

Protecting Wetlands and Wildlife on the Americas' Longest Cable-Stayed Bridge



Nearly 75 percent of the new Arthur Ravenel Jr. Bridge, Charleston, S.C., is constructed over or adjacent to sensitive wetlands and water bodies of the Cooper River system.

by Shannon Renz

Project Overview

THE two existing U.S. Highway 17 bridges over the Cooper River in antebellum Charleston, S.C., are functionally obsolete, characterized by too-narrow lanes, limited capacity and substandard vertical and horizontal ship channel clearance. In an effort to improve traffic safety while increasing overall capacity, the South Carolina Department of Transportation (SCDOT) began the monumental effort of designing and constructing a replacement crossing. The ultimate solution – a \$631-million -2.5-

mile-long bridge with a 1,546-foot cable-stayed main span – is the single largest project in SCDOT history. The replacement is essentially five major projects in one: two interchanges, two approaches and the cable-stayed main span – nearly 75 percent of which is constructed over or adjacent to sensitive wetlands and water bodies of the Cooper River system. HDR was hired to provide environmental management as the owner's representative through a Construction, Engineering and Inspection services contract for the massive bridge replacement project.

NEPA Compliance and Permitting

From the earliest testing through

design and construction, important environmental activities were also taking place in anticipation of the project. No bridge or road is built today without first weighing its impact on the surrounding environment, and then making sure potentially adverse impacts are lessened during construction. Before anyone knew exactly what the new Ravenel Bridge would look like or how it would be funded, the project team had to make sure their construction wouldn't harm the harbor, wetlands or wildlife. As the early financial and design discussions continued, the final environmental impact statement (FEIS) required by the Environmental Protection Agency and the

National Environmental Policy Act (NEPA) was drafted in 1995, completed in 1998 and re-evaluated in 2001 as construction began. Once the re-evaluation FEIS was approved, the next step was obtaining the required permits to do the

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work, an extremely important task of the project schedule. In today's environmental arena, without the proper permits in place construction cannot begin.

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Rip-rap (rock) was used to filter runoff and control erosion near the trestles.

permits usually requires a complete design (60 percent at a minimum), which was not available using this delivery method. In addition, because permits had to be obtained during the Request for Proposal (RFP) stage, both dual and sin-

gle structures had to be permitted because the decision had not yet been made as to whether there would be one or two replacement structures. To expedite the permit process, an interagency task force was formed early on, with upper management from the state and federal resource and regulatory agencies. Realizing that this was a design-build project, it was made clear that any permit modifications would have to be acted on quickly. To manage this, the interagency task force established an agreed-upon method to work through issues in an effort to quickly address concerns through face-to-face meetings.

Efforts to Minimize Impacts to Species

On either side of the Cooper River are environmentally sensitive, low-elevation wetland areas. The Santee-Cooper River Basin comprises the second largest Atlantic coast watershed in the United States and is home to more than 125 fish species – including the federally

protected shortnose sturgeon – and an abundance of waterfowl. Additionally, concerns exist about impacts to the behavior of migratory birds and nesting loggerhead turtles. For these and other reasons, environmental monitoring and

mitigation on the project site is particularly important.

The Cape Romain National Wildlife Refuge 25 miles north of Mount Pleasant has the nation's second largest loggerhead sea turtle nesting ground, averaging 1,000 nests per year. The loggerheads are among South Carolina's most beloved part-time residents. The turtles also like to nest on nearby Sullivan's Island and Folly Beach. Migrating loggerheads lay their eggs on the beaches near Charleston and find their way back to sea via moonlight. Because a bridge adorned with too many lights could directly and negatively impact the turtles' migration pattern, designers have planned limited and directional lighting for the new structure. Light pollution poses a threat to this endangered species, because newly hatched turtles can become disoriented by bright light on land, confusing it with the bright light of the surf. As a result, the hatchlings die when they don't get to the water in time.

The original plans for lighting design on the new bridge called for nearly three times the wattage as the existing lighting on the Grace and Pearman bridges— 174,000 watts compared to 58,500 watts. After the U.S. Fish and Wildlife Service (USFWS) raised concerns about potential harmful impacts to the sea turtles, a series of meetings was held to arrive at a solution. Total wattage was finally reduced to 142,000 watts. Specific design changes included reducing the cable lighting from 1,000-watt bulbs to 250-watt bulbs, eliminating the high-mast lighting on the Charleston and Mount Pleasant interchanges (short mast lighting will be used in place) and using reflective sheeting instead of lights on overhead signage.

Restoring Wetlands and Mitigation Banking

The Webster dictionary defines mitigation as "To cause to become less harsh or hostile, or to make less severe." On projects such as the Cooper River Bridge replacement, it means restoring the natural environment as much as possible, or causing the least possible amount of harm to wildlife and their habitat. Making lighting changes to accommodate sea turtles is an example of mitigation. Other examples include restoring wetlands to

their natural condition after the bridge and interchanges are built. Most of the wetland mitigation for the project is taking place in Mount Pleasant. In addition to removal of all temporary access installed by the contractor, as the old bridges are removed the existing Grace Bridge causeway will be excavated and restored to wetlands.

The preference is always to mitigate onsite, but since this isn't always possible, sometimes an agency will agree to provide off-site mitigation. SCDOT actually has a mitigation bank for this purpose. The mitigation bank works like a real bank, with deposits and withdrawals. Credits are deducted when an agency, such as SCDOT, is unable to mitigate all the required acres, or credit is applied for projects where the agency restored more acres than were required.

The Charleston District office of the U.S. Army Corps of Engineers (Corps) establishes the required mitigation acreages. In South Carolina, the Corps uses factors including existing conditions and adverse impacts to calculate the required replacement acreage. For the Cooper River Bridge replacement project, 4.92 wetland acres were impacted and required mitigation. Using the Corps guidelines, 2.93 acres are being mitigated onsite, and 4.88 acres will be mitigated offsite using credits from the mitigation bank.

Environmentally Conscious Construction

The high-level approaches connecting the interchanges to the bridge had to be constructed over environmentally sensitive wetlands. To protect them, the project team departed from the conventional approach. To lessen permanent impacts to several acres of wetlands in Charleston, the contractor was encouraged by the interagency task force to use temporary work trestles for their access to the project. These structures are constructed above wetlands and are permitted as temporary impacts through the Corps's 404/401-permit process.

The typical process is to place temporary fill in these areas to provide access for construction. This option provides a solid working surface but destroys the wetland's ability to filter surface water

runoff. While temporary access roads were used in a few areas, the contractor built four temporary trestles, which allowed them to move heavy materials and equipment and place foundations without harming the wetlands. The trestles were built at the Charleston interchange, the Mount Pleasant interchange and the western and eastern edges of Drum Island.

The cost to construct the trestles was



Endangered loggerhead sea turtles will benefit when the decorative bridge lighting is turned off during prime migrating months. Photo courtesy of Cape Romain Wildlife Refuge, taken by Karen Beshears on Cape Island.

roughly \$11 million, compared to roughly \$3 million for dredging and filling to create temporary access roads. The timbers used to construct the trestles were recycled as much as possible by moving them to different areas of the project. For example, when the foundations were completed on the Charleston interchange, the pilings and surface timber mats from this trestle were removed and used to construct the trestle for the Morrison Drive ramp in Charleston. Reusing the trestles in this manner saved roughly \$1 million. They suffered too much wear and tear to be used on future projects, but they served their purpose well, greatly reducing environmental impacts to the wetlands. At the completion of construction activity, the trestles will be removed and the area will be restored to pre-construction conditions.

Because much of the construction

and inspection took place on the water, precautions were taken on the contractor crew boats, barges, islands, tug boats, trestles and piers to prevent oil, fuel and other contaminants from making their way into groundwater and surface waters such as the Cooper River. These precautions include implementation and inspection of best management practices (BMPs), enforcement of spill prevention and accident prevention plans, and regular

radio communication between field crews.

Proper permitting and storm water pollution prevention plan (SWPPP) review and implementation also were integral to the success of the environmental efforts. One of the more time-consuming permit requirements was the weekly sediment and erosion control inspections required by the joint Corps 404/401 permit. These inspections took place at 60 monitoring stations in Charleston and 25 in Mount Pleasant. In addition to weekly inspections, the permit also required inspections after every half-inch rain event. The Charleston area averages 52 inches of annual rainfall.

Life After Grace - What the Future Holds

Although the John P. Grace Memorial and Silas N. Pearman Bridges

have ended their useful lives as a means of transport, they will be reincarnated as much-needed marine habitat when they are dismantled and the concrete is turned into approximately 77 acres' worth of artificial reefs. In some sections, the existing bridges will be wrapped (to minimize loose debris), dropped into the river through the use of carefully placed explosive charges, and the material used to construct artificial reefs both inshore and offshore. More than 230,000 tons of concrete from the old bridges will become

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underwater habitat for fish and other marine life. The Grace Bridge has enough environmentally friendly concrete for 26.5 acres of reef, and the Pearman Bridge can create a 50.7-acre reef. The additional habitat will help ensure the development and survival of marine creatures, as a single reef can support up to 50 species. Artificial reefs have become a mainstay in supporting sea life, in South Carolina and elsewhere. According to the South Carolina Department of Natural Resources (SCDNR), only 5 to 10 percent of the continental shelf off of the southeast coast has the proper geologic makeup to support natural reefs.

Artificial reefs attract both bottom-dwelling fish like black seabass, snappers and groupers, and pelagic species (fish that live closer to the surface). Amberjack, King and Spanish mackerel and even some Tuna will school over artificial reef structures. Artificial reefs don't just benefit sea life; they also benefit the bottom line through increased recreational spending. According to SCDNR, the South Carolina artificial reef program

generates roughly \$20 million from recreational fishing alone, and fishing isn't the only recreational option. A study conducted by HDR for SCDOT calculated the annual "recreational user value" of each new artificial reef at \$98,000. If eight artificial reefs are created using material from the Grace and Pearman bridges, the total recreational value is \$784,000.

The Town of Mount Pleasant plans to place a reef around a pier that will be built from the existing Pearman Bridge piers as the focal point of a new waterfront park, in the area once occupied by the Grace and Pearman Bridges. Not all of the reefs using material from the bridges may be in the Charleston area. South Carolina has 44 artificial reefs in its artificial reef program. At the time of this writing, 14 of them have applied to receive material from the old bridges. Twelve currently permitted sites probably will receive concrete from the bridge demolition, according to SCDNR.

As of June 2005, all of the project's foundations are in place, the ship collision islands have been constructed, the two diamond towers are complete, and most of the temporary trestlework has been removed allowing for precious wetlands to begin natural recruitment.

The next year will bring about continued work on demolishing the existing Grace and Pearman Bridges. With a grand opening for the new Ravenel Bridge scheduled for July 16, 2005 – and the new demolition project scheduled to begin approximately a month after that – many challenges no doubt still lie ahead. Of equal certainty is that the environmental issues experienced and resolved in a streamlined approach on the Cooper River Bridge replacement project will prove invaluable on the upcoming demolition project and future design-build mega projects. **L&W**

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Permits were required from the following agencies:

- The U.S. Coast Guard (USCG). Because the bridge crosses navigable waters, the USCG was involved in permitting the bridge's span, width and height, and the depth and dimensions of the rock islands built for pier protection. The USCG also required notification for any work in the waterway requiring alerts to mariners and others in the area.
- The U.S. Army Corps of Engineers. The Corps is responsible for dredging and filling in U.S. waters, including wetlands.
- The South Carolina Department of Health and Environmental Control (DHEC), which has responsibility for stormwater permits and water quality issues. This activity is permitted under the National Pollutant Discharge Eliminating System (NPDES), the permit program under the EPA Clean Water Act.
- The South Carolina Office of Ocean and Coastal Resource Management (OCRM), an office of DHEC, was involved in permitting along a "critical area" of the Cooper River, which includes neighboring wetlands. These items are permitted jointly with the Corps for dredge and fill and water quality.