DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

SECTION 206
LAKE BELLE VIEW
AQUATIC ECOSYSTEM RESTORATION PROJECT

APPENDIX I
STRUCTURAL CONSIDERATIONS

CONTENTS

Figures

Photos

DEFINITE PROJECT REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

SECTION 206
LAKE BELLE VIEW
AQUATIC ECOSYSTEM RESTORATION PROJECT

APPENDIX I
STRUCTURAL CONSIDERATIONS

1. PURPOSE

The study purpose is to evaluate the Federal interest in improving aquatic habitat and enhancing wetland habitat in Lake Belle View and the nearby Sugar River (Figure I.1). The purpose of this appendix is to produce a cost estimate for replacing the Bross Circle Bridge for the proposed Lake Belle View Aquatic Ecosystem Restoration Project. To support the preparation of this appendix, personnel from the Rock Island District's Engineering Division, Structural Branch, developed preliminary designs to provide cost estimates and recommendations.

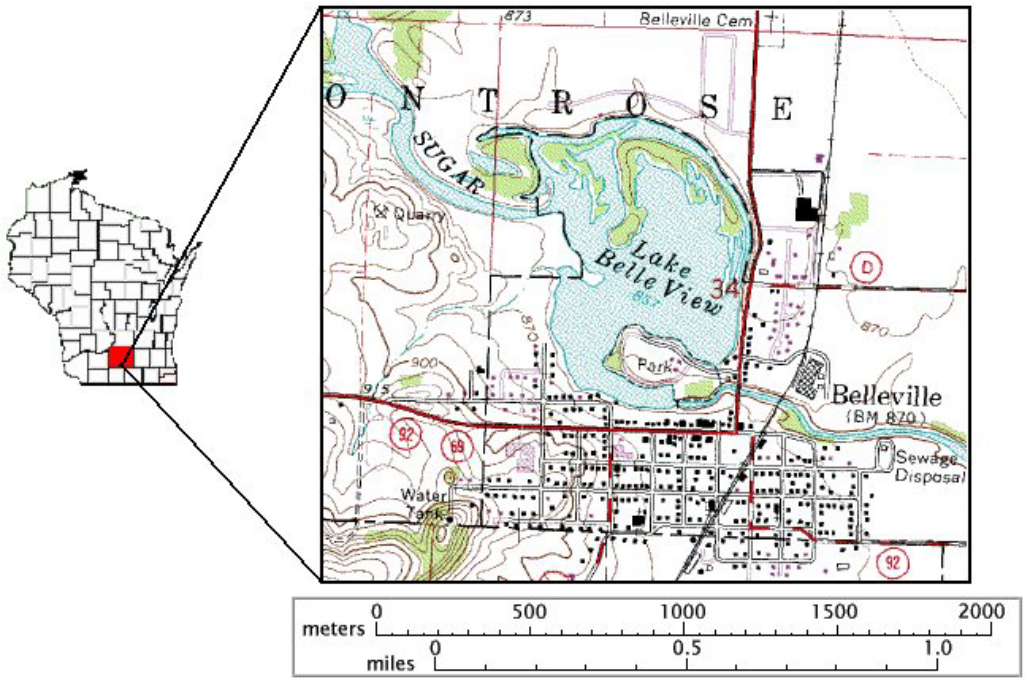


Figure I.1. Location maps.

2. LOCATION AND PROJECT FEATURES

Lake Belle View is a shallow millpond located on the Sugar River in southern Dane County, Wisconsin. It was created in the 1840's when developers dammed a meander of the river to power a sawmill. After the sawmill was established, settlers began moving to the area, and in 1851, the Village of Belleville was founded. Since then, the mill owner converted the sawmill to a feed mill

and constructed a replacement dam farther downstream. This second dam is what currently impounds Lake Belle View. Today, all that remains of the mill are the second dam, the original mill owner's house, and the millrace that drove its waterwheels/turbines. The Village has also grown considerably in size and now has developed property almost completely surrounding the lake.

The Sugar River used to support several species of indicator fish (trout, small mouth bass, etc.) which had free run of the river. Today, the dam impedes their movement, which significantly diminishes the quality of fish habitat. The Wisconsin Department of Natural Resources (WDNR) wishes to restore the fish habitat by re-establishing the original course of the Sugar River. The WDNR originally proposed demolishing the dam to allow the Sugar River to flow on its original course and re-establish the fish passage.

Lake Belle View has become an important part of the Village's heritage. Its citizens do not want to lose their lake by removing the dam. Furthermore, the lake's habitat quality has also diminished over time. The lake has silted in and atrophied and no longer supports a large diversity of plants or wildlife. Algal blooms and carp are now Lake Belle View's predominant inhabitants. The Village also wants to improve the lake's flora and fauna habitat.

3. PROJECT PROPOSALS

The Rock Island District has developed two proposed plans to re-establish the river's natural flow and improve the lake's habitat while keeping the dam (Figure I.2). Both proposals involve dredging the original Sugar River channel, constructing a berm to separate the channel from the lake, and cutting a new channel for the river across the base of the peninsula where the mill was formerly located.

These plans would put the Sugar River back on its original course and eliminate the silting problems typical of river impoundments. These proposals also would keep the dam and the lake. By constructing an inlet structure in the proposed berm, the Village would be able to maintain water in Lake Belle View.

Fireman's Park is a public park that the Village constructed on the peninsula where the mill was located. The citizens have constructed several improvements and use the park relatively frequently. The Village provides access to the park via Bross Circle Bridge, a small bridge across the old millrace (photos I.1, I.2, and I.3). Since both proposed restoration plans involve cutting across the base of the peninsula at the existing millrace, the plans must include replacing the Bross Circle Bridge with a new bridge.

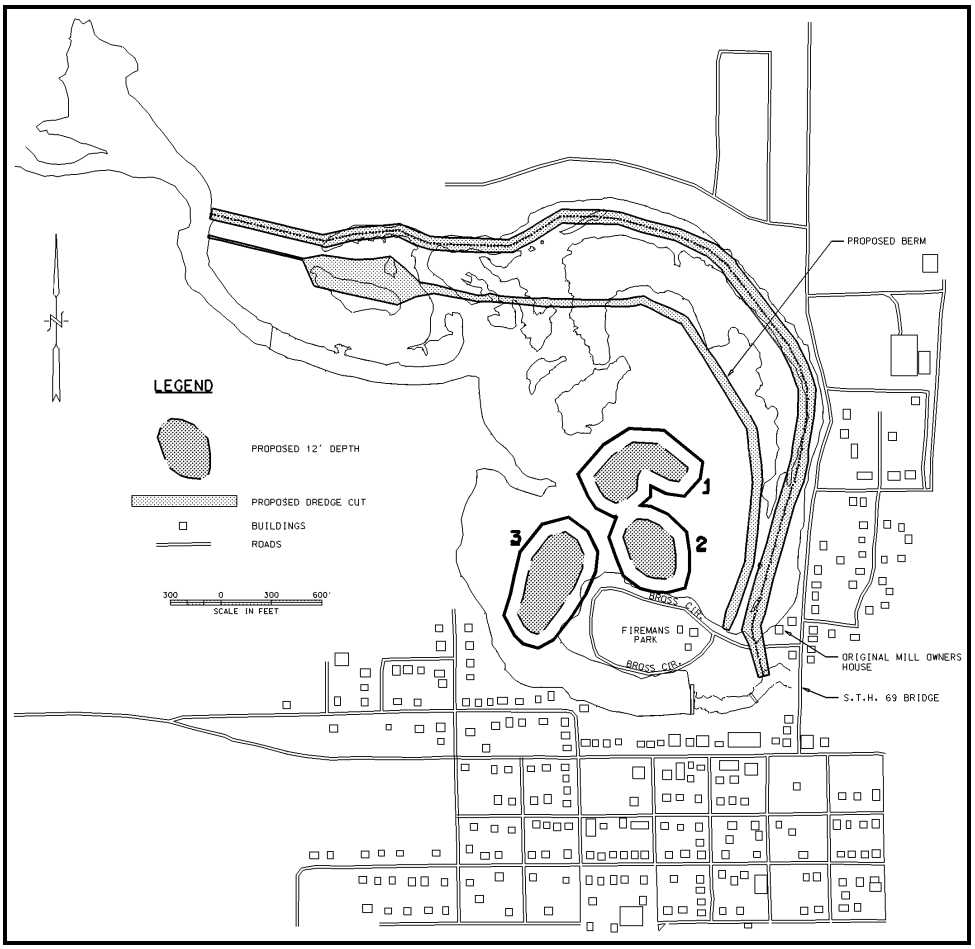


Figure I.2. One of the Corps' two proposed plans.

Photos I.1 and I.2. Views of Bross Circle Bridge and millrace.

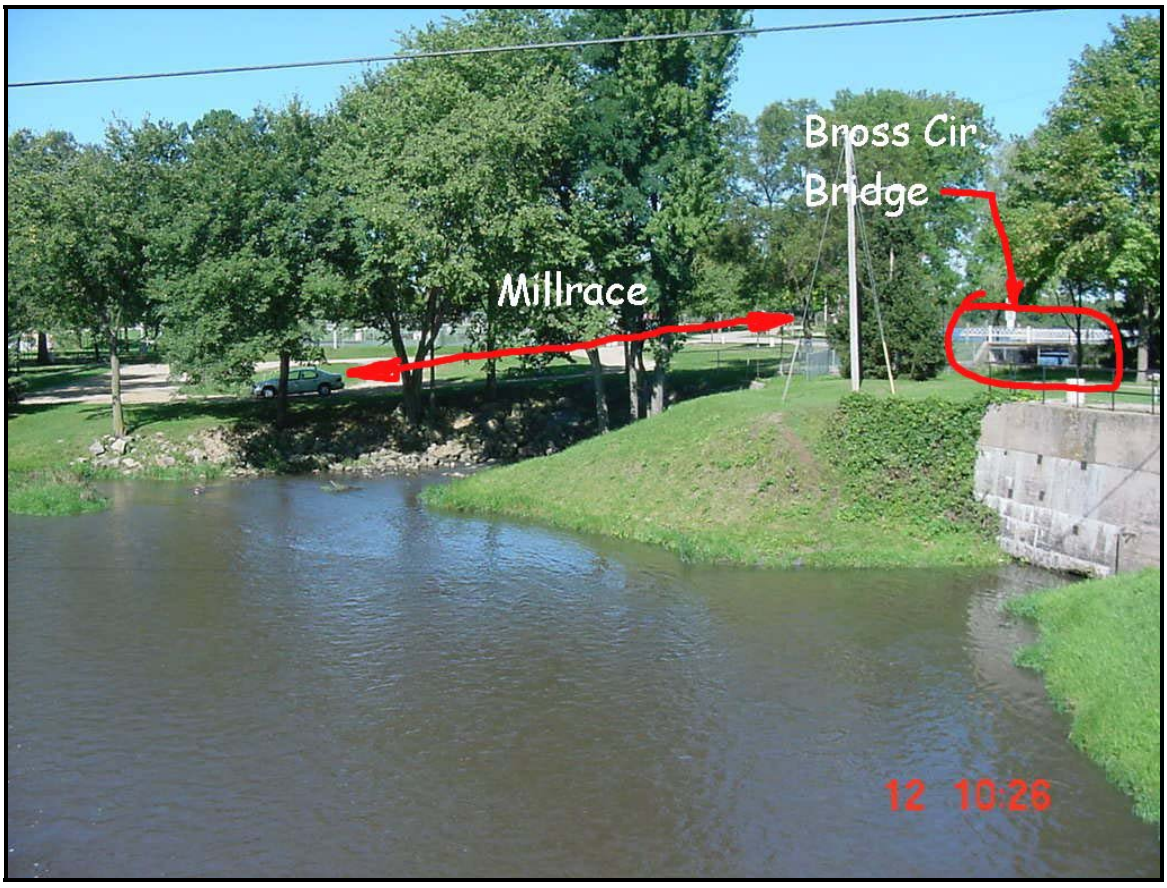


Photo I.3. View of millrace and Bross Circle Bridge from S.T.H. 69 bridge.

4. OBJECTIVE

The objective of this analysis is to estimate the cost of replacing the existing Bross Circle Bridge with a new bridge that will span the proposed river channel. A replacement bridge needs to be designed with sufficient detail to provide a reasonable cost estimate. The Rock Island District's Project Management Branch will then include this cost in an economic analysis of the proposed plans to determine which plan has the highest benefit-to-cost ratio. Since this will be a preliminary design to be estimated in a Definite Project Report, the design does not require the level of detail for plans and specifications (e.g., rebar layouts, connection designs, analyzing every code-specified load case, etc).

5. REFERENCES

1. Uptmor, Louis E., P.E. U.S. Army Engineer District, Rock Island, ED-DN. Interview with author. Rock Island, IL. September 2000.
2. Gambucci, Thomas R. P.E., U.S. Army Engineer District, Rock Island, ED-HH. Interview with author. Rock Island, IL. September 2000.
3. State of Wisconsin, Dept. of Transportation. *Structure B-13-337. S.T.H. 69 Over Sugar River.* Construction Drawings. 1975.

4. Matthew D. Murphy. Wisconsin Dept. of Transportation, Dist. 1. Interview with author. September 2000.
5. U.S. Army Engineer District, Rock Island. Construction Drawings. *Lake Belle View Restoration, Dane Co. Belleville, Wisconsin. Alternate Plan.* 16 June 2000.
6. VanLaarhoven, Charles R. U.S. Army Engineer District, Rock Island, ED-C. Interview with author. Rock Island, IL. September 2000.

6. ASSUMPTIONS

1. The replacement bridge must support the AASHTO HS20 design vehicle. Fireman's Park is a developed property with a little league baseball diamond, football/soccer field, tennis courts and comfort stations. Also, the Village has placed derrick stone bank protection and repaired the dam from the park. The Village may also need to perform floodfighting operations on the peninsula. Construction equipment must be able to pass across the replacement bridge.

2. The cost for constructing the new river channel will be estimated by others. This designer will estimate the cost for constructing the deck, superstructure, substructure, and demolition of the existing bridge. The only cost for earthwork included in these calculations will be that necessary to construct the substructure.

Analysis: Figures I.3 through I.7 show the preliminary layout of the Bross Circle replacement bridge.

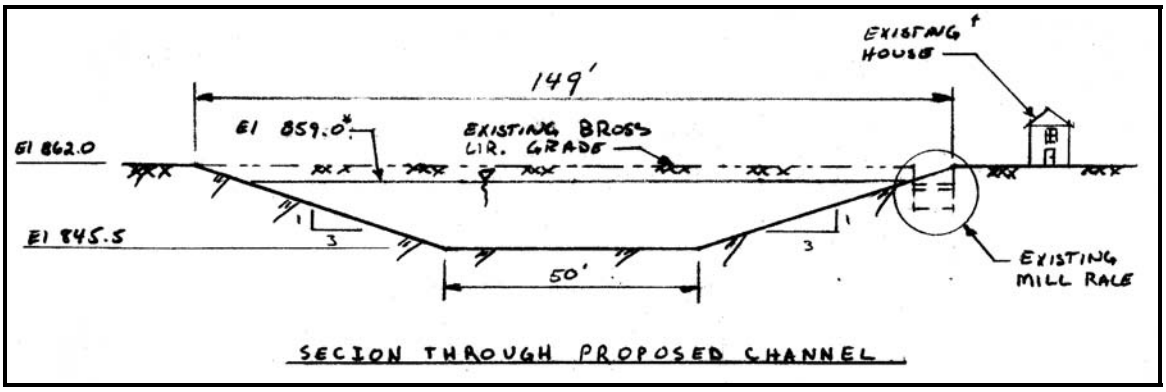


Figure I.3. Section through proposed channel.

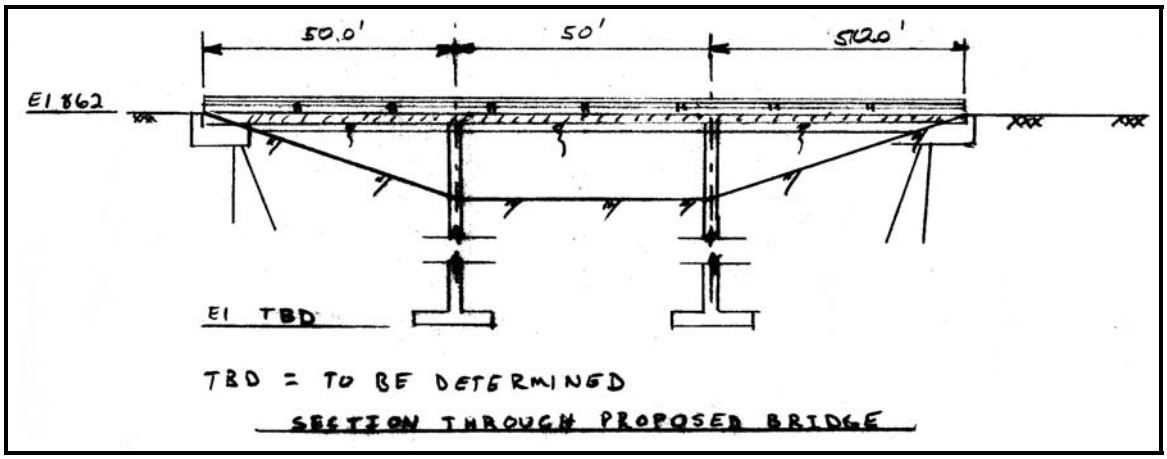


Figure I.4. Section through proposed bridge.

*El 859.0 = 100yr flood event. Normal flow El = 847.5 ±

† CEMVR may not be able to acquire the house or demolish the millrace. The developer who built the mill also built this house for his home. It may be eligible for the National Register of Historic Places. Even if the house and millrace are not eligible, the citizens of Belleville may want to keep them to preserve local history. If that is the case, the Corps will relocate the proposed river channel to protect these structures.

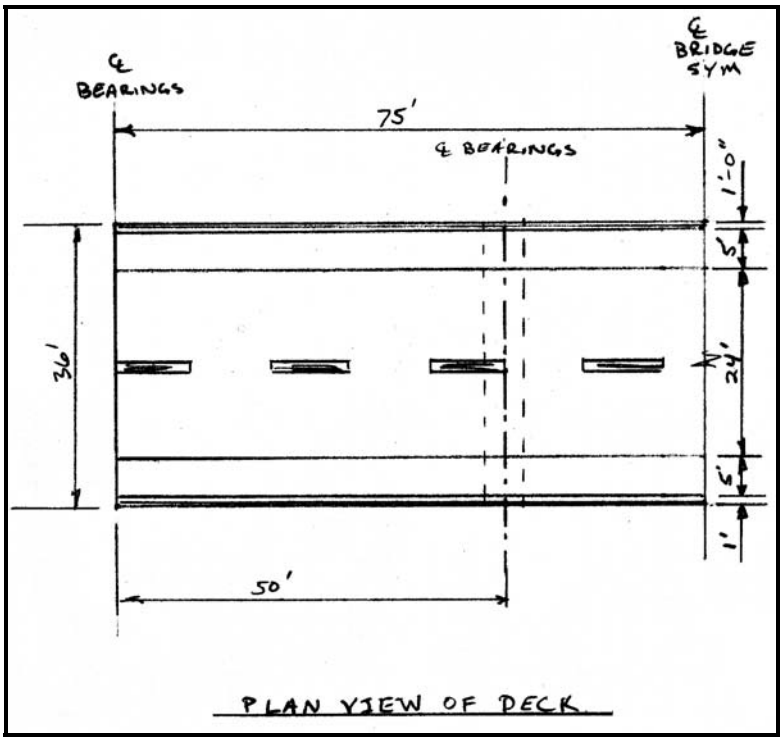


Figure I.5. Plan view of deck.

Designer proposes using a typical concrete deck-steel stringer composite design. The spans will be continuous over three 50-foot spans. The deck and superstructure may have to be raised to accommodate the 100-year flood.

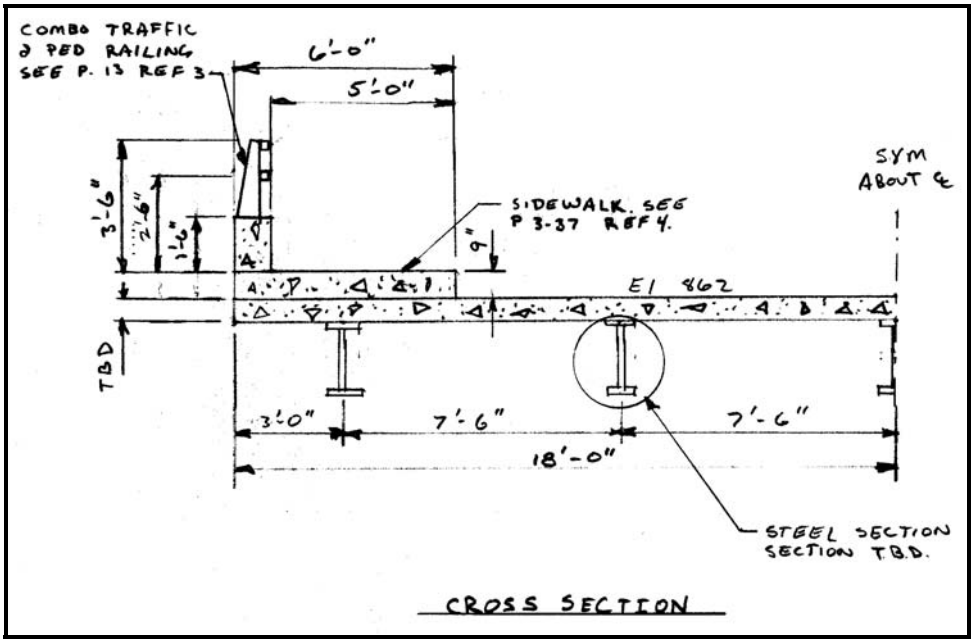


Figure I.6. Cross section.

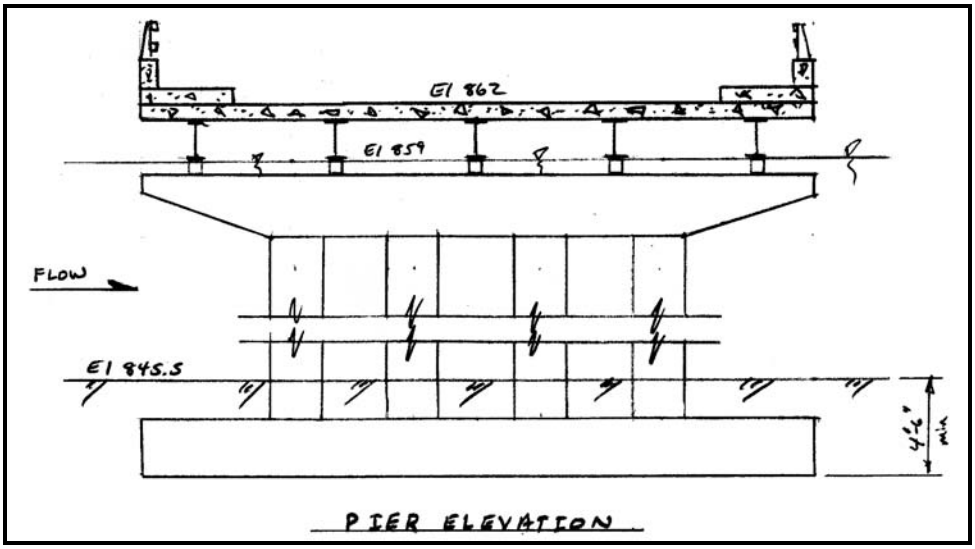


Figure I.7. Pier elevation.

The existing Bross Circle Bridge is only 21 feet wide out to out, with one 16-foot-wide traffic lane. Traffic volumes on Bross Circle Bridge are typically low, with occasional peaks for special events

(e.g., wedding receptions, little league/football/soccer games, etc.). The proposed design will use two 12-foot-wide lanes because a wider bridge will allow easier passage of construction equipment. Furthermore, the probability of two-way traffic across a 150-foot-long bridge is considerably higher than the probability of two-way traffic across a 21-foot-long bridge.

Figures I.8 and I.9 and photos I.4 and I.5 show the S.T.H. 69 bridge located immediately downstream along the Sugar River.

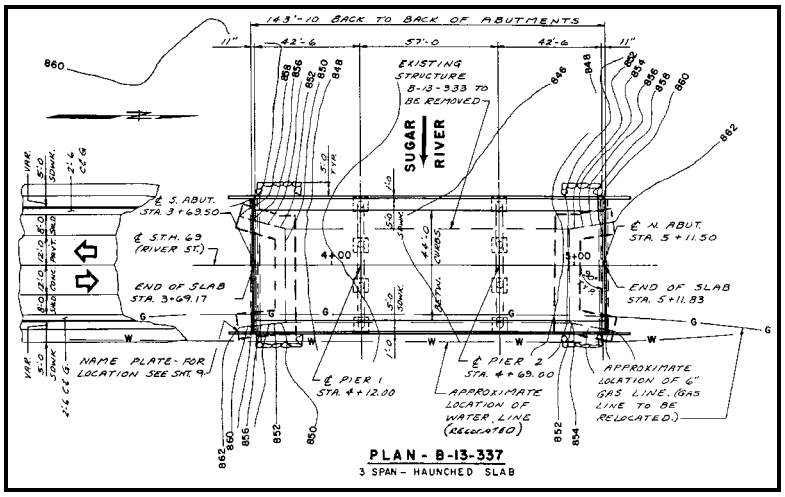


Figure I.8. Plan view of S.T.H. 69 bridge.

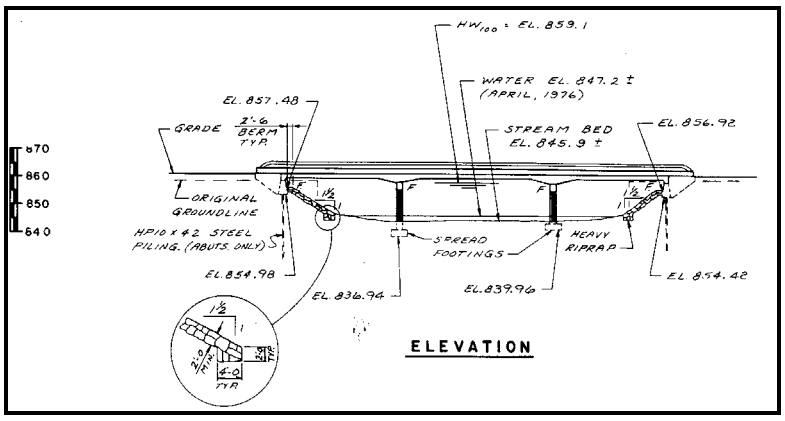
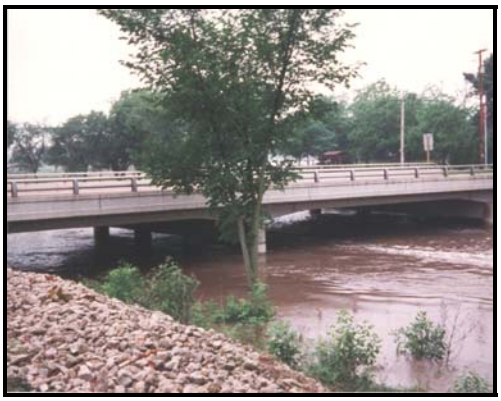


Figure I.9. Elevation view of S.T.H. 69 bridge.



Photos I.4 and I.5. Views of S.T.H. 69 bridge after and during a flood.

Notice there are many similarities between this bridge and the proposed Bross Circle replacement bridge. These include:

- Length (143' – 10" compared to 150' – 0")
- Design load (HS20)
- River channel characteristics (width, depth to bottom, 100 yr flood el)
- Number and length of spans (one 57' - 0" & two 42' – 6" spans compared to three 50' – 0" spans)
- River flow characteristics (it's the same river located in the same area. The S.T.H. 69 bridge will see slightly more flow because it will receive flow from both the proposed new river channel *and* the dam).

The designer assumes that the foundation soils for both bridges are similar because the two bridges are so close together.

The major difference between the two bridges are the width (56' out to out compared to 36' out to out) and the volume of traffic.

The objective is to calculate a cost estimate for replacing the Bross Circle Bridge. Because the proposed replacement bridge design is very similar to the S.T.H. 69 bridge, the designer will use the cost the Wisconsin Department of Transportation (WDOT) paid to build the S.T.H. 69 bridge.

Cost of STH 69 bridge = $225,000 in 1979 (see reference 4).

Adjusting cost for inflation:

$$\text{Ratio of costs: } \frac{\text{Aug } 2000}{\text{Sep } 1979} = \frac{6233}{3120} = 1.998 \text{ (see reference 6).}$$

$$\frac{6233}{3120}(\$225{,}000) = \$449{,}495 \quad \text{Use } \$450{,}000$$

This cost included demolition of the old S.T.H. 69 bridge and constructing the current S.T.H. 69 bridge. The work included in that contract included only sufficient earthwork to construct the substructure.

The size of the proposed Bross Circle Bridge is 150' x 36'. Adjusting the cost estimate for size:

$$\text{Ratio of size} = \frac{(150)(36)}{(143.833)(56)} = 0.6435 = 64.4\%$$

$$\text{Cost of BCB} = 0.644(\$450{,}000) = \$289{,}800 \quad \text{Use } \$300{,}000.$$

WDOT uses another method for estimating the cost of bridges when its design is in a feasibility phase. WDOT estimates the cost of a bridge at \$55 - \$60 per square foot of deck area. By this method:

$$(\$55/\text{sf})(143.833\text{ft})(56\text{ft}) \le \text{Cost of STH 69 Bridge} \le (\$60/\text{sf})(143.833\text{ft})(56\text{ft})$$
$$\$443{,}006 \le \text{Cost of STH 69 Bridge} \le \$483{,}278$$
$$(\$55/\text{sf})(150\text{ft})(36\text{ft}) \le \text{Cost of BCB} \le (\$60/\text{sf})(150\text{ft})(36\text{ft})$$
$$\$297{,}000 \le \text{Cost of BCB} \le \$324{,}000$$

This gives a range of costs for the replacement Bross Circle Bridge of \$300,000 to \$324,000.

7. CONCLUSIONS

The designer estimates the cost for replacing the Bross Circle Bridge is between \$300,000 to \$324,000. This estimate assumes a bridge design similar to the S.T.H. 69 bridge located immediately downstream of the proposed location for the Bross Circle Bridge.

The designer recommends using \$300,000 for the bridge cost in the economic analysis of the project. The designer estimated the cost by examining a similar bridge design instead of examining the specific loads the replacement bridge must carry. Using an upper bound cost accounts for the potential errors in this method of estimating. However, the Bross Circle Bridge will not carry regular truck traffic as the S.T.H. 69 bridge does. The probability for the loads on Bross Circle Bridge being less than those on S.T.H. 69 is moderately high. The Village may choose to use a lighter bridge. This warrants using a value less than the maximum \$324,000 value in the economic analysis.

Note that the proposed Bross Circle Bridge is designed to span the *currently proposed* new Sugar River channel. As of this writing, there is the possibility that the shape of the channel may change. The currently proposed 150-foot-wide river channel would destroy most of the parking lot in Fireman's Park. If the Corps, the WDNR, and the Village decide to implement the Lake Belle View Restoration Project, the Corps may have to change the design of the river channel to that shown in Figure I.10 below.

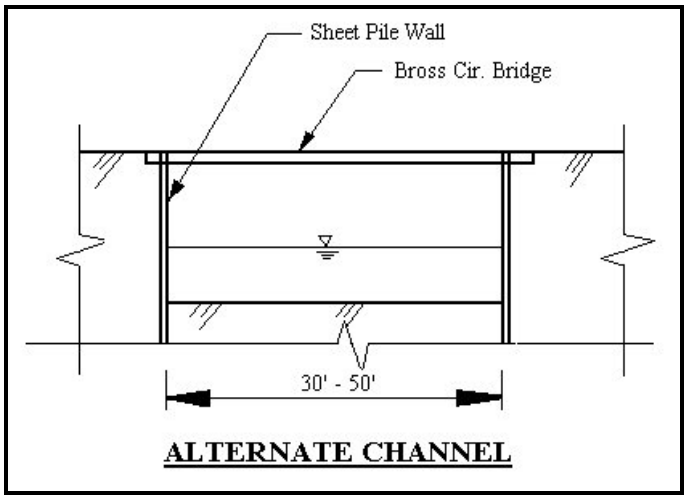


Figure I.10. Alternate channel.

Should that be the case, the length—and the cost—of the *structure* would be reduced. However, the designer believes that the savings associated with this alternate river channel would be lost to other required mitigating features (e.g., extra scour protection to mitigate the effects of necking the river down and forcing it to make a 90° turn; raising the Bross Circle Bridge grade to put it over the 100-year flood elevation; driving the sheet pile; etc.) The $300,000 cost estimate should still be valid for this case as well.