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Assessment of Retention Basin Potential Using Active Remote Sensing

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The increasing frequency of drought periods and the intensification of precipitation distribution extremes in Central Europe, particularly in eastern Hungary, pose significant challenges for water resource management. The Great Hungarian Plain (Alföld) experiences an annual precipitation deficit of 150–250 mm, exacerbating the adverse effects of drought. The Eastern Main Canal (Keleti-főcsatorna) plays a crucial role in water supply, transporting 300–400 million m³ of water annually as part of the Civaqua program. This initiative aims to channel water from the Tisza River to the Tócó stream, ensuring sustainable water supply for the region and maintaining critical water levels in local reservoirs, including the Vezér Street Retention Basin. The basin serves not only water retention and flood control purposes but also provides recreational opportunities for the local community.
This study aims to evaluate strategies for maximizing the capacity and efficiency of retention basins by optimizing the water supply from the Tisza River and the Eastern Main Canal, particularly during drought periods. Additionally, the research explores the potential of basin retention for the storage of precipitation and excess water within the basin and surrounding landscapes. Such retention solutions contribute to efficient water resource management, mitigating drought impacts and enhancing the long-term sustainability of water management practices.
The research employed active remote sensing technologies, including the Apache 3 unmanned surface vessel equipped with a monobeam sonar, providing depth measurement accuracy within 1% of the measured depth. For terrestrial surveys, the Stonex X120GO SLAM Laser Scanner was utilized, delivering millimeter-level precision in 3D mapping. The integration of these technologies enabled the development of detailed basin models, capturing both underwater and aboveground features of the retention basin. The primary focus was the Vezér Street Retention Basin, which serves flood control, water retention, and recreational functions in the Debrecen area.
The lowest point of the Vezér Street Retention Basin is at an elevation of 110.65 m above Baltic Sea level, while the highest point of the basin crown is 114.39 m, resulting in a maximum depth of 3.74 m. The basin's total storage capacity, when fully saturated, is 39,213.59 m³, with a water surface area of 16,354.93 m². At the average water level of 113.69 m, the basin holds approximately 28,253.2 m³ of water, with a water surface area of 15,000.08 m². During the summer, under conditions of 20°C, average atmospheric pressure, and humidity, evaporation rates reach 3

mm/day/m², resulting in a daily water loss of 45,000.24 mm/day. The aquatic biodiversity of the basin is characterized by the presence of *Typha* species, which serve as critical ecological indicators.
The preliminary findings highlight that active remote sensing methods, such as sonar and the Stonex X120GO SLAM Laser Scanner, provide reliable tools for maximizing basin capacity and developing efficient water retention strategies.

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