“NETWORK OF DANUBE WATERWAY ADMINISTRATIONS”

South-East European Transnational Cooperation Programme

CONCEPT FOR OPTIMUM INTERRELATION BETWEEN MAINTENANCE WORK AND RIVER ENGINEERING PROJECTS

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1 LIST OF ABBREVIATIONS

ABBR.	Abbreviation
WFD	Water Framework Directive
IWT	Inland Waterway Transport
DC	Danube Commission
NtS	Notices To Skippers

2 SCOPE OF DOCUMENT

The main objective of the Task 4.1.3. is to prepare a concept for optimum interrelation between maintenance work and river engineering projects.

Based of the **Compilation of National Status quo report for the waterway maintenance** and the **Study about the impacts of the WFD for ecological optimised waterway maintenance,** the concept will improve the interrelation between maintenance work and river engineering projects.

3 INTRODUCTION

Rivers are sources of water for consumption, agriculuture and industry. Rivers also transport sediments that create alluvial landscapes and are essential for the ecological health of many aquatic, riparian and wetland systems. Rivers provide transportation routes, energy and a means of disposal of waste. River valleys offer a relatively flat area for construction.

Rivers have also been important sites for development because of the need for reiable transportation. The advancement of navigation and the transport of people and goods by water have long supported mankind`s social and economic development. Inland Waterway Transport (IWT) has come to be recognized as a energy-saving as well as cost-effective mode of transport.

Development of IWT

Inland navigation offers important opportunities to move cargos on the Danube and its tributaries instead of on the roads, in an energy efficient manner (e.g. with regard to costs of goods transported per tonne - kilometre). It can contribute to mitigating road congestion on some routes. Making more intensive use of the free capacities of the Danube basin waterways can contribute to coping with traffic volumes in a manner that is environmentally and socially friendly, taking advantage of non-structural measures (such as fleet innovation) as well as infrastructure investments. Inland navigation thus needs to participate in future transport growth by maintaining or expanding its current modal-split within the Danube corridor. Forecasts indicate that this could result in a doubling of transport volumes on the Danube within the next 10 years. Currently, the percentage of shipping in total transport volume in the Danube region is below 10%.

4 WATERWAY MAINTENANCE WORKS

A waterway is any navigable body of water. Waterways are the cheapest mode of transport since it's fuel efficient.

These include rivers, lakes, seas, oceans, and canals. In order for a waterway to be navigable, it must meet several criteria:

- The waterway must be deep enough to allow the draft depth of the vessels using it;
- The waterway must be wide enough to allow passage for the beam width of the vessels using it;
- The waterway must be free of barriers to navigation such as waterfalls and rapids, or have a way around them (such as canal locks and boat lifts);
- The current of the waterway must be mild enough to allow vessels to make headway.

Overview about all activities for waterway maintenance that was already concluded in the result of the output 4.8. and from the output O 4.10, regarding the characteristic of waterway, fords (bottlenecks), Hydrology, hydrography, survey, dredging, river engineering projects, signalization, etc.

Navigation is governed by a variety of national and international legislative instruments ensuring safety of navigation.

In order to facilitate economic and safe IWT the following points describe the basic needs for all IWT related infrastructure projects.

Minimum fairway (depth and width) dimensions designed for individual river sections in the context of and based on a strategic understanding of basin-wide IWT requirements including:

- Depth and width of fairway with a view to continuity of availability of sustainable and efficient navigation conditions.

- Curve radius

Construction and maintenance e.g.:

- Low-water regulation by hydraulic structures (e.g. groynes)

- Dredging and refilling of material

Infrastructure to be located taking into account relevant physical and other factors (e.g. proximity to market and connectivity to the wider transport network)

4.1. CHARACTERISTIC OF WATERWAY

Classification of European inland waterways of international importance and the waterway parameters.

According to the Danube Commission …………………. Décision de la Cinquante-troisième session de la Commission du Danube du 12 avril 1995 (doc. CD/SES 53/33 point 2) :

Secteurs :

- Kelheim-Regensburg V « b » ;
- Regensburg-Vienne VI « b » ;
- Vienne-Belgrade VI « c » ;
- Belgrade-Sulina VII

Système de classification de la CEE-ONU conformément à l'**Accord** européen sur les grandes voies navigables d'importance internationale (**AGN**) (ECE/TRANS/120/Rev.1).

…………………

Lieu	Km de fleuve	Longueur	Classe de la CD		Gabarits maxima de bateaux et convois			Hauteur minimale de la passe libre du pont [m]	**	Remarques
			Prévu	Effectif	Longueur*** (m)	Largeur*** [m]	Tirant d'eau [m]			
1	2	3	4	5	8	9	10	11	12	13
Kelheim	2411.6									
		34.8	Vb	Vb[21]	110,0/185,0	11,45/11,45	2,70 [63]	6.00	B	
					110,0/185,0	11,40/11,40	2,70 [63]	6.00	B	
Regensburg	2376.8									
		48.4	VIb	VIb[64]	110,0/185,0	11,45/22,90	2,70 [63]	8.00	A	
					110,0/185,0	11,40/22,80	2,70 [63]	5,75 [65]	A	
	2328.4									
		79.4	VIb	VIa[20 21 28]	110,0/185,0	11,45/22,90[66]	2,70 [63]	8.00	A	
					110,0/110,0	11,40/22,80[66]	2,70 [63]	4,74 [65 67]	B	
	2249.0									
		47.2	VIb	VIb[20 21 64]	120,0/180,0	22,90/22,90	2,70 [63]	8.00	A	
					120,0/185,0	22,80/22,80	2,70 [63]	4,61 [68]	B	
	2201.8									
		163.6	VIb	VIb	…/230,0	23,00/23,00	3,00 [69]	8.00	A	
					…/230,0	23,00/23,00	3,00 [69]	7,42 [70]	A	
	2038.2									
		30.2	VIb	VIb	…/230,0	23,00/23,00	3,00 [71]	8.00	A	
					…/230,0	23,00/23,00	3,00 [72]	8.00	A	
	2008.0									
		58.8	VIb	VIb	…/230,0	23,00/23,00	3,00 [69]	8.00	A	
					…/230,0	23,00/23,00	3,00 [69]	7,85 [73]	A	
	1949.2									
		28.2	VIb	VIc	…/275,0	23,00/23,00	3,00 [69]	8.00	A	
					…/275,0	23,00/23,00	3,00 [69]	8.00	A	
Vienne	1921.0	40.7	VIc	VIb	…/195,0	23,00/23,00	3,00 [71]	10.00	A	vers l'aval : max. 4 lighters/bateaux-marchands
					…/110,0	23,00/35,00				
					…/195,0	23,00/23,00	3,00 [72]	10.00	A	
					…/110,0	23,00/35,00				
Devin	1880.3				…/275,0	23,00/12,00	3,00 [71]	10.00	A	vers l'amont : max 4 lighters/bateaux-marchands
					…/195,0	23,00/23,00				
					…/275,0	23,00/12,00	3,00 [72]	10.00	A	
					…/195,0	23,00/23,00				
		18.3	VIc	VIb	…/275,0	22,80/22,80	3.50	9.10	A	vers l'aval
					…/195,0	22,80/34,20	2.50	7,06 [74]	A	
Bratislava	1862.0				…/275,0	22,80/22,80	3.50	9.10	A	vers l'amont
					…/195,0	22,80/22,80	2.50	7,06 [74]	A	
		51.0	VIc	VIc	275,0/275,0	33,40/33,40	3.50	9.10	A	
Sap	1811.0				275,0/275,0	33,40/33,40	3.50	9.10	A	

Fig. 1 – Sector Kelheim – Sap

In the next two figures, wil come information for the sectors:

Lieu	Km de fleuve	Longueur	Classe de la CD		Gabarits maxima de bateaux et convois			Hauteur minimale de la passe libre du pont [m]	**	Remarques
			Prévu	Effectif	Longueur*** (m)	Largeur*** [m]	Tirant d'eau [m]			
1	2	3	4	5	8	9	10	11	12	13
Sap	1811.0	1809.0	VIc	VIc	195,0/275,0	22,80/33,40	3.50	9.10	A	vers l'aval
					195,0/140,0	22,80/33,40	1.70	9.10	A	
					195,0/275,0	33,40/33,40	3.50	9.10	A	vers l'amont
Kliszka Nema	1791.0				195,0/195,0	33,40/33,40	1.70	9.10	A	
		-1706.2	VIc	VIc	195,0/275,0	22,80/33,40	3.50	9.10	A	vers l'aval
					195,0/140,0	22,80/33,40	1.70	9.10	A	
					195,0/275,0	33,40/33,40	3.50	9.10	A	vers l'amont
Szob	1708.2				195,0/195,0	33,40/33,40	1.70	9.10	A	
		56.2	VIc	VIb	…/…	…/…	…	…	A	
					pas de restrictions	pas de restrictions	1.70	…	A	
Budapest	1652.0	9.5	VIc	VIb	…/…	…/…	…	…	A	vers l'aval
					…/175,0	…/50,00	2.50	7,30 [76]	A	
					…/…	…/…	…	…	A	vers l'amont
	1642.5				…/240,0	…/35,00	2.50	7,30 [76]	A	
		209.5	VIc	VIc	…/…	…/…	…	…	A	secteur à courant libre
	1433.0				pas de restrictions	pas de restrictions	1.70	8,40 [77]	A	
		67.0	VIc	VIc	110,0/280,0	11,40/34,20	2.50	9.10	A	secteur à courant libre
	1366.0				pas de restrictions	pas de restrictions	2.50	8.20	A	
		70.5	VIc	VIc	110,0/280,0	11,40/34,20	2.50	9.10	A	secteur à courant libre
	1295.5				pas de restrictions	pas de restrictions	2.50	9.70	A	
		80.5	VIc	VIc	110,0/285,0	11,40/22,80	…	8.15	A	secteur à courant libre
	1215.0				110,0/285,0	11,40/22,80	2.50	6,82 [78]	B	
		40.0	VIc	VIc	110,0/285,0	11,40/35,00	…	…	A	secteur à courant libre
Belgrade	1175.0				pas de restrictions	pas de restrictions	2.50	k.E.	A	
		100.0	VII	VII	…/…	…/…	…	…	A	canal
	1075.0				pas de restrictions	pas de restrictions	3.50	9.15	A	
		128.0	VII	VII	…/…	…/…	…	…	A	canal
	947.0				pas de restrictions	pas de restrictions	3.50	k.E.	A	
		16.0	VII	VII	…/…	…/…	…	…	A	canal
	931.0				…/300,0	…/33,00	4,50 [79]	10,00 [79]	A	
		65.0	VII	VII	…/…	…/…	…	…	A	canal
					pas de restrictions	pas de restrictions	3.50	k.E.	A	
	866.0									

Fig. 2 - Sap to Belgrade;

Fig. 3 - Belgrade to Sulina

Lieu	Km de fleuve	Longueur	Classe de la CD		Gabarits maxima de bateaux et convois			Hauteur minimale de la passe libre du pont [m]	**	Remarques
			Prévu	Effectif	Longueur*** (m)	Largeur*** [m]	Tirant d'eau [m]			
1	2	3	4	5	8	9	10	11	12	13
	866.0									
		6.0	VII	VII	../..	.../...	...	...	A	secteur à courant libre à partir du km 863,0
	860.0				.../300,0	.../33,00	4,50 [79] 3,50 [80]	10,00 [79] 17,70 [80]	A	
		15.0	VII	VII	.../...	.../...	...	...	A	secteur à courant libre
	845.0				pas de restrictions	pas de restrictions	2.50	k.E.	A	
		675.0	VII	VII	.../...	.../...	...	...	A	secteur à courant libre
	170.0				pas de restrictions	pas de restrictions	2,50 [44]	9.50	A	
		170.0	VII	VII	.../...	.../...	...	...	A	secteur à courant libre
Sulina	0.0				pas de restrictions	pas de restrictions	7,30 [44]	38.00	A	
Canal Danube-mer Noire		64.4	VIc	VIc	138,3/296,0	16,80/23,50	5,50/3,80	16.5	A	

ligne supérieure	-	valeur prévue
ligne inférieure	-	valeur effective

* Différence entre la classification de la CEE-C

** A - agréé pour des transports combinés

B - agréé avec restrictions

*** données diverses pour les bateaux isolés/convois

20	Les prescriptions à l'égard des passes libres des ponts ne sons pas observées
21	Il existe des restrictions concernant le croisement des bateaux
28	La profondeur du parcours navigable ne peut pas être garantie (en fonction du niveau de l'eau)
63	Valable pour l'étiage navigable et de régularisation (ENR) pendant 96 % de la période libre de glaces, calculée d'après les débits observés durant 40 ans
64	Les gabarits maxima (longueur et largeur) des bateaux isolés ne sont pas observés
65	Pont-route de Pfatter
67	Pont-rail de Deggendorf
68	Pont de Passau
69	Tirant d'eau maximum conformément au règlement de police ; profondeur du parcours navigable 2,70 m auprès de l'étiage navigable
70	Pont-route-rail de Linz
71	Tirant d'eau maximum conformément au règlement de police; profondeur du parcours navigable 3,00 m auprès de l'étiage navigable
72	Tirant d'eau maximum conformément au règlement de police ; profondeur du parcours navigable 2,20 m auprès de l'étiage navigable sur certains secteurs
73	Pont-route de Stein/Mautern
74	Pont de Bratislava (km 1868,1). Auprès d'un niveau de +619 cm à la station hydrométrique Bratislava/Devin
76	Pont des chaînes de Budapest (km 1647,0)
77	Pont de Baja (km 1480)
78	Pont-route-rail provisoire de Novi-Sad (km 1254)
79	Données du gouvernement de Serbie. Le tirant d'eau et la passe libre des ponts allant jusqu'à 5,0 m et respectivement 13,50 m sont assurés le cas échéant sur paiement des frais encourus
80	Données du gouvernement de Roumanie

The essence of the DC recommendation is that the dimensions of the waterway must be ensured compared to a low-water navigation, the so-called "DC low-water level". This low-water level is calculated from the ice-free water discharges of the preceding 30 years, and it corresponds to the water level of water discharges with 94% durability.

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 [3] d (m)	Tonnage T (t)		Length L (m)	Beam B (m)	Draught [6] d (m)	Tonnage T (t)	H (m)	
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 [5]	2.50-2.80	1,250-1,450	5.25 or 7.00 [4]	
	Va	Large Rhine vessels	95-110	11.4	2.50-2.80	1,500-3,000		95-110 [1]	11.4	2.50-4.50	1,600-3,000	5.25 or 7.00 or 9.10 [4]	
	Vb							172-185 [1]	11.4	2.50-4.50	3,200-6,000		
	VIa							95-110 [1]	22.8	2.50-4.50	3,200-6,000	7.00 or 9.10 [4]	
	VIb	[3]	140	15.0	3.90			185-195 [1]	22.8	2.50-4.50	6,400-12,000	7.00 or 9.10 [4]	
	VIc							270-280 [1]	22.8	2.50-4.50	9,600-18,000	9.10 [4]	
								195-200 [1]	33.0-34.2 [1]	2.50-4.50	9,600-18,000		
	VII						[2]	275-285	33.0-34.2 [1]	2.50-4.50	14,500-27,000	9.10 [4]	

Fig. 4 – Table of type of inland waterways

4.2. Fords (Bottlenecks)

As recommended by the Danube Commission, navigation gauges are the following parameters: depth, width and radius of curvature. Thus, if one of the parameters are set by the Danube below, the area is a critical point for navigation (bottleneck).

Thus, all critical points are identified for the entire Danube navigation in Austria, Slovakia, Hungary, Croatia, Serbia, Romania and Bulgaria in the number of 186. Depth is the most common parameter that can not be ensured, then the final width and radius of curvature.

In the bellow table (Acti. 4.1 – Compilation of the results):

	A	B	C	D	E	F	G	H	I	J	K	L	M
1			LP					PP1		PP2			
2			via-donau					SVP		VKKI			
3			name, rkm	rkm		width/position	depth						
4	1	bottlenecks	Aggsteiner Wände	2029.8	2030.8	right river bank	27	Devín, 1879,5 - 1879,2	depth	Patkószigeti szűkület	1807.8	1807.7	width
5	2	bottlenecks	Aggsbach/Markt	2027.5	2028.2	left river bank	25	Käsmacher, 1875,7 - 1875,0	depth	Medvei szűkület	1806.6	1806.2	width
6	3	bottlenecks	Aggsbach	2025.3	2026.3	in the middle	25	Lafranconi, 1871,2 - 1870,9	width	Szőgyei szűkület	1800.4	1798.7	width
7	4	bottlenecks	Aggstein	2024.2	2025.3	in the middle	25	Starý most, 1868,2 - 1868,0	width	Csicsói szűkület	1797.6	1796.6	width
8	5	bottlenecks	Schwallenbach	2022.0	2022.5	in the middle	25	Medveďov, Medve 1807,0 - 1805,8	depth	Véneki szűkület	1797.6	1794.4	width
9	6	bottlenecks	Hinterhaus	2019.4	2020.5	right river bank	25	Nagybajcs, 1803,2 - 1802,5	depth	Gönyűi felső szűkület	1792.2	1791.7	width
10	7	bottlenecks	Hofarnsdorf	2018.5	2019.0	in the middle	25	Číčov, Vének, 1800,6 - 1794,1	depth	Gönyűi alsó gázló	1789	1788.4	depth
11	8	bottlenecks	Bacharnsdorf	2017.2	2018.2	right river bank	25	Kľúčska Nemá, Gönyü 1792,1 - 1791,8	depth	Szőnyi gázló	1764.3	1763.9	depth
12	9	bottlenecks	Wösendorf	2016.0	2016.7	left river bank	25	Čenkov, Nyergesújfalu 1735,3 - 1732,2	depth	Almásfüzitői gázló	1757	1756.6	depth
13	10	bottlenecks	Weißenkirchen	2013.5	2014.0	in the middle	25	Kováčov, 1714,5 - 1713,9	depth	Karvai szűkület	1740	1739.7	width
14	11	bottlenecks	Dürnstein	2008.9	2010.2	right river bank	25	Chľaba 1711,2 - 1710,9	depth	Nyergesi gázló	1735.1	1733.7	depth
15	12	bottlenecks	Rothenhof	2005.2	2005.9	whole fairway width	27			Nyergesi szűkület	1732.9	1732.3	width
16	13	bottlenecks	Albern	1918.1	1918.4	left river bank	25			Ebedi gázló	1728.1	1724	depth
17	14	bottlenecks	Buchenau	1911.9	1912.2	right river bank	25			Istenhegyi gázló	1724	1722	depth
18	15	bottlenecks	Buchenau	1910.9	1911.6	left river bank	25			Garamkövesdi gázló	1714.5	1713.9	depth
19	16	bottlenecks	Kuhstand	1909.8	1910.4	left river bank	25			Helemba-szigeti gázló	1713.1	1709.9	depth
20	17	bottlenecks	Fischamend	1907.7	1908.5	left river bank	25			Dömösi szűkület	1701	1700	width
21	18	bottlenecks	Pfarrgraben	1906.5	1907.2	right river bank	25			Dömösi gázló	1698.9	1697.8	depth
22	19	bottlenecks	Orth	1902.1	1902.7	left river bank	25			Visegrádi szűkület	1695.1	1694.5	width
23	20	bottlenecks	Orth	1901.1	1901.6	right river bank	25			Vác I. szűkület	1683	1680.8	width
24	21	bottlenecks	Regelsbrunn	1898.0	1898.8	in the middle	25			Vác II. szűkület	1680.5	1679.8	width
25	22	bottlenecks	Rote Werd	1895.5	1896.5	in the middle	25			Sződligeti szűkület	1675.5	1675	width
26	23	bottlenecks	Petronell	1892.3	1892.8	right river bank	25			Gödi gázló	1668.5	1666.7	depth
27	24	bottlenecks	Petronell	1891.9	1892.5	left river bank	25			Árpád-hídi gázló	1653	1651.4	depth
28	25	bottlenecks	Rübenhaufen	1890.1	1891.2	right river bank	25			Budafoki gázló	1638.7	1637.3	depth
29	26	bottlenecks	Schwalbeninsel	1888.8	1890.0	left river bank	25			Százhalombattai szűkület	1623.7	1622.6	width
30	27	bottlenecks	Treuschütt	1887.6	1888.4	in the middle	25			Dunafüredi szűkület	1619.2	1617.8	width
31	28	bottlenecks	Schanzl	1885.0	1886.1	right river bank	25			Ercsi szűkület	1616.8	1615.8	width
32	29	bottlenecks	Hainburg	1883.5	1884.7	left river bank	25			Kulcsi gázló	1590.7	1590.1	depth
33	30	bottlenecks	Röthelstein	1882.4	1883.5	left river bank	25			Dunaújvárosi gázló	1581.5	1579.3	depth
34	31	bottlenecks	Röthelstein	1881.0	1881.8	right river bank	25			Kisapostagi szűkület	1570.1	1568.9	width
35	32	bottlenecks	Wendeplatz Theben	1879.1	1879.8	in the middle	25			Kisapostagi gázló	1567.3	1565.7	depth
36	33	bottlenecks	Theben	1877.4	1878.5	left river bank	25			Dunaföldvári (felső) gázló	1561	1560	depth
37	34	bottlenecks	Käsmacher	1875.1	1875.7	in the middle	25			Dunaföldvári gázló	1559.8	1559.7	depth
38	35	bottlenecks	Staatsgrenze	1872.4	1873.5	in the middle	25			Dunaföldvári jégmegállásra hajlmamos hely	1560.6	1558	radius
39										Solti gázló	1558.5	1557.5	depth
40								width		Solt alsó gázló	1555.8	1554.8	depth
41								depth		Bölcskei hajóút szűkület	1551.5	1551.4	width
42								radius		Hartai jégmegállásra hajlamos hely	1548	1546	radius
43										Paksi szűkület	1530.5	1529.5	width
44										Barákai gázló	1522	1521.5	depth
45										Kovácspusztai gázló	1512.5	1511.8	depth
46										Siótoroki jégmegállásra hajlamos hely	1499	1497	radius
47										Korpádi szűkület	1493.5	1492.5	width
48										Koppányi szűkület	1483.5	1482.5	width
49										Bajai szűkület	1480.1	1479.1	width
50										Bajai jégmegállásra hajlamos hely	1482	1480	radius
51										Sárospart I. szűkület	1475.5	1474.5	width
52										Sárospart II. szűkület	1472.5	1471.5	width
53										Sárosparti jégmegállásra hajlamos hely	1472	1470	radius
54										Szeremlei szűkület	1469	1468	width
55										Mohácsi szűkület	1451.5	1450.5	width
56										Repityi szűkület	1439.5	1438.5	width
57										Sirinai jégmegállásra hajlamos hely	1439	1438	radius
58										Bédai szűkület	1435.5	1434.5	width

Fig. 5 – Table of bottlenecks from Austria, Slovakia and Hungary

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
PP5					PP6		PP7		IPA1		IPA 2	
AFDJ					CAN		EA EMDR		APP		PLOVPUT	
				depth								
Salcia	820.0	823.0	depth	25	DANUBE km 300- crossing point with CDMN	depth	Chayka, rkm 386 - 382	depth	Šarkanj (rkm 1427-1429)	width	Bezdan, 1428-1426	width
Bogdan Sacian	783.0	785.0	depth	25	CDMN-km 59 -Cernavoda locks	width	Vetren, rkm 395 - 390	depth	Monjoroš (rkm 1412)	depth	Apatin, 1405-1400	width
Pietrisu Dobrina	756.0	758.0	depth	25	CDMN- km 29 -crossing point CPAMN	width	Popina, rkm 407 - 402	depth	Apatin (rkm 1410-1400)	depth	Čivutski rukavac, 1397-1396	width
Linovo	737.0	739.0	depth	25	CDMN-km 2- Agigea locks	width	Dunavets, rkm 424 - 420	depth	Apatin (rkm 1395-1394,3)	depth	Vemelj-Petres, 1394-1389	radius
Bechet	676.0	678.0	depth	25	CPAMN-km 11- Ovidiu locks	width	Kosui, rkm 426 - 424	depth	Petreš (rkm 1393)	width	Staklar, 1375-1373.1	radius
Corabia	629.0	631.0	depth	25	CPAMN-km 1- Navodari locks	width	Brashlyan, rkm 458 - 455	depth	Vemelj (rkm 1391,3-1390,5)	depth	Dalj, 1354.6-1354.4	width
Turcescu	344.0	345.0	depth	25			Mishka, rkm 464 - 460	depth	Aljmaš (rkm 1377,1-1374,9)	depth	Savulja, 1348-1347	width
Caragheorghe	343.0	344.0	depth	25			Gostin, rkm 476 - 474	depth	Savulja (rkm 1348-1347)	depth	Mohovo, 1314-1308	width
Lebada	336.0	337.0	depth	25			Ruse-Giurgiu bridge, rkm 490 - 486	depth	Vukovar (rkm 1333-1331)	depth	Susek, 1288.2-1284.8	width
Marleanu	325.0	326.0	depth	25			Batin, rkm 526 - 522	depth	Vučedol (rkm 1331-1330,5)	depth	Futog, 1265.2-1264.5	width
Fermecatu amonte	322.0	323.0	depth	25			Vardim, rkm 545 - 542	depth	Sotin (rkm 1322,2-1321,7)	width	Arankina ada, 1246.6-1245.8	width
Fermecatu aval	317.0	318.0	depth	25			Condur, rkm 564 - 560	depth	Mohovo (rkm 1311-1315)	depth	Sremski Karlovci, 1240.8-1240.4	width
Cernavoda	296.0	297.0	depth	40			Belene island, rkm 568 - 564	depth			Cortanovci, 1236	width
Seimeni	291.0	292.0	depth	40			Milka island, rkm 572 - 568	depth			Beska, 1231-1227.8	width
Seimeni-Fasole	288.7	292.0	depth	40			G. Barzina, rkm 576 - 573	depth			Prahovo, 862-858	depth
Capidava	279.0	281.2	depth	40			Palets, rkm 586 - 584	depth				
Albanesti	275.0	276.0	depth	40			Somovit, rkm 610 - 608	depth				
Harsova	250.0	252.0	depth	40								
Giurgeni	242.0	245.0	depth	40								
Galati	153.0	155.0	depth	73.2								
Prut upstream	135.2(MM73)	137(MM74)	depth	73.2								
Reni downstream	113(MM61)	116.7(MM63)	depth	73.2								
Isaccea	103.7(MM56)	107.4(MM57)	depth	73.2								
Tulcea upstream	74.1(MM41)	75.9(MM42)	depth	73.2								
Partizani(Rostock)	55.6(MM30)	57.4(MM31)	depth	73.2								
Bara Sulina	-7.7 (HM77)	-9.0 (HM90)	depth	73.2								
Borcea	98.3	99.3	depth	25								
Borcea	96.7	97.7	depth	25								
Borcea	92.7	93.7	depth	25								
Bordusani	22.0	24.0	depth	25								
Piatra Frecatei(Macin)	62.0	63.0	depth	25								
Bedeloiu(Macin)	42.0	43.0	depth	25								
Carcaliu(Macin)	25.0	27.0	depth	25								
Tatanir(Chilia)	75.0	76.0	depth	25								
Ada Marinescu (Sf.Gheorghe)	101.0	103.0	depth	25								

Fig. 6 – Table of bottlenecks from Romania, Bulgaria, Croatia and Serbia

4.3. Hydrology, Hydrography and survey

Over the course of the Danube in Austria up to Romania are gathering various parameters that provide information necessary for navigation, such as water level, water and air temperature, visibility, atmospheric pressure, wind speed and direction, humidity and appearance of ice.

Note, as more systems are used for reference level, Adriatic Sea, Baltic Sea, Black Sea Sulina, etc.. Also, it is provided information on forecast. All data are stored in an archive and are submitted for information by radio / web / NTS / paper / email / sms.

Because they are used, different equipment to determine depth, different acquisition and processing software, different positioning equipment, it can identify the most appropriate way of working on the measurements, the best practice case.

The results are roughly comparable format. (DXF, DWG, SHP, DGN, txt, ASCII, xls) All partners positioning using GPS and differential correction in measurements made using different equipment.

After the measurements are done, it is made a project for signaling, establishing a signaling scheme for position buoys.

	A	B	C	D	E	F	G	H	I	J
1		partner/parameter	LP	PP1	PP2	PP5	PP6	PP7	IPA1	IPA2
2			via-donau	SVP	VKKI	AFDJ	ACN	EAEMDR	APP	PLOVPUT
3	1	owner of the data	public	public	public	public	privat	public	public	public
4	2	hydrometeostation	190	7	69	23	0	6	4	15
5	3	reference level (name)	Meter above Adria	"0" of hydrometeostation	Meter above Baltic	meter above MNS	RMB	YES Baltic	YES	YES
6	4	water level	YES	YES	YES	YES	YES	YES	YES	YES
7	5	water temperature	YES	YES	YES	YES	YES	YES	YES	YES
8	6	air temperature	NO	YES	YES	NO	YES	YES	NO	NO
9	7	visibility	NO	NO	YES	NO	NO	YES	NO	NO
10	8	Atmospheric pressure	NO	NO	YES	NO	NO	YES	NO	NO
11	9	Speed and direction of the wind	NO	NO	YES	NO	NO	YES	NO	NO
12	10	humidity	NO	NO	YES	NO	NO	YES	NO	NO
13	11	ice appearance	YES	YES	YES	YES	YES	YES	YES	YES
14										
15	12	forecast	2	1	3	0	7*	2	0	4
16	13	data stored	YES	YES	YES	YES	YES	YES	YES	YES
17	14	transmit data	radio/sms/Nts/paper/email	Nts,web site,	radio/email/web/paper	radio/paper/web	YES**	radio/paper/email	radio/paper/email	radio/paper/email
18		public / privat								
19		how many station								
20		yes / no								
21		how many days?								
22		radio/sms/Nts/paper/email								
23		ACN								
24		RMB- Baltic Sea Reference								
25		*- the water level ,daily, from AFDJ Galati site								
26		*-forecast for next 7 days taken from National Institute for Hydrology and Water Management								
27		**-datas are colected, automatically, from working place by radio								
28		**-data could be available by paper or email								
29		PLOVPUT								
30		Remark: this data apply to hydrologic stations at the Danube river stretch in Serbia, not to hydrometeo stations in Serbia								
31		APP								
32		water temperature available for 1 station								

Fig. 7 – Table of comparison regarding the survey parameters

4.4. Assessment of the ford

The main recurrent and interdependent tasks with regard to the maintenance of the fairway are:

- 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)

Following figure displays the interrelation between these activities:

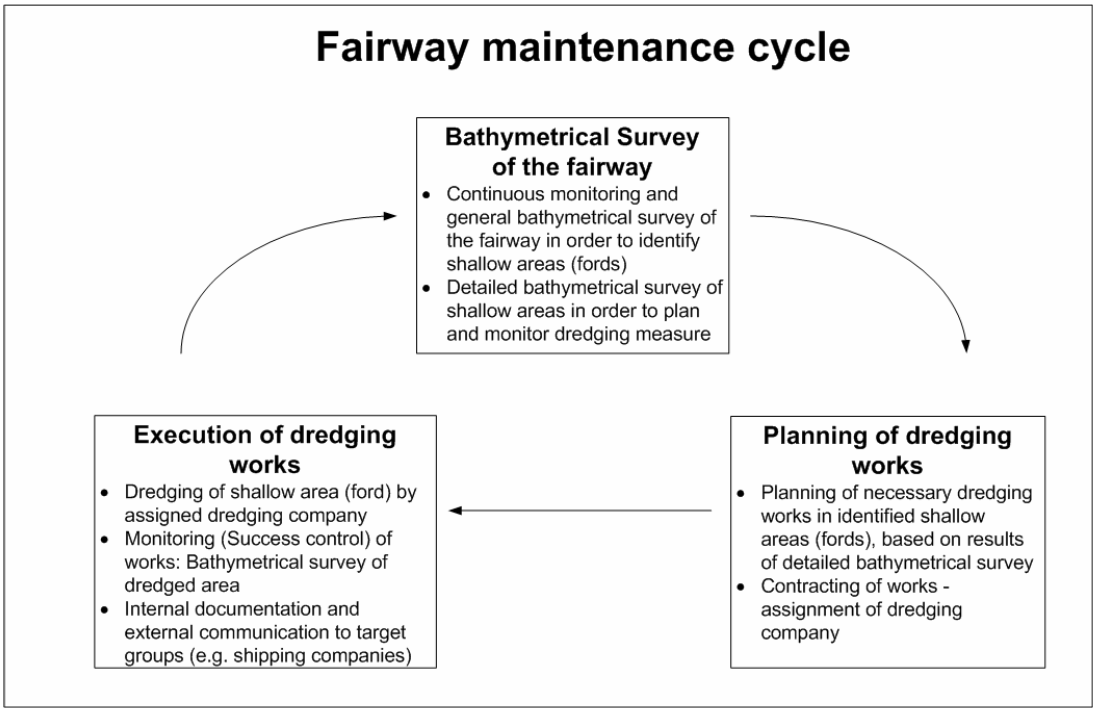

Fig. 8 – Fairway maintenance cycle

First of all, one fairway maintenance cycle had to be done and after, if the dredging isn`t a solution, the following activities are necessary:

- legal requirements for the river engineering projects;
- assessment of the bottleneck;
- Hydrology; Survey;
- Proposal for river engineering projects;
- Environmental assessment;
- flood protection;

A project is necessary if the waterway parameters cannot be achieve in a sector by normal maintenance works.

The assessment of the ford is necessary from all point of view:

- technical (waterway parameters);
- hydrology (free flowing section / backwater), current speed, debits, water level gauge section;
- geologically (sediments);
- environmental (WFD, Natura 200, Ramsar convention, etc);

Concept for optimum interrelation between maintenance work and river engineering projects

First activity that have to be achieve is to dredge the section and monitorized after the works.

Actions to improve the current situation should be seen from both perspectives IWT and ecological integrity and especially focus on the following areas:

- River stretches requiring fairway development and associated effects on special ecological qualities and the water status.
- River stretches requiring ecological preservation/restoration and associated effects on navigability.

Such planning principles should be applied to every project within the Danube river basin and include at least the following steps:

- Establish interdisciplinary planning teams involving key stakeholders, including Ministries responsible for transport, for water management and environment, waterway administrations, representatives of protected areas, local authorities, non-governmental organisations, tourism, scientific institutions and independent (international) experts.
- Define joint planning objectives.
- Set-up a transparent planning process (information/participation) based on comprehensive data and including the environmental benchmarks and current standards required for Strategic Environmental Assessment (SEA – for qualifying plans, programmes and policies) and for Environmental Impact Assessment (EIA – for projects).
- Ensure the comparability of alternatives and assess the feasibility of a plan (including the costs and benefits) and/or project (including a reflection of the status quo, alternatives and non-structural measures as well as environmental and resource costs).
- Assess if the IWT project has a basin wide/transboundary impact.
- Inform and consult the international river commissions in the Danube river basin (ICPDR, Danube Commission, International Sava River Basin Commission) before deciding on new developments, as well as other possibly affected countries.
- Respect the Danube River Basin Management Plan 2009, including its Joint Programme of Measures, and the respective sub-basin and national river basin management plans and programmes of measures as the basis for integrated planning and implementation of IWT infrastructure projects, in the mean time respecting already existing environmental legislation requirements.
- Define and ensure the prerequisites and goals of IWT as well as river/floodplain ecological integrity, followed by a consideration of the need to prevent deterioration, possible mitigation and/or restoration measures to achieve all environmental requirements.
- Ensure that there are no technically viable, environmentally better and not disproportional costly alternative means to achieve the required objective, in line with the requirements of Article 4(7) of the EU WFD.

- Seek to avoid or, if this is not possible, to minimise the impacts of structural/ hydraulic engineering interventions in the river system through mitigation and/or restoration, giving preference to reversible interventions.
- Ensure that, when planning navigation projects, the issue and respective effects of climate change are taken into account.
- Use of best practice measures to improve navigation;
- Carry out a priority ranking of possible measures to ensure the best possible environmental as well as navigation development effect and use of financial resources.
- Ensure flexible funding conditions for projects to enable integrated planning (including the involvement of all stakeholder groups) and adaptive implementation as well as monitoring.
- Monitor the effects of measures and adapt them.

4.5. Dredging

Dredging is very common along the entire Danube River. In the upper Danube countries, commercial dredging is not allowed anymore and the situation in many new EU countries is changing towards more limitations and stronger requirements required by environmental impact studies. However, the total amount of maintenance dredging is still considerable and the amounts dredged in the past often cannot be compensated for by the river itself. If possible, sediments that are dredged at critical sections should be re-inserted into the river to decrease the sediment deficit.

In most sectors of the Danube the critical points are monitorized at different time intervals. Throughout, Danube draws a plan of dredging required, and it is made either private companies or administrations. All dredging work is permanently monitored. It can be seen in the upper sector (Austria), are deposits of mud / clay and gravel, Slovakia (gravel and sand deposits), the lower Danube area (Croatia, Serbia, Romania, Bulgaria) deposits are silt / clay and sand.

When dredging is done, is started the period of monitorized.

4.6. River engineering projects

When dredging is not the optimal solution for creating the navigation conditions in a particular area is affected waterway sector studies and projects proposed several scenarios for improving navigation conditions.

In drawing up these scenarios, taking into account these studies, resulting in a model of evolution: measurements, water level data sets, data on liquid and solid flow, geotechnical studies, and information on waterway sector gauge which is intended to reach.

Scenarios will be prepared in compliance with legislation on environmental protection, water and national and European legislation.

After drawing up the project and its approval, execution can begin work once the Notices to Skippers is ready.

Criteria for river engineering

To implement the above mentioned planning principles the following criteria should be applied during the design phase of navigation projects:

- Use a case-by-case approach which considers both the ecological requirements for river sections and the basin-wide scale and the strategic requirements of IWT at the basin-wide scale when deciding on adequate fairway width and depth.
- "working with nature" wherever possible through implementation of measures according to given natural river-morphological processes following the principle of minimum or temporary engineering intervention,
- integrated design of regulation structures, equally regarding hydraulic, morphological and ecological criteria,
- implementation of measures in an adaptive form (e.g. river bed stabilization by granulometric bed improvement, low water regulation by groynes),
- optimal use of the potential for river restoration (e.g. river banks restoration) and side channel reconnection,
- ensuring that flood water levels are not exacerbated and, ideally, are reduced.

4.7. Interrelation between maintenance work and river engineering projects

Execution of a project to improve navigation conditions for execution of a bridge or other construction works on hydro, on a waterway will be made after consultation and prior approval from the Administration affected waterway sector.

Thus, to ensure the navigation conditions in the progress of works is necessary to consider the next issues:

- Execution planning work in time - Graphic works;
- Equipment and machinery used in the execution;
- Monitoring the Danube sector affected by the works, especially at crucial stages of the project, considering the opinions and agreements obtained from the local authorities and environmental advice;
- Measurements will be made whenever the section has modified;
- Establish a plan of intervention in that event that can generate the closure of traffic;
- Will install additional signs in the affected sector (coastal and floating) will protect the first execution, and will help direct traffic in the area;
- If necessary monitoring and directing traffic under special conditions, and location may be upstream and downstream sectors affected by the works, the second traffic light stations, temporary can be installed;

- May establish special rules of navigation on the period of the works proposed by Waterway Administration, the sector crossing, clearances for navigation, and signs in the area;
- Naval equipment stationed outside the fairway will, if they are in operation, should mark with the buoy anchor position;
- The ships that will be used to transport materials, equipment and personnel across the fairway will avoid using if possible, alternative routes to the construction site;
- If the disturbances are recorded technological process and deviations from original press performance schedule, with implications for phasing in the construction, will inform the authorities in a timely manner;
- Between the waterway Administration and the Performer there will always work together on the measurements on site at each stage involving technological change fairway position, for setting new limits, determining signaling scheme coastal and floating for each item separately and sailing location signals in the field, signaling equipment maintenance work throughout the execution, signalling the final determination on a target completion measurements, and to inform, during the whole work, by Notices to Skippers the navigation.

4.8. Monitoring the results

After completion of works, the Waterway Administration will make the regularly measurements waterway for the sector where works has been performed to observe their effects.

For while observing the target behavior will be executed or not further steps sailing, which will be archived:

- Effects monitoring plan works
- Objective performance monitoring plan in order to support this work

5 WORKFLOW FOR MAINTENANCE WORKS

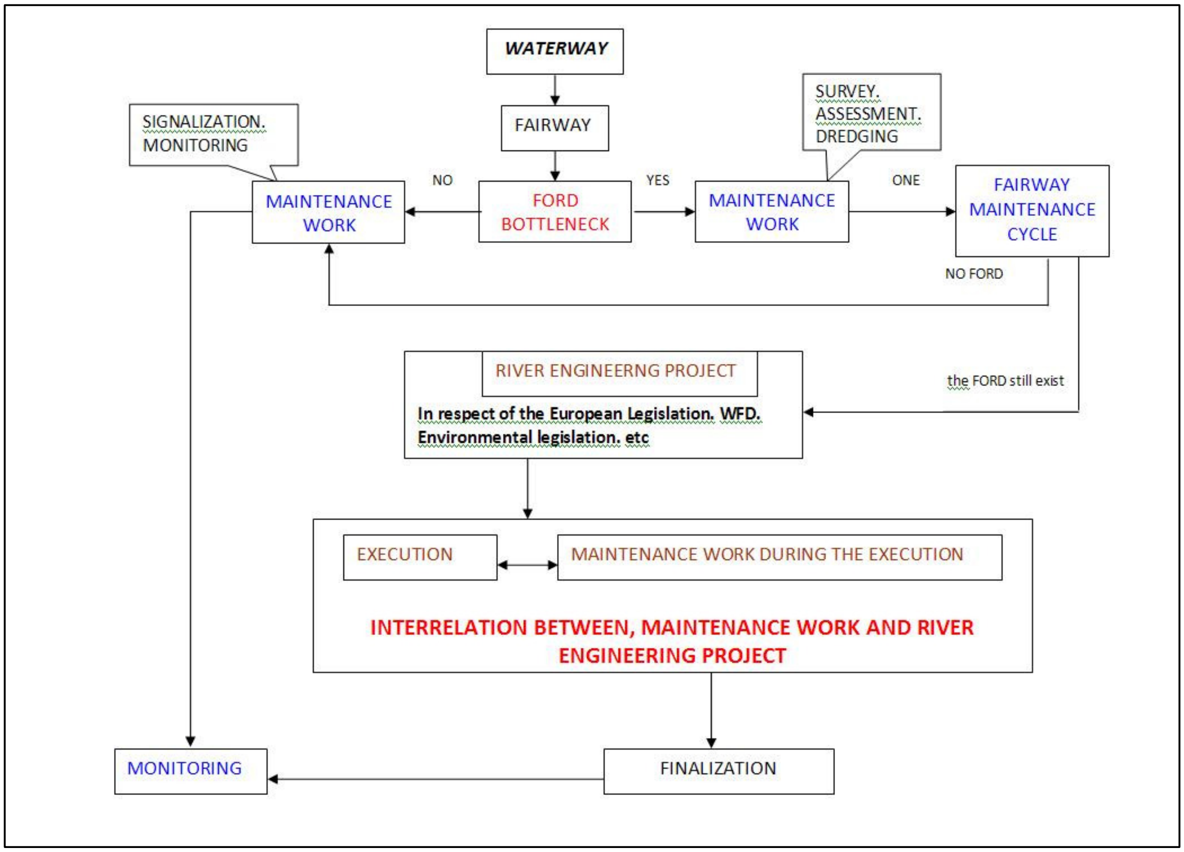

Fig. 9 – Workflow for the maintenance work of the fairway

The results of the activities 3.1, 4.1 and 4.2, allow to create a workflow for maintenance work for waterway.

A fairway is the part from a waterway where the parameters is achieve.

The next important topics can be accounted, in the following order:

1. waterway;
2. fairway;
3. if isn`t the ford/bottlenecks, the regular maintenance work (signalization, monitoring) can be done;
4. if is it the ford/bottlenecks, one fairway maintenance cycle have to be done (survey, assessment, dredging, etc.), after monitorized, if the sector is “clean” can be maintain bt regular maintenance work (signalisation, monitoring);

Concept for optimum interrelation between maintenance work and river engineering projects

5. after the fairway maintenance cycle, if the ford/bottlenecks still exist, an assessment have to be done in respect of all point of view (legal, technical, etc.) and a river engineering project have to proposed few scenarios to solve the section;
6. when the project is approved, the works can be started in respect of the project and the works should be correlated with the maintenance works. All activities survey, signalization, monitoring have to be done to each stage of the project;
7. when the works are finalized the monitoring process is started.

- End of document -