Bentley®
Advancing Infrastructure

CASE STUDY

Companhia Águas de Joinville Keeps Clean Water Flowing for 600,000 Residents in South Brazil

OpenFlow WaterGEMS Saved BRL 4.5 Million with Water Contingency Plan, Reducing Water Production during Severe Droughts

MAINTAINING CLEAN WATER SUPPLY

Companhia Águas de Joinville (CAJ) is the water company that supplies water and sanitation services to approximately 600,000 residents in the city of Joinville, the largest municipality in the state of Santa Catarina in South Brazil. The water supply is split across two production systems. The Cubatão system in the northern zone accounts for 75% of the water production, serving 450,000 residents, while the Piraí system in the southern zone makes up 25% of production, serving 150,000 residents. Amid constant demands to optimize company resources, as well as maintain quality service and clean water supply to the population, CAJ initiated a strategic hydraulic modeling project in 2020. The project would optimize investments and operations based on better knowledge on how the supply system works and how to proactively address network issues.

During that year, the city faced the worst water crisis in 30 years. With regular three-month drought periods plaguing Joinville over the years, 2020 brought worsening conditions, with a six-month drop in the Piraí River water source. This situation directly affected production at the Piraí water treatment plant and the water supply to the area's inhabitants. "Any problems we have within our production process creates an enormous impact on people's quality of life," stated Lucas Emanuel Martins, engineer at CAJ. Committed to bringing clean water and well-being to their consumers 100% of the time, CAJ capitalized on its original digital network analysis initiative, looking to develop a water contingency plan for these dry periods to reduce water production on the fragile source without affecting the people in the area.

ADDRESSING DROUGHT CONDITIONS

To address the drought conditions, CAJ conducted a preliminary study, evaluating three potential alternatives for a contingency plan. They first determined that rerouting water from the Cubatão system to Piraí was the most cost-effective option. Using the hydraulic model, they analyzed and tested their BRL 4.5 million proposal to implement a 1.7-kilometer interconnecting pipeline between the two systems during the drought periods. However, CAJ soon realized that their initial solution yielded insufficient flow transfer, requiring implementation of a 140-horse power booster that resulted in additional operating expenditures of BRL 25,000 per month. The plan also would result in a series of water shortages at the weakest points in the Cubatão supply system and reduce water transport efficiency, affecting 45,000 people. "To our surprise, in these studies, we identified that our solution would not work as well as imagined. It was clear we needed a new solution," said Martins.

Faced with resolving the problems of the weak points in the Cubatão north system and ultimately achieving more water supply to the south zone during drought, CAJ needed to implement a more comprehensive analysis of the municipality's entire distribution network. They needed an advanced modeling and simulation application to ensure that their digital analysis accurately reflected the physical network operation. By generating a successful contingency plan, they would mitigate the effects of drought and minimize risk of impact to Joinville residents and businesses.

HYDRAULIC MODELING KEEPS WATER FLOWING

Given Bentley software's user-friendly interface and interoperability with multiple data sources, CAJ selected OpenFlows WaterGEMS to create a digital twin of the municipality's macro water distribution and supply system (main pipes with diameter greater than 100 millimeters), modeling 285 kilometers of network.

PROJECT SUMMARY

ORGANIZATION

Companhia Águas de Joinville (CAJ)

SOLUTION

Water, Wastewater, and Stormwater Networks

LOCATION

Joinville, Santa Catarina, Brazil

PROJECT OBJECTIVES

- To evaluate drought scenarios with hydraulic modeling to improve quality of life for Joinville residents.
- To generate a network digital twin to optimize water distribution operations.

PROJECT PLAYBOOK

OpenFlows™ WaterGEMS®

FAST FACTS

- The city of Joinville experienced its worst drought in 30 years.
- CAJ used OpenFlows WaterGEMS to develop a digital twin of the marcro distribution network, enabling them to better understand and make decisions to improve system operations.
- The project provides a benchmark for the water industry to use available technology to optimize resources and ensure quality of life to their customers.

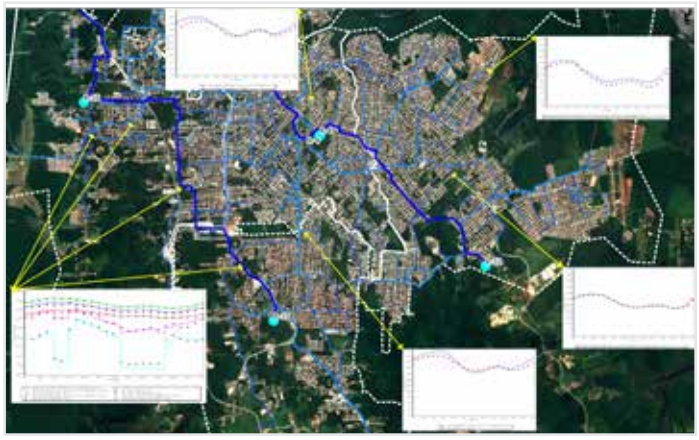
ROI

- Using OpenFlows WaterGEMS, CAJ developed a new contingency plan at near zero cost of implementation, saving BRL 4.5 million.
- The digital twin reduced water production needs by 30% during severe droughts.
- Using Bentley's advanced hydraulic technology, CAJ can keep clean water flowing for 600,000 residents while reducing their annual carbon footprint by 169 tons.

"The WaterGEMS software allowed us to do more with less, seek solutions within the city's existing hydraulic structure, identify opportunities for operational improvements and achieve the expected results with significant savings."

-Lucas Emanuel Martins, Engineer, Companhia Águas de Joinville

The digital twin and hydraulic modeling simulations supported the flow and pressure data that was observed in the field, validating model accuracy and reliability. Working with an accurate digital model, the team performed a reliable assessment of their initial proposed solution. "We used [OpenFlows] WaterGEMS to develop a digital twin of the municipality's mains water system in order to evaluate how the system would behave with the proposed changes," said Martins. Based on their findings, they determined that their original contingency plan was ineffective. "With Bentley, we were able to identify these problems in advance and work on new alternatives for the contingency plan," continued Martins.



Using OpenFlows WaterGEMS to create a digital twin of their entire water distribution system, CAJ saved BRL 4.5 million developing a new solution to ensure consistent, reliable water supply. Image courtesy of Companhia Águas de Joinville.

Having established a reliable digital twin, CAJ performed additional analysis, creating drought scenarios without impacting residents, to develop a new contingency solution. They initiated a complete study of the municipality's main water and macro distribution system, evaluating new interconnection points between the Cubatão and Piraí networks. Using OpenFlows WaterGEMS to calibrate the model, CAJ evaluated various operating network stresses to better understand the systems' behaviors and interaction with one another, as well as identified opportunities for operational improvements in both the northern and southern zones. Through digital optioneering and conceptioneering, they designed a new contingency plan that used the existing network to redistribute the water between Cubatão and Piraí, guaranteeing water supply during severe drought, as well as improving overall water distribution to the entire city. "In addition to being operationally adequate, the [new] proposed solution requires less investment for implementation since the study optimized flow dynamics between the sectors, utilizing the existing structures [and] making new mains or boosters – as was initially planned – redundant," said Martins.

DIGITAL TWINS REVOLUTIONIZE THE WATER INDUSTRY

Using Bentley's hydraulic modeling technology, CAJ identified problems with their initial proposed plan prior to implementation, avoiding unnecessary and costly construction. They transformed a project that was not providing the expected results into a solution that not only provided adequate water supply during drought season, but also optimized Joinville's water distribution operations at near zero cost of implementation, saving BRL 4.5 million. The established contingency solution reduced production by 30%, equivalent to 170 liters per second in the fragile Piraí water source, mitigating the effects of drought, benefitting 150,000 area residents. It also simultaneously resolved the issue of the Cubatão system's weak points, reducing water loss in critical district metered area by 40,000 cubic meters per month, and water shortage complaints by 90% on the critical sector. Based on the digital twin, CAJ saved BRL 360,000 in annual pumping costs and 574 megawatts of power, lowering their carbon footprint by 169 tons per year.

"This project is a positive example of how technology can help us optimize our resources," said Martins. Using Bentley's open modeling application provided a feedback loop between the operations and engineering teams. The operations team brings reality and field problems that engineering teams can dynamically assess through digital models. Both teams can collaborate to decide on applicable solutions, bringing a quick response with minimal impact to customers. Using the digital twin provided CAJ with a broad view of their water operations, allowing them to cost effectively improve their system by making wiser decisions and establishing interventions only where needed.

Digital twins are already a reality and bring a huge evolution to the water industry. By accurately modeling their water infrastructure with Bentley's advanced hydraulic technology, CAJ can now ensure sustainable water supply to Joinville, improving the environment and quality of life for the city's residents. "We, as engineers, have an ethical obligation to use these technologies to optimize our resources, whether financial or environmental, and to improve the quality of life of mankind," said Martins.