

Lake Mburo National Park

Water quality and hydrological monitoring

(April 2024–April 2025)

Executive summary for policy makers and park managers

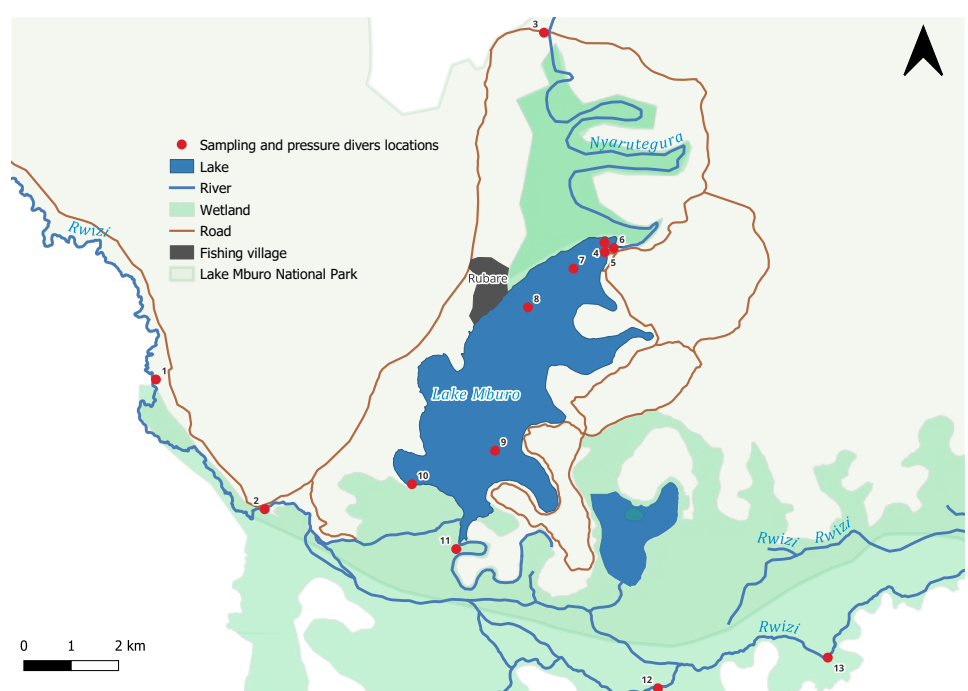
The one year monitoring campaign of water quality in the Lake Mburo – River Rwizi system shows clear signs of high turbidity and eutrophication. Persistent low oxygen levels and recurring nitrogen and phosphorus spikes are found at specific lake sites. Water levels in the lake are shallow (1 – 3.5m). Flow in downstream rivers is close to zero in the dry season. The wetlands at the inflow zones play an important role in ecosystem functioning of the Lake Mburo – River Rwizi system. Restoration efforts should hence target wetland areas around in- and outflow zones. A long-term monitoring campaign is necessary to track trends over time, detect changes in both water quality and hydrology, and evaluate the effectiveness of management interventions.

The monitoring campaign was conducted by the Universities of Mbarara (MUST, Uganda) and Antwerp (UA, Belgium) under the UCoBS programma, financed by VLIRUOS in Flanders, Belgium. Monthly water quality assessments were done at 11 key sites in Lake Mburo National Park and the southern Isingiro region, covering the Rwizi and Nyarutengura rivers and Lake Mburo (Fig. 1). This document presents the main findings from the first year of monitoring, with the purpose of disseminating results to Lake Mburo Park Authorities (UWA), regional water managers, and other stakeholders. More information is provided in the report by Lodi et al. (2025).

What is UCoBS?

The UCoBS project at Mbarara University of Science and Technology is a long-term partnership with Flemish universities aimed at developing community-based, sustainable solutions to demographic and livelihood challenges in south-western Uganda.

UCoBS stands for University as a facilitator Community Based Sustainable Solutions to Demographic Challenges in South Western Uganda. It focuses on improving household resilience, youth employability, natural resource management, health, and access to technology. Through research, capacity building, and local collaboration, the university acts as a facilitator to drive inclusive socio-economic development in the region. www.ucobs.must.ac.ug



▲ Figure 1: Map showing sampling locations within Lake Mburo National Park and the southern Isingiro region. Water quality was measured at locations 1-4 and 7-13, flow velocity at locations 1-3 and 12-13, and water level at locations 2, 3, 5 and 12.

Key findings on water quality:

- **Temperature:** Water temperatures varied seasonally. Rivers showed cooler, more variable temperatures ($\sim 20\text{--}27^\circ\text{C}$), while lake sites remained warmer ($23\text{--}30^\circ\text{C}$), with cooling linked to the colder, short-rainy season.



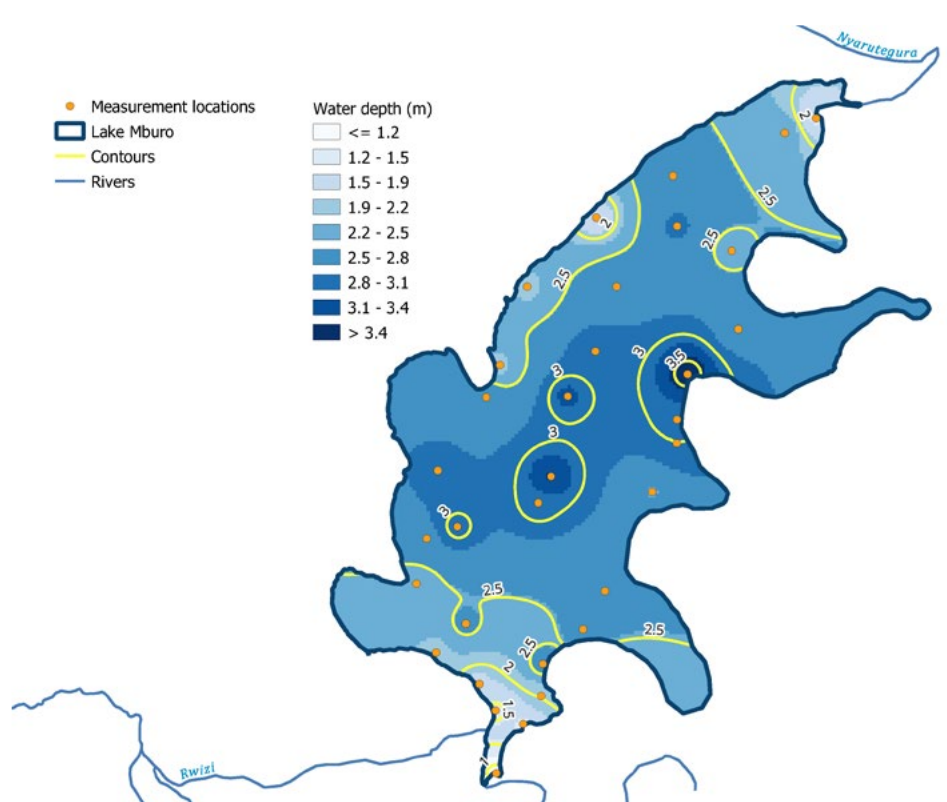
- **Oxygen Saturation:** Oxygen levels varied seasonally, following rainfall patterns; lower levels were observed during the rainy seasons. Upstream river sites maintained higher oxygen levels ($>80\%$), while downstream and lake sites frequently fell below 50% , especially at locations 4 and 10. This suggests eutrophication which is also indicated by the high total inorganic nitrogen and phosphorus values at these sites, and poor circulation. Downstream Rwizi sites often dropped below the critical ecological threshold of 40% , indicating potential chronic oxygen stress for aquatic organisms (Allen & Castillo, 2007).



- **pH Levels:** Upstream sites saw a dip from high (pH $\sim 9\text{--}11$) to near-neutral (pH ~ 8) in mid-2024. Lake sites showed higher values (pH $9\text{--}10$), which can be due to high photosynthetic and other biologic activity (Chislock et al., 2013). Downstream river sites decrease again to neutral values (pH ~ 7).
- **Total Inorganic Nitrogen (TN):** Most sites stayed below ecological thresholds of 0.75 mg/L (Cunha et al., 2018), but location 4 peaked at 1.17 mg/L , indicating nutrient loading likely from runoff and/or faeces of local hippo population (personal observation). Downstream river sites showed very low TN, possibly due to wetland filtration or low input.
- **Phosphate (PO_4):** Lake and downstream river sites showed generally low and stable levels of PO_4 , mostly below 0.025 mg/L . In contrast, upstream sites showed more variation ranging from 0.01 to 0.05 mg/L . The inlet site 10 had occasional peaks approaching 0.075 mg/L between October 2024 and January 2025. These values exceed the commonly cited ecological threshold of 0.03 mg/L , beyond which aquatic ecosystems are at increased risk of eutrophication and algal blooms (Wetzel, 2001).
- **Suspended Particulate Matter:** The SPM ranges show a strongly heterogeneous sediment regime along the Rwizi. The upstream section ($35\text{--}633\text{ mg L}^{-1}$) has the highest and most variable SPM, indicating heavy sediment supply. Lake Mburo ($2\text{--}72\text{ mg L}^{-1}$) has the lowest values, suggesting dilution and/or settling of coarser sediments in the wetlands upstream. The downstream section ($20\text{--}140\text{ mg L}^{-1}$) shows moderate to high SPM, implying re-suspension, contributions from additional tributaries, and remobilization of stored sediments during higher flows.

Key findings on hydrology:

- **Flow Speed:** Upstream flows remained moderate to strong in River Rwizi ranging between 0.50-1.25 m/s after rainy seasons, and between 0.20-0.45 during dry seasons. River Nyarutegura (location 3) was stagnant or even dry most of the time. Downstream river sites slowed down considerably during the dry season going from ~0.5 m/s to almost 0, contributing to low oxygen levels and accumulation of organic matter.
- **Water Levels:** Levels at the river sites peaked during the rainy months (March, May, October and November 2024), but most remained below the initial February 2024 measurements (max. 2.05m deep). Locations 2 and 12 showed an overall decline relative to that baseline. Only two brief increases above the February level were recorded: +17 cm at location 1 in May and +13 cm at location 12 in December. In contrast, the lake site (location 5) consistently stayed above the February 2024 level (0.55m deep), with peaks reaching up to 1 m higher between December 2024 and March 2025.
- **Bathymetry:** A February 2025 sonar survey revealed Lake Mburo is shallow, with depths between 1 and 3.5 meters. The south is shallowest; the central-eastern area is deepest (Fig. 2).



▲ Figure 2: Bathymetric map of Lake Mburo (Feb. 2025). Values of the sampling points were interpolated using an Inverse Distance Weighted (IDW) interpolation (QGIS).

Conclusion & Recommendations:

- Persistent low oxygen levels and recurring nitrogen and phosphorus spikes at specific lake sites indicate a clear sign of eutrophication. Managing nutrients and SPM inputs, especially from runoff, is critical, as agricultural and domestic activities are likely pollution sources. Inputs from hippos are natural, yet their impact on water quality needs more research.
- In addition to measuring water quality parameters such as nutrient concentrations, it is equally important to monitor hydrological variables like flow velocity and water levels. These allow calculation of nutrient fluxes, providing insight into how much is actually being transported through the system. Regular maintenance and protection of monitoring equipment (to prevent theft or loss) are essential to ensure continuity and data reliability.
- Focused restoration and preservation efforts should target wetland areas around inflow zones. Preserving existing wetlands and expanding them where possible will help enhance natural filtration of incoming water before it reaches the lake. These wetlands act as critical buffers that reduce nutrient loads and improve overall water quality.
- Setting up a long-term monitoring campaign is necessary to track trends over time, detect changes in both water quality and hydrology, and evaluate the effectiveness of management interventions. There is also a specific need for improved, range-based monitoring and surveillance of wetland degradation in areas that have not been well monitored (e.g., through the use of drones).

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