

# Water quality studies in the Odra River at the level of Szczecin before, after and during the passage of the flood wave in 2024

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## ABSTRACT

This article examines the water quality of the Odra River near Szczecin before, during, and after the 2024 flood wave caused by the Boris low-pressure system. Data from the Chief Inspectorate for Environmental Protection and independent measurements taken during the flood were compared. Before the flood, the river faced significant ecological challenges, including the presence of “golden algae” (*Prymnesium parvum*) and hypoxia. In several monitoring stations, approximately 40% of dissolved oxygen (DO) measurements were below 3 mg/l, a critical level for fish survival. The overall water status was classified as “below good” (within the meaning of Polish regulations) mostly due to high salinity. The passage of the flood wave reached its qualitative peak on October 1, showing a sharp increase in turbidity, total suspended solids (TSS), and dissolved organic carbon (DOC). Simultaneously, the immense volume of water caused a dilution effect, leading to a temporary drop in conductivity and chloride concentrations to levels significantly lower than annual averages. The study emphasizes that while southern reservoirs and German polders prevented major flooding in the lower Odra, the ecosystem remains vulnerable. The Międzyodrze wetlands seems essential natural filters and polders that are crucial for future flood management and water quality improvement.

**Keywords:** flood, water quality, Odra River.

## INTRODUCTION

The most vulnerable to the effects of anthropogenic pressure are the aquatic ecosystems located in the depressions of the land, thus accumulating negative impacts from the entire catchment area (Zalewski, 2020). An example of this is the Odra River, which is approximately 841 km long with 86.4% of its basin area located in Poland (Hydro IMGW, 2024). The lower Odra collects water from roughly one-third of Poland’s land area, making it highly susceptible to contamination and other forms of human impact. The discharge of polluted water and wastewater from urban and industrial areas poses a significant threat to the river’s water quality. Many large cities, including Wrocław, Opole, Zielona Góra, and Szczecin, are located along its banks, and studies (Osibanjo et al., 2011; Tuan Anh et al., 2023; Uddin et al., 2014) showed that urban land use significantly affects water quality. The proximity of residential

areas correlates with lower dissolved oxygen (DO) levels, higher conductivity, total suspended solids (TSS), increased biological oxygen demand (BOD) and chemical oxygen demand (COD), as well as elevated levels of nitrogen and phosphorus compounds (Tuan Anh et al., 2023). Furthermore, industrial discharges have been shown to clearly influence water quality (Osibanjo et al., 2011), leading to exceedances in levels of COD, nitrate, ammonia, sulfate, calcium, and chloride (Uddin et al., 2014). Water quality depends mostly on the water and sewage management in the catchment (Wiatkowski et al., 2012).

These human-induced pressures lead to severe consequences for the river’s ecosystem, including eutrophication and hypoxia. Eutrophication, driven by excessive nutrient loading from sewage and agriculture, is a primary cause of harmful algal blooms, particularly those of cyanobacteria (O’Neil et al., 2012). A broad study by Kobos et al. found cyanotoxins in 75% of the freshwater

bodies examined in Poland (Kobos et al., 2013). Hypoxia, or low oxygen levels, is most prevalent in the streams that collect water from urban areas (Błaszczak et al., 2022; O’Neil et al., 2012).

Flooding is the most frequent global natural hazard, causing widespread loss of life and property each year (Willner et al., n.d.). Increasingly extreme storms and continuous urbanization are making flood management more challenging (Kuang and Liao, 2020). Climate change intensifies the frequency and severity of flooding events (Kvočka et al., 2016; Tingsanchali, 2012). The 2024 flood in Poland, for instance, was preceded by an “extremely warm” September (Biuletyn Państwowej Służby Hydrologiczno-Meteorologicznej, 2024). The compiled data consistently indicates that climate change and extreme weather phenomena lead to a rise in water temperature, salinity, suspended solids, and algal blooms, while also impacting the DO levels (van Vliet et al., 2023).

## FLOOD IN POLAND – SEPTEMBER 2024

A low-pressure system named Boris brought heavy rain to central Europe between 11 and 15 September, causing widespread flooding across Poland, the Czech Republic, Slovakia, Austria and Romania (European Union, n.d.). In Poland, daily precipitation reached 218 mm on Śnieżnik mountain on September 14<sup>th</sup>, 2024 (Report on the review and update of the preliminary flood risk assessment in the 3rd planning cycle – Attachment 7 – flooding in September 2024, 2025). On this station 453 mm of rainfall was observed from September 12<sup>th</sup> to 15<sup>th</sup> (Institute of Meteorology and Water Management – National Research Institute, 2025). This rainfall caused significant water level increases, with rivers in the Odra basin exceeding their alarm levels. On September 16<sup>th</sup>, 81 instances of rivers exceeding their alarm levels were recorded. The highest exceedance was noted on September 17<sup>th</sup> at the Krzyżanowice station, where the water level was 454 cm above the alarm level (Report on the review and update of the preliminary flood risk assessment in the 3rd planning cycle, 2025). In response to the scale of the event, a state of natural disaster was declared on September 16<sup>th</sup> (Regulation of the Council of Ministers, 2024).

The flood resulted in extensive damage, with total reported expenses and losses to the European Commission reaching 13 billion PLN (Report

on the review and update of the preliminary flood risk assessment in the 3rd planning cycle, 2025). Key impacts of the flood (Report on the review and update of the preliminary flood risk assessment in the 3rd planning cycle, 2025):

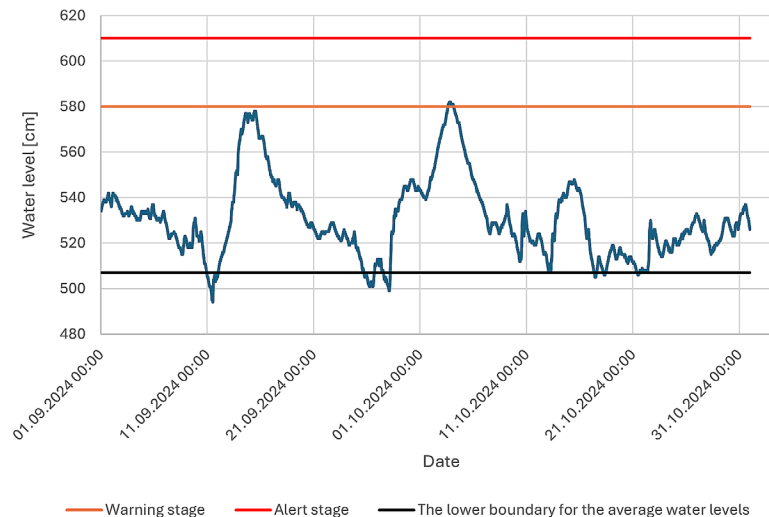
- Fatalities and displaced persons: The event resulted in 9 fatalities and affected over 238,045 people.
- Infrastructure damage: The flood destroyed 229 bridges and damaged 3633 km of roads. 10,522 residential buildings were flooded.
- Environmental and utility impacts: The flood affected 155 wastewater treatment plants, 165 water treatment plants, and water intakes. Additionally, 10 protected areas, such as nature reserves, were impacted.

The scale of the 2024 flood was comparable to the “Millennium Flood” of 1997, a major event that affected Poland (Rajca, 2024). According to flood risk maps, the frequency of such an event is estimated to be once every 100–500 years (Report on the review and update of the preliminary flood risk assessment in the 3rd planning cycle, 2025).

The peak of the flood wave reached Szczecin on October 3<sup>rd</sup>, where the river flows into Lake Dąbie and the Szczecin Lagoon. Despite the immense scale of the flood upstream, no significant flooding incidents occurred in the lower part of the river. This was due to several factors: the operation of retention reservoirs in the south and the intentional flooding of polders in the German Lower Odra National Park (Figure 2).

While alarm levels were exceeded in many towns within the West Pomeranian Province, only warning stages were observed in Szczecin. Figure 1 illustrates the water levels at a gauge south of Szczecin in September and October 2024, showing that the flood peak remained below the alarm level. Interestingly, a higher water level of 620 mm (Institute of Meteorology and Water Management – National Research Institute, 2025), which exceeded alarm stages, was observed on January 11<sup>th</sup>, 2025. This event was not caused by river flooding but by backwater from the Baltic Sea, driven by a strong north wind.

The study focused on assessing the water quality of the Odra River’s during a flood wave. By comparing these findings with the data from before and after the flood, the study determined the environmental impact of such extreme hydrological events.



**Figure 1.** Water level during the passage of flood wave in water gauge in Podjuchy (south of Szczecin).  
Source: own work base on (Hydro IMGW, 2024)



**Figure 2.** The flooded polders of the German Lower Odra National Park.  
(Author: Andrzej Kraśnicki, source: [www.wyborcza.pl](http://www.wyborcza.pl))

## MATERIALS AND METHODS

In the study two types of data are analyzed. Firstly – the data collected by Chief Inspectorate for Environmental Protection (CIEP). Secondly, own data collected during the passage of flood wave.

### Data from CIEP

In 2022, the Odra River suffered an ecological catastrophe caused by an extensive bloom of the algae *Prymnesium parvum*. After the algae died, they released prymnesin toxins into the water, resulting in the massive death of fish and mollusks (The final report of the Odra River situation team, 2023).

Since the catastrophe, more studies have been conducted to evaluate the river's condition and understand the causes of the disaster.

These studies and measurements are intended to accelerate the response to any future signs of a similar event. Another aim of the monitoring is to evaluate its ecological and chemical condition (Adamczyk and Jamry, 2025) according to European Water Directive 2000/60/EC (Eur-Lex, 2000). CIEP initiated two types of monitoring – intervention monitoring and pilot monitoring in continuous mode.

The Intervention monitoring (Procedure monitoring intervention *Prymnesium parvum* ‘golden alium’, 2025) was established at five locations, two of which were near Szczecin. These measurements specifically targeted the golden algae (*Prymnesium parvum*).

- Odra River in Widuchowa. Monitoring began on November 13<sup>th</sup>, 2023 with frequency of approximately once a week.

- Dąbie Lake in the Odra estuary. Monitoring started on July 1<sup>st</sup>, 2024, with a similar frequency.

In both locations, measurements were stopped because of the flood in September 2024.

The pilot monitoring (Chief Inspectorate for Environmental Protection, n.d.), provided continuous data from 32 stations along the Odra River, with four stations located near Szczecin. This system measured temperature, DO, conductivity, and pH on an hourly basis. It operated for about six months until September 17<sup>th</sup>, 2024, when it was also stopped due to the approaching flood wave. This monitoring system was not re-established after the flood.

Locations of measurement stations and sampling points are presented in Figure 3.

### Independent measurement campaign

Sampling was conducted from September 23<sup>rd</sup> to October 11<sup>th</sup>, with samples collected every other day, except for a break on October 5<sup>th</sup>. Instantaneous water samples were taken from four locations, specifically on shore near bridge abutments. This sampling location (Figure 4) was chosen because the reinforced banks, deeper

water, and higher velocity lead to better water mixing, which provides more reliable and representative samples. The other reason was due to a ban on the use of floating craft during the flood wave passage. On-site measurements included temperature, DO (concentration and saturation), conductivity, and pH. For turbidity, chloride, TSS and DOC analysis, samples were collected in 1 L plastic bottles and transported to the laboratory. They were refrigerated at 4 °C and processed within seven days. The specific probes, instruments, and methods used were as follows:

- pH value of water  
Intellical PHC301 pH electrode with HACH HQ40d gauge. Method of measurement – refillable reference element, according to ATSM method D1293–83(90) and USEPA Method 150. Range: 0–14.
- Concentration of DO and oxygen saturation of water  
Intellical LDO101 electrode with HACH HQ40d gauge. Method of measurement – optic, according to DIN ISO 17289:2014. Range 0.05–20 mg/l, accuracy ± 0.1 mg/l (to 8 mg/l) and ± 0.2 mg/l (above 8 mg/l).
- Conductivity  
Intellical CDC401 probe with HACH HQ40d gauge. Method – conductivity cell, EN

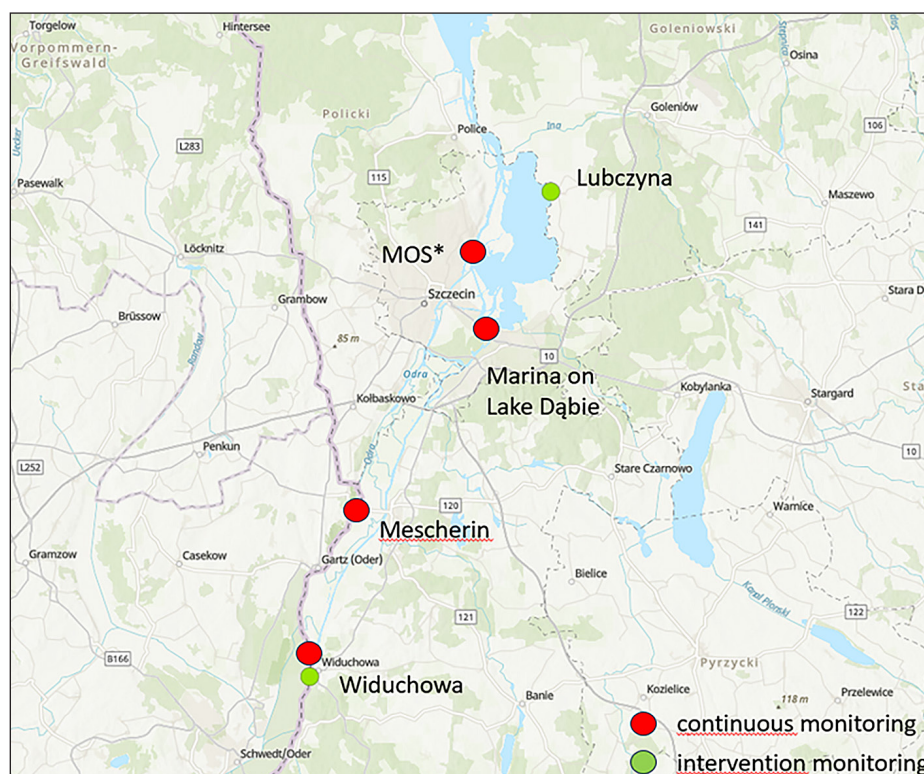


Figure 3. Localisation of continuous monitoring stations and sampling points, \* Maritime Office Szczecin

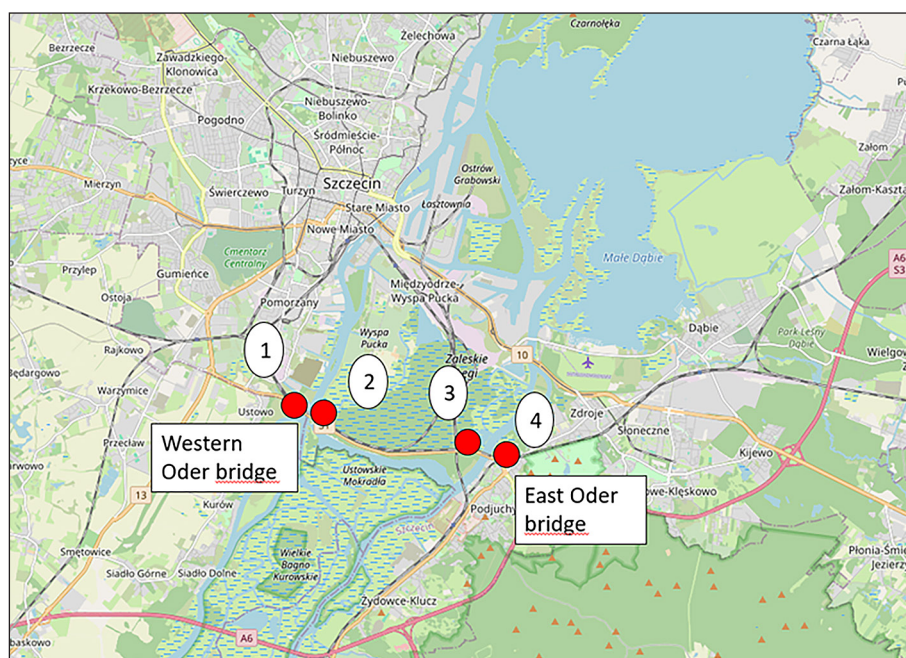


Figure 4. Sampling locations (source: own work base on streetmap.pl/szczecin)

27888:1993, ISO 7888:1985. Range 0.01  $\mu\text{S}/\text{cm}$  – 200 mS/cm, accuracy  $\pm 0.5\%$  of reading.

- TSS

Sample vacuum filtration by fiberglass filters, according to EN 872:2005.

- Turbidity

Hanna HI 88713 – ISO Turbidimeter, method according to ISO 7027. Range 0 – 4000 NTU, accuracy 2% of reading.

- Concentration of chloride

Mohr method (titration), according to ISO 9297:1989.

- DOC

Analytikjena multi N/C 2100 S TOC analyzer. Range 0 – 30000 mg/l. The samples were filtered through 0.45  $\mu\text{m}$  filters before they were given to apparatus.

## RESULTS AND DISCUSSION

### Data from CIEP

During intervention monitoring measurements of: number of cells of *Prymnesium parvum*, water temperature, concentration of DO, conductivity, pH, concentration of sulfates, concentration of chloride, concentration of total phosphorus, concentration of total nitrogen, N:P ratio, were conducted. Results are presented in Figure 5 (Chief Inspectorate for Environmental Protection, n.d.-a).

A few levels are important to mention and highlight. Important levels are the values mentioned in (Procedure monitoring intervention *Prymnesium parvum* ‘golden algiun’, 2025) as optimal conditions for *Prymnesium parvum* growth and its toxicity. The toxic level is the number of algae cells that leads to toxicity. Good state is related to water quality classification according to (Regulation of the Minister of Infrastructure, 2021). In that document, five types of water state were established, where Class I of water quality means the “very good” ecological state and Class V means “bad” state. Classes I and II can be evaluated based on a list of both physicochemical parameters and biological parameters. Classes from III to V can be assigned only based on ecological parameters. This means that for physicochemical parameters, the state of water could be: “very good”, “good” or “worse than good” (< Class II). To establish state of the water, average annual value of a given indicator should be calculated from at least 4 measurements.

Average values, minimum, maximum, coefficient of variation and highlighted levels are presented in Tables 1 and 2.

According to Figure 5 as well as Tables 1 and 2, golden algae were present in May, June, and July 2024, but their concentration did not cause significant toxic conditions. On average, the water temperature and DO concentration were

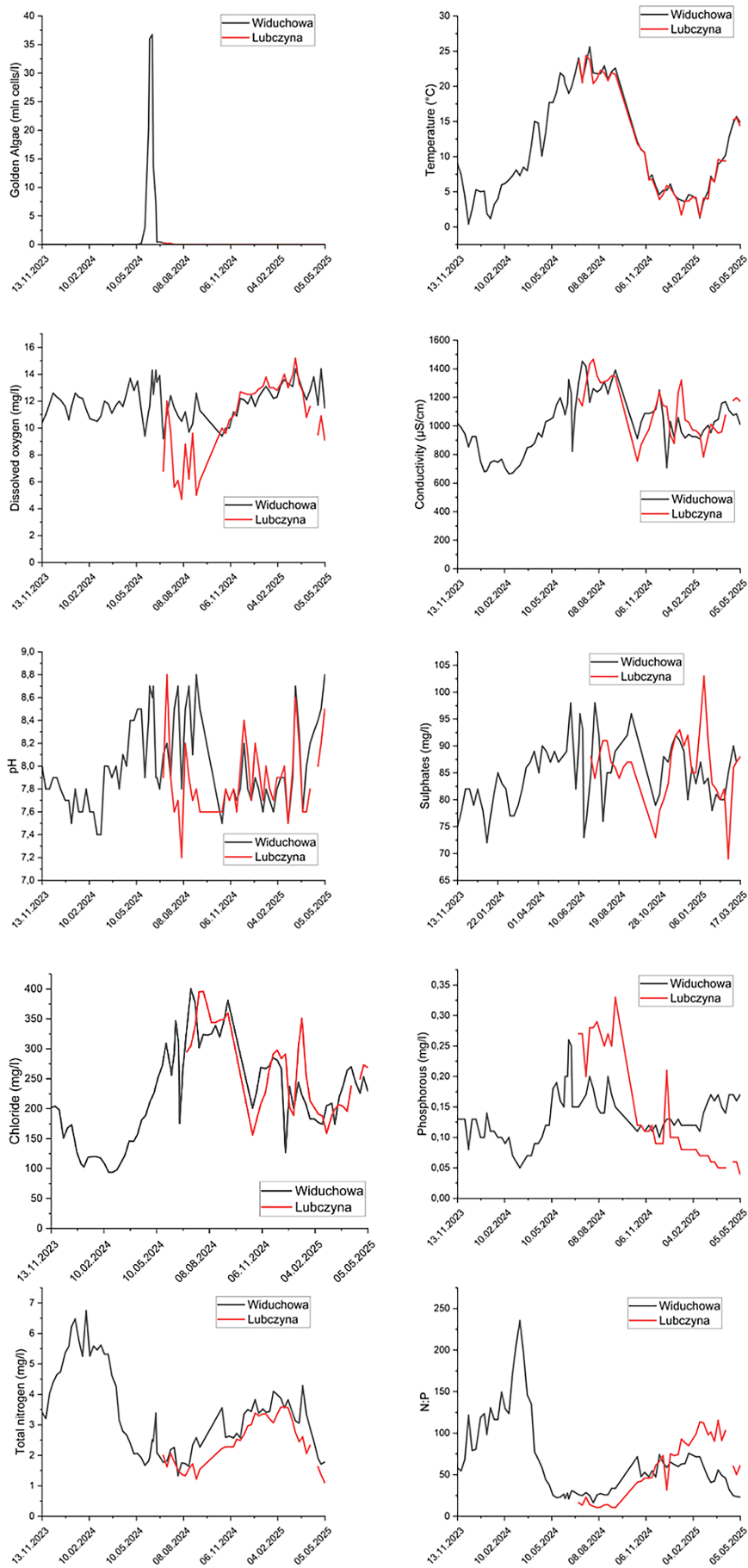


Figure 5. Results of measurements from intervention monitoring

at appropriate levels, corresponding to a Class II water state. The average conductivity, ranging from approximately 665 to 1467  $\mu\text{S}/\text{cm}$ , was higher than the “Good state” level, but not high enough to favor a *Prymnesium parvum* bloom. Measurements indicated a problem with both sulfate and chloride concentrations, although the key levels for phosphorus and total nitrogen were not exceeded. The nitrogen-to-phosphorus molar ratio was high (66.7 and 58.5 on average), which, as noted in reference (Procedure monitoring intervention *Prymnesium parvum* ‘golden algium’, 2025), does not hinder algal growth but increases the toxicity of the algae.

The average results of the continuous monitoring, presented in Table 3, show the average values for each of the four parameters. All the measurements presented in graph form are in Appendix A. As the measurements were conducted hourly, the total amount of data for each parameter is 2755 (for Widuchowa station) and 3899 (for others). While the water quality indicators were generally similar across all stations, minor differences were observed.

The Widuchowa station had slightly higher average values for temperature, pH, and DO. This is the last point where the Odra flows in a single riverbed before splitting into the Western and Eastern Odra.

The Marina on Lake Dąbie station had the lowest conductivity, a difference of about 9% compared to the other three river stations. This distinction is notable, as it was the only station located in a lake rather than a riverbed.

The pH values from the continuous monitoring were generally similar to those from the intervention monitoring. However, a significant difference was observed in conductivity measurements, which were notably higher in the continuous monitoring data.

It is worth mentioning that at three stations – Mescherin, Szczecin MOS, and Marina on Lake Dąbie – a significant number of DO measurements were below critical levels. Specifically, 39%, 42%, and 37% of measurements, respectively, were below 3 mg/l. This is a cause for concern, as most fish become distressed when the DO levels drop below 4 mg/l (Boys et al., 2022) and

**Table 1.** Characteristic values of measured parameters in intervention monitoring at the Widuchowa station

Parameter	Average $\pm$ standard deviation	Min / Max	Coefficient of variation	Important level - algae	Condition met	Good state (II)	Condition met
Temperature [ $^{\circ}\text{C}$ ]	11.2 $\pm$ 7.2	0.4 / 25.6	0.64	-	✓	< 24	✓
DO [mg/l]	11.9 $\pm$ 1.2	9.2 / 14.4	0.10	-	✓	> 7.4	✓
Conductivity [ $\mu\text{S}/\text{cm}$ ]	1009 $\pm$ 194	665 / 1453	0.19	< 1500	✓	< 943.5	x
pH	8.01 $\pm$ 0.37	7.4 / 8.8	0.05	< 8.9	✓	7.5 - 8.4	✓
Sulphates [mg/l]	84.9 $\pm$ 5.8	72 / 98	0.07	-	x	< 71.5	x
Chloride [mg/l]	222.0 $\pm$ 77.2	94 / 400	0.35	< 170	x	< 75.6	x
Phosphorus [mg/l]	0.13 $\pm$ 0.04	0.05 / 0.26	0.30	< 0.75	✓	< 0.3	✓
Total nitrogen [mg/l]	3.36 $\pm$ 1.34	1.33 / 6.75	0.40	-	✓	< 4	✓
N:P	66.7 $\pm$ 47.1	16 / 236	0.71	12 - 20	x	-	x

**Table 2.** Characteristic values of measured parameters in intervention monitoring at the Lubczyna station

Parameter	Average $\pm$ standard deviation	Min / Max	Coefficient of variation	Important level - algae	Condition met	Good state (II)	Condition met
Temperature [ $^{\circ}\text{C}$ ]	11.2 $\pm$ 7.6	1.4 / 24.4	0.68	-	✓	< 24	✓
DO [mg/l]	10.8 $\pm$ 2.8	4.7 / 15.2	0.26	-	✓	> 7.4	✓
Conductivity [ $\mu\text{S}/\text{cm}$ ]	1110 $\pm$ 181	754 / 1467	0.16	< 1500	✓	< 943.5	x
pH	7.90 $\pm$ 0.31	7.2 / 8.8	0.04	< 8.9	✓	7.5 - 8.4	✓
Sulphates [mg/l]	86.2 $\pm$ 6.2	69 / 103	0.07	-	x	< 71.5	x
Chloride [mg/l]	264.8 $\pm$ 69.0	156 / 396	0.26	< 170	x	< 75.6	x
Phosphorus [mg/l]	0.14 $\pm$ 0.09	0.04 / 0.33	0.64	< 0.75	✓	< 0.3	✓
Total nitrogen [mg/l]	2.40 $\pm$ 0.76	1.1 / 3.59	0.31	-	✓	< 4	✓
N:P	58.5 $\pm$ 34.9	10.4 / 115.6	0.6	12 - 20	x	-	x

can die if concentration fall below 2 mg/l (Francis-Floyd, 2020; Small et al., 2014).

### Independent measurement campaign

The results of conducted water samples analysis within the performed research are given in Figure 6. Each line in the figure corresponds to one of the four sampling locations (1–4) shown in Figure 4.

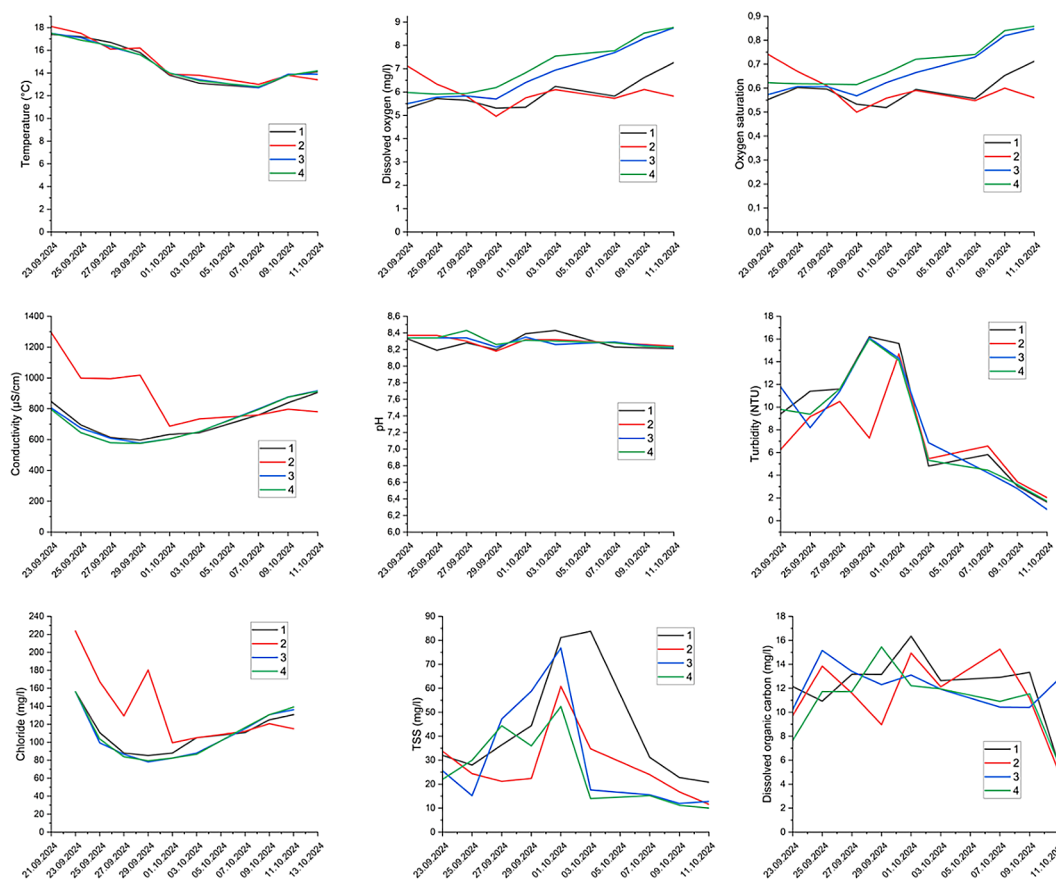
The general observation is that parameter values are relatively similar across all four sampling locations, with a few significant exceptions. The conductivity and chloride values for

the right side of the western bridge are consistently higher than the other samples, particularly during the period from September 23<sup>rd</sup> to October 1<sup>st</sup>. A likely explanation for this is a nearby stormwater system outlet, with a pipe diameter of approximately 300 mm, which collects runoff from the bridge and surrounding roads and discharges it near location 2. Consequently, the conductivity data from location 2 for the period of September 23<sup>rd</sup> to October 1<sup>st</sup> was excluded from further calculations due to this likely disturbance. The average values for all parameters across all four locations were then calculated, and these results are presented in Table 4.

**Table 3.** Average values of measured parameters for each station

Measurement station	Temperature [°C]	Conductivity [ $\mu$ S/cm]	pH	DO [mg/l]
Widuchowa	22.2±2.02	1413±151	8.24±0.39	7.38±3.23
Mescherin	20.7±3.8	1348±163	7.85±0.33	4.75±3.42
Szczecin (MOS)	20.6±3.6	1414±270	7.84±0.40	5.02±3.95
Marina on Lake Dąbie	20.9±3.8	1265±234	8.10±0.44	5.85±4.47
Average*	21.1±0.6	1360±61	8.0±0.17	5.8±1.0

**Note:** \*average of averages.



**Figure 6.** Results of measurements in sampling points

**Table 4.** Average value of all measured parameters

Parameter	23 Sep	25 Sep	27 Sep	29 Sep	01 Oct	03 Oct	07 Oct	09 Oct	11 Oct	Average
Temperature [°C]	17.6±0.3	17.2±0.2	16.4±0.2	15.8±0.24	13.9±0.1	13.4±0.3	12.8±0.1	13.8±0.1	13.9±0.3	15.0±1.7
Concentration of DO [mg/l]	5.98±0.71	5.94±0.24	5.81±0.1	5.54±0.46	6.09±0.57	6.71±0.58	6.75±0.98	7.39±1.04	7.65±1.22	6.4±0.69
Oxygen saturation [%]	62%±7%	62%±3%	61%±1%	55%±4%	59%±5%	64%±5%	64%±9%	73%±10%	74%±13%	64%±6%
Conductivity [µs/cm]	612±23	504±21	451±15	438±10	461±33	671±37	779±19	847±33	879±57	765±97
pH [-]	8.35±0.02	8.31±0.07	8.34±0.06	8.22±0.03	8.34±0.03	8.33±0.06	8.27±0.02	8.24±0.01	8.23±0.01	8.3±0.05
Turbidity [NTU]	9.3±2	9.5±1.2	11.3±0.4	13.9±3.8	14.7±0.6	5.6±0.76	5.3±1	3.1±0.2	1.6±0.4	8.3±4.4
Concentration of chloride [mg/l]	117±3	78±5	65±2	61±3	63±7	96±8	114±2	127±4	130±9	117±24
TSS [mg/l]	34±8	24.4±5.7	37.3±10.1	40.4±13.2	67.8±11.7	37.5±8.2	21.5±6.6	15.7±4.6	13.8±4.2	31.9±15.6
DOC [mg/l]	9.9±1.6	12.9±1.7	12.5±0.8	12.5±2.3	14.2±1.6	12.2±0.3	12.4±1.9	11.6±1.1	5.3±0.3	11.5±2.4

**Note:** color scale was applied to each parameter, where red means higher value, blue – lower and white – medium.

The average values presented in Table 4 reveal a significant event on October 1<sup>st</sup>, when parameters like turbidity, TSS and DOC reached their peak, being several times higher than on other days. This suggests a wave of contaminants passed through the Odra River. Conversely, parameters such as oxygen saturation, conductivity, and chloride concentration were at or near their minimum values on the same day. The low conductivity and chloride levels were notably below the minimums observed by the Chief Inspectorate for Environmental Protection's continuous monitoring, indicating that this water had a distinct, different character. Conductivity, chloride concentration and oxygen concentration were close to minimum values observed in intervention monitoring. It indicates that this was a specific event but still within the scope of previous observations. At the days with the largest values of TSS, it was observed that there was a visible sediment on the bottom of the river and it was different than before.

The monitoring results align with measurements conducted by Sługocki and Czerniawski in 2015 and 2019–2022 for Lower Odra (Sługocki and Czerniawski, 2023), who also noted instances of hypoxia (low oxygen) in the river during the summer of 2022. Prędecka et al. noticed that it is possible that enormous amounts of water related to the flood wave passage diluted both organic and inorganic pollutants (Prędecka et al., 2019). In that study, the sanitary condition of the Vistula River after the flood wave receded was characterized by high variability. The model conducted by Zhang et al (Zhang et al., 2012) predict that chemical oxygen demand (COD) and total nitrogen concentrations significantly increased in the reservoir on the Li River

(China) during a flood event. It was caused by agricultural land use in the catchment. The study on the Muar River floods in 2006 and 2007 indicated that heavy rainfall and surface runoff increased the pollutant loads into the river (Ching et al., 2015). It may also lead to a decrease in DO. The contaminant pulses resulting from extreme floods can be elevated for days to years post-flood (Kaushal et al., 2014). It is possible that the contamination cumulates in bottom sediments and it could stay there for long. It was not measured and investigated. However, increases in suspended solids and turbidity were observed, thus part of them would settle on the bottom of the river and surrounded wetlands and polders.

Flood protection strategies besides reduction in damages caused by extreme flooding will also protect aquatic ecosystems and their ecosystem services (Talbot et al., 2018). From the ecohydrological perspective, river floodplains are extremely important and capacious ecosystems which absorb flood and pollutant peaks and may minimize the danger of flooding (Kiedrzyńska et al., 2015). From that perspective, it seems that taking care of the Międzyodrze wetlands is an important part of flood management in Lower Odra. It constitutes natural retention polder, which flattens the flood wave (Humiczewski and Łągiewka, 2025). This feature can be lost because of plant overgrowth and transformation into land.

## CONCLUSIONS

The current state of water in the Odra River is considered below good. The ecosystem is under significant anthropogenic pressure and modification, which has negatively affected water

quality. The monitoring efforts conducted since 2023 show that high concentrations of chloride, which contribute to high conductivity, may facilitate blooms of *Prymnesium parvum*, a risk factor for future ecological disasters. Measurements also confirm that hypoxia is occurring in the ecosystem, a finding corroborated by other studies on the Odra River. This issue with water quality in major rivers is a global problem linked to urbanization.

Water quality monitoring in the Odra River provides continuous verification of its condition. The physical and chemical parameters tested prevent the river water from being classified as Class II (good) quality. In 2024, the presence of ‘golden algae’ was observed, though not in quantities sufficient to cause toxic conditions.

During the flood wave, the estuary section of the Odra River did not cause significant damage or flooding. A notable “peak” in quality indicators was observed on October 1<sup>st</sup>, while the highest water levels at the study site were recorded on October 3<sup>rd</sup> between 6 and 9 p.m.

The flood wave carried significant amounts of pollutants, including suspended solids, DOC, and turbidity. Interestingly, the water carried by the flood wave also caused a decrease in chloride concentration and, consequently, a drop in conductivity.

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