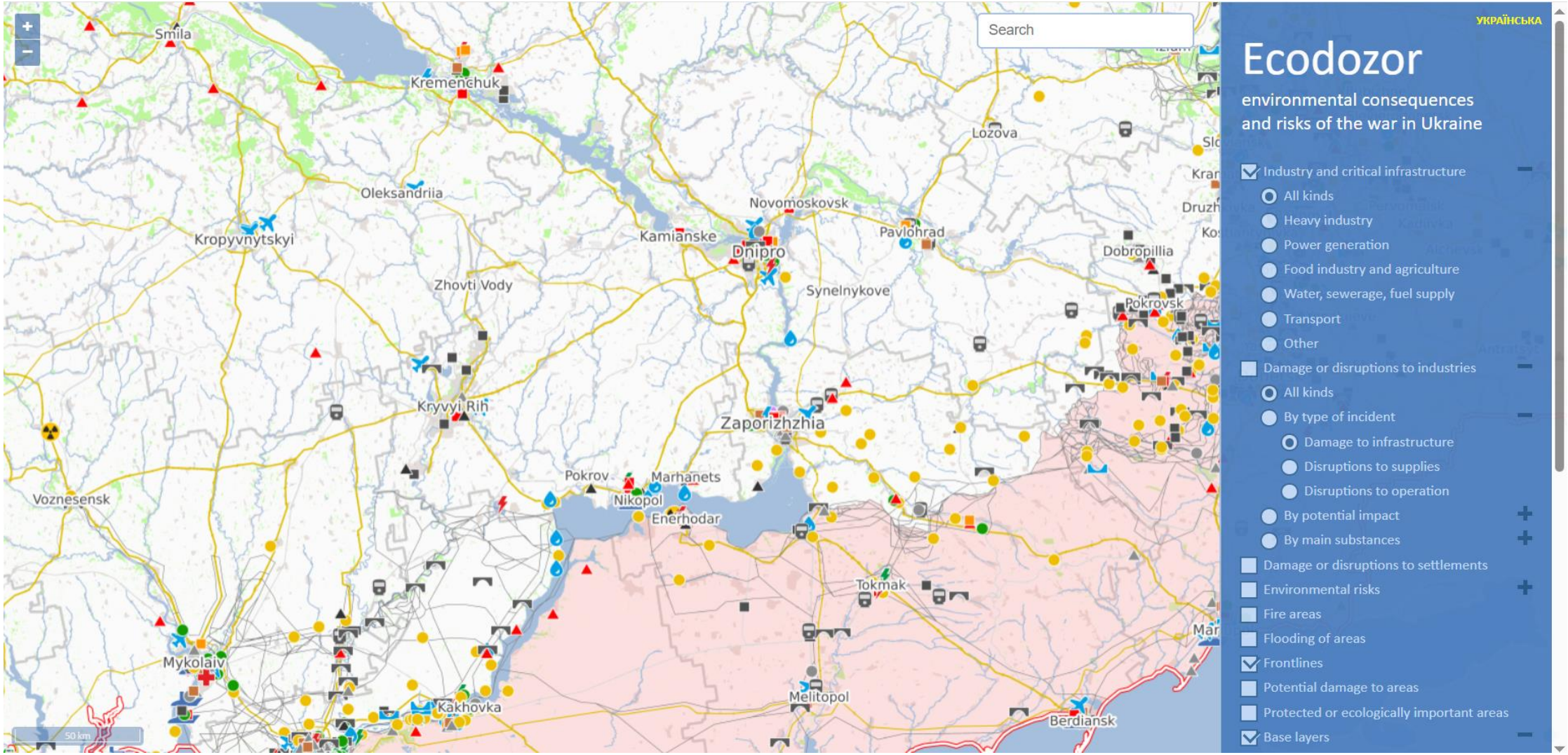
War-related impacts on water resources as an additional challenge towards European standards: selected communities of the Lower Dnipro region

Iryna Babanina,

Researcher, the Conflict and Environment Observatory

Concentration of industrial and infrastructure damage incidents around the assessed area



Source: [Ecodozor]

Major water infrastructure challenges

- The destruction of the Kakhovka Reservoir – the largest man-made disaster with long-term economic, humanitarian, hydrological and climate (Pichura et al., 2024) impacts that will develop for many years and only a fraction of them is assessed so far;

- The disaster required large-scale emergency efforts such as massive re-routing of water from other sources in the region naturally prone to medium-high water stress (WRI);

- Damage to Karachunivske Reservoir dam disrupted the complicated management of Inhulets river for some time;

- Immense investments will be needed to just keep the infrastructure functioning, and upgrade to meet the European requirements, such as WFD and DWD, is very problematic.

Water monitoring in the context of war threats

- State Water Agency MPC (maximum permissible concentrations) map – updated infrequently;
- Basin authority monitoring schedule -12 times per year;
- Many points are inaccessible for safety reasons;
- EcoZagroza water map – no archive data;
- State statistical data, regional environmental reports;
- Ad hoc data from the State Environmental Inspectorate, CPHs may be obtained;
- State Geological Survey data (groundwater) is closed and the status of hydrogeological monitoring activities is unclear;
- Humanitarian providers data – “fresh” data, but limited access/availability;
- NGO data can cover basic water safety studies.

Lower Dnipro basin authority open data analysis 2023 to 2024

- Open data on MPC excess for heavy metals, PAHs, and biogenic indicators;
- Data over February 2023 – March 2024 analyzed;
- Limitations:
  - No consistency – the number of monitoring points increased over the year;
  - No long-term data available;
  - Tracking only excessive concentrations does not allow to detect trends;
  - Only highest values (“anomalies”) visualized for some pollutants and points.

Lower Dnipro basin authority open data analysis 2023 to 2024

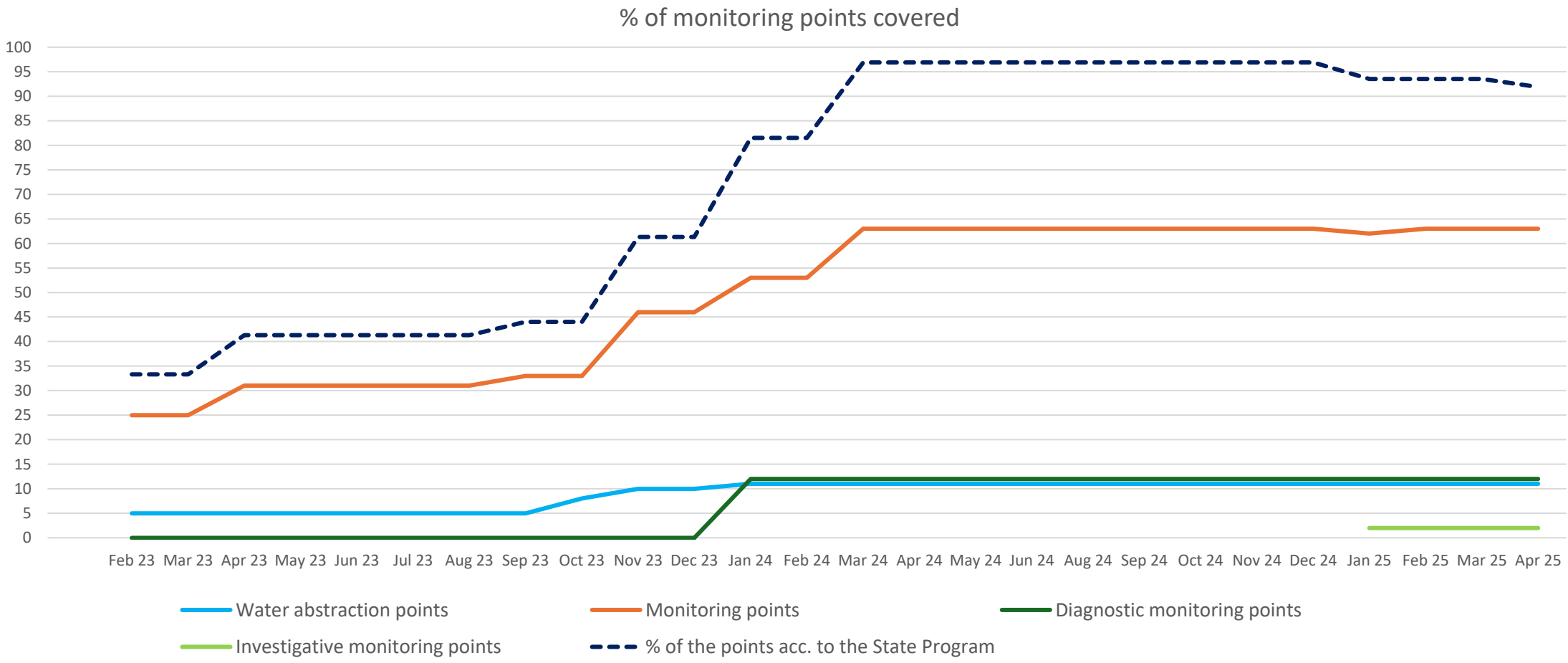
MPCs for basic analyzed pollutants:

- Hg – 0.07 mcg/dm3;
- Cd – 1.5 mcg/dm3;
- Co – 0.005 mg/dm3;
- Cr – 0.001 mg/dm3;
- Cu – 0.001 mg/dm3;
- Zn – 0.01 mg/dm3;
- Pb – 14 mcg/dm3;
- Mn – 0.01 mg/dm3.

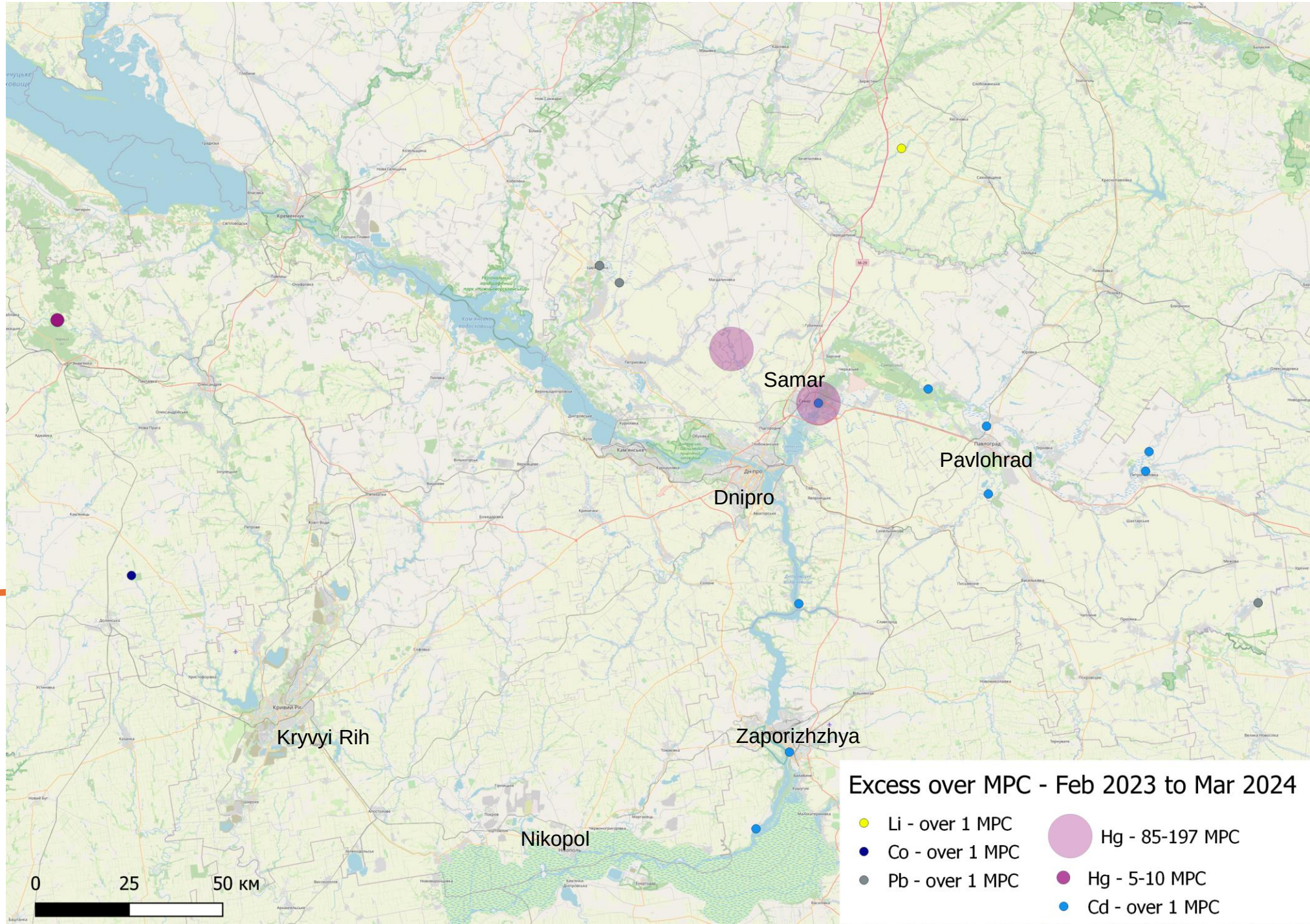
Occasional excess of PAHs (anthracene, fluoranthene, benzo(g,h,i)perylene and pesticides.

Certain other metals, chemicals, medications detected within applicable environmental standards.

Lower Dnipro monitoring points



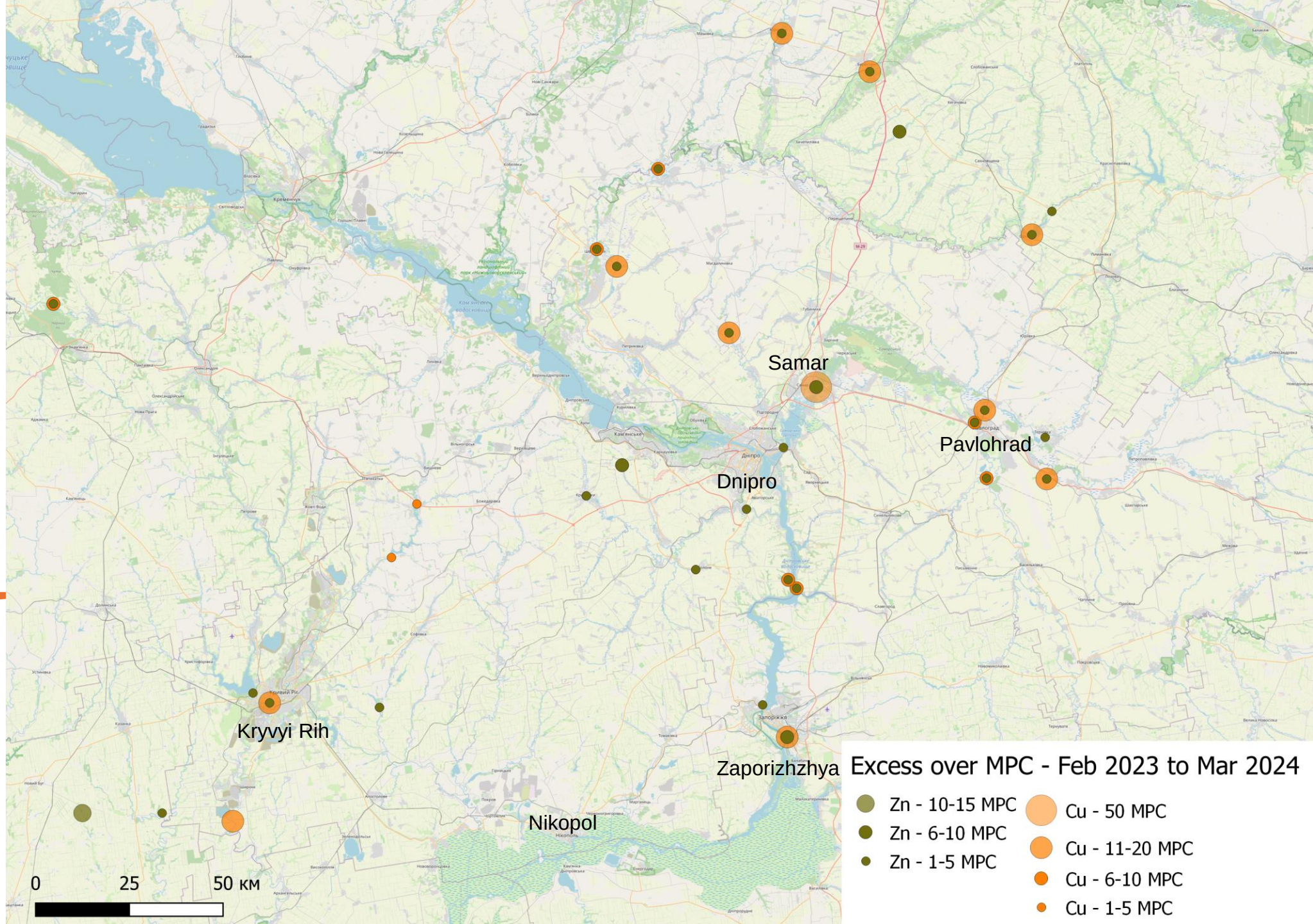
Hg, Cd, Li, Co, Pb


Samar
Pavlohrad
Dnipro
Kryvyi Rih
Zaporizhzhya
Nikopol
0
25
50 км
Excess over MPC - Feb 2023 to Mar 2024
Li - over 1 MPC
Co - over 1 MPC
Pb - over 1 MPC
Hg - 85-197 MPC
Hg - 5-10 MPC
Cd - over 1 MPC

Lower Dnipro basin authority open data analysis 2023 to 2024

- Sporadic excesses of Cd recorded across multiple points in Feb 2023, Nov 2023, Jan 2024 and March 2024;
- High excess values of Hg detected in February and July 2023 in Kilchen river, in June 2023 – in Kaidakskyi and Lomovskyi water abstraction points (0.76 mcg/dm3 and 0.38 mcg/dm3). In July 2023, very high values were detected in Samara river, Samar city (13.8 mcg/dm3), in August 2023 – high levels in the same points in Samara and Kilchen rivers. Both rivers are known to suffer from severe industrial and household pollution long before the full-scale war, but such anomalies may indicate an accident or untreated industrial wastewater discharge, and high Hg contents in drinking water abstraction points are of special concern.

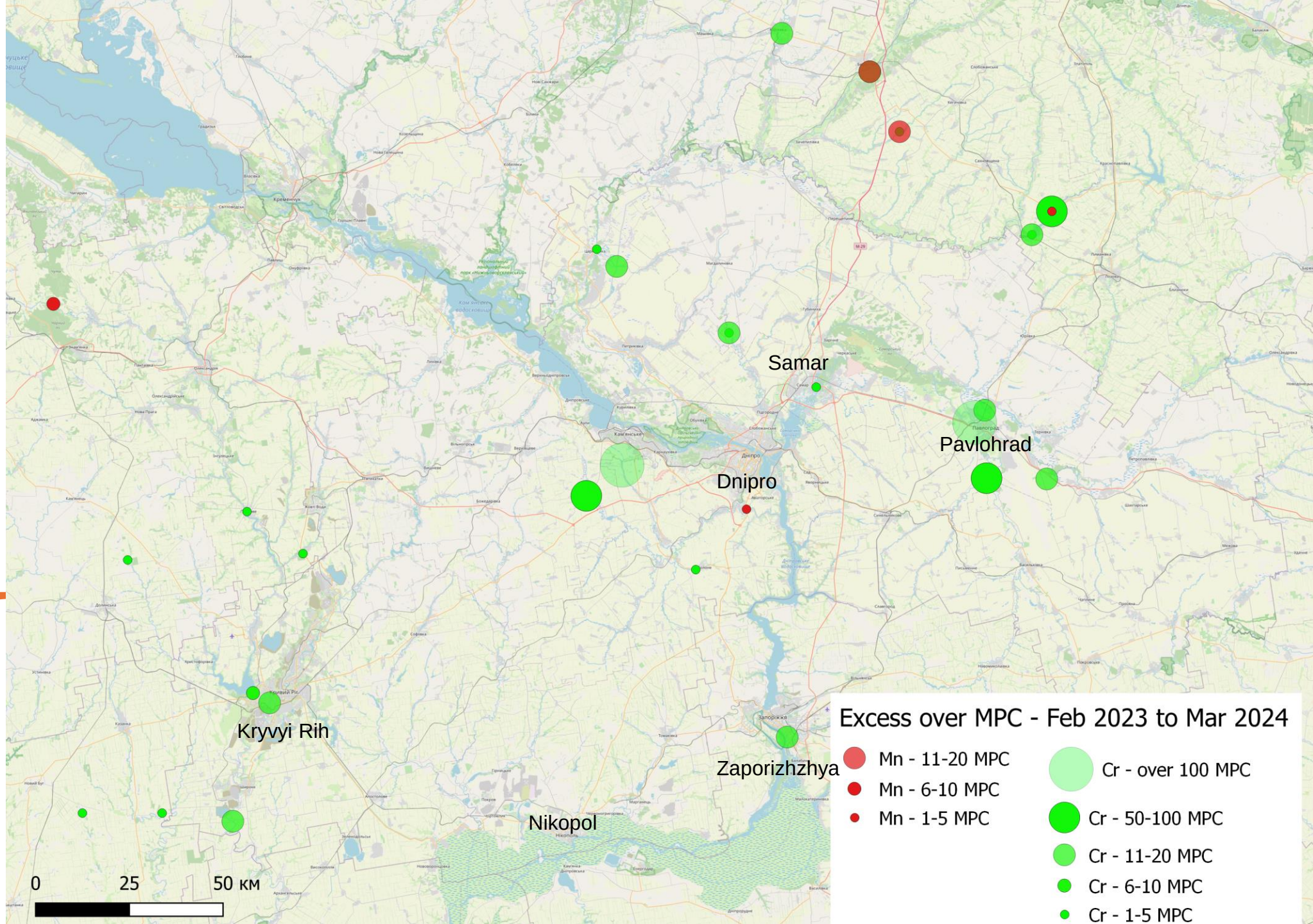
Cu, Zn


Samar
Pavlohrad
Dnipro
Kryvyi Rih
Zaporizhzhya
Nikopol
0
25
50 км
Excess over MPC - Feb 2023 to Mar 2024
Zn - 10-15 MPC
Zn - 6-10 MPC
Zn - 1-5 MPC
Cu - 50 MPC
Cu - 11-20 MPC
Cu - 6-10 MPC
Cu - 1-5 MPC

Lower Dnipro basin authority open data analysis 2023 to 2024

- The Cu and Zn excess concentrations in drinking water are clearly pinpointed to the large industrial centers. Excessive values of Zn can be attributed to industrial and diffuse pollution, or, for relatively low and frequently found values, to natural content. Excess copper content in the drinking water abstraction points can be of concern.

Cr, Mn


Samar
Pavlohrad
Dnipro
Kryvyi Rih
Zaporizhzhya
Nikopol
0
25
50 км
Excess over MPC - Feb 2023 to Mar 2024
Mn - 11-20 MPC
Mn - 6-10 MPC
Mn - 1-5 MPC
Cr - over 100 MPC
Cr - 50-100 MPC
Cr - 11-20 MPC
Cr - 6-10 MPC
Cr - 1-5 MPC

Lower Dnipro basin authority open data analysis 2023 to 2024

- Cr and Mn excess values are mostly concentrated around large industrial centers. While Mn is a routine substance for water testing and is quite easily removed by water treatment systems.

- Overall, while development of RBMPs and the state surface water monitoring programs, especially the 2025 update to the programs introducing investigative monitoring in specifically affected points (e.g. on Seim river to address transboundary pollution threats from Russia and on Inhulets river in Darivka to monitor complex pressures related to mining effluent threats and water use), the monitoring system is still insufficient in frequency and coverage.

Compounded pressures on water resources in the conflict-affected communities of Lower Dnipro area:

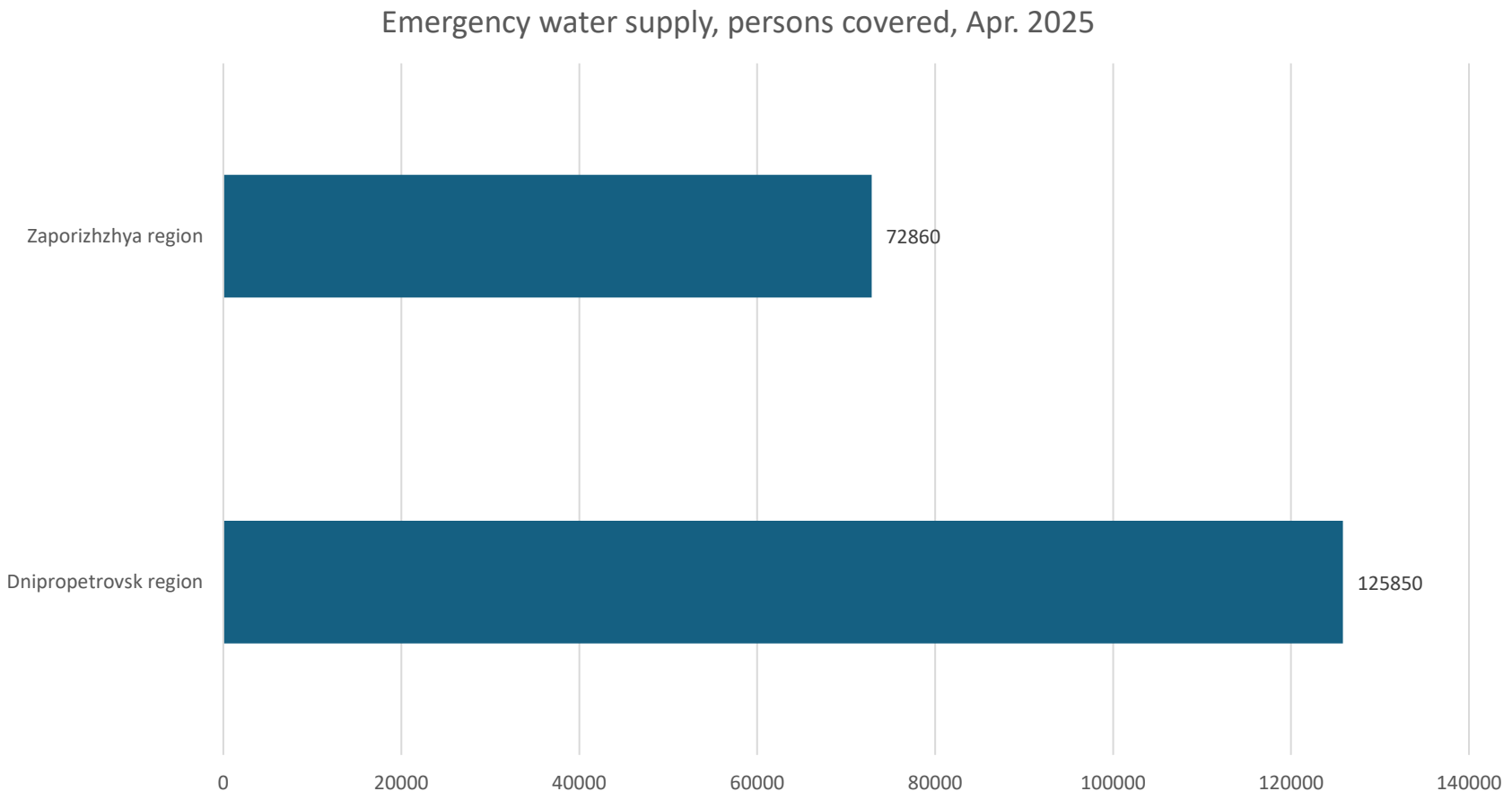
- Pollution:
  - Poor treatment;
  - Emergency dumps and accidents;
  - Legacy pollution;
  - Wastewater;
  - Tailings.
- Over-exploitation:
  - Redirecting surface water;
  - Emergency boreholes.

Unknown dumping pipe in Zaporizhzhia which became visible after the Dnipro level receded

Groundwater pressures

- Simplified procedure for borehole drilling (Regulations on experimental water supply project in Dnipropetrovsk, Kherson, Zaporizhzhya, Mykolaiv and Kharkiv regions);
- Lack of proper accounting for groundwater use;
- Vulnerability of unconfined aquifers (N. Lyuta, I. Sanina, 2022);
- Emergency borehole needs;
- Unsustainable use of artesian water (e.g. to replace irrigation previously provided from surface water bodies)
- Rechange issues (climate change; loss of hydraulic impact of Kakhovka reservoir in adjacent communities).

Humanitarian needs in water supply



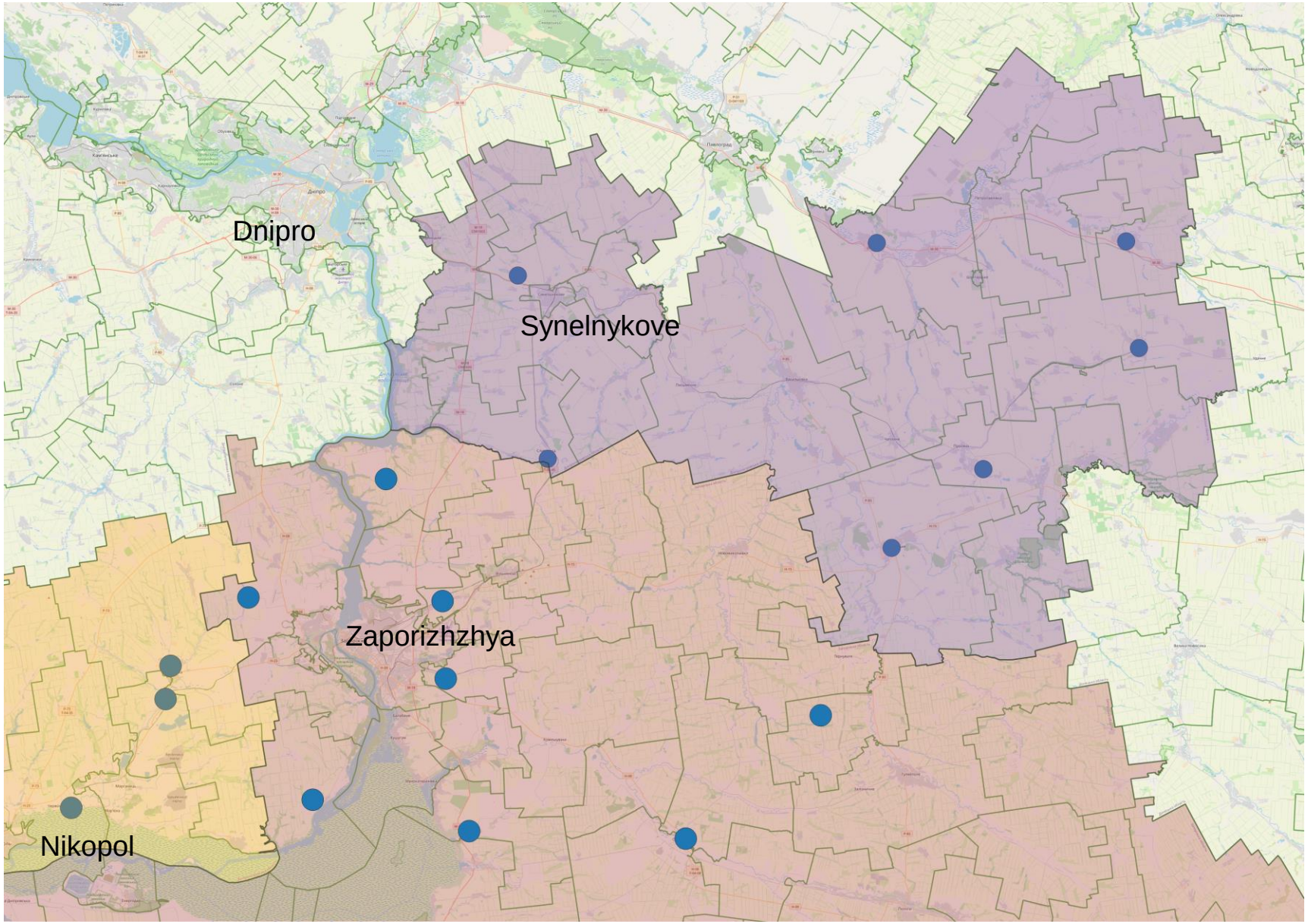
Source: UNICEF WASH Cluster data

Communities with urgent needs for boreholes - 2025

No data on the total number of boreholes drilled to date and on the volume of abstraction is available.

Humanitarian providers usually have basic quality test datasets, though these are not openly accessible.

Communities often do not know if there are unused boreholes, what is their condition and if they were properly sealed – contamination risks.



Source: UNICEF WASH Cluster data

Key issues with water quality from alternative sources - boreholes

	Standard	Dnipro	Kryvyi Rih	Zaporizhzhya	Apostolove	Nikopol	Pavlohrad	Synelnykove	Samar
No. of samples		*336*	*36*	*23*	*2*	*5*	*28*	*6*	*113*
Dry residue, mg/dm3	≤1000	1696,00	2540,00	1815,00	2660,00	1767,00	1724,00	1892,00	3309,00
Total hardness, mmol/dm3	≤7	14,50	26,78	16,44	29,60	19,31	12,77	17,54	23,17
Total iron content, mg/dm3	≤0,2	0,97	1,41	1,90	0,41	0,24	0,94	0,30	1,34
No. of samples		*295*	*21*	*14*	*1*	*3*	*21*	*5*	*102*
Manganese, mg/dm3	≤0,05	0,44	0,27	0,50	0,31	1,63	0,10	0,03	0,8
No. of samples		*257*	*18*	*14*	*1*	*3*	*18*	*3*	*96*
Chlorides, mg/dm3	≤250	279,00	685,00	208,00	127,00	113,50	339,00	204,00	911,00
No. of samples		*329*	*28*	*23*	*2*	*5*	*28*	*6*	*96*
Nitrates, mg/dm3	≤50	37,87	34,43	52,22	62,50	51,60	10,80	103,80	31,71

Source: WaterNet analytical database aggregated data

Key issues with water quality from alternative sources – shallow wells

	Standard	Dnipro	Kryvyi Rih	Zaporizhzhya	Apostolove	Nikopol	Pavlohrad	Synelnykove	Samar
No. of samples		*26*	*3*	*4*	*1*	*1*	*n/a*	*n/a*	*3*
Dry residue, mg/dm3	≤1000	1716,00	3166,00	875,00	3260,00	422,00	*n/a*	*n/a*	2083,00
Total hardness, mmol/dm3	≤7	17,32	26,47	10,23	30,40	4,90	*n/a*	*n/a*	24,53
Total iron content, mg/dm3	≤0,2	0,06	0,07	2,04	0,03	0,03	*n/a*	*n/a*	0,19
No. of samples		*15*	*1*	*1*	*1*	*1*	*n/a*	*n/a*	*1*
Manganese, mg/dm3	≤0,05	0,12	0,01	2,07	0,01	0,01	*n/a*	*n/a*	1
No. of samples		*13*	*1*	*1*	*1*	*1*	*n/a*	*n/a*	*3*
Chlorides, mg/dm3	≤250	186,00	103,00	103,00	398,00	99,00	*n/a*	*n/a*	284,00
No. of samples		*26*	*3*	*4*	*1*	*1*	*n/a*	*n/a*	*3*
Nitrates, mg/dm3	≤50	100,00	90,40	60,75	71,00	30,00	*n/a*	*n/a*	225

Source: WaterNet analytical database aggregated data

Conclusions

- The war damage to the water infrastructure is unprecedented and only a fraction of it has been assessed so far;
- State monitoring capacities are being gradually harmonized with the European requirements overall, but may be insufficient to respond to sudden wartime threats or incidents;
- Emergency and temporary solutions may not be sustainable in the long run;
- Addressing industrial and legacy pollution is de-prioritized because of resources and urgency of other problems;
- Regulations had been relaxed (groundwater, drinking water sanitary rules) to accelerate response.
- Immense resources are needed to provide basic water supply in many locations, and achieving the Directive (EU) 2020/2184 on the quality of water intended for human consumption is even more challenging.