



# Chaoyang Underground Pumping Station Will Improve Water Supply to 1.5 Million Residents

Bentley's Collaborative 3D Modeling Applications Reduced Design Errors by 95% and Saved CNY 10 Million

## RESOLVING A WATER DISTRIBUTION SHORTAGE

The Chaoyang underground pumping station project aims to pressurize and transfer water to purification plants, which will improve water supply to 1.5 million residents in China's Liaoning province. After pressurization at the station, the water will flow through several pipelines to be treated at different facilities. Then, the water will be distributed throughout the region at a maximum capacity of 440,800 tons per day to help alleviate the water shortage for industrial and agricultural production, the ecological environment, and domestic use. The CNY 82 million water improvement scheme is expected to promote sustainable economic, social, and environmental development that will not only benefit the local area, but also boost the revitalization of Northeast China.

Liaoning Water Conservancy and Hydropower Survey and Design Research Institute served as the design unit for the project, which features numerous aboveground and underground structures, including a power plant buried 75 meters underground, a water supply tunnel, a substation, nine pumps, and aboveground management infrastructure. To ensure adequate water pressurization and distribution, they needed to connect and integrate these structures, and they faced technical, engineering, and coordination challenges managing 13 different disciplines amid a tight timeline.

## ESTABLISHING DIGITAL ENGINEERING PROCESSES

Located in a gully between the Daling River and low hills, the project area is narrow and presented complicated geological conditions, compounded by the underground plant requiring connection to the power distribution room in the aboveground management zone. The site also featured underground functional caverns, including a

ventilation corridor, drainage corridor, and traffic hole, that impacted the tunnel layout, pipeline configuration, and structural connections between the buildings. "The Chaoyang underground pumping station project has a large number of aboveground and underground structures with complex geological conditions, interlaced underground caverns, and densely distributed pipelines for electro-mechanical equipment," said Jian Pan, BIM engineer with the Liaoning Water Conservancy and Hydropower Survey and Design Research Institute.

Faced with these site and structural challenges, the institute realized that 2D traditional design processes were not sophisticated enough to adequately arrange the plant infrastructure on such a short design schedule, and would negatively impact construction and investment. They wanted to implement collaborative 3D digital solutions to efficiently coordinate the multiple disciplines and optimize design and construction while meeting schedule and budget demands. However, to achieve this lifecycle digitalization, they needed integrated BIM and reality modeling technology in an open, connected data environment.

## LEVERAGING BENTLEY'S INTEGRATED APPLICATIONS

The institute selected ProjectWise<sup>®</sup> and MicroStation<sup>®</sup> to develop a collaborative design management system, and leveraging Bentley's 3D BIM and reality modeling applications, facilitated coordinated design and information sharing among the 13 disciplines. Working in this connected data environment provided a unified engineering approach, enabling multidiscipline data management and design, streamlining workflows on the short design cycle. "Chaoyang underground pumping station has comprehensively adopted ProjectWise, 3D geology, oblique photography, 3D reinforcing, 3D virtual modeling, VR roaming and digital delivery to achieve

## PROJECT SUMMARY

### ORGANIZATION

Liaoning Water Conservancy and Hydropower Survey and Design Research Institute Co., Ltd.

### SOLUTION

Water, Wastewater, and Stormwater Networks

### LOCATION

Chaoyang, Liaoning, China

### PROJECT OBJECTIVES

- ◆ To apply BIM technology to overcome challenges designing the Chaoyang underground pumping station.
- ◆ To develop mixed-reality solutions that can be extended into construction, operations, and maintenance stages.

### PROJECT PLAYBOOK

ContextCapture, LumenRT, MicroStation, OpenBuildings, OpenRoads, ProjectWise

### FAST FACTS

- ◆ The Chaoyang underground pumping station will help improve water distribution to 1.5 million residents in Liaoning province.
- ◆ ProjectWise and MicroStation provided a collaborative environment for coordinated modeling and information sharing among the 13 design disciplines.
- ◆ Bentley's open BIM and reality modeling and visualization applications enabled them to fully grasp site conditions and perform clash detection.

### ROI

- ◆ Using Bentley modeling, visualization, and construction simulation applications shortened the design cycle by 20 days.
- ◆ Working in a connected data environment streamlined the design process, improving design efficiency by 40%.
- ◆ The digital mixed-reality solutions reduced design errors by 95% and saved CNY 10 million.

“By using Bentley software, the efficiency of engineering design has been significantly enhanced and design error reduced, providing strong support for the digital transformation of the water conservancy industry.”

-Yichao Han, Chief Engineer, Liaoning Water Conservancy and Hydropower Survey and Design Research Institute Co., Ltd.

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all-around 3D co-design, defeating all difficulties encountered during the engineering phases,” said Wang Yixin, director of the digital center. Using drones and ContextCapture, they collected data and images to generate a reality model of the 1.2 square-kilometer project area, and with OpenRoads applications, developed a 3D geological model for the deeply buried underground plant.

To address the complicated layout, avoid collisions between the cavern structures, and optimize configuration of mechanical and electrical equipment in the limited space, the institute relied on the clash detection features in OpenBuildings® Designer and Navigator. Through the innovative application of LumenRT, they vividly visualized the entire facility design to identify errors and design deficiencies, improving overall design quality. Leveraging Bentley’s integrated software applications, the institute established collaborative digital engineering processes, performed construction simulation, and achieved 3D mixed-reality solutions that allowed them to fully grasp the site conditions and overcome the geological, coordination and technical challenges of the project.

## DIGITALIZATION PROMOTES INDUSTRY TRANSFORMATION

“Bentley’s software has laid a solid foundation for refined design, standardized construction, and reasonable management, as well as created favorable conditions for improving project quality, accelerating design progress, and reducing project investment,” said Pan. Working in a connected data environment using ProjectWise as the collaborative platform simplified workflows and streamlined coordination and communication among the various disciplines, shortening the design cycle from 70 days to 50 days. Using Bentley software to perform clash detection and construction simulation reduced engineering construction costs by CNY 10 million. Compared to traditional design methods, Bentley’s collaborative 3D modeling and visualization application increased design efficiency by 40% and reduced design errors by 95%.



Using Bentley modeling, visualization, and construction simulation applications shortened the design cycle by 20 days.

Through the integration of BIM, reality modeling, and virtual reality technology, the institute clearly and intuitively expressed design intent and achieved digital deliverables that can be applied and extended into the construction, management, and operations of the plant. They developed mixed reality solutions that support coordinated engineering and visually demonstrate the design and construction processes, improving quality and efficiency and resolving on-site issues to achieve design optimization, cost savings, and technological innovation. Based on the success of this project, they have developed corporate collaborative BIM standards and are taking the lead in applying Bentley’s advanced digital workflows to future projects, driving digital transformation within the water conservancy industry.