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Project Summary

Organization:
AEGEA

Solution:
Water Networks

Location:
Região dos Lagos,
Rio de Janeiro, Brazil

Project Objective:
- Develop a master plan extended to 2041 to expand sewerage coverage at reduced costs and further reduce the pollution in Brazil's Lakes Region.

- Increase sewage collection and treatment coverage to 90 percent by 2023.

- Decontaminate Araruama Lagoon to restore social, environmental, and economic benefits to the region.

Products Used:
SewerGEMS®, SewerCAD®, WaterGEMS®, WaterCAD®

Fast Facts

- SewerGEMS built a hydraulic model that integrated GIS, CAD, and SCADA data to create an overview of the entire concession area.

- Modeling scenarios helped prioritize planned investments that were part of the Prolagos concession agreement.

- More than 80 what-if scenarios produced plans incorporating 900 kilometers of combined sewage and drainage networks, 63 lift stations, and seven treatment plants.

ROI

- By 2017, Prolagos invested more than BRL 550 million to achieve 77 percent coverage.

- The master plan reduced the cost of achieving 90 percent coverage by 58 percent.

SewerGEMS Optimizes AEGEA's Sewerage Network Expansion in Lakes Region
90 Percent Coverage Expected at 58 Percent Lower Cost with Master Plan

Saving Araruama Lagoon

Prolagos, an AEGEA company, provides water and sanitation services for five municipalities in the state of Rio de Janeiro, Brazil. The concession covers the famed Lakes Region (Região dos Lagos), where seasonal populations fluctuate from nearly 400,000 to more than 2 million. AEGEA prepared the Brazilian Reals (BRL) 570 million Sewerage Master Plan 2041 to expand sewerage coverage to 90 percent by 2023 and stop contamination of the region's main attraction, Araruama Lagoon. Using SewerGEMS to model the combined sewerage and drainage systems enabled AEGEA to optimize capital expenditures (CAPEX) and operating expenditures (OPEX). Since 1998, the concessionaire has invested more than BRL 550 million, tripling the population's access to clean water and expanding sewage collection and treatment for 76 percent of the population.

Five Municipalities Combine Sewage

AEGEA holds 23.6 percent of Brazil's private sanitation market and now serves 5 million people in 48 municipalities, up from seven municipalities in only seven years. The company has leveraged its growth by forming strategic partnerships with private investors such as Equipav, S.A., GIC Private Limited, and IFC (International Finance Corporation, World Bank Group). These partners help to fund the infrastructure investments required to raise the standard of living in these municipalities.

The Araruama Lagoon had once been a major water sports attraction, but lack of sanitation and illegal sewage discharge had contaminated the waters and killed off the aquatic plants and animals. Hundreds of thousands of residents and more than one million Carnival revelers had suffered ill health as a result of the pollution. Employment in fishing, tourism, and recreation had drastically declined, affecting the regional economy.

To restore balance to the ecosystem and the economy, Prolagos needed to stop the influx of contaminants and reverse the eutrophication of the lagoon. If the Araruama Lagoon's pristine state was restored, tourists would return to the area and spur on the economy. To achieve this, AEGEA established Prolagos as the concessionaire responsible for the Lakes Region in 1998 and went into a 25-year water and sanitation concession agreement, charging the subsidiary with restoring the health of the world's largest hypersaline lagoon ecosystem.

In 2011, the public-private partnership contract was extended with Prolagos to 2041. To find a solution that would yield immediate yet sustainable results, AEGEA worked with Prolagos to evaluate alternatives and formulate the AEGEA Prolagos Sewerage Master Plan 2041.

Planning improvements for this concession area proved to be complex. With five municipalities in its charge, Prolagos operated a sanitary sewage system that incorporated the combined sewage systems for different sewage and drainage areas. Flow patterns varied depending on the amount of precipitation and whether the population was in high or low season. The master planning team needed hydraulic modeling, design, and analysis software to visualize the current and future sewerage network.

Smart Wastewater Management Network Prioritizes Investments

Bentley's SewerGEMS modeling software allowed AEGEA to build a hydraulic model that integrated data from existing GIS, CAD, and SCADA systems. This created a wastewater management network showing an overview of the entire concession area and provided multiple data streams for real-time, real-world decision support. By modeling various what-if scenarios, the project team gained an understanding of how to prioritize the planned investments that were part of the concession agreement through the end of its term in 2041.
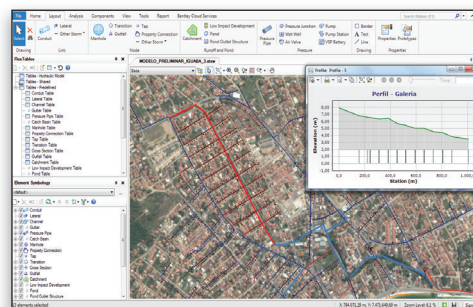
AEGEA utilized their SewerGEMS model to identify the ideal solution by examining numerous what-if scenarios.

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The design and analysis software democratized the planning process by allowing Prolagos to factor in the considerations that were important to the concession area. The vision was to provide sanitation for all communities at a cost that was affordable to every citizen. The plan had to accommodate both residential and tourist population growth over time. Above all, the plan had to provide for the decontamination of the lagoon and the continuous environmental protection of the body of water.

Bentley water and sewer modeling applications enabled AEGEA to observe the gains and losses that would result from each proposed intervention. Running scenarios allowed the team to envision the consequences of their decisions. The team looked at a variety of situations, such as how intervention would affect wet weather discharges into the lagoon; the network impact of separating rainwater and sewage; and the best time to add more household connections to the network. These and other scenarios helped to filter through design alternatives.

The team also integrated Bentley modeling applications with the Prolagos Operational Control Center (CCO), which is the supervisory and control center for the entire water supply and sewage collection and treatment system in the concession area. The team simulated the effects of alternate investment scenarios on operational efficiency, such as daily sewage levels and energy consumption. Hydraulic models for Prolagos' current and future water supply system were also incorporated to avoid conflicts or contamination. AEGEA engaged the Prolagos operations staff in validating the model results.

Selecting an Alternative

AEGEA ran more than 80 what-if scenarios and analyzed more than 2,500 kilometers of sewage and drainage networks in their model. These scenarios ultimately led to the development of nine final scenarios incorporating 900 kilometers of combined sewage and drainage networks, plus 63 lift stations, and seven treatment plants. Each scenario featured different expansion plans over time, with interventions at 5-, 10-, and 15-year intervals.

Two alternatives emerged as contenders for incorporation in the master plan. The first alternative took a traditional approach to sewer design and provided separate sewer systems. Calling for the improvement of the antiquated sewerage system in one of the oldest cities in Brazil, this program would cost three times as much as the average cost. Tariffs were impractical in this scenario and sanitation improvements would not be evident until 2020. This alternative was deemed to be cost-prohibitive.

The second alternative was to create a combined sewer system that utilized the existing drainage systems. The investment required to expand the separate sewerage collection system was affordable and collection and treatment would begin as early as 2001. The plan for this 650-kilometer sewer and drainage network included an interceptor sewer around the lagoon to reduce illegal discharges. Prolagos estimated that this option would increase sewage collection coverage to 30 percent by 2001, 40 percent by 2006, 70 percent by 2011, 80 percent by 2018, and 90 percent by 2023. This cost-effective plan became the preferred alternative.

Getting Buy-in

Developing the master plan using SewerGEMS accelerated the approval process by demonstrating the plan's return on investment. AEGEA drew a triple bottom line—economic, social, and environmental— for measuring the value of the proposed interventions. The master plan addressed the concerns of key stakeholders, including customers, civic groups, government agencies, nongovernmental organizations, and other external groups, as well as internal stakeholders such as AEGEA board members.

The visualization of the network design in SewerGEMS helped stakeholders see the social, economic, and environmental benefits. The master plan AEGEA recommended was optimized for capacity, performance, operating efficiency, energy consumption, and other parameters. Savings at each interval included proven strategies, such as limiting lift stations to one every 15 kilometers, improving pump station efficiency, optimizing pipe sizes, and decreasing sewage treatment volume. AEGEA demonstrated that the plan reduced previously estimated investment costs by 58 percent while still achieving the goal of 90 percent coverage by 2023.

Triple Bottom Line

As of the end of 2017, Prolagos has invested more than BRL 550 million to improve access to clean water, increasing sewage collection to 77 percent. Illegal discharges have dropped to zero. The Araruama Lagoon has been restored, with an organic load removal rate of 10 tons per day and biological oxygen demand reduction from 25 to 5 milligrams per liter. Fishermen report 39 species of fish and shrimp now thrive in the clean water. Waterborne diseases related to unsafe water and sanitation have decreased by 93 percent and related hospitalization costs have decreased by 62 percent. Tourism has resurged, making the Lakes Region the fifth most visited destination in Brazil.

SewerGEMS has allowed Prolagos to achieve the incremental milestones of the Sewage Master Plan 2041 by providing options for maximizing performance while minimizing CAPEX and OPEX. Expanding sewerage coverage to 90 percent was estimated to cost USD 600 million in a 2014 study for the Prolagos concession area, but that estimate was revised to USD 250 million in the Sewage Master Plan 2041, representing a 58 percent cost reduction. Energy costs, one of the highest operating costs for the concession, will be lowered by 30 percent in the Sewage Master Plan 2041. This energy cost savings was obtained as a result of the reduction in pump stations combined with the pumping system efficiency improvement due to the 35 percent decrease of treated sewage achieved with separated systems. This represents an annual cost savings of nearly BRL 700,000.

Based on the success in the Prolagos concession, AEGEA is developing master plans for sewage infrastructure in other municipalities, going beyond traditional financial measures to achieve benefits for communities and the environment. The Brazilian government set a national goal of 93 percent of sewage treatment by 2033. Despite federal funding, investment gaps make the continued participation of the private sector essential. Using SewerGEMS, concessionaires can optimize their investments and achieve a triple bottom line, raising the standard of living and reducing health risks associated with poor sanitation in their service areas.

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