



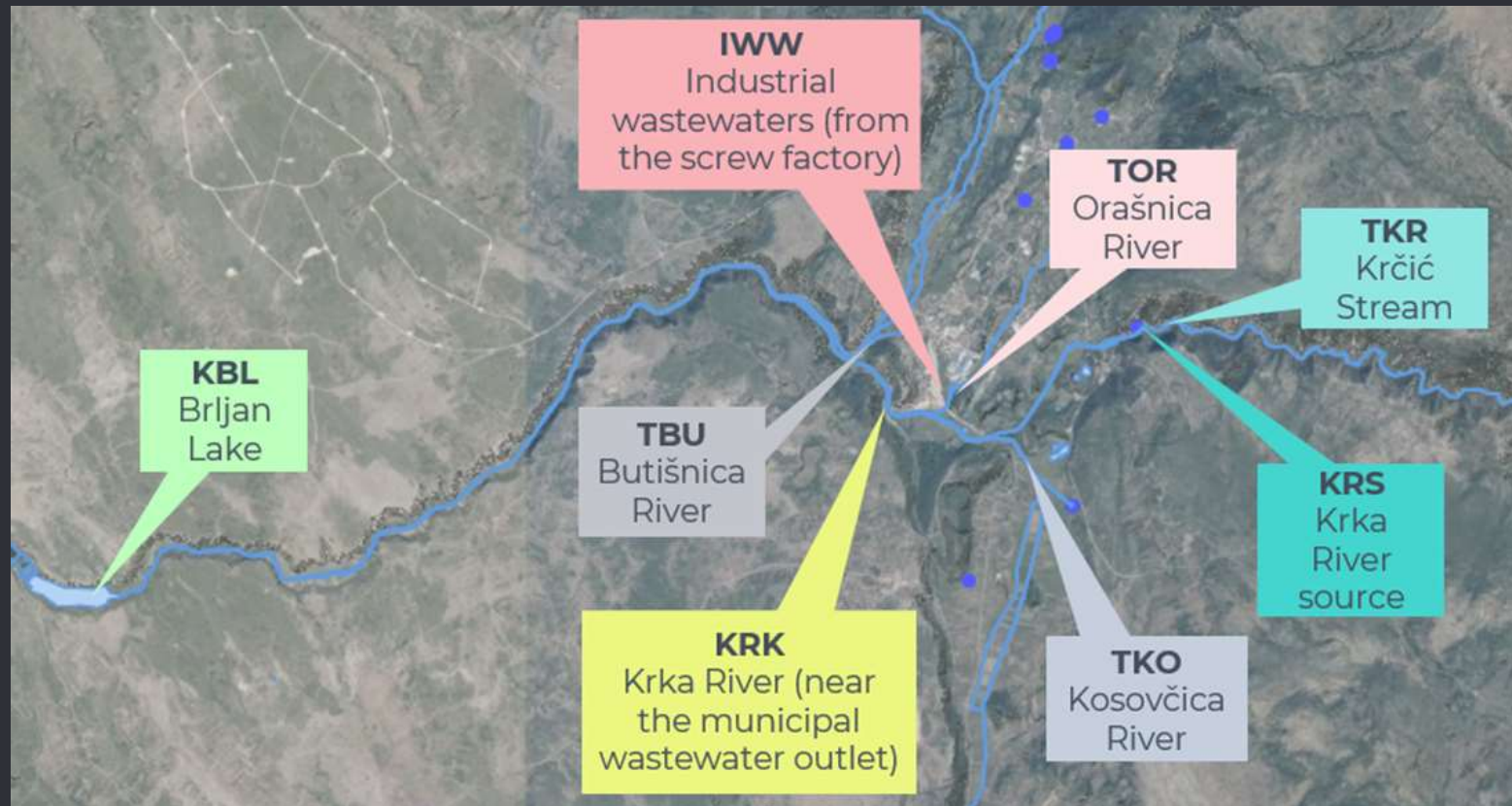
Physico-chemical water parameters

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Sampling

- January, April, July, October 2021.
- in triplicates at 8 locations – Krčić Stream runs dry



Measurements

in situ

- water temperature, concentration and saturation of dissolved oxygen, conductivity, total dissolved solids, pH
- portable field meters (Mettler Toledo)



Measurements

in laboratory

- water samples stored in dark at temperature up to 8°C
- determined using the standardized methods
- concentrations of nutrients, turbidity, chemical oxygen demand, m-alkalinity, carbonate and total hardness of water, free CO₂ - (Hach 2013, APHA 2018)
- total and dissolved organic carbon – HRN EN 1484:2002
- phenols and mineral oils - ASTM D 4763-06, 2020



Results

- water quality of Krka River and its tributaries - estimated following the Directive on water quality status – ecological status based on physico-chemical water parameters
- industrial wastewaters – the exact emission limit values for certain parameters defined by Regulation on limit values for wastewater emissions

	TKR Krčić Stream	KRS Krka River source	TOR Orašnica River	TKO Kosovčica River	KRK municipal wastewater outlet	TBU Butišnica River	KBL Brljan Lake
January	good	good	moderate	moderate	moderate	moderate	good
April	good	good	moderate	moderate	moderate	moderate	moderate
July		very good	moderate	moderate	moderate	moderate	moderate
October		good	moderate	moderate	moderate	good	good

IWW	January	April	July	October
pH	7.23	7.32	7.75	7.89
KPK/ Mn mg O2/L	12	3030	2770	101.7
amonia mgN/L	13.15	7.88	21	2.4
total nitrogen mgN/L	30.6	21.2	60	69
nitrate mgN/L	9.05	7.09	3.07	3.07
nitrite mgN/L	7.41	0.405	1.23	9.09
total phosphorus mgP/L	1.35	2.21	8.54	1.3
TOC mg/L	9.932	100	22.82	21.18
phenols µg/L		< 5	46,8	182
mineral oils µg/L		38177	24902	56811

January

surface waters

	pH	KPK Mn mg O ₂ /L	amonia mg N/L	nitrate mg N/L	total nitrogen mg N/L	total phosphorus mg P/L
very good	7,4-8,5	2	0,01	0,4	0,6	0,02
good	7,0-7,4 8,5-9,0	4	0,05	0,7	1	0,06

wastewaters

pH	KPK Mn mg O ₂ /L	amonia mg N/L	nitrate mg N/L	nitrite mgN/L	total nitrogen mg N/L	total phosphorus mg P/L
6,5 – 9,0	125	10	2	1	15	2

location	TKR	KRS	TOR	TKO	KRK	TBU	KBL	IWW
turbidity / FAU	1	0	9	3	10	4	1	31
temperature / °C	9	11	9	11	10.63	7	8	-
conductivity µScm-1	341	431	558	740	497	759	526	3670
TDS mg/L	170.3	215	279	370	248	379	263	1834
pH	8.37	7.29	7.91	7.92	7.77	8.12	8.09	7.23
ORP mV	106.5	-8.2	-42.5	-43.1	-34.4	-53.2	-52	-5.6
dissolved oxygen mg O ₂ /L	11.91	10.07	10.44	10.49	10.63	11.4	12.59	-
oxygen saturation O ₂ %	106.5	93.9	92.9	97.8	95.6	96.4	108.4	-
mg/L CO ₂	3.8	5.2	2.5	2.8	1.6	2.3	2.7	20.3
KPK/ Mn mg O ₂ /L	2.5	1.6	4.1	3.8	6	4.3	2.4	12
amonia mgN/L	<0,01	<0,01	0.04	0.03	0.15	0.02	<0,01	13.15
total nitrogen mgN/L	0.2	0.2	1	0.6	1.3	0.9	0.3	30.6
nitrate mgN/L	0.05	0.03	0.1	0.09	0.14	0.1	0.02	9.05
nitrite mgN/L	0.009	0.01	0.014	0.018	0.027	0.016	0.017	7.41
total phosphorus mgP/L	0.013	0.006	0.022	0.062	0.107	0.014	0.002	1.35
m- alkalinity	3.78	3.98	3.01	4.45	4.07	3.61	3.66	2.32
KT°dH	10.69	11.14	8.43	12.46	11.39	10.11	10.25	6.49
UT°dH	12.95	13.06	10.75	14.23	12.45	12	13.15	8.07
status	good	good	moderate	moderate	moderate	moderate	good	

● April

surface waters

	pH	KPK Mn mg O ₂ /L	amonia mg N/L	nitrate mg N/L	total nitrogen mg N/L	total phosphorus mg P/L
very good	7,4-8,5	2	0,01	0,4	0,6	0,02
good	7,0-7,4 8,5-9,0	4	0,05	0,7	1	0,06

wastewaters

pH	KPK Mn mg O ₂ /L	amonia mg N/L	nitrate mg N/L	nitrite mgN/L	total nitrogen mg N/L	total phosphorus mg P/L
6,5 – 9,0	125	10	2	1	15	2

	TKR	KRS	TOR	TKO	KRK	TBU	KBL	IWW
turbidity / FAU	3	0	8	3	4	3	0	2355
temperature / °C	10	10,5	13,5	13,5	10,3	11,3	12,6	-*
conductivity µScm-1	351	388	1127	1071	430	881	533	3280
TDS mg/L	175,6	193,9	564	536	215	440	266	1642
pH	8,53	7,54	7,61	7,91	7,97	8,2	7,42	7,32
ORP mV	-76,6	-22,4	-26,4	-42,9	-46,1	-59	-16,6	-6,2
dissolved oxygen mg O ₂ /L	11,6	10,39	8,62	10,98	10,62	10,62	9,77	-*
oxygen saturation O ₂ %	106,6	96,1	85,2	108,9	97,9	100,1	93,4	-*
mg/L CO ₂	2,1	4,7	2,7	2,1	31	1,1	4,34	14,01
KPK/ Mn mg O ₂ /L	0,17	0,19	11	2,11	8,83	4,6	4,84	3030
amonia mgN/L	<0,01	0,02	0,19	0,21	0,04	0,02	0,03	7,88
total nitrogen mgN/L	0,6	0,1	1,9	3,1	0,8	0,6	0,2	21,2
nitrate mgN/L	0,05	0,08	0,22	0,07	0,15	0,11	0,09	7,09
nitrite mgN/L	0,006	0,014	0,021	0,016	0,017	0,019	0,019	0,405
total phosphorus mgP/L	0,013	0,009	0,053	0,011	0,084	0,012	0,01	2,21
m- alkalinity	3,91	3,8	3,04	3,67	3,42	4,07	4,03	2,31
KT°dH	10,95	10,64	8,51	10,27	9,57	11,39	11,28	6,49
UT°dH	11,71	11,5	11,59	13	11,45	11,54	14,57	7,84
status	good	good	moderate	moderate	moderate	moderate	moderate	

July

surface waters

	pH	KPK Mn mg O ₂ /L	amonia mg N/L	nitrate mg N/L	total nitrogen mg N/L	total phosphorus mg P/L
very good	7,4-8,5	2	0,01	0,4	0,6	0,02
good	7,0-7,4 8,5-9,0	4	0,05	0,7	1	0,06

wastewaters

pH	KPK Mn mg O ₂ /L	amonia mg N/L	nitrate mg N/L	nitrite mgN/L	total nitrogen mg N/L	total phosphorus mg P/L
6,5 – 9,0	125	10	2	1	15	2

	KRS	TOR	TKO	KRK	TBU	KBL	IWW
turbidity / FAU	0	3	2	4	4	1	35
temperature / °C	10.5	18.6	20.4	14.9	15	17	-
conductivity μScm-1	451	540	1426	581	881	662	5460
TDS mg/L	226	320	731	291	440	331	2750
pH	7.58	7.48	7.29	7.92	8.2	8.28	7.75
ORP mV	-25.1	-19.4	-41.5	-43.9	-59	-64.8	-37.3
dissolved oxygen mg O ₂ /L	10.5	8.29	7.28	9.26	10.62	10.6	-
oxygen saturation O ₂ %	95.6	88.6	82.7	93.9	100.1	112	-
mg/L CO ₂	4	1.7	2	4.1	1.6	2.5	8.8
KPK/ Mn mg O ₂ /L	0.72	3.02	4.9	165.5	4.41	4.01	2770
amonia mgN/L	0.01	0.02	0.03	4.6	0.05	0.13	21
total nitrogen mgN/L	0.2	0.5	0.3	6.5	0.8	0.9	60
nitrate mgN/L	0.04	0.02	0.02	0.41	0.1	0.07	3.07
nitrite mgN/L	<0,001	0.003	0.008	0.052	0.011	0.005	1.23
total phosphorus mgP/L	0.003	0.086	0.016	0.89	0.014	0.01	8.54
m- alkalinity	3.72	3.8	4.11	5.39	3.75	3.91	2.14
KT°dH	10.42	10.64	15.21	15.09	10.05	10.95	5.99
UT°dH	15.29	14.03	11.48	18.11	13.23	14.61	8.19
status	very good	moderate	moderate	moderate	moderate	moderate	

October

surface waters

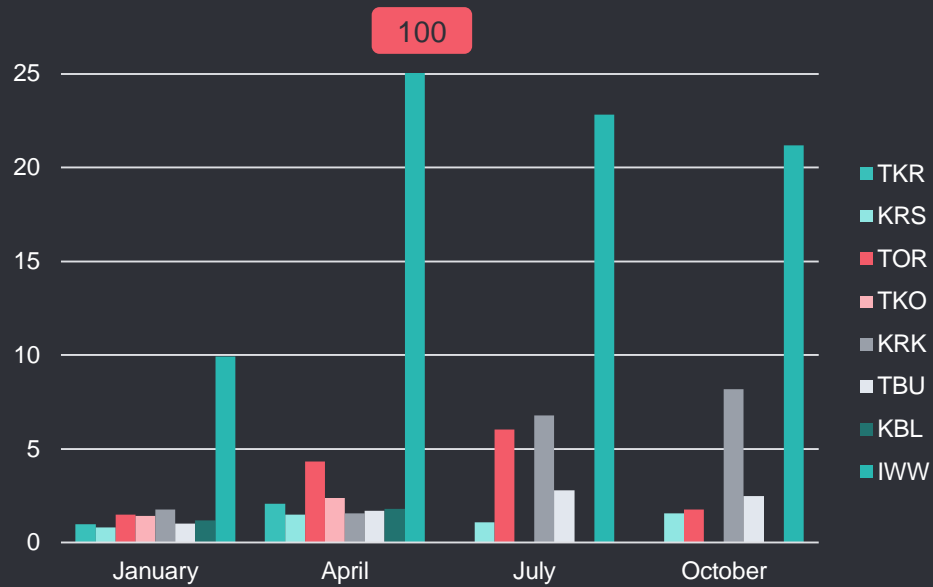
	pH	KPK Mn mg O ₂ /L	amonia mg N/L	nitrate mg N/L	total nitrogen mg N/L	total phosphorus mg P/L
very good	7,4-8,5	2	0,01	0,4	0,6	0,02
good	7,0-7,4 8,5-9,0	4	0,05	0,7	1	0,06

wastewaters

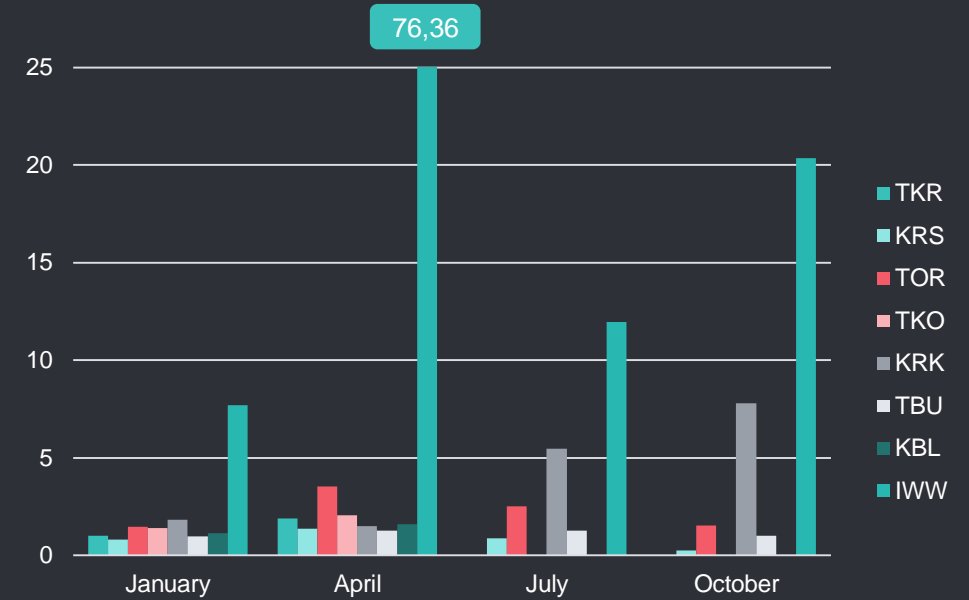
pH	KPK Mn mg O ₂ /L	amonia mg N/L	nitrate mg N/L	nitrite mgN/L	total nitrogen mg N/L	total phosphorus mg P/L
6,5 – 9,0	125	10	2	1	15	2

	KRS	TOR	TKO	KRK	TBU	KBL	IWW
turbidity / FAU	0	2	3	0	1	0	15
Temperature / °C	10	10.2	9.5	10	11.7	11.2	.*
conductivity µScm-1	435	806	1407	435	955	664	10570
TDS mg/L	216	403	704	216	478	332	5290
pH	7.51	7.54	7.93	7.51	8.1	8.3	7.89
ORP mV	-26	-28.4	-49.5	-26	-59.7	-71	-50
dissolved oxygen mg O ₂ /L	10	8.29	9.96	10	9.5	11.7	
oxygen saturation O ₂ %	103.8	88.6	88.5	103.8	88.7	108	.*
mg/L CO ₂	5.7	2	2.4	5.7	4.9	3.8	9.1
KPK/ Mn mg O ₂ /L	0.98	1.74	4.83	0.98	3.11	1.38	101.7
Amonia mgN/L	0.02	0.07	0.09	0.02	0.03	0.04	2.4
Total nitrogen mgN/L	0.3	1.8	1.2	0.3	0.8	0.7	69
Nitrate mgN/L	0.11	0.25	0.05	0.11	0.03	0.23	3.07
Nitrite mgN/L	0.008	0.028	0.008	0.008	0.009	0.007	9.09
Total phosphorus mgP/L	0.004	0.017	0.048	0.004	0.037	<0,001	1.3
m- alkalinity	3.7	3.11	4.83	3.7	4.27	4.64	2.06
KT°dH	10.36	8.71	13.52	10.36	11.76	12.99	5.77
UT°dH	11.41	12.27	15.1	11.41	13.53	14.48	6.26
status	good	moderate	moderate	good	good	good	

TOC (mg/L)



DOC (mg/L)



Regulation on limit values for wastewater emissions:

TOC 30 mg/L

phenols 100 µg/L

mineral oils 10000 µg/L

	phenols (µg/L)		
	April	July	October
IWW (NF)	< 5	46,8	182
IWW (F)	< 5	39,8	

	mineral oils (µg/L)		
	April	July	October
IWW (NF)	38177	24902	56811
TOR (NF)	56,7	380	540
KRK (NF)	< 5	1863	1787
IWW (F)	34348,8	23469	
TOR (F)	< 5	<5	
KRK (F)	< 5	408	

● Conclusion

- water quality was more site than season dependent, especially at wastewater impacted sites which reflected discharge peaks
- in all seasons poor ecological status for IWW and moderate for KRK and TOR
- compared to KRS, poorer values of some physico-chemical water parameters recorded at TBU and TKO, as a result of agricultural and industrial activity



- Thank you!