



Project Summary

Organization:

Hatch Australia

Solution:

Water and Wastewater

Location:

Adelaide, Australia

Project Objective:

- Commission a AU\$ 1.4 Billion world-class reverse osmosis desalination plant of daily 100-gigaliter-capacity
- Take pressure off the existing rain water catchment system and allow water levels to regenerate while the plant supports the city of Adelaide operating under permanent water restrictions
- Design and build a 3D model to give an accurate cost estimation for the project
- Use 3D models to visualize the impact of the plant design on the environment and community as the culturally important site posed several design challenges

Products used:

Bentley PlantWise, MicroStation, Bentley Navigator

Fast Facts

- Three factors influencing project success were design efficiency and sustainability, minimal environmental impact, and overall cost of construction, operation, and maintenance
- About 40 percent less time used for the estimation process and optimized plant design for the most efficient use of expensive materials like specialized stainless steel pipe and large bore glass-reinforced plastic pipe using Bentley PlantWise
- Substantial time savings by using 3D model in PlantWise

Desalination Plant Provides a Reprieve From Water Restrictions

Australian Consortium Delivers a World-Class Plant Within Conservative Energy Footprint

SA Water Commissions Reverse Osmosis Plant

As Australia suffers through one of the most serious and sustained droughts in the nation's history, its cities are devising increasingly innovative responses. The South Australia capital city of Adelaide, for instance, has been operating under permanent water restrictions. To take advantage of the abundant salt water in this port town, South Australia Water (SA Water) commissioned a daily 100-gigaliter-capacity, reverse osmosis desalination plant to supplement the freshwater supply, take pressure off the existing rain water catchment system, and allow water levels to regenerate. When completed, the plant will supply from one-quarter to one-half of Adelaide's water needs and will be Australia's biggest desalination plant. Using Bentley software, Hatch Associates was able to quickly provide an optimized plant design that saved time and money.

After a lengthy qualification process, the Adelaide Aqua consortia — comprising ACCIONA Agua, United Utilities, McConnell Dowell, and Abigroup Contractors — was short-listed along with two other concerns. Convinced that any of the three could deliver a world-class plant, SA Water invited the three organizations to provide detailed fixed-price estimates and other design details in order to make a decision based on three factors: design efficiency and sustainability, minimal environmental impact, and overall cost of construction, operation, and maintenance.

To provide the level of detail requested, Adelaide Aqua had to fast track design to within 12 weeks. The consortia contracted the front-end engineering and design (FEED), to Hatch Associates who opted to do this work with 3D modeling technology for two reasons. First, building a model was the best way to get truly accurate cost estimates. With a 3D model, material take-offs could be based on predesigned and proven piping layouts, and plant layout could be optimized with 3D tools and a comparison of different options. Second, the 3D model could be used to visualize plant impact on the environment, community, and a culturally important site. It seemed like an enormous amount of work for what was essentially a bidding document, but with AU\$1.4 billion at stake, the investment was considered worthwhile. Using Bentley's comprehensive

design tools, PlantWise required a lot less manpower than traditional detailed design tools.

Staying on Schedule

Using Bentley PlantWise®, the Hatch team generated a 3D model of the reverse osmosis process building, intake pump station, outfall energy recovery shaft, and other utility buildings within the allocated schedule. The material take-offs modeled in excess of 300 pieces of equipment and 550 major piping process lines. The estimating process took 40 percent less time than anticipated. One aspect of the model work, the piping material take-offs, was especially significant when it came to estimating cost. In desalination plants, two major expenses are specialized stainless steel pipe, which can cost about \$23,000 per installed linear meter, and large bore (up to 2-meter diameter) glass-reinforced plastic pipe. By using the model, MicroStation®, and PlantWise, Hatch was able to optimize plant design for the most efficient use of these expensive materials.



Desalination plant internal layout in 3D

The site itself created design challenges, as it was bound on one side by the creek identified as culturally important and was on steeply sloped land with a height difference of 30 meters from the shoreline to the main access road. The design team was able to compare multiple options to arrive at a system that made the best use of gravity and available access. To mitigate the effects of saline concentrate release, a detailed

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diffusion plan was also devised. Rapid virtual prototyping was used to determine the most efficient layout—after a base reverse osmosis process building layout was defined, three additional building layouts were created and evaluated against the base for overall costs, efficiency, appearance, and other factors.

Reverse osmosis is an energy-intensive process. In fact, so much energy is required that making the case for a desalination plant on sustainability grounds can be difficult. To counter the impact of the energy-intensive reverse osmosis process, energy recovery devices were included in the process building and outfall shaft, and solar energy panels installed on the process building roof. The energy recovery devices use energy stored in the brine to boost the output of the high-pressure pumps feeding the reverse osmosis units. In the outfall shaft, energy recovery turbines will produce electricity and return power to the grid for use by the process plant. The solar panels will power street lighting on site.

Modeling Under Pressure

Alex Stanojevic, iPasDT global functional lead at Hatch, credited the 3D model in PlantWise as a key factor in winning the Adelaide bid. He noted the following significant advantages to deploying 3D modeling:

- When the model was completed, the team could bulk upload the materials take-off from PlantWise into the material control system. This included piping and structural commodities, and was the main tool for developing accurate cost estimates in such a short time frame.
- The estimated 750 hours of modeling time needed in the detailed engineering tool it usually uses (PlantSpace) was cut to 450 hours using PlantWise, which used automatic pipe routing to find the optimum routes for pipes and locations of equipment. This was a 40 person man-hour savings.
- The ability to explore various options and instantly reroute the piping systems was very helpful. Three different plant layout options were developed in two days, and the team was able to consistently reroute more than 550 pipelines in less than two minutes. Also, the software allowed the team to immediately compare material take-off quantities and associated cost differences.
- Project setup, with minimal application configuration, took two days in PlantWise versus an estimated six weeks to build in a conventional 3D environment.

- The model allowed use of Bentley® Interference Manager, which greatly increased confidence in piping layouts.
- The ability to review the design using Navigator with all PlantWise intelligent information enabled greatly enhanced team coordination and allowed review by principals in remote locations.
- The ability to import the PlantWise model into PlantSpace® enabled detailed design and analysis to continue without loss of data.

The work done by Hatch was successful, and Adelaide Aqua was awarded the AU\$1.4 billion contract to build the desalination plant, which is expected to start providing water to Adelaide in December of 2010. South Australian Premier Mike Rann commented on the contract, "After rigorous assessment against hundreds of environmental, technical, financial, legal, and social criteria, Adelaide Aqua has emerged as the consortia best placed to deliver this critical infrastructure for our state."

Minister for Water Security Karlene Maywald added, "The companies involved in the Adelaide Aqua consortium have significant experience in constructing and operating desalination plants around the world, in particular the application of leading-edge reverse osmosis technology. We have said from the start we do not want to compromise the environment and we are confident the approach proposed will ensure that we have a plant designed, built, and operated with maximum environmental efficiency."

Room for Expansion

In a 2009 press release, Adelaide Aqua suggested that the plant eventually could be expanded, and two years after initial completion could be producing as many as three giga-liters a day. That would make the Adelaide plant the largest of its kind in the world and meet well over half of Adelaide's water needs. Without the excellent pricing and operational information provided by a model built and analyzed in less than 12 weeks, Adelaide Aqua may not have been given the chance to realize this important, groundbreaking infrastructure.

"With Bentley's FEED applications, we are able to meet ever-increasing tight schedule demands while not compromising on the accuracy and quality of the deliverables. Allowing us to be competitive. And when combined with our world-class process expertise, this allows us to support our client's needs," concluded Stanojevic.