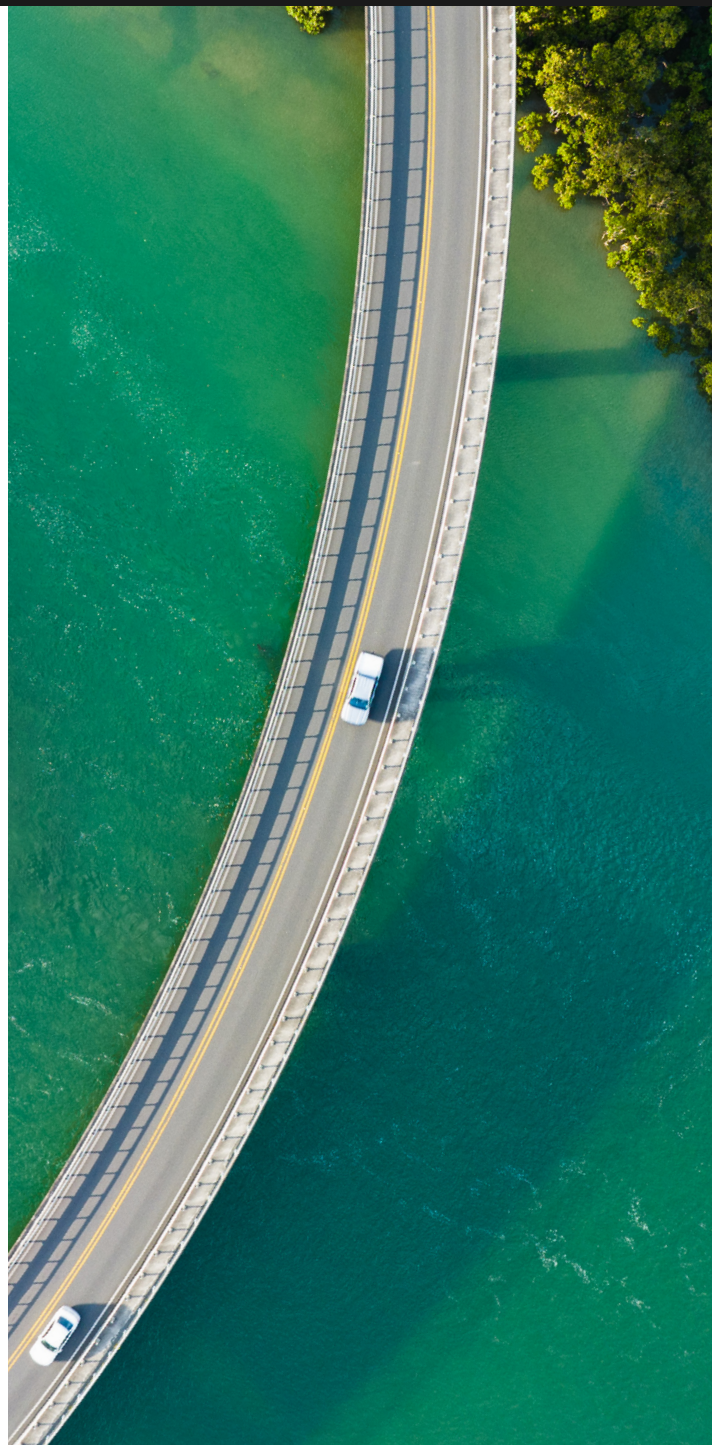
How the World Is Future-proofing Infrastructure: Three Critical Strategies

Designing for the changing climate

Table of Contents



Plan, Design, Build, and Operate Systems for a Changing Climate

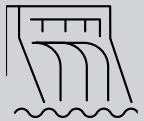
Utilities, governments, and engineering firms across the globe are adapting to the changing climate by future-proofing aboveground and belowground infrastructure. These stakeholders rely on engineering software from Bentley Systems to plan, design, build, and operate systems that can withstand extreme weather events. Cities use our solutions to build drainage systems that can protect citizens in the face of floods, and energy companies use our design applications to ensure offshore wind farms can withstand severe storms, to name just two examples.

Our applications help stakeholders reduce greenhouse gas emissions during and after project construction. Project teams can design bridges that require less energy to operate. Distributed teams can collaborate and reduce the carbon emissions of a new rail system. Cities can heat more homes by optimizing renewable energy reserves. Organizations are also using our solutions to deliver sustainable infrastructure projects on time (or early in the case of EchoWater), allowing them to de-risk project delivery.

In the pages ahead, we'll discuss how industry leaders use our solutions to future-proof infrastructure and solve complex engineering challenges. Their three critical strategies are:

Integrating renewable energy sources—including solar, wind, and geothermal—into the existing electrical grid.

Encouraging public and active transportation modes by upgrading infrastructure.



Creating a holistic approach to water management.

Renewables and Grid

Renewable energy investment and capacity additions reached their highest levels in 2023. Global clean energy investment rose to USD 1.7 trillion, up 7% from 2022. Globally, 50% more renewable capacity was added in 2023 than in 2022, reaching nearly 510 gigawatts. The clean energy transition also has a positive impact on the economy and job creation. However, more renewable power is needed to reach net-zero by 2050. Protecting grid infrastructure is also critical.

Energy producers and their partners are using Bentley solutions to overcome engineering challenges and integrate renewable energy sources into the existing electrical grid.

Learn More

Use Case

Solar Farms in Italy

Italferr S.p.A. | *Italy*

FS Group, one of Italy's largest industrial companies, is working toward a goal to shift 40% of the country's total power generation to renewable energy sources. To help make this transition, the company installed solar farms at 26 locations throughout Italy. This enormous and complex undertaking required careful project management and precise, secure data procedures. Teams needed to track assets, ensure structural support, and monitor security systems at each of the 26 facilities.

Italferr, a partner on the project, chose ProjectWise®, software for infrastructure project delivery, to manage collaboration and establish a connected data environment. Engineering teams used Bentley's design applications to create digital twins of each site. The collaborative environment helped stakeholders understand the design intent and communicate with each other. As a result, teams improved productivity, saved work hours, and reduced the need for on-site travel. These solar farms have helped increase Italy's solar generation by 10%.

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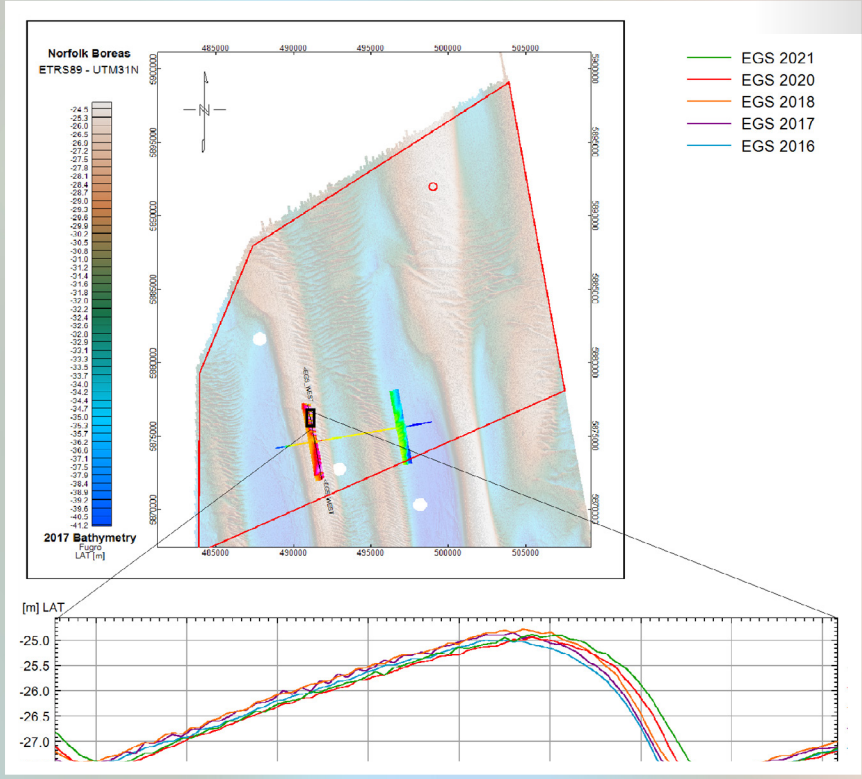
Image courtesy of Vattenfall



Use Case

Offshore Wind Farms on the Atlantic Coast

Vattenfall | *United Kingdom*

Before European energy company Vattenfall built a wind farm off the coast of the United Kingdom, its engineers needed to understand the complex geological conditions of the ocean floor. The depth and stability of the seabed would make a significant impact on the design and positioning of the foundation. Design teams used Oasis montaj® to combine a range of geological data into an accurate terrain model. The data guided teams to reduce the amount of steel used in the construction, safeguard against structural failure, and support the production of renewable energy.

Learn More

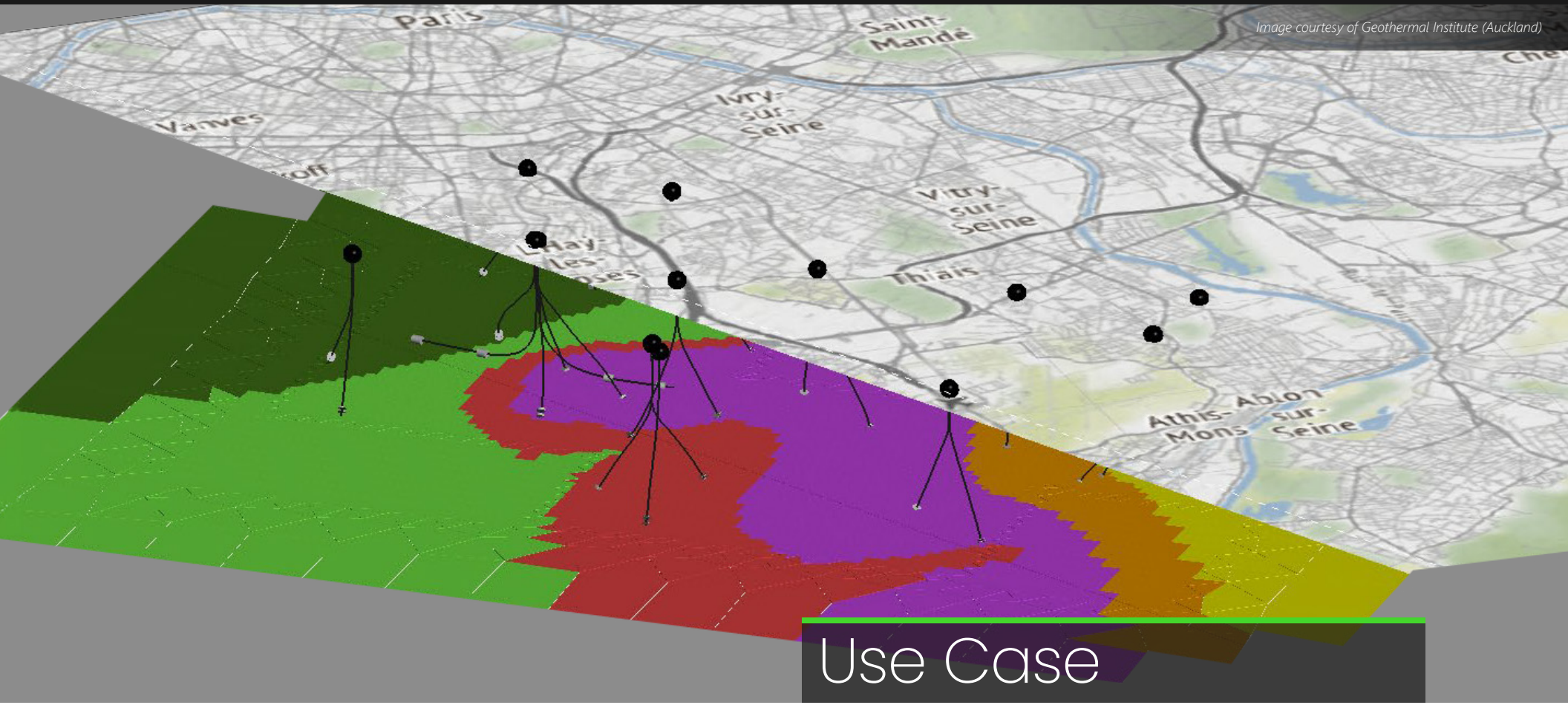


Image courtesy of Geothermal Institute (Auckland)

Use Case

Geothermal Reservoirs in the City of Light

Geothermal Institute (Auckland) | *France*

Geothermal reservoirs under the streets of Paris already generate enough energy to heat over 250,000 homes and the Paris Orly Airport. But engineers wanted to improve their geotechnical understanding of the reservoirs. Researchers from New Zealand's University of Auckland collaborated with Geofluid, a geothermal consulting company, to understand and optimize this energy powerhouse. The team used Seequent's **Leapfrog® Energy** to build a detailed geological model of the temperature and pressure changes within the reservoir. Their findings will help Paris reach its zero-carbon heating goals.

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Public and Active Transportation Modes

The transportation sector presents a huge opportunity to reduce emissions and create cities that are more livable. Transportation accounted for 28% of all global greenhouse gas emissions in 2022, according to the U.S. Environmental Protection Agency.

Mobility planners and departments of transportation are using Bentley's mobility simulation software to make better-informed decisions about how to modernize urban transit and long-distance transportation infrastructure. The technology is helping reduce congestion and improve routes and schedules. In turn, those improvements are transforming urban areas into 15-minute cities, where residents can access their necessities within 15 minutes by walking, biking, or using public transit. Together, these changes are not only cutting emissions, they're also improving quality of life.

Here are some of the ways transportation engineers are using Bentley technology to decrease the carbon footprint of transportation and build sustainable cities.

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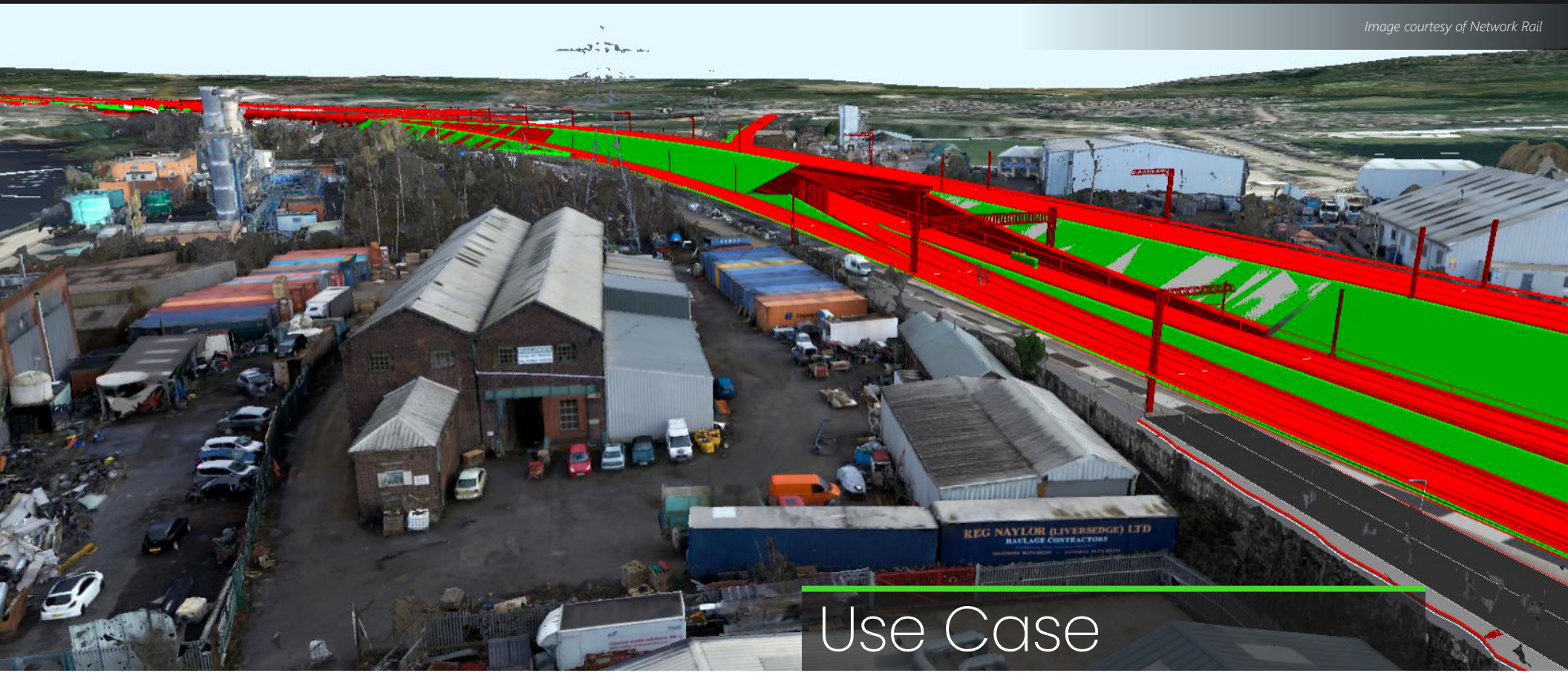

Image courtesy of Network Rail

Use Case

Digital Data and Carbon Platform

Network Rail | *United Kingdom*

Network Rail was looking for ways to calculate and reduce whole-life carbon emissions while managing the construction of HS2, an integrated rail plan for the North and Midlands. To accomplish this, Network Rail—which manages Britain's railway infrastructure—partnered with engineering firm Jacobs to develop a more accurate method for calculating carbon emissions. Engineers used Bentley's digital twin technology to collect data on energy usage, calculate the carbon footprint of projects, and identify areas for improvement.

By focusing on reducing carbon emissions early in the project, when changes are easiest to make, teams can build sustainable infrastructure that will continue reducing carbon emissions for years into the future.

Learn More

Image courtesy of IDOM

Use Case

Developing a Modern Railway in the Baltic States

IDOM | *Estonia, Latvia, and Lithuania*

The Baltic States—Estonia, Latvia, and Lithuania—have lacked a modern railway since the dissolution of the Soviet Union. That's why **the EU has deemed** Rail Baltica a "priority transport project." Rail Baltica, a new passenger and freight railway corridor, will reach over 800 kilometers and connect the Baltic States to the European rail network. Critically, the railway will reduce climate change costs by lowering carbon emissions, atmospheric pollutants, and noise.

Engineering consulting firm IDOM was tasked with **designing 339 kilometers of new track** in six different sections. The engineers needed a connected data environment that allowed teams spread across the region to collaborate in real time. Using Bentley's Open applications, teams were able to collaborate on 3D modeling and create accurate estimates for the construction phase. Engineering teams used **Bentley Descartes™** to integrate and process reality modeling data for information modeling workflows.

Rail Baltica teams achieved a 90% accuracy rate when transitioning from design to construction, minimizing change orders and reaching a new level of quality and sustainability in infrastructure management. Project managers estimate that the rail project will reduce air pollution by 18.3% and lower noise by 4.5%. Rail Baltica will also save 5.3 million passenger hours per year, and billions of euros in both freight transport and climate change costs.

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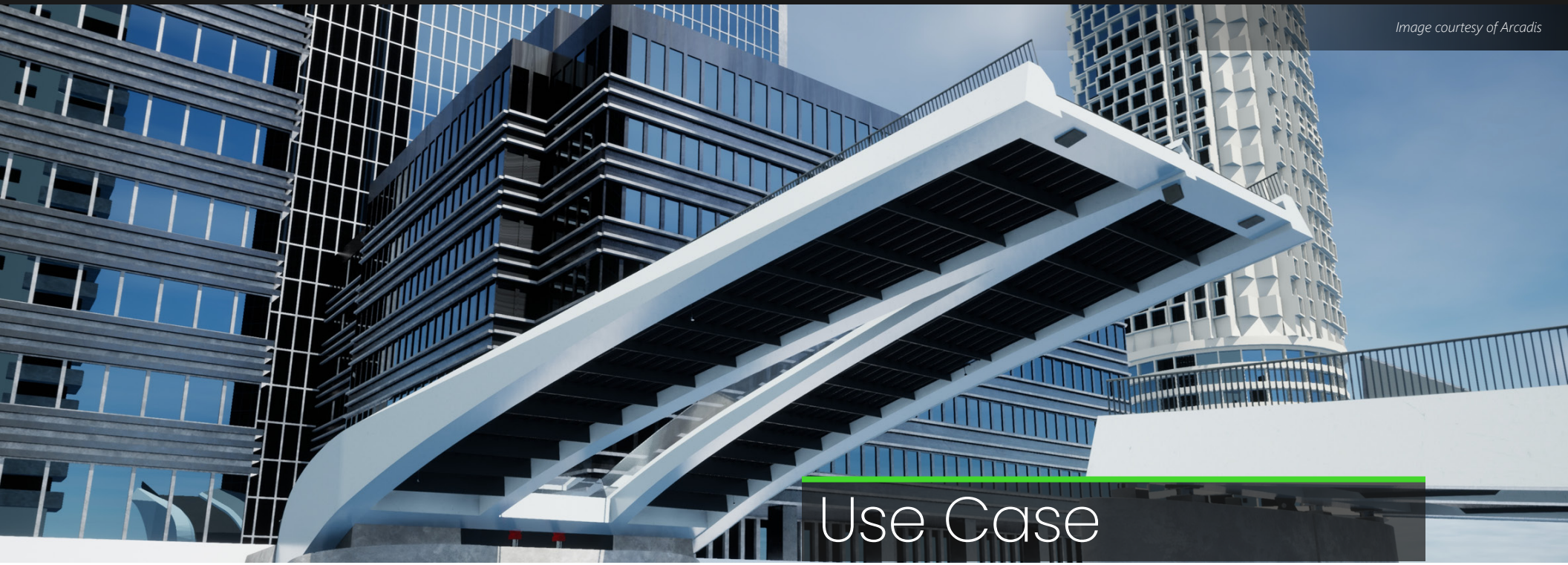

Use Case

South Dock Pedestrian Bridge

Arcadis | *United Kingdom*

Design consultancy Arcadis was tasked with creating a pedestrian bridge in London's central Canary Wharf. The team wanted to design something visually striking that would also lower carbon emissions. This request was an especially tall order because they were designing a bascule, or lifting bridge, which requires energy to open for tall ships.

The engineering team used Bentley solutions to brainstorm and collaborate in a secure, connected data environment. Using a federated model, they accessed and integrated data from separate systems.

They developed a pedestrian bridge with multiple means of reducing carbon emissions. Not only does the design include a concealed counterweight that helps minimize the energy needed to open the bridge, but the engineering team also found ways to reduce the carbon footprint of the construction materials. Finally, the pedestrian bridge encourages people to walk, the ultimate mode of low-carbon transportation.

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Water Conservation and Climate Resilience

Climate change threatens water supply and food security. Droughts and floods displace thousands of people, contaminate water supplies, and claim lives. Southern Europe experienced severe droughts in 2022 and 2023, exacerbating water scarcity and damaging agricultural production in the region. In July 2021, catastrophic floods devastated parts of Western Europe. Over 200 people died, and thousands more were displaced when record rainfall led to rivers bursting their banks, flooding towns and villages. Infrastructure was heavily damaged, with homes, roads, and bridges destroyed.

Governments and utilities across the globe are looking for ways to build resilient water management structures. The solution may be a "one water" approach to water cycle management. This holistic approach aims to manage all water resources together, from source to tap. Those resources include water from faucets, rivers, rainfall, aquifers, and even sewers.

Engineering teams are using Bentley technology to improve water supplies, ensure water quality, and protect their communities.

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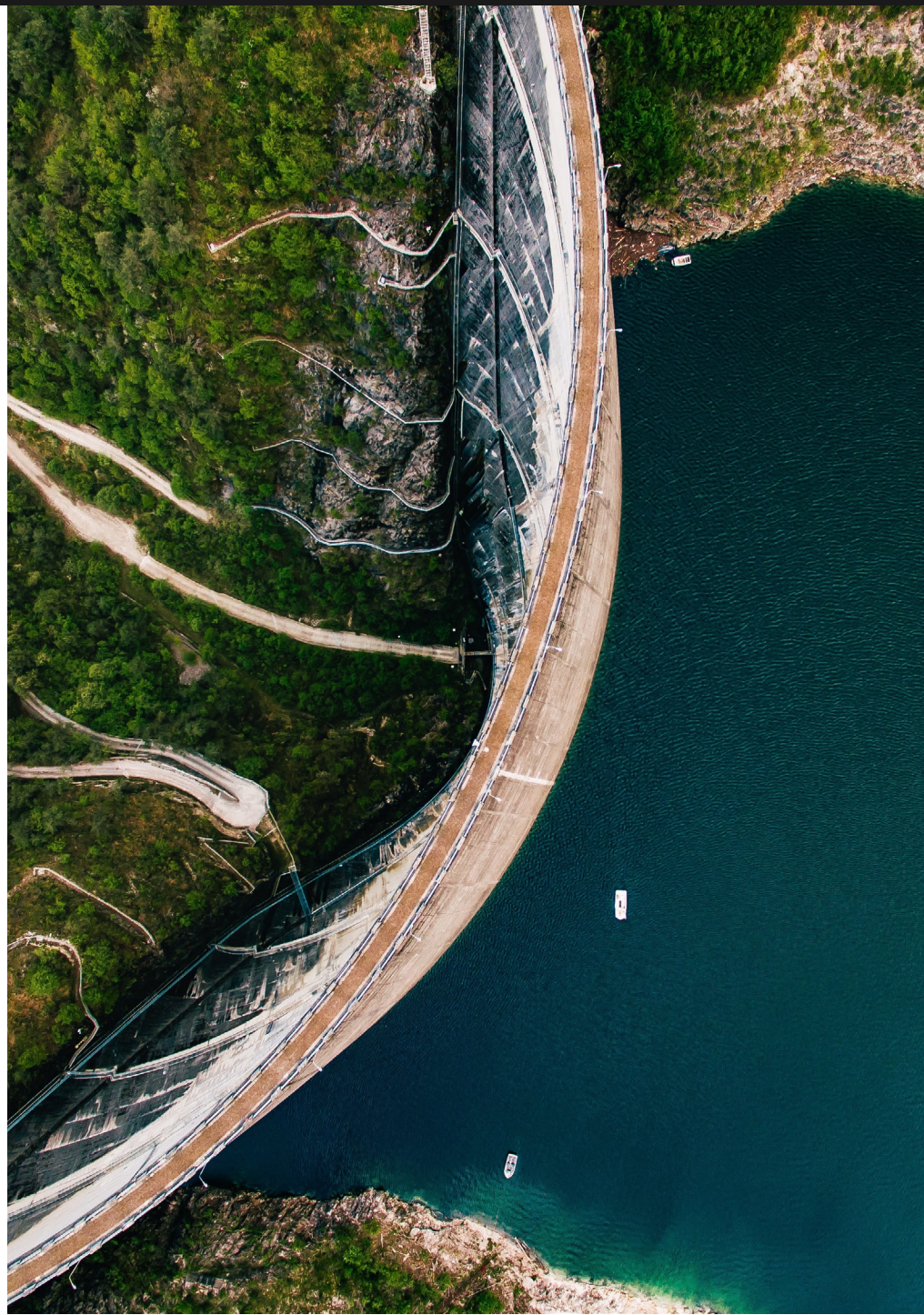

EchoWater Project in California's Central Valley

Project Control Cubed LLC | *United States*

Plant managers at the EchoWater wastewater treatment plant in the Sacramento Valley wanted to upgrade the facility and increase treatment capacity, but they faced challenges. The wastewater discharge permit required that the final wastewater leaving the treatment plant be clean, reusable water to benefit California's Central Valley agriculture. The project also required a team to manage 22 individual projects, improve water quality, and maintain costs.

EchoWater got help from engineering and digital construction firm Project Control Cubed (PC3). The PC3 team used Bentley's digital twin technology to create detailed construction simulations. These what-if scenarios helped the team predict and address obstacles to mitigate the risk of system shutdowns.

The EchoWater project, completed in spring 2023, produces about 135 million gallons per day of tertiary-treated water that can be reused for agriculture. The USD 400-million project was also delivered under budget.

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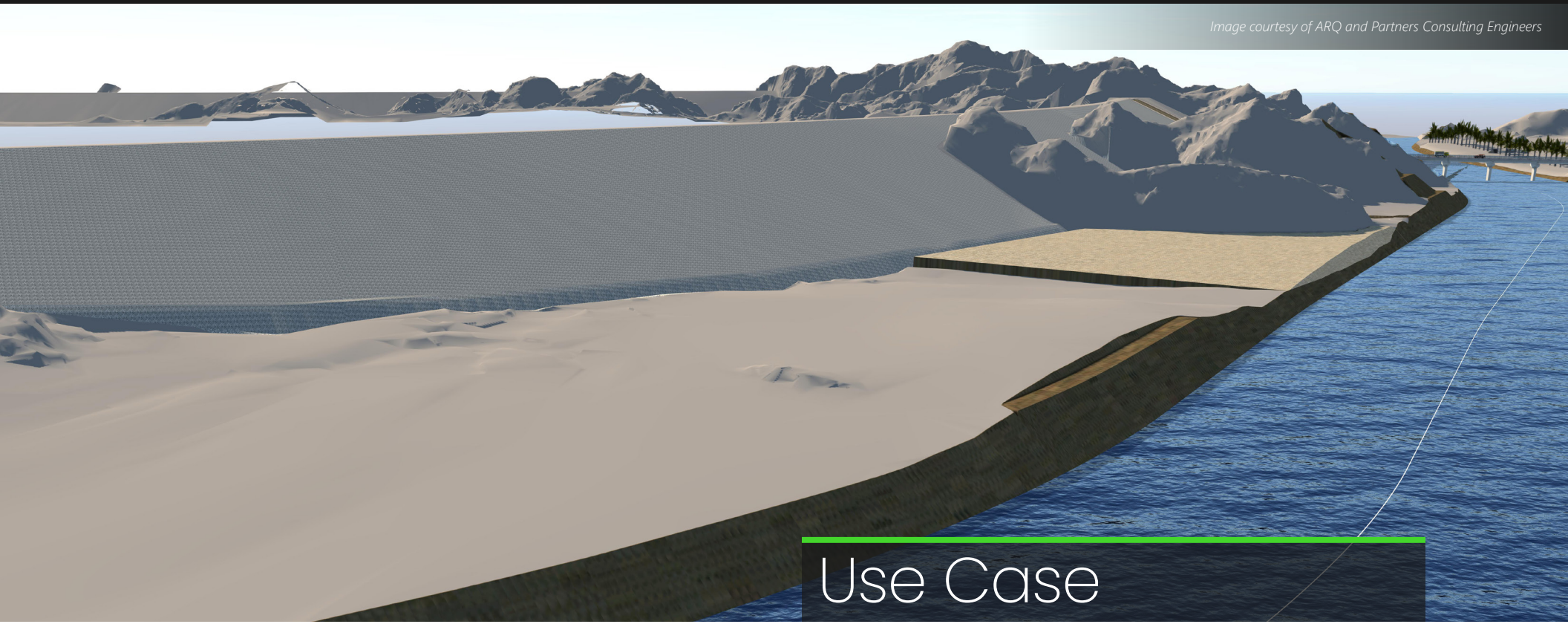

Use Case

Jufainah Dam Crossing in Oman

ARQ and Partners Consulting Engineers | *Oman*

A series of flash floods threatened a community outside Muscat, the capital city of Oman. Oman's Ministry of Agriculture, Fisheries Wealth, and Water Resources decided to build a collection of six dams, including the Jufainah B6 dam, to protect the region. However, the proposed location was along a geological fault zone, creating a challenge for engineering firms ARQ and Partners Consulting Engineers.

The firms used Bentley's PLAXIS® 3D to perform sophisticated geotechnical analysis and assess early designs. The software helped the teams choose a design that would reduce the stress placed on the dam's plastic concrete core. This design lowered construction costs by 30% and reduced the time to build by two months.

The Jufainah B6 dam will help protect over 800,000 people living in the region, while also helping prevent aquifer depletion and providing irrigation to the agricultural region.

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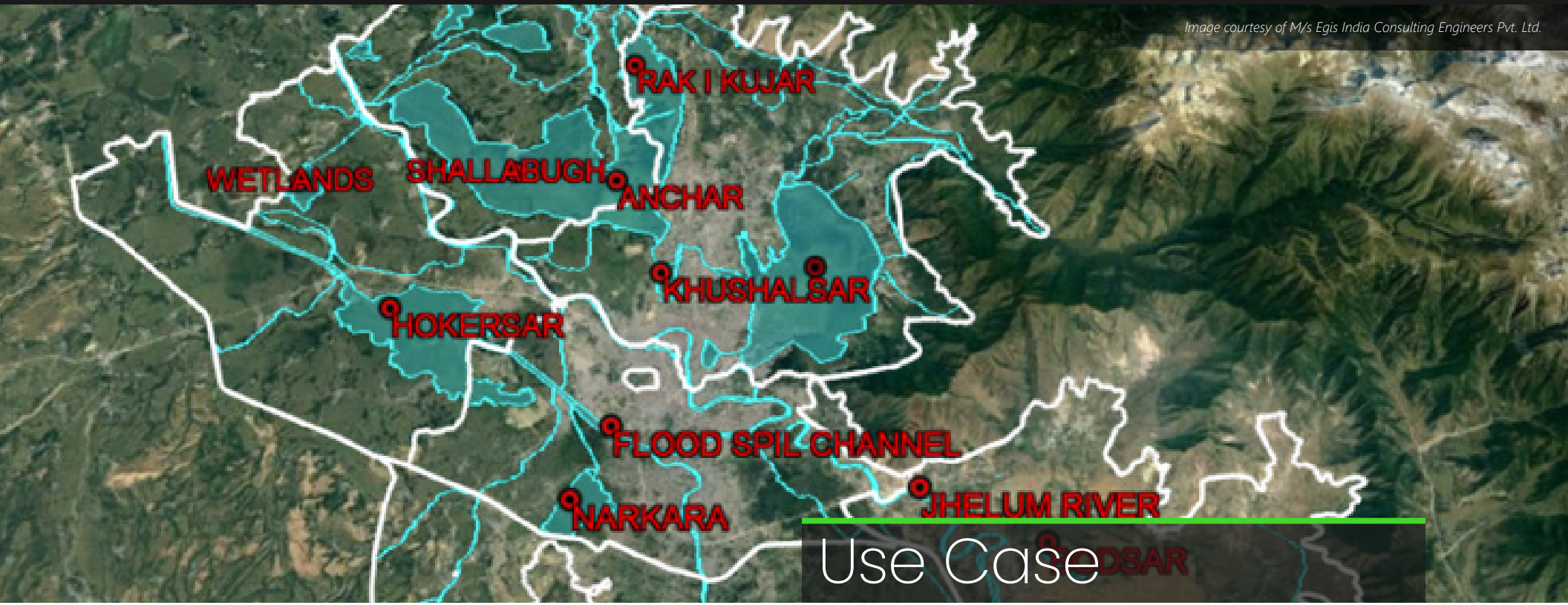

Image courtesy of M/s Egis India Consulting Engineers Pvt. Ltd.

Use Case

Drainage System in Srinagar, India

M/s Egis India Consulting Engineers Pvt. Ltd. | *India*

Srinagar, a city nestled in India's stunning Kashmir Valley, needed to upgrade and increase the capacity of its sewer and stormwater drainage system. However, there were several engineering challenges to overcome. Flat terrain makes gravity-based stormwater drainage difficult, and a severe flood in 2014 had left Srinagar profoundly damaged. The city reached out to M/s Egis India Consulting Engineers to create a 767-square-kilometer stormwater drainage system separate from the existing sewer system.

The engineering teams used OpenFlows™ Sewer to design an effective drainage system. Teams modeled and compared different scenarios to assess the risk of flooding and prevent sewage discharge.

The new system reduces the risk of flood and sewage discharge and has improved water quality and living conditions for Srinagar residents.

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