Alteration of the Canadian Pacific Railway Drawbridge Over the Upper Mississippi River, La Crosse, Wisconsin Under the Provisions of Truman-Hobbs Act

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ABSTRACT

This paper primarily addresses the feasibility study of the alteration of the Canadian Pacific Railroad Bridge over the Upper Mississippi River at La Crosse, Wisconsin. This paper also briefly addresses the Truman-Hobbs Program which is administered by the U.S. Coast Guard (USCG) Bridge Administration Division. Included in this paper are the key elements considered in the selection of the alternate, future navigation impacts, future channel stability and maintenance, potential west bank erosion, traffic during construction and design option evaluation criteria.

COAST GUARD BRIDGE ALTERATION PROGRAM

In 1968, the USCG assumed responsibility for the bridge program from the U.S. Army Corps of Engineers. USCG policy is to ensure that bridges, crossing the navigable waters of the United States, do not unreasonably obstruct the needs of waterway traffic. To maintain navigation safety and freedom of mobility, the Truman-Hobbs Act is administered by the USCG to ensure that bridges provide sufficient clearances for the types of vessels that transit through the bridge site at present and in future. Under this program, the USCG investigates mariners' complaints, conducts detailed investigation for bridges, the nature of unreasonable navigation obstructions, and tangible benefits to navigation. If the USCG determines that a bridge is unreasonably obstructive to navigation by means of benefit over cost ratio of 1.0 or greater, USCG will issue an "Order to Alter" to the bridge owner requiring bridge owner alter the bridge and provide the required navigation opening as described in the Truman-Hobbs Act (33 USCA 511-523). An apportionment of alteration costs between the bridge owner and government is prepared according to Title 33, Part 116 of the Code of Federal Regulations – Navigation and Navigable Waters.

STATUS OF LA CROSSE BRIDGE ALTERATION PROJECT

The Commandant of the U.S. Coast Guard determined the La Crosse Bridge to be an unreasonable obstruction to navigation in 1998 based on a detailed investigation, public hearing and engineering study. The Commandant's Order to Alter directed the bridge owner to alter the bridge by constructing the new bridge on the same alignment as the existing bridge, providing a horizontal clearance of no less than 300' measured normal to the channel and a vertical clearance of no less than 52' above the two percent flowline or 60' above normal pool, whichever is greater, in open position. A minimum vertical clearance in the closed position of 21.9' above the normal pool is required. The Bridge Administration Division located in USCG Headquarters in Washington, DC oversees the bridge alteration project and works closely with bridge owner and waterway users. The new bridge is currently under feasibility study by HNTB in Kansas City, Missouri. The goals of the study are to find the most cost-effective design scheme that can be accepted by all surface transportation users and parties with channel maintenance responsibility. Improved navigation safety and mobility are the highest priority goals of the bridge project. Figure 1 shows the navigation chart in the bridge vicinity.

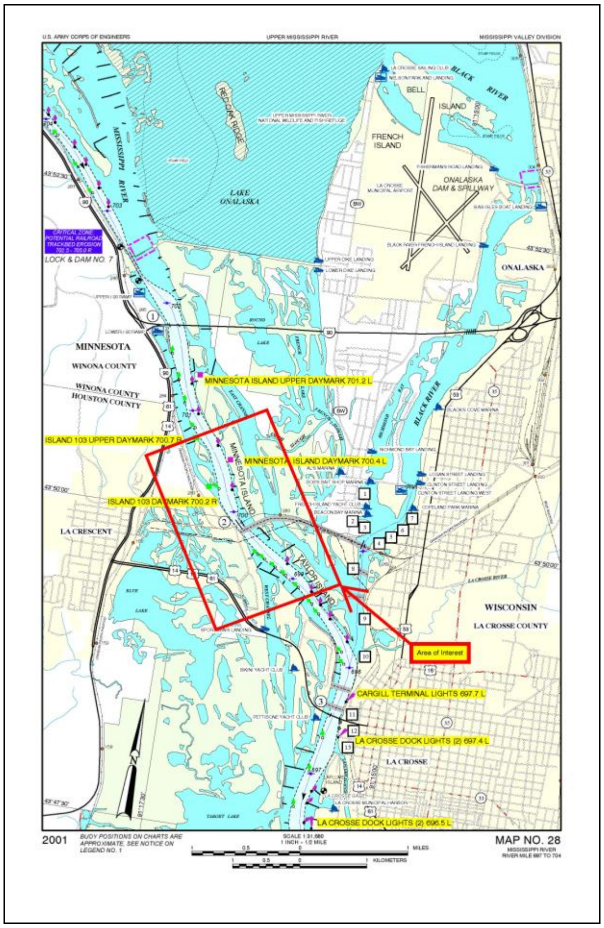

Figure 1 – Navigation Chart

DESRIPTION OF THE EXISTING BRIDGE

The original railroad swing bridge constructed in 1876, replaced a ferry boat that had previously been used to transport trains from the rail lines in La Crosse, Wisconsin, to the rail lines in Minnesota that ran from La Crescent to Minneapolis. The existing iron bridge constructed in 1902 with approximately $565,000 is a 1,055’- 2” single track structure that carries Canadian Pacific railroad traffic over the Upper Mississippi River at mile 699.8. The bridge is composed of six spans from east to west: one 40’- 7” deck girder span, two 164’- 2” Pratt truss spans, one 248’ camelback truss span, one 359’ swing span and one 75’ deck girder span. The railroad traffic over the bridge carried 48.7 million gross tons in 2007. The swing span was originally powered by steam engines, but was electrified in 1952. For the swing span, the horizontal clearance in the west side is 151’ and horizontal clearance in the east side is 150’. The minimum vertical clearance in the closed position is 21.9’ above normal pool. On an average, 3,440 bridge transits are made every year. The bridge operator is on the site 24 hours, seven days a week. See Figure 2 and 3 for the existing bridge.

Figure 2 - Existing Bridge

Figure 3 - Existing Swing Span

DESCRIPTION OF CURRENT NAVIGATION

An average of 13.9 million tons of cargo per year was transported past this bridge during the period of 1980 through 1995. In 2007, it was 10.4 million tons. The existing bridge is located approximately 2.9 miles downstream from Lock and Dam No. 7. The existing navigation opening is close to the west bank. It is positioned immediately below a bend in the river that makes it extremely difficult for tows to line up with the bridge on downbound transits. The navigation difficulty is compounded by shallow water depths, severe cross current toward the west bank, and reduced channel width caused by the angle of bridge alignment to the waterway. Numerous complaints from the navigation industry have been received alleging the bridge is an unreasonable obstruction to the navigation due to the extremely restricted horizontal clearances provided by the existing swing bridge. The federally authorized and maintained navigation channel is at least 300 feet wide throughout the Upper Mississippi River. When the bridge was originally built, the average tow consisted of 4 to 5 barges. Today, the average tow in the Upper Mississippi River consists of 15 barges, powered by 3,200 to 4,800 horsepower towboat. A typical barge measures 195' long by 35' wide. Barges in tows are usually arranged 5 long and 3 wide. A typical towboat is 150' long and 40' wide and thus when coupled with its barges has an overall dimension of approximately 1,150' long by 105' wide. See Figure 4 for bridge traffic with helper boat.

Figure 4 - Barge Traffic

Figure 5 - West Bank

CONCERNS OF WEST BANK RESIDENTS

Landowners on the west bank are very concerned about bank erosion and damage to their property by barge traffic. There are also private docks sticking out into the river on the west bank both upstream and downstream of the railroad bridge. See Figure 5 for the present bank condition.

DESIGN OPTIONS

Six options are considered in the feasibility study. See Figures 6 through 10 for elevation views of the design options.

Figure 6 – Existing Condition

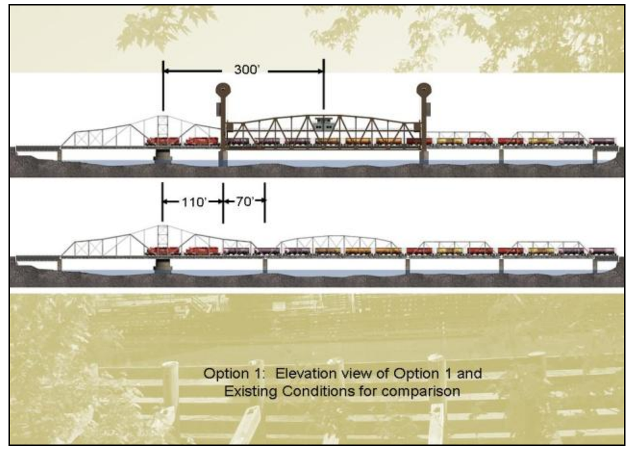

Figure 7 – Option 1

1. Option 1
   - relocate the navigation span approximately 300’ eastward
   - new 330’ lift span with 300’ horizontal clearance
   - pier 3 and 4 replaced with new piers
   - swing span modified and operable

2. Option 1A
   - similar to Option 1 except swing span modified and inoperable

3. Option 1A’
   - similar to Option 1A with expedited span change out

4. Option 2
   - relocate the navigation span approximately 400’ eastward
   - new 330’ lift span with 300’ horizontal clearance
   - existing pier 4 remains with new pier 4 immediately adjacent
   - pier 3 replaced with new piers
   - swing span fixed in place

Figure 8 – Option 2

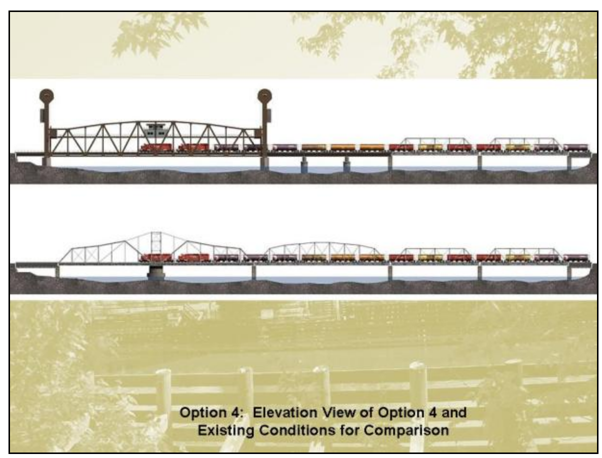

Figure 9 - Option 4

5. Option 4
   - leave the new navigation span in its present location
   - new 384’ lift span with 300’ horizontal clearance
   - pier 5 removed
   - pier 4 and 6 replaced with new pier 6 & 7
   - new pier 4 and 5
   - new 56’ end span
   - swing span removed

6. Option 5
- leave the new navigation span in its present location
- New 360’ lift span with 300’ horizontal clearance

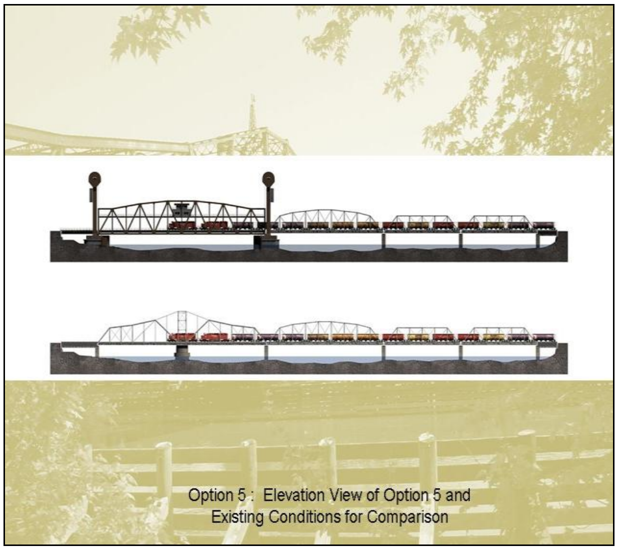

Figure 10 – Option 5

- pier 5 removed
- pier 4 and 6 replaced with new piers
- new 71’ end span
- swing span removed

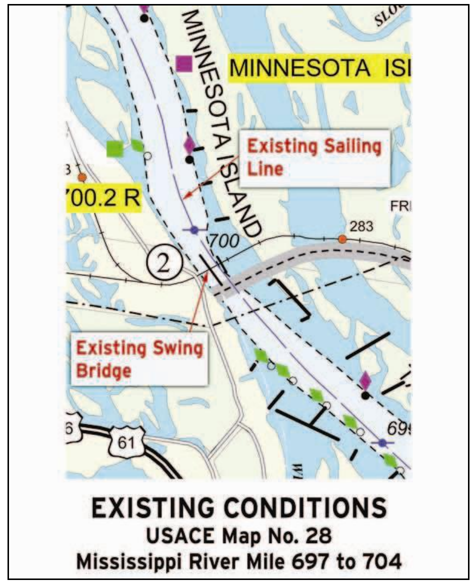

Figure 11 – Existing Sailing Line

HYDRAULIC ASSESSMENT

A hydraulic assessment for various design options was made by the U.S. Army Corps of Engineers under an interagency memorandum of agreement with the U.S. Coast Guard. The Corps’ Adaptive Hydraulic (ADH) Modeling System was the two-dimensional model used for the study. ADH was used to calculate stage and velocity as well as relative changes in sediment transportation to assess how each option will effect navigation, channel maintenance and potential west bank erosion.

1. Future Navigation Impacts

The existing channel opening is very close to the west bank while the sailing line is close to the east bank. Therefore, all options will improve the current navigation by shifting the navigation opening eastward. Option 1 appears to provide a good location for the new lift bridge since the flow vectors line up well with the most likely navigation paths and the amount of maneuvering needed to line up with the bridge opening will be minimal. Option 2 is satisfactory with removal of several affected wing dams along the east bank. Option 4 and 5 will improve the existing conditions for navigation since they will have a wider bridge opening. See Figure 11 for the present sailing line.

Further investigation regarding navigation impacts on tows was conducted using vessel force calculation program developed by the Corps’ Engineering Research and Development Center in Vicksburg, Mississippi. The program reads geometry and depth solutions in ADH format in conjunction with input file of tow location. The output consists of forces computed assuming hydrostatic pressure. The program is used only as a screening device to compare one condition to another. The executable estimates lateral forces on a 3 by 5 tow as it approaches the lock. The estimated maximum lateral forces on 15-barge (5 long, 3 wide) tow drafting 9 feet for each condition are shown in the following table:

Condition Tested	25% Duration Flow Condition (lbs)	Bank Full Flow Condition (lbs)	Upper Limit of Navigation Flow Condition (lbs)
Existing Condition	3479	6303	9799
Option 1	4485	7078	8114
Option 2	6166	9588	14712
Option 4 and 5	2781	5274	8325

Option 1 shows a slight lateral force increase over the existing condition for the 25% duration and the bank full flow condition, but these increases do not exceed the force calculated for the existing condition, upper limit of navigation scenario. For the upper limit of navigation condition, Option 1 shows a decrease over the existing condition.

Option 2 shows the lateral forces are much higher than those for the existing condition and Option 1. This indicates there may be potential navigation problems. Additional geometric modifications of the east bank would reduce the calculated maximum lateral force further, but this would involve filling in the scour holes downstream of the existing wing dams to smooth the geometry of the left bank. This may not be allowed by regulating agencies. Option 4 and 5 show the lateral forces are lower than those for the existing condition and therefore do not indicate any concerns for navigation.

2. Channel Stability and Maintenance

The changes in velocity are minor and therefore not much change in erosion and deposition outside the immediate vicinity of the bridge is expected. However, the new bridge opening in Option 2 will be located in somewhat shallower water, closer to the inside bend of the channel. Thus, it is possible that additional dredging would be needed to maintain the path of navigation.

3. Potential West Bank Erosion

From 1,500 feet upstream of the bridge to 3,000 feet downstream of the bridge there are localized velocity changes greater than 2 percent, the location of which depends on the option. None of these changes are of concern except for the roughly 5 to 10 percent increase in velocity along the west bank up to 2,100 feet downstream of the bridge caused by Option 4 and 5 under the upper limit of navigation condition. Since bank erosion has been an issue along this portion of the the west bank, a 5 to 10 percent increase in velocity may make the condition slightly worse. The velocity increase may affect a number of private property owners and therefore any mitigation measures would have to be coordinated with all of these owners.

TRAFFIC DURING CONSTRUCTION

Rail and navigation traffic impacts during construction are anticipated. Required closure periods are different among options. Additional horizontal restrictions in the east navigation channel are required for Option 1.

OPTION EVALUATION CRITERIA

All options in the feasibility study will be evaluated against ten project criteria using a numerical matrix and weighting factors to select the preferred option. The project criteria were established based on the understanding of the overall goals of the project that are summarized in the following table:

Criteria	Weighting Factors
Construction Cost	25
Construction Difficulties	15
Construction Risk	20
Rail Operations During Construction	40
Marine Operations During Construction	40
Future Navigation Impacts	25
Impacts to Property Owners	15
Environmental Impact and Permitting	10
Future Channel Maintenance	25
Future Bridge Maintenance	20

NEXT

Stakeholders of the railroad and navigation are working on the evaluation matrix. Selection of the preferred option will be made when the evaluation matrix is completed.

ACKNOWLEDGEMENTS

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