LIFE4ZOO: Sustainable water circulation in zoos

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Emily Warrender September 16, 2025

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LIFE4ZOO is a project dedicated to sustainable water circulation for the future of zoos, as explained by experts Tomáš Lederer, Petr Kvapil and Paola Sepúlveda-Ruiz

Zoos require water daily, and during droughts, every drop becomes crucial. The LIFE4ZOO project offers a concrete and functional solution, reusing water from animal enclosures through a smart combination of natural and modern technologies for treatment. How does it work, and why is it important? The experts and the system's designers provide further explanation here.

The traditional approach, where all used water is sent directly into the sewer, is highly wasteful. LIFE4ZOO presents an innovative concept for sustainable water management and reuse.

"Our goal is to ensure that zoos have access to reliable supplies of quality water even during drought periods, which are becoming an increasingly pressing problem," explains Tomáš Lederer from the Institute for Nanomaterials, Advanced Technologies and Innovation at the Technical University of Liberec.

Water plays a vital role in this task. It is used for all animals where water availability is essential for thermoregulation. Other uses include swimming pools, artificial waterfalls designed to simulate natural habitats, and irrigation of green spaces. These water-related practices are critical to animal welfare because they help regulate body temperature, promote natural social behaviour and provide protection from sunlight. Water is also used for cleaning enclosures and for services to visitors and staff.

“Water reuse will ensure not only operational reliability but also savings,” Lederer adds, noting that up to a 50% reduction in water use is expected in Liberec Zoo.

Water contamination is monitored directly around the enclosures. Analyses revealed relatively low concentrations of phosphorus and nitrogen, often lower than those found in municipal wastewater. The main microbiological and chemical contaminants were identified, allowing the entire system to be tailored accordingly.

Two loops, one goal: Water saving in Liberec Zoo

The system consists of two main parts. The first loop circulates a large volume of clean drinking water available in animal enclosures.

The second, containing the lake and harvested rainwater, serves to replenish this loop. “Animals will only drink from the first loop, from which all pollutants have been removed,” says Petr Kvapil, Director of Photon Water, the project’s technology partner.

The treatment occurs in two phases: first, in a constructed vertical wetland where organic substances are removed, followed by membrane filtration and disinfection unit.

“Thanks to the final membrane treatment, we can ensure high-quality water. We must also apply sanitisation, as this loop will continue to be used in different animal enclosures, and we need to protect their health,” adds Tomáš Lederer.

How does the system work in Liberec Zoo?

The wetland, based on natural biological processes, is a key component of the centralised system, designed with respect for both the animals’ environment and the practical needs of the zoo.

At Liberec Zoo, where the system is currently being commissioned, it shows how a robust and controlled approach can work in practice. Unlike conventional technologies, the wetland functions as a complex yet natural filter and does not disturb the conditions for the animals.

“The zoo will become self-sufficient in water consumption. We will enable reuse directly on-site, reduce dependence on valuable drinking water, and significantly lower operating costs,” summarises Tomáš Lederer.

Energy independence

The daily operation of the system requires a reliable energy supply, which is why the project includes energy self-sufficiency.

“We need energy to run the water treatment plant and pumps to distribute the water throughout the zoo,” explains Kvapil.

The entire operation will be powered by solar panels installed on the roof of the entrance building.

“We calculated that the solar energy will cover the operation of the pumps and water treatment plant with reserve. Moreover, it’s ideal that the highest water demand is in summer, which is also when the panels perform best,” he adds.

Flexible water solutions at Barcelona Zoo

The Barcelona Zoo has conducted a comprehensive assessment of water sources, flows, uses, and key demands across the facility. “This evaluation allows the zoo to calculate its water balance, identify areas of highest consumption, and categorise wastewater quality. These key steps allowed us to design an on-site pilot plant adapted to the zoo’s complex water flows,” says Paola Sepúlveda-Ruiz from University of Barcelona.

The system includes different types of constructed wetland units designed to test which combinations work the best. “Some parts of the system are designed to handle more polluted wastewater, while others treat lighter wastewater. By combining and testing these approaches, the zoo aims to identify the most effective and sustainable treatment methods,” explains Paola Sepúlveda-Ruiz, emphasising that these methods replicate natural filtration processes, allowing the on-site treatment and reuse of wastewater.

After this natural treatment, the water is designed to undergo additional filtration and disinfection to ensure it is safe for reuse. Once treated, this water will be utilised within the zoo for non-potable purposes depending on the final water quality achieved.

Educational dimension

Beyond the technical dimension, both zoos place a strong emphasis on environmental education and citizen engagement. The system is accessible to visitors and integrated into the zoo’s interpretive pathways, enabling the public to observe and understand the water treatment process in real-time.

Potential beyond zoos

Although the project is focused on zoos, its use can be much broader.

“A zoo functions somewhat like a city within a city, and it is in such areas that our solution makes the most sense,” explains Petr Kvapil.

The benefits are not just in reduced drinking water consumption and operating costs, but also in relieving pressure on the municipal sewage system.

The system developed within the LIFE4ZOO project can also be applied elsewhere, such as in visitor attractions seeking to enhance water management efficiency.

“For example, agricultural enterprises face similar challenges as zoos. We are in discussions about the potential use of our comprehensive water treatment and reuse approach with farms, as well as with botanical gardens, some industrial parks, and other organisations,” concludes Petr Kvapil, noting that the project offers consultations for sustainable solutions.

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Project

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Primary Contributor

Tomáš Lederer
Institute for Nanomaterials, Advanced Technologies and Innovation