

I-5 Skagit River Bridge – Estimate of the Direct Cost of Closure

What happened?

On the evening of Thursday, May 23, 2013 a segment of the I-5 Skagit River Bridge collapsed forcing through traffic off I-5 onto detour routes until the morning of Thursday, June 19 when the temporary bridge replacement was complete and opened to traffic. The Washington State Patrol has confirmed that an oversized load struck the trusses that supported the bridge causing the collapse.

Purpose of the Study

When this type of disruption occurs on a major interstate highway like I-5 the question many people ask is, “What is the economic impact?” This is a question that requires sophisticated modeling techniques to fully answer. Given this difficulty, WSDOT has taken a first step in this study by estimating the direct cost of the bridge closure. The economic impact of the change in taxable sales in the regional economy near the I-5 Skagit Bridge will be addressed partially by examining the taxable sales in the area during the period when the I-5 Skagit Bridge was out.

Official Detour Routes

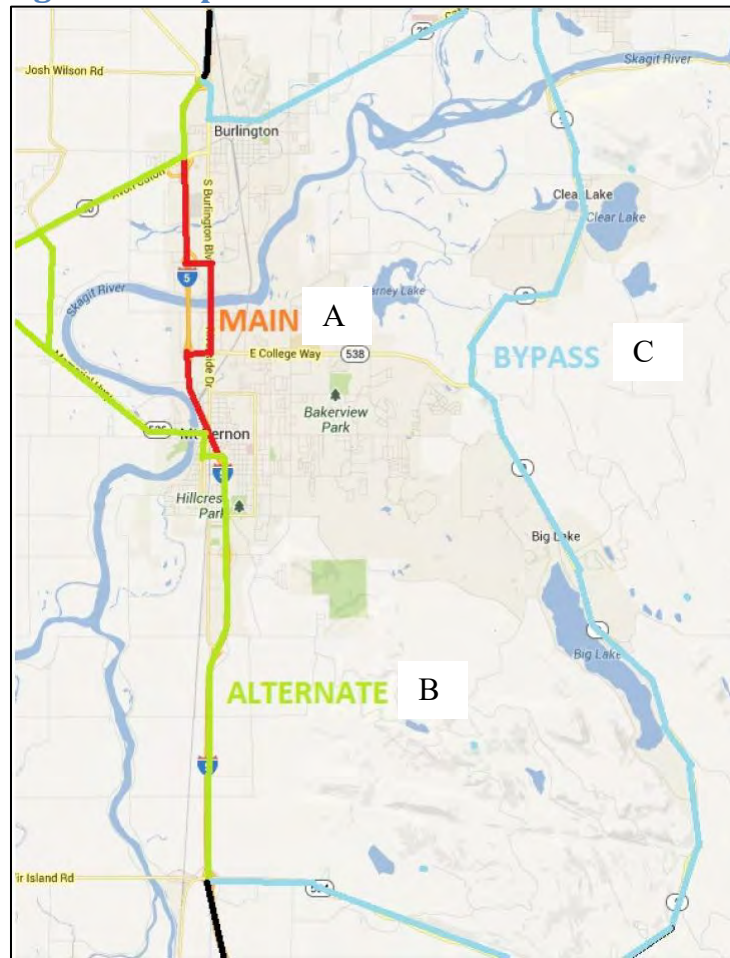
During the bridge closure and prior to the temporary bridge replacement, WSDOT established three official detour routes (A, B and C); they are described and mapped in Table and Figure 1.

Table 1: Official Detour Routes

Main Detour Route - A		Length
NB I-5 from exit 227 to SR 538/E College Way, turn left onto Riverside Drive and then left onto George Hopper Road and back to I-5		0.6 additional miles
SB I-5 from exit 229 onto George Hopper Road, then head south on Riverside Drive / Burlington Blvd and then turn right onto SR 538 and back to I-5		
Alternate Detour Route - B		Length
NB I-5 from exit 226 and west to SR 536/ E Kincaid Street, continue on SR 536, then turn right onto SR 20 and back to I-5		4.2 additional miles
SB I-5 from exit 230 and west to SR 20 then south onto Avon Allen Rd. Head east on SR 536/Memorial Hwy and back to I-5		
Bypass Detour Route - C		Length
NB I-5 from exit 227 and east to SR 538, then north on SR 9, turn right onto SR 20, then head north on Burlington Blvd and back to I-5		15.7 additional miles
SB I-5 from exit 230 and east to SR 20 then south onto SR 9, turn right and head west on SR 534 and back to I-5		

NB = north bound SB = south bound

Figure 1: Map of WSDOT Official Detour Routes



WSDOT's Approach to Estimating the Direct Cost of this Closure

WSDOT's approach to estimating the direct cost of having the I-5 Skagit bridge out of service involved using the measured traffic volumes and estimated costs to compute the increase in travel cost associated with traffic being forced onto detour routes. This analysis was performed for both weekday and weekend traffic. WSDOT calculated three main cost components to estimate the increased cost associated with traffic being diverted from I-5 onto the three detour routes. These costs were computed separately for both autos and trucks, on the average weekday and the average weekend day, and for each of the three detour routes. These costs are:

- Increased variable operating cost due to the detour route
- Increased travel time cost due to the detour route
- Increased travel time cost for normal traffic on the detour route due to increased congestion

WSDOT made additional assumptions to value the delay time for each vehicle driver and the operating costs per vehicle type. See Table 2. These costs have been estimated based on the most recent studies and available wage and cost information.

Table 2: Cost and Value of Time Assumptions

Standard Cost and Occupancy Rate Assumptions	
Variable operating cost per mile	\$0.20 per mile for autos
	\$1.10 per mile for trucks
Value of time per person-hour	\$11.42 per person-hour for autos
	\$22.44 per person-hour for trucks
Standard occupancy rates	1.1 persons/auto
	1.0 persons/truck

Measured Traffic Volumes

Before the I-5 Skagit river bridge collapsed, the last full year of actual traffic volume was 2012. In 2012, WSDOT estimated the annual average daily traffic (AADT) on the I-5 Skagit river bridge at 65,465 for weekday traffic volume and 70,615 for annual average weekend traffic (AAWT), see Table 3 below. Weekend I-5 traffic was heavier than weekday traffic volumes by 5,150 total vehicles or 7.8% in 2012.

Table 3: Weekday /Weekend Traffic Volume on I-5 Skagit River Bridge: 2012

Traffic Volumes	Total	Autos	Trucks
Weekday: AADT on I-5 Skagit River Bridge (2012)	65,465	56,212	9,253
Weekend: AAWT on I-5 Skagit River Bridge (2012)	70,615	64,626	5,988

After a section of the I-5 Skagit river bridge collapsed, WSDOT started setting up traffic counters on the detour routes to measure the number of vehicles taking the official detours during this period when the I-5 Skagit river bridge was out. Due to data availability issues on the detour routes, WSDOT established a baseline time period, to represent normal conditions, as the time immediately after the temporary bridge was opened, June 20-24, 2013.

Tables 4 and 5 below provide summary weekday and weekend traffic volume information for the detour routes during the incident and after the replacement bridge was put in place as well as the I-5 traffic volume on the Skagit river bridge after the replacement. As anticipated, there were substantial increases in traffic volumes on the detour routes after the bridge collapse and significantly fewer trucks traveling on the weekends, although the total number of vehicles on average on weekends, 49,046, was nearly the same as weekdays at 50,851. Truck volume was

Table 4: Weekday Traffic Volume After the Bridge Collapse and After the Replacement Bridge

Weekday Traffic Volumes	Total	Autos	Trucks
AADT on three detour routes after the bridge collapse and before the temporary bridge replacement (June 1-19, 2013)	50,851	43,517	7,334
AADT on three detour routes after the temporary bridge replacement (June 20-24, 2013) (<i>Baseline</i>)	26,069	23,438	2,631
AADT on I-5 after the temporary bridge replacement (June 20-24, 2013)	65,099	57,981	7,118

Table 5: Weekend Traffic Volume After the Bridge Collapse and After the Replacement Bridge

Weekend Day Traffic Volumes	Total	Autos	Trucks
AAWT on three detour routes after the bridge collapse and before the temporary bridge replacement (June 1-19, 2013)	49,046	43,856	3,190
AAWT on three detour routes after the temporary bridge replacement (June 20-24, 2013) (<i>Baseline</i>)	21,864	20,567	1,297
AAWT on I-5 after the temporary bridge replacement (June 20-24, 2013)	64,093	61,009	3,084

down 46% on weekends to AAWT of 3,190 as opposed to 5,988 under normal conditions on average weekend days. The total weekday traffic volume on I-5 Skagit River Bridge after the temporary bridge replacement was 65,099 which was real close to the 2012 AADT for the bridge at 65,465. This reveals that overall the I-5 bridge traffic did come back after the replacement bridge was in place.

Missing Vehicles During the Detour Period

WSDOT also observed that there were around 40,000 vehicles missing from post collapse traffic counts on the detour routes when compared to the baseline data. The total traffic volume during the detour period was down in total from the baseline traffic volume on weekdays by 40,683 or 44% and on weekends by 43,433 or 47%.

Table 6: Unmeasured Traffic Volume During the Detour Period

Weekday Traffic Volumes	Total	Autos	Trucks
Unmeasured AADT from baseline traffic volumes on all routes	-40,683	-36,133	-4,552
Unmeasured AAWT from baseline traffic volumes on all routes	-43,433	-39,337	-4,095

WSDOT recognizes the potential inaccuracies with this measurement technique and has no exact way to quantify the amount of traffic that either did not travel or used an unofficial detour route during the time period the bridge was down and the official detour routes were in place. WSDOT is able to make educated estimates through comparison of post incident traffic volumes with known normal average traffic volumes on these routes. It is thought that these unmeasured vehicles might have used only small segments of the three official detour routes that were not monitored by traffic data collection sites, used other local detour routes unmeasured by WSDOT, or adjusted or postponed their trips to avoid the bridge collapse area. Several different methods to estimate user costs for this missing traffic were considered, but ultimately WSDOT decided to assume that the delay incurred by the missing traffic was equivalent to the delay incurred on the shortest detour route A, as this assumption yields a conservative cost estimate. For these missing vehicles, the estimated cost takes into account both increased variable operating costs and increased travel time costs.

Other Considerations

It should also be noted that the time period that the I-5 Skagit River Bridge was closed includes the busy Memorial Day holiday weekend, which typically sees higher than average traffic volumes. Because the bridge collapse occurred immediately prior to the holiday, WSDOT was able to warn drivers about anticipated travel delays and encourage them to alter their weekend travel plans to avoid I-5 in the Skagit County area. Memorial Day holiday weekend travel impacts are not taken into account in this analysis.

Total Direct Cost Estimates

The I-5 Bridge was unusable for a total of 17 weekdays and 9 weekend days. This analysis counts Monday May 27, Memorial Day, as a weekend day, as the thought is that Memorial Day more closely resemble a weekend day with businesses and worksites being closed for the holiday. Table 7 below shows direct cost estimates for the average weekend day and the average weekday for each of the detours and for the missing or unmeasured vehicles. The assumption is that the average amount of delay incurred by the unmeasured traffic is the same as for the traffic that actually used detour A. When looking at Table 7, for weekdays the total per day road-user costs associated with detour A is \$101,940 which is lower than the \$159,146 estimated per weekday road-user costs for unmeasured traffic. This difference is due to the total volume of vehicles using detour A being 17,679 on the average weekday compared to a total of 40,683 unmeasured vehicles on the average weekday. Even though the assumptions about the amount of delay are the same the significantly different volume drives this estimated cost difference.

Table 7: Total Direct Costs Estimate from I-5 Skagit River Bridge Collapse

Total Direct Cost Estimates			
	Main - A	Alternative - B	Bypass - C
Total per day road-user costs associated with each detour	\$101,940 weekday	\$33,977 weekday	\$24,952 weekday
	\$85,845 weekend	\$41,347 weekend	\$25,281 weekend
Estimated per day road-user costs for unmeasured traffic displaced from I-5 but not using three official detours	\$159,146 weekday		
	\$168,064 weekend day		
Total direct cost per day	\$320,015 weekday		
	\$320,537 weekend day		
Costs Associated with Entire Duration of Bridge Closure			
Total direct cost for 17 weekdays	\$5,440,255		
Total direct cost for 9 weekend days	\$2,884,833		
Total direct cost	\$8,325,088		

The estimated direct cost for the I-5 Skagit River Bridge being closed is \$320,015 per weekday and \$320,573 per weekend day, with the total direct cost of the 26 day bridge closure estimated to be \$8.3 million.

The total cost of the bridge replacement is \$20.7 million, with \$8.1 million for the temporary bridge; \$8.5 million for the new permanent bridge, and \$4.1 million for additional repair work to other parts of the bridge. The new permanent structure was put in place on September 14, 2013 with minimal direct cost to users.

According to the WSDOT NW Region Program Management, if the temporary bridge had not been used and this segment of I-5 remained closed until a permanent replacement structure could be built, it is estimated that it would have taken until around Labor Day for I-5 to re-open to traffic. The direct cost of this closure would have been estimated at \$32 million, assuming the bridge would have been closed to traffic from the time it collapsed on the evening of May 23 through August 31. This is a duration of 100 total days, 69 weekdays and 31 weekend days with Memorial Day and Independence Day counted as weekend days. The investment of \$8.1 million to build the temporary bridge saved users approximately \$23.7 million in direct time delay and vehicle operating costs.