

EMASESA

Implementation of a digital twin to optimize decision-making in drinking water and wastewater management

EMASESA (Empresa de Abastecimiento y Saneamiento de Aguas de Sevilla) **manages one of the most complex metropolitan water cycle systems in southern Spain, serving 1.4 million people in the city of Seville and eleven municipalities in its metropolitan area, either directly or indirectly.**

The supply system is supported by six regulating reservoirs located in the Guadalquivir basin, various surface water intakes, and production infrastructure consisting of three drinking water treatment plants (DWTPs). These facilities ensure water quality in compliance with current health standards. **EMASESA distributes 100 hm³ of water annually through approximately 4,000 km of distribution pipelines, 34 pumping stations, and 35 water tanks, of which around 70 hm³ are delivered directly as drinking water. The system achieves water efficiency exceeding 86% (14% non-revenue water), and average consumption is 106 L/person/day.**

EMASESA **operates a 3,044 km sewer network, with 46 pumping stations, five wastewater treatment plants (WWTPs) that treat 70 hm³ per year, a composting plant, and six stormwater retention basins.** In addition, 5% of wastewater is reclaimed for other uses, and more than 73,000 tons of sludge are recycled annually. Energy production reaches 19 GWh through **biogas cogeneration at the WWTPs**, supplemented by photovoltaic and hydroelectric power from the supply system.

The scale and complexity of this infrastructure position EMASESA **as a leading public utility in terms of sustainability, the circular economy, and advanced water cycle management.** Its 2030 Strategic Plan includes innovative digitalization projects, such as *Embalses Digital 5.0* and *CREANDO*, both funded by *NextGenerationEU* under the Spanish government's PERTE program.

Challenges

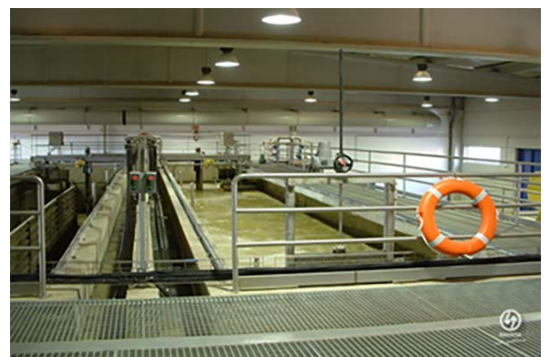
EMASESA faced water cycle management challenges, stemming from the metropolitan scale of the service (over one million residents), the diversity and extent of its infrastructure (extensive networks, pumping stations, reservoirs, wastewater treatment plants, storm tanks), and a context of recurring water scarcity in the Guadalquivir river basin. In terms of water supply, this resulted in the **need to boost system resilience, reduce losses, optimize pressure, and increase energy efficiency.** In wastewater treatment, this involved **managing highly variable flow rates, minimizing impacts from heavy rainfall events, and increasing the operational robustness** of WWTPs and retention systems.

In parallel, the company aimed to **align its operations with an increasingly demanding regulatory compliance and environmental performance framework**, where discharge regulations and effluent quality requirements (including their transition to stricter standards) called for more stable,



Program highlights:

- Enhanced regulatory compliance and environmental sustainability
- Proactive response to the impacts of climate change
- Optimization of operations and maintenance
- Comprehensive information management for effective decision-making
- Continuous improvement of operational process automation



Stormwater detention tank at EMASESA

traceable, and optimized operations, supported by advanced process and network controls. In addition, **sustainability and circular economy objectives**, already underway in the utility's sludge recovery and biogas-based energy production, required greater efficiency, transparency, and continuous performance monitoring.

EMASESA's digital transformation agenda required the consolidation of over 150,000 signals, 200 hydraulic sectors, over 400,000 meters (75% remotely read), water quality data, real-time external data, numerical modeling, and AI algorithms into a single platform. The goal was **to equip the system with predictive capabilities and optimize its operations**, including the drinking water service, wastewater infrastructure operations, and overall energy consumption. Against this backdrop, **digitalization became a core component of governance, efficiency, and resilience** for the entire water cycle.

Solutions

Following the [design and initial deployment of a data lake](#) at EMASESA, **this project has incorporated various applications from the Xylem Vue platform** to optimize advanced water cycle management.

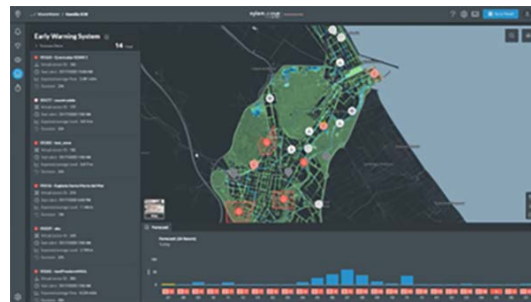
The supply network's digital twin, based on the Real-Time What-If Scenarios application, enables real-time simulation of the system's past and future hydraulic behavior under diverse operating conditions. This capability supports incident anticipation, scenario analysis, and decision-making in high-stress and contingency situations.

The model is powered by Xylem Vue's **Smart Water Engine (SWE)**, which **unifies and standardizes information from SCADA, IoT sensors, smart meters, GIS, and corporate systems into a common repository**, eliminating data silos and enabling more proactive, efficient management that supports the integration of advanced algorithms and AI/ML. Additionally, it uses an **Operational Intelligence layer that centralizes monitoring through KPIs, alerts, and dashboards** to provide an integrated, real-time overview of the status of the network, its assets, and its processes.

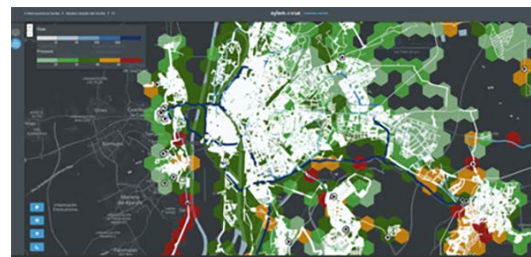
The deployment of the digital twin is complemented by other drinking water solutions, such as Meter Data Analytics (remote meter reading), Leak Detection (advanced leak detection), and Plant Management (advanced DWTP operations), all focused on reducing water and energy consumption.

In the wastewater sector, the project includes the launch of a specific digital twin, utilizing the same structural, modular architecture. This provides EMASESA with a virtual environment that replicates the network's hydraulic behavior in real time, combining real-time data from sensors with hydrological and hydraulic modeling. The Xylem Vue Real-Time What-If Scenarios application **monitors the network's status, generates early warnings for flooding and overflows, analyzes "what-if" scenarios, and supports operational decision-making** through optimized setpoints, reducing discharges and their environmental impact, and improving efficiency and regulatory compliance. In addition, **the Xylem Vue Plant Management application enables process optimization at the Copero and Ranilla WWTPs**, where a digital twin of each plant has been implemented.

Finally, the project includes the implementation of an **early warning system (EWS)**. This system provides real-time observational and high-resolution predictive weather data from multiple specialized institutional



Early Warning System (EWS) tool



Digital twin of the supply network

"Now we will be able to identify where blockages and flood-prone areas are likely to occur well in advance, enabling proactive system management to prevent unnecessary overflows."



Ángel Mena,
Head of Distribution at EMASESA

networks, integrating data from radar, rain gauges, and deterministic and probabilistic numerical models. This helps **anticipate heavy rainfall events, assess risks, and feed the digital twins with reliable predictions**. In addition, it centralizes and validates meteorological information, generates advanced rainfall analyses, and integrates warning and notification systems, **strengthening preventive management, service security, and coordinated response with other agencies** during extreme events.

The solutions initially implemented have evolved to gradually adapt to EMASESA's operational requirements. In this process, the **utility has contributed its technical criteria and expert knowledge of the water cycle**, facilitating the adaptation of the solutions to the operational environment.

This joint effort has enabled **the solutions to be adapted and validated under EMASESA's operational conditions**, as a large utility with an advanced level of prior digitalization. It has also been essential for consolidating their use in real-world operational conditions, **incorporating practices and standards that improve their reliability and performance**. In this regard, it is worth noting that some of the improvements developed during the project have contributed to the technical evolution of the model itself, reflecting a **collaboration based on the complementarity** between technological capabilities and operational expertise.

Results

The Xylem Vue platform has enabled EMASESA to achieve all its digital transformation objectives. Thanks to the use of Xylem Vue's advanced AI algorithms, **the utility can perform continuous water balancing, objectively measure improvements in network performance, and reduce non-revenue water and fraud**. Advanced analytics also enable anticipation of water quality issues, demand trends, and maintenance needs, simultaneously improving the system's hydraulic, energy, and economic efficiency. These capabilities **support reductions in per capita consumption, moving toward the ultimate goal of 90 L/person/day**, which is key to adapting to climate change and increasingly frequent drought scenarios.

In addition, this project provides EMASESA with an **advanced early warning and scenario simulation system** capable of anticipating flooding and overflows during heavy rainfall, as well as **optimizing the preventive management of pumping stations and retention basins** within its wastewater system. Digital twins, combined with weather forecasts and what-if simulations, **strengthen operational and strategic planning, improve internal coordination and liaison with Civil Defense authorities, and promote more transparent and traceable** water cycle management. This enhances accountability and **reduces environmental risks**, thereby protecting water quality and ensuring compliance with increasingly stringent regulatory requirements.

The project reflects an **effective public-private partnership**, in which Xylem's digital technology and EMASESA's operational expertise have complemented each other to tailor the solution to the utility's needs.

"Smart metering gives us a wealth of information about water consumption across our network (...), and it also helps inform end users, so saving water isn't just our responsibility – it's a responsibility shared by society as a whole."



José Luis López,
Head of the Digital Transformation
Division at EMASESA