Contents

Annex 1.

River Network Schematization

River Network Schematization

Definition of coefficients a, b, c and d:

$$V = aQ^b \qquad H = cQ^d$$

with Q discharge (m^3/s)
V streamflow velocity (m/s)
H water depth (m)

Segment Nr	River	Upstream km	Downstream km	Length (m)	a	b	c	d	Country
178	Danube	2775	2725	50000	0.189	0.4	0.152	0.6	D
179	Danube	2725	2675	50000	0.189	0.4	0.152	0.6	D
180	Danube	2675	2625	50000	0.189	0.4	0.152	0.6	D
181	Danube	2625	2588	37000	0.189	0.4	0.152	0.6	D
182	Danube	2588	2512	76000	0.00286	1	3.3	0	D
183	Danube	2512	2496	16000	0.135	0.4	0.117	0.6	D
184	Danube	2496	2444	52000	0.00171	1	4	0	D
185	Danube	2444	2411	33000	0.0909	0.4	0.0917	0.6	D
186	Danube	2411	2318	93000	0.00115	1	4.7	0	D
187	Danube	2318	2281	37000	0.0601	0.4	0.0979	0.6	D
188	Danube	2281	2225	56000	0.000838	1	6.4	0	D
189	Danube	2225	2203	22000	0.000838	1	6.4	0	D
1	Danube	2203	2163	40000	0.00038	0.99	10.048	0.01	A
2	Danube	2163	2147	16000	0.00075	0.93	5.385	0.06	A
3	Danube	2147	2120	27000	0.00091	0.9	4.492	0.1	A
4	Danube	2120	2096	24000	0.00071	0.93	5.701	0.06	A
5	Danube	2096	2060	36000	0.00063	0.93	6.317	0.06	A

Segment Nr	River	Upstream km	Downstream km	Length (m)	a	b	c	d	Country
6	Danube	2060	2038	22000	0.00112	0.88	3.684	0.11	A
7	Danube	2038	2015	23000	0.06041	0.42	0.236	0.39	A
8	Danube	2015	1980	35000	0.0008	0.91	5.063	0.08	A
9	Danube	1980	1949	31000	0.00057	0.95	6.958	0.05	A
10	Danube	1949	1921	28000	0.00112	0.87	3.715	0.12	A
11	Danube	1921	1880.3	40700	0.4444	0.21	0.186	0.39	A
12	Morava	101.8	69.5	32302	0.19462	0.31	0.182	0.47	CZ
13	Morava	69.5	0	69468	0.48736	0.09	1.147	0.14	SK-A
14	Danube	1880.3	1852.4	27890	2.85248	0	5.293	0	SK-H
15	Danube	1852.4	1819	33370	0.00004	1.33	7.5	0	SK-H
16	Danube	1819	1811	8000	0.07532	0.35	0.128	0.52	SK-H
17	Danube	1811	1795	16000	0.21181	0.17	0.539	0.26	SK-H
18	Raba	201	156	45000	0.24625	0.33	0.224	0.5	H
19	Raba	156	99	57000	0.22623	0.31	0.198	0.46	H
20	Raba	99	74	25000	0.24684	0.32	0.225	0.47	H
21	Raba	74	30	44000	0.23573	0.34	0.21	0.51	H
22	Raba	30	0	30000	0.25129	0.3	0.231	0.45	H
23	Danube	1795	1766	29000	0.07201	0.35	0.1	0.53	SK-H
24	Vah	63.2	28.7	34445	2.48321	0	3.616	0	SK
25	Vah	28.7	0	28705	2.11282	0	3.451	0	SK
26	Danube	1766	1716	50000	0.13689	0.26	0.181	0.39	SK-H
27	Hron	73.1	52.2	20900	0.27949	0.31	0.137	0.47	SK
28	Hron	52.2	0	52200	0.21363	0.35	0.099	0.52	SK
29	Danube	1716	1708	8000	0.05553	0.38	0.068	0.57	SK-H
30	Danube	1708	1680	28000	0.0572	0.35	0.084	0.53	H
31	Danube	1680	1655	25000	0.05431	0.38	0.066	0.56	H
32	Danube	1655	1581	74000	0.05337	0.38	0.069	0.58	H
33	Danube	1581	1532	49000	0.04614	0.38	0.061	0.58	H

Segment Nr	River	Upstream km	Downstream km	Length (m)	a	b	c	d	Country
34	Danube	1532	1507	25000	0.14395	0.25	0.284	0.37	H
35	Danube	1507	1479	28000	0.06453	0.33	0.111	0.5	H
36	Danube	1479	1433	46000	0.06796	0.33	0.12	0.49	H
37	Danube	1433	1417	16000	0.09709	0.28	0.231	0.43	CR/YU
38	Danube	1417	1383	34000	0.05807	0.34	0.122	0.51	CR/YU
39	Drava	440.3	430.2	10160	0.00163	1	4.386	0	SL
40	Drava	430.2	418.3	11900	0.00135	1	4.512	0	SL
41	Drava	418.3	405.1	13130	0.00114	1	4.813	0	SL
42	Drava	405.1	392.5	12680	0.00105	1	7.364	0	SL
43	Drava	392.5	383.9	8560	0.00183	1	5.269	0	SL
44	Drava	383.9	368.4	15540	0.00101	1	6.451	0	SL
45	Drava	368.4	362.3	6070	0.00134	1	13.778	0	SL
46	Drava	362.3	337.5	24770	0.0025	1	6.667	0	SL
47	Drava	337.5	332.4	5100	0.11882	0.37	0.093	0.56	SL
48	Drava	332.4	311	21400	0.00036	1	5.6	0	SL
49	Drava	311	304	7000	0.00038	1	3.708	0	CR
50	Drava	304	284	20000	1.198	0	2.989	0	CR
51	Drava	284	274	10000	0.00011	1	6.241	0	CR
52	Drava	274	263	11000	1.198	0	2.989	0	CR
53	Drava	263	250	13000	0.00008	1	7.262	0	CR
54	Drava	250	238	12000	1.198	0	2.989	0	CR
55	Mura	124	75.3	48720	0.13777	0.36	0.117	0.54	SL
56	Mura	75.3	0	75280	0.24581	0.26	0.265	0.38	CR
57	Drava	238	193.9	44060	0.44495	0.14	0.753	0.22	CR
58	Drava	193.9	112.4	81500	0.44495	0.14	0.753	0.22	CR
59	Drava	112.4	0	112440	0.16734	0.28	0.22	0.42	CR
60	Danube	1383	1334	49000	0.09097	0.26	0.24	0.39	CR/YU
61	Danube	1334	1282	52000	0.06479	0.32	0.144	0.48	CR/YU

Segment Nr	River	Upstream km	Downstream km	Length (m)	a	b	c	d	Country
62	Danube	1282	1235	47000	0.06763	0.35	0.154	0.52	YU
63	Danube	1235	1215	20000	0.05316	0.34	0.107	0.5	YU
64	Tisa	993	966	27000	0.62742	0.34	0.12	0.51	UK
65	Tisa	966	941	25000	0.36557	0.38	0.072	0.57	UK
66	Tisa	941	926	15000	1.60995	0.04	1.268	0.06	UK
67	Tisa	926	912	14000	1.60995	0.04	1.268	0.06	UK
68	Tisa	912	890	22000	1.575	0.02	1.593	0.04	UK
69	Tisa	890	872	18000	1.575	0.02	1.593	0.04	UK
70	Tisa	872	849	23000	0.69845	0.1	0.791	0.15	UK
71	Tisa	849	803	46000	0.69845	0.1	0.791	0.15	UK
72	Tisa	803	744	59000	0.2376	0.25	0.213	0.37	UK
73	Tisa	744	724	20000	0.09382	0.35	0.251	0.53	H
74	Tisa	724	686	38000	0.09883	0.28	0.272	0.42	H
75	Somes	69	49	20000	0.12011	0.38	0.1	0.57	RO
76	Somes	49	0	49000	0.08232	0.34	0.18	0.51	H
77	Tisa	686	628	58000	0.07531	0.35	0.181	0.53	H
78	Tisa	628	550	78000	0.09678	0.32	0.263	0.49	H
79	Laborec	45	16.4	28650	0.19558	0.36	0.226	0.55	SK
80	Uh	107	81	26000	0.57347	0.33	0.093	0.5	UK
81	Uh	81	66	15000	0.32649	0.37	0.087	0.55	UK
82	Uh	66	56	10000	0.35818	0.34	0.11	0.5	UK
83	Uh	56	21	35000	0.17246	0.36	0.132	0.53	UK
84	Uh	21	0	21000	0.07415	0.38	0.112	0.57	SK
85	Laborec	16.4	0	16350	0.13112	0.39	0.166	0.58	SK
86	Latorica	180	168	12000	0.43713	0.35	0.086	0.53	UK
87	Latorica	168	136	32000	0.43713	0.35	0.086	0.53	UK
88	Latorica	136	104	32000	0.48892	0.26	0.175	0.39	UK
89	Latorica	104	78	26000	0.2497	0.2	0.648	0.31	UK

Segment Nr	River	Upstream km	Downstream km	Length (m)	a	b	c	d	Country
90	Latorica	78	31	47000	0.2497	0.2	0.648	0.31	UK
91	Latorica	31	10.2	20800	0.15086	0.31	0.49	0.46	SK
92	Latorica	10.2	0	10200	0.11038	0.35	0.448	0.52	SK
93	Ondava	61.5	0	61520	0.24114	0.31	0.396	0.47	SK
94	Bodrog	66.5	48	18500	0.12065	0.38	0.113	0.58	SK
95	Bodrog	48	0	48000	0.22566	0.32	0.331	0.47	H
96	Tisa	550	497	53000	0.10228	0.32	0.286	0.49	H
97	Slana	124	77	47000	0.14274	0.35	0.28	0.52	H
98	Slana	77	50	27000	0.16173	0.28	0.338	0.43	H
99	Slana	50	31	19000	0.14333	0.36	0.282	0.53	H
100	Hornad	184.3	120.2	64100	0.34228	0.37	0.079	0.55	SK
101	Torysa	62.8	0	62850	0.49135	0.33	0.176	0.5	SK
102	Hornad	120.2	97	23200	0.30359	0.35	0.109	0.52	SK
103	Hornad	97	0	97000	0.30359	0.35	0.109	0.52	H
104	Slana	31	0	31000	0.14333	0.36	0.282	0.53	H
105	Tisa	497	404	93000	0.16917	0.23	0.608	0.34	H
106	Tisa	404	336	68000	0.08353	0.33	0.211	0.49	H
107	Zagyva	104	0	104000	0.56467	0	2.205	0	H
108	Tisa	336	240	96000	0.1015	0.31	0.283	0.47	H
109	Tisa	240	180	60000	0.1073	0.31	0.307	0.46	H
110	Feher-Cris	275	142	133000	0.27047	0.34	0.124	0.52	RO
111	Feher-Cris	142	133	9000	0.22763	0.25	0.564	0.37	H
112	Fekete-Cris	69	15	54000	0.26806	0.37	0.132	0.56	RO
113	Fekete-Cris	15	0	15000	0.16332	0.34	0.343	0.52	H
114	Cris	133	91	42000	0.1834	0.2	0.599	0.29	H
115	Sebes-Cris	87	55	32000	0.20176	0.39	0.106	0.58	RO
116	Sebes-Cris	55	34	21000	0.13165	0.3	0.364	0.45	H
117	Sebes-Cris	34	0	34000	0.15087	0.25	0.447	0.38	H

Segment Nr	River	Upstream km	Downstream km	Length (m)	a	b	c	d	Country
118	Cris	91	0	91000	0.176	0.21	0.543	0.32	H
119	Mures	133	66	67000	0.11911	0.38	0.104	0.57	RO
120	Mures	66	0	66000	0.0735	0.39	0.152	0.58	H
121	Tisa	180	164	16000	0.04236	0.37	0.151	0.55	H
122	Tisa	164	106	58000	0.04236	0.37	0.151	0.55	YU
123	Tisa	106	65	41000	0.08866	0.28	0.459	0.41	YU
124	Tisa	65	37	28000	0.04327	0.37	0.156	0.55	YU
125	Tisa	37	0	37000	0.07875	0.29	0.384	0.43	YU
126	Danube	1215	1170	45000	0.03653	0.38	0.061	0.57	YU
127	Sava	842.1	802.5	39610	0.16421	0.34	0.152	0.51	SL
128	Sava	802.5	778.8	23680	0.16421	0.34	0.152	0.51	SL
129	Sava	778.8	729.1	49710	0.12603	0.38	0.102	0.57	SL
130	Sava	729.1	684	45100	0.173	0.34	0.112	0.51	CR
131	Sava	684.8	578	106800	0.20191	0.3	0.173	0.45	CR
132	Sava	578	500.5	77500	0.14607	0.33	0.138	0.49	CR
133	Sava	500.5	424	76500	0.16344	0.27	0.231	0.4	CR
134	Sava	424	287	137000	0.09368	0.33	0.116	0.5	CR
135	Sava	287	200	87000	0.09941	0.35	0.12	0.52	CR
136	Sava	200	113	87000	0.18079	0.31	0.175	0.46	BH/YU
137	Sava	113	64	49000	0.21164	0.26	0.222	0.38	YU
138	Sava	64	0	64000	0.26159	0.22	0.305	0.34	YU
139	Danube	1170	1149	21000	0.00077	0.78	2.559	0.19	YU
140	Danube	1149	1105	44000	0.00031	0.88	6.758	0.09	YU
141	Danube	1105	1072	33000	0.00053	0.8	4.961	0.13	YU
142	Danube	1072	943	129000	0.03148	0.37	0.072	0.55	YU/RO
143	Danube	943	845	98000	0.07786	0.27	0.279	0.4	YU/RO
144	Danube	845	833.6	11400	0.04135	0.35	0.085	0.53	RO/BG
145	Danube	833.6	811	22600	0.05761	0.3	0.143	0.45	RO/BG

Segment Nr	River	Upstream km	Downstream km	Length (m)	a	b	c	d	Country
146	Danube	811	795	16000	0.15132	0.2	0.608	0.3	RO/BG
147	Danube	795	742	53000	0.04223	0.36	0.083	0.53	RO/BG
148	Lom	62	0	62000	0.44061	0.33	0.124	0.5	BG
149	Danube	742	725	17000	0.22204	0.14	1.081	0.2	RO/BG
150	Danube	725	691	34000	0.03829	0.38	0.065	0.56	RO/BG
151	Jiu	76	0	76000	0.12747	0.37	0.069	0.56	RO
152	Ogosta	97	0	97000	0.22565	0.33	0.145	0.49	BG
153	Danube	691	679	12000	0.0901	0.25	0.279	0.37	RO/BG
154	Danube	679	637	42000	0.03148	0.38	0.067	0.57	RO/BG
155	Iskar	332.1	175.7	156400	0.28244	0.39	0.109	0.58	BG
156	Iskar	175.7	134.9	40800	0.47535	0.3	0.134	0.45	BG
157	Iskar	134.9	0	134900	0.20124	0.33	0.206	0.49	BG
158	Danube	637	604	33000	0.55553	0	4.278	0	RO/BG
159	Olt	26	0	26000	0.48834	0.14	0.523	0.21	RO
160	Danube	604	575	29000	0.03994	0.38	0.054	0.57	RO/BG
161	Danube	575	537	38000	0.60492	0	4.112	0	RO/BG
162	Yantra	268	203.8	64200	0.71458	0.31	0.112	0.47	BG
163	Yantra	203.8	0	203800	0.25176	0.35	0.109	0.52	BG
164	Danube	537	493	44000	0.03809	0.37	0.069	0.55	RO/BG
165	Danube	493	432	61000	0.03743	0.37	0.063	0.55	RO/BG
166	Arges	31	0	31000	0.9369	0	1.368	0	RO
167	Danube	432	375.5	56500	0.05235	0.33	0.105	0.5	RO/BG
168	Danube	375.5	345	30500	0.03737	0.38	0.061	0.56	RO
169	Danube	345	238	107000	0.69679	0	7.456	0	RO
170	Ialomita	77	0	77000	0.13347	0.37	0.157	0.56	RO
171	Danube	238	170	68000	0.64704	0	6.672	0	RO
172	Danube	170	155	15000	0.68308	0	16.496	0	RO
173	Siret	76	0	76000	0.18797	0.27	0.329	0.41	RO

Segment Nr	River	Upstream km	Downstream km	Length (m)	a	b	c	d	Country
174	Danube	155	134	21000	0.42383	0	8.063	0	RO
175	Prut	79	0	79000	0.08038	0.36	0.292	0.54	RO/MO
176	Danube	134	80	54000	0.42737	0	8.164	0	RO/UK
177	Danube	80	0	80000	0.38773	0	7.055	0	RO/UK

Annex 2.

Schematization Data Germany

Schematization Data Germany

1. Extent of the Network

Upstream boundary: Donaueschingen (km. 2775).

2. Methodology for Cross Section Relations

Free flowing stretches: d = 0.6, b = 0.4, a and c computed from Manning equation (assuming constant width):

$$a = \frac{1}{W^{0.4}}\left(\frac{\sqrt{S}}{n}\right)^{0.6}$$

$$c = \left(\frac{n}{W\sqrt{S}}\right)^{0.6}$$

with: n Manning's coefficient, value of 0.05 used
W river width (m)
S slope (m/m)

For regulated stretches: d = 0, b = 1, a and c computed from average cross sections and average depths:

$$a = \frac{1}{A}$$

$$c = H$$

with: A cross section (m^2)
H depth (m)

3. Basic Data Used

KM's	Character	Cross section data	a	b	c	d
2775-2588	free	S = 0.0011, W = 35 m	0.189	0.4	0.152	0.6
2586-2511.8	regulated	A = 350, H = 3.3	0.00286	1	3.3	0
2511.8-2496	free	S = 0.0008, W = 62.5	0.135	0.4	0.117	0.6
2496-2444.1	regulated	A = 584, H = 4.0	0.00171	1	4.0	0
2444-2410	free	S = 0.0005, W = 120	0.0909	0.4	0.0917	0.6
2410-2318	regulated	A = 872, H = 4.7	0.00115	1	4.7	0
2318-2260	free	S = 0.0002, W = 170	0.0601	0.4	0.0979	0.6
2260-2203	regulated	A = 1194, H = 6.4	0.000838	1	6.4	0

Annex 3.

Basic Catchment Data

Basic Catchment Data

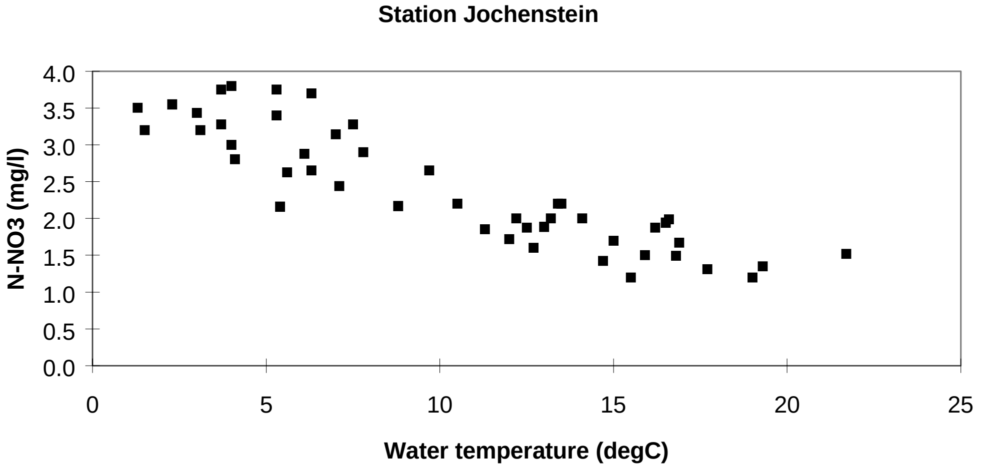
Location	Remarks	D	A	CZ	SK	H	SL	CR	YU	BH	BG	RO	MO	UK
Inn		10.2	15.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jochenstein		57.9	18.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Danube us Morava		58.9	45.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morava		0.0	3.7	21.1	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vah		0.0	0.0	0.0	18.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hron		0.0	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Danube us Ipoly		58.9	58.6	21.1	27.7	11.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ipoly		0.0	0.0	0.0	3.6	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Raba		0.0	9.0	0.0	0.0	11.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sio		0.0	0.0	0.0	0.0	14.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Danube Mohacs		58.9	58.6	21.1	31.3	44.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mura at A border		0.0	10.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mura		0.0	10.3	0.0	0.0	2.5	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Drava at A border		0.0	11.8	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Drava at SL border		0.0	11.8	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Drava		0.0	22.1	0.0	0.0	6.5	4.7	6.9	0.0	0.0	0.0	0.0	0.0	0.0
Danube Bogojevo	excl. Drava	58.9	58.6	21.1	31.3	44.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0
Sava at SL border		0.0	0.0	0.0	0.0	0.0	11.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sava start BiH		0.0	0.0	0.0	0.0	0.0	11.7	12.6	0.0	0.0	0.0	0.0	0.0	0.0
Sava stop BiH		0.0	0.0	0.0	0.0	0.0	11.7	25.1	0.0	38.7	0.0	0.0	0.0	0.0
Sava		0.0	0.0	0.0	0.0	0.0	11.7	25.1	31.0	38.7	0.0	0.0	0.0	0.0
Tisa at UA border		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	8.0
Somes		0.0	0.0	0.0	0.0	3.7	0.0	0.0	0.0	0.0	0.0	15.7	0.0	0.0
Bodrog		0.0	0.0	0.0	7.3	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9
Slana	incl. Hernad	0.0	0.0	0.0	7.6	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hernad		0.0	0.0	0.0	4.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zagyva		0.0	0.0	0.0	0.0	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cris		0.0	0.0	0.0	0.0	11.7	0.0	0.0	0.0	0.0	0.0	14.9	0.0	0.0
Mures		0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	27.9	0.0	0.0
Tisa us. Mures		0.0	0.0	0.0	14.9	40.6	0.0	0.0	0.0	0.0	0.0	40.1	0.0	12.9

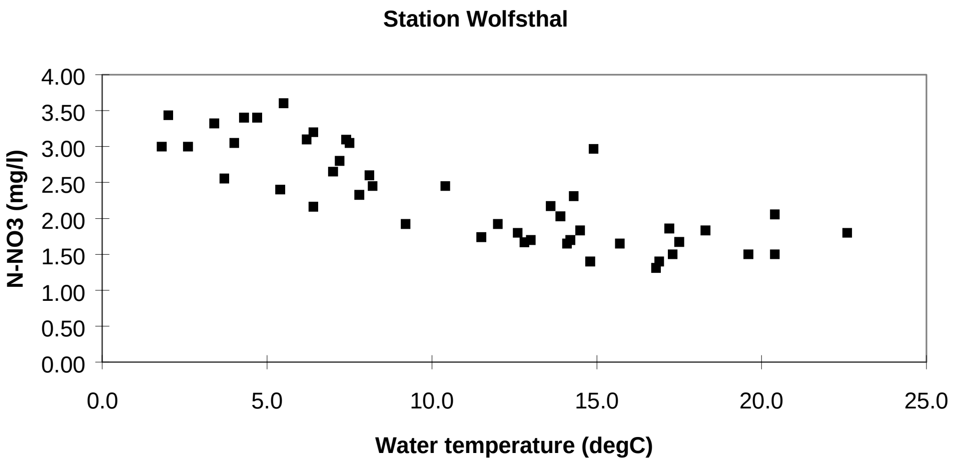
Location	Remarks	D	A	CZ	SK	H	SL	CR	YU	BH	BG	RO	MO	UK
Tisa		0.0	0.0	0.0	14.9	42.5	0.0	0.0	9.0	0.0	0.0	77.5	0.0	12.9
Danube Pancevo		58.9	80.7	21.1	46.2	93.0	16.4	34.4	43.0	38.7	0.0	85.5	0.0	12.9
V.Morava		0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.2	0.0	0.0	0.0	0.0	0.0
Danube VelGrad		58.9	80.7	21.1	46.2	93.0	16.4	34.4	83.2	38.7	0.0	86.5	0.0	12.9
Timok		0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.3	0.0	0.0	0.0
Danube NovoSelo		58.9	80.7	21.1	46.2	93.0	16.4	34.4	89.1	38.7	0.3	87.5	0.0	12.9
Ogosta		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6	0.0	0.0	0.0
Jiu		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.1	0.0	0.0
Iskar		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.1	0.0	0.0	0.0
Olt		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	0.0	0.0
Vit/Osam		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6	0.0	0.0	0.0
Danube Svistov		58.9	80.7	21.1	46.2	93.0	16.4	34.4	89.1	38.7	26.1	125.6	0.0	12.9
Jantra		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	0.0	0.0	0.0
R. Lom		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0
Danube Ruse	excl. Lom	58.9	80.7	21.1	46.2	93.0	16.4	34.4	89.1	38.7	34.8	133.0	0.0	12.9
Arges		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.6	0.0	0.0
Danube Silistra		58.9	80.7	21.1	46.2	93.0	16.4	34.4	89.1	38.7	46.9	147.6	0.0	12.9
Danube Vadu Oii	excl. Ialomita	58.9	80.7	21.1	46.2	93.0	16.4	34.4	89.1	38.7	46.9	148.6	0.0	12.9
Ialomita		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4	0.0	0.0
Siret		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.9	0.0	2.1
Prut		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	8.2	10.5
Danube at Delta		58.9	80.7	21.1	46.2	93.0	16.4	34.4	89.1	38.7	46.9	232.9	12.0	34.3

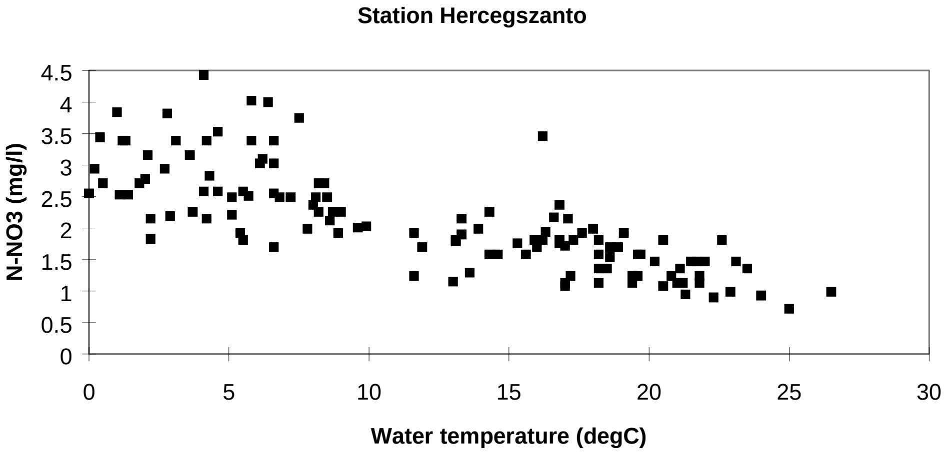
Annex 4.

Correlation between Nitrates and Temperature for Selected Stations in 1994-1997

Correlation between Nitrates and Temperature for Selected Stations in 1994-1997



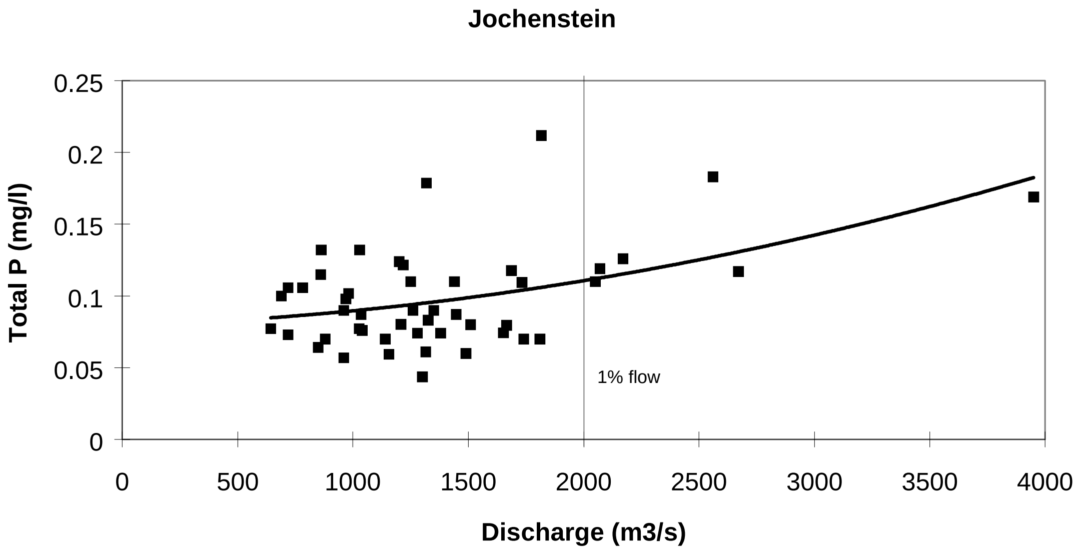


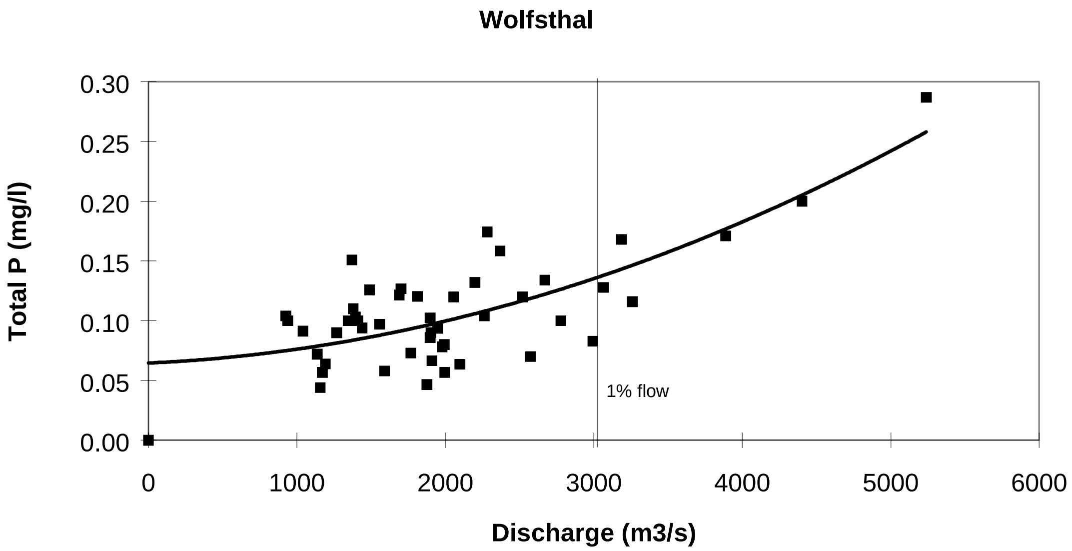


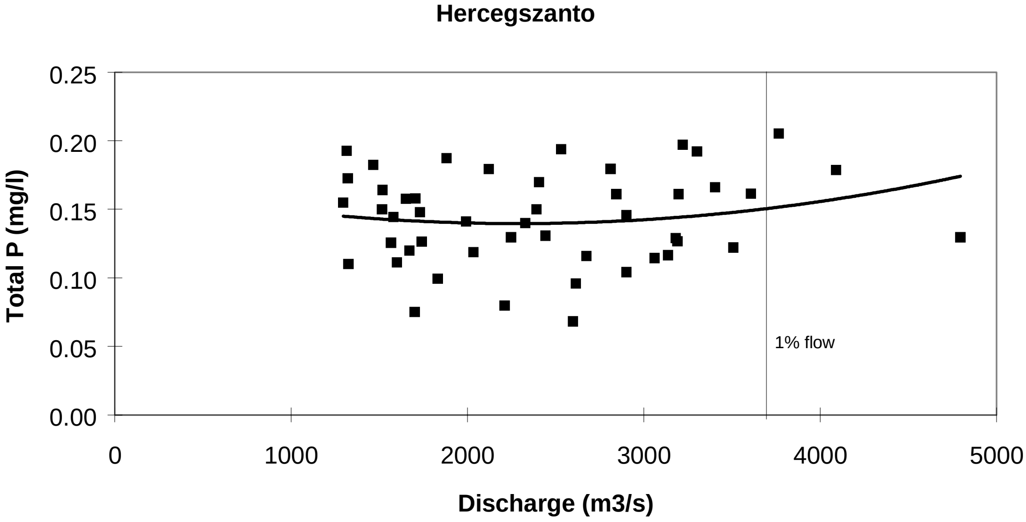
Annex 5.

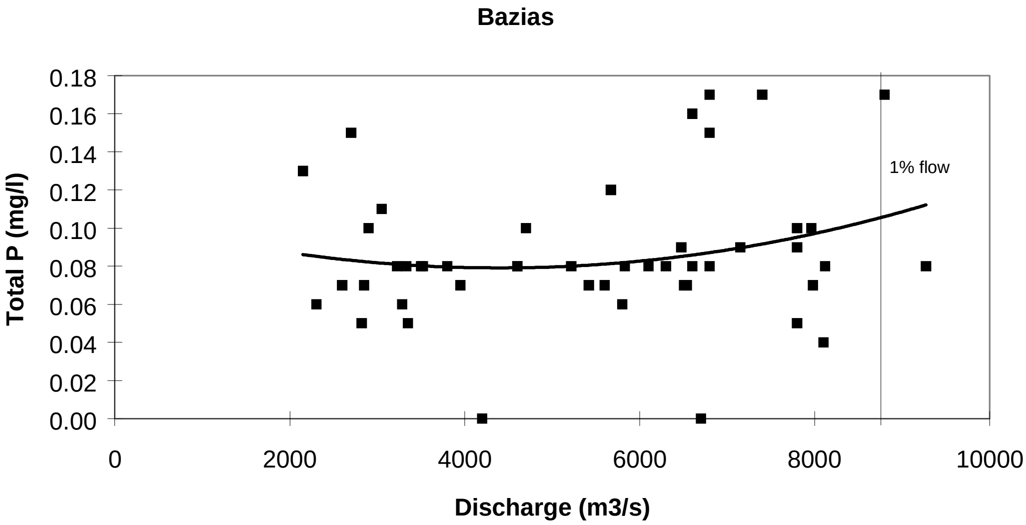
Correlation between Total Phosphorus and Discharge for Selected Stations in 1994-1997

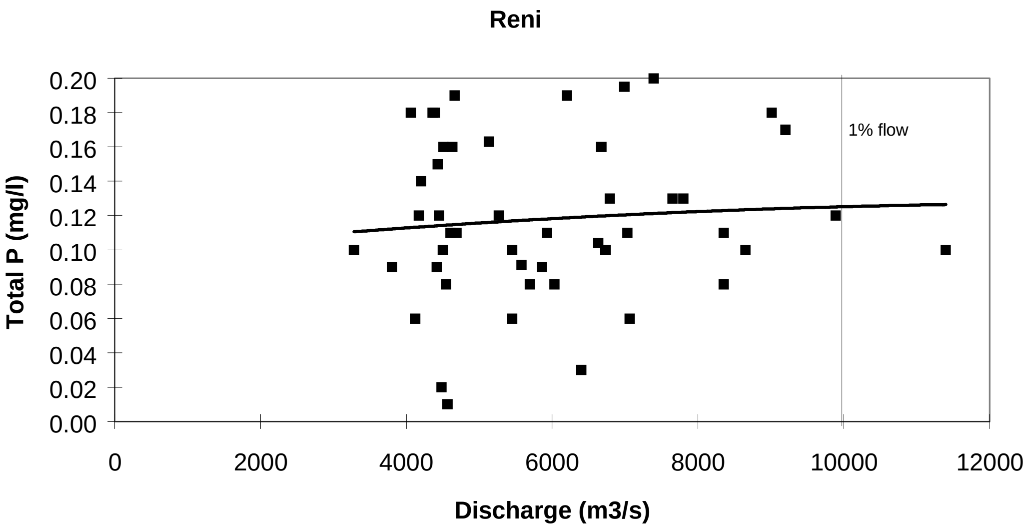
Correlation between Total Phosphorus and Discharge for Selected Stations in 1994-1997






Hercegszanto
Total P (mg/l)
0.25
0.20
0.15
0.10
0.05
0.00
0
1000
2000
3000
4000
5000
Discharge (m3/s)
1% flow


Bazias
Total P (mg/l)
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0
2000
4000
6000
8000
10000
Discharge (m3/s)
1% flow


Reni
Total P (mg/l)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0
2000
4000
6000
8000
10000
12000
Discharge (m3/s)
1% flow

Annex 6.

Point Sources List

Point Sources List

Cat. M = municipal
A = agricultural
I = industrial

N nitrogen discharge in t/a

P phosphorus discharge in t/a

Cf. conflict between different sources of information?

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Germany	M	1	Albstadt-Ebingen	Schmiecha	85	2.3	EMIS-Municipal	
Germany	M	2	Leutkirch	Eschach	120.5	2.3	EMIS-Municipal	
Germany	M	3	Warthausen	Riss	54	3.2	EMIS-Municipal	
Germany	M	4	Riedlingen	Donau	42	7	EMIS-Municipal	
Germany	M	5	Ehingen(Donau)	Donau	65.4	3.5	EMIS-Municipal	
Germany	M	6	Sigmaringen	Donau	43.4	2.1	EMIS-Municipal	
Germany	M	7	Laupheim	Dürnach	22	3	EMIS-Municipal	
Germany	M	8	Saulgau	Schwarzach	30	1.3	EMIS-Municipal	
Germany	M	9	Burladingen	Fehla	5.7	0.6	EMIS-Municipal	
Germany	M	10	Mengen	Ablach	14	1	EMIS-Municipal	
Germany	M	11	AZV Oberes Laucherttal	Lauchert	39.8	2.2	EMIS-Municipal	
Germany	M	12	Rottenacker	Donau	9.5	1.6	EMIS-Municipal	
Germany	M	13	Donaueschingen	Donau	25	2.2	EMIS-Municipal	
Germany	M	14	St Georgen	Brigach	19	0.9	EMIS-Municipal	
Germany	M	15	Tuttlingen	Donau	35	2.1	EMIS-Municipal	
Germany	M	16	Villingen	Brigach	60	2.5	EMIS-Municipal	
Germany	M	17	ZV OBERE ILLER SITZ SONTHOFEN	Iller	206	10.1	EMIS-Municipal	
Germany	M	18	ZV GRUPPENKLAERWERK KEMPTEN S. LAUBEN	Iller	291	8.4	EMIS-Municipal	
Germany	M	19	MEMMINGEN	Iller	45	1.0	EMIS-Municipal	
Germany	M	20	VOEHRINGEN	Iller	36	0.7	EMIS-Municipal	
Germany	M	21	ZV MITTLERES ILLERTAL SITZ ILLERTISSEN	Iller	19	4.5	EMIS-Municipal	
Germany	M	22	ZV NEU-ULM/ULM KA.STEINHAEULE S.NEU ULM	Iller	208	5.3	EMIS-Municipal	
Germany	M	23	ELCHINGEN	Iller	17	0.3	EMIS-Municipal	
Germany	M	24	WEISSENHORN	Iller	14	4.7	EMIS-Municipal	
Germany	M	25	ZV OTTOBEUREN-HAWANGEN S.HAWANGEN	Iller	27	9.9	EMIS-Municipal	
Germany	M	26	ZV UNTERES GUENZTAL SITZ ICHENHAUSEN	Iller	16	1.0	EMIS-Municipal	
Germany	M	27	GUENZBURG	Iller	54	11.2	EMIS-Municipal	
Germany	M	28	MINDELHEIM	Donau	16	0.2	EMIS-Municipal	
Germany	M	29	BAD WOERISHOFEN	Donau	10	2.3	EMIS-Municipal	
Germany	M	30	ZV MINDEL-GRUPPE SITZ THANNHAUSEN	Donau	19	3.7	EMIS-Municipal	
Germany	M	31	KRUMBACH	Donau	42	4.7	EMIS-Municipal	

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Germany	M	32	ZV MINDEL-KAMMEL SITZ OFFINGEN	Donau	36	3.8	EMIS-Municipal	
Germany	M	33	GUNDELFINGEN	Donau	19	1.1	EMIS-Municipal	
Germany	M	34	LAUINGEN	Donau	18	2.7	EMIS-Municipal	
Germany	M	35	DILLINGEN / DONAU	Donau	12	9.3	EMIS-Municipal	
Germany	M	36	DINKELSBUEHL	Donau	21	0.8	EMIS-Municipal	
Germany	M	37	FEUCHTWANGEN	Donau	14	0.7	EMIS-Municipal	
Germany	M	38	OETTINGEN/BAY	Donau	8	0.8	EMIS-Municipal	
Germany	M	39	NOERDLINGEN	Donau	22	1.5	EMIS-Municipal	
Germany	M	40	DONAUWOERTH	Donau	32	1.8	EMIS-Municipal	
Germany	M	41	WERTINGEN	Donau	9	0.5	EMIS-Municipal	
Germany	M	42	ZV SCHMUTTERTAL SITZ HIRBLINGEN	Donau	18	4.0	EMIS-Municipal	
Germany	M	43	ZV FUESSEN SITZ FUESSEN	Lech	37	0.8	EMIS-Municipal	
Germany	M	44	SCHONGAU	Lech	33	1.9	EMIS-Municipal	
Germany	M	45	PEITING	Lech	15	0.5	EMIS-Municipal	
Germany	M	46	LANDSBERG/LECH	Lech	87	1.5	EMIS-Municipal	
Germany	M	47	ZV LECHFELD-GEMEINDEN S.KLOSTERLECHFELD	Lech	4	0.6	EMIS-Municipal	
Germany	M	48	MARKTOBERDORF	Lech	19	1.9	EMIS-Municipal	
Germany	M	49	KAUFBEUREN	Lech	153	3.6	EMIS-Municipal	
Germany	M	50	TUERKHEIM-VG	Lech	17	0.5	EMIS-Municipal	
Germany	M	51	BUCHLOE	Lech	26	2.7	EMIS-Municipal	
Germany	M	52	SCHWABMUENCHEN	Lech	15	0.8	EMIS-Municipal	
Germany	M	53	BOBINGEN	Lech	25	1.9	EMIS-Municipal	
Germany	M	54	AUGSBURG	Lech	462	26.1	EMIS-Municipal	
Germany	M	55	GERSTHOFEN	Lech	7	2.2	EMIS-Municipal	
Germany	M	56	RAIN/LECH	Donau	6	0.8	EMIS-Municipal	
Germany	M	57	NEUBURG/DONAU	Donau	80	2.7	EMIS-Municipal	
Germany	M	58	ZV ZENTRALKLAER-ANLAGE INGOLSTADT	Donau	467	12.0	EMIS-Municipal	
Germany	M	59	FRIEDBERG-PAAR	Donau	3	0.5	EMIS-Municipal	
Germany	M	60	AICHACH	Donau	32	1.8	EMIS-Municipal	
Germany	M	61	SCHROBENHAUSEN	Donau	49	1.4	EMIS-Municipal	
Germany	M	62	MANCHING	Donau	29	2.1	EMIS-Municipal	
Germany	M	63	MAINBURG	Donau	20	1.4	EMIS-Municipal	
Germany	M	64	ABENSBERG	Donau	23	3.7	EMIS-Municipal	
Germany	M	65	ZV OBERES ILMTAL SITZ REICHERTSHAUSEN	Donau	11	1.6	EMIS-Municipal	
Germany	M	66	PFAFFENHOFEN/ILM	Donau	87	1.4	EMIS-Municipal	
Germany	M	67	LEUTERSHAUSEN	Altmühl	9	0.5	EMIS-Municipal	
Germany	M	68	GUNZENHAUSEN	Altmühl	48	2.0	EMIS-Municipal	
Germany	M	69	TREUCHTLINGEN	Altmühl	14	1.3	EMIS-Municipal	
Germany	M	70	EICHSTAETT	Altmühl	21	0.7	EMIS-Municipal	
Germany	M	71	FREYSTADT	Altmühl	16	1.5	EMIS-Municipal	
Germany	M	72	ZV IM RAUME KELHEIM SITZ KELHEIM	Donau	30	1.6	EMIS-Municipal	

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Germany	M	73	TIRSCHENREUTH	Naab	18	0.6	EMIS-Municipal	
Germany	M	74	ZV ALTENSTADT-NEUSTADT SITZ NEUSTADT	Naab	38	1.5	EMIS-Municipal	
Germany	M	75	WEIDEN	Naab	93	1.8	EMIS-Municipal	
Germany	M	76	KEMNATH	Naab	8	1.8	EMIS-Municipal	
Germany	M	77	GRAFENWOEHR	Naab	20	0.4	EMIS-Municipal	
Germany	M	78	NEUNBURG/WALD	Naab	19	0.5	EMIS-Municipal	
Germany	M	79	ZV SCHWANDORF-WACKERSDORF SITZ SCHWANDO.	Naab	76	1.8	EMIS-Municipal	
Germany	M	80	ZV MAXHUETTE-HAIDHOF SITZ TEUBLITZ	Naab	9	0.3	EMIS-Municipal	
Germany	M	81	SULZBACH-ROSENBERG	Naab	29	5.2	EMIS-Municipal	
Germany	M	82	ZV AMBERG-KUEMMERSBRUCK SITZ AMBERG	Naab	75	3.1	EMIS-Municipal	
Germany	M	83	SCHWARZENFELD	Naab	5	2.8	EMIS-Municipal	
Germany	M	84	REGEN	Regen	22	3.0	EMIS-Municipal	
Germany	M	85	ZWIESEL	Regen	15	0.7	EMIS-Municipal	
Germany	M	86	TEISNACH	Regen	8	1.0	EMIS-Municipal	
Germany	M	87	VIECHTACH	Regen	14	1.2	EMIS-Municipal	
Germany	M	88	ZV LAMER WINKEL SITZ LAM	Regen	27	2.8	EMIS-Municipal	
Germany	M	89	KOETZTING	Regen	5	0.3	EMIS-Municipal	
Germany	M	90	FURTH/WALD	Regen	19	1.0	EMIS-Municipal	
Germany	M	91	CHAM	Regen	48	1.6	EMIS-Municipal	
Germany	M	92	RODING	Regen	8	0.5	EMIS-Municipal	
Germany	M	93	ZV SULZBACHTAL SITZ NITTENAU	Regen	33	1.6	EMIS-Municipal	
Germany	M	94	REGENSBURG	Donau	282	35.5	EMIS-Municipal	
Germany	M	95	PFEFFENHAUSEN	Donau	14	0.9	EMIS-Municipal	
Germany	M	96	ROTTENBURG/LAABER	Donau	13	1.5	EMIS-Municipal	
Germany	M	97	BOGEN	Donau	41	1.0	EMIS-Municipal	
Germany	M	98	STRAUBING	Donau	183	3.7	EMIS-Municipal	
Germany	M	99	MITTENWALD	Isar	20	0.9	EMIS-Municipal	
Germany	M	100	BAD TOELZ	Isar	71	2.1	EMIS-Municipal	
Germany	M	101	GARMISCH-PARTENKIRCHEN	Isar	97	2.8	EMIS-Municipal	
Germany	M	102	MURNAU/STAFFELSEE	Isar	16	1.1	EMIS-Municipal	
Germany	M	103	PENZBERG	Isar	45	3.2	EMIS-Municipal	
Germany	M	104	ZV ISAR-LOISACHGRUPPE SITZ GERETSRIED	Isar	27	2.5	EMIS-Municipal	
Germany	M	105	MUENCHEN I	Isar	3501	78.2	EMIS-Municipal	
Germany	M	106	UNTERFOEHRING	Isar	8	0.3	EMIS-Municipal	
Germany	M	107	ISMANING	Isar	15	2.2	EMIS-Municipal	
Germany	M	108	GARCHING/MUENCHEN	Isar	31	3.4	EMIS-Municipal	
Germany	M	109	MUENCHEN II - GUT MARIENHOF	Isar	1559	21.1	EMIS-Municipal	

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Germany	M	110	OBERSCHLEISSHEIM	Isar	0	3.4	EMIS-Municipal	
Germany	M	111	ZV UNTERSCHL.ECHING NEUFAHRN S. HOLLERN	Isar	66	1.0	EMIS-Municipal	
Germany	M	112	FREISING	Isar	62	1.9	EMIS-Municipal	
Germany	M	113	ZV MUENCHEN OST SITZ POING	Isar	151	2.3	EMIS-Municipal	
Germany	M	114	ZV ERDINGER MOOS SITZ ERDING	Isar	67	0.7	EMIS-Municipal	
Germany	M	115	MOOSBURG/ISAR	Isar	15	1.7	EMIS-Municipal	
Germany	M	116	PEISSENBERG	Isar	30	0.6	EMIS-Municipal	
Germany	M	117	WEILHEIM/OB	Isar	44	0.6	EMIS-Municipal	
Germany	M	118	ZV AMMERSEE-OST-WEST S.ECHING/AMMERSE	Isar	69	2.3	EMIS-Municipal	
Germany	M	119	FUERSTENFELDBRUCK	Isar	10	1.2	EMIS-Municipal	
Germany	M	120	ZV AMPER-GRUPPE SITZ EICHENAU	Isar	179	7.9	EMIS-Municipal	
Germany	M	121	ZV STARNBERGER SEE SITZ STARNBERG	Isar	212	4.5	EMIS-Municipal	
Germany	M	122	DACHAU	Isar	53	1.6	EMIS-Municipal	
Germany	M	123	KARLSFELD	Isar	45	2.1	EMIS-Municipal	
Germany	M	124	LANDAU/ISAR	Isar	33	6.2	EMIS-Municipal	
Germany	M	125	LANDSHUT	Isar	194	6.2	EMIS-Municipal	
Germany	M	126	DINGOLFING	Isar	59	1.2	EMIS-Municipal	
Germany	M	127	PLATTLING	Isar	54	2.6	EMIS-Municipal	
Germany	M	128	ZV HENGERSBERG SITZ HENGERSBERG	Donau	16	0.6	EMIS-Municipal	
Germany	M	129	DEGGENDORF	Donau	86	3.3	EMIS-Municipal	
Germany	M	130	VILSBIBURG	Donau	23	1.1	EMIS-Municipal	
Germany	M	131	ZV MITTLERES VILSTAL SITZ REISBACH	Donau	25	1.9	EMIS-Municipal	
Germany	M	132	ARNSTORF	Donau	5	0.3	EMIS-Municipal	
Germany	M	133	ROSSBACH	Donau	1	0.1	EMIS-Municipal	
Germany	M	134	VILSHOFEN	Donau	19	1.1	EMIS-Municipal	
Germany	M	135	FREYUNG	Donau	9	0.8	EMIS-Municipal	
Germany	M	136	HUTTHURM	Donau	5	0.4	EMIS-Municipal	
Germany	M	137	KIEFERSFELDEN	Inn	7	0.7	EMIS-Municipal	
Germany	M	138	ZV BRANNENBURG-FLINTSBACH SI.BRANNENBUR	Inn	6	0.6	EMIS-Municipal	
Germany	M	139	RAUBLING	Inn	30	0.9	EMIS-Municipal	
Germany	M	140	ZV BOCKAU SIMSSEE-PRIEN-ACHENTAL	Inn	35	3.5	EMIS-Municipal	
Germany	M	141	ZV REINHALTUNG DES CHIEMSEE S. PRIEN	Inn	105	3.2	EMIS-Municipal	
Germany	M	142	ZV TEGERNSEE SITZ BAD WIESSEE	Inn	86	1.3	EMIS-Municipal	
Germany	M	143	ZV SCHLIERACHTAL SITZ SCHLIERSEE	Inn	23	1.2	EMIS-Municipal	

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Germany	M	144	HOLZKIRCHEN	Inn	25	0.7	EMIS-Municipal	
Germany	M	145	FELDKIRCHEN-WESTERHAM	Inn	22	0.3	EMIS-Municipal	
Germany	M	146	MARKT BRUCKMUEHL	Inn	10	0.1	EMIS-Municipal	
Germany	M	147	BAD AIBLING	Inn	33	1.6	EMIS-Municipal	
Germany	M	148	BAD FEILNBACH	Inn	3	0.5	EMIS-Municipal	
Germany	M	149	ROSENHEIM	Inn	173	5.7	EMIS-Municipal	
Germany	M	150	GRAFING/MUENCHEN	Inn	33	1.3	EMIS-Municipal	
Germany	M	151	EBERSBERG	Inn	19	1.1	EMIS-Municipal	
Germany	M	152	WASSERBURG/INN	Inn	54	1.7	EMIS-Municipal	
Germany	M	153	HAAG/OB	Inn	6	0.5	EMIS-Municipal	
Germany	M	154	MUEHLDORF	Inn	5	0.6	EMIS-Municipal	
Germany	M	155	WALDKRAIBURG	Inn	78	2.0	EMIS-Municipal	
Germany	M	156	ALTOETTING-NEUOETTING	Inn	78	2.0	EMIS-Municipal	
Germany	M	157	ZV ACHENTAL SITZ GRASSAU	Inn	18	0.3	EMIS-Municipal	
Germany	M	158	TRAUNSTEIN	Inn	50	3.6	EMIS-Municipal	
Germany	M	159	TRAUNREUT	Inn	34	1.3	EMIS-Municipal	
Germany	M	160	TROSTBERG	Inn	6	0.2	EMIS-Municipal	
Germany	M	161	GARCHING/ALZ	Inn	8	0.3	EMIS-Municipal	
Germany	M	162	BERCHTESGADEN	Inn	39	1.8	EMIS-Municipal	
Germany	M	163	BAD REICHENHALL	Inn	20	1.7	EMIS-Municipal	
Germany	M	164	FREILASSING	Inn	11	1.1	EMIS-Municipal	
Germany	M	165	WAGING/SEE	Inn	4	0.8	EMIS-Municipal	
Germany	M	166	SIMBACH/INN	Inn	30	2.0	EMIS-Municipal	
Germany	M	167	ZV BAD FUESSING SITZ BAD FUESSING	Inn	49	2.5	EMIS-Municipal	
Germany	M	168	EGGENFELDEN	Inn	31	2.4	EMIS-Municipal	
Germany	M	169	PFARRKIRCHEN	Inn	67	1.7	EMIS-Municipal	
Germany	M	170	GRIESBACH /ROTTAL	Inn	20	1.3	EMIS-Municipal	
Germany	M	171	PASSAU	Donau	126	3.4	EMIS-Municipal	
Germany	I	1	Schwäbische Zellstoff AG, Ehingen	Donau	21	1.2	EMIS-Industrial	
Germany	I	2	Höchst AG	Inn	25	4.1	EMIS-Industrial	
Germany	I	3	Wacker Chemie GmbH	Inn	380	15	EMIS-Industrial	
Germany	I	4	Faserwerk Kehlheim GmbH	Donau	77	2.1	EMIS-Industrial	
Germany	I	5	Nitrochemie Aschau GmbH	Inn	260	45	EMIS-Industrial	
Germany	I	6	MD Papier GmbH	Isar	13	5.5	EMIS-Industrial	
Germany	I	7	Haindl Papier GmbH	Lech	7	1.6	EMIS-Industrial	
Germany	I	8	Gebr. Lang AG	Lech	5	2.1	EMIS-Industrial	
Germany	I	9	Nuclear power plant Gundremmingen	Donau	2	5	EMIS-Industrial	
Austria	M	1	Eisenstadt-Stadt	Wulka	30.5	2.6	EMIS-Municipal	
Austria	M	2	Wulkaprodersdorf	Wulka	38.5	2.3	EMIS-Municipal	
Austria	M	3	Neusiedl a.See	Neusiedler See	5.8	0.3	EMIS-Municipal	
Austria	M	4	Deutschkreuz	Rabnitz	4.8	0.5	EMIS-Municipal	
Austria	M	5	Siget	Pinka	20	1.1	EMIS-Municipal	
Austria	M	6	Klagenfurt	Glan	284	11	EMIS-Municipal	

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Austria	M	7	Feldkirchen	Glan	19.6	1.2	EMIS-Municipal	
Austria	M	8	Mittleres Lavantal	Lavant	64.9	5.4	EMIS-Municipal	
Austria	M	9	Spittal a.d.Drau	Drau	160.2	14	EMIS-Municipal	
Austria	M	10	St.Veit a.d.Glan	Glan	39.5	5.5	EMIS-Municipal	
Austria	M	11	Villach	Drau	76.5	32.6	EMIS-Municipal	
Austria	M	12	Völkermarkt	Drau	1.9	0.2	EMIS-Municipal	
Austria	M	15	Amstetten	Ybbs	77	20	EMIS-Municipal	
Austria	M	16	Baden	Schwechat	36	1.8	EMIS-Municipal	
Austria	M	17	Trumau-Schönau	Schwechat	96	8	EMIS-Municipal	
Austria	M	18	Bad Vöslau	Schwechat	57.6	3.6	EMIS-Municipal	
Austria	M	19	Bruck/Leitha-Neusiedl/See	Leitha	20	1.3	EMIS-Municipal	
Austria	M	20	Groß-Enzersdorf	Donau	216	1	EMIS-Municipal	
Austria	M	21	Horn	Kamp	14	1.4	EMIS-Municipal	
Austria	M	22	Korneuburg	Donau	32	3.2	EMIS-Municipal	
Austria	M	23	Krems	Donau	104	43	EMIS-Municipal	
Austria	M	24	Mödling	Schwechat	10	8	EMIS-Municipal	
Austria	M	25	Oberes Schwarzatal	Schwarza	21	2.1	EMIS-Municipal	
Austria	M	26	Wieselburg	Große Erlauf	156	13	EMIS-Municipal	
Austria	M	27	Anzbach-Laabental	Große Tulln	32	3.2	EMIS-Municipal	
Austria	M	28	Mittleres Pielach-S.u.Kr.Tal	Pielach	51	4.3	EMIS-Municipal	
Austria	M	29	An der Traisen	Donau	220	14	EMIS-Municipal	
Austria	M	30	Schwechat	Schwechat	186	13	EMIS-Municipal	
Austria	M	31	Klosterneuburg	Donau	114	9.5	EMIS-Municipal	
Austria	M	32	Oberes Piestingtal	Piesting	47.2	2.95	EMIS-Municipal	
Austria	M	33	Wr.Neustadt Süd	Leitha	152	12	EMIS-Municipal	
Austria	M	34	Zwettl	Kamp	25.6	1.6	EMIS-Municipal	
Austria	M	35	Wolfgangsee / Ischl	Traun	45	2	EMIS-Municipal	
Austria	M	36	Trattnachtal	Innbach	94	9	EMIS-Municipal	
Austria	M	37	Oberes Kremstal	Krems	15	5	EMIS-Municipal	
Austria	M	38	Linz / Asten	Donau	2270	124	EMIS-Municipal	
Austria	M	39	Ried i.I. / Umgebung	Inn	24	3	EMIS-Municipal	
Austria	M	40	Steyr	Enns	78	3	EMIS-Municipal	
Austria	M	41	Ager West	Traun	38	2	EMIS-Municipal	
Austria	M	42	Attersee	Traun	31	4	EMIS-Municipal	
Austria	M	43	Vöckla-Redl	Traun	12	2	EMIS-Municipal	
Austria	M	44	Welser Heide	Traun	89	8	EMIS-Municipal	
Austria	M	45	Schwanenstadt	Traun	7	2	EMIS-Municipal	
Austria	M	46	Traunsee-Nord	Traun	49	4	EMIS-Municipal	
Austria	M	47	Salzburg/Siggerw.	Salzach	807	109	EMIS-Municipal	
Austria	M	48	Trumerseen	Mattig	16.8	1.7	EMIS-Municipal	
Austria	M	49	Zell / See	Salzach	133.3	10.1	EMIS-Municipal	
Austria	M	50	Saalbach	Saalach	32.3	6.3	EMIS-Municipal	
Austria	M	51	Saalfelden	Saalach	75.6	10.8	EMIS-Municipal	
Austria	M	52	Bischofshofen	Salzach	74.4	18.4	EMIS-Municipal	
Austria	M	53	Graz	Mur	1680	380	EMIS-Municipal	
Austria	M	54	Feldbach	Raab	40	1.3	EMIS-Municipal	
Austria	M	55	Knittelfeld	Mur	60	2	EMIS-Municipal	
Austria	M	56	Wagna-Leibnitz	Mur	40	7	EMIS-Municipal	
Austria	M	57	Wildon	Mur	40	3	EMIS-Municipal	

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Austria	M	58	Leoben	Mur	34	10	EMIS-Municipal	
Austria	M	59	Innsbruck	Inn	137.3	15	EMIS-Municipal	
Austria	M	60	Imst	Inn	31.2	7.5	EMIS-Municipal	
Austria	M	61	Zirl	Inn	6.3	2	EMIS-Municipal	
Austria	M	62	Fritzens	Inn	39.6	9.9	EMIS-Municipal	
Austria	M	63	Kitzbühel	Großache	26.8	5.9	EMIS-Municipal	
Austria	M	64	Kirchdorf i.T.	Großache	15.5	4.6	EMIS-Municipal	
Austria	M	65	Kirchbichl	Inn	72.8	17.1	EMIS-Municipal	
Austria	M	66	Radfeld	Inn	30	5.9	EMIS-Municipal	
Austria	M	67	Vils	Lech	61.4	5	EMIS-Municipal	
Austria	M	69	Strass i.Z.	Inn	79.5	9.7	EMIS-Municipal	
Austria	M	70	Wien-Blumental	Liesing (Schwechat)	200	15	EMIS-Municipal	
Austria	M	71	Wien-Simmering	Donau	5600	150	EMIS-Municipal	
Austria	I	1	ÖCW Weißenstein/DEGUSSA	Drau		3.6	EMIS-Industrial	
Austria	I	2	Jung-Bunzlauer GmbH&CoKG	Thaya	160	7.3	EMIS-Industrial	
Austria	I	3	Lenzing AG (pulp)	Ager		1.9	EMIS-Industrial	
Austria	I	4	Steyrermühl AG (paper)	Traun	4.7	2.2	EMIS-Industrial	
Austria	I	5	SCA Laakirchen (paper)	Traun	6.8	1.1	EMIS-Industrial	
Austria	I	6	SCA Fine Paper Hallein 1997			20	EMIS-Industrial	
Austria	I	10	BIOCHEMIE GmbH Kundl	Inn	530		EMIS-Industrial	
Czech	M	M1	Brno	Svratka	552	139	NR	Yes
Czech	M	M2	Zlin	Drevnice	302	46	NR	Yes
Czech	M	M3	Uherske Hradiste	Morava	73	11	NR	Yes
Czech	M	M4	Hodonin	Morava	31	3	NR	Yes
Czech	I	I1	Kozelunzny Otrokovice	Morava	229.58	3.72	NR	Yes
Czech	I	I2	Fosfa Postorna	Dyje	0.968	102.799	NR	Yes
Czech	M	3	OLOMOUC	Morava	324	115.5	EMIS-Municipal	
Czech	M	4	PREROV	Becva	130.9	7.8	EMIS-Municipal	
Czech	M	6	PROSTEJOV	Valova	133.2	13.4	EMIS-Municipal	
Czech	M	7	JIHLAVA	Jihlava	149.7	7	EMIS-Municipal	
Czech	M	8	TREBIC	Jihlava	64	4.1	EMIS-Municipal	
Czech	M	9	ZNOJMO	Dyje	50	8.1	EMIS-Municipal	
Czech	M	10	VSETIN	Vsetinska Becva	29.2	12.8	EMIS-Municipal	
Czech	M	11	SUMPERK	Desna	159.1	13.3	EMIS-Municipal	
Czech	M	12	VALASSKE MEZIRICI	Becva	62.8	4.8	EMIS-Municipal	
Czech	M	13	KROMERIZ	Morava	132	13	EMIS-Municipal	
Czech	M	15	BRECLAV	Dyje	110.3	2.3	EMIS-Municipal	
Czech	M	16	VYSKOV	Hana	61.1	9.4	EMIS-Municipal	
Czech	M	17	BLANSKO	Svitava	21.8	4.9	EMIS-Municipal	
Czech	M	18	HRANICE	Becva	37.4	6.7	EMIS-Municipal	
Czech	M	19	SVITAVY	Vendelsky brook	27	3.2	EMIS-Municipal	
Czech	M	20	ZUBRI - ROZNOV	Roznovska Becva	31.5	11.2	EMIS-Municipal	
Czech	M	21	BYSTRICE p. HOST.	Bystricka	27.3	1	EMIS-Municipal	
Czech	M	22	DACICE	Moravska Dyje	8.4	2	EMIS-Municipal	
Czech	M	23	LANSKROUN	Ostrovsky brook	19.8	4.2	EMIS-Municipal	
Czech	M	24	BOSKOVICE	Bela	19.9	5.8	EMIS-Municipal	
Czech	M	25	LETOVICE	Svitava	25.4	1.2	EMIS-Municipal	

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Czech	M	26	SLAPANICE	Ricka	21.4	1.4	EMIS-Municipal	
Czech	M	27	ZIDLOCHOVICE	Svratka	2.9	1.3	EMIS-Municipal	
Czech	M	28	MIKULOV	Mikulovka	16.6	6	EMIS-Municipal	
Czech	M	29	BRUMOV-BYLNICE	Brumovka	14.3	2.1	EMIS-Municipal	
Czech	M	30	NAPAJEDLA	Morava	20.7	4	EMIS-Municipal	
Czech	M	31	KYJOV	Kyjovka	36.4	2.3	EMIS-Municipal	
Czech	M	32	BUCOVICE	Litava	24	1.6	EMIS-Municipal	
Czech	M	33	VELKE MEZIRICI	Oslava	13.5	2.5	EMIS-Municipal	
Czech	M	34	UNICOV	Oskava	6.4	0.4	EMIS-Municipal	
Czech	M	35	ZABREH	Moravska Sazava	78.9	1.1	EMIS-Municipal	
Czech	M	36	TREST	Trestsky brook	6.4	1.5	EMIS-Municipal	
Czech	M	37	STERNBERK	Sitka	10.4	8	EMIS-Municipal	
Czech	I	1	JEDU - Dukovany	Skryjsky brook	5.9	10	EMIS-Industrial	
Slovakia	M	1	Bratisl. zb. A Lafr.	Danube	68.4	***11.4***	EMIS-Municipal	
Slovakia	M	2	Bratislava Petrzalk	Danube	15.87	***2.6***	EMIS-Municipal	
Slovakia	M	3	Šamorín	Danube	29.51	***4.9***	EMIS-Municipal	
Slovakia	M	4	Štúrovo	Danube	27.73	***4.6***	EMIS-Municipal	
Slovakia	M	5	Skalica	Skalické rybníky	26.73	***4.5***	EMIS-Municipal	
Slovakia	M	6	Skalica	Kopciansky kanál	5.97	***1.0***	EMIS-Municipal	
Slovakia	M	7	Holic	Kistor	23.38	***3.9***	EMIS-Municipal	
Slovakia	M	8	COV Myjava	Myjava	31.34	***5.2***	EMIS-Municipal	
Slovakia	M	9	Senica	Teplica	30.94	***5.2***	EMIS-Municipal	
Slovakia	M	10	Devín.N.Ves	Mláka	6.21	***1.0***	EMIS-Municipal	
Slovakia	M	11	ÚCOV Vrakuna	Malý Dunaj	182.66	***30.4***	EMIS-Municipal	
Slovakia	M	12	Pezinok	Blatina	14.93	***2.5***	EMIS-Municipal	
Slovakia	M	13	Senec	Cierna Voda	32.26	***5.4***	EMIS-Municipal	
Slovakia	M	14	Modra	Stolicný potok	5.36	***0.9***	EMIS-Municipal	
Slovakia	M	15	Dunaj. Streda	K.Gabcíkovo-Topol	21.42	***3.6***	EMIS-Municipal	
Slovakia	M	16	Liptov. Hrádok	Váh	12.35	***2.1***	EMIS-Municipal	
Slovakia	M	17	Liptov. Mikuláš	Váh	480	9.8	EMIS-Municipal	
Slovakia	M	18	Nizná	Orava	19.3	***3.2***	EMIS-Municipal	
Slovakia	M	19	Dolný Kubín	Orava	29.26	***4.9***	EMIS-Municipal	
Slovakia	M	20	Námestovo	Orava	16.11	***2.7***	EMIS-Municipal	
Slovakia	M	21	Turc. Teplice	Teplica	0.63	***0.1***	EMIS-Municipal	
Slovakia	M	22	Martin-Vrútky	Váh	220.13	***36.7***	EMIS-Municipal	
Slovakia	M	23	Cadca	Kysuca	40.07	***6.7***	EMIS-Municipal	
Slovakia	M	24	Kysuc.N.Mìsto	Kysuca	38.11	***6.4***	EMIS-Municipal	
Slovakia	M	25	Rajec	Rajcianka	7.71	***1.3***	EMIS-Municipal	
Slovakia	M	26	Zilina-Hricov	Váh	173.96	***29.0***	EMIS-Municipal	
Slovakia	M	27	Bytca	Váh	4.4	***0.7***	EMIS-Municipal	
Slovakia	M	28	Povaz. Bystrica	Váh	47.2	***7.9***	EMIS-Municipal	
Slovakia	M	29	Púchov	Váh	16.08	***2.7***	EMIS-Municipal	
Slovakia	M	30	DubnicaN.Váh.	Nosický kanál	20.84	***3.5***	EMIS-Municipal	
Slovakia	M	31	Trenc. Teplá	Teplicka	42	***7.0***	EMIS-Municipal	
Slovakia	M	32	Trencín lavá str.	Váh	59.74	***10.0***	EMIS-Municipal	
Slovakia	M	33	Nové M.n.Váhom	Biskupický kanál	31.44	***5.2***	EMIS-Municipal	
Slovakia	M	34	Pieštany	Dubová	78.03	***13.0***	EMIS-Municipal	
Slovakia	M	35	Stará Turá	Trstie	22.99	***3.8***	EMIS-Municipal	
Slovakia	M	36	Hlohovec	Váh	344.2	38.9	EMIS-Municipal	
Slovakia	M	37	Sered	Váh	22.77	***3.8***	EMIS-Municipal	

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Slovakia	M	38	Šala	Kolárovský k.	9.83	***1.6***	EMIS-Municipal	
Slovakia	M	39	Trnava	Trnávka	158.32	***26.4***	EMIS-Municipal	
Slovakia	M	40	Galanta	Salibský Dudváh	34.12	***5.7***	EMIS-Municipal	
Slovakia	M	41	Komárno	Váh	79.33	***13.2***	EMIS-Municipal	
Slovakia	M	42	Prievidza	Handlovka	160.81	***26.8***	EMIS-Municipal	
Slovakia	M	43	Handlová	Handlovka	35.13	***5.9***	EMIS-Municipal	
Slovakia	M	44	Partizánske	Nitra	23.64	***3.9***	EMIS-Municipal	
Slovakia	M	45	Bánovce n. Bebravou	Bebrava	18.07	***3.0***	EMIS-Municipal	
Slovakia	M	46	Zlaté Moravce	Zitava	32.55	***5.4***	EMIS-Municipal	
Slovakia	M	47	Šurany	Malá Nitra	8.88	***1.5***	EMIS-Municipal	
Slovakia	M	48	Nové Zámky	Nitra	142.7	8.196	EMIS-Municipal	
Slovakia	M	49	Filakovo	Belina	20.7	1.49	EMIS-Municipal	
Slovakia	M	50	Lucenec	Krivánsky potok	66.5	8.46	EMIS-Municipal	
Slovakia	M	51	Velký Krtíš	Krtíš	13.2	1.83	EMIS-Municipal	
Slovakia	M	52	Brezno	Hron	33.1	3.15	EMIS-Municipal	
Slovakia	M	53	Zvolen	Hron	9.93	***1.7***	EMIS-Municipal	
Slovakia	M	54	Detva	Slatina	15.5	1.16	EMIS-Municipal	
Slovakia	M	55	Ziarn. Hronom	Hron	6.6	0.92	EMIS-Municipal	
Slovakia	M	56	Levice	Podluzianka	134.5	8.53	EMIS-Municipal	
Slovakia	M	57	Roznava	Slaná	74.5	7.02	EMIS-Municipal	
Slovakia	M	58	Revúca	Murán	23.4	1.66	EMIS-Municipal	
Slovakia	M	59	Rimavská Sobota	Rimava	38.9	6.15	EMIS-Municipal	
Slovakia	M	60	Šaca	Ida		3.33	EMIS-Municipal	
Slovakia	M	61	Snina	Cirocha	33.87	2	EMIS-Municipal	
Slovakia	M	63	Trebišov	Trnávka	24.01	***4.0***	EMIS-Municipal	
Slovakia	M	64	Spišská N. Ves	Hornád	146.1	9.05	EMIS-Municipal	
Slovakia	M	65	Sabinov	Torysa	8.15	***1.4***	EMIS-Municipal	
Slovakia	M	66	Prešov	Torysa	160.67	15.45	EMIS-Municipal	
Slovakia	M	1	Nitra	Nitra	181	17	EMIS-Municipal	Yes
Slovakia	M	2	Malacky	Malina (Morava)	54	10	EMIS-Municipal	Yes
Slovakia	M	3	Banska Bystrica	Hron	61	3	EMIS-Municipal	Yes
Slovakia	M	4	Michalovce	Laborec	51	13	EMIS-Municipal	Yes
Slovakia	M	5	Svidník	Ondava	39	6	EMIS-Municipal	Yes
Slovakia	M	6	Trencin, right side	Vah	84	19	EMIS-Municipal	Yes
Slovakia	M	7	Humenné	Laborec	160	21	EMIS-Municipal	Yes
Slovakia	M	8	Ruzomberok	Vah	632	9	EMIS-Municipal	Yes
Slovakia	M	9	Topolcany	Nitra	134	26	EMIS-Municipal	Yes
Slovakia	M	10	Košice	Hornád	395	79	EMIS-Municipal	Yes
Slovakia	I	1	Istrochem Bratislava	Danube	37.4		EMIS-Industrial	
Slovakia	I	7	Chemko Strázske	Ondava (Tisa)	33.16		EMIS-Industrial	
Slovakia	I	8	Slovenský hodváb Senica	Teplica (Morava)	2.14		EMIS-Industrial	
Slovakia	I	10	Biotika Slovenska Lupca	Hron	151		EMIS-Industrial	
Slovakia	I	11	Tanning Factory Bosany	Nitra	30		EMIS-Industrial	
Slovakia	I	12	Povaz. Chem. Plants	Vah	168		EMIS-Industrial	
Hungary	I	8	Agroferm (Kaba)	Kösely/Tisza	199.1	18.4	EMIS-Industrial	
Hungary	I	I2	Balatonfuzfo: NIKE Rt.	Sed-Nador	835.8	12	NR	
Hungary	M	14.	Békéscsaba	Kettos-Körös/Tisza	57.6	36	EMIS-Municipal	
Hungary	M	2.	Budapest north	Danube	524	103	EMIS-Municipal	
Hungary	M	1.	Budapest south	Danube	715	50	EMIS-Municipal	

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Hungary	M	M4	Budapest Untreated	Danube	3490	***582***	NR	
Hungary	M	13.	Debrecen	Kösely/Tisza	544.25	321.2	EMIS-Municipal	
Hungary	I	I10	Dunaujvaros: Dunaferr	Danube	287.1		NR	
Hungary	I	I9	Dunaujvaros: Dunapack	Danube	1		NR	
Hungary	M	6.	Gyor	Danube	423	63	EMIS-Municipal	
Hungary	I	I5	Labatlan: Piszke Paper	Danube	0.1		NR	Yes
Hungary	M	5.	Miskolc	Tisza, Sajó	388.5	130	EMIS-Municipal	
Hungary	I	I29	Mohacs: Wood ind.	Danube	0.6		NR	
Hungary	M	10.	Nagykanizsa	Dencsar canal	36	12	EMIS-Municipal	
Hungary	M	12.	Nyíregyháza	Tisza	221.2	17.7	EMIS-Municipal	
Hungary	M	8.	Pécs	Dráva	121.5	49.3	EMIS-Municipal	
Hungary	I	I31	Stornya: Leather Fact.	Danube	37.2		NR	
Hungary	I	7	Sugar Factory (Szolnok)	Tisza	33.2	3.8	EMIS-Industrial	
Hungary	I	I1	Szazhalombatta: MOL	Danube	8		NR	
Hungary	M	M7	Szeged	Tisza	540	90	NR	Yes
Hungary	M	15.	Székesfehérvár	Danube	257	36	EMIS-Municipal	
Hungary	M	7.	Szolnok	Tisza	200	49	EMIS-Municipal	Yes
Hungary	I	I15	Szolnok Neusidler Paper	Tisza	1.9	0.1	NR	Yes
Hungary	M	11.	Szombathely	Sorok-Perint, Rába	137	46	EMIS-Municipal	
Hungary	M	9.	Zalaegerszeg	Zala	46	6.4	EMIS-Municipal	
Hungary	I	13	Tisza Chemical Works	Tisza	89.2	16.9	EMIS-Industrial	
Hungary	M	M5	Dunaujvaros	Danube	160	25	NR	
Hungary	I	I3	Kbarcika: Borsodchem	Sajo	123.4		NR	
Hungary	I	I4	Gyor: Szeszip V.	Danube	0.1		NR	
Hungary	I	I6	Nyergesujfalu: Viscosa	Danube	1.6		NR	
Hungary	I	I11	Petfurdo: Nitrogen Works	Sed-N	727.1		NR	
Hungary	I	I12	Sajobabony: WasteMan.	Sajo	60		NR	
Hungary	I	I13	Tiszaujvaros TVK Rt.	Tisza	2	0.3	NR	
Hungary	I	I14	Szolnok TVM Rt.	Tisza	89.2	16.9	NR	
Hungary	I	I28	Dorog: Richter G. Ch.	Danube	55.4		NR	
Hungary	I	I30	Paks: Canning Fact.	Danube	0.5		NR	
Hungary	I	I32	Pecs: Leather Fact.	Drava	78		NR	
Hungary	I	I34	Hszoboszlo: MOL Rt	Berettyo	82	3.3	NR	
Hungary	I	I35	Kfelegyhaza: GYTV.	Tisza	3.5		NR	
Hungary	I	I36	Szolnok: Solami Ltd.	Tisza	10	4.2	NR	
Hungary	I	I38	Szarvas: Thermal W.	Koros	6.6	0.3	NR	
Hungary	I	I39	Mako: Floratom	Tisza	5.7		NR	
Hungary	A	A1	Mosca: Agr. Co-op	Danube	16	2.1	NR	
Hungary	A	A2	Kornye: Agroindustry	Danube	7.3	0.4	NR	
Hungary	A	A4	Hildpuszta: Hajosvin	Local cr.	0.1	0.1	NR	
Hungary	A	A5	Heviz: Balaton Fshery Plc.	Balaton	1.2	0.3	NR	
Hungary	A	A6	Dalma Transdanubian Fruit	Local cr.	3.1	0.2	NR	
Hungary	A	A7	Zagyvarekas: Conavis Rt.	Zagyva	0.4	0.2	NR	
Hungary	A	A8	Oroshaza: Agr. Co-op Dozsa	Tisza	0.4		NR	
Hungary	A	A9	Folddeak: Agr. Co-op	Tisza	1.2		NR	
Slovenia	M	1	Ljubljana	Sava	1069	240	EMIS-Municipal	
Slovenia	M	2	Maribor	Drava	564	180	EMIS-Municipal	

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Slovenia	M	3	Domzale	Sava	218	24	EMIS-Municipal	
Slovenia	M	4	Vrhnika	Sava	4	0.3	EMIS-Municipal	
Slovenia	M	7	Ptuj	Drava	166	8	EMIS-Municipal	
Slovenia	M	8	Kranj	Sava	126	13	EMIS-Municipal	
Slovenia	M	9	Skojja Loka	Sava	48	9	EMIS-Municipal	
Slovenia	M	10	Velenje	Sava	123	16	EMIS-Municipal	
Slovenia	M	11	Zalec	Sava	7	1	EMIS-Municipal	
Slovenia	M	12	Novo mesto	Sava	45	18	EMIS-Municipal	
Slovenia	M	13	Murska Sobota	Mura	108	9	EMIS-Municipal	
Slovenia	M	14	Ormoz	Drava	2	3	EMIS-Municipal	
Slovenia	M	15	Jesenice	Sava	3.3	5	EMIS-Municipal	
Croatia	I	8	"Petrokemija Kutina", Kutina	Sava	400		EMIS-Industrial	Yes
Croatia	I	6	"Pliva" Savski Marof	Sava	76.5		EMIS-Industrial	
Croatia	M	5	Belisce	Drava	89	8	EMIS-Municipal	
Croatia	M	M7	Bjelovar	Sava	103	16	NR	Yes
Croatia	M	1	Cakovec	Drava	22	7	EMIS-Municipal	Yes
Croatia	I	3	Complex "Belisce", Belisce	Drava	38.7		EMIS-Industrial	
Croatia	A	2	Farm "Senkovac" Slatina	Drava	12	10.5	EMIS-Industrial	Yes
Croatia	I	7	Farm Dubravica", Dubravica	Sava	179.9	46.7	EMIS-Industrial	
Croatia	M	10	Karlovac	Kupa	320	80	EMIS-Municipal	Yes
Croatia	M	M9	Koprivnica	Drava	54	9	NR	Yes
Croatia	M	6	Osijek	Drava	530	90	EMIS-Municipal	Yes
Croatia	I	11	Pik Vrbovec,Vrbovec	Sava	10.1	2.8	EMIS-Industrial	
Croatia	M	9	Sisak	Sava	240	60	EMIS-Municipal	Yes
Croatia	M	11	Slavonski Brod	Sava	240	60	EMIS-Municipal	Yes
Croatia	I	4	Sugar factory Osijek	Drava	17.7	5.3	EMIS-Industrial	
Croatia	M	2	Varazdin	Drava	140	60	EMIS-Municipal	Yes
Croatia	M	7	Vukovar	Danube	53	9	EMIS-Municipal	
Croatia	M	8	Zagreb	Sava	4400	1100	EMIS-Municipal	Yes
Croatia	I	I7	Zeljezara Sisak	Sava	3	0.2	NR	Yes
Croatia	I	1	"Podravka-Danica, Koprivnica	Drava	53.4	1.8	EMIS-Industrial	
Croatia	I	5	Brewery Osijek	Drava	4.3	3	EMIS-Industrial	
Croatia	A	A2	Farm Luzani	Sava	0	2	NR	
Croatia	I	I1	Gavrilovic Petrinja	Sava	4	2	NR	
Croatia	M	4	Virovitica	Drava	56	5	EMIS-Municipal	
Bosnia-H	M	1	Sarajevo	Bosna/Sava	620.5	176	EMIS-Municipal	
Bosnia-H	M	2	Zenica	Bosna/Sava	531.4	159.4	EMIS-Municipal	
Bosnia-H	M	3	Doboj	Bosna/Sava	374.1	112.2	EMIS-Municipal	
Bosnia-H	M	4	Tuzla	Jala/Spreca/Bosna/ Sava	481.3	144.4	EMIS-Municipal	
Bosnia-H	M	5	Prijedor	Sana/Una/Sava	411.5	123.2	EMIS-Municipal	
Bosnia-H	M	6	Banja Luka	Vrbas/Sava	712.3	213.7	EMIS-Municipal	
Yugoslavia	M	M1a	Belgrade	Danube	5840	1314	NR	
Yugoslavia	M	M1b	Belgrade	Danube	716	144	NR	
Yugoslavia	M	M1c	Belgrade	Danube	776	194	NR	
Yugoslavia	M	M1d	Belgrade	Sava	201	45	NR	
Yugoslavia	M	M 2	Novi Sad	Danube	988	298	NR	
Yugoslavia	M	M 3	Nis	Nisava	826	289	NR	

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Yugoslavia	M	M 4	Pristina	Sitnica	570	148	NR	
Yugoslavia	M	M 5	Zrenjanin	Begej	975	226	NR	
Yugoslavia	M	M 6	Pancevo	Danube	571	190	NR	
Yugoslavia	M	M 7	Vrbas/Kula/Crvenka	DTD Kanal	547	151	NR	
Yugoslavia	M	M 8	Leskovac	J. Morava	295	132	NR	
Yugoslavia	M	M 9	Krusevac	Z. Morava	333	79	NR	
Yugoslavia	M	M 10	Cacak	Z. Morava	410	139	NR	
Yugoslavia	M	M 11	Indjija	Danube	362	61	NR	
Yugoslavia	M	M 12	Sabac	Sava	287	113	NR	
Yugoslavia	M	M 13	Vranje	J. Morava	286	92	NR	
Yugoslavia	M	M 14	Valjevo	Kolubara	293	122	NR	
Yugoslavia	M	M 15	Novi Pazar	Z. Morava	252	101	NR	
Yugoslavia	M	M 16	Subotica	Palic & Ludos lakes	696	187	NR	
Yugoslavia	M	M 17	Uzice	Z. Morava	222	62	NR	
Yugoslavia	M	M 18	Zajecar	V. Timok	205	55	NR	
Yugoslavia	M	M 19	Senta	Tisa	238	55	NR	
Yugoslavia	M	M 20	Bor	Borska	145	43	NR	
Yugoslavia	M	M 21	Pirot	Nisava	240	56	NR	
Yugoslavia	M	M 22	Pljevlja	Cehotina	115	38	NR	
Yugoslavia	M	M 23	Rozaje	Ibar	38	12	NR	
Yugoslavia	M	M 24	Blace	Blatasnica	48	15	NR	
Yugoslavia	M	M 25	Kolasin	Tara	35	7	NR	
Yugoslavia	M	M 26	Mojkovac	Tara	19	5	NR	
Yugoslavia	M	M 27	Gusinje	Plavsko Lake	20	5	NR	
Yugoslavia	M	M 28	S. Mitrovica	Sava	292	75	NR	
Yugoslavia	M	M 29	Kraljevo	Z. Morava	241	62	NR	
Yugoslavia	M	M 30	Smederovo	Danube	260	94	NR	
Yugoslavia	M	M 31	K. Mitrovica	Ibar	178	77	NR	
Yugoslavia	M	M 32	Pozarevac	V. Morava	195	89	NR	
Yugoslavia	M	M 33	Knjazevac	B. Timok	125	55	NR	
Yugoslavia	M	M 34	Gnjilane	B. Morava	105	34	NR	
Yugoslavia	M	M 35	Vladicin Han	J. Morava	88	38	NR	
Yugoslavia	M	M 36	Prokuplje	Toplica	122	34	NR	
Yugoslavia	M	M 37	Bijelo Polje	Lim	108	31	NR	
Yugoslavia	M	M 38	Pozega	Z. Morava	86	31	NR	
Yugoslavia	M	M 39	Cuprija	V. Morava	102	29	NR	
Yugoslavia	M	M 40	Berane	Lim	101	28	NR	
Yugoslavia	M	M 41	Ruma	Sava	93	22	NR	
Yugoslavia	M	M 42	Lazarevac	Kolubara	83	21	NR	
Yugoslavia	M	M 43	Sjenica	Vapa	65	15	NR	
Yugoslavia	M	M 44	Lipljan	Sitnica	72	21	NR	
Yugoslavia	M	M 45	Loznica	Drina	70	29	NR	
Yugoslavia	M	M 46	Novi Sad II	Danube	79	16	NR	
Yugoslavia	M	M 47	Prijepolje	Lim	73	26	NR	
Yugoslavia	M	M 48	Priboj	Lim	59	31	NR	
Yugoslavia	M	M 49	Kovin	Danube	54	15	NR	
Yugoslavia	M	M 50	Ivanjica	Moravica	45	17	NR	
Yugoslavia	A	A1	Sirig		398	57	NR	
Yugoslavia	A	A2	Zitoradja		168	20	NR	
Yugoslavia	A	A3	Varvarin		62	15	NR	

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Yugoslavia	A	A4	Surcin		292	36	NR	
Yugoslavia	A	A5	Obrenovac		168	20	NR	
Yugoslavia	A	A6	Cenej		245	31	NR	
Yugoslavia	A	A7	Subotica		175	22	NR	
Yugoslavia	A	A8	Srbobran		69	18	NR	
Yugoslavia	A	A9	Becej		642	78	NR	
Yugoslavia	A	A10	Ada		69	18	NR	
Yugoslavia	A	A11	Coka		208	26	NR	
Yugoslavia	A	A12	Pancevo		168	20	NR	
Yugoslavia	A	A13	Velika Plana		168	20	NR	
Yugoslavia	A	A14	Petrovac		183	23	NR	
Yugoslavia	A	A15	Zajecar		168	20	NR	
Yugoslavia	A	A16	Padinska Skela		208	26	NR	
Yugoslavia	A	A17	Secanj		245	31	NR	
Yugoslavia	A	A18	Vrbas		292	36	NR	
Yugoslavia	A	A19	Kikinda		16	6	NR	
Yugoslavia	A	A20	Leskovac		62	15	NR	
Romania	A	A 29	Avicola Satu Mare	Sar/Somes	1		NR	
Romania	A	A 25	Combil Gh. Doja	Ialomita/Ialomita	96		NR	
Romania	I	I 109	Agricola Bacau	Siret	693		NR	
Romania	I	I 88	Agrocomsuin Bontida	Somes-Tisa	620		NR	
Romania	I	I 77	Antibiotice Iasi	Bahluiet/Prut	12	3.6	NR	Yes
Romania	I	I 53	Aro Campulung	Arges	4	0.8	NR	
Romania	I	I 55	Arpechim Pitesti	Dambovnic / Arges	92	3.5	NR	
Romania	I	I 32	Automecanica Medias	Mures	1		NR	
Romania	I	43	Avicola Satu Mare	Somes-Tisa	0.7		EMIS-Industrial	
Romania	I	I 94	Avicola Ungheni	Mures	41		NR	
Romania	I	I 17	Azomures Tg Mures	Mures/Mures	1641		NR	
Romania	I	I 103	Beta Tandareni	Ialomita/Ialomita	70		NR	
Romania	I	I 116	Braigal Braila	Danube/Dunare	892		NR	
Romania	I	I 39	C.S. Resita	Bega-Timis	10		NR	
Romania	I	I 50	Celohart Zarnesti	Bistra/Olt	40		NR	
Romania	I	I 66	Chimcomplex Borzesti	Trotus/Siret	22		NR	
Romania	I	I 81	CICH Tr. Magurele	Danube/Dunare	990	39	NR	
Romania	I	I 37	Ciocanul Nadrag	Bega-Timis	1		NR	
Romania	I	I 121	Colorom Codlea	Vulcanita/Olt	9		NR	
Romania	I	56	Combilcarial Gh.Doja	Ialomita	96		EMIS-Industrial	
Romania	I	I 101	Combilcarum Cazanesti	Ialomita	766		NR	
Romania	I	I 98	Comseltest Padureni	Bega-Timis	229		NR	
Romania	I	I 99	Comsuin Beregsau	Bega-Timis	818		NR	
Romania	I	I 97	Comsuin Birda	Bega-Timis	1033		NR	
Romania	I	45	Comsuin Moftin	Somes-Tisa	91	6.2	EMIS-Industrial	
Romania	I	I 96	Comsuin Periam	Mures/Aranca	59		NR	
Romania	I	63	Comsuin Ulmeni	Danube	472	1.3	EMIS-Industrial	
Romania	I	62	Comtom Tomesti	Prut	38	0.3	EMIS-Industrial	Yes
Romania	I	I 54	Dacia Pitesti	Doamnai / Arges	94	8.9	NR	
Romania	I	I 46	Doljchim Craiova	Jiu / Jiu	992		NR	
Romania	I	I 70	Fibrex Savinesti	Bistrita/Siret	831		NR	
Romania	I	I 78	Fortus Iasi	Prut	0		NR	
Romania	I	I 64	Gerom Buzau	Buzau	0.6		NR	

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Romania	I	I 93	Indagrara Arad	Mures/Mures	400		NR	
Romania	I	I 65	Letea Bacau	Bistrita/Siret	1838	517	NR	
Romania	I	I 106	Mark-Pork Vanatori	Siret	75		NR	
Romania	I	I 108	Martincom Martinesti	Siret	13		NR	
Romania	I	14	Nitramonia Fagaras	Olt	1253	0.14	EMIS-Industrial	
Romania	I	I 95	Nutrimur Iernut	Mures/Mures	51		NR	
Romania	I	I 100	Oltchim Rm. Valcea	Olt/Olt	548		NR	
Romania	I	I 71	Pergodur P. Neamt	Bistrita/Siret	18	1.3	NR	
Romania	I	I 114	Prodsuis Stanilesti	Prut	18		NR	
Romania	I	61	Pyretus Falciu	Prut	9	0.1	EMIS-Industrial	
Romania	I	I 33	Resial Alba Iulia	Mures	2		NR	
Romania	I	I 48	Romacril Rasnov	Ghimbasel / Olt	9		NR	
Romania	I	I 83	Romag Tr. Severin	Topolnita/Dunare	1	19	NR	Yes
Romania	I	I 57	Romfosfochim Valea Calugareasca	Telejen/Ialomita	11	3.2	NR	
Romania	I	I 75	Rulmentul Barlad	Siret	9	0.6	NR	
Romania	I	I 29	Sidermet Calan	Mures	6		NR	
Romania	I	I 22	Siderurgica Hunedoara	Cerna/Mures	74		NR	
Romania	I	I 76	Sidex Galati	Siret/Siret	1078	4.5	NR	
Romania	I	I 72	Sofert Bacau	Bistrita/Siret	380		NR	
Romania	I	I 87	Somes Dej	Somesul Mic/Somes-Tisa	130		NR	
Romania	I	I 16	Sometra Copsa Mica	Tarnava Mare/Mures	4467		NR	
Romania	I	59	Spirt Ghidiceni	Siret	202	0.1	EMIS-Industrial	
Romania	I	I 91	Stratus Mob Blaj	Tarnave/Mures	55		NR	
Romania	I	I 104	Suinded Dedulesti	Buzau	174		NR	
Romania	I	57	Suinprod Neamt	Siret	111	15.4	EMIS-Industrial	
Romania	I	I 111	Suinprod Independenta	Siret	323		NR	
Romania	I	I 92	Suinprod Salcud	Mures	196		NR	
Romania	I	I 107	Suintest Focsani	Siret	68		NR	
Romania	I	3	Terapia Cluj	Somes-Tisa	284	0.5	EMIS-Industrial	
Romania	I	19	U.P.S. Govora	Olt	175		EMIS-Industrial	
Romania	I	I 102	Ulcom Slobozia	Ialomita/Ialomita	16		NR	
Romania	I	I 128	UPS Govora	Olt/Olt	175		NR	
Romania	I	40	Verachim Giurgiu	Danube	2.8	5	EMIS-Industrial	
Romania	I	21	Viromet Victoria	Olt	339		EMIS-Industrial	
Romania	M	36	Alba Iulia	Mures	266	54.6	EMIS-Municipal	Yes
Romania	M	M 50	Alexandria	Vedea	109.05	9.6	NR	Yes
Romania	M	41	Arad	Mures	278.2	57	EMIS-Municipal	
Romania	M	15	Bacau	Siret	459	71	EMIS-Municipal	
Romania	M	48	Baia Mare	Somes	180	37	EMIS-Municipal	
Romania	M	M 8	Barlad	Siret	133.15	7.5	NR	
Romania	M	M 45	Bistrita I	Somes	244.24		NR	
Romania	M	M 46	Bistrita II	Somes	343.46		NR	
Romania	M	M 6	Botosani	Sitna - Prut	229.74	31.28	NR	Yes
Romania	M	5	Braila	Danube	420	65.7	EMIS-Municipal	Yes
Romania	M	25	Brasov	Olt	806	104	EMIS-Municipal	Yes
Romania	M	M 54	Bucuresti	Dambovita / Arges	10872	2218	NR	
Romania	M	16	Buzau	Buzau	423	80.7	EMIS-Municipal	Yes
Romania	M	1	Calarasi	Danube	27.93	5.6	EMIS-Municipal	

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Romania	M	M 52	Campulung Muscel	r. Targului / Arges	82	23	NR	Yes
Romania	M	49	Cluj	Somes	516	94.7	EMIS-Municipal	
Romania	M	M 28	Craiova	Jiu / Jiu	985	277	NR	Yes
Romania	M	M 51	Curtea de Arges	Arges	87	4	NR	
Romania	M	M 34	Deva	Mures / Mures	186.2	52.4	NR	Yes
Romania	M	4	Drobeta Tr. Severin	Danube	91.5	18	EMIS-Municipal	
Romania	M	12	Focsani	Siret	172.18	41	EMIS-Municipal	
Romania	M	M 17	Galati	Danube/Danube	1044	293	NR	Yes
Romania	M	2	Giurgiu	Danube	130	31	EMIS-Municipal	
Romania	M	37	Hunedoara	Mures	38.85	8	EMIS-Municipal	
Romania	M	7	Iasi	Prut	368	60.4	EMIS-Municipal	
Romania	M	29	Lugoj	Timis	86	17.7	EMIS-Municipal	Yes
Romania	M	M 38	Medias I	Mures	41.69	11.26	NR	
Romania	M	M 39	Medias II	Mures	195.44	15.88	NR	
Romania	M	10	Onesti	Siret	33.7	6.7	EMIS-Municipal	
Romania	M	42	Oradea	Cris	290	39	EMIS-Municipal	
Romania	M	26	Petrosani	Jiu	102	22.7	EMIS-Municipal	
Romania	M	14	Piatra Neamt	Siret	229.6	42.1	EMIS-Municipal	
Romania	M	M 53	Pitesti	Arges	475	37	NR	
Romania	M	M 20	Ploiesti	Ialomita	884	319	NR	Yes
Romania	M	M 30	Resita I	Barzava / Bega-Timis	235	71.7	NR	Yes
Romania	M	M 31	Resita II	Barzava / Bega-Timis	122.47		NR	Yes
Romania	M	M 23	Rm. Valcea	Olt / Olt	240	49.3	NR	
Romania	M	11	Roman	Siret	209	42.9	EMIS-Municipal	
Romania	M	47	Satu Mare	Somes	164.77	33.7	EMIS-Municipal	
Romania	M	21	Sf. Gheorghe	Olt	114	23.4	EMIS-Municipal	
Romania	M	24	Sibiu	Olt	480	94	EMIS-Municipal	
Romania	M	22	Slatina	Olt	252	28.4	EMIS-Municipal	
Romania	M	19	Slobozia	Ialomita	192.1	39.4	EMIS-Municipal	
Romania	M	13	Suceava	Siret	195.4	43.4	EMIS-Municipal	
Romania	M	M 18	Targoviste	Ialomita/Ialomita	131	29	NR	
Romania	M	27	Tg. Jiu	Jiu	180	36	EMIS-Municipal	
Romania	M	40	Tg. Mures	Mures	290	62	EMIS-Municipal	Yes
Romania	M	M 32	Timisoara	Bega / Bega-Timis	676	98	NR	
Romania	M	M 33	Timisoara	Bega / Bega-Timis	316	75	NR	
Romania	M	3	Tulcea	Danube	220	52.4	EMIS-Municipal	
Romania	M	35	Turda	Mures	206	10.6	EMIS-Municipal	Yes
Romania	M	M 9	Vaslui	Siret	89.1	5.6	NR	
Romania	M	43	Zalau	Somes	110	24.4	EMIS-Municipal	Yes
Romania	M	44	Zalau	Somes	20.35	4.2	EMIS-Municipal	Yes
Bulgaria	M	m1	Gorna Oriahovitza & Liaskovets	Yanta	502	50	NR	Yes
Bulgaria	M	m14	Lom	Danube	189.8	38	NR	Yes
Bulgaria	M	m3	Lovetch	Osam	454	30	NR	Yes
Bulgaria	M	m7	Montana	Ogosta	446	65	NR	Yes
Bulgaria	M	m8	Popovo	Russenski Lom / Cherni Lom / Popowska	138	31	NR	Yes
Bulgaria	M	m9	Russe	Danube	2884	483	NR	Yes
Bulgaria	M	m6	Sevlievo	Yantra / Rossitza	184	26	NR	Yes

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Bulgaria	M	m11	Silistra	Danube	84	16	NR	Yes
Bulgaria	M	m5	Sofia	Iskar	1283	327	NR	Yes
Bulgaria	M	m10	Svishtov	Danube	226	28	NR	Yes
Bulgaria	M	m2	Troyan	Osam	298	35	NR	Yes
Bulgaria	M	m13	Vidin	Danube	327.4	42.7	NR	Yes
Bulgaria	M	m4	Vratza	Ogosta / Leva / Botunya	33	1.3	NR	Yes
Bulgaria	M	17	Cherven briag	Iskar	117	29	EMIS-Municipal	
Bulgaria	M	7	Dobrich	Suha	178	21	EMIS-Municipal	
Bulgaria	M	8	Gabrovo	Yantra	201	52	EMIS-Municipal	
Bulgaria	M	m12	Levski	Osam	160	28	NR	
Bulgaria	M	6	Pleven	Vit	487	138	EMIS-Municipal	
Bulgaria	M	9	Razgrad	Russenski Lom	220	24	EMIS-Municipal	
Bulgaria	M	12	Samokov	Iskar	291	73	EMIS-Municipal	
Bulgaria	M	3	Veliko Tarnovo	Yantra	408	82	EMIS-Municipal	
Bulgaria	I	15	Antibiotic/Razgrad (2)	Beli Lom/R.Lom	19	1.89	EMIS-Industrial	
Bulgaria	I	3	Bimas/Russe (3)	Danube	23.8	1.99	EMIS-Industrial	
Bulgaria	I	4	Chlebna maja/Russe (1)	Danube	82.1	11.8	EMIS-Industrial	
Bulgaria	I	11	EKKO-ET/ Etropole (1)	Iskar	58.4		EMIS-Industrial	
Bulgaria	I	10	Kraft Jacobs Suchard/Svoge (1)	Iskretzka/Iskar	4.1	0.18	EMIS-Industrial	
Bulgaria	I	5	Lesoplast/Trojan (1)	Osam	7.5	0.75	EMIS-Industrial	
Bulgaria	I	14	Lovico/Suhindol (3)	Rositza/Yantra	12	1 5	EMIS-Industrial	
Bulgaria	I	8	Sevko/Sevlievo (1)	Rositza/Yantra	60		EMIS-Industrial	
Bulgaria	I	7	Sugar Factory/G.Orjachovtza(3)	Yantra	700	0.55	EMIS-Industrial	Yes
Bulgaria	I	1	Sviloza/Svishtov (1)	Danube	67	1	EMIS-Industrial	
Bulgaria	I	6	Velur/Lovetch (1)	Osam	273		EMIS-Industrial	
Bulgaria	I	I2	Vratza Himco	Ogosta /Dubnica / Lewa	242.3	3.6	NR	
Bulgaria	I	2	Zachar Bio/Russe (1)	Danube	79.5	5	EMIS-Industrial	
Moldova	M	I2	Briceni Lipcani TP	Prut	0.01	0.001	NR	
Moldova	I	I1	Briceni Sugar Plant	Prut	31.1	4	NR	
Moldova	M	I13	Cahul Town TP	Prut	20.18	8.3	NR	
Moldova	M	I12	Cantemir Town TP	Prut	13.9	1.8	NR	
Moldova	M	I14	Comrat Town TP	Yalpugh	2.18	2.3	NR	
Moldova	M	I3	Edinet Cupcini TP	Ciugur	7.32	6.883	NR	
Moldova	A	I4	Edinet pig farm	groundwater	0.004	0.001	NR	
Moldova	M	I7	Falesti Town TP	Prut	11.85	1.6	NR	
Moldova	M	I6	Glodeni Town TP	Prut	64.1	3.6	NR	
Moldova	M	I11	Leova Town TP	Prut	1.21	1.23	NR	
Moldova	M	I10	Nisporeni Town TP	Prut	9.9	1.3	NR	
Moldova	M	I5	Riscani Costesti TP	Prut	0.5	0.06	NR	
Moldova	M	I15	Taraclia Town TP	Lunguta - Yalpugh	2	0.93	NR	
Moldova	M	I9	Ungeni Costesti TP	Prut	1.25	0.16	NR	
Moldova	M	I8	Ungeni Town TP	Prut	122.6	7.5	NR	
Ukraine	I	I1	Cardboard plant Rakhiv	Tizsa	34.6	20.6	NR	Yes
Ukraine	I	I2	Paper fact. Izmail	Danube	16.6	4.1	NR	Yes
Ukraine	I	I9	Timber processing fact. Teresva	Tizsa	40	4	NR	Yes
Ukraine	M	M4	Chernivtsi WWTP	Prut	145.1	18.3	NR	

Country	Cat.	Id	Name	Recipient	N	P	Source	Cf.
Ukraine	M	M1	Izmail WWTP	Danube	213.4	37.5	NR	
Ukraine	M	M2	Kolomyia WWTP	Prut	106	34.5	NR	
Ukraine	M	M3	Mukachevo WWTP	Latoryt sya	95.1	48.85	NR	
Ukraine	I	I3	Paper mill Kolomyia	Prut	13.1	6.5	NR	
Ukraine	I	I4	Pilot entertprise Lusa	Prut	19.2	1.4	NR	
Ukraine	I	I10	Timber Proc. fact. Verkhovyna	Cheremosh	26.1	3.4	NR	
Ukraine	I	I11	Timber Proc. fact. Vorokhta	Prut	18.5	2.1	NR	
Ukraine	I	I12	Timber proc. plant Svaliava	Latorytsia	8.7	2.6	NR	
Ukraine	I	I13	Timber proc. plant V. Bychkov	Tisza	7.5	1.6	NR	
Ukraine	I	I5	Timber processing fact. Berehomet	Prut	22	6.7	NR	
Ukraine	I	I6	Timber processing fact. Cheremosh	Cheremosh	21.5	5.5	NR	
Ukraine	I	I7	Timber processing fact. Deliatyna	Prut	22.4	3.9	NR	
Ukraine	I	I8	Timber processing fact. Perchyna	Uzh	40	0.96	NR	
Ukraine	M	M5	Uzhgorod WWTP	Uzh	326.7	130.1	NR	

Annex 6A. River Network and Major Point Sources

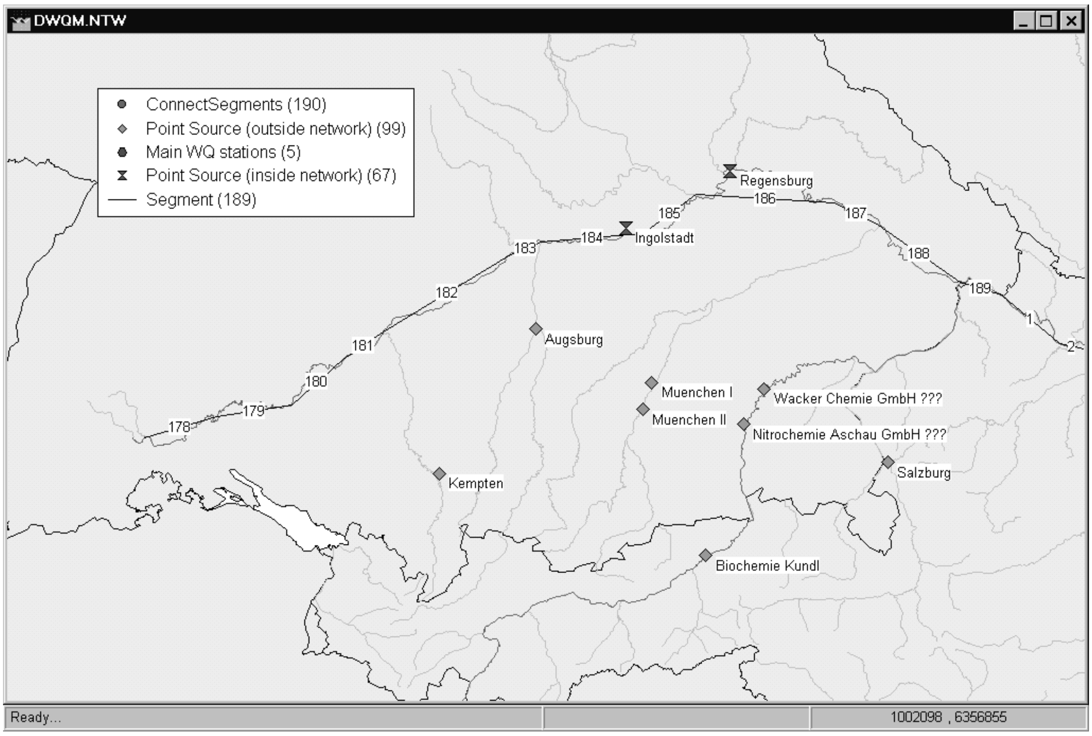


Figure A6-1.a Germany, West Austria.

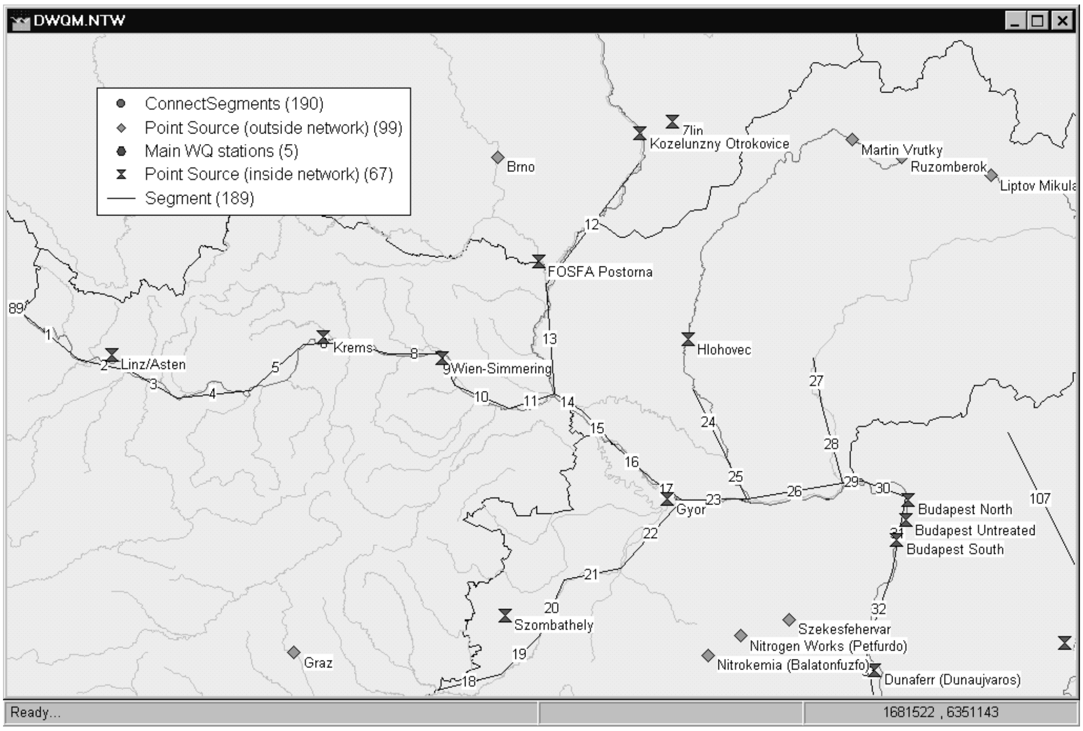


Figure A6-1.b Austrian Danube, Czech Republic, West Slovakia, Northwest Hungary.

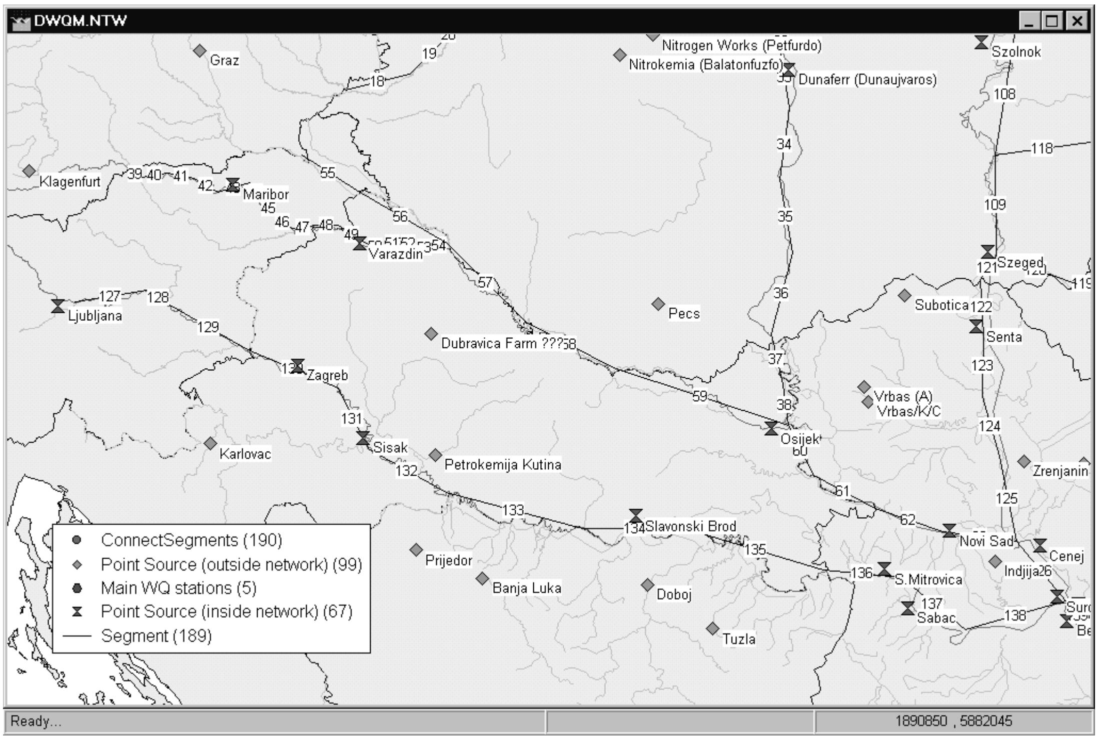


Figure A6-1.c Sava and Drava basins, Lower Tisa, Southwest Hungary.

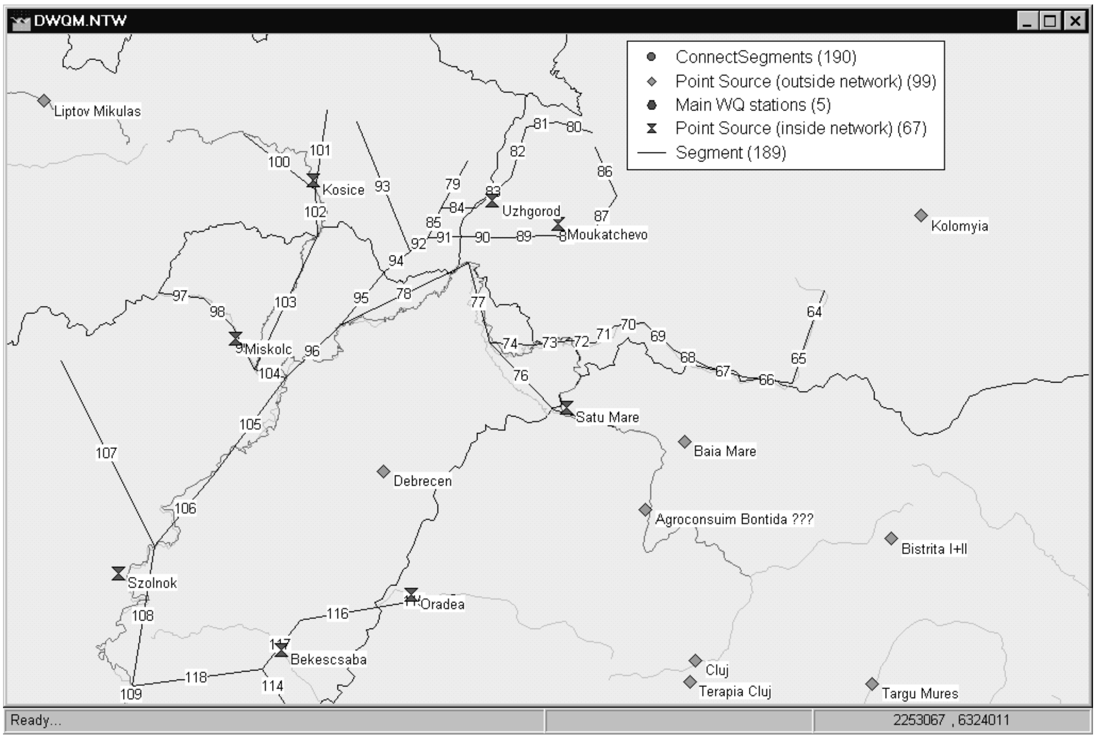


Figure A6-1.d Upper Tisa basin (Slovakia, Ukraine, Romania, Hungary).

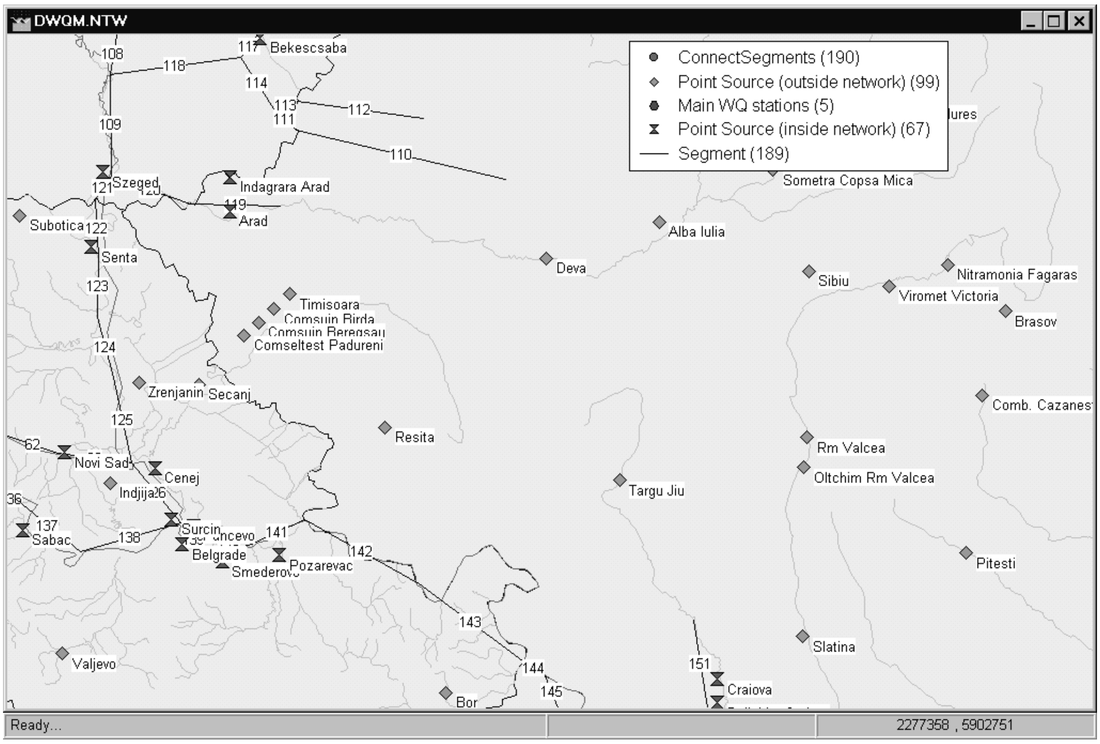


Figure A6-1.e Danube in Yugoslavia.

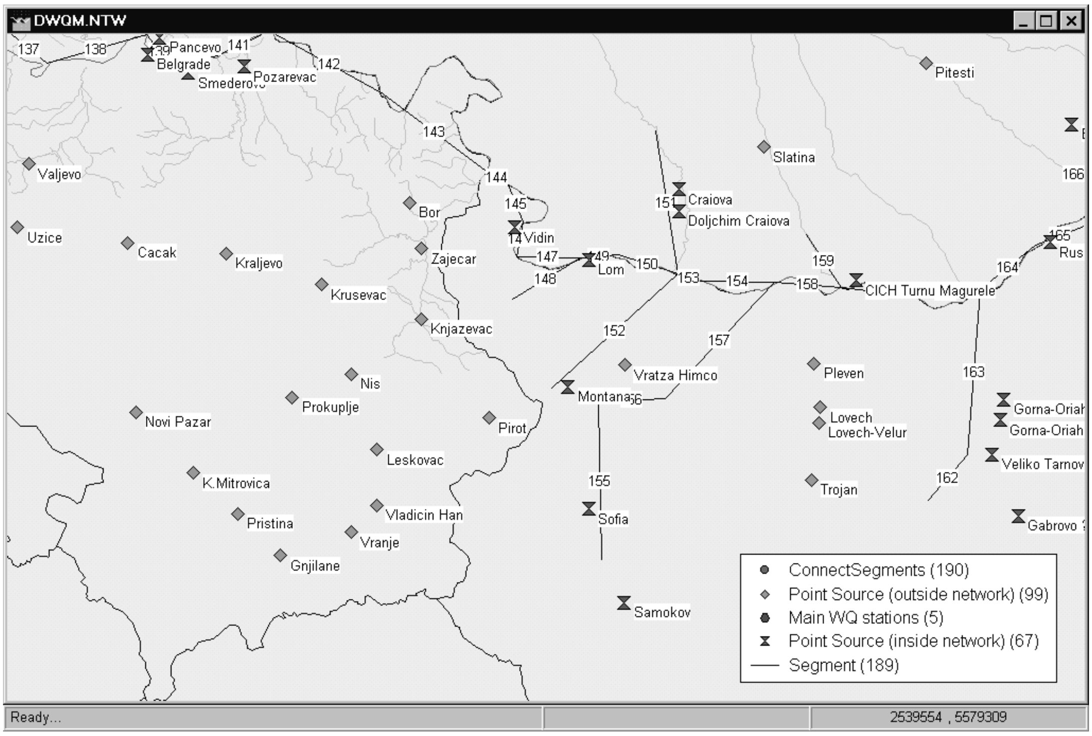


Figure A6-1.f South Yugoslavia, Northwest Bulgaria, Southwest Romania.

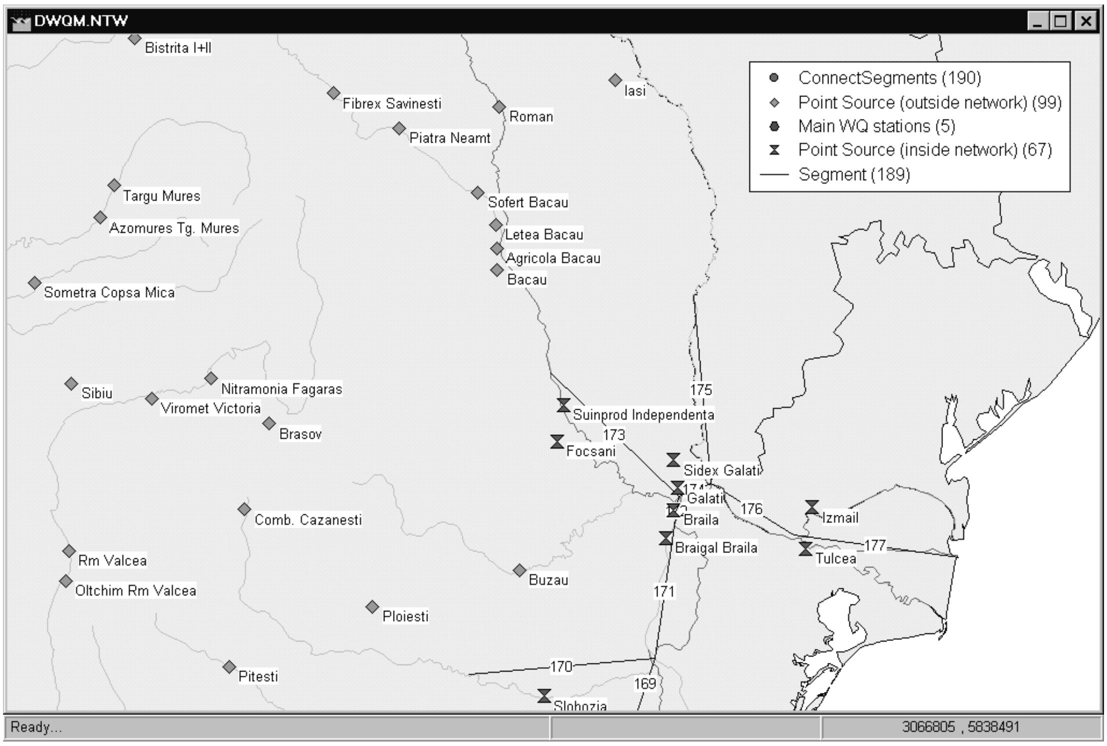


Figure A6-1.g East Romania.

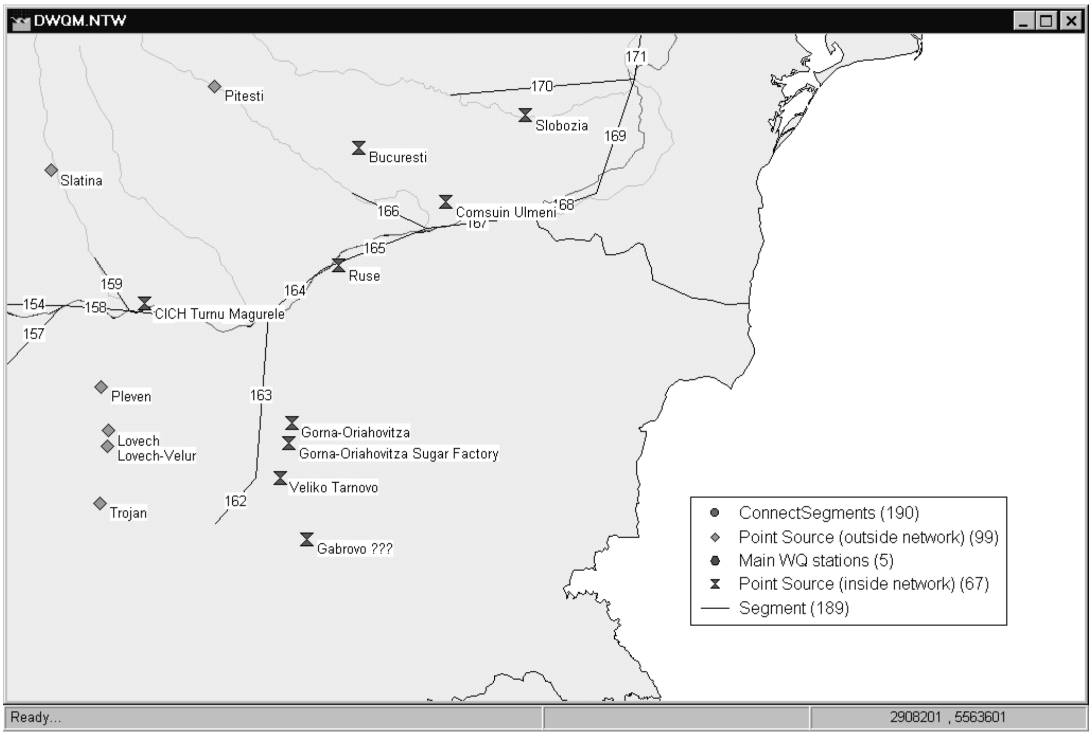


Figure A6-1.h Northeast Bulgaria.

Annex 7.

Overview of Data Derived from Nutrient Balances Project

Overview of Data Derived from Nutrient Balances Project

SUMMARY OF DATA FROM NUTRIENT BALANCES PROJECT													
REFERENCE YEAR 1992													
	D	A	CZ	SK	H	SL	CR	YU	BH	BG	RO	MO	UK	Sum/Aver
Surface area (1000 km2)	56	81	21	47	93	16				46	238	13	26	637
arable (%)	*25*	22	*45*	*66*	51	15				37	39	51	24	
meadows and pastures (%)	*16*	24	*16*	*22*	13	17				16	20	12	19	
forest (%)	46	42	34	*10*	18	51				25	26	12	54	
other (%)	13	12	5	*2*	18	17				22	15	24	4	
arable (1000 km2)	14.0	17.8	9.5	31.0	47.4	2.5				17.0	92.8	6.6	6.2	245
meadows/pastures	9.0	19.4	3.4	10.3	12.1	2.8				7.4	47.6	1.6	4.9	118
forest	25.8	34.0	7.1	4.7	16.7	8.4				11.5	61.9	1.6	14.0	186
other	7.3	9.7	1.1	0.9	16.7	2.8				10.1	35.7	3.1	1.0	88
Population (million)	9	8	2.75	5.1	10.3	1.7				3.9	22.7	1.1	2.8	67
sewered (%)	*90*	71	76	59	42	74				62	40	14	41	55
Sewered people (million)	8.1	5.3	2.1	3.0	4.3	1.3				2.4	9.1	0.2	1.1	37
Non-sewered people (million)	0.9	2.2	0.7	2.1	6.0	0.4				1.5	13.6	0.9	1.7	30
Mineral fertilizer use (kgN/ha)	91	46	60	60	23	25				54	17	34	40	
Mineral fertilizer use (kgP/ha)	17	11	9	9	1	6				4	9	12	26	
Manure production (kgN/ha)	89	69	34	33	26	32				21	11	28	30	
Manure production (kgP/ha)	18	14	10	10	7	4				6	2	8	12	
per ha of agricultural area!!														

Basic data from Nutrient Balances project											
Nitrogen											
Year 1992											
	D	A	CZ	SK	H	SL	BG	RO	MO	UK	Sum/Aver
industries	1	2	4	3	3	6	4	18	0	0	41
direct discharges of private households	0	1	3	3	5	1	1	0	0	0	14
non-treated sewage	0	1	1	2	8	4	8	14	0	0	38
storm weather overflow	2	2	2	1	0	1	3	5	0	0	16
effluents from municipal WWTP’s	18	23	9	16	14	4	6	26	1	3	120
effluents from manureTP’s	0	0	0	0	0	0	0	15	0	0	15
base flow	65	54	13	27	5	4	4	95	3	4	274
erosion, runoff (from agriculture land)	11	8	4	10	28	4	6	38	9	17	135
discharge of manure	2	2	0	0	8	0	7	25	0	1	45
erosion, run-off from forests and others	10	9	0	0	0	0	2	0	0	9	30
nitrogen fixation	0	0	0	0	20	0	0	4	0	0	24
TOTAL	109	102	36	62	91	24	41	240	13	34	752
percolation from population	*5*	13	4	10	18	3	7	73	3	2	138
percolation from agriculture	*63*	47	13	28	45	4	11	168	11	20	410
percolation from other areas	*25*	22	0	1	25	1	13	158	0	0	245
total percolation	93	82	17	39	88	8	31	399	14	22	793
base flow / percolation (%)	70	66	76	69	6	50	13	24	21	18	35
FERTILIZER APPLIED											
specific use mineral fertilizer (kg/ha)	91	46	60	60	23	25	54	17	34	40	
total amount (kT/a)	209	171	77	248	137	13	132	239	28	45	1298
specific production manure (kg/ha)	89	69	34	33	26	32	21	11	28	30	
total amount (kT/a)	204	257	44	136	155	17	51	154	23	34	1075

EMISSION FACTORS											
Head specific industrial discharges (kg/cap/a)											0.61
Head specific direct discharges hh's (kg/cap/a)	*related to non-sewered population!*										0.47
Head specific storm water overflow (kg/cap/a)	*related to sewered population!*										0.43
Head specific effl. sewered (kg/cap/a)	*related to sewered population!*										4.3
Specific erosion (agr. soils) (kg/ha/a)											3.7
Specific erosion (forestry, other) (kg/ha/a)											1.1
Specific percolation (agriculture area) kg/ha/a											11.28
Specific percolation (inhabitants) kg/cap/a											2.06
Specific percolation (other areas) kg/ha/a											8.94
Specific production of manure (kg/ha/a)											29.6
Discharged fraction of manure (%)											4.2

Basic data from Nutrient Balances project											
Phosphorus											
Year 1992											
	D	A	CZ	SK	H	SL	BG	RO	MO	UK	Sum/Aver
industries	0.1	0.1	0.5	0.1	1.7	0.4	0.1	4.3	0	0	7.3
direct discharges of private households	0	0.2	0.2	0.3	1.5	0.1	0.3	0	0	0	2.6
non-treated sewage	0	0.1	0.3	0.5	2	0.8	1.8	2.1	0	0	7.6
storm weather overflow	0.3	0.4	0.3	0.2	0	0.1	0.4	1.1	0	0.1	2.9
effluents from municipal WWTP’s	1.6	3	2.1	3.2	3.2	0.8	1.4	3.6	0.2	1	20.1
effluents from manureTP’s	0	0	0	0	0	0	0	3	0	0	3
base flow	0	0.5	0.1	0.3	0	0.4	0.5	4.3	0	0.4	6.5
erosion, runoff (from agriculture land)	5.1	3.1	0.6	1.4	5.0	0.1	0.7	6.8	2.1	2.8	27.7
discharge of manure	0.8	0.4	0.1	0.0	1.6	0.0	1.8	4.5	0.0	0.5	9.7
erosion, run-off from forests and others	0.8	0.8	0.0	0.0	0.6	0.0	0.3	0.0	0.0	0.9	3.4
nitrogen fixation											0
TOTAL	8.7	8.6	4.2	6	15.6	2.7	7.3	29.7	2.3	5.7	90.8
percolation from population		1.2	0.6	1.5	3.4	0.4	0.6	1.7	0.2	0.2	9.8
percolation from agriculture		0.3	0.6	1.4	0.0	0.1	1.1	1.6	0.1	4.3	9.5
percolation from other areas		0.3	0.0	0.2	0.0	0.2	0.0	0.1	0.0	0.0	0.8
total percolation		1.8	1.2	3.1	3.4	0.7	1.7	3.4	0.3	4.5	20.1
base flow / percolation (%)		28	8	10	0	57	29	126	0	9	32
FERTILIZER APPLIED											
specific use mineral fertilizer (kg/ha)	17	11	9	9	1	6	4	9	12	26	
total amount (kT/a)	39	41	12	37	6	3	10	126	10	29	313
specific production manure (kg/ha)	18	14	10	10	7	4	6	2	8	12	
total amount (kT/a)	41	52	13	41	42	2	15	28	7	13	254

EMISSION FACTORS		
Head specific industrial discharges (kg/cap/a)		0.11
Head specific direct discharges hh's (kg/cap/a)	*related to non-sewered population!*	0.09
Head specific storm water overflow (kg/cap/a)	*related to sewered population!*	0.08
Head specific effl. sewered (kg/cap/a)	*related to sewered population!*	0.80
Specific erosion (agr. soils) (kg/ha/a)		0.8
Specific erosion (forestry, other) (kg/ha/a)		0.1
Specific percolation (agriculture area) kg/ha/a		0.26
Specific percolation (inhabitants) kg/cap/a		0.15
Specific percolation (other areas) kg/ha/a		0.03
Specific production of manure (kg/ha/a)		7.0
Discharged fraction of manure (%)		3.8

Annex 8.

Overview of Data Supporting Diffuse Pollution Loads Estimates, Derived from National Reviews

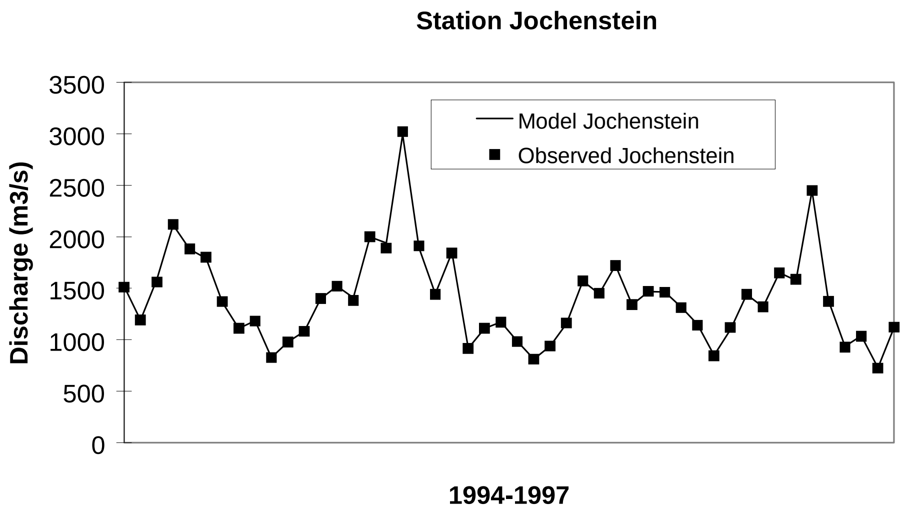
Overview of Data Supporting Diffuse Pollution Loads Estimates, Derived from National Reviews

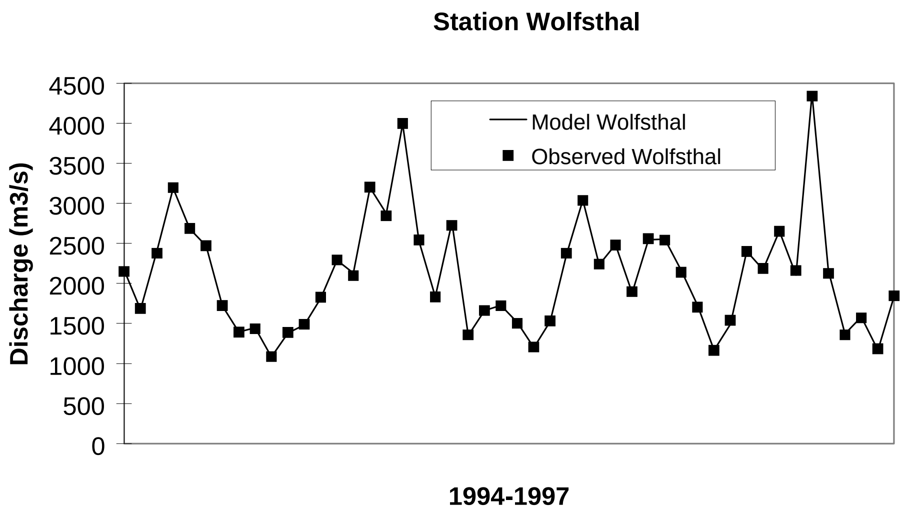
SUMMARY OF DATA FROM NATIONAL REVIEWS														
YEAR 1994-1997														
		D	A	CZ	SK	H	SL	CR	YU	BH	BG	RO	MO	UK	Sum/Av.
Surface area in Danube (1000 km2)		56	81	21	47	93	16	35	89	39	46	232	12	34	801
arable (%)		29	18	59	32	54	16	47	62	*20*	42	42		25	
meadows and pastures (%)		21	24	4	19	12	27	8	13	*30*	3	21		19	
forest (%)			40		38	20	50							55	
other (%)		*50*	17	*37*	12	14	7	*45*	*25*	*50*	*55*	*37*	*100*	1	
Check		100	100	100	100	100	100	100	100	100	100	100	100	100	
Population (million)		9.135	8.072	2.778	5.166	10.174	1.742	3.249	9.016	2.946	3.897	22.608	1.096	3.080	83
sewered (%)	from draft EMIS inventory	75	93.5	75	53	44	45	35			65	50		50.4	
sewered (%)	from NR				50	45	46	41	*45*	52	67	41	14	51	
Mineral fertilizer use (kgN/ha)	country totals FAO, 1996	101.57	31.93	61.34	29.75	52.45	40.25	40.73		5.00	25.26	18.25	23.46	14.59	
Mineral fertilizer use (kgP/ha)	country totals FAO, 1996	23.99	15.34	11.79	8.19	12.05	20.05	16.98		1.50	2.16	9.53	15.64	2.87	
Mineral fertilizer use (kgN/ha)	National review	78	31.93		32.8		35.6					38	10		
Mineral fertilizer use (kgP/ha)	National review	25	15.34		8.8		20.9					18	1		
per ha of agricultural area!!															
pig density	country totals FAO, 1997	1.40	1.04	0.95	0.81	0.86	0.71	0.51		0.03	0.25	0.56	0.37	0.27	
cattle density	country totals FAO, 1997	0.91	0.62	0.44	0.36	0.15	0.61	0.19		0.13	0.10	0.23	0.25	0.37	
Agriculture area (1000 ha)	country totals NR Austria, 1994	17308	3528	4276	2446	6122	788	2312		2000	6018	14798	2557	41861	
Number of pigs (millions)	National review 1994											9.30			
Number of cattle (millions)	National review 1994											3.60			
Number of pigs (millions)	National review 1996											3.50			
Number of cattle (millions)	National review 1996											3.50			
Number of pigs (millions)	NR Danube area						0.51	1.41							
Number of cattle (millions)	NR Danube area						0.38	0.29							
Manure production (tN/y)							23430								
Manure production (tP/y)							5882								

Annex 9.

Computed Flows in Verification Run

Computed Flows in Verification Run





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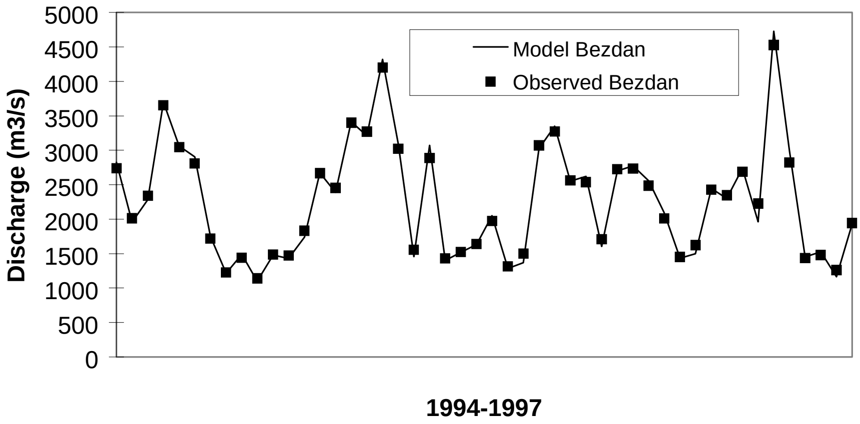
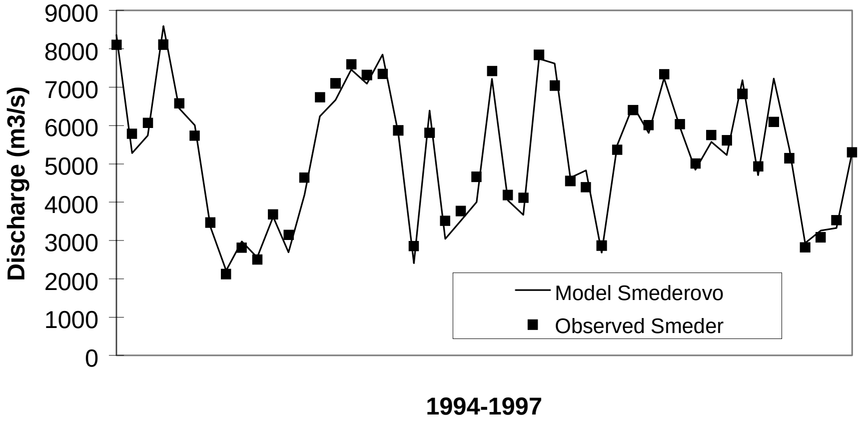
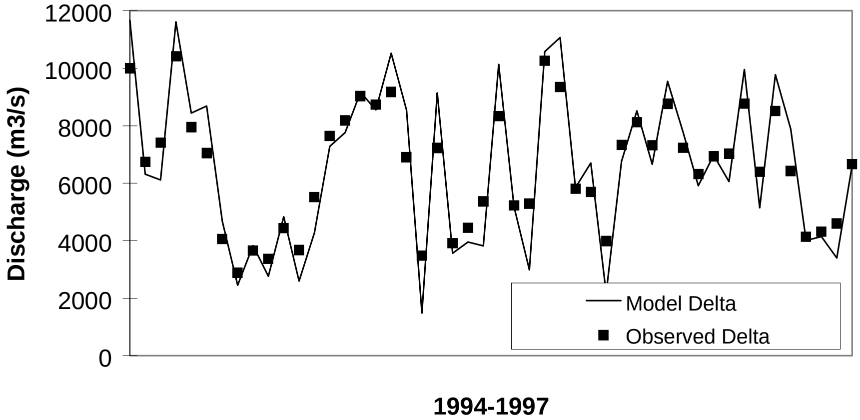


Station Smederovo



Station Delta



Annex 10.

Data about Floodplains, Wetlands and Reservoirs

Data about Floodplains, Wetlands and Reservoirs

	Floodplains	Wetlands	Reservoirs
Germany	No data	Only a map available, no data.	No data
Austria	Total about 370 km2 (flooded 1/30 year).	Reported insignificant.	No quantitative data (reservoirs are included in the DBAM schematisation).
Czech Republic	Total of 410 km2, indicated on map. Extreme flood 1997: 1,946 km2.	Total of 19,000 ha, indicated on map.	Total of 569 Mm3, tabulated. 3 reservoirs > 100 Mm3 (table page 10, NR part A).
Slovakia	Total of 1469 km2 (flooded 1/10 year) total of 2973 km2 (flooded 1/1000 year)	Total of 149,000 ha, indicated on map. 2 areas > 20,000 ha.	Total of 1750 Mm3, tabulated. 5 reservoirs > 100 Mm3 (table 4-10, NR part B).
Hungary	Total of 1500 km2.	Total of 150,000 ha, indicated on map. 2 areas > 20,000 ha.	Total of 385 Mm3, tabulated. 1 reservoir > 100 Mm3 (table 4-8, NR part B).
Slovenia	Total of 664 km2	Estimate 26,000 ha (NR part A).	Total 345 Mm3, listed in table 5 of NR Part A.
Croatia	1805 Mm3 (?) in Sava basin	Total of 68,000 ha, 1 area > 20,000 ha.	Total of 50,6 Mm3 for storage, 159 Mm3 for hydropower
Yugoslavia	16,000 km2 for extreme floods, indicated on map	No quantitative data	Reported total of 6,500 Mm3, including Iron Gates (ca. 3,500 Mm3)
Bosnia-Herzegovina	Total of 1,704 km2	No data	Total of 763 Mm3, 2 bigger than 100 Mm3.
Bulgaria	Reported insignificant.	Total of 8,500 ha	Total of 2,311 Mm3. Some tabulated data.
Romania	Total of 7,452 km2. Tabulated data available.	Total of 293,000 ha, tabulated. 4 areas > 20,000 ha.	Total of about 10,000 Mm3, including Iron Gates (ca. 3,900 Mm3). 17 reservoirs > 100 Mm3 (table 4.5.1, NR part B).
Moldova	Total of 2,000 km2	No data	Total of about 1,000 Mm3. 1 reservoir > 100 Mm3 (tables 3.4.7.3/3.4.7.4, NR part B).
Ukraine	No data	No data	Total of lakes 700 Mm3 (part A), total of reservoirs 22 Mm3 (part B).

Annex 11.

First Working Paper on the Development of the DWQM

Note to Annex 11

The first working paper on the development of the Danube Water Quality Model was an intermediate product from the process that has eventually given the results presented in the main text of the report. Therefore, the text of appendix 11 is sometimes outdated. Many minor and even some major changes have been applied to the methodology after the completion of the working paper.

Contents

1. Introduction

The present working paper has been written in the framework of the "Danube River Basin Pollution Reduction Programme" (from now on called "the project"). It describes the extension of the so-called "Danube Water Quality Model" (DWQM), necessary to make it suitable for supporting different analyses in the project. The DWQM was developed during the ARP Project EU/AR/203/91 "Water Quality Targets and Objectives for surface waters in the Danube Basin".

The present document is written by J.A.G. van Gils M.Sc. of DELFT HYDRAULICS, who is invited to be the Water Quality Modelling Specialist in the project. The activities of the Water Quality Modelling Specialist are described in the Draft Terms of Reference. The writing of the present paper is part of these activities.

The present working paper describes the proposed methodology for extension of the DWQM. The proposed set up was to an important degree directed by the recommendations made during the Inception Workshop of the project, held in Krems on 27-29 November 1997. A draft version of the paper (January, 1998) has been discussed during a workshop held on 26 January 1998 with the "Technical Working Group" (TWG). This TWG provides guidance to the Water Quality Modelling Specialist and assists in the development and application of the DWQM. The present version of the working paper has been updated in agreement with the recommendations of the TWG.

2. Objectives of the DWQM

The model shall constitute a tool for supporting:

1. the so called "trans-boundary diagnostic analysis",
2. the elaboration of basin-wide strategies,
3. the assessment of the effects of specific projects for pollution reduction and control,
4. the assessment of the effects of specific projects for water management.

3. Overview of Proposed Methodology

The DWQM focuses primarily on the surface water network of the Danube Basin. This property makes it suitable for executing analyses on a trans-boundary level, which is a crucial aspect of the project.

Below, the main characteristics of the model will be discussed. First, the underlying mathematical equations will be explained (par. 3.1), followed by an overview of the schematization (par. 3.2) and a discussion of hydrology data (par. 3.3). Next, the in-stream physical and bio-chemical processes will be presented, with the focus on removal processes. A very important aspect is the quantification of emissions (par. 3.5), where the link is made between human activities and nutrient loads to the surface water. Finally, separate paragraphs will be dedicated to the "geographical data gap" (par. 3.6), to the calibration/verification of the model (par. 3.7) and to the selection of the reference year (par. 3.8).

3.1. Model Equations

3.1.1. Water Balance Equation

For the surface water network we will use the one-dimensional water balance equation, which states that the longitudinal increase of the river discharge Q should be in balance with lateral inflows and the change of the water volume in the river:

$$\frac{\partial Q}{\partial x} + \frac{\partial A}{\partial t} = q \qquad \text{(Eq. 1)}$$

with
- Q discharge (m^3/s)
- A wet cross section (m^2)
- q lateral inflow ($m^3/s/m$)
- x longitudinal co-ordinate (m)
- t time (s)

The equation is time-dependent and thus allows for the modelling of time-dependent hydrological conditions. It will be used to back-compute the lateral inflow q from the observed river discharges Q and the computed wet cross section A (see next paragraph).

3.1.2. Momentum Equation

A simplified momentum equation will be used to compute the relation between the river discharge Q and the wet cross section A, for free flowing river stretches. Assuming quasi steady state, we propose to use the well-known Manning equation for this purpose:

$$Q = \frac{1}{n} A R^{2/3} \sqrt{S} \qquad \text{(Eq. 2)}$$

with
- Q discharge (m^3/s)
- n Manning coefficient ($s/m^{1/3}$)
- A wet cross section (m^2)
- R hydraulic radius (m)
- S slope (m/m)

From the wet cross-section the approximate actual width B and actual depth H may be computed, if the shape of the cross-section is known.

For river stretches influenced by the backwater effect of dams and weirs, Eq. 2 is not valid. Specific information needs to be used in order to compute A, B and H (see paragraph 3.2 below).

3.1.3. Pollutants Balance Equation

We use the advection equation, with added terms for pollution sources and in-stream processes:

$$\frac{\partial Qc}{\partial x} + \frac{\partial Ac}{\partial t} = P + W \qquad \text{(Eq. 3)}$$

with
- Q discharge (m^3/s)
- A wet cross section (m^2)
- x longitudinal co-ordinate (m)
- t time (s)
- c pollutant concentration (g/m^3)
- P sinks and sources due to various in-stream processes (g/s/m)
- W diffuse and point sources of pollutant (g/s/m)

The term W will be explained in paragraph 3.4.

The term P will be explained in paragraph 3.5.

3.2. River Geometry

The modelled area will be expanded to include the Danube itself as well as the main tributaries. We propose to use the river network which was set up in the ARP project EU/AR/303/91 "Development of Danube Basin Alarm Model". See Appendix A for an overview.

River cross-section data will be used from the same data source. They include all information necessary to compute the wet cross section A, the actual river width B and river depth H as described in paragraph 3.1.2.

3.3. River Hydrology

The river hydrology affects the dilution of pollutants, and governs the removal processes (via the residence time, average water depth and river width). The time-dependency of removal processes is believed to be an important factor. Therefore, the variation over the year of the river hydrology will be considered.

The time scale for the variation of the hydrology should be monthly at least. If data availability allows it, we will proceed to bi-weekly averaged hydrological conditions.

3.4. In-Stream Processes (incl. Removal of Pollutants)

3.4.1. State Variables

The model should be able to reproduce adequately the nitrogen and phosphorus cycles, with the particular objective to quantify the relevant removal processes. The main removal processes of nutrients in the Danube River are:

- denitrification (for N), determined by the concentration of N-NO3;
- net sedimentation of adsorbed and particulate fractions to the sediments (for both N and P).

Therefore we envision to include explicitly the following state variables:

- for nitrogen:
  - the inorganic species N-NH4 and N-NO2/N-NO3;
  - organic nitrogen (from pollution discharges or from mortality of biomass);
  - nitrogen in phytoplankton biomass;
- for phosphorus:
  - inorganic species: dissolved and adsorbed P-PO4;
  - organic phosphorus (from pollution discharges or from mortality of biomass);
  - phosphorus in phytoplankton biomass.

3.4.2. Overview of In-Stream Processes

In order to model the state variables mentioned above we include the following processes:

- for both N and P:
  - uptake of inorganic dissolved nutrients by phytoplankton growth;
  - mortality of phytoplankton, which forms nutrients in organic form;
  - mineralization of organic nutrients to inorganic forms;
  - sedimentation of particulate fractions;
- for phosphorus:
  - sorption of phosphates to suspended solids;
- for nitrogen:
  - nitrification of N-NH4, which forms N-NO3;
  - denitrification of N-NO3.

For the description of these processes we refer to the Technical Reference Guide of the computer program DELWAQ, which is the primary tool for building the DWQM. The removal processes will be treated explicitly below.

3.4.3. Denitrification in Surface Waters

The denitrification process removes nitrogen from the water system. Under reduced conditions nitrates may be used to oxidise organic matter. The result of this process is that nitrogen gas escapes to the atmosphere. The proper conditions for denitrification are usually present in the top layer of aquatic sediments, just below the oxic layer. Under very specific conditions denitrification can also occur in the water column: if the oxygen concentration is near zero or the suspended solids concentration is very high. We assume that such conditions occur only locally and that denitrification in the water column does not play a significant role on a Danube-wide scale. Therefore, we consider denitrification in the sediments only, assuming that there is always enough reduced organic matter to drive the denitrification process. The process is usually modelled as a "diffusive flux" into the sediments:

$$P_{N-NO3} = -\frac{D}{L} C_{N-NO3} B \qquad \text{(Eq. 4)}$$

with
C pollutant concentration (g/m^3)
P source/sink term in pollutant mass balance equation (g/s/m)
D diffusion coefficient for transfer from water to sediment (m^2/s)
L vertical transfer length for diffusive process (m)
B river width (m)

There is a strong seasonal variation in L. L is determined primarily by the thickness of the oxic layer, since denitrification takes place just below the oxic layer. During summer, there is a higher biological activity in the top sediment layer, and consequently a more intense oxidation of organic matter. As a result the oxic layer is thinner and L is smaller during summer. The equation above shows that as a consequence the denitrification process proceeds at a higher rate. This strong seasonal effect is represented in the following denitrification model which we propose to use:

$$P_{N-NO3} = -k_{DN}\theta^{T-20}C_{N-NO3}B \qquad \text{(Eq. 5)}$$

with k_{DN} denitrification rate constant (m/s)
θ coefficient expressing temperature dependency (-)
T water temperature (degrees)

Literature reports a value of θ = 1.12 and values of k_{DN} = 0.1-0.2 m/d (0.2 m/d in Lake Veluwe, 0.12 m/d in Lake IJssel). Available data will be analysed for waters in the Danube Basin, with special attention to the Iron Gates lakes (see also paragraph 3.4.5).

The denitrification process can only proceed if there is sufficient organic matter. We will check whether the denitrification rates computed by the model can be sustained by the available amount of organic matter.

Van Dijk ea. [1997] describe a method to estimate the in-stream denitrification from water quality measurements. If the available data allow it, this method will be used to evaluate the reliability of the denitrification rates computed by the model.

3.4.4. Net Sedimentation

Suspended solids may settle from the water column to the aquatic sediments. This process can be formulated as follows:

$$P = -v_{set}\left(1 - \frac{\tau}{\tau_{cr,s}}\right) C B \qquad \text{(Eq. 6)}$$

with v_{set} settling velocity (m/s), range 0.1-1.0 m/d
τ shear stress (Pa)
$\tau_{cr,s}$ critical shear stress for settling (Pa), range 0.05-0.2 Pa
P source/sink term in pollutant mass balance equation (g/s/m)

The settling velocity depends on the size and the density of the particles. It will be dependent on the water temperature, in order to represent the viscosity effect. The shear stress τ indicates the level of turbulence generated by the flow, and it can be computed from the stream flow velocity. The critical shear stress τ_{cr} indicates the level of turbulence necessary to keep the particles in suspension.

Once settled, the particles may be re-suspended if the bottom shear stress becomes large enough. This process may be formulated as follows:

$$P = +F\left(\frac{\tau}{\tau_{cr,r}} - 1\right)C_{solid}B \qquad \text{(Eq. 7)}$$

with
- F resuspension rate of sediment ($g/m^2/s$)
- τ shear stress (Pa)
- $\tau_{cr,r}$ critical shear stress for resuspension (Pa), range 0.1-0.5 Pa
- C_{solid} concentration of pollutant in top sediment layer (g/g)
- P source/sink term in pollutant mass balance equation (g/s/m)

It is reasonable to expect that in the rapidly flowing parts of the river all sedimentation is counteracted by resuspension, so that averaged over one year there is no net sedimentation. There may be however, a seasonal storage of nutrients: sedimentation during a dry periods is counteracted by resuspension in the subsequent wet period.

Net sedimentation is to be expected particularly in reservoirs and flood plains.

For the calibration of the parameters governing net sedimentation we will use available measurements of suspended solids concentrations. Particular attention will be paid to the Iron Gates lakes (see also paragraph 3.4.5).

3.4.5. Nutrient Removal in Wetlands, Reservoirs and Flood Plains

It is generally accepted that wetlands, reservoirs and flood plains may remove substantial amounts of nutrients from the river which feeds them. There has been a separate ARP Project EU/AR/201/91 “Present and possible future role in nutrient removal from surface water by wetlands, flood plains and reservoirs.” devoted to this subject. From this project it became clear that the removal by such systems depends primarily on:

- the horizontal area;
- the so-called “hydraulic loading” of the area (representing the residence time).

The model presented so far features this dependency on area and residence time. Therefore, the model is able to represent nutrient removal in wetlands, reservoirs and flood plains. Three conditions have to be fulfilled however:

1. the areas in question need to be included in the schematization;
2. an estimate of the hydraulic loading should be available;
3. removal coefficients for the model presented herein should be harmonised with data from the ARP Wetlands Project and/or other literature.

The conditions mentioned under 1. and 2. come down to estimating the following characteristics of wetlands, reservoirs and flood plains (in case they are not already part of the schematization mentioned in paragraph 3.2):

- length, width, depth,
- velocity or discharge.

If these numbers depend on the discharge or water level of the feeding river, this information should be available too.

The information available in the main report of the ARP Wetlands Project does not allow the computation of removal coefficients for the areas studied. At this moment we trust that this information will be available in the relevant progress reports.

Finally, the ARP Wetlands Project warns us to distinguish between real removal (denitrification, reed harvesting) and storage (accumulation in lake sediments). The latter may not constitute a sustainable sink of nutrients. Therefore, when we proceed to the assessment of the effects of specific projects for water management, we may consider not to include the sedimentation of nutrients in newly constructed wetlands. Thus, we will not overestimate the sustainable nutrient removal capacity of such projects.

3.5. Pollution Sources

This paragraph contains a lot of information derived from the ARP Project EU/AR/102A/91 "Nutrient balances for Danube countries". This general statement is included here, in stead of making individual quotations.

3.5.1. Point Sources

We propose to include the following types of point sources:

P1 direct discharges from private households;

P2 direct discharges from industries;

P3 direct discharges of manure;

P4 effluents from waste water treatment plants;

P5 storm water overflows.

Data are necessary to quantify these point sources. Furthermore, supportive data are necessary in order to define the costs of pollution control measures and/or the prioritisation of measures.

Data about municipal pollution sources have been collected:

for settlements larger than 10,000 p.e.'s:

- location
- sewerage (yes/no)
- treatment level (no/prim/...)
- treatment capacity
- age of treatment installation
- effect on drinking water supply (yes/no)
- local dilution capacity
- local water quality

for settlements smaller than 10,000 p.e.'s:

- total amount per country
- percentage connected to sewer
- percentage treated

Data about industrial pollution sources have been collected:

for installations larger than 50,000 p.e.'s:

- location
- treatment level (no/prim/...)
- treatment capacity
- age of treatment installation
- effect on drinking water supply (yes/no)
- local dilution capacity
- local water quality

The EMIS group is compiling basin-wide overviews of point sources. This information, as far as it is available, will be included in the modelling exercise.

3.5.2. Diffuse and Scattered Sources

We propose to include the following types of diffuse sources to the surface water:

D1 base flow (inflow from aquifers);

D2 erosion and runoff from agricultural soils;

D3 erosion and runoff from forests and other areas;

D4 nitrogen fixation in surface waters.

As stated above, for communities smaller than 10,000 p.e.'s no data have been collected at the level of the individual settlements. The pollution from these communities can be considered a "scattered source", and will be treated in the model as a diffuse source.

D5 discharges on surface water from small communities.

Estimates have been made for these sources.

Base flow

The base flow comprises contributions from different origin. In order to quantify it, we have to take a look at the nutrient balance for the ground water. The relevant nutrient sources for the ground water are:

D1a percolation from agricultural soils;

D1b percolation from forests and other areas;

D1c percolation from landfills, septic tanks and sewer systems;

D1d infiltration.

The outflow to the surface waters (base flow) also depends on:

- denitrification in the ground water (estimated between 15% and 65% of total inputs for different countries);
- accumulation in the ground water (charging/decharging).

The estimation or computation of all contributions above is a difficult issue. Meinardi ea. [1994] compute the age of the ground water in the Danube basin from several tens to several hundreds of years. This means that the time scales associated to the response of the base flow concentration to changes in the nutrient sources is significantly longer as the time horizon of the present project. With the above in mind, we will keep the base flow contribution to the emission to the surface water at its present level.

3.5.3. Introduction of Pollution Sources in the Model

Point sources (P1 to P5)

Point sources will be introduced as an amount of N and P in mass units per time unit, at their precise locations in the river network. We expect no variation over the year. However, if it is necessary and the information is available, point sources can be made time dependent.

"Constant diffuse sources"

In this category belong the base flow (D1) and the small communities (D5). They are introduced as a constant concentration per country, attached to the minimum summer flow. In order to compute this concentration, the yearly pollution load per country is divided by the sum of the summer lateral inflows per country (scaled up for a period of a year). Thus, a constant but distributed load is achieved.

N-fixation (D4) will also be treated as a constant diffuse source. This is not really correct, but we refrain from more complex modelling since this term is rather small.

"Variable diffuse sources"

In this category belong the runoff/erosion (D2 and D3). They are introduced as a constant concentration per country, this time attached to the difference between the actual flow and the minimum summer flow. In order to compute this concentration, the yearly pollution load per country is divided by the yearly total of lateral inflows per country minus the sum of the summer inflows per country mentioned above. Thus, a variable and distributed load is achieved.

3.5.4. Scenario Development for Pollution Sources

Scenarios are to be developed for pollution from municipal, industrial and agricultural sources. For every scenario the list of point sources (P1 to P5) will be updated, using the available information.

For diffuse sources the following aspects need to be considered:

- estimates of erosion/runoff from agricultural soils (D2);
- estimates of direct discharges to the surface water from small communities, for which no data have been collected at the level of the individual settlements (D5).

The diffuse sources from ground water, forests and other soils (D1 and D3) as well as nitrogen fixation in surface waters (D4) will not be included in the scenarios in the present project. The magnitude of these sources will be kept constant.

The definition of the effect of different scenarios for agricultural production and practices on diffuse sources will be done by expert judgement. Given the excellent baseline set by the ARP Project EU/AR/102A/91 "Nutrient balances for Danube countries", it will be possible to do this with an accuracy that fits the objectives of the present project.

3.6. Geographical Data Gaps

The present work heavily depends on four Applied Research Projects:

- Nutrient Balances
- Water Quality Targets and Objectives
- Danube Basin Alarm Model
- Wetlands, Flood plains and Reservoirs

Only in the Danube Basin Alarm Model an explicit contribution from Croatia, Bosnia-Herzegovina and the Federal Republic of Yugoslavia was included. Therefore, extra attention should be paid to the data collection and verification for those countries. Special attention is needed for the emission side of the problem, which was covered for the other Danube countries by the "Nutrient Balances" project.

3.7. Calibration and Verification

The main method for judging the results of the DWQM will be:

comparison of calculated and measured in-stream load profiles

This will be done at the level of the Danube river itself, and for the large cross-boundary tributaries Tisa, Drava and Sava. The reasons for this choice are: (1) accurately measuring in-stream load profiles is only possible in large rivers (demonstrated during the "Nutrient Balances" project), and (2) the diffuse sources are estimated at the country level, so no accuracy may be expected within individual countries. With regard to the availability and quality of the available data, there are the following considerations:

- The water quality stations within the Trans-National Monitoring Network (TNMN) will be utilised in the calibration.
- The "Nutrient Balances" project presented a method of estimating errors in the measured in-stream load profiles. This method will be utilised as far as possible.
- One of the main recommendations of the Inception Workshop was to use measured data for the *total nutrient concentration* rather than inorganic nutrients only. This recommendation is accepted. However, we expect that such data will be sparse and/or the quality will be poor. We may be forced to *estimate* total nutrient concentrations from measurements of inorganic nutrient concentrations. Such estimates will be based on available literature. We need to be aware that the reliability of such estimates is small, and that they will increase *significantly* the error in the observed in-stream loads.
- It is well-known that monthly sampling (as it is done in the TNMN) is *not sufficient* to compute the in-stream nutrient loads. Large fractions of the yearly load are transported during very short periods with a peak discharge, which are not adequately sampled. We will take notice of this problem and apply a correction factor to the measured in-stream loads.

We propose not to make too many changes in the model parameters during the calibration stage of the model, since there are so many input data with a high level of uncertainty. There are parameters enough to tune, and it would probably be possible to match the computed and the measured in-stream loads rather nicely, but such an exercise would be meaningless, unless new research results would become available and support the modification of some input data. In stead, we propose use this stage of the project mainly to verify the performance of the model. If it is unsatisfactory, we will have to go back to the Pollution Loads and/or the In-stream Processes and find weak spots in the assumptions and/or the data.

3.8. Selection of Reference Year

One of the main recommendations of the Inception Workshop was to use the more recent data from the "Trans-National Monitoring Network (TNMN)" rather than older data collected in the framework of the "Bucharest Declaration". This means that the baseline scenario should be set in the period 1995-1997. We are aware of the fact that the in-stream nutrient loads are not the result of the emission levels only. They are also affected to a large extent by (the variation in) the hydrology. This aspect will be taken into account in the evaluation of the model results.

The selection of a reference year in 1995-1997 means that the point sources data and nutrient balances used to estimate diffuse sources probably have to be updated.

4. References

This document has been drafted using the four main reports from the relevant Applied Research Projects:

- ARP Project EU/AR/203/91 "Water Quality Targets and Objectives for surface waters in the Danube Basin";
- ARP project EU/AR/303/91 "Development of Danube Basin Alarm Model";
- ARP Project EU/AR/102A/91 "Nutrient balances for Danube countries";
- ARP Project EU/AR/201/91 "Present and possible future role in nutrient removal from surface water by wetlands, flood plains and reservoirs".

Use has been made of specific documentation related to the DWQM as well:

- Progress Rapport Phase 1, written by DELFT HYDRAULICS in the framework of ARP Project EU/AR/203/91;
- Progress Rapport Phase 2, written by DELFT HYDRAULICS in the framework of ARP Project EU/AR/203/91;
- Technical Reference Manual of the computer program DELWAQ, version 4.0 by DELFT HYDRAULICS, April 1995.

Additional information about the modelling of water quality processes has been derived from:

- DiToro, D.M., D.J. O'Connor & J.A. Mueller, 1987, Course on water quality modelling. Manhattan College, New York.

Further references:

- [Meinardi ea., 1994].
  "Vulnerability to diffuse pollution of European soils and groundwater", C.R. Meinardi, A.H.W. Beusen, M.J.S. Bollen, O. Klepper, National Institute of Public Health and the Environment, Report no. 461.501.002, Bilthoven, The Netherlands, December, 1994.
- [van Dijk ea., 1997].
  "Source apportionment and quantification of nitrogen transport and retention in the River Rhine", S. van Dijk, J. Knoop, M.J.M. de Wit, R.J. Leewis, National Institute of Public Health and the Environment, Report no. 733.008.004, Bilthoven, The Netherlands, April, 1997.

Annex A Danube Tributaries Included in the Danube Basin Alarm Model

- Morava
- Raba
- Vah
- Hron
- Drava
- Mura
- Tisa
- Somes
- Laborec
- Uh
- Latorica
- Ondava
- Bodrog
- Slana
- Hornad
- Torysa
- Zagyva
- Cris
- Mures
- Sava
- Lom
- Jiu
- Ogosta
- Iskar
- Olt
- Yantra
- Arges
- Borcea
- Ialomita
- Macin
- Siret
- Prut

Annex B Proprietary Status of the Danube Water Quality Model

The full ownership of all development work done during the present project (as well as the ARP Project EU/AR/203/91 “Water Quality Targets and Objectives for surface waters in the Danube Basin”) on the DWQM resides with the financier of these projects, or any other body designated by the financier as owner.

After the completion of the present project, the following items will be available to the owner or any other "Danubian" party considered a beneficiary:

- a set of computer programs which form the generic water quality program DELWAQ: which has been safeguarded against use for other areas than the Danube, but will be fit to accommodate changes in input data and model coefficients;
- a set of input files to run the program (including separate files for all scenarios and alternatives which have been distinguished during the project).

This implies the full ownership of the products of the work done for the present project. This excludes the right to obtain the source code of the computer program, since the creation of this code *is by no means* financed by the present project (nor by the ARP Project EU/AR/203/91). It should be noted that each line of computer code written in the present project (which is not foreseen) will also be “owned” by the financier.

The right to use the computer program for consulting purposes for other areas than the Danube is excluded as well. However, the use of the computer program for scientific purposes for other areas than the Danube can be discussed between DELFT HYDRAULICS and interested scientific institutes and universities.

Providing documentation and training with the purpose of further developing, maintaining and running the DWQM is not included in the present contract between GEF and DELFT HYDRAULICS.

Annex 12.

Summary of Additional Pollution Sources Data, Developed for 1996-1997 during the Current Project by the University of Vienna

Summary of Additional Pollution Sources Data, Developed for 1996-1997 during the Current Project by the University of Vienna

1996

Surface Waters N in kt	Romania		Bulgaria		Ukraine		Moldova		Hungary		Slovenia		Czech Republic	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to
storm weather overflow	5	5	2	3	0	0	0	0	1	1	0	1	2	2
Industries (with and without treatment)	18	18	2	4	0	0	0	0	2	2	5	7	1	4
direct discharges private households	**3**	**5**	0	2	0	0	0	0	2	3	1	2	1	2
municipal waste water management	37	40	11	14	2	4	1	1	14	18	4	6	7	10
effluents from awwtp	10	15	0	0	0	0	0	0	0	0	0	0	0	0
base flow	86	95	3	5	3	5	2	4	5	5	4	5	13	13
erosion, run-off	38	38	5	7	14	20	7	11	**28**	**28**	3	4	4	4
discharge of manure	10	30	2	4	1	1	0	0	6	8	2	3	0	0
surface runoff from forests+others	0	0	2	2	7	11	0	0	0	0	0	0	0	0
N-fixation 3	4	4	0	0	0	0	0	0	20	20	0	0	0	0
total national Input	**211**	**250**	**27**	**41**	**27**	**41**	**9**	**16**	**78**	**85**	**19**	**28**	**28**	**35**
	231		34		34		13		82		24		32	

Surface Waters P in kt	Romania		Bulgaria		Ukraine		Moldova		Hungary		Slovenia		Czech Republic	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to
storm weather overflow	1.1	1.1	0.3	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.3
Industries (with and without treatment)	1.0	3.0	0.1	0.1	0.0	0.0	0.0	0.0	1.5	1.5	0.2	0.6	0.1	0.5
direct discharges private households	0.6	1.0	0.0	0.6	0.0	0.0	0.0	0.0	0.7	1.0	0.1	0.2	0.1	0.2
municipal waste water management	5.7	6.1	2.6	3.8	0.8	1.2	0.1	0.2	3.3	4.5	0.8	1.2	1.5	2.4
effluents from awwtp	2.0	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
base flow	4.3	4.3	0.3	0.7	0.3	0.5	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
erosion, run-off	6.8	6.8	0.5	0.9	2.2	3.4	1.6	2.5	3.0	6.6	0.1	0.1	0.6	0.6
discharge of manure	1.9	5.6	0.5	0.9	0.4	0.6	0.0	0.0	1.3	1.6	0.6	1.3	0.1	0.1
surface runoff from forests+others	0.0	0.0	0.3	0.3	0.7	1.1	0.0	0.0	0.5	0.7	0.0	0.0	0.0	0.0
total national Input	**23.4**	**32.0**	**4.6**	**7.7**	**4.5**	**6.9**	**1.7**	**2.7**	**10.4**	**16.0**	**2.0**	**3.6**	**2.8**	**4.2**
* Industrial P-discharges of Austria decr	27.7		6.2		5.7		2.2		13.2		2.8		3.5	

1996

Surface Waters N in kt	Slovakia		Austria		Germany		Yugoslavia		Bosnia-Herzeg.		Croatia		Danube Basin	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to
storm weather overflow	1	1	1	2	2	2	1	2	0	1	0	1	15	21
Industries (with and without treatment)	1	2	2	2	1	1	8	12	1	1	2	2	43	55
direct discharges private households	2	3	0	2	0	0	1	2	1	1	1	1	12	23
municipal waste water management	9	14	19	21	17	17	20	20	7	7	4	7	152	179
effluents from awwtp	0	0	0	0	0	0	0	0	0	0	0	0	10	15
base flow	23	30	48	60	65	89	38	54	22	24	12	17	324	406
erosion, run-off	3	9	4	11	11	13	14	25	2	4	6	8	139	182
discharge of manure	0	0	1	2	1	2	1	5	0	0	2	3	26	58
surface runoff from forests+others	3	6	7	10	9	10	2	6	1	3	1	2	32	50
N-fixation 3	0	0	0	0	0	0							24	24
total national Input	**42**	**65**	**82**	**110**	**106**	**134**	**85**	**126**	**34**	**41**	**28**	**41**	**776**	**1013**
	54		96		120		106		37		35		895	

Surface Waters P in kt	Slovakia		Austria		Germany		Yugoslavia		Bosnia-Herzeg.		Croatia		Danube Basin	
	from	to	from	to	from	to							from	to
storm weather overflow	0.2	0.2	0.2	0.2	0.3	0.5	0.3	0.5	0.1	0.2	0.1	0.1	3	4
Industries (with and without treatment)	0.0	0.1	0.0	0.1	0.1	0.1	2.8	4.1	0.1	0.1	0.3	0.4	6	11
direct discharges private households	0.3	0.3	0.0	0.2	0.0	0.0	0.3	0.5	0.1	0.2	0.1	0.2	2	4
municipal waste water management	2.1	3.4	1.8	2.2	0.7	0.8	6.0	6.0	3.0	3.0	0.8	1.2	29	36
effluents from awwtp	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	2	4
base flow	0.2	0.4	0.4	0.6	0.0	0.8	0.6	1.0	0.2	0.4	0.3	0.4	7	9
erosion, run-off	1.0	2.3	1.4	4.2	4.0	5.1	4.1	5.5	0.8	1.7	1.2	1.9	27	42
discharge of manure	0.0	0.0	0.3	0.5	0.0	0.8	1.3	1.8	0.0	0.0	0.4	0.6	7	14
surface runoff from forests+others	0.3	0.4	0.5	1.0	0.1	0.8	0.2	0.5	0.2	0.2	0.1	0.2	3	5
													0	0
total national Input	**4.1**	**7.1**	**4.6**	**9.0**	**5.2**	**8.9**	**15.6**	**19.9**	**4.5**	**5.8**	**3.3**	**5.0**	**86.7**	**128.8**
* Industrial P-discharges of Austria decr	5.6		6.8		7.1		17.8		5.2		4.2		107.8	

Annex 13.

List of Emissions Directly to the River, Developed for the PRP Simulations

List of Emissions Directly to the River, Developed for the PRP Simulations

Explanation of columns:

Cate	*M for Municipal, I for Industrial, A for Agricultural*
N-Bas	*N emissions in the Baseline case for the Pollution Reduction Programme (t/y), values in **bold** are corrected values to fit the reductions in the Polution Reduction Programme*
P-Bas	*P emissions in the Baseline case for the Pollution Reduction Programme (t/y), values in **bold** are corrected values to fit the reductions in the Polution Reduction Programme*
Source	*Information source: NR = National Review, PRP = Pollution Reduction Programme, EMIS = EMIS database*
Segment	*Number of DWQM segment where the point source is located*
N-Red	*Reduction of N emissions in the Pollution Reduction Programme (t/y)*
P-Red	*Reduction of P emissions in the Pollution Reduction Programme (t/y)*

Country	Cate	Name	Recipient	N-Bas	P-Bas	Source	Segment	N-Red	P-Red
Yugoslavia	A	Surcin		3300	175	NR	139	3300	175
Yugoslavia	A	Cenej		5800	240	NR	126	5800	240
Yugoslavia	A	D._Makovic_Obrenovac	Sava	3300	175	PRP	138	3300	175
Yugoslavia	A	Pig_Farm_DP_Petrovac	Banat-Eastern Serbia	2100	110	PRP	141	2100	110
Bosnia_Hercegovina	A	pig_farm_Nova_Topola	Una/Vrbas	*1130*	*250*	PRP	133	*1130*	*250*
Bosnia_Hercegovina	A	pig_ farm_ Brcko	Drina	*1570*	*350*	PRP	135	*1570*	*350*
Bulgaria	I	Sugar_Factory_G.Orjachovtza	Yantra	700	1	EMIS-Industrial	162		
Czech_Republic	I	Fosfa_Postorna	Dyje	1	103	NR	13		
Czech_Republic	I	Kozelunzny_Otrokovice	Morava	230	4	NR	12		
Hungary	I	Dunaujvaros_Dunaferr	Danube	287		NR	33		
Romania	I	Comsuin_Ulmeni	Danube	472	1	EMIS-Industrial	167		
Romania	I	CICH_Tr._Magurele	Danube/Dunare	990	39	NR	160		
Romania	I	Braigal_Braila	Danube/Dunare	892		NR	172		
Romania	I	Doljchim_Craiova	Jiu / Jiu	992		NR	151		
Romania	I	Indagrara_Arad	Mures/Mures	400		NR	119		
Romania	I	Suinprod_Independenta	Siret	323		NR	173		
Romania	I	Sidex_Galati	Siret/Siret	1078	**11**	NR	173	755	11
Slovenia	I	ICEC_Krško	Sava	1418	315	PRP	129	1418	315
Yugoslavia	I	IHP_Prahovo_(fertilizers)	Banat-Eastern Serbia		3000	PRP	141		3000
Yugoslavia	I	HI_Zorka_-_Sabac	Sava	200	280	PRP	137	200	280

Country	Cate	Name	Recipient	N-Bas	P-Bas	Source	Segment	N-Red	P-Red
Austria	M	Wien-Simmering	Donau	5600	150	EMIS-Municipal	9	2000	
Austria	M	Linz_Asten	Donau	2270	124	EMIS-Municipal	2	770	64
Austria	M	Krems	Donau	104	43	EMIS-Municipal	6		
Bulgaria	M	Russe	Danube	2884	483	NR	165	603	219
Bulgaria	M	Vidin	Danube	327	43	NR	146		
Bulgaria	M	Lom	Danube	190	38	NR	149		
Bulgaria	M	Sofia	Iskar	1283	**551**	NR	155	273	551
Bulgaria	M	Samokov	Iskar	291	73	EMIS-Municipal	155		
Bulgaria	M	Montana	Ogosta	446	65	NR	152		
Bulgaria	M	Gorna_Oriahovitza&Liaskovets	Yanta	502	**247**	NR	162	464	247
Bulgaria	M	Veliko_Tarnovo	Yantra	408	82	EMIS-Municipal	162		
Bulgaria	M	Gabrovo	Yantra	201	52	EMIS-Municipal	162		
Croatia	M	Osijek	Drava	530	90	EMIS-Municipal	59		
Croatia	M	Varazdin	Drava	140	60	EMIS-Municipal	49		
Croatia	M	Zagreb	Sava	4400	1100	EMIS-Municipal	130	1320	220
Croatia	M	Sisak	Sava	240	60	EMIS-Municipal	131		
Croatia	M	Slavonski_Brod	Sava	240	60	EMIS-Municipal	134		
Czech_Republic	M	Zlin	Drevnice	302	46	NR	12		
Germany	M	Ingolstadt	Donau	467	12	EMIS-Municipal	184		
Germany	M	Regensburg	Donau	282	35	EMIS-Municipal	186		
Hungary	M	Budapest_Untreated	Danube	3490	***582***	NR	31		
Hungary	M	Budapest_south	Danube	715	**122**	EMIS-Municipal	31	203	122
Hungary	M	Budapest_north	Danube	524	**183**	EMIS-Municipal	31	308	183
Hungary	M	Gyor	Danube	423	63	EMIS-Municipal	17		
Hungary	M	Békéscsaba	Kettos-Körös/Tisza	58	36	EMIS-Municipal	117		
Hungary	M	Szombathely	Sorok-Perint, Rába	137	46	EMIS-Municipal	19		
Hungary	M	Szeged	Tisza	540	90	NR	121		
Hungary	M	Szolnok	Tisza	200	49	EMIS-Municipal	108		
Hungary	M	Miskolc	Tisza, Sajó	389	130	EMIS-Municipal	99		
Romania	M	Oradea	Cris	290	39	EMIS-Municipal	115		
Romania	M	Bucuresti	Dambovita / Arges	10872	2218	NR	166	7509	1744
Romania	M	Braila	Danube	**822**	66	EMIS-Municipal	172	822	
Romania	M	Tulcea	Danube	220	52	EMIS-Municipal	177		
Romania	M	Galati	Danube/Danube	1044	293	NR	174	812	275

Country	Cate	Name	Recipient	N-Bas	P-Bas	Source	Segment	N-Red	P-Red
Romania	M	Slobozia	Ialomita	192	39	EMIS-Municipal	170		
Romania	M	Craiova	Jiu / Jiu	985	277	NR	151	597	245
Romania	M	Arad	Mures	278	57	EMIS-Municipal	119		
Romania	M	Focsani	Siret	172	41	EMIS-Municipal	173		
Romania	M	Satu_Mare	Somes	165	34	EMIS-Municipal	75		
Slovakia	M	Košice	Hornád	395	79	EMIS-Municipal	102		
Slovakia	M	Hlohovec	Váh	344	39	EMIS-Municipal	24		
Slovenia	M	Maribor	Drava	**945**	**210**	EMIS-Municipal	43	945	210
Slovenia	M	Ljubljana	Sava	**1575**	**350**	EMIS-Municipal	127	1575	350
Slovenia	M	Domzale-Kamnik	Sava	630	140	PRP	127	630	140
Ukraine	M	Izmail_WWTP	Danube	213	38	NR	177		
Ukraine	M	Mukachevo_WWTP	Latoryt sya	95	49	NR	88		
Ukraine	M	Uzhgorod_WWTP	Uzh	327	130	NR	83		
Yugoslavia	M	Zrenjanin	Begej	975	226	NR	125	160	214
Yugoslavia	M	Belgrade	Danube	5840	1314	NR	139	876	1183
Yugoslavia	M	Novi_Sad	Danube	988	298	NR	63	148	268
Yugoslavia	M	Belgrade	Danube	776	194	NR	139		
Yugoslavia	M	Pancevo	Danube	571	190	NR	139		
Yugoslavia	M	Belgrade	Danube	716	144	NR	139		
Yugoslavia	M	Smederovo	Danube	260	94	NR	140		
Yugoslavia	M	Sabac	Sava	287	113	NR	137		
Yugoslavia	M	S._Mitrovica	Sava	292	75	NR	136		
Yugoslavia	M	Belgrade	Sava	201	45	NR	139		
Yugoslavia	M	Senta	Tisa	238	55	NR	122		
Yugoslavia	M	Pozarevac	V. Morava	195	89	NR	141		
TOTAL				83669	16756			39588	11141

Annex 14.

Update of Estimations of Nitrogen and Phosphorus Emissions to Surface Waters in the Danube Basin for the Year 1996/97

TECHNISCHE UNIVERSITÄT WIEN

INSTITUT FÜR
WASSERGÜTE UND
ABFALLWIRTSCHAFT

KARLSPLATZ 13/226
A-1040 WIEN
TEL.: +43 1 / 588 01
FAX: +43 1 / 588 01 22699

Update of Estimations of Nitrogen and Phosphorus Emissions to Surface Waters in the Danube Basin for the Year 1996/97

Prof. H. Kroiss

M. Zessner

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1. Introduction

In the year 1997 the study “Nutrient Balances for Danube Countries” was completed at the Institute for Water Quality and Waste Management of the Vienna University of Technology in co-operation with the Department of Water and Wastewater Engineering of the Budapest University of Technology and institutions from eight further countries from the Danube Basin. The study was financed by the PHARE-programme of the EC-commission in the framework of the Environmental Programme for the Danube River Basin. One of the tasks of this study was to establish nutrient balances (nitrogen and phosphorus) for the parts of Ukraine, Moldova, Romania, Bulgaria, Hungary, Slovakia, Slovenia, Czech Republic, Austria and Germany, that belong to the Danube Basin. The study was done based on the material accounting method from Baccini and Brunner (1991). The target years of this study were the year 1988/99 and the year 1992, one representing a year before and one representing a year after the political changes in big parts of the Danube Basin.

The Danube Water Quality Model (DWQM), that was developed in the framework of the River Danube Pollution Reduction Programme (RDPRP) of GEF/UNDP (van Gils, 1999) has the task to connect emission estimations with the measured water quality data by modelling processes of the nutrient transformation and transport in the river course. Water quality data for this modelling exercise are used from the years 1994 – 1997. Due to the political and economical chances in big parts of the Danube Basin, that are still going on, emission estimations for the year 1992 are not necessarily representative for the period 1994 – 97. Thus it was the task of this study to update the 1992-emission estimations from the “Nutrient Balance-study” for the year 1996/97. However, due to the restricted time and financial support of this work, it was not possible to renew or improve the existing “Nutrient Balance-study”. Furthermore this work can never replace a periodical update of nutrient balances for the countries of the Danube Basin, which is necessary for the future. This work is mainly based on the results of the “Nutrient Balance-study”. The task was to estimate changes of emissions of nitrogen and phosphorus to surface waters between 1992 and 1996/97 based on data delivered during the work on the RDPRP (national reviews and additional data collection) and the emission inventory of the EMIS-Expert Group (municipal and industrial point sources). Yugoslavia, Bosnia-Herzegovian and Croatia did not participate in the “Nutrient Balance-study”. Nutrient balances for the year 1992 do not exist. An estimation of nutrient emissions was done in the framework of the work on the DWQM (van Gils, 1999). These estimations were taken over and supplemented by own estimations. As a consequence these estimations have a much weaker base than the results of the other countries.

For the different pathways of emissions into surface waters (inputs) common definitions were used for the different countries. The emission inventory of the EMIS expert group is an important information in addition to the results of the “Nutrient Balance-study”. To have a better comparability with this emission inventory the definitions used in the “Nutrient Balance-study” were changed for the presentation of the results in this work. To reach better comparability results from the “Nutrient Balance-study” for the year 1992 are presented according to the new definition in this work.

- In the “Nutrient Balance-study” the term “effluents, wastewater treatment” was used for effluents of all kind of wastewater treatment, including municipal, industrial and agricultural treatment plants. We now use **“municipal wastewater management”** for all emissions from municipal sewers after or without treatment. This input into surface waters is comparable with the emissions from the inventory of municipal point sources from the EMIS Expert Group bearing in mind that EMIS/EG did not cover the total emissions (in general 75 % wastewater, that is collected in sewer systems). Furthermore we now use **“Industries (with and without treatment)”** for all emissions from industrial enterprises that are not connected to municipal sewer systems but discharge their wastewater after or without treatment directly into surface waters. This input into surface waters is comparable with the emissions from the inventory of industrial point sources from the EMIS Expert Group. The term **“agricultural wastewater treatment”** is now used for discharges from treatment plants that treat wastewater (manure) from agriculture.

- The term “direct discharge, household” was used in the “Nutrient Balance-study” for all discharges from households that do not receive any treatment, including discharges to municipal sewers without treatment. We now use **“direct discharge household”** only for those discharges from households that are not connected to municipal sewer systems and discharge their wastewater to surface waters.
- The term “direct discharge, industry” was used in the “Nutrient Balance-study” for all discharges from industry that do not receive any treatment, including discharges to municipal sewers without treatment. Instead of that we now use “Industries (with and without treatment)” for all emissions from industrial enterprises that are not connected to municipal sewer systems but discharge their wastewater after or without treatment into surface waters. Emissions from industries connected to municipal sewer systems are now included into “municipal wastewater management”.

The other definitions of input fluxes into surface waters were taken over from the “Nutrient Balance-study” and are shortly characterised in the following.

- **“Storm weather overflow”**: Emissions from a storm weather overflow of combined municipal sewer systems and rainwater emissions from a separate sewer system.
- **“Base flow”:** Emissions that reach the surface waters via groundwater, inter flow and drainage. It is calculated as net exfiltration (exfiltration minus infiltration). This emissions stem mainly from percolation from agricultural soils, from forestry and from septic tanks and pits.
- **“Erosion, runoff, agriculture”:** Soil erosion and surface runoff of fertilisers and air-depositions from agricultural soils.
- **“Discharge of manure”:** Direct discharges of manure into surface waters without treatment process.
- **“Surface runoff from forests+others”:** Soil erosion and surface runoff of air-depositions from forests and other soils (e.g. uncultivated land).
- **“N-fixation 3”:** Fixation of N_2 from the air by organisms in the surface waters.

The following chapters show the nitrogen and phosphorus emissions into surface waters for the different countries. The values for the year 1992 were taken from the “Nutrient Balance-study” and are presented according to the new systematic explained above. Based on these data estimations for the year 1996/97 are shown and changes are explained.

2. Update of Estimates

2.1. Germany

For the German part of the Danube Basin an additional study was performed for estimating the nitrogen and phosphorus emissions into surface waters (UBA-Berlin, 1998). This study estimates emissions into surface waters for the years 1993 – 1995. There are some divergences to the estimations in the “Nutrient Balance-study”. Thus, both data from Behrendt and the Nutrient Balances were used as upper and lower boundaries for the presentation of German nutrient emissions into surface waters of the Danube Basin in table 1 and 2. The changes between the estimations for 1992 and 1996/97 are not due to real changes in emissions but reflect only different basic data!

A significant reduction of nutrient emissions between 1992 and 1996/97 was reached by improving municipal wastewater treatment plants. The best information available for the year 1996/97 is the German EMIS-inventory for municipal point discharges. It covers 75 % of the wastewater collected in sewer systems. Thus the nitrogen and phosphorus emissions according to this inventory were multiplied by a factor 1.33 to get estimates for the total emissions from municipal wastewater management for the year 1996/97.

Table 1 Nitrogen emissions into surface waters

Surface Waters N in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	2	2	2	2
Industries (with and without treatment)	1	1	1	1
direct discharges private households	0	0	0	0
municipal wastewater management	18	18	17	17
effluents from agricultural wwtp	0	0	0	0
base flow	65	65	65	89
erosion, run-off	11	11	11	13
discharge of manure	2	2	1	2
surface runoff from forests+others	10	10	9	10
N-fixation 3	0	0	0	0
Total national Input	109	109	106	134

Table 2 Phosphorus emissions into surface waters

Surface Waters P in kt	1992		1996/97	
	From	To	From	To
Storm weather overflow	0.3	0.3	0.3	0.5
Industries (with and without treatment)	0.1	0.1	0.1	0.1
Direct discharges private households	0.0	0.0	0.0	0.0
Municipal wastewater management	1.6	1.6	0.7	0.8
Effluents from agricultural wwtp	0.0	0.0	0.0	0.0
Base flow	0.0	0.0	0.0	0.8
Erosion, run-off	5.1	5.1	4.0	5.1
Discharge of manure	0.8	0.8	0.0	0.8
Surface runoff from forests+others	0.8	0.8	0.1	0.8
Total national Input	8.7	8.7	5.2	8.9

2.2. Austria

In Austria significant reductions of emissions between the years 1992 and 1996/97 were reached by an improvement of municipal wastewater treatment in this period. The following municipalities with more than 10.000 inhabitants in this period improved their wastewater treatment plants to biological treatment with nitrogen (> 70 %) and phosphorus (> 80 %) removal: Eisenstadt, Villach, Völkermarkt, Bad Vöslau, Krems, St. Pölten (An der Traisen), Schwechat, Zwettl, Steyr, Vöcklabruck (Ager West), Wels + Marchtrenk, Gmunden (Traunsee Nord), Saalfelden, Knittelfeld, Leoben, Innsbruck, Wörgl (Kirchbichl), Schwaz. In addition, the Main Treatment Plant of Vienna improved the phosphorus removal. All together the nitrogen emissions were reduced by about 4 kt/a and the phosphorus emissions by about 1.1 kt/a. Furthermore a fertiliser factory closed down. That reduced the phosphorus emissions by nearly 0.5 kt/a.

It can be assumed that the other emissions did not change significantly in the period between 1992 and 1996/97. Smaller changes in the estimates for the year 1992 and the year 1996/97 are not due to actual changes of the emissions but due too an improvement of estimates.

Table 3 Nitrogen emissions into surface waters

Surface Waters N in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	2	3	1	2
Industries (with and without treatment)	2	2	2	2
direct discharges private households	1	1	0	2
Municipal wastewater management	22	26	19	21
Effluents from agricultural wwtp	0	0	0	0
base flow	48	60	48	60
erosion, run-off	4	11	4	11
Discharge of manure	2	2	1	2
surface runoff from forests+others	7	10	7	10
N-fixation 3	0	0	0	0
Total national Input	88	115	82	110

Table 4 Phosphorus emissions into surface waters

Surface Waters P in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	0.3	0.5	0.2	0.2
Industries (with and without treatment)	0.5	0.5	0.0	0.1
direct discharges private households	0.1	0.2	0.0	0.2
Municipal wastewater management	2.6	3.2	1.8	2.2
Effluents from agricultural wwtp	0.0	0.0	0.0	0.0
base flow	0.4	0.6	0.4	0.6
erosion, run-off	1.4	4.7	1.4	4.2
Discharge of manure	0.3	0.5	0.3	0.5
surface runoff from forests+others	0.5	1.0	0.5	1.0
Total national Input	6.1	11.2	4.6	9.0

2.3. Czech Republic

There is no improvement of the treatment level of municipal wastewater treatment documented if the inventory for municipalities > 10.000 inhabitants (1992 – 1995) from the “Nutrient Balances” is compared with the inventory for municipal point sources of the EMIS/EG (1996/97). Nevertheless, there are significant differences in the estimations of the total nitrogen and phosphorus emissions from municipal point sources between the “Nutrient Balance-study” and the EMIS inventory even if the fact that the EMIS inventory covers only 75 % of the wastewater collected in sewer systems is considered by multiplying the results with a factor 1.33. The EMIS results are much lower than the Nutrient Balance results. Thus, the emission estimations for municipal point sources from the

“Nutrient Balances” were used as upper boundaries for these emissions. As lower boundary it was considered that at least 13 g nitrogen and 3 g phosphorus per inhabitant connected to a sewer system and day is discharged to municipal wastewater and the removal rate of the mainly high loaded biological treatment plants is less than 30 % for nitrogen and 40 % for phosphorus. Results of the EMIS inventory based on measurements are below this value and were considered to be too low.

For industrial point discharges (industries with and without treatment) results from “Nutrient Balances” and the EMIS inventory were used as upper and lower boundaries. There were no significant changes in the agricultural production (use of fertiliser, harvest, animal farming) or the consumption of food in the Czech Republic between the years 1992 and 1996/97. Thus no changes of the diffuse nutrient emissions were assumed.

Table 5 Nitrogen emissions into surface waters

Surface Waters N in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	2	2	2	2
Industries (with and without treatment)	4	4	1	4
direct discharges private households	3	3	1	2
Municipal wastewater management	10	10	7	10
Effluents from agricultural wwtp	0	0	0	0
base flow	13	13	13	13
erosion, run-off	4	4	4	4
Discharge of manure	0	0	0	0
surface runoff from forests+others	0	0	0	0
N-fixation 3	0	0	0	0
Total national Input	36	36	28	35

Table 6 Phosphorus emissions into surface waters

Surface Waters P in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	0.3	0.3	0.3	0.3
Industries (with and without treatment)	0.4	0.5	0.1	0.5
direct discharges private households	0.1	0.2	0.1	0.2
Municipal wastewater management	2.0	2.4	1.5	2.4
Effluents from agricultural wwtp	0.0	0.0	0.0	0.0
base flow	0.1	0.1	0.1	0.1
erosion, run-off	0.6	0.6	0.6	0.6
Discharge of manure	0.1	0.1	0.1	0.1
surface runoff from forests+others	0.0	0.0	0.0	0.0
Total national Input	3.6	4.2	2.8	4.2

2.4. Slovakia

The performance of the nutrient balance for Slovakia during the “Nutrient Balance-study” was not completed by the Slovakian team of experts. Especially the diffuse emissions from agriculture had to be estimated based on rough assumptions because the complete data set was not delivered. Additional data from the data collection in the framework of the RDPRP (“National reviews, additional data collection) were used to check estimates from the “Nutrient Balance study”.

While in the “Nutrient Balance-study” it was assumed that 59 % (3,01 million inhabitants) of the population in Slovakia are connected to sewer systems, the EMIS-inventory speaks of 53 % (2.74 million inhabitants). This reduces the estimated emissions from municipal wastewater treatment by 2 kt N/a and 0.3 kt P/a. A real reduction of emissions by about 2 kt N/a was reached by upgrading the treatment plants to nitrogen removal of following towns (inventory for municipalities > 10.000 inhabitants (1992 – 1995) from the “Nutrient Balances” as compared to the inventory for municipal point sources of the EMIS/EG (1996/97)): Nitra, Malacky, Banska Bystrica, Michalovce, Humenne, Ruzomberok, Topolancy and Kosice. Thus, the results from the “Nutrient Balances” were reduced by 4 kt N/a and 0.3 to get an upper boundary for the emissions from municipal wastewater management for the year 1996/97. Still there are significant differences in the estimations of the total nitrogen emissions from municipal point sources between the “Nutrient Balance-study” and the EMIS inventory, even if the fact that the EMIS inventory covers only 75 % of the wastewater that is collected in sewer systems is considered by multiplying the results with a factor 1.33. The EMIS results are much lower than the Nutrient Balance results for nitrogen. For phosphorus data are missing in the EMIS inventory. For the lower boundary it was considered that at least 13 g nitrogen and 3 g phosphorus per inhabitant connected to a sewer system is discharged daily to municipal wastewater and that the removal rate of the mainly high loaded biological treatment plants is less than 30 % for nitrogen and 40 % for phosphorus. Results of the EMIS inventory based on measurements for nitrogen are below this value and were considered to be too low.

All the other changes are more an improvement of existing estimates than real changes of emissions. Based on area specific emission factors the diffuse emissions were re-estimated. Data and assumptions used are shown in table 7. For the calculation of the base flow in addition to the percolation from soils the percolation from septic tanks and pits was estimated for nitrogen. 2.5 million people are connected to septic tanks and pits. For these people it was assumed that the specific wastewater production is 11 g N/(cap.d), that 60 – 90 % of this amount percolates to the underground and that again 20 % is retained in the underground and 80 % reaches the groundwater (Hamm, 1991). For denitrification in groundwater a denitrification rate of 35 – 65 % of the total input into groundwater was assumed. For phosphorus it was assumed that most of the amount percolating from septic tanks and pits is retained in the underground.

Table 7 Area, area specific percolation and erosion + runoff, Slowakia

	area km^2	N-percolation kg/(ha.a)	P-percolation kg/(ha.a)
Arable land, incl. Vineyards and orchards	14,750	20-30	0.05-0.1
Pastures and meadows	8,420	4-6	0.05-0.1
Forests	19,930	5	0.05-0.1
Other soils	5,914	-	-
Total area Danube Basin	49,014		

Table 7 continued

	area km^2	N-erosion+runoff kg/(ha.a)	P-erosion+runoff kg/(ha.a)
Arable land, incl. vineyards and orchards	14,750	1.6-5.0	0.6-1.3
Pastures and meadows	8,420	0.6-1.5	0.2-0.4
forests	19,930	0.6-1.5	0.1
Other soils	5,914	3-5	0.2-0.4
Total area Danube Basin	49,014		

Table 8 Nitrogen emissions into surface waters

Surface Waters N in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	1	1	1	1
Industries (with and without treatment)	3	3	1	2
direct discharges private households	3	3	2	3
Municipal wastewater management	18	18	9	14
Effluents from agricultural wwtp	0	0	0	0
base flow	26	28	23	30
erosion, run-off	10	10	3	9
Discharge of manure	0	0	0	0
surface runoff from forests+others	0	0	3	6
N-fixation 3	0	0	0	0
Total national Input	61	63	42	65

Table 9 Phosphorus emissions into surface waters

Surface Waters P in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	0.2	0.2	0.2	0.2
Industries (with and without treatment)	0.1	0.1	0.0	0.1
direct discharges private households	0.3	0.3	0.3	0.3
Municipal wastewater management	3.7	3.7	2.1	3.4
Effluents from agricultural wwtp	0.0	0.0	0.0	0.0
base flow	0.3	0.3	0.2	0.4
erosion, run-off	1.0	1.8	1.0	2.3
Discharge of manure	0.0	0.0	0.0	0.0
surface runoff from forests+others	0.0	0.0	0.3	0.4
Total national Input	5.6	6.4	4.1	7.1

2.5. Hungary

As for the Czech Republic and for Slovakia the total emissions from municipal point sources according to the inventory of the EMIS Expert Group are significantly lower than the results of the "Nutrient Balances" based on an inventory of all municipalities with more than 10.000 inhabitants and estimates for the rest. Looking at the nutrition behaviour (table 10) it can be seen that the nutrient content in the consumed food decreased significantly (16 %) between 1992 and 1996/97.

To come to an upper boundary estimate for the emissions from municipal wastewater management (nitrogen and phosphorus) for the year 1996/97 the result from the “Nutrient Balances” for the year 1992 were reduced proportionally to the reduction of the nutrient content in food. Similar to the Czech Republic and to Slowakia the lower boundary was determined: it was considered that at least 13 g nitrogen per inhabitant (connected to a sewer system) and day is discharged to municipal wastewater and that the removal rate of the mainly high loaded biological treatment plants is less than 30 % for nitrogen. For phosphorus missing data in the EMIS inventory for two towns (Budapest and Szeged) were supplemented by an estimate and the sum of phosphorus emissions from this inventory - representing 75 % of the wastewater collected in sewer systems - was multiplied with 1.33 to get the lower boundary for the phosphorus emissions from municipal wastewater management.

Table 10 Food consumption, Hungary

	consumption		average content					
	kg/(cap.a)		% N	% P	kgN/(cap.a)		kgP/(cap.a)	
	1992	1996			1992	1996	1992	1996
Meat	76	60	3	0.35	2.3	1.8	0.27	0.21
Milk	160	138	0.55	0.1	0.9	0.8	0.16	0.14
Eggs	19	15	1.8	0.15	0.3	0.3	0.03	0.02
Fish	3	3	3	0.2	0.1	0.1	0.01	0.01
Potatos	56	67	0.35	0.075	0.2	0.2	0.04	0.05
Bred	100	81	1.25	0.2	1.3	1.0	0.20	0.16
Vegetable	85	90	0.4	0.1	0.3	0.4	0.09	0.09
Fruits	73	64	0.1	0.015	0.1	0.1	0.01	0.01
Rice	6	5	1.2	0.17	0.1	0.1	0.01	0.01
Sum					5.5	4.7	0.81	0.70

A further change of the emission estimations for Hungary is due to the change in the estimates but not due to real changes of emissions. In the framework of the work on the DWQM Jolankai (1999) indicated that the emission estimations for erosion and runoff from the “Nutrient Balance-study” is too high for Hungarian conditions. Thus it was agreed on area specific factors for erosion and runoff of 0,6 – 1,3 kg/(ha.a) for arable land, 0,1 kg/(ha.a) for forests and 0.2 – 0.4 kg/(ha.a) for pastures, meadows and other soils (e.g. unproductive land) to come to emission estimates for the year 1996/97.

Table 11 Nitrogen emissions into surface waters

Surface Waters N in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	0	1	1	1
Industries (with and without treatment)	2	2	2	2
direct discharges private households	1	1	2	3
Municipal wastewater management	21	21	14	18
Effluents from agricultural wwtp	0	0	0	0
base flow	5	5	5	5
erosion, run-off	28	28	28	28
Discharge of manure	8	8	6	8
surface runoff from forests+others	0	0	0	0
N-fixation 3	20	20	20	20
Total national Input	85	86	78	85

Table 12 Phosphorus emissions into surface waters

Surface Waters P in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	0.1	0.1	0.0	0.0
Industries (with and without treatment)	1.5	1.5	1.5	1.5
direct discharges private households	0.9	0.9	0.7	1.0
Municipal wastewater management	5.2	5.2	3.3	4.5
Effluents from agricultural wwtp	0.0	0.0	0.0	0.0
base flow	0.0	0.0	0.1	0.1
erosion, run-off	6.8	7.8	3.0	6.6
Discharge of manure	1.6	1.6	1.3	1.6
surface runoff from forests+others	0.0	0.0	0.5	0.7
Total national Input	16.1	17.1	10.4	16.0

2.6. Slovenia

Calculations in the “Nutrient Balance-study” were based an a wrong level of connections to sewer systems. The EMIS-inventory as well as the “national reviews” of the River Danube Pollution Reduction Programme confirm that in Slovenia only about 45 % of the population is connected to sewer systems. Based on this value the “Nutrient Balance” estimations for 1992 for “direct discharges privat households” and “municipal wastewater management” were changed to the new estimate for the year 1996/97. For municipal wastewater management the upper boundary of the emission estimates for the year 1996/97 is based on the inventory of municipalities with more than 10.000 inhabitants from the “Nutrient Balances” with an additional estimation for the smaller municipalities (the number of connections to sewer systems was reduced as compared to the 1992-estimate). The lower boundary is based on the EMIS inventory, with additional emission estimations for two towns (Celje and Lasko) where these data were missing. To achieve the total emissions the sum of emissions from the EMIS inventory, which covers 75 % of the wastewater collected in sewer systems, was multiplied with 1.33.

For Industrial discharges there is no information about nitrogen and phosphorus emissions in the EMIS-inventory. Thus the information from “Nutrient Balance study” is the only one available. In the “Nutrient Balance-study” the discharge of manure was stated with zero. This was changed according to information in the “national reviews” and the “additional data collection” in the framework of the RDPRP.

There were no big changes in the agricultural production, animal farming, the food consumption or wastewater treatment, which would point out any real changes of nutrient emissions. All changes for Slovenia between the years 1992 and 1996/97 are due to improvements in the estimations and not due to changes of emissions.

Table 13 Nitrogen emissions into surface waters

Surface Waters N in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	0	1	0	1
Industries (with and without treatment)	5	7	5	7
direct discharges private households	0	1	1	2
Municipal wastewater management	8	8	4	6
Effluents from agricultural wwtp	0	0	0	0
base flow	4	5	4	5
erosion, run-off	3	4	3	4
Discharge of manure	0	0	2	3
surface runoff from forests+others	0	0	0	0
N-fixation 3	0	0	0	0
Total national Input	20	26	19	28

Table 14 Phosphorus emissions into surface waters

Surface Waters P in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	0.1	0.1	0.1	0.1
Industries (with and without treatment)	0.2	0.6	0.2	0.6
direct discharges private households	0.1	0.2	0.1	0.2
Municipal wastewater management	1.4	1.6	0.8	1.2
Effluents from agricultural wwtp	0.0	0.0	0.0	0.0
base flow	0.1	0.1	0.1	0.1
erosion, run-off	0.1	0.1	0.1	0.1
Discharge of manure	0.0	0.0	0.6	1.3
surface runoff from forests+others	0.0	0.0	0.0	0.0
Total national Input	2.0	2.7	2.0	3.6

2.7. Croatia

For Croatia a nutrient balance for the year 1992 does not exist. Based on average values for the Danube Basin a rough estimation of nutrient emissions to surface waters was done in the framework of the DWQM (van Gils, 1999). There were no new data delivered on which a improvement of the estimate could be based on, thus the DWQM – estimate was taken. As documentation of the uncertainties connected with the estimations, 80 % and 120 % of the DWQM-estimates were taken as lower and upper boundary for the year 1996/97.

Table 15 Nitrogen emissions into surface waters

Surface Waters N in kt	1992		1996/97	
	From	To	From	To
storm weather overflow			0	1
Industries (with and without treatment)			2	2
direct discharges private households			1	1
Municipal wastewater management			4	7
Effluents from agricultural wwtp			0	0
base flow			12	17
erosion, run-off			6	8
Discharge of manure			2	3
surface runoff from forests+others			1	2
N-fixation 3				
Total national Input			28	41

Table 16 Phosphorus emissions into surface waters

Surface Waters P in kt	1992		1996/97	
	From	To	From	To
storm weather overflow			0,1	0,1
Industries (with and without treatment)			0,3	0,4
direct discharges private households			0,1	0,2
Municipal wastewater management			0,8	1,2
Effluents from agricultural wwtp			0,0	0,0
base flow			0,3	0,4
erosion, run-off			1,2	1,9
Discharge of manure			0,4	0,6
surface runoff from forests+others			0,1	0,2
Total national Input			3,3	5,0

2.8. Bosnia-Herzegovina

For Bosnia-Herzegovina a nutrient balance for the year 1992 does not exist. A rough estimation of nutrient emissions to surface waters was done in the framework of the DWQM (van Gils, 1999) based on average values for the Danube Basin. These values were partially accepted. In addition, own estimates were done or in some cases it was possible to take data directly from the “National review”.

Emissions of minor importance where estimates were accepted from the DWQM-estimate were: storm weather overflow and direct discharges private households.

For industries (with and without treatment) data from the “National review” (chapter: industrial hot spots) were taken. For municipal wastewater management the “National review” gives an estimate for the total emissions (chapter: municipal hot spots), too. Noticeable is the difference between the estimates in the “National review” and the values from the EMIS-inventory. At first the percentage of the population connected to sewer systems differs between 52 % in the “National review” and 31 % in the EMIS-inventory. Second the emission values in the EMIS inventory for municipal point sources are much lower even if it is considered that the EMIS inventory covers only a part of the total emissions. Because the estimate in the “National review” is the only estimate for the total emissions, it was used for the year 1996/97 in table 18 and 19.

The agricultural production and especially the animal farming was on a very low level in 1996. The number of cattle and pigs was reduced to only 25 % between 1992 and 1996. Thus, it was estimated that there were no direct emissions (manure, treated or not) from agricultural sources. The diffuse emissions were estimated based on area specific emission factors. Data and assumptions used are shown in table 17. For the calculation of the base flow in addition to the percolation from soils percolation from septic tanks and pits was estimated for nitrogen. 1.4 million people are connected to septic tanks and pits. For these people it was assumed that the specific wastewater production is 11 g N/(cap.d), that 60 – 90 % of this amount percolates to the underground and again 20 % is retained in the underground and 80 % reaches the groundwater (Hamm, 1991). For denitrification in groundwater a denitrification rate of 20 – 40 % of the total input into groundwater was assumed. For phosphorus it was assumed that most of the amount percolating from septic tanks and pits is retained in the underground.

Table 17 Area, area specific percolation and erosion + runoff, Bosnia-Herzegovina

	area km^2	N-percolation kg/(ha.a)	P-percolation kg/(ha.a)
Arable land	9,116	15-20	0.05 – 0.1
Vineyards and orchards	901	15-20	0.05 – 0.1
Pastures and meadows	7,196	4-6	0.05 – 0.1
forests	17,736	5	0.05 – 0.1
Other soils	1,770	-	-
Total area Danube Basin	38,719		

	area km^2	N-erosion+runoff kg/(ha.a)	P-erosion+runoff kg/(ha.a)
Arable land	9,116	1.6-3.0	0.6-1.3
Vineyards and orchards	901	1.6-3.0	0.6-1.3
Pastures and meadows	7,196	0.6-1.5	0.2-0.4
Forests	17,736	0.6-1.5	0.1
Other soils	1,770	3-5	0.2-0.4
Total area Danube Basin	38,719		

The total emissions from diffuse sources estimated with the above mentioned method are in the same order of magnitude as the estimations of the total diffuse emissions that are stated in the “national review” (chapter: agricultural hot spots). These data are from pre-war years. The agricultural production has been decreasing substantially since then. However, it can be assumed that for the diffuse emissions via groundwater or erosion it takes some years till a reduction of productivity leads to a reduction of emissions. This is due to the role of stocks in soils and groundwater.

Table 18 Nitrogen emissions into surface waters

Surface Waters N in kt	1992		1996/97	
	From	To	From	To
storm weather overflow			0	1
Industries (with and without treatment)			1	1
direct discharges private households			1	1
Municipal wastewater management			7	7
Effluents from agricultural wwtp			0	0
base flow			22	24
erosion, run-off			2	4
Discharge of manure			0	0
surface runoff from forests+others			1	3
N-fixation 3				
Total national Input			34	41

Table 19 Phosphorus emissions into surface waters

Surface Waters P in kt	1992		1996/97	
	From	To	From	To
storm weather overflow			0.1	0.2
Industries (with and without treatment)			0.1	0.1
direct discharges private households			0.1	0.2
Municipal wastewater management			3.0	3.0
Effluents from agricultural wwtp			0.0	0.0
base flow			0.2	0.4
erosion, run-off			0.8	1.7
Discharge of manure			0.0	0.0
surface runoff from forests+others			0.2	0.2
Total national Input			4.5	5.8

2.9. Yugoslavia

As for Bosnia-Herzegovina and Croatia a nutrient balance for the year 1992 does not exist. A rough estimation of the nutrient emission to surface waters was done in the framework of the DWQM (van Gils, 1999) based on average values for the Danube Basin. The estimates from the DWQM were accepted for storm weather overflow. For “direct discharges, private households” it was assumed that 10 % of the private households not connected to sewer systems discharge their wastewater directly into surface waters. The head specific wastewater production was calculated with 11 g N/(cap.d) and 3 g P/(cap.d).

For industries (with and without treatment) data from the “National review” (part B, Table 2.1-1) were taken. In the text a reduction of emissions down to 35 – 55 % as compared to the values in the table is mentioned. This is due to the break down of industrial production. Accordingly, the values from Table 2.1-1 were reduced according to this. For municipal wastewater management the “national review” gives an estimate for total emissions (part B, Table 2.1-1), too. This estimates go well along with head specific values of 13 g N/(cap.d) and 3 g P/(cap.d)

Values for direct discharges of manure are based on information from the national reviews (part B, chapter agricultural hotspots) and from the additional data collection (nutrients in manure minus nutrients in manure used as fertiliser).

The diffuse emissions were estimated based on area specific emission factors. Data and assumptions used are shown in table 20. For the calculation of the base flow in addition to the percolation from soils percolation from septic tanks and pits was estimated for nitrogen. 3.6 million people (4 million minus 10 % direct discharging to rivers) are connected to septic tanks and pits. For these people it was assumed that the specific wastewater production is 11 g N/(cap.d), that 60 – 90 % of this amount percolates to the underground and again 20 % is retained in the underground and 80 % reaches the groundwater (Hamm, 1991). For denitrification in groundwater a denitrification rate of 35 – 65 % of the total input into groundwater was assumed. Due to lower groundwater recharge rates and longer retention times this rate is higher than in Bosnia-Herzegovina. For phosphorus it was assumed that most of the amount percolating from septic tanks and pits is retained in the underground.

Table 20 Area, area specific percolation and erosion + runoff, Bosnia-Herzegovina

	area km^2	N-percolation kg/(ha.a)	P-percolation kg/(ha.a)
Arable land	37,560	15-20	0.05 – 0.1
Vineyards and orchards	380	15-20	0.05 – 0.1
Pastures and meadows	17,280	4-6	0.05 – 0.1
Forests	25,210	5	0.05 – 0.1
Other soils	8,489	-	-
Total area Danube Basin	88,919		

	area km^2	N-erosion+runoff kg/(ha.a)	P-erosion+runoff kg/(ha.a)
Arable land	37,560	1.6-3.0	0.6-1.3
Vineyards and orchards	380	1.6-3.0	0.6-1.3
Pastures and meadows	17,280	0.6-1.5	0.2-0.4
forests	25,210	0.6-1.5	0.1
Other soils	8,489	3-5	0.2-0.4
Total area Danube Basin	88,919		

Changes in nutrition and agricultural production between the years 1992 and 1996 were small. It can be assumed that except for the industrial discharges changes of emissions between the years 1992 and 1996 are beyond the uncertainties of the estimation.

Table 21 Nitrogen emissions into surface waters

Surface Waters N in kt	1992		1996/97	
	From	To	From	To
storm weather overflow			1	2
Industries (with and without treatment)			8	12
direct discharges private households			1	2
Municipal wastewater management			20	20
Effluents from agricultural wwtp			0	0
base flow			38	54
erosion, run-off			14	25
Discharge of manure			1	5
surface runoff from forests+others			2	6
N-fixation 3				
Total national Input			85	126

Table 22 Phosphorus emissions into surface waters

Surface Waters P in kt	1992		1996/97	
	From	To	From	To
storm weather overflow			0.3	0.5
Industries (with and without treatment)			2.8	4.1
direct discharges private households			0.3	0.5
Municipal wastewater management			6.0	6.0
Effluents from agricultural wwtp			0	0
base flow			0.6	1.0
erosion, run-off			4.1	5.5
Discharge of manure			1.3	1.8
surface runoff from forests+others			0.2	0.5
Total national Input			15.6	19.9

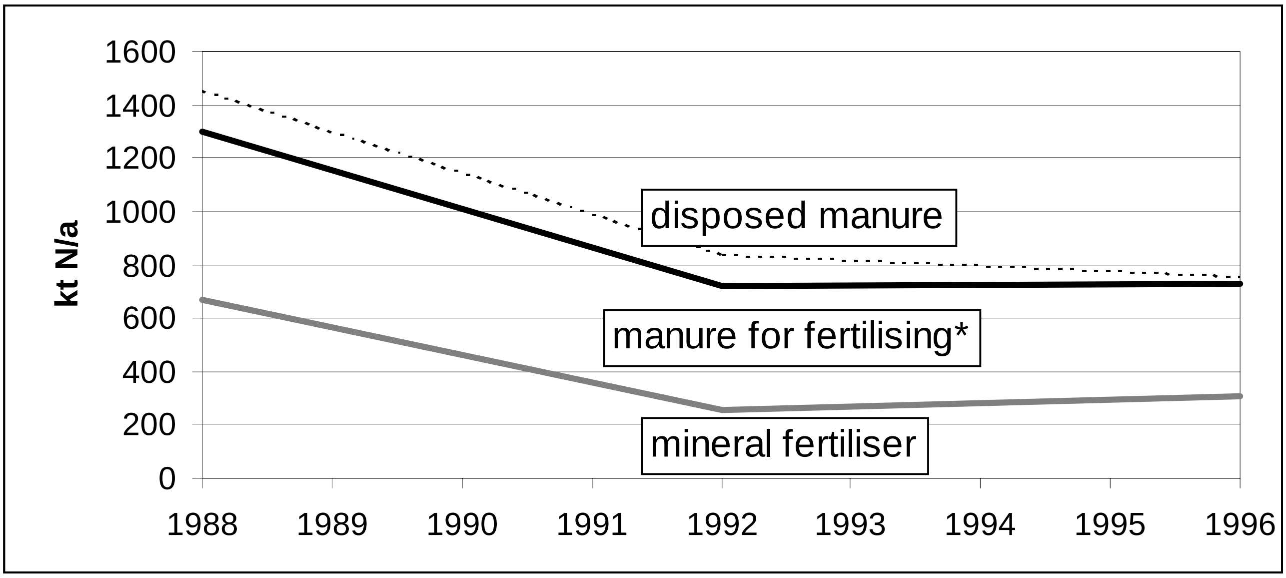
2.10. Romania

Between the years 1992 – 1996 no changes with regard to food consumption or wastewater management are documented for Romania. In general values from the “Nutrient Balances” fit well with values from the EMIS-inventories for municipal and industrial point sources. Small adjustments were made. Only for the P-emissions there is a significant difference between these two sources. Here, values between the results of the “Nutrient Balances” and the EMIS-inventory were chosen. For “direct discharges private households” an additional estimation was done with the assumption, that up to 10 % of the private households not connected to sewer systems discharge their wastewater directly into surface waters. The head specific wastewater production was calculated with 11 g N/(cap.d) and 1,8 g P/(cap.d). According to information from “Nutrient Balances” and additional data collection in the framework of RDPRP smaller head specific values for phosphorus as compered to other countries (as for instance Yugoslavia) are due to the use of mainly phosphate free detergents.

A significant change in the agriculture of Romania is that the number of livestock in farms was reduces. Between 1992 and 1996 the livestock was reduced from 8.6 million to 6,8 million GVE (Großvieheinheiten – is the amount of livestock which correspond to 500 kg weight of living animal). This is a reduction of livestock of about 20 %. Since 1988 the reduction of livestock is about 40 % of the value from 1988 (11,6 million GVE). Especially the activity of animal farms on industrial scale (more than 1,000 pigs) decreased tremendously. The “National review” (part B) reports that in the past 8 years 60 % of these farms closed and the remaining have only an acitvity of 40 – 50 %. Thus, based on the estimation of emissions for agricultural wastewater treatment plants and discharges of manure for the year 1988 from the “Nutrient Balances” a reduction of emissions in the same percentage as the reduction of activity of “industrialised” animal farms was assumed for these emission pathways for the year 1996/97.

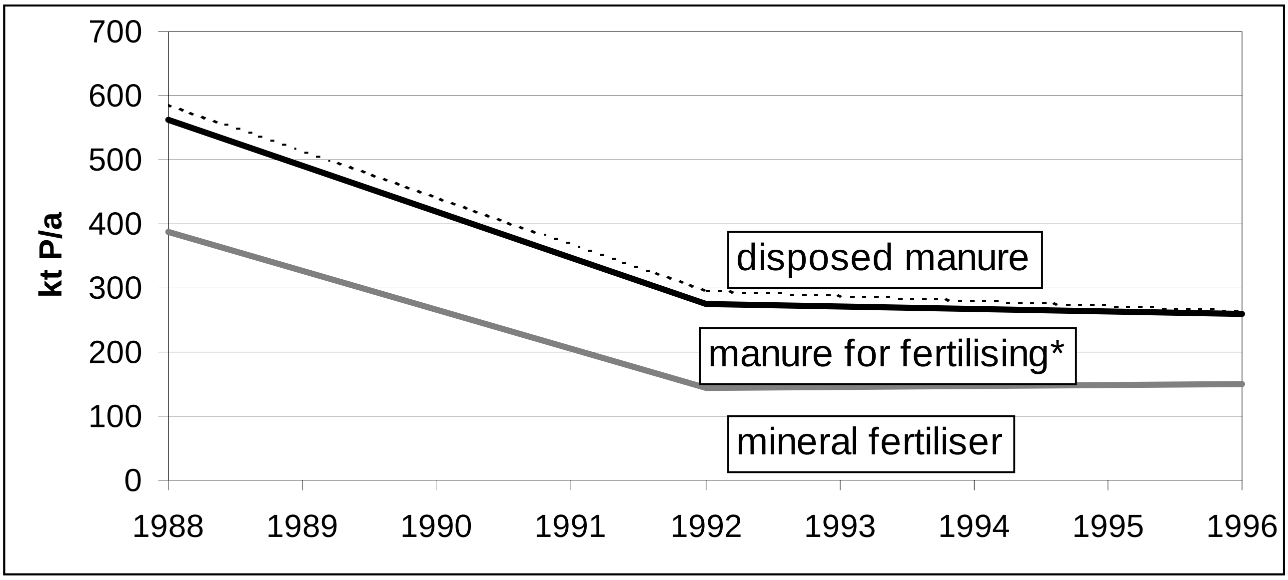
No changes of agricultural plant production can be observed from the information delivered. After a break down from 1988 to 1992 the use of mineral fertiliser has been rising again between 1992 and 1996, according to information from the “National reviews” (but there is a contradiction with information from the RDPRP-additional data collection). All together the total amount of available fertiliser (mineral fertiliser + manure produced – manure discharged to surface waters) remained nearly constant between 1992 and 1996 (figure 1 and 2). Thus, from this no changes of diffuse pollution can be concluded. Nevertheless, a reduction of animal farming leads to a reduction of losses of nitrogen into the air and thus to a reduction of depositions on agricultural land but also on forests. Sooner or later, this will lead to a reduction of emissions to surface water via base flow. However, it is very hard to predict the amount of emission reduction and the time scale of this reduction, because the knowledge about the role of stocks and the time lack between reduction of nutrient input into soils and the reduction of diffuse emissions is poor. A possible emission reduction via base flow was estimated with less than 10 % of the actual emission via base flow.

Figure 1 Development of N-fertilisers in Romania



** estimated based on specific manure production of livestock minus disposed manure*

Figure 2 Development of P-fertilisers in Romania



** estimated based on specific manure production of livestock minus disposed manure*

Table 23 Nitrogen emissions into surface waters

Surface Waters N in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	5	5	5	5
Industries (with and without treatment)	18	18	18	18
direct discharges private households	2	3	3	5
Municipal wastewater management	40	40	37	40
Effluents from agricultural wwtp	36	38	10	15
base flow	95	95	86	95
erosion, run-off	38	38	38	38
Discharge of manure	71	77	10	30
surface runoff from forests+others	0	0	0	0
N-fixation 3	4	4	4	4
Total national Input	309	318	211	250

Table 24 Phosphorus emissions into surface waters

Surface Waters P in kt	1992		1996/97	
	From	To	From	To
Storm weather overflow	1.1	1.1	1.1	1.1
Industries (with and without treatment)	4.3	4.3	1.0	3.0
Direct discharges private households	0.3	0.4	0.6	1.0
Municipal wastewater management	5.7	5.7	5.7	6.1
Effluents from agricultural wwtp	9.0	11.0	2.0	4.1
Base flow	4.3	4.3	4.3	4.3
Erosion, run-off	6.8	6.8	6.8	6.8
Discharge of manure	12.0	15.0	1.9	5.6
Surface runoff from forests+others	0.0	0.0	0.0	0.0
Total national Input	43.5	48.6	23.4	32.0

2.11. Bulgaria

In Bulgaria a reduction of food consumption between 1992 and 1996 led to a reduction of nutrients in food of about 20 %. It was assumed that the emissions from municipal wastewater management were reduced by the same percentage as assumed for the year 1992 in the “Nutrient Balance-study”. These reduced “Nutrient Balance”-data were used as lower boundary for the 1996/97 estimate, while results from the EMIS inventory multiplied with a factor 1.33 are the upper boundary of this estimate. For industries (with and without treatment) the “Nutrient Balance”-data and results from EMIS inventory are the lower and the upper boundaries for 1996/97-emission estimates.

The reduction of productivity and intensity of agricultural production, that started with 1988/89 went on between 1992 and 1996. The amount of livestock expressed as GVE (Großvieheinheiten – is the amount of livestock which corresponds to 500 kg weight of living animal) was reduced to 50 % between 1992 and 1996. Considering that this reduction is mainly due to a reduction of big animal farms and that the need of saving fertilisers increased, a reduction of discharges of manure down to 25 – 50 % as compared to 1992 was estimated for the year 1996.

The use of mineral fertiliser was reduced to 73 % for nitrogen fertilisers and 23 % for phosphorus fertilisers between 1992 and 1996. In the same time the plant production went down to 70 % of the 1992-harvest. On a long term run all these changes surely will have effects on the diffuse nutrient emissions. However, the estimate for nitrogen emissions via base flow already was very low. Thus, it was not changed. Changes of emissions via erosion require a longer time of reduced intensity of production because the stock in soil plays an important role. Again no changes of estimates were made.

Table 25 Nitrogen emissions into surface waters

Surface Waters N in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	2	3	2	3
Industries (with and without treatment)	4	4	2	4
direct discharges private households	0	2	0	2
Municipal wastewater management	14	14	11	14
Effluents from agricultural wwtp	0	0	0	0
base flow	3	5	3	5
erosion, run-off	5	7	5	7
Discharge of manure	7	7	2	4
surface runoff from forests+others	2	2	2	2
N-fixation 3	0	0	0	0
Total national Input	37	44	27	41

Table 26 Phosphorus emissions into surface waters

Surface Waters P in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	0.3	0.4	0.3	0.4
Industries (with and without treatment)	0.1	0.1	0.1	0.1
direct discharges private households	0.0	0.6	0.0	0.6
Municipal wastewater management	3.2	3.2	2.6	3.8
Effluents from agricultural wwtp	0.0	0.0	0.0	0.0
base flow	0.3	0.7	0.3	0.7
erosion, run-off	0.5	0.9	0.5	0.9
Discharge of manure	1.8	1.8	0.5	0.9
surface runoff from forests+others	0.3	0.3	0.3	0.3
Total national Input	6.5	8.0	4.6	7.7

2.12. Moldavia

Table 27 Nitrogen emissions into surface waters

Surface Waters N in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	0	0	0	0
Industries (with and without treatment)	0	0	0	0
direct discharges private households	0	0	0	0
Municipal wastewater management	1	1	1	1
Effluents from agricultural wwtp	0	0	0	0
base flow	2	4	2	4
erosion, run-off	8	10	7	11
Discharge of manure	0	0	0	0
surface runoff from forests+others	0	0	0	0
N-fixation 3	0	0	0	0
Total national Input	10	15	9	16

Table 28 Phosphorus emissions into surface waters

Surface Waters P in kt	1992		1996/97	
	from	To	From	To
storm weather overflow	0.0	0.0	0,0	0,0
Industries (with and without treatment)	0.0	0.0	0,0	0,0
direct discharges private households	0.0	0.0	0,0	0,0
Municipal wastewater management	0.1	0.2	0,1	0,2
Effluents from agricultural wwtp	0.0	0.0	0,0	0,0
base flow	0.0	0.0	0,0	0,0
erosion, run-off	1.7	2.4	1,6	2,5
Discharge of manure	0.0	0.0	0,0	0,0
surface runoff from forests+others	0.0	0.0	0,0	0,0
Total national Input	1.8	2.6	1,7	2,7

The results from Moldavia remain unchanged. From the few data delivered it was not possible to conclude any estimations for changes of emissions. As documentation of the uncertainties connected with the estimations, 80 % and 120 % of the 1992-estimates were taken as lower and upper boundary, respectively for the year 1996/97.

2.13. Ukraine

As best estimate for the year 1996/97 the results from the "Nutrient Balance-study" were taken unchanged for the emissions from wastewater management. No significant changes were documented. For diffuse pollution it was not possible to estimate changes between 1992 and 1996 due to extremely inconsistent data (e.g. number of animals and land use for 1996 in "national review" and "additional data collection", number of animals and use of mineral fertilisers for 1992 in "Nutrient Balances" and "additional data collection"). The "Nutrient Balance" estimate for 1992 remained unchanged. As documentation of the uncertainties connected with the estimations, 80 % and 120 % of the 1992-estimates were taken as lower and upper boundary, respectively for the year 1996/97.

Table 29 Nitrogen emissions into surface waters

Surface Waters N in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	0	0	0	0
Industries (with and without treatment)	0	0	0	0
direct discharges private households	0	0	0	0
Municipal wastewater management	3	3	2	4
Effluents from agricultural wwtp	0	0	0	0
base flow	4	4	3	5
erosion, run-off	17	17	14	20
Discharge of manure	1	1	1	1
surface runoff from forests+others	9	9	7	11
N-fixation 3	0	0	0	0
Total national Input	34	34	27	41

Table 30 Phosphorus emissions into surface waters

Surface Waters P in kt	1992		1996/97	
	From	To	From	To
storm weather overflow	0.1	0.1	0,1	0,1
Industries (with and without treatment)	0.0	0.0	0,0	0,0
direct discharges private households	0.0	0.0	0,0	0,0
Municipal wastewater management	1.0	1.0	0,8	1,2
Effluents from agricultural wwtp	0.0	0.0	0,0	0,0
base flow	0.4	0.4	0,3	0,5
erosion, run-off	2.8	2.8	2,2	3,4
Discharge of manure	0.5	0.5	0,4	0,6
surface runoff from forests+others	0.9	0.9	0,7	1,1
Total national Input	5.7	5.7	4,5	6,9

3. Summary

Table 31 shows a summary of average values of emission estimates for different countries and different years. It can be seen that the decreasing tendency of emissions between 1988 and 1992 (ARP Project EU/AR/102A/91, 1997) was continued from 1992 to 1996. The reduction of manure discharges in Romania and Bulgaria is the main reason for the decreasing emissions between 1992 and 1996. A further reduction is due to the improvement of wastewater treatment mainly in Germany and Austria and a reduced food consumption (Bulgaria, Hungary).

Table 31 Nitrogen and Phosphorus emissions to surface waters in the Danube Basin

values in kt N/a	D	A	CZ	SK	H	SL	CR	BH	YU	RO	BG	MD	UA	DB[1)]
1988[2)]	108	106	38	65	125	29				414	47	20	35	1234
1992[2)]	109	102	36	62	86	23				314	41	13	34	1025
1992[3)]	123	100	32	56	85	24				314	41	13	34	1028
1996/97	120	96	32	54	82	24	35	37	106	231	34	13	34	898

values in kt P/a	D	A	CZ	SK	H	SL	CR	BH	YU	RO	BG	MD	UA	DB[1)]
1988[2)]	10.3	10.3	4.0	6.5	17.3	2.5				62.4	8.1	2.7	7.1	164
1992[2)]	8.7	8.7	3.9	6.0	16.6	2.4				46.1	7.3	2.3	5.7	135
1992[3)]	7.8	8.2	3.5	5.6	14.0	2.8				44.4	7.9	2.3	5.7	128
1996/97	7.1	6.8	3.5	5.6	13.2	2.8	4.2	5.2	17.8	27.7	6.1	2.2	5.7	108

1) *For the years 1988 and 1992 the sum of the country results (without CR, BH and YU) was multiplied with 1.25 to come to an estimate for the total Danube Basin (DB)*

2) *From ARP Project EU/AR/102A/91, „Nutrient Balances for Danube Countries“*

3) *New estimate for 1992 based on additional information from data collection in the framwork of RDPRP, EMIS/EG inventory and UBA-Berlin (1998)*

A decrease of agricultural productivity leads to a reduction of diffuse emissions, too. The main reduction of agricultural productivity happened between 1988 and 1992. A reduction of diffuse emissions (base flow, erosion and runoff) was already considered by the experts of the different countries in the “Nutrient balance-study” between 1988 and 1992, even if it is doubtful if the reduction of diffuse emissions happens this fast. The role of stocks in soil and groundwater may lead to a significant time lack between the reduction of productivity and the reduction of emissions. In this respect further investigations are needed. Between 1992 and 1996 the agricultural production remained more or less constant in most of the countries. However, in Bulgaria and Bosnia-Herzegovina a reduction of agricultural productivity was documented. On a long term run this may lead to a further reduction of diffuse emissions if the product-ivity remains on the same low level or is decreasing further, but the other way round a rise of productivity will lead to increasing emissions again. Besides the “real” changes in emissions some emission values were only due to new information. These changes do not reflect actual changes in emissions and are shown separately in table 31.

In figures 3 and 4 the emission estimates are compared with measurements of the nitrogen and phosphorus load in the Danube before it enters the Black Sea. At Reni there is a sampling station before the Danube Delta. The sampling station at Sulina is in the middle channel of the Danube in the Delta, 5 km upstream from the discharge to the Black Sea. Measured concentrations are multiplied with the flow at Reni to sum up for yearly loads. Even if the absolute values of emissions estimates and measured loads differ a lot, it can be seen that at least for the measurements at Sulina and the total phosphorus loads measured at Reni there is the same decreasing tendency between the years 1998 and 1996/97. However, this decreasing tendency is not confirmed by the measurements at Reni.

Figure 3 Emissions estimates for the Danube Basin and load measurements in the Danube for nitrogen

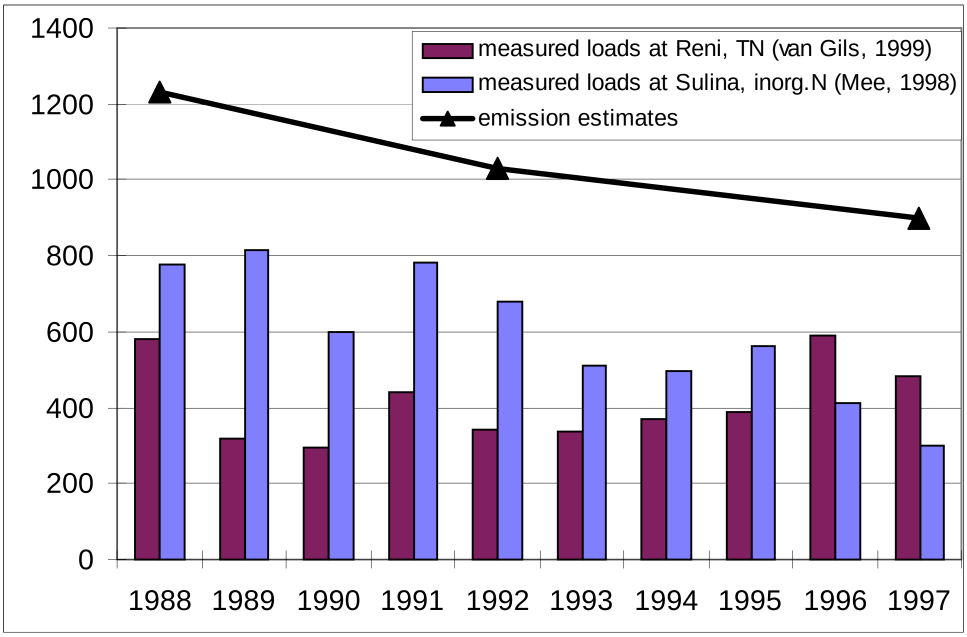
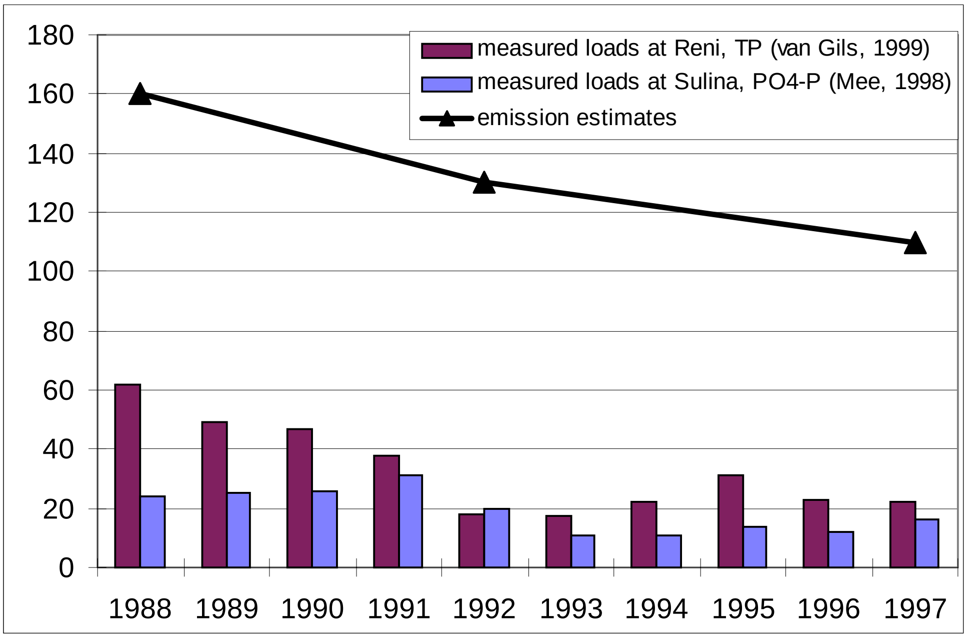


Figure 4: Emissions estimates for the Danube Basin and load measurements in the Danube for phosphorus



Concluding, it has to be repeated that the evaluation of emissions done here is not a complete recalculation of either the nutrient balances or the emissions into surface waters for the countries of the Danube Basin. Based on the "Nutrient Balances for Danube Countries" and additional information mainly from "National reviews" and an additional data collection from RDPRP and the inventory of the EMIS-expert group of the International Commission for the Protection of the Danube River it was estimated which changes of nutrient emissions between 1992 and 1996 can be expected due to the information delivered. This work never can replace a periodical improvement, update and renewal of national and international nutrient balances, which are, together with well-aimed load measurements in the rivers and improved understandings of retention and losses of nutrients in the water system (e.g. DWQM), important tools for co-operation and decision making in water protection on a Danube and Black Sea Basin level.

o.Univ.Prof.Dipl.Ing.Dr. H. Kroiss

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Annex 15.

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