

CONTEXT-SENSITIVE DESIGN CASE STUDY NO. 8

Bridge 9 on Smiths Bridge Road over Brandywine Creek, Delaware

LOCATION

Bridge #1-009 on Smiths Bridge Road (N221) over the Brandywine Creek north of Wilmington in New Castle County, DE.

PROJECT DESCRIPTION

Bridge 9 (Smiths Bridge) is a one-lane wide, three-span steel beam bridge with timber deck and railing with a superstructure dating from 1962 when it was rebuilt following a fire. The original superstructure was a single-span timber covered bridge constructed in 1839. The substructure consists of stone abutments dating back to the original 1839 bridge and stone faced concrete piers that were constructed in the 1950's when steel beams were added for support. The substructure is considered to be a contributing element to the historic district in which the bridge lies. The latest condition evaluation reports that the bridge deck is in poor condition, with the superstructure and substructure in fair condition. Based on the condition of the bridge, the scope of work was determined to include replacement of the superstructure and rehabilitation of the substructure. Construction will begin in mid-summer 2002 and be completed in 136 calendar days. Bid cost was \$1.2 million. Preliminary engineering cost was \$166,000. Right of way cost is \$10,000. Civil engineering cost is estimated at \$148,000.

PURPOSE AND NEED STATEMENT

There was no official purpose and need statement for the project. Projects come up on DelDOT's (Delaware Department of Transportation) bridge schedule due to their deficiency rating and at that time the Department determines the project scope. The original project scope here was to replace the deck and rehabilitate the substructure. It was following the first Public Workshop at which DelDOT staff took input from the public that DelDOT decided to alter the initial scope of the project.

DelDOT staff attempted to have a "mission statement" for the working group that incorporated the concerns raised by the public in the first two Public Workshops. DelDOT drafted a mission statement with a focus on engineering and safety concerns, but the working group and the Department could not come to an agreement on the wording. Therefore it was dropped. The public's concerns and options obtained from the first two Public Workshops were used to guide the working group's efforts.

CONTEXT SENSITIVE FACTORS

The following context-sensitive factors were raised: Aesthetics, historic issues, environmental concerns, noise concerns, multi-modalism (pedestrian/cyclists), traffic calming (speed, traffic volumes, trucks), safety, vandalism, and flooding.

The landmark 1839 bridge was recorded by the Historic American Building Survey in a Works Project Administration project in 1936. As built drawings were available from 1956 when the bridge was rehabilitated adding stone-faced concrete piers when steel beams were added for support. Community residents remember the landmark bridge that stood until it was burned through arson in 1961. The documentary record of the historic bridge gave design engineers good information to develop a replacement for the superstructure of the bridge that is not a literal recreation of the historic structure, but is based on its design qualities.

The decision to build a one-lane covered bridge required a design exception to AASHTO design guidelines. While normally a road classified as a rural collector requires a 80 km./hour design speed, such a design speed would have required extensive re-alignment of the approaches and significant wetland fills (exceeding allowable limits and requiring mitigation). DelDOT engineers determined that a 20 mph speed limit would be appropriate. DelDOT's engineers determined their principal concern with the poor sight distances on the approaches to the bridge could be met by a limited realignment on the north side of the bridge to provide better sight distances.

The following are the geometric values called for by AASHTO's guidelines and those provided in this project:

DelDOT Design Criteria Form

Design Criteria			
Design Factor	Required by Road Design Manual	Required by AASHTO Green Book For 20 MPH	Provided
Design Speed	80 km/h (50 mph)	30 km/h (20 mph)	30 km/h (20 mph)
Width of Clear Zone	8 m (24 ft)	5 m (16 ft)	0.6 m (2 ft)
Width of Through Lanes	3.6 m (12 ft)	3.6 m (12 ft)	3.0 m (10 ft)
Width of Auxiliary Lanes	N/A	N/A	N/A
Width of Shoulder	2.4 m (8 ft)	2.4 m (8 ft)	0.6 m (2 ft)
Width of Median Shoulder	N/A	N/A	N/A
Width of Median	N/A	N/A	N/A
Stopping Sight Distance	122 m (400 ft)	30 m (100 ft)	30 m (100 ft)
Passing Sight Distance	N/A	N/A	N/A
Maximum Horizontal Curvature	6°45'	58°13'	58°13'

Minimum K (Crest)	34 m (110 ft)	3 m (10 ft)	3.4 m (11.2 ft)
Minimum K (Sag)	27 m (90 ft)	4 m (13 ft)	4.1 m (13.5 ft)
Maximum % of Grade	6 %	10 %	8 %
Maximum Front Slope (Unprotected Section)	4:1	4:1	4:1
Maximum Back Slope	4:1	4:1	N/A
Barrier Offset	0.6 m (2 ft)	0.6 m (2 ft)	0 m (0 ft)

Improved sight line distances will be achieved by realigning and raising the approach from the west side of the bridge and by lowering the bridge deck by one foot. The reduced section height of the superstructure will allow this while maintaining the current soffit elevation of the bridge.

HISTORY OF PROJECT

The project was initiated as a deck replacement/rehabilitation project. DeIDOT staff had a request from a community organization, which they were working with on another project, to approach the public with a “blank sheet of paper”. The concern was that on the typical bridge project, public input is sought late in the process after most of the decisions that would affect the community have been made. Because this project could be accomplished in many different ways and is a local landmark in which many people and organizations have an interest, DeIDOT agreed.

HIGHWAY AGENCY INVOLVEMENT

Bridge 9 had a history of maintenance problems relating to its wooden plank surface and frequent need for repair to the timber bridge rail. When the bridge came up for deck replacement and rehabilitation work, DeIDOT’s North District decided the project was more than they could handle and turned to the Office of Preconstruction in Dover that provides designs for all districts in the state. DeIDOT’s engineers thought that the ADT of 3,600 vehicles per day warranted building a two-lane facility. The accident history for the bridge was not severe: 18 accidents over ten years (including one fatality and three injuries). Most accidents were caused by the poor sight distance at the approaches to the bridge.

RESOURCE AGENCIES INVOLVEMENT

An architectural resources survey conducted at DeIDOT’s request revealed the Smith’s Mill-Granogue Historic District, a rural historic landscape encompassing seven inventoried resources, and recommended the district as eligible for the National Register of Historic Places. The National Park Service defines a rural historic landscape as a “geographical area that historically has been used by people, or shaped or modified by human activity, occupancy, or intervention, and that possesses a significant concentration, linkage, or continuity of areas of land use, vegetation, buildings and structures roads and waterways, and natural features.” The elements of Smiths Bridge that survive from the 1839 bridge were judged to constitute a contributing element

to the historic district. Therefore, the Delaware Historic Preservation Office and the New Castle County Historic Review Board were involved in review of the project.

A U.S. Army Corps of Engineers Nationwide Permit was required for the abutment work in the waterway and any placement of riprap in scour holes. The area surrounding Bridge 9 was designated in the Brandywine Valley Scenic River and Highway Study, conducted by New Castle County in 1987, as a priority area for protection, and therefore consultation with the County's Department of Planning was recommended. Consultation with the Department of Natural Resources and Environmental Control was needed to address findings in a Natural Heritage Survey that one state rare fish species, known as the Comely Shiner, is found near the project area. However, because of the limited nature of the project, impacts were not anticipated.

The project received a Class II, Categorical Exclusion under NEPA requirements.

COMMUNITY INVOLVEMENT

Prior to the first Public Workshop, initial contact was made with the adjacent property owners by letter and follow up interview. At the request of a community group that was working with DelDOT on a nearby project, the Department agreed to hold a public meeting with a "blank sheet of paper". Notice of the public meeting was placed on a sign adjacent to the bridge. One hundred people attended this first meeting held in April 2000. Sixty-eight of the attendees returned a questionnaire that asked them to identify their concerns with the bridge's operation and their proposed solutions. The questionnaire also asked people to identify community groups to which they belonged. Many respondents were concerned that if a two-lane bridge was built, it would encourage more traffic through the area. Also there was strong opposition to installing a traffic signal to control traffic flow as being incompatible with the character of this rural setting.

A second workshop was held two months later. DelDOT staff organized the responses to the April questionnaire into four options, one lane open, one lane covered, one lane covered with bike/pedestrian lane, and two lanes open. At the second Public Workshop DelDOT distributed a questionnaire and asked the workshop attendees to rank the options. One hundred questionnaires were returned.

DelDOT then organized a 15-member Working Group to help them to refine the project concepts. A letter was sent to the various civic groups, organizations, property owners, and legislators asking if they would like to participate in the Working Group. The following were represented on the working group:

- Preservation Delaware (private historic preservation organization)
- Kennett Pike Association (local civic group)
- Centerville Civic Association (local civic group)
- Brandywine Conservancy (private environmental organization)
- Delaware Greenways (private organization for preservation and enhancement of natural, scenic, historic, cultural, and recreational resources)
- Delaware Nature Society (private organization for the preservation of natural resources)
- State Historic Preservation Office
- Adjacent Property Owners

- DeIDOT Locations Studies Group (obtains state and federal permits for environmental and historic issues)
- Legislators

The responses from the second set of questionnaires gave nearly equal votes to the one lane covered option and to the one lane covered with bike-pedestrian lane option. Support for a two-lane option was negligible. The Working Group strongly supported the one lane covered option, possibly because the width of the one lane covered with bike-pedestrian lane option (which included an intermediate member separating the lanes) was 20 feet or essentially wide enough for two lanes at a point in the future. The Working Group agreed upon the one lane covered option with a 15-foot width, allowing enough width to accommodate bikes and pedestrians.

NATURAL ENVIRONMENT ISSUES

The principal environmental impact is a small reduction of wetlands due to the road realignment on the west side of the bridge. The amount of wetland fill was minimized and kept below the level, which would require mitigation, by the use of a concrete retaining wall along much of the realignment.

In addition to other environmental issues discussed in the Resource Agencies Involvement section, a New Castle County Floodplain Permit is required due to the abutment work. Hydrological calculations to prove that the improvements will not decrease the storage capacity of the floodplain and not increase the floodplain elevation were provided to the County in the floodplain permit application and the County issued a permit.

HUMAN ENVIRONMENT ISSUES

As noted in the section under Resource Agencies Involvement, Smiths Bridge is located in and its historic substructure contributes to the Smith's Mill-Granogue Historic District, a rural historic landscape. The special character of this area is widely recognized by those who live near and use this road. Respect for preserving the historic and scenic qualities of the area and developing a bridge design that would fit well with these qualities was a goal of all participants in this project.

SCHEDULE OF ACTIVITIES

February 3, 1998	Estimate supplied to North District Maintenance for replacement of timber deck.
August 18, 1998	Project added to Design project list.
October 2, 1998	Bridge rehabilitation project initiated with expectations to match existing geometry.
August 20, 1999	Submitted Survey Plans.
Sept.-Dec. 1999	Developed design alternatives in preparation for public workshop.
Dec. 1999-Feb. 2000	Met with adjacent property owners and environmental agencies.
April 10, 2000	Held public workshop "with a blank sheet of paper" at citizens' request, distributed questionnaire to determine public concerns.

Apr.-May 2000	Reviewed questionnaires, developed design options.
May 26, 2000	Presented design options to DelDOT's Program Development Committee and received favorable response.
June 26, 2000	Held public workshop, presented design options, requested public preferences.
July 2000	Tabulated design option survey.
July 24, 2000	Met with Director of Preconstruction, determined to proceed with one lane covered bridge with separate bike lane.
Aug.-Sept. 2000	Set up working group.
October 17, 2000	Held first working group meeting.
October 24-25, 2000	Toured covered bridges in Southeastern Pennsylvania.
November 6, 2000	Held second working group meeting.
November 21, 2000	Held third working group meeting; reached consensus on 15-foot one lane wide covered bridge that would accommodate vehicles along with pedestrians and bicyclists
December 6, 2000	Met with Brandywine Conservancy and an adjacent property owner concerning preservation easement.
December 18, 2000	Held fourth working group meeting; reached consensus on roadway re-alignment.
December 2000	Prepared Hydraulic Study of proposed construction.
Jan.-Mar. 2001	Developed Preliminary Plans.
March 15, 2001	Distributed Preliminary Plans to working group.
March 26, 2001	Held fifth working group meeting; reviewed Preliminary Plans.
June 18, 2001	Final public workshop.
January 15, 2001	Construction plans finalized
March 13, 2002	Bid opening.
July 2002	Estimated start of construction; 136 calendar day work period.

PROJECT OUTCOME TO DATE AND LESSONS LEARNED

DelDOT staff's request that the Department provide a facilitator for the Working Group meetings was denied since the Department would not usually use such services on a bridge project. Consequently, the project engineers found it very difficult to manage the Working Group meetings, because they needed to serve both as facilitators and also to represent their own positions regarding design guidelines and safety issues. Since some members of the Working Group had past experiences with DelDOT that led them to lack trust in interactions with the agency, a facilitator could have helped bring a sense of balance to all discussions to help build trust. As an example, the attempt to achieve consensus on a mission statement failed because the engineers brought to a Working Group meeting a mission statement focused on engineering ethics and safety and were then in a difficult position to evolve a consensus statement that could have reflected all parties' interests.

Following DelDOT's design procedures, the Design Exception is normally requested after preliminary plan submittal. This procedure left the design engineers in an uncomfortable position as they made commitments or created a perception that any of the public's proposed solutions agreed upon would be approved by the Department. The actual Design Exception request was not submitted until mid-January, 2002 when the project was going into advertising

for bids. The design engineers, however, did have informal concurrence from those who would be signing the exception much earlier.

DelDOT's current procedure for bridge projects does not include a concept development phase. This project was outside the norm for DelDOT's procedures. The design engineers were quite successful with the public involvement process due to their own creativity and ingenuity. However, including a concept development phase for future bridge projects would lend itself to supporting Context Sensitive Design principles.

A two-day trip to Pennsylvania and Maryland to observe traffic flow at existing covered bridges helped the design engineers to reach a comfort level regarding their safety concerns about the alignment.

Information signs announcing the public meetings were quite successful at drawing a large interested group of people to participate.

Bringing the public in early on a project of this nature worked very well. They had a say in what the problem was as well as having a say in the proposed fix. This format allowed DelDOT to achieve community buy-in.

An important accomplishment was the willingness of the Department to approach this project differently by allowing public input into the "scope" of the project. This community input and support allowed Del DOT to propose a one-lane structure. It was the majority of the community's view that this narrow road with poor alignment could not support the added traffic that a two-lane bridge would invite. Also, there was a strong desire to maintain the rural and historic nature of the area along this road, which DelDOT believes the proposed covered bridge accomplishes.

The most difficult decision was to keep this structure a one-lane bridge. The bridge carries and AADT of 3600. Upon review of the accident history at this site and visiting other covered bridges in neighboring states, it was determined that the cause of the majority of the accidents at this site and the element which allowed other one lane covered bridges to carry a comparable AADT was sight distance. Therefore the most noteworthy design element was the realignment of the west approach, which will keep speeds low due to the curvature but allow improved sight distance to enhance safety and traffic flow.

DelDOT has gained respect and good will from the participants in the public involvement process for this project. DelDOT's engineers are proud of their design and pleased they had the opportunity to work on a project that will add lasting value to the community.



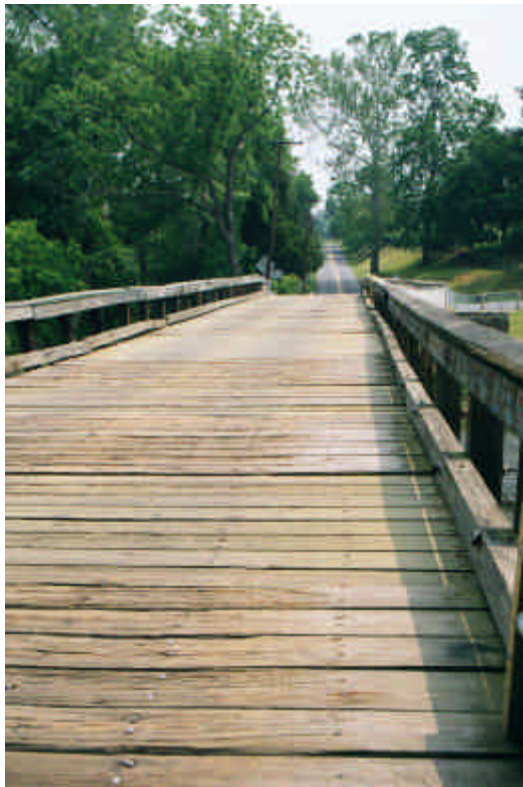
B.1 Smiths Bridge from the east approach.



B.2 Aerial view of existing Smiths Bridge.



B.3 Side view of existing Smiths Bridge



B.4 Deck of Smiths Bridge.



B.5 Smiths Bridge from east approach.



B.6 Smiths Bridge from west approach.



B.7 Smiths Bridge from West approach.



B.8 Close up of Smiths Bridge at west approach.



B.9 HABS Photo of Smiths Bridge constructed in 1839. Photo was taken from east approach in 1939.



B.10 HABS photo of Smiths Bridge with side view taken in 1939.



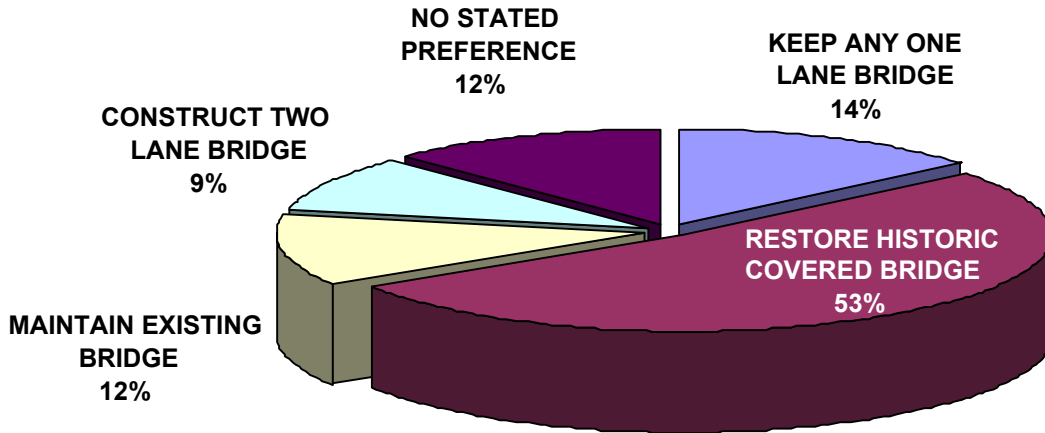
B.11 HABS photo of Smiths Bridge showing interior of 1839 covered bridge. Photo was taken in 1939.

Public's Concerns

- Traffic Calming (34%)
- Maintain Historic Character (49%)
- Protect Environment (11%)
- Safety (31%)
- Pedestrians and Bikes (14%)
- Noise (2%)
- Flooding (3%)

B.12 Power point slide used at second Public Workshop to provide responses from public to questionnaire passed out at first Public Workshop.

Public's Solutions



B.13 Power point slide used at second Public Workshop to provide responses from public to questionnaire passed out at first Public Workshop.



B.14 DelDOT visualization of aerial view of proposed bridge design.



B.15 DeIDOT visualization of side view of proposed bridge design.