precision 1cm +/- 20 cm)
- DGPS-RTK positioning (Position measurement precision +/- 20 cm)
- Data processing application: 'Masterchart 3.40' by Danish Company 'Marimatech'
- Complete 'Marimatech' and 'Autodesk' software officially purchased and registered.

The surveys are performed using an E-SEA SOUND 103 Echo Sounder, mounted on boat, 5m in length, specially equipped for this type of activity and owned by Plovput. All data (provided coordinates and measured points) are in the State Geographical Coordinate System.

Before the survey is commenced, coordinates of boundary points are entered into the software.

Survey lines run along predefined profiles (cross sections).

Data on depth and location (x, y, z) is transferred to the specialized software for hydrographic surveys – "Masterchart". Software synchronizes data constantly, so that the boat position is provided in real time.

Information on speed of sound in water is entered, according to the information provided from SVP (sound velocity profiler) device. Differential GPS station is mounted at the reference point with known geographic coordinates. A Station is connected to the boat with radio signal, sending information on differential correction, providing the required accuracy for the performed survey.

Depth information is obtained by using the time necessary for ultrasound waves to travel from echo-sounder to the river bottom and back. Two sounders are mounted on the boat. One is set to send the signal, and another to receive the ultrasound signal. This kind of system helps to perform measurements of depths 30cm below the eco-sounder, and 50 cm below the water surface, which is of great importance in the case of survey in shallow waters, and along the shoreline.

Data on depth and location are synchronized in real-time, and information stored in ASCII format in the form of x, y (position) and z (depth) coordinates.

Water levels are measured and updated every couple of hours, in relation to the reference point in order that the depth soundings can be converted to a bed level.

After completion of the survey, quality control is being performed, spikes removed, and data stored into the database with cleaned x, y, z coordinates for each of the cross sections.

Since April 2001, Plovput's is equipped with Multi beam survey system. It has been used occasionally, at the river sectors with extremely bad nautical conditions. This equipment should be upgraded and used more in the near future.

5.1.3. Bottlenecks

Danube section with a free flow in the Republic of Serbia is divided into the following sections:

- From the Serbian-Hungarian border (km 1433.0) to Backa Palanka (km 1295.4)
- From Backa Palanka (km 1295.4) to the confluence of the Tisza (km 1214.6)
- From the confluence of the Tisza (km 1214.6) to the confluence of the Sava (km 1169.6)

Bottlenecks at the free flow section of the Danube

From the Serbian-Hungarian border (km 1433.0) to Backa Palanka (km 1295.4)

- From km 1428 to km 1426 (sector Bezdan) – fairway width at certain profiles is up to 170 m. Considering the position of the fairway axis and available with for navigation at this sector, it is not considered a bottleneck or a shoal.
- From km 1405 to km 1400 (sector Apatin) fairway width is 50 – 70 m. widening of the fairway width is not possible without exhaustive regulation works. Due to unfavorable configuration of the terrain at km 1402, where river flow passes from one into another curve, which affects the ship managing. At water levels that corespond to the level of + 130 cm at the hydro-metheorological station Vukovar, navigation is transfered to the left side of the river, along the Serbian bank where safe navigation can be provided at the width of 60 m – 90 m.

- From km 1397 to km 1396 (sector Civutski Rukavac) fairway width is 140 – 165 m. Greatest narrowing of the fairway is at the transition pass from one curvature to the next one.
- From km 1394 to km 1389 (sector Vemelj – Petres) at certain profiles fairway width is about 165 m. This sector characterizes with the sharp curvature from km 1390.7 to km do km 1389.800. All the same, the river with at the entrance and exit of this sector amounts to 220 m. As a consequence radius of the curvature is just 600 m.
- Sector Staklar from km 1375.0 to km 1373.1 characterizes with greater curvature of the river channel with radius of curvature of 875. Since that radius is still greater than 750 m and considering Danube Commission recommendations (for sections with unfavorable geomorphologic conditions R ≥ 750 m) this sector is not considered unfavorable.
- At the part from km 1354.6 to km 1354.4 (sector Dalj) at the exit from the curvature, fairway width falls to 155 – 165 m.
- From km 1348 to km 1347 (sector Savulja) fairway with ranges from 135 m to 170 m.
- From km 1308 to km 1314 (sector Mohovo) – river channel shape, as well as the material it is formed in cause fairway narrowing. At that sector river bottom is of rocky material and current fairway was set up by mining that was carried out at the end of the sixties in last century. Fairway with varies from 120 m to 170 m at the low navigation level (EN). However, considering the Danube Commission recommendations for the Sections with rock bottom where required waterway width B should be ≥ 100 m, this sector can be reckoned favorable with regard to the safe navigation.

From Backa Palanka (km 1295.4) to the confluence of the Tisza (km 1214.6)

- From km 1288.2 to km 1284.8 (sector Susek) fairway width is 125 – 160 m.
- From km 1265.2 do km 1264.5 (sector Futog) fairway width is 165 - 170 m. This sector used to be bottleneck during previous years (considered as a shoal) from km 1264.5 to km 1266.5 where was formed a sand bar couple of years ago that shifted from one bank to another. At certain parts of this sector that bar caused fairway width of 100 m. Comparing cross profiles from previous years and surveying from 2008, it is clear that sand bar lessened significantly, especially at the part from km 1265.1 to km 1264.7 which was the most critical one. On the other hand, there has been sedimentation downstream from the profile at km 1264.6 toward km 1264.2
- From km 1246.6 to km 1245.8 (river island across Sremski Karlovaci) fairway width is 155 m - 170 m. River bottom at this stretch is of material that easily degrades. So is formed a river island in the middle of the river and this sector is deemed as a shoal. That island increased with a tendency to increase in the future as well at the cost of the fairway width.

- From km 1240.4 to km 1240.8 at low water levels there is a slight narrowing of the fairway (165 m - 175 m). At this stretched fairway is in the curvature and there is sedimentation from km 1241 to km 1240 at the left (convex) bank. In the future can be expected further sedimentation and worsening of navigation conditions.
- In the immediate zone around km 1236.0 was registered sedimentation in the fairway toward the left bank. In the case of further sedimentation, i.e. if the send bar formed there should be carried out necessary measures for elimination of that problem.
- From km 1231.0 to km 1227.8 (''Channel Gardinovac'') fairway width varies from 95 m to 179 m. This stretch belongs to the sector Beska that characterizes with numerous sand bars that conditioned the position of the fairway along the left bank without the alternative for its displacement without considerable regulation works.

From the confluence of the Tisza (km 1214.6) to the confluence of the Sava (km 1169.6)

At this section were not registered bottlenecks

Section from Belgrade (the confluence of the Sava km 1169.6) to HPP Djerdap I (km 1132.0) and from HPP Djerdap I to HPP Djerdap II

Downstream from the Belgrade the flow is under the influence of the HPP Djerdap I backwater. The section from Belgrade to HPP Djerdap II belongs to the waterway class VII, and requirements for the safe navigation are met.

Section from HPP Djerdap II (km 863) to Serbian-Bulgarian border (km 845.650)

This section characterizes with free flow and waterway belongs to the class Vic. At this section great obstacle, as well danger to the safe navigation, represent sunken vessels from the Second World War at Prahovo (km 860.800)

At the end of World War II more than 100 vessels were sunk by the retreating German army in the Danube river stretch from km 862 to km 858 to prevent the allied forces to defeat the German army. Apparently, all kind of vessels that were present in the area at that moment were sunk, varying from fishing boats to war ships and hospital ships. These wrecks endanger navigation and should be removed in a short term.

It can be concluded, that apart from the stretch at Prahovo which has nothing to do with geomorphologic conditions, the most critical sectors – bottlenecks are located at the joint part of the Danube between Serbia and Croatia. At certain sectors, such as Apatin, navigation is carried out under difficult conditions and significant regulation works are necessary to provide safe navigation.

Downstream from the Tisza and especially downstream from the confluence of the Sava in Belgrade, where the flow is under the influence of the backwater, geomorphologic conditions are favorable without bottlenecks and conditions for navigation are satisfying.

5.1.4. Signalization

Floating and costal signs are approximately managed 40 times a year or 3.3 times a month (overall average). This greatly depends of weather/hydrological conditions during the year.

Material used for the buoy fabrication is aluminum or AlMg3 alloy sheets 4mm thick. For costal signs 5-6 m long steel pipes are used for poles and aluminum sheet with retro reflective foil adhered for panels.

All lighted floating and coastal signs are fitted with solar LED navigation lights.

Buoys are anchored with concrete triangular shaped anchor that is attached to the buoy body via 25 m long zinc coated steel chain and shackles.

5.2. Report for river engineering constructions and execution

The Danube is in Serbia a highly regulated river. To create favourable conditions for navigation, a large amount of side branches have been closed off, bends have been cut off; banks and dikes have been protected by means of protection works. Also at various locations a deeper fairway has been established by means of groynes. All the river training structures like bank protection works; groynes; T–shaped groynes, except the quay walls in the towns along the rivers, are made of sorted and unsorted stones directly deposited on the slope or on filter material. The quay walls in the towns along the rivers are concrete revetments.

The training works are not in optimal condition. Regular maintenance of the training works did not occur during the past years due to the limited availability of funds.

Last large training works on the Danube were performed on sector ”Krcedin” in 1996 (more than 40.000 m3 of stone buited in). Since then, negligible number of training works has been conducted.

The most applied solution for training works on the Serbian part of the Danube river is combination of dredging and training works. The choice of a method to be applied depends on various factors of which the cost are often most important. Training works require a relatively high initial investment, while maintenance will be relatively low because the training works will to a large extend guarantee the required dimensions of the fairway.

Usually a lower initial investment is required for the dredging strategy, but the annual maintenance cost will be relatively high because accretion will continue unhindered and maintenance dredging will be required. Which method is the least expensive option depends on the dynamics and behaviour of the river (determining the cost of annual dredging) and the costs of the required training works to maintain the river on its depth and width. In addition also environmental considerations will play a role in the final choice.

For the Danube the implementation of training works are most favourable due to the dynamic morphologic behaviour of the river. This means that for the Danube most bottlenecks are solved by implementing training works and only on smaller projects dredging has been applied.

In river sections where the fairway is not deep or wide enough due to the division of the river flow over a too vast area it is proposed to construct groynes, as these tend to concentrate the flow to the low water bed of the river. This concentration of flow may result in a more widened or deepened profile.

For the distance between the groynes a distance of 1.5 to 2 times the length of a groyne is assumed. The length of the groyne is determined for every location separately.

The bends which tend to be morphologically very dynamic can be fixed by constructing bank protection works. Bank protections are proposed at locations where navigation is hindered or hampered due to the dynamic behaviour of the bend and where an existing protection has to be removed as part of a project to solve a bottleneck. Furthermore, bank protection works will be proposed at the opposite bank of a proposed groyne system, to prevent erosion at the opposite bank, as this bank erosion would counteract the functioning of the groynes. Damage to river banks caused by increased traffic on the river is not expected.

Most of the problems for navigation occur due to the presence of a narrow profile in sharp bends. In a bend it is often not necessary to fully fix the curve by means of a bank and/or bottom protection, because it behaves fairly stable. For navigation a dynamic curve does not always create a problem if sufficient width and depth are available for navigation and a marking system is present indicating the fairway.

Inventory of the river training structures on the Danube river in Serbia

No.	River kilometer	River bank	Type of the stucture
1	1432+200	Right	Groyn
2	1431+350	Right	Groyn
3	1428+455 - 1427+991	Right	Groyn
4	1429+850 - 1429+300	Left	Bank protection
5	1422+100	Right	Groyn
6	1421+700	Right	Groyn
7	1421+400	Right	Groyn
8	1421+100	Right	Groyn
9	1420+800	Right	Groyn
10	1420+250	Left	Groyn
11	1419+950	Left	Groyn
12	1419+500	Right	Groyn
13	1416+250 - 1415+950	Left	Bank protection

14	1414+450 - 1414+250	Left	Bank protection
15	1415+780 - 1415+298	Left	Bank protection
16	1420+650 - 1419+800	Right	Bank protection
17	1415+378 - 1414+920	Left	Bank protection
18	1415+950 - 1415+870	Left	Bank protection
19	1414+437 - 1414+910.5	Left	Bank protection
20	1399+500 - 1399+900	Left	Bank protection
21	1401+500 - 1403+600	Left	Bank protection
22	1403+700	Left	Closure Bund
23	1396+000	Left	Closure Bund with bank protection
24	1394+400 - 1395+000	Left	Bank protection
25	1395+300 - 1395+400	Left	Bank protection
26	1395+500 - 1395+800	Left	Bank protection
27	1396+700 - 1397+000	Right	Bank protection
28	1396+000	Left	Bank protection
29	1399+000	Left	Groyn
30	1398+300	Left	Groyn
31	1397+800	Left	Groyn
32	1397+380	Left	Groyn
33	1396+900	Left	Groyn
34	1396+000 - 1396+610	Left	Stone rock disposal
35	1399+100 - 1399+570	Left	Bank protection
36	1396+100 - 1395+600	Right	Stone rock disposal
37	1387+250	Left	Closure Bund
38	1386+700	Left	Closure Bund
39	1388+000 - 1384+170	Right	Bank protection
40	1391+500	Right	Guide Bund
41	1389+600 - 1390+600	Left	Guide Bund
42	1391+500	Right	Sill and Guide Bund
43	1391+500 - 1393+000	Right	Guide Bund
44	1391+500 - 1392+700	Right	Stone rock disposal
45	1393+000	Right	Closure Bund
46	1388+500	Left	Groyn
47	1388+100	Left	Groyn
48	1387+700	Left	Groyn

49	1383+500 - 1382+800	Left	Bank protection
50	1382+800 - 1382+080	Left	Bank protection
51	0+080 - 0+250	Right	Guide Bund
52	1382+100 - 1382+900	Right	Guide Bund
53	1383+000	Right	Groyn
54	1380+500	Right	Groyn
55	1379+000	Right	Groyn
56	1380+800	Left	Groyn
57	1378+875 - 1379+300	Left	Bank protection
58	1380+150	Left	Groyn
59	1379+640	Left	Groyn
60	1379+100	Left	Groyn
61	1378+500	Left	Groyn
62	1373+000	Left	Bank protection
63	1374+170	Left	Sill with Closure Bund
64	1373+ 950	Left	Sill
65	1373+750	Left	Sill, Closure Bund
66	1374+060	Left	Sill
67	1373+865	Left	Sill
68	1361+550	Left	Groyn
69	1361+000	Left	Groyn
70	1361+550	Left	Closure Bund
71	1361+100	Right	Groyn
72	1360+700	Right	Groyn
73	1360+300	Right	Groyn
74	1359+850	Right	Groyn
75	1359+000	Right	Closure Bund
76	1367+850	Right	Groyn
77	1367+000	Right	Groyn
78	1355+300	Right	Sill
79	1355+100	Right	Sill
80	1354+900	Right	Sill
81	1349+830	Left	Groyn
82	1349+300	Left	Groyn
83	1348+800	Left	Groyn

84	1347+350 - 1349+350	Right	Bank protection
85	1308+000 - 1308+800	Right	Guide Bund
86	1309+300 - 1309+500	Right	Guide Bund
87	1308+400	Right	Groyn
88	1308+550	Right	Groyn
89	1309+000	Right	Closure Bund
90	1308+500 - 1309+800	Left	Guide Bund
91	1308+400 - 1310+300	Left	Bank protection
92	1289+500 - 1288+500	Right	Bank protection
93	1291+200 - 1291+400	Left	Bank protection
94	1294+570	Left	Groyn
95	1294+240	Left	Groyn
96	1293+950	Left	Groyn
97	1293+600	Left	Groyn
98	1291+400	Left	Groyn
99	1291+100	Left	Groyn
100	1291+000	Left	Groyn
101	1290+500	Left	Groyn
102	1293+900	Right	Guide Bund
103	1292+000	Right	Groyn
104	1291+500	Right	Groyn
105	1291+150	Right	Groyn
106	1287+300 - 1288+200	Right	Bank protection
107	1287+000	Right	Closure Bund
108	1287+000	Right	Groyn
109	1283+600	Left	Groyn
110	1280+400	Left	Groyn
111	1283+200	Left	Groyn
112	1276+780	Right	Groyn
113	1276+300	Right	Groyn
114	1275+700	Right	Groyn
115	1275+000	Right	Groyn
116	1274+700	Right	Groyn
117	1274+400	Right	Groyn
118	1273+800 - 1274+100	Right	Bank protection

119	1272+500	Right	Bank protection with Groyn
120	1276+560	Left	Bank protection
121	1276+200	Left	Guide Bund
122	1275+220 - 1274+750	Left	Bank protection
123	1272+560 - 1272+800	Left	Guide Bund
124	1272+250	Left	Groyn
125	1272+150 - 1272+290	Left	Bank protection
126	1271+150 - 1279+100	Left	Bank protection
127	1273+300 - 1272+200	Left	Bank protection
128	1272+100	Right	Groyn
129	1271+650	Right	Groyn
130	1271+250	Right	Groyn
131	1270+600	Right	Closure Bund with Groyn
132	1271+150 - 1269 + 150	Left	Bank protection
133	1264+700	Right	Groyn
134	1264+250	Right	Groyn
135	1263+800	Right	Groyn
136	1261+500 - 1262+600	Left	Bank protection
137	1227+915 - 1230+150	Left	Bank protection
138	1211-1209+500	Right	Bank protection
139	1209+000 - 1209+500	Right	Bank protection
140	1208+150 - 1208+500	Left	Bank protection
141	1214+700 - 1213+800	Left	Bank protection
142	1214+300	ADA	Bank protection
143	1214+300	ADA	Closure Bund
144	1214+200 - 1214+500	ADA	Bank protection
145	1208+150 - 1207+660	Left	Bank protection
146	1214+364 - 1213+650	Right	Stone rock disposal
147	1213+100	Left	Groyn
148	1212+800	Left	Groyn
149	1212+600	Left	Groyn
150	1219+000	Right	Groyn
151	1218+500	Right	Groyn
152	1218+000	Right	Groyn
153	1217+200	Right	Groyn

154	1216+550	Right	Groyn
155	1215+800	Right	Groyn
156	1215+000	Right	Groyn
157	1214+200	Right	Closure Bund
158	1211+000	Left	Groyn
159	1209+000	Left	Groyn
160	1221+800 - 1222+700	Left	Guide Bund
161	1224+000	Right	Groyn
162	1223+700	Right	Groyn
163	1184+500 - 1184+200	Left	Bank protection
164	1184+400 - 1184+000	Left	Guide Bund
165	1184+200	Left	Groyn
166	1183+700	Left	Groyn
167	1183+200	Left	Groyn
168	1182+700	Left	Groyn
169	1182+100	Left	Groyn
170	1181+500	Left	Groyn
171	1180+000	Left	Groyn

5.3. Common sector, waterway maintenance

In Serbia, on the Danube, there are two common sectors:

- from the Hungarian border at km 1433 to Bačka Palanka at km 1295 where the river forms the border between Serbia and Croatia;
- from km 1075 till the Bulgarian border at km 845, and forms the border between Serbia and Romania.

Border line between Croatia and Serbia on the Danube is still not defined. Nevertheless, countries are trying to cooperate in various ways on technical level in order to overcome potential consequences to navigation caused by the number of bottlenecks.

In October 2009 Ministries from both countries have signed bilateral agreement between Croatia and Serbia, as a platform for technical actions. It is a great step forward and we all expect big development in common waterway maintenance after the agreement is being ratified by both parliaments.

On the Croatian – right side of the Danube River, there is a nature park Kopacki Rit, one of the most important, largest and most attractive preserved intact wetlands in Europe. It attracts not only visitors but also many experts and scientists from the whole region.

On the Serbian – left side of the Danube, there is a town of Apatin, with it's shipyard, port and marine. The town of Apatin is the administrative, economic, cultural, educational and tourist centre with more than 20.000 inhabitans and as many as 24 ethnic groups.

These two different areas exists closely side by side, but between them the heaviest section for navigation among two coutries is situated. Main stream splits into two branches forming large sandy island. Both river banks are heavily endangered and Danube impend to change the coarse, enter into the Kopacki rit, and leave Apatin without water. At the moment, few different aims are to be achived from both countries: ensure safe navigation by marking the left and the right side of the fairway in accordance with daily hydrological conditions, protect the river banks from future failure, and the bigest challenge among them all – to find resources for fiancing large river training works taking into account enviromental aspect of the problem concerning Kopacki Rit.

This leads us to a potential workshop on inland navigation matters which could be organized in this area under the hat of NEWADA project. This is an initial idea which is going to be discuused with the other NEWADA partners, and depending on a interest expessed for it, the idea might arise to the usefull event.

On the other hand, cooperation with representatives of the Romanian dates far in the past. Although this sector of the Danube navigation problems are not expressed as at the common sector with Croatia, there are many topics on which the exchange of experience would be useful.

Currently, cooperation is most based on communication through the ENC group related to RIS, but the common opinion is that the working group related exclusively to the problems of navigation should be re-activated in order to exchange and improve the quality of the information.

Here are some **challenges for the Future:**

- Overcomingthe obstacles in bilateral relationships
- Improving cross-border cooperation in the region
- Applying European standards in IWT
- Promoting inland waterway transportation

5.4. Waterway maintenance in the ice period

During the ice period survey activities are not performed since Plovput does not have a vessel equipped to work in the icy conditions.

During the ice period we are using standard signalization. Number of floating signals from Dec 15th to March 15th (period of potential ice appearance) is reduced to the minimum needed for the safe navigation. Sometimes, when the winter is mild, this period of reduction is shorter or not applied at all.

Signalization is managed regularly every 10 days or if current hydrological conditions demand- more frequently. When it is certain that the ice float will continue to increase, all floating signals are withdrawn from the river surface. The only signals left are the one on the river banks. This remains until the ice danger passes.

5.5. Waterway maintenance in the lowest level period

During the low level periods hydrographic survey is performed only at sectors where navigation conditions are critical, if necessary.

In the lower level period signalization activity is higher than usual and in conjunction with water level tendencies especially from rkm1170 till rkm1433. Buoys are managed every 7 days regularly or every few days if an unplanned intervention is needed (change in river bed caused by a ship run aground or signal failure/destruction).

5.6. Waterway maintenance in the highest level period

During the high level periods, hydrographic survey is performed only at critical sectors.

In the highest level period floating signalization can be reduced in order to reduce the risk of damaging it. When Port Authority is about to declare the navigation prohibition, all floating signs are either pulled out from the river or removed from their position (laid aside from the river main stream and drawn to the bank).

Buoys are managed every 7-10 days regularly or every few days if it is needed (huge amounts of floating debris or if a buoy drifts away).

5.7. Report about the prevention and restoration of flood damages

Flood control in Republic of Serbia is under the authority of the Ministry of Agriculture, Forestry and Water Management. Public Water Management Companies ''Srbijavode'' and ''Vode Vojvodine'' are set up to implement water management (including flood control), and they are entrusted with management of water regions and water structures, as public property owned by the state. Forty-five public and 10 other water management companies are involved in maintenance, flood control, and rehabilitation of flood protection structures in Serbia.

During the flood period skippers are informed about every major event trough NOTICES TO SKIPPERS that are issued by Port Authorities and distributed on internet, via media, fax, e-mail etc.

After the flood period, most damage suffers coastal signalization which is most of the time greatly submerged in rising water. Signs are being ripped away or distorted in position due to the land slide caused by waves or river rise, or floating debris pressuring the sign body. Most of the damaged coastal signs can be retrieved and repaired afterwards.

Floating signs that are left in the position are often damaged and overrun by the ships or drift away and permanently lost.

5.8. Planning for lock maintenance and repairing

On the Serbian section of the Danube River two hydropower plants with navigation locks were constructed – Iron Gate (Djerdap) I and Iron Gate (Djerdap) II. Both dams are located on the joint sector with Romania, and navigation locks are located on both sides. On the Serbian side company "HE Djerdap", in close cooperation with Romanian side, is in charge of maintenance of the whole structure and all accompanying objects of the hydro-power and navigation system Iron Gate. Since its construction in 1971 navigation lock at Iron Gate I dam did not have any major reconstructions, and in 2006 in Master plan and feasibility Study on Inland Waterways in Serbia, complete overhaul of that navigation lock was listed as one of the priority projects in the field of inland navigation on Serbian section of the Danube River. Design documentation was prepared and funded by EU.

Navigation lock at the Iron Gate II was put into operation in 1985, and is currently operational, and no major reconstruction is planned for near future.

Plovput has close cooperation with "HE Djerdap". Users of the waterway are informed on any works on the locks via Notices to skippers published by Plovput's RIS system and web page.

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