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RECONSTRUCTING CONNECTIONS

How the Scudder Falls Bridge replacement project upgraded the path from New Jersey to Pennsylvania | By Joe Danyo and Kevin Skeels, Contributing Authors

Editor's Note: If the Scudder Falls Toll Bridge project looks familiar to you, it's because it was named to our annual list of Top 10 Bridges for 2022, earning eighth place. The project was a perfect fit for this issue, so we asked the authors to explain in greater detail how they accomplished this bridge replacement. Enjoy!

► **THE SCUDDER FALLS** Bridge replacement project broke ground in 2017. The objective was to replace a deteriorating, congestion-prone, functionally obsolete bridge that had become an increasingly hazardous commuter bottleneck.

The old bridge opened in 1961, and today an average of 40,000 vehicles a day cross the Delaware River, between Bucks County, Pennsylvania and Mercer County, New Jersey.

The previous bridge was an outdated four-lane structure. It had a non-redundant plate-girder structure with fracture-critical pin-and-hanger connections. The bridge is owned and operated by the Delaware River Joint Toll Bridge Commission (DRJTBC), a bistate federal-compact agency. The commission was committed to replacing the bridge with dual structures having

increased redundancy and greater capacity to handle current and future traffic demands.

The primary beneficiaries of the new dual-span bridge, which carries I-295 over the river, are suburban Bucks County residents who make daily commutes between their homes and the abundant business and government office centers in New Jersey's Trenton-Princeton metropolitan area.

Michael Baker International's bridge design evaluated precast concrete segmental, spliced precast concrete I-girder, and multi-girder steel superstructure types. Steel superstructures were selected for the two 1,850-foot main river bridges and approaches, except one structure utilized precast concrete I-beams.

The new bridge was the marquee element of the five-year-long, \$570 million Scudder Falls Bridge Replacement Project, completed in 2022. The multi-faceted undertaking was spread across a 4.4-mile-long interstate highway corridor in Lower Makefield, Pennsylvania and Ewing, New Jersey.

In addition to the high-capacity river bridge, the project yielded widened approach roadways, safer flanking highway interchanges, a shared-use path for pedestrians and bicyclists,



Photo credit: Michael Baker International

drainage and wetlands upgrades, and an all-electronic tolling facility that keeps traffic moving.

To reduce the amount of in-water work, Michael Baker increased the bridge span lengths to 279 feet, which allowed for the elimination of a pier line from the conceptual design that was developed and permitted. The foundation design utilized five-foot diameter drilled shafts with the fixed pier located at mid-span (in the center of the river). This only required expansion joints at the two abutments.

The new span is designed for a 100-year service life, using a polyester-polymer concrete (PPC) overlay for the road deck's wearing surface.

The bridge design addressed the river crossing's former safety, capacity, and traffic-operations. The bridge's upstream span, which opened in July 2019, has three through-travel lanes and an auxiliary lane running between the two highway interchanges near each end of the bridge.

The downstream span, which opened in July 2021, has three through-travel lanes and two auxiliary lanes. One of the auxiliary lanes stretches from the last highway interchange

in Pennsylvania to the second exit in New Jersey. The other auxiliary lane connects the two interchanges near each end of the bridge. Each new span has flanking shoulders for vehicular breakdowns and emergencies. Each span's left shoulder is 14-feet wide to handle potential future bus rapid-transit service.

The DRJTBC system has eight toll bridges and 12 non-toll bridges, two of which are pedestrian-only. The agency also oversees 39 approach bridges and 79 lane miles of road surface. The DRJTBC is self-sustaining; its operations, projects and facilities are funded solely from the revenues collected at the agency's eight toll bridges.

Toll collection was a significant project consideration. The prior bridge was a non-tolled crossing. To mitigate public resistance, the DRJTBC needed a problem-free all-electronic-tolling (AET) system that would enhance the bridge project's free-flowing traffic objectives.

Michael Baker designed a partially enclosed steel-supported gantry from which toll-collection cameras and equipment is suspended on the Pennsylvania side of the bridge's upstream span. The gantry is walkable, allowing for maintenance and repairs of



Scudder Falls Route 29 Interchange looking towards Pennsylvania. Photo credit: Michael Baker International

tolling equipment without roadway closures. This is the DRJTBC's first AET facility. The location's 90%-plus rate of E-ZPass usage attests to the facility's early success and public acceptance.

The toll gantry is easily accessed from an adjacent four-story building the Michael Baker team designed to house the AET system's support equipment and a command center for DRJTBC bridge monitors and security staff. The building is sized to handle possible additional future equipment needs. A nearby stand-by generator can power the AET equipment and associated building systems in the event of electrical service disruptions.

To further enhance the customer experience, the bridge's approach roadways, approach bridges and adjoining interchanges were widened, reconstructed, or realigned. Two miles of I-295 on the bridge's Pennsylvania side were widened to three lanes in each direction.

The Pennsylvania highway interchange closest to the bridge was realigned and traffic signals were installed to control movements of vehicles exiting or entering at that interchange's arterial road. New Jersey's mile-long I-295 bridge approach was overhauled and outfitted with various drainage improvements. Additional noise walls were installed in conjunction with this work.

The highway's New Jersey Route 29 interchange was completely redesigned and reconstructed with two traffic-calming roundabouts. Prior to the project, the old I-295/Route 29 interchange had the highest crash incidents in the project area. Accidents now have been virtually eliminated.

Passive transportation also was a project consideration. The Michael Baker team designed a 10-foot-wide shared-use

pedestrian/bicycle path on the new bridge's upstream span. Ramps and pathways provide connectivity with recreational canal towpaths on the Pennsylvania and New Jersey sides. This is the only bridge in the DRJTBC system where bicyclists can pedal across. Bicyclists must dismount and walk across the other 15 DRJTBC bridges that are outfitted with walkways.

The project team overcame significant challenges in designing the project, including sequencing construction in a manner that enabled vehicular traffic to move through the corridor and across the river while construction took place.

The team also addressed differing elevations in existing and proposed grades while maintaining traffic. Notably, the New Jersey side of the new Scudder Falls Bridge was up to six feet higher than the former structure. To account for this, temporary supports of excavations were constructed to enable the progression of bridge erection and protect existing infrastructure that remained in service.

The project area's rocky terrain was another design consideration, as was an unnamed stream culvert on the bridge's Pennsylvania side that had to be realigned beneath the existing I-295 approach with a jack-and-bore process. Design also accounted for increased stormwater runoff generated by the project's new or expanded facilities.

This was achieved with numerous drainage upgrades throughout the project area, including the use of bio-retention basins in New Jersey and pre-treatment forebays and infiltration basins in Pennsylvania to control runoff and treat the increased impervious pavement area.

Considerable effort went into responsibly planning, designing, and constructing these regional transportation improvements.



A decade-long environmental documentation process preceded design and construction. Photo credit: Michael Baker International

Michael Baker performed the final design of the project, which was executed in three major construction stages. Other primary project team members were Trumbull Corporation, general contractor; AECOM Technical Services, Inc., program manager; Hill International, Inc., construction manager; and TRC, WSP, and Gannett Fleming, construction inspections.

A decade-long environmental documentation process preceded design and construction, culminating with federal regulatory approval in 2012. AECOM, HNTB and Jacobs Engineering Group were instrumental in achieving this early-planning milestone.

Following the federal go-ahead, the DRJTBC successfully endeavored to secure project financing. Advance tree cutting work and noise-abatement installation also were carried out along portions of the impending bridge replacement project's I-295 work zone. Michael Baker led the planning/design of these pre-project activities, which were later performed by A.P. Construction Inc. and PKF-Mark III, Inc.

A COLLABORATIVE APPROACH

To design the project for the DRJTBC, the Michael Baker team worked closely with the Federal Highway



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Administration, the Pennsylvania and New Jersey departments of transportation, the U.S. Army Corps of Engineers, and a patchwork of other state, regional and federal permitting agencies. Respective aspects of the project in the two states required different specifications. The team therefore had to adhere to specific design criteria for each state, and oftentimes needed to work from separate documents.

Project work was scheduled in a manner to protect endangered species and river spawning areas. In New Jersey, Wetlands and Riparian Bank credits were secured for qualifying impacts in that state. A wetlands-mitigation area to be perpetually protected by the DRJTBC was established near the bridge's Pennsylvania abutment. The design of the wetlands-mitigation site included excavation, application of topsoil and plantings. A fencing plan shields saplings from depredation by deer. An alternative nesting site was designed and constructed on a nearby island in deference to a peregrine falcon that had once nested on the former Scudder Falls Bridge. In New Jersey, a tree planting plan was crafted in compliance with that state's No Net Loss Reforestation Act.

Collaboration extended to the execution of project construction as well. An owner's-controlled insurance program (OCIP) conducted by Arthur J. Gallagher & Co. and The Hartford protected the project's workforce. A bi-state project

labor agreement involving the Mercer-Burlington Building & Construction Trades Council in New Jersey and the Building & Construction Trades Council of Philadelphia ensured the inclusion of regional tradespersons in the project. Additionally, the DRJTBC's Identified Business Enterprise (IBE) program channeled over \$100 million in work to IBE subcontractors and consultants – nearly 18 percent of the total project outlay. Accordingly, minorities and women constituted nearly 20 percent of the project workforce.

LOOKING TO THE FUTURE

As designed by Michael Baker International, the DRJTBC Scudder Falls Bridge Replacement Project's wide array of improvements promise to serve generations of motorists from New Jersey, Pennsylvania and beyond. The related passive-transportation facilities, environmental-protection measures, and wildlife habitat considerations will further enhance the Delaware River watershed as a natural and recreational resource for decades to come. **R&B**

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