Vermont Agency of Transportation

Alternative Study

Richford - Sutton BHF 0814(1)

Bridge #3

October 2015

Site Information

Bridge #3 located on VT Route 105A is located at the border crossing between Richford, VT and Sutton, PQ. This structure has a main span consisting of a steel thru-truss along with a steel rolled beam approach span.

Inspection Report Information

Bridge Deck Rating	5 Fair
Superstructure Rating	5 Fair
Substructure Rating	5 Fair
Channel Rating	8 Very Good

Site Visit Summary

The following is a summary of the substructure and the superstructure components:

- **Approach Span Beams:** The beams on the approach span have some section loss on the top and bottom flanges. However, the approach span has significant capacity over that of the truss span. These beams can be cleaned and painted in a rehabilitation project and will provide plenty of capacity for the desired design truck.

- **Abutment #1 (Approach Span Abutment):** Abutment #1 is a concrete skeletal abutment that is cracking and in poor condition. There is also significant undermining between the two columns of the abutment. This abutment should be replaced with a new substructure.

- **Pier:** The pier has significant spalling that should be repaired/encased in a rehab.

- **Bottom Chords:** The channel sections that make up the bottom chords have significant section loss. Although a closer inspection may find that some portions could be salvaged, it seems most appropriate to replace both bottom chords in their entirety.

- **Bottom Laterals:** The bottom laterals are made up of small angle sections. They appear to be in good condition and could potentially be salvaged.

- **Exterior Stringers:** Both exterior stringers are in poor condition and should be replaced across the span. Since each stringer is segmented due to abutting the floor beams, there is potential that some of the mid-span, exterior stringers could be salvaged but they were not visible during this site visit.

- **Interior Stringers:** The three interior stringers appeared to be in good condition. These members can probably be salvaged with the exception of the very end of the last stringers tying into Abutment #2 or the pier.

- **Floor Beams:** Overall the condition of the floor beams appeared good. In some instances the very ends of the beams were in poor shape, where they connected with the bottom chord. These beams could be salvaged and some may need small sections of W-Beam welded onto the ends. It would be necessary to look into the ability to do this, as well as whether the cost would be much lower than a full replacement of the beam.

- **Gusset Plates:** All connections and gusset plates that were reasonably visible appear to be in poor condition. Since most connections would have at least one member being replaced that tied into it, all these gusset plates and connections should also be replaced.

- **Truss End Diagonals:** The end posts (diagonals at the ends) were in good condition with the exception of some section loss close to the bottom chords. It was proposed that these members could be salvaged from approximately the height of the guardrail and up. This assumes that the good condition of the members continues up to the top chord, which during the visit was not inspected closely. Another thing to consider with salvaging these members is how exactly a new section is spliced onto the existing section and whether that cost would be significantly less than a brand new member.

- **Truss Verticals:** The posts (vertical members) were in good condition with the exception of some section loss close to the bottom chords. It was proposed that these members could be salvaged from approximately the height of the guardrail and up. This assumes that the good condition of the members continues up to the top chord, which during the visit was not inspected closely. Another thing to consider with salvaging these members is how exactly a new section is spliced onto the existing section and whether that cost would be significantly less than a brand new member.

- **Truss Interior Diagonals:** The diagonals were in good condition with the exception of some section loss close to the bottom chords. It was proposed that these members could be salvaged from approximately the height of the guardrail and up. This assumes that the good condition of the members continues up to the top chord, which during the visit was not inspected closely. Another thing to consider with salvaging these members is how exactly a new section is spliced onto the existing section and whether that cost would be significantly less than a brand new member. Diagonals D3, D4, and D5 (diagonals making up the "X" portion of the truss at midspan) may be completely be salvaged since there was no apparent deterioration anywhere.

- **Struts:** The struts (horizontal members) at mid height of the truss can be salvaged since they all appeared to be in good condition.

- **Abutment #2:** Abutment #2 was in fair condition and can be rehabilitated. There were some significant cracks and exposed rebar found throughout the abutment, and some missing pieces of concrete. Some class II and class III repair should be done on this abutment in a rehabilitation project.

- **Top Chords:** Overall the top chords appeared to be in good condition. Initial thoughts would be that the majority of these members could be salvaged, but without a closer and more thorough inspection it is hard to definitively determine.

- **Top Laterals:** The condition of the top laterals appeared to be in okay shape and could potentially be salvaged, but without a closer and more thorough inspection it is hard to definitively determine.
- **Top Struts:** The condition of the top struts appeared to be in okay condition and could potentially be salvaged. The lattice on the top struts does have some significant peeling paint which may warrant replacement, but without a closer and more thorough inspection it is hard to definitively determine.

- **Portals:** The condition of the portals appeared to be in okay condition and could potentially be salvaged. The lattice on the portals does have some significant peeling paint which may warrant replacement, but without a closer and more thorough inspection it is hard to definitively determine.

Alternatives

The alternatives considered for this project are as follows:

1. Do Nothing
2. Rehabilitation
3. Replace Entire Bridge

1. Do Nothing

   The Do Nothing Alternative could be a viable option here but would mean the eventual closing of the structure and thus the adjacent border station. There are nearby border stations and given the light amount of traffic at this particular crossing this may be a feasible alternative. The decision to close a border station is outside the discussion area of this report. The intent in including this as an option was merely to address the fact that this option should at least be considered.

2. Rehabilitation

   There are two rehabilitation options that are considered in this report.

   (A) The first is to replace only what is absolutely required and clean and paint the truss. This alternative would have a design life of about 15 years, would leave the existing substructures in only fair condition. The intent of this alternative would be to address the worst of the deficiencies and to slow down the deterioration of the truss. The posted rating on the bridge would likely remain unchanged. The estimated cost of this alternative is approximately $1.5M.

(B) The second rehabilitation option would be to address all of the bridge deficiencies that can be addressed in a rehabilitation. All truss members with significant section loss will be patched or replaced. These members would include but not be limited to the bottom chord, exterior stringers, end floor beams, and a majority if not all of the floor beam to bottom chord and bottom chord to vertical/diagonal gusset plates. The approach span beams will be salvaged as even with minor section loss, the design capacity of these members far exceeds the capacity of the main truss span. Both the approach and truss span decks will be replaced with similar partially filled concrete grid decks in order to reduce any increases in dead loads on the structure. In addition the joints and bearings will also be replaced in this alternative. In terms of the substructures, the approach span abutment will be replaced, and the remaining substructures will be rehabilitated using a combination of encasement and/or class I, II, and III concrete repairs. All structural steel will be cleaned and painted. This alternative would have a design life of 30 years and the structure would be able to safely carry an H-15 vehicle. The estimated cost of this alternative is approximately $3.5M.

3. Full Bridge Replacement

   Full bridge replacement would include a new structure on a new or existing alignment. Given the historic nature of the existing truss this option was not fully explored. However, if there is a determination that the existing truss can be documented and destroyed then this alternative could be explored further. Based on square foot costs, the estimated cost of this alternative would be approximately $4.5M.

Historical Significance

Since Bridge #3 is deemed a historically significant structure in the State of Vermont, as well as in the Province of Quebec, Canada, all considered alternatives will maintain the existing bridge geometries and look to replicate the structure as closely as possible, while maintaining current safety standards. The bridge will be repainted green in color and replacement of any structural steel members will be replaced in kind, but with Grade 50 steel.

Maintenance of Traffic

All alternatives considered propose closing the bridge to traffic during construction. The Contractor will be responsible for site specific signage and traffic control at the bridge, but each Owner will be responsible for their own additional traffic control outside the project location, including detour signage. It is anticipated that the bridge closure period will last an entire construction period of about 9 months from mid-April to mid-December.

Conclusion

This conclusion is based on the belief that the border crossing must remain open and that closing this structure permanently is not a viable alternative.

Given the relative costs, benefits, and implications for construction methods, **Alternative 2(B)** is recommended for this site. This will provide a safe vehicle passage for an H-15 vehicle. This alternative would provide additional capacity versus the existing posted load rating and would provide a longer design life then a patch/clean and paint project. This alternative will eliminate known and potential unknown structural flaws, restoring the original load carrying capacity of the structure. It is recommended that the roadway be closed to traffic during construction and that a project duration of 9 months will be required to complete the project.

A more detailed cost breakdown is provided in Appendix A.

A graphic representation of the proposed rehabilitation for Alternative 2(B) is provided in Appendix B.

APPENDIX A – Cost Breakdown for proposed truss rehabilitation project

COST:	Preliminary Engineering	$300,000
	Right of Way	N/A
	Roadway (Minor Approach Work)	$50,000
	Maintenance of Traffic (Detour Sign Package)	$50,000
	Substructure (New Approach Span Abutment)	$200,000
	Substructure (Pier Rehabilitation)	$350,000
	Substructure (Main Span Abutment Rehabilitation)	$200,000
	Truss Rehabilitation (Replacement and Patching of Members)	$500,000
	New Partially Filled Grid Deck	$300,000
	New Bearings and Joints	$60,000
	Cleaning and Painting of Structure	$1,000,000
	Erosion Control	$50,000
	Mobilization (Includes Field Office)	$350,000
	Construction Costs	$3,110,000
	Construction Engineering + Contingencies	$500,000
	Total Construction Costs w CEC	$3,610,000
	Total Project Costs	**$3,910,000**