

# Assessment of water quality indicators in the Orla River nitrate vulnerable zone in the context of new threats in Poland

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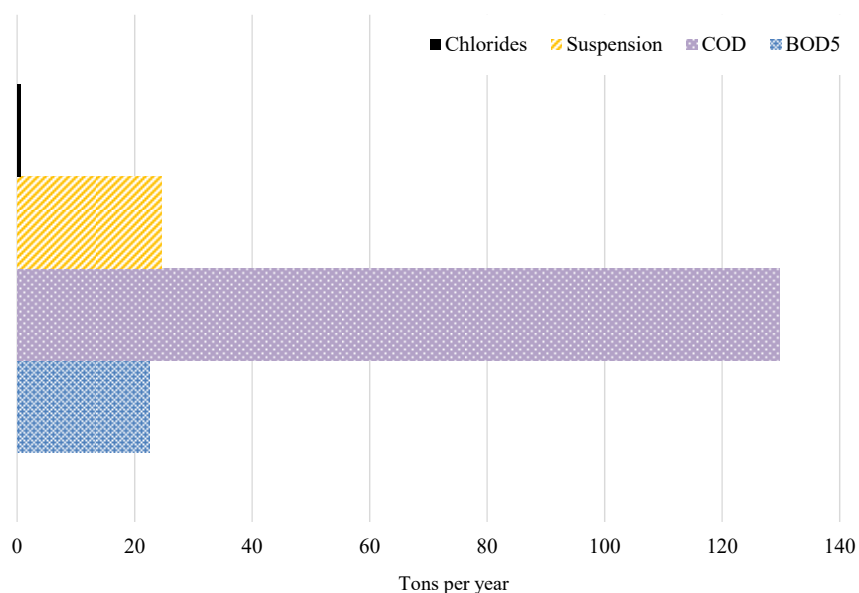
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**Table S1.** Flows from the multiannual period from 1981 to 2010 (1) and specific flows in moderately dry years (2) at the Korzeńsko gauge cross-section

No.	Catchment area [km <sup>2</sup> ]	Flows*			
		QN* [m <sup>3</sup> ·s <sup>-1</sup> ]	NNQ [m <sup>3</sup> ·s <sup>-1</sup> ]	SNQ [m <sup>3</sup> ·s <sup>-1</sup> ]	SSQ [m <sup>3</sup> ·s <sup>-1</sup> ]
1	1224.77	0.24	0.06	0.32	4.46
2		0.13	0.07	0.16	1.43

\*QN, inviolable flow determined using the simplified method of Kostrzewa [42] according to the hydrobiological criterion; NNQ, the lowest annual flows in the multiannual period; SNQ, mean low annual flows in the multiannual period; SSQ, mean flows in the multiannual period



**Figure S1.** Selected pollutant loads carried with the discharge of treated water from treatment plants located in the Orla River catchment

**Table S2.** Correlation coefficients of the studied physicochemical parameters and the area of livestock buildings in selected buffers

Parameter	Building area		Phosphorus content in soil	Potassium content in soil
	[1 km buffer]	[3 km buffer]		
pH	-0.747	-0.703	0.056	0.127
Temperature	-0.334	-0.324	0.205	0.117
Conductivity (EC)	0.036	0.160	-0.513	-0.158
Phosphates (SRP)	0.564	0.107	-0.427	-0.328
Total phosphorus (TP)	0.644	0.310	-0.383	-0.407
Nitrite nitrogen	0.486	0.351	-0.365	0.040
Nitrate nitrogen	-0.446	0.264	-0.188	0.408
Ammonium nitrogen	0.573	-0.249	-0.318	-0.276
Organic nitrogen	0.768	0.409	-0.205	-0.238
Total nitrogen (TN)	0.716	0.487	-0.270	-0.221
Potassium	-0.233	0.474	-0.291	-0.394
Calcium	-0.007	-0.179	-0.512	-0.121
Dissolved oxygen (DO)	-0.507	0.447	0.255	0.066

**Table S3.** Correlation coefficients of the studied physicochemical parameters during seasons and the area of livestock buildings within the 1 km buffer

Parameter	Spring	Summer	Autumn	Winter
	Area of building [1 km buffer zone]			
pH	-0.635	-0.207	-0.541	-0.686
Temperature	-0.634	-0.138	-0.091	0.097
Conductivity (EC)	0.332	-0.143	-0.187	0.313
Phosphates (SRP)	-0.106	0.513	0.905	0.318
Total phosphorus (TP)	0.141	0.536	0.913	0.311
Nitrite nitrogen	-0.165	-0.325	-0.044	0.949
Nitrate nitrogen	-0.111	-0.223	-0.481	-0.219
Ammonium nitrogen	0.197	0.304	0.837	0.735
Organic nitrogen	0.032	0.132	0.810	0.981
Total nitrogen (TN)	0.077	0.417	0.917	0.895
Potassium	-0.204	-0.337	-0.136	-0.055
Calcium	-0.245	-0.064	0.059	0.248
Dissolved oxygen (DO)	-0.312	-0.260	-0.497	-0.760

**Table S4.** Correlation coefficients of the studied physicochemical parameters during seasons and the area of livestock buildings within the 3 km buffer

Parameter	Spring	Summer	Autumn	Winter
	Area of building [3 km buffer zone]			
pH	-0.702	-0.090	-0.485	-0.681
Temperature	-0.448	-0.096	-0.054	-0.282
Conductivity	0.576	-0.108	0.055	0.251
Phosphates (SRP)	-0.219	0.253	0.680	0.176
Total phosphorus (TP)	-0.010	0.242	0.646	0.169
Nitrite nitrogen	-0.150	-0.222	-0.122	0.611
Nitrate nitrogen	-0.118	-0.287	-0.410	0.132
Ammonium nitrogen	0.079	0.156	0.732	0.551
Organic nitrogen	-0.030	-0.013	0.738	0.611
Total nitrogen (TN)	-0.008	0.194	0.734	0.628
Potassium	-0.259	-0.315	0.131	-0.230
Calcium	0.140	0.140	0.573	0.627
Dissolved oxygen (DO)	-0.432	0.118	-0.494	-0.391

**Table S5.** Mahalanobis distances between monitoring points.

O2	3.33																		
O3	11.70	7.16																	
O4	7.41	5.37	1.74																
O5	9.87	5.70	1.83	1.33															
O6	4.69	4.82	7.47	5.28	6.48														
R	7.97	6.21	4.51	3.83	5.72	7.46													
ZP	2.87	5.49	6.97	4.19	5.66	6.46	4.97												
O7	1.36	3.19	6.92	3.98	5.64	2.28	5.14	1.90											
O8	3.54	8.07	11.31	7.95	10.11	7.82	10.13	2.50	3.55										
O9	3.49	8.25	13.20	9.38	11.72	7.91	10.86	2.94	3.58	0.37									
SZ	5.30	6.59	9.22	7.30	9.68	10.00	8.92	3.70	5.54	2.33	3.25								
D	4.26	7.51	9.30	7.59	9.89	5.54	3.78	3.46	2.63	6.39	6.38	8.36							
M	1.98	5.04	10.24	5.98	8.87	7.17	6.46	1.92	2.44	3.73	4.12	3.13	4.35						
O10	3.79	8.36	10.81	8.10	10.87	7.15	10.44	3.23	3.57	0.72	1.04	2.67	6.24	4.11					
O11	5.11	8.59	14.19	11.00	12.89	9.95	13.36	4.99	5.87	0.89	1.05	1.96	9.90	5.42	1.61				
ZS	13.32	11.82	14.99	13.85	13.68	14.11	14.64	11.27	12.43	12.01	13.21	8.38	17.36	11.16	12.36	10.15			
	O1	O2	O3	O4	O5	O6	R	ZP	O7	O8	O9	SZ	D	M	O10	O11			

**Table S6.** Differences in physicochemical parameters between the mean value of the studied year and the general mean.

Year	pH	Temp	EC	Alk	SRP	TP	Nitrite	Nitrate	Ammo	TN	K	Ca	DO
2011	0.141	1.416	-0.015	-27.84	-0.488	-0.614	0.045	0.768	-1.038	-1.545	-3.783	-0.373	0.171
2012	0.108	-0.417	-0.088	26.36	1.241	1.437	-0.033	-0.732	1.960	5.580	1.884	-1.197	0.038
2014	-0.248	-0.999	0.102	1.48	-0.754	-0.823	-0.013	-0.035	-0.922	-4.035	1.899	1.570	-0.209

**Table S7.** Differences in physicochemical parameters between the mean value for the season of the year and the overall mean.

<b>Season of the year</b>	<b>pH</b>	<b>Temp</b>	<b>EC</b>	<b>Alk</b>	<b>SRP</b>	<b>TP</b>	<b>Nitrite</b>	<b>Nitrate</b>	<b>Ammo</b>	<b>TN</b>	<b>K</b>	<b>Ca</b>	<b>DO</b>
summer	0.127	9.135	0.011	9.07	2.276	2.337	-0.027	-2.060	1.977	3.586	3.896	-22.72	-0.758
autumn	-0.050	-3.438	0.107	30.93	-0.265	-0.368	-0.033	-0.437	0.200	1.614	5.455	9.383	-0.291
winter	-0.157	-9.654	0.061	-40.71	-1.479	-1.238	-0.032	1.874	-1.206	-2.412	-4.810	12.60	0.541
spring	0.080	3.957	-0.179	0.71	-0.532	-0.731	0.092	0.622	-0.970	-2.788	-4.542	0.742	0.509