SRF No. 0034686

MEMORANDUM

TO: Rabinder Bains, Mn/DOT OIM

FROM: Dave Montebello, P.E., Principal
Mary Karlsson, Engineer
SRF Consulting Group, Inc.

DATE: May 5, 2004

SUBJECT: ST. CROIX RIVER CROSSING
BENEFIT-COST ANALYSIS MEMORANDUM

This memorandum summarizes the benefit-cost analysis performed for the St. Croix River crossing alternatives being evaluated as part of the St. Croix River Crossing Supplemental Draft Environmental Impact Statement (SDEIS). The objective of a benefit-cost analysis is to bring all of the direct effects of a transportation investment into a common measure (dollars), and to allow for the fact that benefits accrue over a long period of time while costs are incurred primarily in the initial years. The primary elements that can be monetized are travel time, changes in vehicle operating costs, vehicle crashes, and remaining capital value. The benefit-cost analysis can provide an indication of the economic desirability of an alternative, but decision-makers must weigh the results against other considerations, effects, and impacts of the project.

The project area is located in the St. Croix River valley near Stillwater, Minnesota. The project limits begin near the interchange at TH 36/TH 5 in the Stillwater and Oak Park Heights area on the Minnesota side of the river, and end near the junction of STH 35/64 on the Wisconsin side of the river. The major roadways impacted by the project include TH 36, TH 95, I-94, local routes in the City of Stillwater, TH 8, and STH 35 and STH 63 in Wisconsin.

The primary issues to be addressed by the project are the operational, safety, and capacity issues associated with river crossing trips moving through the Stillwater/Oak Park Heights area.

DESCRIPTION OF ALTERNATIVES

Base Condition – No Build Alternative

The "Base Condition" or No Build Alternative assumes that no major changes are done to TH 36, the river crossing, and/or other streets that serve the current crossing other than routine maintenance and/or other major maintenance that preserves the present functional integrity of the system. The No Build Alternative is depicted in Figure 1 and can be described as follows:

FIGURE 1 BASE CONDITION

- The basic roadways and Lift Bridge remain as they are today with respect to operational capacities.
- TH 36 continues to be a four-lane urban expressway west of TH 95; east of TH 95 it continues to be a two-lane rural facility into downtown Stillwater. Parking and turn lanes are located at existing locations.
- The Stillwater Lift Bridge (Mn/DOT Br. No. 4654 and Wis/DOT Br. No. B-55-919) remains a two lane bridge. The August 2003 report by HNTB *Maintenance Projections and Annualized Costs – Report of Findings Stillwater Lift Bridge* recommended routine and major bridge maintenance. Maintenance costs outlined in the report do not account for continued operation of the Lift Bridge for vehicular traffic beyond 2010 (see Attachment A for report assumptions and costs). The report suggested that maintenance costs with vehicular traffic would be several times that of the bridge with no vehicular traffic. To account for continued use by vehicular traffic, the benefit-cost analysis included operation costs of $450,000 per year for the No Build Alternative, three times the operation costs outlined in the HNTB report.

  The structural reports on the existing bridge also suggest that at some point, major rehabilitation will be needed. As a result, the benefit-cost analysis assumed that the Lift Bridge will be closed and rehabilitated at a cost of $26 million in the years 2020 and 2021. Rehabilitation was chosen as the preferred alternative because it is consistent with the historical nature of the bridge. The year 2020 was selected for rehabilitation because it accounted for improvements made in 2005. See Attachment B for a summary of the assumptions and costs made if the Lift Bridge continues serving vehicular traffic.
- STH 35 in Wisconsin is assumed to remain as is; two-lanes going up the bluff and one lane going down the bluff.
- Other regional improvements will be assumed in the Twin Cities area (see regional model assumptions Attachment C).

Build Alternatives B-1 Through E
The build alternatives (Alternatives B-1, C, D, and E) convert TH 36 on the Minnesota side of the St. Croix River to a freeway facility between TH 5 and Wisconsin. Please refer to Attachment C for more information on the specific changes. Figure 2 shows the approximate alignment of each studied alternative.

Build Alternative B-1
Alternative B-1 (Figure 3) converts TH 36 in Minnesota to a freeway facility from TH 5 to Wisconsin. The new river crossing would consist of a four-lane bridge with a bicycle/pedestrian trail on the north side of the bridge. The 4,920-foot bridge (2,840 feet over water) would be located 7,550 feet south of the Lift Bridge along the Minnesota shoreline, 6,350 feet south of the Lift Bridge along the Wisconsin shoreline, and would perpendicularly cross the St. Croix River.

FIGURE 2 – STUDIED ALTERNATIVES

FIGURE 3 – ALTERNATIVE B-1

Two sub-alternatives of B-1 address the future use of the Lift Bridge. Alternative B-1_a converts the Lift Bridge to a bicycle and pedestrian facility, eliminating reliability concerns about bridge closures as a result of flooding, maintenance, and repair, and consideration of mitigating bluff land impacts. Alternative B-1_b keeps the Lift Bridge open to vehicular traffic, except when it is closed for two years for rehabilitation (2020 and 2021). The capital investment and maintenance costs associated with keeping the Lift Bridge open to vehicular traffic, as described for the No Build alternative, are included for Alternative B-1_b. Alternatives B-1_a and B-1_b have the same geometrics and bridge location; the difference between the two sub-alternatives is the use of the Lift Bridge.

Build Alternative C

Alternative C (Figures 4 and 5) converts TH 36 to a freeway facility from TH 5 to Wisconsin. The new river crossing would consist of a four-lane bridge with a bicycle/pedestrian trail on the north side of the bridge. The new 4,020-foot ridge (2,000 feet over water) would be located approximately 4,450 feet south of the Lift Bridge along the Minnesota shoreline and 3,600 feet south of the Lift Bridge along the Wisconsin shoreline. The river crossing would begin on the Minnesota side by crossing over TH 95 just north of the Sunnyside Marina. The bridge would continue northeast, crossing perpendicular to the river to the Wisconsin bluff.

Figures 4 and 5 also show the two options carried forward for the alignment of STH 35 and STH 64 in Wisconsin, the roadway connections, and realignment of CTH E. Figure 4 shows Option 1, which includes a diamond interchange at the relocated CTH E with a curved STH 35/64 alignment turning north and intersecting the existing STH 35/64 alignment about 4,250 feet west of the existing 20th Street intersection. Figure 5 shows Option 2 includes a folded-diamond interchange at STH 35 with a diagonal alignment of STH 35/64 traveling northeast and intersecting the existing STH 35/64 alignment at 20th Street.

Like Alternative B-1, there are two Lift Bridge scenarios in Alternative C: converting the Lift Bridge into a bicycle and pedestrian facility, or remaining open to vehicular traffic.

For simplicity, the benefit-cost analysis focused on Alternative C, Option 1 with the Lift Bridge open to bicycle/pedestrian traffic only. This was done because Option 1 is the more expensive alignment, the Option 2 alignment does not induce substantial changes in benefits or costs, and the results for Alternative B-1 are indicative of the effects of keeping the Lift Bridge open to vehicular traffic in Alternative C.

FIGURE 4 – ALTERNATIVE C: WISCONSIN OPTION - 1

FIGURE 5 – ALTERNATIVE C: WISCONSIN OPTION - 2

Build Alternative D

Alternative D (Figure 6) converts TH 36 to a freeway facility from TH 5 to Wisconsin. The new river crossing would consist of a four-lane bridge located 1,900 feet south of the existing Lift Bridge along the Minnesota shoreline and 160 feet south of the Lift Bridge along the Wisconsin shoreline. The approximately 3,950-foot bridge (2,550 feet over water) would cross the river at a skew, meeting the Wisconsin bluff near the existing Lift Bridge crossing. The Lift Bridge would be converted to a bicycle and pedestrian facility with a trail connecting the Lift Bridge to Houlton.

Build Alternative E

Alternative E (Figure 7) converts the existing TH 36 in Minnesota to a freeway facility from TH 5 to Wisconsin. At the river crossing, this alternative would operate as a one-way pair system by using the existing Lift Bridge as a two-lane roadway for westbound traffic and constructing a new bridge south of the Lift Bridge for two lanes of eastbound traffic. The existing signal system in downtown Stillwater would remain in place, but would be modified to accommodate the westbound one-way flow of traffic off the Lift Bridge. Westbound flows would continue to encounter Lift Bridge interruption and travel through the core downtown area (30 mph – Main Street area). The capital investment and maintenance costs associated with keeping the Lift Bridge open to vehicular traffic, as described for the No Build alternative, are included for Alternative E.

The new bridge would be approximately 3,000-feet long (2,530 feet over water). It would be located 1,750 feet south of the Lift Bridge along the Minnesota shoreline, extending diagonally, northeast across the river to approach the bluff immediately south of the Lift Bridge. On the Wisconsin side, eastbound traffic on the new bridge would meet westbound traffic on STH 64 at the westernmost end of County Road E. A pedestrian/bicycle trail would be provided on the new bridge.

The Lift Bridge will be closed for two years during rehabilitation (2020 and 2021). During this time and other times when the Lift Bridge is not in service for extended periods, the new bridge will operate as a two-lane facility having one lane of traffic in each direction.

BCA METHODOLOGY

This benefit-cost analysis assesses the potential benefits and costs of each alternative so that a comparison between alternatives can be made. The following methodology and assumptions were used for the benefit-cost analysis:

1. The main benefit components analyzed included:
   - Travel time/delay (vehicle hours traveled - VHT - changes)
   - Operating costs (vehicle miles traveled - VMT - changes)
   - Safety

FIGURE 6 – ALTERNATIVE D

FIGURE 7 – ALTERNATIVE E

- Annual maintenance costs (roadways, facilities)[1]
- Major maintenance/replacement costs[2]
- Remaining Capital Value: The remaining capital value (value of improvement beyond the analysis period) was considered as a reduction in cost and subtracted from total cost to obtain a net cost.
- Initial capital costs were broken into different categories in accordance with service life (consistent with the recommendations of Mn/DOT's Office of Investment Management - OIM) and applied in the mid-year of the construction period.

2. The analysis compared the different build alternatives to the No Build Alternative using the regional traffic forecasting model. The regional model assumptions are included in Attachment C.

3. The analysis assumed that all of the build alternatives will be implemented over four years, starting in 2006 with completion in 2010. Therefore, 2011 was the first full year that benefits will be realized from the project and 2009 was taken as the median year of construction. The analysis focused on the estimated weekday benefits for the twenty-year period from 2011 to 2030[3]. Additional benefits will accrue on the weekends; these are not included in the analysis. The present value of all benefits and all costs was calculated considering 2004 as the year of current dollars.

4. The assumed discount rate is 3.5 percent per discussions with OIM. This rate is consistent with directives by OIM as of November 2003.

5. Year 2010 and year 2030 VHT and VMT were determined using a Twin Cities regional travel demand forecast model enhanced for the St. Croix River Crossing study. For the purpose of this analysis, all trips from the full regional model were counted, including trips occurring in St. Croix County (WI), a portion of River Falls (Pierce Co. WI), and Polk (WI) and Chisago (MN) counties south of USH 8. Because the full model was used, and the model was run to consistent and full equilibration for each alternative, all marginal benefits and costs associated with any induced travel can be assumed included. Savings due to reduction of VHT and VMT were calculated using composite costs per mile and per hour.

6. Composite costs per mile and per hour were generated accounting for several variables. The composite cost per mile took into account the percent split of autos and trucks traveling in the area. Based on 2002 traffic count information, the analysis included four

[1] Annual maintenance costs for roadways were obtained from the Minnesota Department of Transportation.
[2] Major maintenance and replacement costs were obtained from the Minnesota Department of Transportation. These costs include activities such as mill and overlay and roadway reconstruction. Information for these costs was not provided by the Wisconsin Department of Transportation.
[3] The study estimated 260 weekdays, Monday – Friday, per year.

percent trucks.[4] The composite cost per hour also took into account peak and non-peak vehicle occupancy ratios and the number of hours of congested (peak) operation.[5]

7. Value of time, operating costs for vehicles, and remaining capital value assumptions were consistent with values published in November 2003 by OIM (see Attachment D for the values). Time values per person hour are also consistent with those published by the U.S. DOT.[6]

8. The analysis included VMT, VHT, and safety effects accounting for closing the Lift Bridge during major rehabilitation. Due to its condition, the Lift Bridge will undergo major repairs in 2005. The 2005 repairs will not address all of the Lift Bridge's structural deficiencies. Because of the remaining deficiencies, Mn/DOT estimates the bridge will need to undergo major rehabilitation. The rehabilitation was assumed to occur in 2020 and 2021 with the Lift Bridge being closed for these two years.[7] The increased costs associated with traffic diversion (time, miles traveled, safety) are included in the analysis for the No Build Alternative, Alternative $B\text{-}1_b$, and Alternative E, the alternatives that continue to use the Lift Bridge to carry vehicular traffic.

9. The Lift Bridge is closed on average for 5-days per year because of river flooding.[8] The increased costs associated with traffic diversion (time, miles traveled, safety) are included in the analysis for the No Build Alternative, Alternative $B\text{-}1_b$, and Alternative E, the alternatives that continue to use the Lift Bridge to carry vehicular traffic.

10. Safety benefits were estimated based on the forecasted change in VMT by facility type for the alternatives. VMT data, segmented by facility type (freeway and non-freeway), was estimated using the regional transportation model. Alternatives that shift trips to safer, lower crash cost facilities and/or modes generate safety benefits. In this case, a shift from a local road to a freeway facility would generate benefits. Crash data for different facility types was obtained from Mn/DOT for the three-year period 1999-2001. This data was used to identify a crash rate per 100 million vehicles miles for each level of crash severity. Severity ranges from fatal crashes to property damage only. These rates

[4] Four percent truck flow is based off of 2002 traffic flow maps from Mn/DOT.
[5] Peak and non-peak occupancy ratios were derived from the regional forecasting model. Peak rates are 1.36 persons per vehicle for No Build and 1.33 persons per vehicle for Build Alternatives. Off peak rates are 1.49 persons per vehicle for No Build and 1.48 persons per vehicle for Build Alternatives. An origin-destination study done in the project area in summer 1998 showed weekday vehicle occupancy rates of 1.33 for peak periods and 1.63 for off peak.
[6] The analysis tested the effects of using a lesser value of time for autos consistent with that in the 1990 Twin Cities Travel Behavior Inventory. The National Modeling Peer Review Panel recommended using the 1990 value of time. Using the 1990 value, each alternative's benefit-cost ratio was greater than 1.0. The OIM value was chosen for final analysis because it is consistent with Mn/DOT policies, and produces results comparable to other Mn/DOT and U.S. DOT projects.
[7] Estimated closure duration is based on an April 2004 memo from Larry Erickson, SRF Consulting Group, Inc.
[8] Historical data on bridge closures due to flooding is not well documented. Closures are based on review of limited data from Mn/DOT, the US Coast Guard, and the US Army Corp of Engineers. 5-day estimate is documented in a March 2004 memo from Jeremy Nielsen and Jonathon Kusa, SRF Consulting Group, Inc.

were identified separately for freeway and non-freeway facilities.[9] Once the freeway and non-freeway crash rate by severity were established, the safety benefit was quantified using crash cost assumptions that are consistent with values published by the OIM.

11. Roadway maintenance costs consisted of different components for the Build and No Build alternatives. Maintenance costs for the Build alternatives consisted of Mn/DOT estimates of annual maintenance cost per lane-mile of roadway and annual maintenance cost for the Lift Bridge (as a bicycle/pedestrian or motor vehicle facility). No Build maintenance costs were approximated by adding together the following estimates:

    - Annual maintenance cost per lane-mile (Mn/DOT)
    - Annual Lift Bridge maintenance cost
    - Cost of major maintenance activities (e.g. mill and overlay, etc.) periodically scheduled for TH 36 (Mn/DOT).[10]

    Maintenance costs were estimated for the state trunk highway system only (Minnesota and Wisconsin). The frontage roads in Oak Park Heights under the build alternatives were not included.

12. Because many components of the initial capital costs have service lives well beyond the 20-year benefit-cost analysis period, the remaining capital value was calculated for each alternative. The remaining capital value was subtracted from the initial capital cost to determine the net capital cost. The final value is expressed in terms of 2004 dollars. In determining remaining capital value, the initial costs of the alternatives were separated into the following categories:[11]

    - Right of Way
    - New Structural Elements (bridges, retaining wall, etc.)[12]
    - Roadway/Pavement[13]
    - Lift Bridge Rehabilitation[14,15]

---

[9] Statewide crash data for rural freeways was used to estimate freeway facility crashes. A weighted average of statewide crash data for rural four-lane expressways, rural two-lane roadways with ADTs 5,000 - 8,000, and urban two-lane roadways with ADTs 1,500 - 5,000 was used to estimate non-freeway (collector and local facility) crashes.
[10] The analysis did not include costs of major maintenance activities (e.g. mill and overlay, etc.) for Wisconsin roadways. This information was not available from the Wisconsin Department of Transportation.
[11] Costs attributable to mitigating the effects of the different alternatives were not included.
[12] Structural capital investments calculated using standard engineering procedures.
[13] Roadway capital investments calculated using standard engineering procedures.
[14] Lift Bridge rehabilitation is estimated at $26 million and is incurred in the No Build Alternative, Alternative B-1_b, and Alternative E, the alternatives that continue to use the Lift Bridge to carry vehicular traffic.
[15] The Lift Bridge is estimated to have a service life of 50 years as compared to a typical 60-year service life. The 10-year difference is due to the bridge being rehabilitated instead of reconstructed.

13. Several factors were not quantified as part of the analysis. These factors include the following:

- Affecting the No Build Alternative, Alternative B-1_b, and Alternative E (Alternative B-1_b to a lesser extent)

  - Vehicle delay, operations, and safety costs attributable to closing the Lift Bridge to perform routine maintenance. Mn/DOT documents the dates when the Lift Bridge is closed for maintenance, but the extent and duration of each closing is not available.

  - Vehicle delay costs associated with raising the Lift Bridge deck to accommodate river traffic. The Bridge is scheduled to lift 21 times daily between 8 A.M. and 10 P.M. weekdays and 23 times daily on weekends and holidays between 8 A.M. and midnight from May 15 through October 15. In the off season (October 16 – May 14), the Lift Bridge is raised upon 24 hours notice.

- Affecting the Build Alternatives (Alternative E to a lesser extent due to continued travel through traffic signals in downtown Stillwater)

  - Operational benefits related to reductions in signal cycling (vehicles on free-flow facility vs. through signals on TH 36).

The results of the analysis are as follows:

Alternative B-1$_a$

BENEFIT CALCULATIONS

VMT benefits [1] (million $)	=	$	97.0
VHT benefits [1]	=	$	915.5
Safety benefits [1]	=	$	43.4
Maintenance costs [1]	=	$	2.8
Total benefits	=	$	1,058.6

[1] See Attachment E for assumptions and calculations.

COST CALCULATIONS

Costs for the new river crossing and its connections are based on detailed layouts. The costs were placed into the following categories:

Base Condition Right-of-way costs (million $)	=	$	0
Base Condition Structures	=	$	26.0
Base Condition Roadway	=	$	0
Base Condition Total Cost (In Constant Dollars)	=	$	26.0

Present Value of Initial Capital Costs [1]	=	$	14.5
Less (Remaining Cap. Value) [1]	=	$	9.7
Base Condition Net Cost	=	$	4.8

Alternative B-1 Right-of-way costs	=	$	45.0
Alternative B-1 Structures	=	$	42.5
Alternative B-1 Roadway	=	$	236.5
Alternative B-1 Total Cost (In Constant Dollars)	=	$	324.0

Present Value of Initial Capital Costs [1]	=	$	272.8
Less (Remaining Cap. Value) [1]	=	$	$91.9
Alternative B-1 Net Cost	=	$	180.9

Cost Exclusive to Alt. B-1 = Alt. B-1 Net Cost - Base Condition Net Cost = $176.0

[1] See Attachment E for assumptions and calculations.

BENEFIT/COST CALCULATION

Benefit Cost Ratio = $1,058.7 / 176.0 = 6.0

Alternative B-1$_b$

BENEFIT CALCULATIONS

VMT benefits [1] (million $)	=	$	120.0
VHT benefits [1]	=	$	938.7
Safety benefits [1]	=	$	28.9
Maintenance costs [1]	=	$	2.8
Total benefits	=	$	1,090.3

[1] See Attachment F for assumptions and calculations.

COST CALCULATIONS

Costs for the new river crossing and its connections are based on detailed layouts. The costs were placed into the following categories:

Base Condition Right-of-way costs (million $)	=	$	0
Base Condition Structures	=	$	26.0
Base Condition Roadway	=	$	0
Base Condition Total Cost (In Constant Dollars)	=	$	26.0

Present Value of Initial Capital Costs [1]	=	$	14.5
Less (Remaining Cap. Value) [1]	=	$	9.7
Base Condition Net Cost	=	$	4.8

Alternative B-1 Right-of-way costs	=	$	45.0
Alternative B-1 Structures	=	$	42.5
Alternative B-1 Roadway	=	$	236.5
Lift Bridge (Local Traffic Only)	=	$	26.0
Alternative B-1 Total Cost (In Constant Dollars)	=	$	350.0

Present Value of Initial Capital Costs [1]	=	$	287.3
Less (Remaining Cap. Value) [1]	=	$	101.6
Alternative B-1 Net Cost	=	$	185.7

Cost Exclusive to Alt. B-1 = Alt. B-1 Net Cost - Base Condition Net Cost = $180.9

[1] See Attachment F for assumptions and calculations.

BENEFIT/COST CALCULATION

Benefit Cost Ratio = $1,090.3 / 180.9 = 6.0

Alternative C (Wisconsin Option 1)

BENEFIT CALCULATIONS

VMT benefits [1] (million $)	=	$	102.5
VHT benefits [1]	=	$	865.6
Safety benefits [1]	=	$	17.7
Maintenance costs [1]	=	$	2.8
Total benefits	=	$	988.6

[1] See Attachment G for assumptions and calculations.

COST CALCULATIONS

Costs for the new river crossing and its connections are based on detailed layouts. The costs were placed into the following categories:

Base Condition Right-of-way costs (million $)	=	$	0
Base Condition Structures	=	$	26.0
Base Condition Roadway	=	$	0
Base Condition Total Cost (In Constant Dollars)	=	$	26.0

Present Value of Initial Capital Costs [1]	=	$	14.5
Less (Remaining Cap. Value) [1]	=	$	9.7
Base Condition Net Cost	=	$	4.8

Alternative C Right-of-way costs	=	$	44.0
Alternative C Structures	=	$	63.1
Alternative C Roadway	=	$	148.9
Alternative C Total Cost (In Constant Dollars)	=	$	256.0

Present Value of Initial Capital Costs [1]	=	$	215.5
Less (Remaining Cap. Value) [1]	=	$	77.0
Alternative C Net Cost	=	$	138.5

Cost Exclusive to Alt. C = Alt. C Net Cost - Base Condition Net Cost = $133.7

[1] See Attachment G for assumptions and calculations.

BENEFIT/COST CALCULATION

Benefit Cost Ratio = $988.6 / 133.7 = 7.4

Alternative D

BENEFIT CALCULATIONS

VMT benefits [1] (million $)	=	$	107.5
VHT benefits [1]	=	$	929.4
Safety benefits [1]	=	$	20.0
Maintenance costs [1]	=	$	2.9
Total benefits	=	$	1,059.8

[1] See Attachment H for assumptions and calculations.

COST CALCULATIONS

Costs for the new river crossing and its connections are based on detailed layouts. The costs were placed into the following categories:

Base Condition Right-of-way costs (million $)	=	$	0
Base Condition Structures	=	$	26.0
Base Condition Roadway	=	$	0
Base Condition Total Cost (In Constant Dollars)	=	$	26.0

Present Value of Initial Capital Costs [1]	=	$	14.5
Less (Remaining Cap. Value) [1]	=	$	9.7
Base Condition Net Cost	=	$	4.8

Alternative D Right-of-way costs	=	$	46.0
Alternative D Structures	=	$	77.8
Alternative D Roadway	=	$	154.2
Alternative D Total Cost (In Constant Dollars)	=	$	278.0

Present Value of Initial Capital Costs [1]	=	$	234.1
Less (Remaining Cap. Value) [1]	=	$	84.4
Alternative D Net Cost	=	$	149.7

Cost Exclusive to Alt. D = Alt. D Net Cost - Base Condition Net Cost = $144.9

[1] See Attachment H for assumptions and calculations.

BENEFIT/COST CALCULATION

Benefit Cost Ratio = $1,059.8 / 144.9 = 7.3

<u>Alternative E</u>

BENEFIT CALCULATIONS

VMT benefits [1] (million $)	= -	$	0.3
VHT benefits [1]	=	$	393.8
Safety benefits [1]	=	$	14.8
Maintenance costs [1]	= -	$	0.1
Total benefits	=	$	408.1

[1] See Attachment I for assumptions and calculations.

COST CALCULATIONS

Costs for the new river crossing and its connections are based on detailed layouts. The costs were placed into the following categories:

Base Condition Right-of-way costs (million $)	=	$	0
Base Condition Structures	=	$	26.0
Base Condition Roadway	=	$	0
Base Condition Total Cost (In Constant Dollars)	=	$	26.0

Present Value of Initial Capital Costs [1]	=	$	14.5
Less (Remaining Cap. Value) [1]	=	$	9.7
Base Condition Net Cost	=	$	4.8

Alternative E Right of way costs	=	$	46.0
Alternative E Structures	=	$	75.6
Alternative E Roadway	=	$	125.4
Lift Bridge (Westbound Traffic Only)	=	$	26.0
Alternative E Total Cost (In Constant Dollars)	=	$	273.0

Present Value of Initial Capital Costs [1]	=	$	222.5
Less (Remaining Cap. Value) [1]	=	$	86.1
Alternative E Net Cost	=	$	136.4

Cost Exclusive to Alt. E = Alt. E Net Cost - Base Condition Net Cost = $131.6
[1] See Attachment I for assumptions and calculations.

BENEFIT/COST CALCULATION

Benefit Cost Ratio = $408.1 / 131.6 = 3.1

SUMMARY OF BENEFIT/COST RESULTS

A summary of the analysis results can be found in the table below. The results show all of the alternatives are beneficial from the economic perspective.

Table 1
Summary of Initial Benefit-Cost Results

Alternative	Estimated Benefits (mil. $)	Estimated Costs (mil. $)	B/C Ratio
B-1_a	$1,058.6	$176.0	6.0
B-1_b	$1,090.3	$180.9	6.0
C (WI Option 1)	$988.6	$133.7	7.4
D	$1,059.8	$144.9	7.3
E	$408.1	$131.6	3.1

In order to gain more insight into which alternative might be most beneficial from an economic perspective, an incremental benefit-cost comparison was performed. Alternatives were lined up, from least expensive to most expensive; then comparisons were made between successive alternatives to identify the additional benefits gained between the alternatives for the incremental cost. Using this incremental comparison, it was determined that Alternative D would result in the highest amount of benefits for the incremental increase in cost (see Table 2).

Table 2
Incremental Benefit-Cost Comparison

Alternative	Estimated Benefits (mil. $)	Δ Benefits (mil. $)	Estimated Cost (mil. $)	Δ Cost (mil. $)	Incremental Benefit/Cost Ratio Δ Benefit/Δ Cost	Incremental Benefit/Cost Ratio Δ Benefit/Δ Cost
E	$ 408.1		$ 131.6			
		$ 580.6		$ 2.1	$ 271.7	
C (vs. E)	$ 988.6		$ 133.7			
		$ 71.2		$ 11.2	$ 6.4	
D (vs. C)	$ 1,059.8		$ 144.9			
		$ (1.2)		$ 31.2	$ (0.0)	*D Compared to*
B-1_a (vs. D)	$ 1,058.6		$ 176.0			*B-1_b:*
		$ 31.7		$ 4.8	$ 6.6	0.8
B-1_b (vs. B-1a)	$ 1,090.3		$ 180.9			

Based on the benefit-cost analysis, Alternatives B-1_a, B-1_b, C, and D clearly outperform Alternative E by providing substantially more benefit for the cost. These four alternatives should be considered as equally beneficial from an economic perspective.

cc: Beth Bartz, SRF Consulting Group, Inc.
Project File

H:/projects/4686/TP/b-c analysis/Memo - Benefit Cost Analysis.doc

ATTACHMENT A

Lift Bridge Operation and Maintenance Assumptions and Costs

From the August 2003 report by HNTB Maintenance Projections and Annualized Costs – REPORT OF FINDINGS STILLWATER LIFT BRIDGE.

Report Assumptions

1. The projection of future operations and maintenance needs is based on the existing condition of the lift bridge as documented, application of an assumed level of maintenance and preservation and probable deterioration of the Lift Bridge over time.
2. A new St. Croix River transportation crossing will be operational in 2010.
3. The Lift Bridge will carry only pedestrian traffic when the new transportation crossing becomes operational.
4. Maintenance and preservation projections are considered over a 45-year period from 2010 through 2055 (after the Lift Bridge is no longer carrying vehicular traffic).
5. The annualized cost of operation, maintenance and preservation efforts is projected to be $322,000. Of the annualized cost, $104,000 is attributed to operation of the bridge, $43,000 for routine maintenance and $175,000 for structure preservation efforts.
6. If a high volume of unrestricted vehicular traffic (passenger and commercial vehicles) is sustained on the Lift Bridge through 2055, the structure will require extensive structural preservation efforts, up to and including replacement of individual components, construction of secondary and redundant structural systems and/or replacement of trusses in their entirety.
7. Replacement and construction activities identified in Number 5 above will require the Lift Bridge to be closed to vehicular traffic for extended periods of time, likely months, on multiple occasions to accommodate preservation repairs. Closure to vehicular traffic will eventually be required on a semi-regular basis.
8. The additional cost to maintain the Lift Bridge with unrestricted traffic is difficult to quantify with any degree of accuracy due to the extent of variables involved; however, it is anticipated that the cost would be several times that of allowing no vehicular traffic on the Lift Bridge[16].
9. The Secretary of Interior's Standards for Historic Preservation Projects will be required to be applied to future repairs. Application of the standards with respect to future repairs has not been addressed because the future repair needs and proposed response to the future repair needs cannot be determined with any degree of accuracy. Some of the required retrofit, secondary structural systems and/or wholesale replacement of components that will be required if there is unrestricted vehicular traffic may compromise the historic integrity of the Lift Bridge.

[16] The report does not quantify the actual costs of opening the Lift Bridge to unrestricted traffic. However, the report does indicate that if a low volume of personal passenger vehicles and picks-up trucks are allowed to the Lift Bridge at a reduced speed and the use of de-icing chemical is restricted, additional annualized costs of maintenance and operational activities are estimated to be $51,000.

10. All costs are provided in 2003 US dollars without consideration of escalation and without an allowance for contingency.

The following pages show the anticipated maintenance and preservation activities and associated costs for the Lift Bridge between 2010 and 2055.

Operations

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
1	Bridge Tender	Operate Br.	$ 98,700	15	15	15	$ 4,441,500
2	Electricity & Phone	Provide Service	$ 1,400	15	15	15	$ 63,000
3	Administration	Main. Records	$ 2,000	15	15	15	$ 90,000
4	Coordination	Pub. & Agency	$ 1,900	15	15	15	$ 85,500
5	Training	Personnel Training	$ 600	2	2	2	$ 3,600
6	Not Used		$ -				$ -
			Projected Costs:	**$ 1,561,200**	**$ 1,561,200**	**$ 1,561,200**	**$ 4,683,600**
			Annualized Cost:	**$ 104,100**			

Routine Maintenance

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
7	Flush Deck, drains, exp. Joints, sub-struct.	Power Wash	$ 2,800	15	15	15	$ 126,000
8	Structural Inspection	Base Inspection	$ 15,700	11	11	11	$ 518,100
9	In-Depth Structural Inspection	4-Year Inspection	$ 27,300	4	4	4	$ 327,600
10	Structural Analysis & Rating	Struct. Rating	$ 59,500		1		$ 59,500
11	Mech. & Elect. Inspection	Base Inspection	$ 5,900	7	7	7	$ 123,900
12	Underwater Inspection	5-year Inspection	$ 14,000	3	3	3	$ 126,000
13	Lamp Replacement - LED (10 each)	Replace Lamps	$ 50,400	2	1	2	$ 252,000
14	Lamp Replacement - HP Sodium	Replace Lamps	$ 800	3	3	3	$ 7,200
15	Sweep Clean Deck	Sweep	$ 600	15	15	15	$ 27,000
16	Snow Removal	Snow Removal	$ 450	90	90	90	$ 121,500
17	Counterweight Wire Ropes	Clean & lubricate	$ 2,000	15	15	15	$ 90,000
18	Gears/Bearing/Couplings/Shaft	Clean & lubricate	$ 1,000	3	3	3	$ 9,000
19	Operating Wire Ropes & Take-Up Devices	Clean / Lub / Adj.	$ 2,700	15	15	15	$ 121,500
20	Main Drive Motor	Clean/Lub./Repair	$ 100	15	15	15	$ 4,500
21	Gear Reducers	Clean & lubricate	$ 1,300	1	1	1	$ 3,900
22	Auxiliary Drive Motor	Clean/Lub./Repair	$ 100	15	15	15	$ 4,500
23	Limit Switches	Clean & lubricate	$ 300	2	2	2	$ 1,800
24	Traffic Barriers (Veh. & Ped.)	Clean & lubricate	$ 200	5	7	7	$ 3,800
25	Not Used		$ -				$ -
26	Not Used		$ -				$ -
27	Not Used		$ -				$ -
			Projected Costs:	**$ 639,300**	**$ 648,800**	**$ 639,700**	**$ 1,927,800**
			Annualized Cost:	**$ 42,800**			

Structure Preservation - Engineering

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
28	Repair Design	Engineering	$ 271,000	1	1	1	$ 813,000
29	Repair Adminstation	Constr. Admin.	$ 306,700	1	1	1	$ 920,100
			Projected Costs:	**$ 585,100**	**$ 585,100**	**$ 585,100**	**$ 1,755,300**
			Annualized Cost:	**$ 39,000**			

Structure Preservation - Substructure

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
30	Foundations	None	$ -				$ -
31	Scour Repair	Aggregate on ice	$ 5,000	2	2	2	$ 30,000
32	W. Concourse Concrete Patching & Surf. Treat.	Repair	$ 25,300		1		$ 25,300
33	West Abut. Concrete Patching & Surf. Treat.	Repair	$ 8,700		1		$ 8,700
34	Piers 1 to 7 Concrete Repair Above Waterline	Sup, Br. - Replace	$ 400,000		1		$ 400,000
35	Pier 8 Concrete Repair Above Waterline	Sup, Br. - Replace	$ 80,000	1		1	$ 160,000
36	Pier 1 to 7 Concrete Repair Below Waterline	Repair	$ 289,000		1		$ 289,000
37	Pier 8 Concrete Repair Below Waterline	Repair	$ 57,800	1		1	$ 115,600
38	E. Abut Concrete Surface Repair	Repair	$ 22,900		1		$ 22,900
39	E. Abut Settlement Adjustments	Jack & Fill Pedestal	$ 19,700		1		$ 19,700
40	E. Abut. Slope Protection	Repair	$ 2,900		1		$ 2,900
			Projected Costs:	**$ 147,800**	**$ 778,500**	**$ 147,800**	**$ 1,074,100**
			Annualized Cost:	**$ 23,900**			

Structure Preservation - Superstructure - Spans 1 & 2

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
41	Mill and Overlay	Repair	$ 5,400			1	$ 5,400
		Projected Costs:		$ -	$ -	$ 5,400	$ 5,400
		Annualized Cost:		$ 100			

Structure Preservation - Superstructure - Truss Spans

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
42	Remove Flood Water Debris	Remove & Discard	$ 10,100	3	3	3	$ 90,900
43	Pack Rust Sealing	Paint Bridge	$ 37,500	1	1	1	$ 112,500
44	Bridge Painting - Below Deck	Paint Bridge	$ 455,400	1		1	$ 910,800
45	Bridge Painting - Full Structure	Paint Bridge	$ 1,665,100		1		$ 1,665,100
46	Bearings	Clean & lubricate	$ 1,700	2	2	2	$ 10,200
47	Stringers	Struct. Repair	$ 28,500		1		$ 28,500
48	Floor Beams	Struct. Repair	$ 46,800		1		$ 46,800
49	Lower Chord Members	Struct. Repair	$ 190,200		1		$ 190,200
50	Truss Webs (Vertical & Diagonals)	Repair	$ 458,400	1			$ 458,400
51	Truss Upper Lateral Bracing	Misc. Repair	$ 10,000	1	1	1	$ 30,000
52	Truss Lower Lateral Bracing	Lft. Span Only	$ 4,000			1	$ 4,000
53	Truss - Portal Frames	Misc. Repair	$ 20,000	1	1	1	$ 60,000
54	Truss - Interior Sway Bracing	Misc. Repair	$ 20,000	1	1	1	$ 60,000
55	Spot Painting	Misc. Repair	$ 15,000	1		1	$ 30,000
		Projected Costs:		$ 1,050,000	$ 2,051,800	$ 595,600	$ 3,697,400
		Annualized Cost:		$ 82,200			

Structure Preservation - Superstructure - Span 10

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
56	Deck	Patch/Crack Rep.	$ 5,500		1		$ 5,500
57	Strip Seal	Clean	$ 400	7	7	7	$ 8,400
58	Strip Seal	Rem. & Replace	$ 4,300		1		$ 4,300
		Projected Costs:		$ 2,800	$ 12,600	$ 2,800	$ 18,200
		Annualized Cost:		$ 400			

Structure Preservation - Sidewalk Support System

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
59	Standard Support Brackets	Repair	$ 6,800			1	$ 6,800
60	Lift-Span Support Brackets	Repair	$ 6,800			1	$ 6,800
61	Fascia Stringer	Repair	$ 6,800			1	$ 6,800
62	Stringers	Repair	$ 7,300			1	$ 7,300
		Projected Costs:		$ -	$ -	$ 27,700	$ 27,700
		Annualized Cost:		$ 600			

Structure Preservation - Deck

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
63	Vehicular & Transition Deck	Patch	$ 10,600		1	2	$ 31,800
64	Vehicular & Transition Deck	Sealing	$ 174,200		1		$ 174,200
65	Span 9 to 10 Expansion Joints	Replace Gland	$ 7,400	1	1	1	$ 22,200
66	Drainage System	Repair	$ 1,200		1	1	$ 2,400
67	Pedestrian Deck	Seal	$ 44,000		1		$ 44,000
68	Pedestrian Deck	Patch	$ 3,800		1	2	$ 11,400
69	Ped. Deck Expansion Joints	Clean & Adjust	$ 1,400	1	1	1	$ 4,200
70	Ped. Deck Expansion Joints	Replace	$ 9,600				$ -
		Projected Costs:		$ 8,800	$ 242,600	$ 38,800	$ 290,200
		Annualized Cost:		$ 6,400			

Structure Preservation - Railing

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
71	Concrete Railing	Minor Repair	$ 2,500	2	2	4	$ 20,000
72	Pedestrian Railing	Minor Repair	$ 900		2	3	$ 4,500
73	Pedestrian Railing	Spot Repair	$ 7,700			2	$ 15,400
			Projected Costs:	**$ -**	**$ 1,800**	**$ 18,100**	**$ 19,900**
			Annualized Cost:	**$ 400**			

Structure Preservation - Support System

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
74	Strike Plates & Live Load Shoes	Clean & adjust	$ 2,300	1	1	1	$ 6,900
75	Span & Counterweight Guides	Repair	$ 18,200			1	$ 18,200
76	Ladders/ Platforms	Repair	$ 1,100		1		$ 1,100
			Projected Costs:	**$ 2,300**	**$ 3,400**	**$ 20,500**	**$ 26,200**
			Annualized Cost:	**$ 600**			

Structure Preservation - Balance System

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
77	Counterweight Wire Ropes	Replace	$ 768,000		1		$ 768,000
78	Counterweights	Concrete Repair	$ 15,300			1	$ 15,300
			Projected Costs:	**$ -**	**$ 768,000**	**$ 15,300**	**$ 783,300**
			Annualized Cost:	**$ 17,400**			

Preservation Main. - Drive System

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
79	Operating Wire Ropes	Replace	$ 94,500		1		$ 94,500
80	Circ. Breakers / Brakes	Minor Repair	$ 7,000		1	1	$ 14,000
			Projected Costs:	**$ -**	**$ 101,500**	**$ 7,000**	**$ 108,500**
			Annualized Cost:	**$ 2,400**			

Structure Preservation - Distribution/Control System

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
81	Motor Controls	Misc. Repair	$ 5,100			1	$ 5,100
82	Switchgear	Misc. Repair	$ 2,200			1	$ 2,200
83	Wire & Cable & Festoon Cables	Misc. Repair	$ 12,800			1	$ 12,800
84	Conduit and Junction Boxes	Misc. Repair	$ 2,100			1	$ 2,100
85	Control Console	Misc. Repair	$ 2,200			1	$ 2,200
86	Portable Traffic Controls	Misc. Repair	$ 500			1	$ 500
87	PLC Control System	Replace	$ 25,700		1		$ 25,700
88	Transformer	Misc. Repair	$ 1,100			1	$ 1,100
			Projected Costs:	**$ -**	**$ 25,700**	**$ 26,000**	**$ 51,700**
			Annualized Cost:	**$ 1,100**			

Structure Preservation - Navigation Guidance System

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
89	Lights Fixtures	Misc. Repair	$ 1,300	1	2	2	$ 6,500
90	Signage Lighting	Misc. Repair	$ 1,800			1	$ 1,800
91	Radio Trans./Receiver	Replace	$ 200	1			$ 200
			Projected Costs:	**$ 1,500**	**$ 2,600**	**$ 4,400**	**$ 8,500**
			Annualized Cost:	**$ 200**			

Structure Preservation - Traffic Control System

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
92	Traffic Barriers (Veh. & Ped.)	Misc. Repair	$ 1,300	1	1	1	$ 3,900
93	Traffic Signals / Bells & Gongs	Misc. Repair	$ 500	1	1	1	$ 1,500
94	Traffic Gate Support	Misc. Repair	$ 2,500			1	$ 2,500
			Projected Costs:	**$ 1,800**	**$ 1,800**	**$ 4,300**	**$ 7,900**
			Annualized Cost:	**$ 200**			

Structure Preservation - Machinery/Tender's House

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
95	Deck & Grating	Misc. Repair	$ 1,300		1	1	$ 2,600
96	Windows / Door / Lock Set	Misc. Repair	$ 400		1	1	$ 800
97	Sheathing & Roof	Misc. Repair	$ 2,500			1	$ 2,500
98	AC / Heating / Telephone / Detection / Suppres.	Misc. Repair	$ 400	1	2	3	$ 2,400
			Projected Costs:	**$ 400**	**$ 2,500**	**$ 5,400**	**$ 8,300**
			Annualized Cost:	**$ 200**			

Structure Preservation - Bridge Lighting

Ref. No.	Item	Action	Cost Per Event (2003 US$)	Occurrences Years 2010 to 2024	Occurrences Years 2025 to 2039	Occurrences Years 2039 to 2055	45 Yr. Cost (2003 US $)
99	Roadway Lighting	Misc. Repair	$ 2,200	1	1	1	$ 6,600
			Projected Costs:	**$ 2,200**	**$ 2,200**	**$ 2,200**	**$ 6,600**
			Annualized Cost:	**$ 100**			

Component Failure

Ref. No.	Item	Action	Cost Per Event (2003 US$)				45 Yr. Cost (2003 US $)
100	Substruct. E. Abut. Foundation Stabilization	Repair	$ 350,000				$ 500,000
101	Substructure Chloride Extraction (6 Piers)	Repair	$ 571,500				$ 572,000
102	Substructure - Pier Replacement (2 each)	Demo. & Replace	$ 450,000				$ 450,000
103	Superstructure Bearings	Rehab.	$ 48,500				$ 48,000
104	Lower Chord Connections - Bolts for Rivets	Repair	$ 256,000				$ 256,000
105	Low. Chrd. Gusset Plate Repair	Replace	$ 650,000				$ 650,000
106	Vehicular & Transition Deck	Replace	$ 402,000				$ 402,000
107	Pedestrian Deck	Replace	$ 200,000				$ 200,000
108	Cntrwght. Trunnion Replacement	Replace	$ 425,000				$ 425,000
109	Operating Drums Replacement (2 each)	Replace	$ 62,000				$ 62,000
110	Counterweight Sheave (1 each)	Replace	$ 650,000				$ 650,000
106	Demolition - One Time Cost If Bridge Removed	Remove Bridge	$ 600,000				$ 600,000
			Annualized Cost:	**$ 107,000**			**$ 4,815,000**

These opinions of maintenance projections and annual cost are based on concepts without benefit of :
1) prel. design & plans, 2) final design & plans, 3) accurate quantities or 4) confirmation of the level of maintenance.
Therefore, the opinions cost are subject to change.

The cost of labor, equipment and materials for maintenance are subject to market forces, which HNTB has no control over. The opinions of probable construction costs provided herein are made on the basis of engineering experience and represent our best judgment as experienced design professionals. However, no warranty or guarantee is provided or implied that actual total maintenance and operations costs will not vary significantly from the opinions of cost presented herein.

ATTACHMENT B

Revised Lift Bridge Operation and Maintenance Assumptions and Costs

Revised to Include Lift Bridge Continuing to Serve Vehicular Traffic

The assumptions for the Stillwater Lift Bridge were based on the August 6, 2003 HNTB report, "Maintenance Projections and Annualized Costs: Report of Findings – Stillwater Lift Bridge" and the March 25, 2004 memorandum developed by SRF Consulting Group, Inc., as well as discussions with Larry Erickson, Patrick Rivard, Beth Bartz and Dave Montebello (of SRF Consulting Group, Inc.). Based on these memorandums and discussions, it is estimated that the $5 million major maintenance project scheduled in 2005 would extend the useful life of the Lift Bridge, but that additional work would need to be completed in order to keep the bridge open to vehicular traffic to 2030. For the purposes of the benefit-cost analysis, the year 2020 was estimated as the year in which major rehabilitation and/or replacement of the Lift Bridge will be required to continue safely accommodating traffic.

The following assumptions are being made to complete the benefit-cost analysis:

1. Alternatives that use the Lift Bridge for pedestrians only (Alternatives $B\text{-}1_a$, C and D) will have operation and maintenance costs of approximately $150,000 annually – the costs as determined by the HNTB report.

2. Alternatives that maintain vehicular traffic on the Lift Bridge (Alternatives $B\text{-}1_b$, E and "No Build") will require additional operation and maintenance costs. For the purposes of the benefit-cost analysis, there is no difference in operation and maintenance costs for opening the bridge to regional versus local traffic. Operation and maintenance costs for Alternatives $B\text{-}1_b$, E and "No Build" will be $450,000 annually. The $450,000 figure was derived by multiplying the $150,000 operation and maintenance costs for keeping the Lift Bridge for pedestrian use by three. Three times was selected as a reasonable proxy for HNTB's recommendation that the operation and maintenance costs for keeping the Lift Bridge open to traffic would be "several" times the amount they outlined in their report for keeping the bridge open to pedestrians.

3. The Lift Bridge will be rehabilitated starting in the year 2020 under the No Build scenario and Alternatives $B\text{-}1_b$ and E. Rehabilitation was chosen over replacement as the preferred alternative because it stays in line with the historical nature of the Lift Bridge. The year 2020 was estimated because it is believed that the improvements made starting in 2005 would be sufficient until 2020. The year 2020 also assumes that there will be no significant damage due to flooding or other events that would require the bridge to be rehabilitated at an earlier date. It is assumed that the rehabilitation costs will be the same for "No Build", Alternative $B\text{-}1_b$, and Alternative E.

4. The lift bridge rehabilitation is estimated to cost $26 million in constant dollars.

5. It is estimated to take two years to rehabilitate the Stillwater Lift Bridge. During this time, the bridge will be closed to all traffic (rehabilitation of the trusses requires their removal and the closing of the bridge). Traffic will be required to use other river crossings in the "No Build" scenario, but will be detoured to the new river crossing under the build scenario for Alternatives E and $B\text{-}1_b$.

6. Rehabilitation of the bridge will enable the bridge to be operational through the year 2070 (assumes a 50-year life for the bridge – a rehabilitated bridge will not have the useful life of a reconstructed bridge which is approximately 70 years). The remaining useful life beyond 2030 (the analysis period in the benefit-cost analysis) will be subtracted off the initial capital cost of the rehabilitation.

ATTACHMENT C

Regional Model Assumptions

1. Planned and Programmed Improvements (Year 2030)
Transportation Policy Plan, Metropolitan Council, January 24, 2001 (Assumed for all alternatives)

- I-94 Lane addition from Minnesota River to Weaver Lake Road and from McKnight Road to Century Ave
- I-694 lane addition from I-35W to TH 36
- I-35E lane addition from I-694 to Downtown St Paul and Hwy 7 to TH 110
- TH 36 lane addition from I-35W to I-35E
- TH 100 upgrade from expressway to freeway from TH 55 to I-694 and Lane Addition from I-394 to Hwy 3
- TH 169 upgrade expressway to freeway from Old Shakopee Road to I-494
- TH 252 capacity improvements
- I-494 reconstruction from I-94 to TH 5 in accordance with Final EIS
- Wakota Bridge expansion and related lane additions on I-494 and TH 61
- TH 610 freeway extension from TH 169 to I-94
- TH 212 constructed as freeway between I-494 and CR 147

2. Regional Model Assumptions for Build Alternatives B-E

In Minnesota, TH 36 from TH 5 to a new river crossing bridge would be converted to a grade-separated facility. The following list describes the modifications to TH 36, local roads, and the frontage roads parallel to TH 36 that would be included with Alternatives B, C, D and E.

- The at-grade crossings of TH 36 with Washington/Norell Avenues, Oakgreen/Greeley Avenues (CSAH 66), and Osgood Avenue (County Road 24) would be removed.
- Existing frontage roads would be realigned and buttonhook interchanges would provide full access to TH 36 just east of Washington/Norell Avenue and west of Osgood Avenue;
- Local roads would be accessible from the realigned frontage roads;
- The Beach Road overpass would be realigned to the west; and
- Lookout Trail would be reconstructed as a cul-de-sac north of the St. Croix Overlook.

ATTACHMENT D

Mn/DOT Office of Investment Management (OIM) Recommended Standard Values for Use In Economic Analysis in Fiscal Year 2004

Assumptions	Source	Current Value
Discount Rate, real (percent)	-	3.5%[1]
Auto time value per person hour (dollars per hour)	U.S. DOT Guidance	$10.04
Truck driver time value per person hour (dollar per hour)	U.S. DOT Guidance	$18.61
Auto variable operating costs (dollars per mile)	Derived from AAA, Your Driving Costs, 1997 edition	$0.28
Truck variable operating costs (dollars per mile)	ATA Trucking Information Services[2]	$1.45
Mn/DOT Crash Values		Per crash[3]
Fatal	Mn/DOT, Office of Traffic Engineering, Feb 1999	$3,400,000
Injury Type A only	Mn/DOT, Office of Traffic Engineering, Feb 1999	$270,000
Injury Type B only	Mn/DOT, Office of Traffic Engineering, Feb 1999	$58,000
Injury Type C only	Mn/DOT, Office of Traffic Engineering, Feb 1999	$29,000
Property Damage only	Mn/DOT, Office of Traffic Engineering, Feb 1999	$4,200

[1] Value based on Real Interest Rate (market rate less inflation) on 30-year Treasury Notes and Bonds.
[2] Truck variable cost excludes tax and license, driver, insurance, and depreciation.
[3] Value updated to relect 1998-2000 crash data and adjusted for inflation.

Recommended remaining capital value factors for use in economic analysis in FY 2004

Minnesota Department of Transportation, Office of Investment Management, Nov 2003

Percent of Capital Value Remaining

Expected Life	25	30	35	40	50	60	100
Analysis: 20 years	0.27	0.45	0.58	0.67	0.78	0.87	0.97

ATTACHMENT E

BENEFIT/COST ANALYSIS FOR ALTERNATIVE B-1_a

ATTACHMENT F

BENEFIT/COST ANALYSIS FOR ALTERNATIVE B-1_b

ATTACHMENT G

BENEFIT/COST ANALYSIS FOR ALTERNATIVE C

ATTACHMENT H

BENEFIT/COST ANALYSIS FOR ALTERNATIVE D

ATTACHMENT I

BENEFIT/COST ANALYSIS FOR ALTERNATIVE E