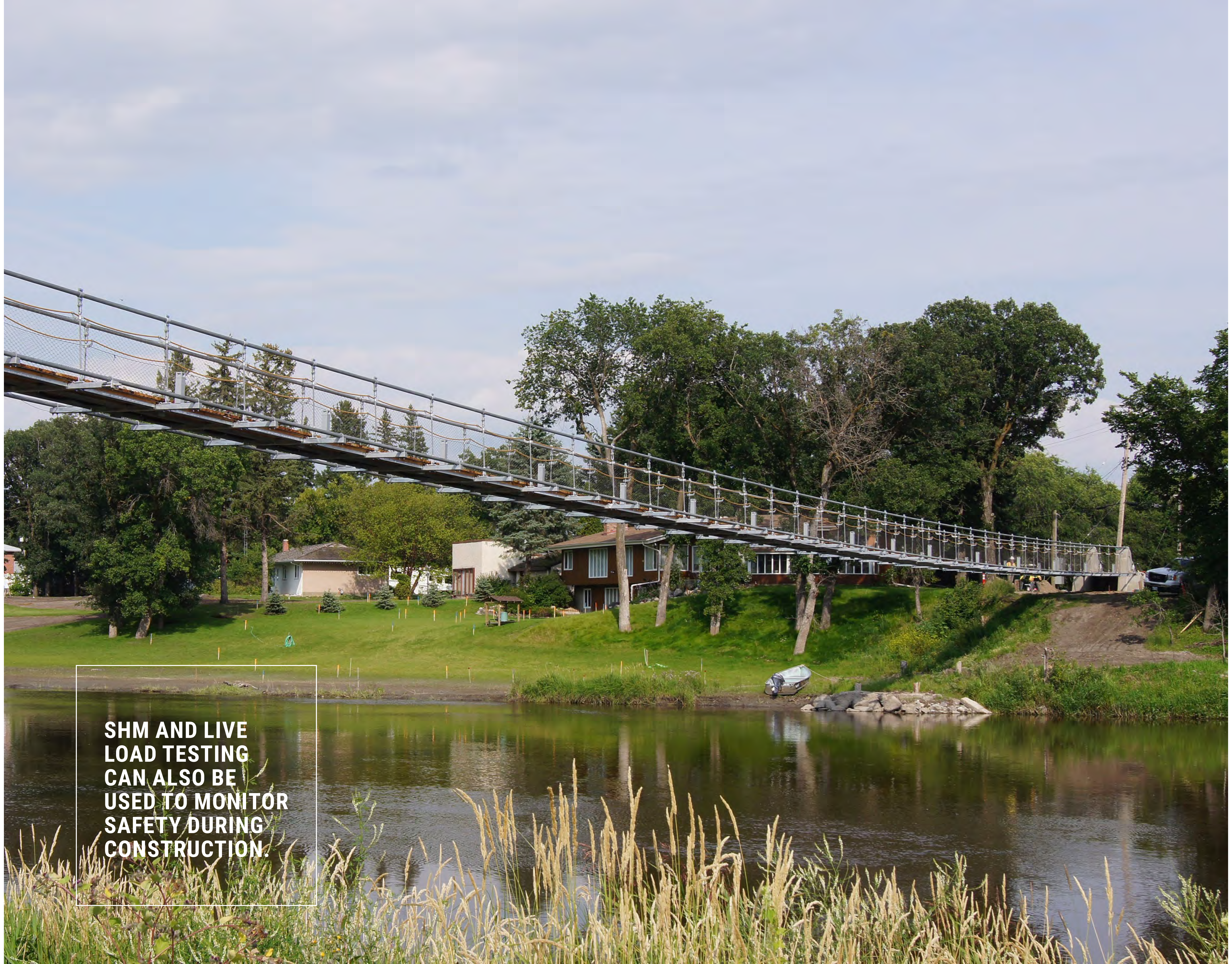
Stantec

Keeping bridges healthy at optimal life-cycle costs

STRUCTURAL HEALTH MONITORING
& NONDESTRUCTIVE TESTING

Overview

Bridges traverse valleys and cross waterways, acting as the backbone to commerce while supporting our communities and the traveling public. Constant exposure to a diverse range of weather conditions and man-made hazards can affect a bridge's ability to provide uninterrupted service and safely support the vehicles that cross it. New materials and complex details tend to be designed conservatively. Through our structural health monitoring and live load testing services, we provide our clients with a reliable condition and capacity of their bridges and structures to reflect as-built in-service conditions and provide advance warning of performance issues. In turn, they can make well-informed decisions to optimally maintain their bridge and other structural assets.

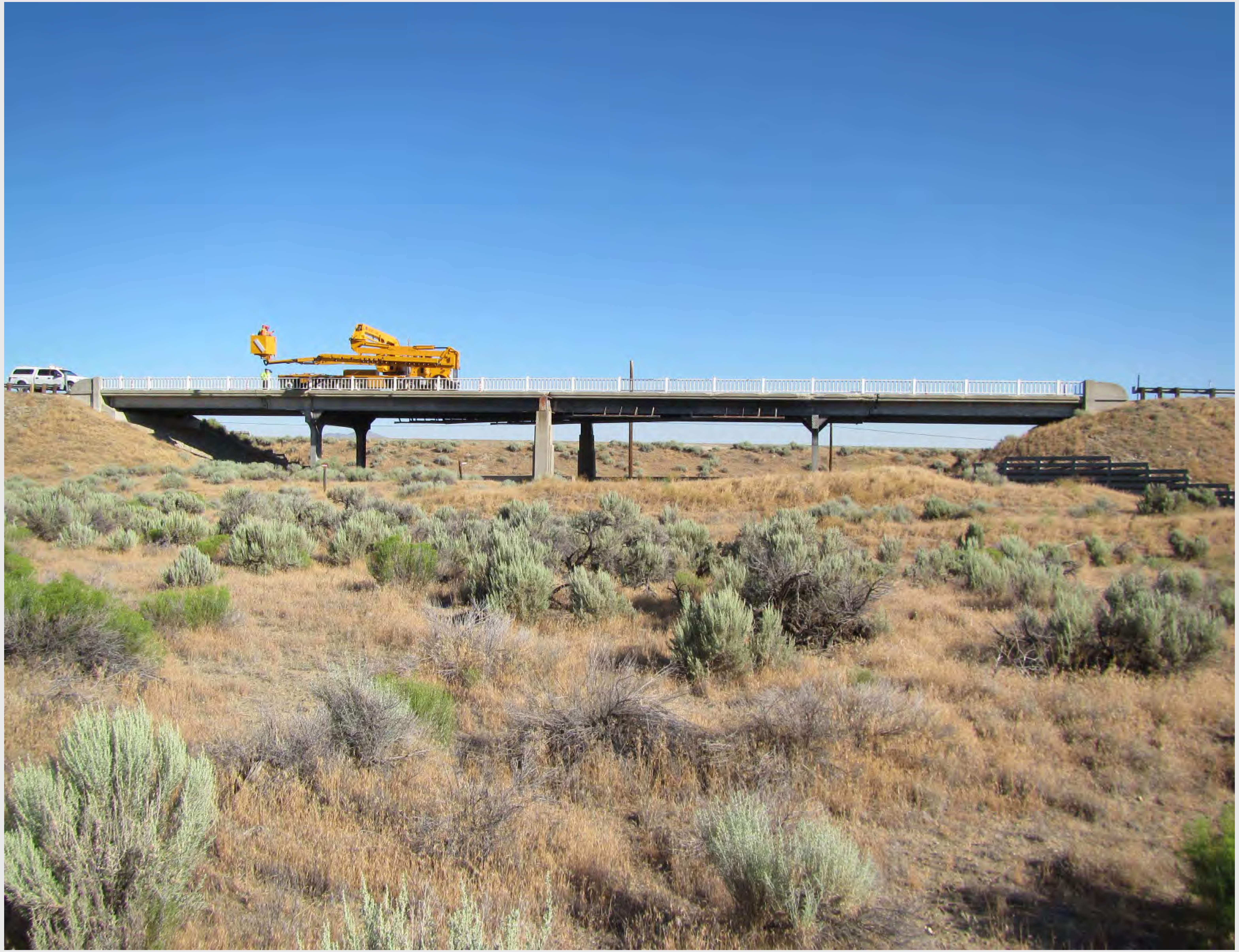


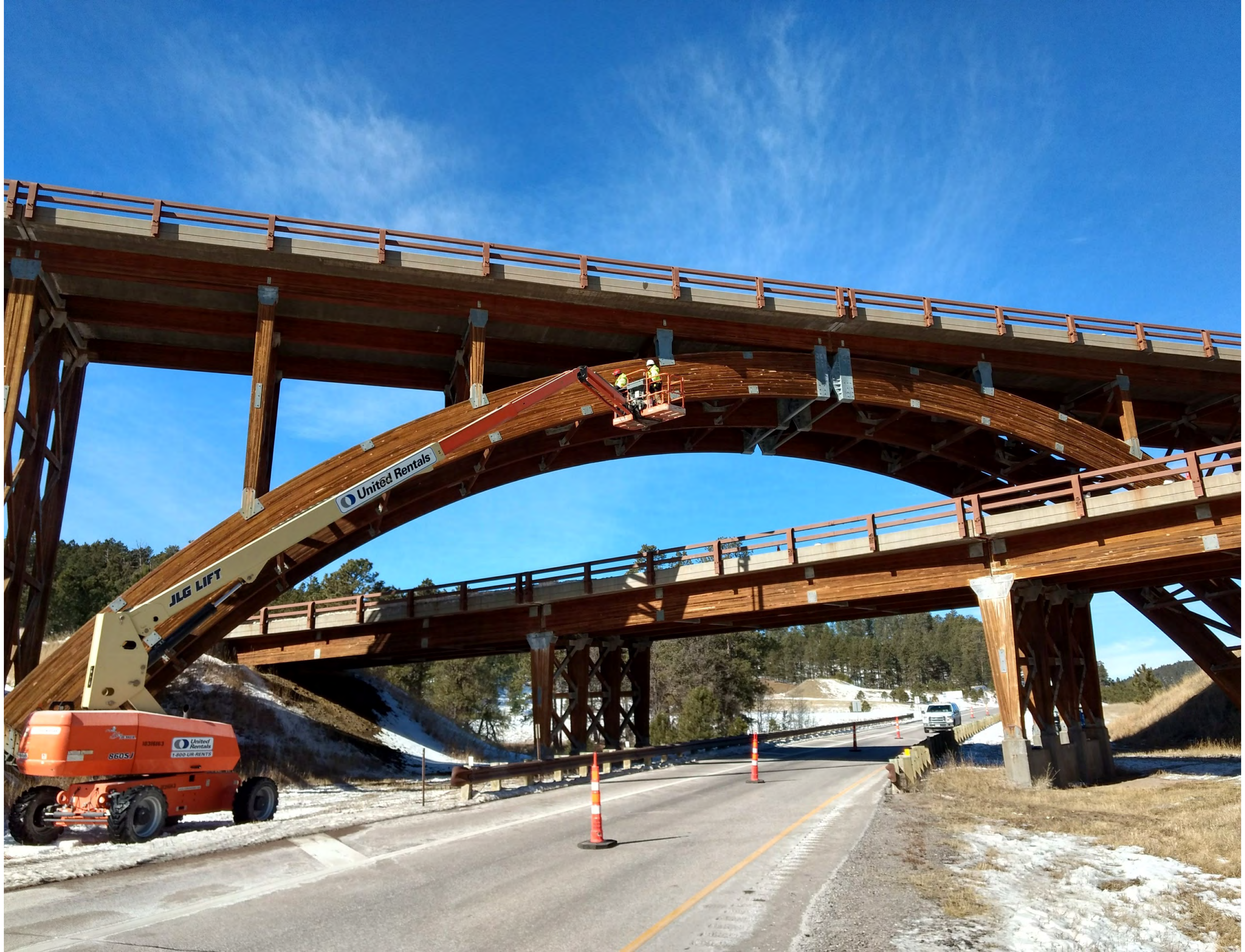
Structural health monitoring

To keep the traveling public safe, fully understanding a bridge's vitality and taking the necessary steps to keep the bridge "in shape" to meet current and future needs is essential. Structural monitoring (SHM) does just that. By combining a variety of sensing technologies and data analytics to capture, log, and analyze real-time demands and associated structural response to those demands, owners can reliably determine the current condition of the bridge, and make data driven informed decisions on what actions to take.

Live load testing

When making critical decisions, the data you base your decision on must reflect actual field conditions for demand and capacity. Current load rating methods paint an accurate depiction, but still rely on a bit of theorization to provide results. Our live load rating services remove the guesswork and erases doubt. Using our instrumentation with sensors, we can measure structural parameters (such as strains, stresses, displacements, vibration, etc.) while under load to obtain realistic structural capacity, modal parameters (natural frequencies, damping, damping, mode shapes ,etc.), remaining service life, and verify theoretical/design assumptions.





Nondestructive testing

To understand a bridge's health, you need to understand conditions of the entire structure. Visual inspections can assess deterioration at the surface but cannot see hidden defects or tell how deep those variances are. Nondestructive testing methods can supplement visual inspections to provide data on the conditions below the structure's surface, giving a complete picture of the current bridge conditions without decreasing the bridge's serviceability.

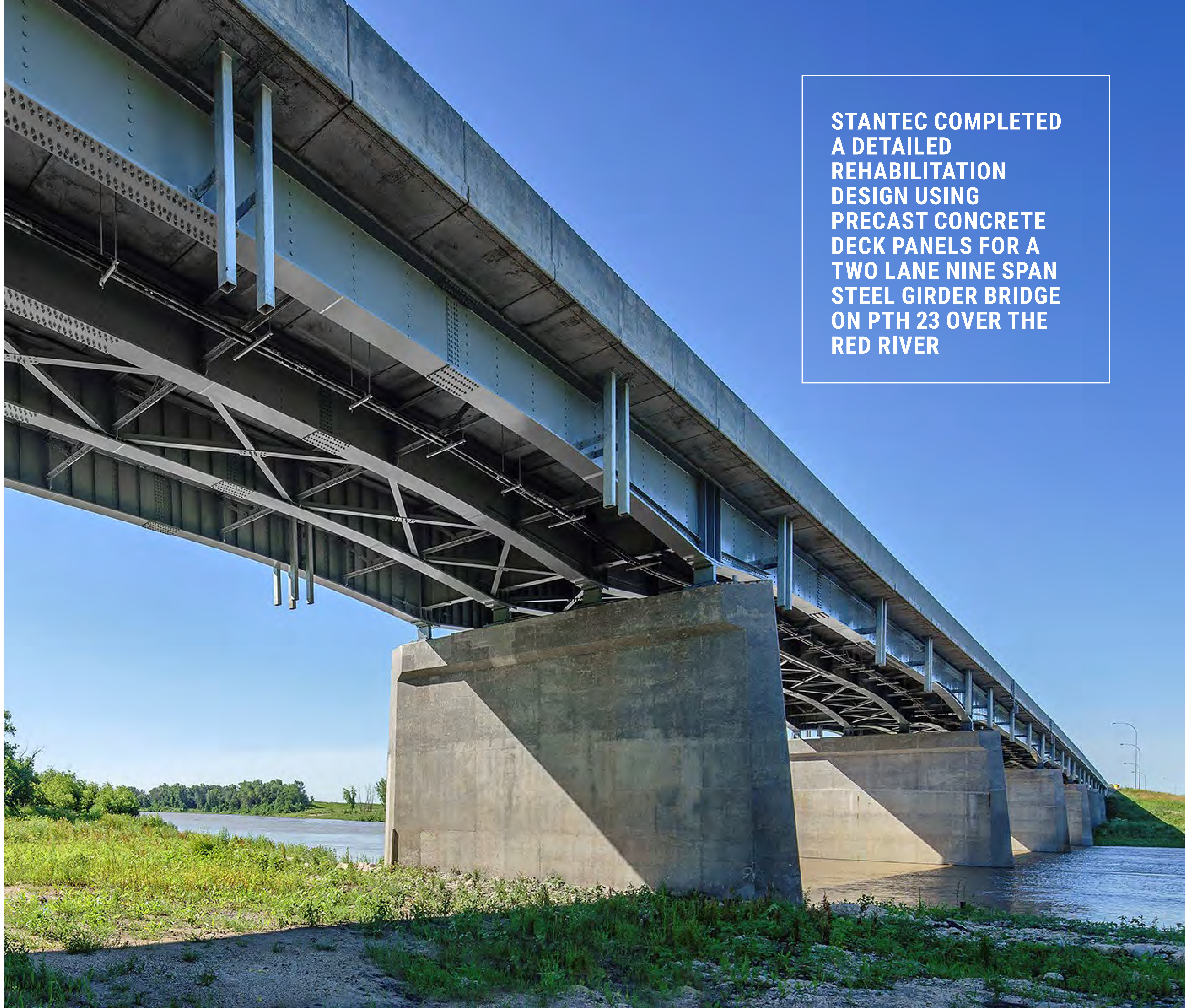
MARQUIS PROJECT

BRIDGE REHABILITATION DESIGN FOR A STRUCTURE ON PTH 23 OVER THE RED RIVER

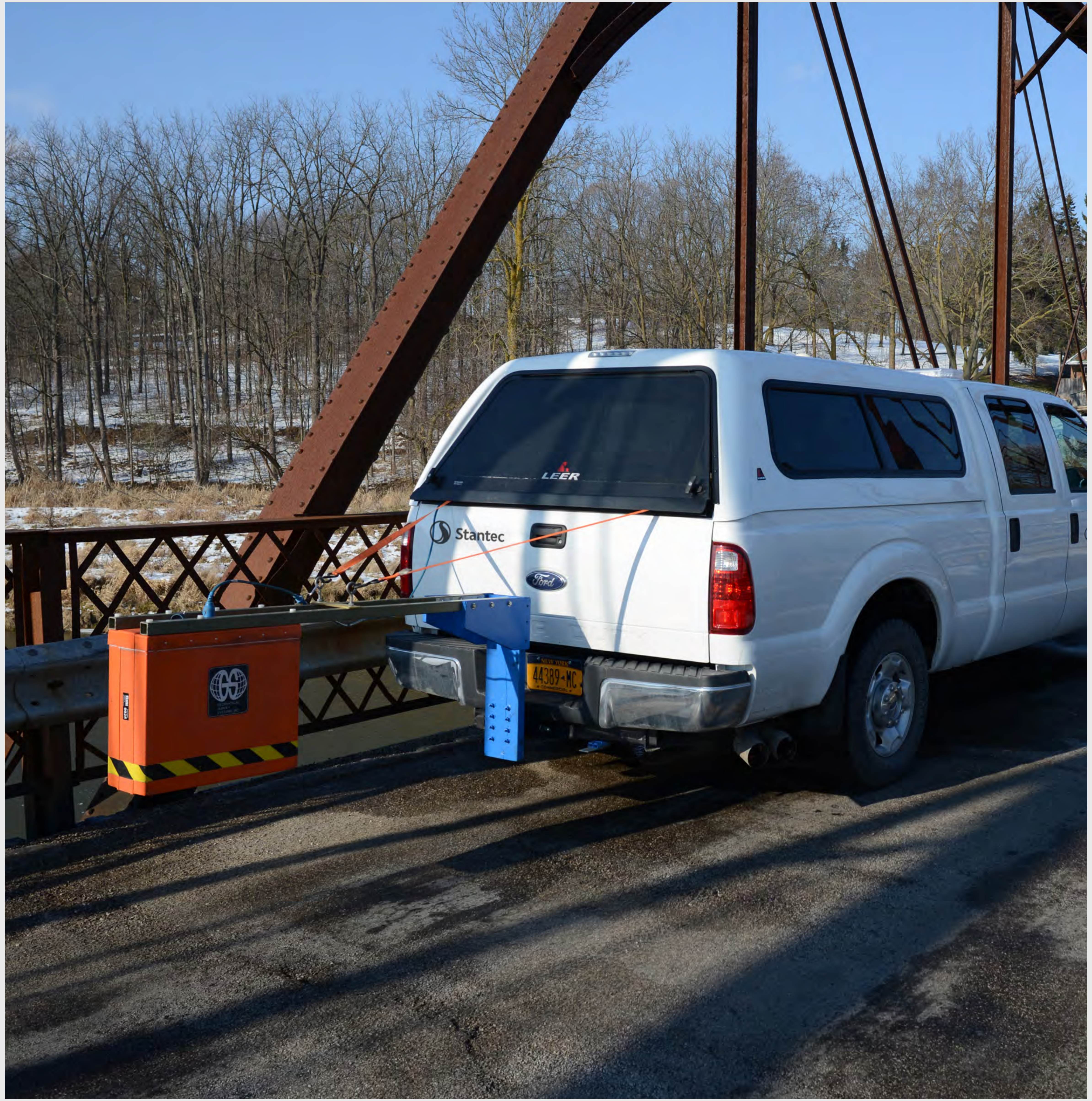
The rehabilitation consisted of steel girder strengthening and replacing the cast-in-place deck with full width full depth precast prestressed concrete deck panels to accommodate current loading requirements. Precast deck panels were chosen to accelerate construction and reduce traffic disruption during potential flood events and planting and harvest seasons. Structural Health Monitoring (SHM) including Bridge Weigh in Motion (BWIM) was incorporated into the structure.

The assignment included a site inspection to identify constraint induced fracture (CIF) details and categorizing them in terms of severity and location. Results were provided in a report evaluating the risk of CIF failure and providing a recommended course of action to the client.

This was the first application of full width full depth precast panels of this magnitude and complexity by the Manitoba Department of Infrastructure. The panels were made composite with the steel girders using Ductal® ultra-high-performance concrete (UHPC) grouted shear pockets and transverse joints. The design incorporated SHM which involved the installation of sensors to provide precast panel performance data to monitor the continuity and composite action with the girders in the negative moment regions. An innovative use of BWIM technology included installation of sensors in two sections of a simply supported span to calculate vehicle characteristics such as truck speed, axle spacing, axle weights and gross vehicle weight. Real time data from the sensor system will be used as input parameters to evaluate the performance of the bridge.



STANTEC COMPLETED A DETAILED REHABILITATION DESIGN USING PRECAST CONCRETE DECK PANELS FOR A TWO LANE NINE SPAN STEEL GIRDER BRIDGE ON PTH 23 OVER THE RED RIVER



CHAMPLAIN BRIDGE GROUND PENETRATING RADAR (GPR) SURVEY

The Champlain Bridge, which connects Ottawa, Ontario to Gatineau, Quebec, was built in the late 1920s and consists of five separate structures. The National Capital Commission (NCC) needed to assess the current condition of the bridge deck which had been in place for 18 years.

We completed nondestructive evaluation methods, specifically ground penetrating radar (GPR) survey and analysis, to determine and identify potential voids, areas of rebar deteriorations, chloride "hot spots", areas of delamination, and rebar cover. Our survey work also determined the observed asphalt thickness and the rebar locations.

We broke up our survey into five segments which correlated to the five structures of the bridge. We provided NCC with a report that detailed the methods used, our observations, and the results from the collected data for the bridge deck in each of the five segments.

By using a NDE method, we were able to provide NCC with an understanding of the current bridge deck conditions without compromising the bridge's useful life.

MARQUIS PROJECT

SDDOT KEYSTONE WYE US 16A BRIDGES BRIDGE INSPECTION, LOAD RATING, AND REHABILITATION DESIGN SERVICES

The Keystone Wye Bridges have been an impressive gateway to the Black Hills for nearly 50 years. Each year, millions of tourists cross these unique structural glued laminated timber bridges to visit Mount Rushmore, Keystone, Custer State Park, and other attractions including the Keystone Wye itself.

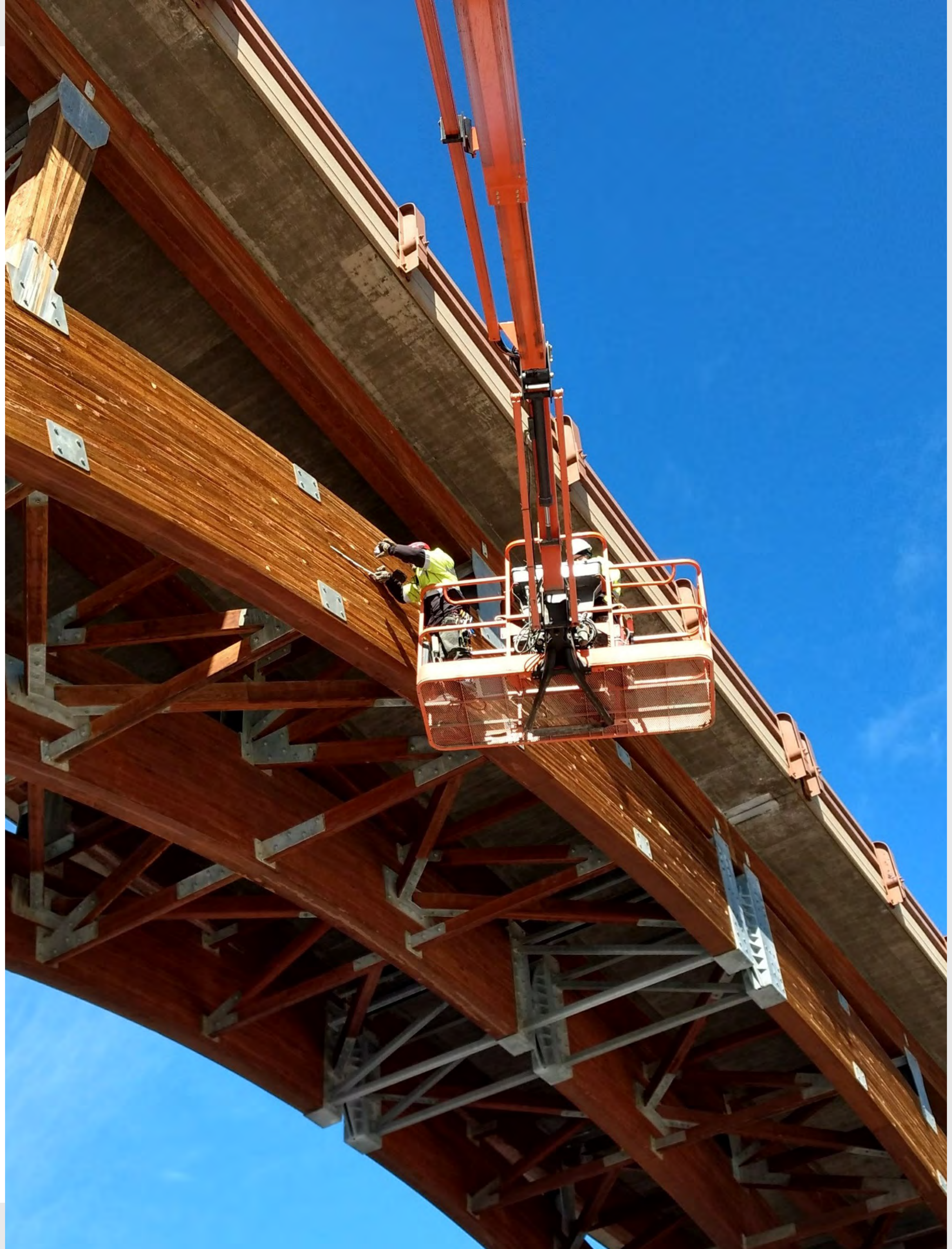
In order to preserve this gateway for another 50 years, the South Dakota Department of Transportation (SDDOT) asked Stantec to help them maneuver through the challenges of assessing the current condition, smartly restoring the structures, and laying out a future path for preservation.

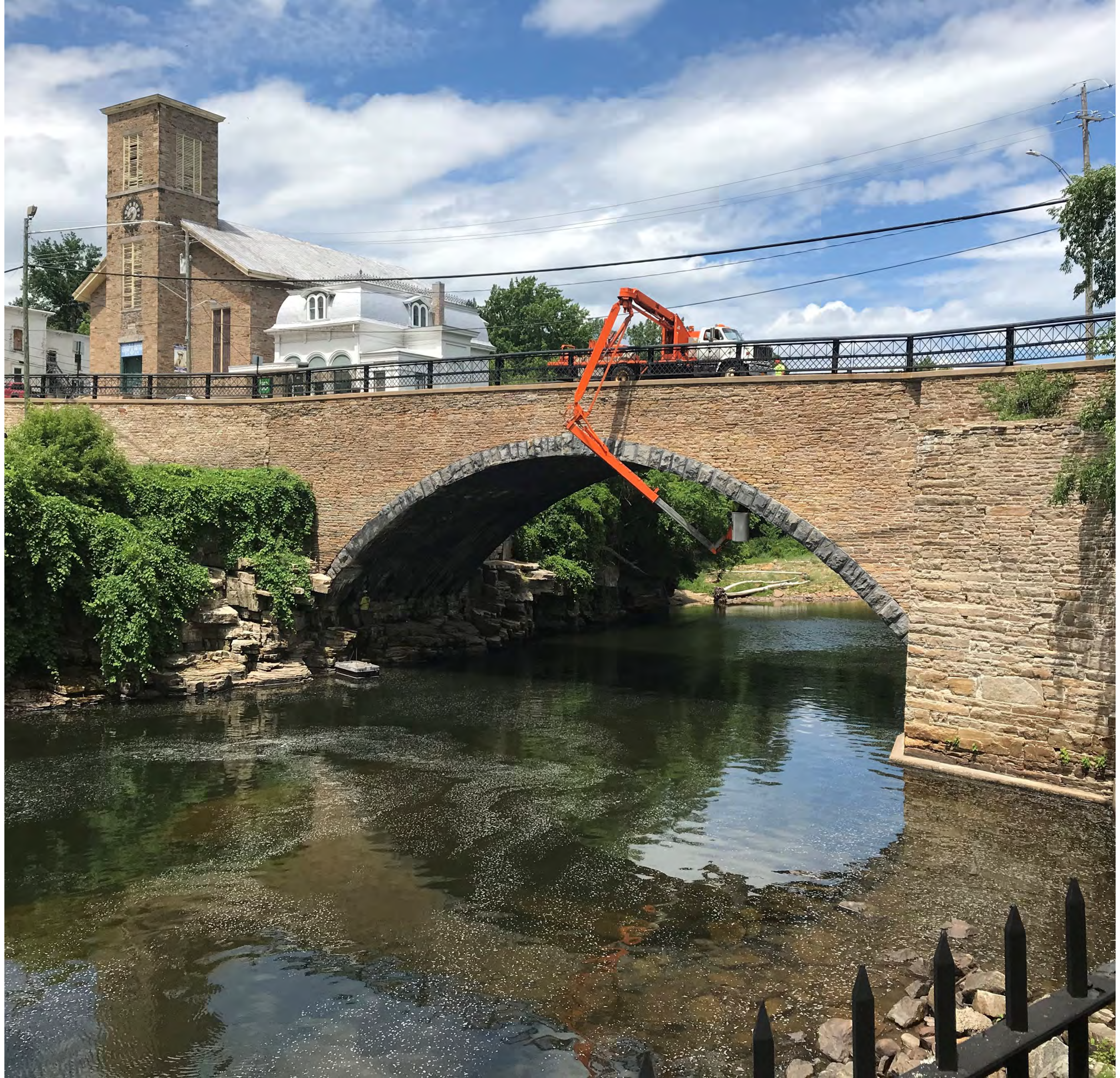
Preservation projects commonly have hidden conditions, which can cause additional risks to the project's cost, schedule, and quality. As the first step in developing a course of action, a team of engineers from Stantec and Wood Research and Development inspected the bridges in March 2018. The team conducted detailed inspections and a high level of testing to fully understand the scope of the bridges' conditions.

Using nondestructive stress wave timing, the team identified the extent of decay concealed within the timber, reducing the risks of discovering unexpected concealed decay during construction. This testing also serves as a baseline data point for tracking the future performance of the timber.

While the timber members are generally in good condition, testing identified areas with reduced specific gravity, which is generally an indication of reduced strength due to decay. Core sampling confirmed the type of timber material. Our team entered the routine inspection data into the SDDOT's bridge management system and presented the findings in bridge inspection reports.

The team's load ratings assisted in identifying alternatives for repair and preservation actions to extend the anticipated service life of the structures. Final design plans, estimates, and specifications are complete and submitted, with construction expected to begin September 2021 with completion scheduled for May 2022.





MAIN STREET (KEESEVILLE) OVER AUSABLE RIVER

Stantec provided preliminary design services for Clinton County to evaluate rehabilitation alternatives for this historic earth filled masonry arch bridge with the goal of removing the load posting and allowing legal loads to cross the bridge. This type of structure has traditionally been categorized as unratable and improvements required to increase load rating capacity are usually extensive. However, our team has been able to generate a finite element model to determine the load carrying capacity of this structure based on current technology and engineering methods. The analysis was supplemented with load testing to measure strains, displacements, and rotations at appropriate locations to calibrate the model and to confirm theatrical assumptions. This innovative approach will allow the County to remove the load posting and progress a minimal to moderate rehabilitation, saving a substantial amount of money.

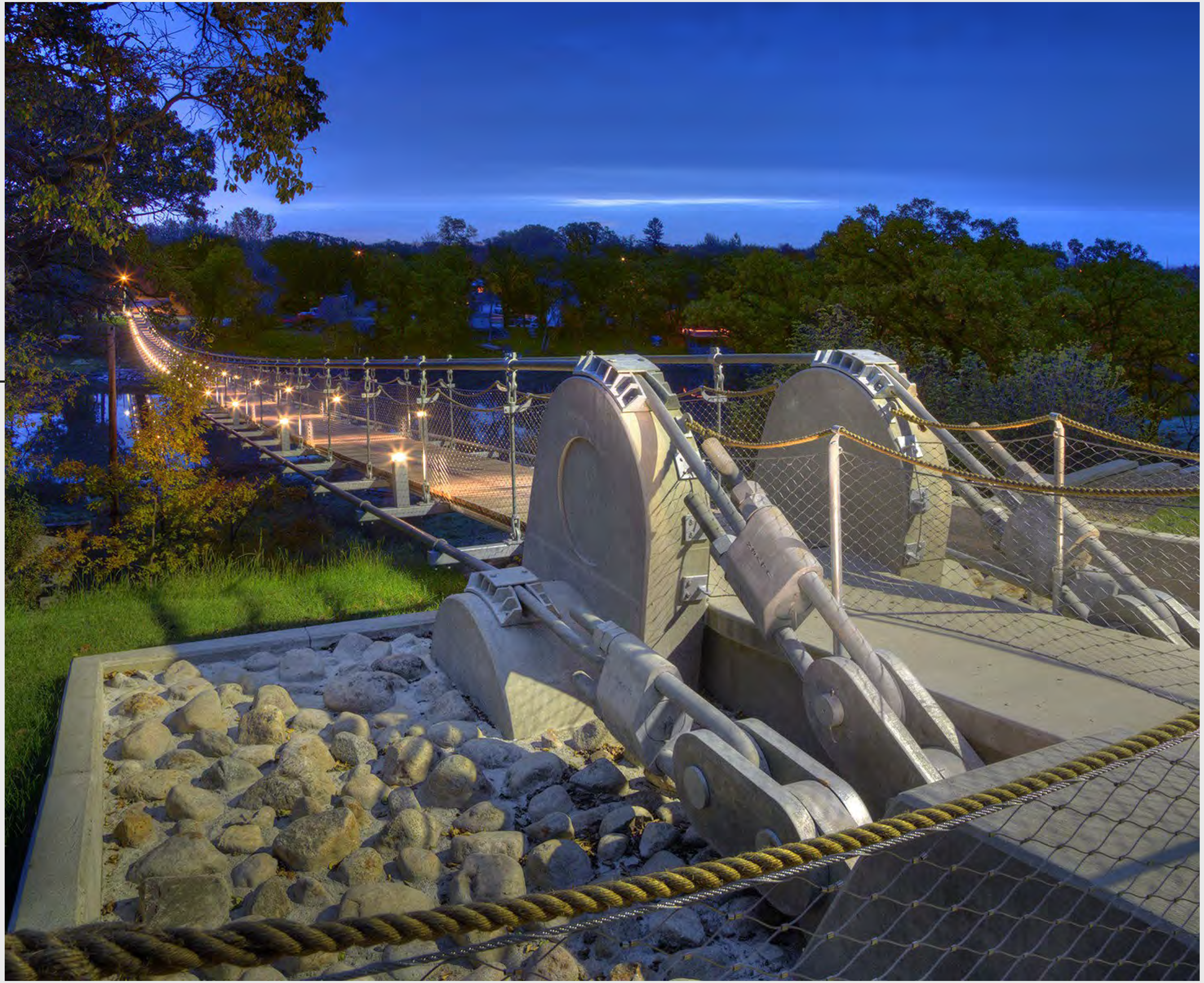
MARQUIS PROJECT

TOWN OF SOURIS SWINGING BRIDGE

When flood waters rose quickly in 2011, the Town elected to cut the bridge loose from its moorings, sacrificing the structure to save the banks of the river. The Town of Souris Council and residents were eager to have their swinging bridge rebuilt. With flood events increasing in severity and frequency, Stantec engineers designed a bridge to accommodate this reality. The new bridge is approximately 1.7 metres higher than the previous bridge. It is also founded on steel H-piles and soil anchors for stability.

The town also wanted to hold onto their thrill-seeking attraction of a swinging bridge. We designed the bridge to span 184 meters, the longest pedestrian suspension bridge in Canada. We worked with 30 soliders from the CFB Shilo to test the dynamic behaviour of the and ensure pedestrians' safety. We placed 20 accelerometers in five locations which recorded the lateral swinging, vertical, and twisting movements of the bridge under normal and extreme load conditions. The bridge passed all tests.

Designed by Stantec engineers with the community in mind, built by WBS Construction, and with a landscape designed by HTFC Planning & Design, this beautiful bridge recreates a memorable and historic landmark in the picturesque Town of Souris.



Design with community in mind

Communities are fundamental. Whether around the corner or across the globe, they provide a foundation, a sense of place and of belonging. That's why at Stantec, we always design with community in mind.

We care about the communities we serve—because they're our communities too. This allows us to assess what's needed and connect our expertise, to appreciate nuances and envision what's never been considered, to bring together diverse perspectives so we can collaborate toward a shared success. We're designers, engineers, scientists, and project managers, innovating together at the intersection of community, creativity, and client relationships. Balancing these priorities results in projects that advance the quality of life in communities across the globe.

Stantec trades on the TSX and the NYSE under the symbol STN. Visit us at stantec.com or find us on social media.

CONNECT WITH US

STANTEC.COM