COMMUNITY outreach was an important component of two of the projects featured in this issue—the Brightwater Treatment System, in King County, Washington, and the Lake Champlain Bridge replacement, which links the communities of Crown Point, New York, and Champlain Point, Vermont. In the case of the Lake Champlain Bridge, the daily lives of residents were severely disrupted by the closure of the structurally distressed 80-year-old bridge, as they were cut off from employment, medical services, and child care, for example, and local farmers faced the problem of not being able to bring in their full harvests or tend to their livestock. The public outcry was extraordinary, and a temporary solution—a ferry service—was implemented. As Theodore P. "Ted" Zoli, P.E., MASCE, explains in his first-person article, the existing bridge replacement involved an approach known as dynamic design/build, which was executed at an unprecedented speed. During a six-day public involvement process, residents, a public advisory committee, and historic preservation consultants were able to review five proposed bridge replacement alternatives. As a result, residents were fully on board with the design of the replacement bridge, which had been designed within a span of just 10 weeks.

In the case of the Brightwater Treatment System—one of the most advanced in the United States—King County established a comprehensive public outreach program to alleviate any concerns and ensure that the 11.6-acre site would be an asset to the community. Thanks to community involvement, the facility features public open space that integrates wildlife habitats, storm-water management, and recreational and educational facilities of which the community is proud.

From the outset of the project, local residents placed high importance on environmental stewardship and placed an emphasis on state-of-the-art technology that would protect water quality. To this end, King County elected to use membrane bioreactor technology in lieu of a conventional activated sludge approach.

In the current economic climate, with widespread concern over budget deficits and public spending at all levels of government, it is likely to become increasingly important to engage communities in this way. Large infrastructure projects are often costly, time-consuming, and inconvenient, and they leave communities with liabilities regarded as either assets or liabilities. By engaging all interested parties in decisions about location, design, timing, and cost, engineering firms and their partners can engender the type of support from those constituents that makes executing those projects easier and leaves communities with infrastructure for which they truly feel a commitment to preserving and maintaining in the future.

Anne Elizabeth Powell
Editor in Chief
A BRIDGE BY THE PEOPLE, FOR THE PEOPLE

Motivated to reconnect two communities devastated by the closure of the Lake Champlain Bridge, HNTB Corporation designed a replacement span within 10 weeks. The modified network tied-arch bridge, created for maximum constructability, features a center arch span that was built off-site, floated in, and lifted 75 ft into place. The new structure opened a little more than two years after the existing bridge had been closed, setting a precedent for accelerated bridge delivery.

By Theodore P. "Ted" Zoli, P.E., M.ASCE

RESTING STATELY AND QUIETLY amid the Adirondack Mountains, the Lake Champlain Bridge made it possible for the rural bistate communities of Crown Point, New York, and Chimney Point, Vermont, to share life-sustaining economies and life-saving emergency services, including a hospital and a fire department. Nearly 3,500 motorists a day relied on the bridge as the most efficient route to work, school—even the grocery store.

I know all of this because I was born 90 mi to the east of the bridge and grew up in the region. My grandfather was a road builder, and he and my father's construction company built a few sections of the Northway (Interstate 87) through Adirondack Park. I grew up around construction equipment and could run a bulldozer long before I had a driver's license. Whenever I had a reason to go to Vermont, I would make a point of using the old bridge. The trip would cost me an extra half an hour, but the vantage point to view the lake that you got and the whole experience of crossing the bridge made it well worth the extra time.

Little did I know while crossing the bridge that some 30 years later I would have to make a call to the New York State Department of Transportation and recommend demolition of the iconic structure.
The center arch span would be constructed simultaneously with the approach spans and then be floated in, lifted 75 ft, and attached.

The entire environmental, design, and construction process would be completed in a little more than two years. The Lake Champlain Bridge was a historic steel truss bridge stretching 2,187 ft across the water. When it opened in 1929, it held an important place in the evolution of continuous trusses and in the practice of U.S. bridge engineering. Its designer, Charles M. Spofford, was an early pioneer in design methods for continuous systems, particularly trusses. His 1937 book, Theory of Continuous Structures and Arches, discussed in detail the design aspects of continuous truss bridges. This structural form was a clear early innovation in the design of continuous trusses, and Spofford’s rule in its development cannot be overlooked.

By 2009 the bridge had reached 80 years of service life, and deterioration was progressing rapidly in both the superstructure and the substructure. That summer the bridge’s joint owners, New York and Vermont, executed a bistate agreement to commence project scoping. Under this agreement, NYSDOT would be responsible for advancing the project. The three colead agencies—NYSDOT, the Vermont Agency of Transportation (VTrans), and the Federal Highway Administration (FHWA)—would share project oversight.

HNTB Corporation, out of our New York City office, with a team of subconsultants, was contracted to carry out project scoping with the intent of continuing through the environmental impact study and possibly through bridge rehabilitation or bridge replacement. Project scoping through final design was estimated to take approximately five years. In a matter of weeks, this timeline would change dramatically.

On August 26, 2009, representatives of the colead agencies and HNTB walked the bridge. There were a few dozen of us. The truss was clearly under distress, but I had seen worse. After the walk-through, we got in a boat with NYSDOT’s Region 1 structures engineer, Tom Hoffman, to inspect the unreinforced piers, which were in surprisingly bad condition. I leaned over to Tim and said, “We won’t be replacing this bridge because of the truss. It’s bad but looks repairable; the piers look shot.”
Assessing the condition of the Lake Champlain Bridge was the first time we deployed accelerometers and tiltmeters to identify a structure's behavior and fragility. This provided NYSDOT with continuous measurements of the piers under daily thermal cycles. A visual inspection told us the piers were damaged significantly and quite fragile, but there is nothing like quantitative evidence to put more certainty behind a rough decision like closing a bridge.

In the literature regarding the design of the Lake Champlain Bridge, Spofford was asked specifically about the use of unrefined piers, but he doesn't give a direct answer. He must have been influenced by the quality and strength of the concrete, which he had developed specifically for the project. Next to the site were iron ore mine tailings, which were used as aggregate for the concrete of the piers. The iron ore is from the New York side of Lake Champlain and the iron ore quality was the highest from anywhere in the world at the time.

Spofford conducted tests at the Massachusetts Institute of Technology using the mine tailings as aggregate and declared the concrete to be unusually strong. As part of the test series, he even simulated casting concrete in deep water (more than 50 ft) and invented a new means of placing underwater concrete by bucket instead of by tremie. However, this method of construction precluded the placement of reinforcement without divers, and using divers would have been unusually complex, expensive, and dangerous.

FOR MANY AREA RESIDENTS October 16, 2009, began as any other day: with a commute across the Lake Champlain Bridge. They would be the last ever to use the iconic span.

On August 29, 2011, the assembled center arch span was lifted into the lift location on the center arch span to 39 ft 6 in. high (typical).

George made the decision alone, and he made it swiftly. By 1:30 PM the bridge was closed. We immediately began working on an emergency stabilization strategy. But after three weeks of developing a workable solution, we came to the conclusion that we would spend more money fixing the bridge than we would replacing it. Further, to perform repairs, crews would have to understand the structure, and such operations, coupled with high winds, cold weather, and lake ice, could further destabilize the structure. The risk to personnel was too great. Our recommendation, the bridge was destroyed by means...
of controlled demolition on December 28, 2009.

The immediate effect of the bridge’s closure on local residents was far reaching. The only viable alternative route during winter months added 95 mi to commutes. Residents were cut off from employment, medical services, child care, and family members. Farmers with fields on opposite sides of the lake could not bring in their fall harvest as there was no way to get equipment across the lake. Others were leaving home at 3 AM to arrive at work on time. The public outcry was on a scale that is hard to articulate. Their lives simply did not work with the bridge out of service.

On October 20, 2009, less than a week after the closing, Vermont’s secretary of transportation, David Dill, issued a declaration of emergency, followed the next day by New York Governor David A. Paterson’s rare disaster emergency declaration.

The 83-year-old bridge was considered building a temporary bridge but rejected the idea due to the high cost and the time to construct (at least six months). As short-term mitigation, NYSDOT and VTrans negotiated subsidies for two existing ferry services, which allowed commuters to cross the lake at no cost. In addition, several shuttle bus services, with corresponding park-and-ride areas, were created on each side of the lake.

Our subcontractor, MJ Engineering and Land Surveying, P.C., of Clifton Park, New York, had been involved in designing other ferry terminals on Champlain and began building a third emergency ferry terminal to reroute daily traffic at the bridge site. Under enormous pressure, MJ began design of the temporary ferry service on November 1, 2009. It opened on February 1, 2010—an amazing feat and welcome relief, which ended the states of emergency.

To expedite development and delivery of the new bridge, NYSDOT decided to complete design on a compressed schedule with the traditional linear functions of final design/field packaging, advertisement, and permitting performed concurrently. We have since termed this approach dynamic design/build, and the project was executed at an unprecedented speed, shaving years off conventional design processes. It would be the fastest, most under-the-gun job of my career.

We introduced five proposed bridge replacement alternative designs during a rigorous six-day public involvement process, which began on December 10, 2009. During those six days, we met with the historic preservation consulting parties, a public advisory committee (PAC), and the public at large. The first in the series of meetings was attended by the colead agencies, historic preservation consulting parties, and our design team. We were able to explain the risks and drawbacks of replacing the bridge with another truss bridge, as well as discuss the potential benefits of using a more modern bridge type. Our goal was to collect input and alleviate possible issues that could arise during the 50-day review process required by section 106 of the National Historic Preservation Act of 1966, which began with this meeting.

The following day, December 11, 2009, members of the FHWA, NYSDOT, VTrans, and our team met with the PAC to reveal the proposed designs. The PAC showed overwhelming support for the network tied-arch bridge, but many felt the bridge lacked something—the tradition from arch span to standard steel girders was too abrupt.

Scott Newman, the historic preservation officer for VTrans, suggested extending the arch design below the bridge deck to better reflect the design of its historic predecessor. His sensitivity informed our new design. The network tied-arch main span supported by multipurpose rigid frames that could be well integrated into the construction of the crossing.

T
he new design, which I call a "modified" network tied-arch, was unveiled on December 12, 2009, during three back-to-back public information meetings in Ticonderoga, New York. The sessions drew more than 600 attendees. Residents voted overwhelmingly for the modified network tied-arch.

On December 15, 2009, the PAC reconvened to make a formal recommendation of the modified network tied-arch alternative to the commissioner of NYSDOT and the secretary of VTrans. Within just two months, public anger over closing the bridge had transformed into a deep appreciation of our work for a replacement. I have been humbled by public meetings on a wide array of projects. For a public whose lives had been so disrupted by our closing the old bridge to show us such appreciation for the new design was the most humbling experience of my career. I cannot overstate the effect that this had on the design team. Of course we had many late nights and lost weekends, but knowing the public was in great need and was so appreciative of our work made long hours pass quickly.

On August 26, 2011, workers unfurled the United States flag on the center arch span prior to the start of the span’s journey across Lake Champlain.

The National Environmental Policy Act (NEPA) process for the new bridge began on December 1, 2009. The colead agencies resolved to reduce the minimum five-year process to four months without taking shortcuts. This was an extremely ambitious goal given that we were rebuilding a bridge in a location we would never have built in otherwise due to the significant environmental constraints. Three major decisions expedited the NEPA process:

- The replacement structure would be constructed along the same alignment as the original cantilever.
- NYSDOT would manage the demolition, new bridge design, and temporary ferry construction separately to eliminate confusion.
- To expedite the extensive permitting process while still following FHWA and NYSDOT guidelines, the FHWA arranged a federal regulatory agency summit on January 12, 2010. Federal agencies that would have a role in the project participated, and all agreed on the permitting requirements, process, and project time line.

Collaboration among the more than 40 agencies continued throughout the permitting phase, including approvals needed from the U.S. Coast Guard, the U.S. Army Corps of Engineers, endangered species consultants, and various agencies for Clean Water Act provisions, as well as coordination with the Saint Regis Mohawk Tribe.

Infrastructure has some similarities to our health care system. As a culture, we tend to be very good at "trauma" and not so focused on maintenance. Typically, a bridge like this has a 100-year design period. However, given the economic hardships of the bridge outage and the cost of the temporary ferry system to both states—$30,000 a day—our team of 30 engineers delivered the final design in 10 weeks.

Preliminary engineering began on December 16, 2009, following the public involvement process. We worked closely with NYSDOT, VTrans, and the FHWA and held early technical coordination meetings. We presented the overall design concept to the colead agencies on January 6, 2010. Our preliminary drawings included proposed geometry, typical bridge sections, and conceptual details for primary structural members. During the meeting we established the necessary design criteria and the roadway cross section and identified the new structure’s functional needs. There was no room in the schedule for changing direction or modifying the basic design concepts once final design began. Engaging all involved agencies was critical in making conceptual design decisions.

The mandatory 30-day review period required by section 106 of the National Historic Preservation Act ended on January 14, 2010. That
Infrastructure has some similarieties to our health care system, as a cure here tends to be very good at "trauma" and not so focused on maintenance.

Zoli says the completed bridge, "I am proud of having been associated with something bigger than me and the grand feeling about what we can do when we work together."