Interstate Highway (IH) 35W Multimodal Corridor Improvements Benefit Cost Appendix

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North Central Texas
Council of Governments

Transportation Department

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I. Methodology

The following description provides the methodology for various sections within the Benefit Cost Analysis (BCA), including detailed calculations of benefits and costs of the IH 35W Multimodal Corridor Improvements Project for the years between 2015 and 2039, for each cost and benefit factor. Benefits are assumed to incur after project completion in 2018 for a 20-year life span of the projects to 2039.

Traffic forecasts were conducted for current conditions (2014) and for build and no-build conditions in 2018 and 2035 using the NCTCOG DFX Regional Travel Demand Model. This version of the travel demand model and the no-build transportation networks were used for *Mobility 2035: The Metropolitan Transportation Plan for North Central Texas – 2014 Amendment*. The only modification made in running the two build alternatives was the addition of the IH 30/IH 35W Managed Lane Access Ramp Project to the transportation network.

a. Project Cost

Proposed construction costs were obtained from the North Tarrant Express Segment 3A (NTE 3A) project team. Annual construction costs were estimated based on the proposed construction schedule for the IH 30/IH 35W Managed Lane Access Ramp. The cost for the purchase of express bus vehicles and site improvement costs associated with the Park and Ride location were included as a capital investment in the first quarter of 2018. The project schedule is shown in section III.c of the IH 35W Multimodal Corridor Improvements FY 2015 TIGER Discretionary Grant Application.

b. Short Term Jobs

Per BCA guidance, the proposed transportation investment per quarter was divided by $76,900 to calculate the short-term job years and short-term jobs generated by quarter. These results were used to calculate the number of direct construction jobs created by funding the IH 30/IH 35W Managed Lane Access Ramp Project. No job creation benefit was included in the overall benefits of the project, nor for the operations of the express bus which are considered transfer payment, rather than net benefit.

c. Direct User Cost (Economic Competitiveness)

The direct cost to users of the managed lane system is difficult to calculate precisely. According to the project website (http://www.texpresslanes.com/pricing/how-pricing), "TEXpress Lanes use congestion-management pricing to help manage traffic flow and provide faster, more predictable travel. Roadside equipment recalculates real-time prices every 5 minutes, 24 hours a day, aiming to ensure the lanes are moving at 50 mph or faster." The "exact toll prices after the first six months of the project opening are difficult to predict since they are based on real-time traffic demand. Average toll prices may range from 10 cents to 25 cents per mile during lighter traffic, and 45 cents to 75 cents during rush hour.

To ensure that the estimated cost to users applied in the BCA is conservative, the highest cost is assumed for all users. For morning and evening peak periods, the 75 cents per mile rate is used and for the off-peak periods, the 45 cents per mile rate is applied. The per-mile costs are multiplied by the number of users during each period, then they are multiplied again by 2.5 miles – the distance between the new IH 30/IH 35W Managed Lane Access Ramp and the next managed lane entrance ramp near NE 28th Street in Fort Worth.

Note that model results were used to forecast user volumes for the years 2018 and 2035. Intermediate years were estimated based on a linear progression. Travel volumes after 2035 were assumed to remain constant.

The direct cost to users of the express bus service was calculated using number of trips and a bus fare price for using the service. The maximum number of daily trips was estimated at 3,000 one-way trips per day at a maximum fare of $10.00 per one-way trip. The ridership estimates are based on *Mobility 2035: The Metropolitan Transportation Plan for North Central Texas – 2014 Amendment* projected rail ridership on the IH 35W corridor limits of the express bus service, while the bus fare estimate is based on the Fort Worth Transportation Authority's regional transit system one-way bus fare. The per-trip cost ($10.00) was multiplied by the number of annual trips (3,000 times 365).

Note that estimated number of daily trips remains consistent for forecasted years up to 2039. The figure remains at 3,000 one-way trips per day as a conservative measure for forecasted years, although ridership is expected to increase over time. The figure was not applied a growth rate as an analysis conducive to this project was not completed.

Equation for Annual Direct User Cost:

$$RAMP - Annual\ Direct\ User\ Cost$$
$$= Peak\ Period\ Users\ (Daily) \times\ 365\ days\ \times 2.5\ miles\ \times \frac{\$0.75}{mile}$$
$$+ Offpeak\ Period\ Users\ (Daily) \times\ 365\ days\ \times 2.5\ miles\ \times \frac{\$0.45}{mile}$$

$$EXPRESS\ BUS\ SERVICE - Annual\ Direct\ User\ Cost$$
$$= Number\ of\ Trips\ (Daily) \times\ 365\ days\ \times \$10.00$$

d. Travel Time Benefit (Economic Competitiveness)

Regional travel time benefits were calculated based on travel demand modeling conducted for the project. Travel time benefits were calculated at the metropolitan planning area level to reflect all shifts in regional traffic patterns that would result from the construction of the project and operation of the express bus service. These travel time benefits reflect the reduced traffic congestion experienced by managed lane system users, express bus users, and all other users of the transportation facilities in the region.

Equation for Annual Travel Time Benefit:

$$RAMP - \ Annual\ Travel\ Time\ Benefit = \left(Daily\ Hours\ of\ Congestion\ Delay\ (Build\ Network) - Daily\ Hours\ of\ Congestion\ Delay\ (No\ Build\ Network)\right) \times 365\ days \times \frac{\$13.00}{hour}$$

$$EXPRESS\ BUS - \ Annual\ Travel\ Time\ Benefit = \left(Average\ Trip\ Time\ in\ Minutes \times \frac{3{,}000\ (Number\ of\ Trips)}{60\ (Minutes\ per\ Hour)}\right) \times 365\ days \times \frac{\$13.00}{hour}$$

e. Geometric Crash Reduction Benefit (Safety)

The construction of the new access ramp will allow some traffic to travel directly from the eastbound IH 30 to IH 35W ramp to the managed lane system without entering the IH 35W general purpose lanes. The area where ramp traffic merges into the general purpose lanes is a short auxiliary lane. Ramp traffic not bound for westbound Spur 280 is required to transition one lane to the left. This weaving section is followed by another weaving section where a combined ramp from northbound US 287 and eastbound IH 30 also join northbound IH 35W. This entrance ramp is also configured as an auxiliary lane that transitions into a ramp from IH 35W to eastbound SH 121.

Regional safety is increased by providing an opportunity for managed lane users to bypass these two weaving sections. The total length of the two auxiliary lane sections is 0.78 miles. The annual crash frequency for this stretch of IH 35W was calculated based on 2013-2014 data. This data was then normalized by the annual vehicle miles traveled (VMT) for this roadway based on travel demand model current year estimates and multiplied by 100 million to yield a crash rate per hundred million vehicles miles traveled (HMVMT).

No specific weaving length crash modification factor was available from the Crash Modification Factor Clearinghouse (http://www.cmfclearinghouse.org/). The

Texas Transportation Institute published a paper (http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/0-4703-5.pdf) with accident modification factors based on specific transportation facility design elements. The following equation was derived for weaving sections on freeways:

$$AMF_{wev} = e^{152.9/L^*_{wev}}$$

Based on the measured length of the weaving section, 1,275 feet, the accident modification factor (AMF) for existing conditions is 1.1274. The option of bypassing the weaving section completely would yield an AMF for the managed lane ramp users of 1.0. Combining these two results, the calculated crash modification factor (CMF) for the managed lane users is 1.0/1.1274 or 0.887. This CMF was applied to the crash rates on IH 35W to estimate the build condition crash rate for managed lane ramp users based on the KABCO rating system used by the Texas Department of Transportation (TxDOT).

Operation of an express bus service is anticipated to reduce the number of private automobile trips by providing transportation users with a multi-modal high occupancy alternative. With the estimation of 3,000 daily trips taken off the IH 35W corridor, a reduction in annual vehicle miles traveled can be expected. The reduction in vehicle miles traveled will not only reduce congestion, it will reduce crash occurrences. Regional safety is increased by providing the motorist an opportunity to switch over from driving to an express bus service. The modal diversion to a safer mode of travel, public transportation, is enhanced by the estimated reduction in injuries and fatalities.

Crash incident costs are dependent on the reduction of vehicle miles traveled. To calculate the reduction in the risk of crashes, the crash rate was calculated for the corridor limits of the express bus service, approximately 19 miles one way. The annual crash frequency for this stretch of IH 35W was calculated based on 2013-2014 data. This data was also then normalized by the annual VMT for this roadway based on travel demand model current year estimates and multiplied by 100 million to yield a crash rate per HMVMT.

It is important to note the forecasted years' reduction in crashes remained consistent as the estimated number of trips reduced remained consistent. Although the absolute number of crashes reduced are expected to change the difference between crashes with the express bus service and without the express bus service remain the same.

Equation for Annual Geometric Crash Reduction Benefit:

$$RAMP - Annual\ Geometric\ Crash\ Reduction\ Benefit = Managed\ Lane\ Ramp\ Users\ (Daily) \times 365\ days \times 0.78\ miles \times KABCO\ Crash\ Reduction\ Rate \times KABCO\ to\ AIS\ Conversion \times Monetized\ Value_{By\ AIS\ Type}$$

$$EXPRESS\ BUS - \ Annual\ Geometric\ Crash\ Reduction\ Benefit = Express\ Bus\ Service\ Corridor\ Volumes\ (Daily) \times 365\ days \times 39\ miles \times KABCO\ Crash\ Reduction\ Rate \times KABCO\ to\ AIS\ Conversion \times Monetized\ Value_{By\ AIS\ Type}$$

f. Regional Crash Reduction Benefit (Safety)

Traffic that transitions to the managed lane system and the express bus service frees up capacity on the general purpose lanes. This additional capacity allows some traffic from local thoroughfares to transition to limited-access facilities. This redistribution of traffic helps to improve regional transportation safety because limited-access facilities are relatively safer than local thoroughfares and other secondary streets. This benefit is calculated by comparing the proportion of system-wide VMT on each functional classification of roadway under the build and no-build conditions. The estimated daily reduction in trips as a result of the express bus services was included in the build condition.

The Iowa Department of Transportation published crash rates per HMVMT for vehicles traveling on limited-access facilities based on 2001-2009 data (http://www.iowadot.gov/crashanalysis/pdfs/crash_rate-density_comparables_segments_2001-2009_20100706_dividedroadmainline.pdf). A similar publication listed crash rates per HMVMT on secondary roadways based on 2002-2011 data (http://www.iowadot.gov/crashanalysis/pdfs/crash_rate-density_comparables_segments_2002-2011_20130215_secondary_functionalclass.pdf). TxDOT and NCTCOG do not have similar data, so the Iowa data was used to calculate the safety benefits to transportation system users in the Dallas-Fort Worth area.

Freeways, freeway ramps, and managed or HOV lanes were assumed to generate crashes at the same rate as “Urban Expressways” in Iowa. Freeway service (or frontage) roads were assumed to be comparable to principal arterials. Other Dallas-Fort Worth roadways were directly comparable to the Iowa classification system. This methodology is based on the assumption that the differential in crash rates between roads of each functional classifications is similar regardless of the absolute crash rate of a state or region.

Equation for Annual Regional Crash Reduction Benefit:

$$\begin{aligned} &Annual\ Regional\ Crash\ Reduction\ Benefit \\ &= (Daily\ VMT_{By\ Roadway\ Class}\ (Build\ Network) \\ &- Daily\ VMT_{By\ Roadway\ Class}\ (No\text{-}Build\ Network)) \times 365\ days \\ &\times Iowa\ Crash\ Rate_{By\ Roadway\ Class} \times KABCO\ to\ AIS\ Conversion \\ &\times Monetized\ Value_{By\ AIS\ Type} \end{aligned}$$

NOTE:

A static version of the Microsoft Excel spreadsheets used to calculate the costs and benefits are included below. A copy of the Microsoft Excel file is also included in the IH 30/IH 35W Managed Lane Access Ramp Project FY 2014 Grant Application submittal.

Project Cost

[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	
Constant Source								**{1}**	
								$ 76,900	
Equation								**[D] / {1}**	**[I] x 4**
						Total Project Spending		**Short Term Jobs**	
Year	**Quarter**	**Engineering/ ROW/Utilities Spending**	**Construction Spending**	**Express Bus Vehicle Purchase**	**Park and Ride Site Improvements**	**By Quarter**	**By Year**	**Construction JOB-YEARS BY QUARTER**	**Construction JOBS BY QUARTER**
2014	Q1					$ -			
2014	Q2					$ -	$ -		
2014	Q3					$ -			
2014	Q4					$ -		0.0	0
2015	Q1					$ -		0.0	0
2016	Q2	$ 1,009,534				$ 1,009,534		0.0	0
2016	Q3	$ 1,009,534				$ 1,009,534	$ 11,028,601	0.0	0
2016	Q4	$ 1,009,533		$ 4,500,000	$ 3,500,000	$ 9,009,533		0.0	0
2017	Q1		$ 1,156,389			$ 1,156,389		15.0	60
2017	Q2		$ 2,312,779			$ 2,312,779		30.1	120
2017	Q3		$ 3,469,168			$ 3,469,168	$ 10,407,505	45.1	180
2017	Q4		$ 3,469,168			$ 3,469,168		45.1	180
2018	Q1		$ 3,469,168			$ 3,469,168		45.1	180
2018	Q2		$ 3,469,168			$ 3,469,168		45.1	180
2018	Q3		$ 3,469,168			$ 3,469,168	$ 11,563,894	45.1	180
2018	Q4		$ 1,156,389			$ 1,156,389		15.0	60
2019	Q1					$ -		0.0	0
2019	Q2							0.0	0
2019	Q3					$ -	$ -	0.0	0
2019	Q4					$ -		0.0	0
2020	Q1					$ -		0.0	0
2020	Q2					$ -		0.0	0
2020	Q3					$ -	$ -		
2020	Q4					$ -			
Total		**$ 3,028,601**	**$ 21,971,399**	**$ 4,500,000**	**$ 3,500,000**	**$ 33,000,000**	**$ 33,000,000**		

Sources: {1} Conversion Factor: 1 job-year per $76,900 in spending (See TIGER BCA Resource Guide - Updated 3/28/14)

Direct User Cost

[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]			[I]	[J]	[K]				[L]			
Column Source	{1}																		
Constant Source	{2}	{3}	{4}			{6}					{7}								
	365	2.5	$ 0.75		$ 0.25					$ 10									
Equation		[B] x {2} x {3}	[C] x {4}		[E] x {2} x {3}	[F] x {6}	[D] + [G]	[I] / (1.07^[O])	[I] / (1.03^[O])		[I] x {2}	[J] x {7}	[I] / (1.07^[O])	[I] / (1.03^[O])		[H] + [K]	[I] / (1.07^[O])	[I] / (1.03^[O])	
Year	AM and PM Peak Period Daily Trips	AM and PM Peak Period VMT	Maximum Expected Cost	Off-Peak Period Daily Trips	Off-Peak Period VMT	Maximum Expected Cost	Maximum Expected Annual User Cost Paid in Tolls	7% NPV Maintenance Cost Reduction Benefits	3% NPV Maintenance Cost Reduction Benefits	Year	Daily Trips Express Bus	Annual Trips Express Bus	Maximum Expected Annual User Cost Paid in Fares	7% NPV Maintenance Cost Reduction Benefits	3% NPV Maintenance Cost Reduction Benefits	Year	Maximum Expected Annual User Cost Total	7% NPV Maintenance Cost Reduction Benefits	3% NPV Maintenance Cost Reduction Benefits	Year
2015	0	0	$ -	0	0	$ -	$ -	$ -	$ -	1	0	0		$ -	$ -	1		$ -	$ -	1
2016	0	0	$ -	0	0	$ -	$ -	$ -	$ -	2	0	0		$ -	$ -	2		$ -	$ -	2
2017	0	0	$ -	0	0	$ -	$ -	$ -	$ -	3	0	0		$ -	$ -	3		$ -	$ -	3
2018	0	0	$ -	0	0	$ -	$ -	$ -	$ -	4	0	0		$ -	$ -	4		$ -	$ -	4
2019	588.0	536,550	$ (402,412.50)	4113.0	3,753,113	$ (938,278.13)	$ (1,340,691)	$ (955,894)	$ (1,156,492)	5	3,000	1,095,000	$ (10,950,000)	$ (7,807,199)	$ (9,445,566)	5	$ (12,290,691)	$ (8,763,093)	$ (10,602,058)	5
2020	589.1	537,570	$ (403,177.39)	3899.0	3,557,838	$ (889,459.38)	$ (1,292,637)	$ (861,338)	$ (1,082,563)	6	3,000	1,095,000	$ (10,950,000)	$ (7,296,447)	$ (9,170,453)	6	$ (12,242,637)	$ (8,157,786)	$ (10,253,016)	6
2021	590.2	538,590	$ (403,942.28)	3685.0	3,362,563	$ (840,640.63)	$ (1,244,583)	$ (775,064)	$ (1,011,960)	7	3,000	1,095,000	$ (10,950,000)	$ (6,819,110)	$ (8,903,352)	7	$ (12,194,583)	$ (7,594,173)	$ (9,915,312)	7
2022	591.4	539,610	$ (404,707.17)	3471.0	3,167,288	$ (791,821.88)	$ (1,196,529)	$ (696,391)	$ (944,551)	8	3,000	1,095,000	$ (10,950,000)	$ (6,373,000)	$ (8,644,031)	8	$ (12,146,529)	$ (7,069,390)	$ (9,588,582)	8
2023	592.5	540,629	$ (405,472.06)	3257.0	2,972,013	$ (743,003.13)	$ (1,148,475)	$ (624,694)	$ (880,211)	9	3,000	1,095,000	$ (10,950,000)	$ (5,956,074)	$ (8,392,263)	9	$ (12,098,475)	$ (6,580,769)	$ (9,272,474)	9
2024	593.6	541,649	$ (406,236.95)	3043.0	2,776,738	$ (694,184.38)	$ (1,100,421)	$ (559,398)	$ (818,817)	10	3,000	1,095,000	$ (10,950,000)	$ (5,566,425)	$ (8,147,828)	10	$ (12,050,421)	$ (6,125,823)	$ (8,966,645)	10
2025	594.7	542,669	$ (407,001.84)	2829.0	2,581,463	$ (645,365.63)	$ (1,052,367)	$ (499,972)	$ (760,253)	11	3,000	1,095,000	$ (10,950,000)	$ (5,202,266)	$ (7,910,513)	11	$ (12,002,367)	$ (5,702,238)	$ (8,670,766)	11
2026	595.8	543,689	$ (407,766.73)	2615.0	2,386,188	$ (596,546.88)	$ (1,004,314)	$ (445,927)	$ (704,405)	12	3,000	1,095,000	$ (10,950,000)	$ (4,861,931)	$ (7,680,110)	12	$ (11,954,314)	$ (5,307,858)	$ (8,384,515)	12
2027	596.9	544,709	$ (408,531.62)	2401.0	2,190,913	$ (547,728.13)	$ (956,260)	$ (396,814)	$ (651,166)	13	3,000	1,095,000	$ (10,950,000)	$ (4,543,861)	$ (7,456,417)	13	$ (11,906,260)	$ (4,940,675)	$ (8,107,584)	13
2028	598.1	545,729	$ (409,296.51)	2187.0	1,995,638	$ (498,909.38)	$ (908,206)	$ (352,218)	$ (600,431)	14	3,000	1,095,000	$ (10,950,000)	$ (4,246,599)	$ (7,239,240)	14	$ (11,858,206)	$ (4,598,817)	$ (7,839,671)	14
2029	599.2	546,749	$ (410,061.40)	1973.0	1,800,363	$ (450,090.63)	$ (860,152)	$ (311,759)	$ (552,099)	15	3,000	1,095,000	$ (10,950,000)	$ (3,968,784)	$ (7,028,388)	15	$ (11,810,152)	$ (4,280,543)	$ (7,580,487)	15
2030	600.3	547,768	$ (410,826.29)	1759.0	1,605,088	$ (401,271.88)	$ (812,098)	$ (275,086)	$ (506,073)	16	3,000	1,095,000	$ (10,950,000)	$ (3,709,144)	$ (6,823,678)	16	$ (11,762,098)	$ (3,984,230)	$ (7,329,751)	16
2031	601.4	548,788	$ (411,591.18)	1545.0	1,409,813	$ (352,453.13)	$ (764,044)	$ (241,877)	$ (462,259)	17	3,000	1,095,000	$ (10,950,000)	$ (3,466,490)	$ (6,624,930)	17	$ (11,714,044)	$ (3,708,366)	$ (7,087,189)	17
2032	602.5	549,808	$ (412,356.07)	1331.0	1,214,538	$ (303,634.38)	$ (715,990)	$ (211,836)	$ (420,569)	18	3,000	1,095,000	$ (10,950,000)	$ (3,239,710)	$ (6,431,971)	18	$ (11,665,990)	$ (3,451,546)	$ (6,852,540)	18
2033	603.6	550,828	$ (413,120.96)	1117.0	1,019,263	$ (254,815.63)	$ (667,937)	$ (184,690)	$ (380,915)	19	3,000	1,095,000	$ (10,950,000)	$ (3,027,766)	$ (6,244,632)	19	$ (11,617,937)	$ (3,212,456)	$ (6,625,547)	19
2034	604.8	551,848	$ (413,885.85)	903.0	823,988	$ (205,996.88)	$ (619,883)	$ (160,189)	$ (343,214)	20	3,000	1,095,000	$ (10,950,000)	$ (2,829,688)	$ (6,062,750)	20	$ (11,569,883)	$ (2,989,878)	$ (6,405,964)	20
2035	605.9	552,868	$ (414,650.74)	689.0	628,713	$ (157,178.13)	$ (571,829)	$ (138,104)	$ (307,386)	21	3,000	1,095,000	$ (10,950,000)	$ (2,644,568)	$ (5,886,165)	21	$ (11,521,829)	$ (2,782,672)	$ (6,193,551)	21
2036	607.0	553,888	$ (415,415.63)	475.0	433,438	$ (108,359.38)	$ (523,775)	$ (118,223)	$ (273,354)	22	3,000	1,095,000	$ (10,950,000)	$ (2,471,559)	$ (5,714,723)	22	$ (11,473,775)	$ (2,589,782)	$ (5,988,077)	22
2037	607.0	553,888	$ (415,415.63)	475.0	433,438	$ (108,359.38)	$ (523,775)	$ (110,489)	$ (265,392)	23	3,000	1,095,000	$ (10,950,000)	$ (2,309,868)	$ (5,548,275)	23	$ (11,473,775)	$ (2,420,357)	$ (5,813,667)	23
2038	607.0	553,888	$ (415,415.63)	475.0	433,438	$ (108,359.38)	$ (523,775)	$ (103,260)	$ (257,663)	24	3,000	1,095,000	$ (10,950,000)	$ (2,158,755)	$ (5,386,674)	24	$ (11,473,775)	$ (2,262,016)	$ (5,644,337)	24
2039	607.0	553,888	$ (415,415.63)	475.0	433,438	$ (108,359.38)	$ (523,775)	$ (96,505)	$ (250,158)	25	3,000	1,095,000	$ (10,950,000)	$ (2,017,528)	$ (5,229,781)	25	$ (11,473,775)	$ (2,114,034)	$ (5,479,939)	25
20-Year Project Life Present through 2040								$ (8,119,729)	$ (12,629,930)					$ (90,516,773)	$ (149,971,740)			$ (98,636,501)	$ (162,601,670)	

Sources: {1} Daily ramp volumes are forecast using the NCTCOG DFX Regional Travel Demand Model
{2} Daily Express Bus trips are forecast using the NCTCOG DFX Regional Travel Demand Model
{3} Number of estimated week day travel in one year - NCTCOG
{4} Length on planned NTE managed lane before the first northbound entrance north of the proposed ramp.
{5} The maximum e› http://www.texpresslanes.com/pricing/how-pricing

{6} The maximum e› http://www.texpresslanes.com/pricing/how-pricing

{7} The maximum expected Express Bus fare

Travel Time Total

[A]	[B]	[C]		[D]	[E]	[F]	[G]	
Column Source	{1}							
Constant Source		{2}		{3}				
		365		$ 13.00				
Equation				[D] x {2}	[E] x {3}	[D] / (1.07^[G])	[D] / (1.03^[G])	
Year	RAMP Regional Vehicle Hours of Congestion Delay Reduced (hours/day)	EXPRESS BUS Regional Vehicle Hours of Congestion Delay Reduced (hours/day)	TOTAL Regional Vehicle Hours of Congestion Delay Reduced (hours/day)	TOTAL Regional Vehicle Hours of Congestion Delay Reduced (hours/year)	Total Time Savings Benefit	7% NPV Time Savings Benefits	3% NPV Time Savings Benefits	Year
2015					$ -	$ -	$ -	1
2016					$ -	$ -	$ -	2
2017					$ -	$ -	$ -	3
2018					$ -	$ -	$ -	4
2019	845.74	830.65	1676.39	611,881	$ 7,954,450	$ 5,671,413	$ 6,861,578	5
2020	821.81	828.19	1650.00	602,250	$ 7,829,244	$ 5,216,956	$ 6,556,869	6
2021	797.87	825.74	1623.61	592,618	$ 7,704,039	$ 4,797,688	$ 6,264,088	7
2022	773.94	823.29	1597.23	582,987	$ 7,578,833	$ 4,410,950	$ 5,982,801	8
2023	750.00	820.84	1570.84	573,356	$ 7,453,628	$ 4,054,280	$ 5,712,585	9
2024	726.07	818.38	1544.45	563,725	$ 7,328,422	$ 3,725,398	$ 5,453,034	10
2025	702.13	815.93	1518.06	554,094	$ 7,203,216	$ 3,422,196	$ 5,203,757	11
2026	678.20	813.48	1491.68	544,462	$ 7,078,011	$ 3,142,722	$ 4,964,374	12
2027	654.26	811.03	1465.29	534,831	$ 6,952,805	$ 2,885,167	$ 4,734,522	13
2028	630.33	808.58	1438.90	525,200	$ 6,827,600	$ 2,647,861	$ 4,513,848	14
2029	606.39	806.12	1412.52	515,569	$ 6,702,394	$ 2,429,256	$ 4,302,012	15
2030	582.46	803.67	1386.13	505,938	$ 6,577,189	$ 2,227,921	$ 4,098,687	16
2031	558.52	801.22	1359.74	496,306	$ 6,451,983	$ 2,042,533	$ 3,903,556	17
2032	534.59	798.77	1333.36	486,675	$ 6,326,778	$ 1,871,865	$ 3,716,315	18
2033	510.65	796.32	1306.97	477,044	$ 6,201,572	$ 1,714,786	$ 3,536,670	19
2034	486.72	793.86	1280.58	467,413	$ 6,076,367	$ 1,570,249	$ 3,364,337	20
2035	462.78	791.41	1254.20	457,782	$ 5,951,161	$ 1,437,283	$ 3,199,042	21
2036	438.85	788.96	1227.81	448,150	$ 5,825,956	$ 1,314,995	$ 3,040,523	22
2037	414.92	786.51	1201.42	438,519	$ 5,700,750	$ 1,202,555	$ 2,888,523	23
2038	390.98	784.06	1175.04	428,888	$ 5,575,545	$ 1,099,200	$ 2,742,798	24
2039	367.05	781.60	1148.65	419,257	$ 5,450,339	$ 1,004,220	$ 2,603,112	25
20-Year Project Life Present through 2039					**$ 57,889,494**	**$ 93,643,032**		

Sources: {1} Daily reduction in vehicle hours of congestion delay is forecast using the NCTCOG DFX Regional Travel Demand Model
{2} Number of estimated week day travel in one year - NCTCOG
{3} Conversion Factor: Average value of time for roadway users = $13.00 (See TIGER BCA Resource Guide - Updated 3/27/15)

Crash Analysis - Ramp

Crashes on IH 35W from DC Ramp to SP 280 Exit Ramp to SH 121 Exit Ramp

	# Not Injured	# of Possible Injury Crashes	# of Non-Incapacitating Injury Crashes	# of Incapacitating Injury Crashes	# Fatality Crashes	# Unknown Injury Crashes
Total Crashes (2013-201	139	51	32	15	3	5
Crashes Per Year	69.50000	25.50000	16.00000	7.50000	1.50000	2.50000
Daily Volume (2014)	**90,595**	**Daily VMT (2014)**	**118,679**	**Total VMT (2014)**	**43,317,999**	
No Build Crashes per HM	160.44139	58.86698	36.93615	17.31382	3.46276	5.77127
Calculated CRF	**Managed lane users avoid weaving sections on IH 35W (Calculated CMF)**				**0.887**	**89%**
Build Crashes per HMVM	142.31151	52.21502	32.76236	15.35736	3.07147	5.11912
Managed Lane Benefit	-18.12988	-6.65197	-4.17378	-1.95646	-0.39129	-0.65215
Daily Volume (2019)	**4,700**	**Daily VMT (2019)**	**3,666**	**Total VMT (2019)**	**1,338,090**	
Build Crashes per HMVM	-0.24259	-0.08901	-0.05585	-0.02618	-0.00524	-0.00873
Daily Volume (2035)	**1,082**	**Daily VMT (2035)**	**844**	**Total VMT (2013)**	**308,045**	
Build Crashes per HMVM	-0.05585	-0.02049	-0.01286	-0.00603	-0.00121	-0.00201

1. This data consist of all locatable crashes that include latitude and longitude information
2. This data consist of all crash types that occurred within 100 feet of IH 35W in the project area
3. This data is composed of TxDOT "Reportable Crashes" only
   a. A "Reportable Motor Vehicle Traffic Crash" is defined by TxDOT as: any crash involving motor vehicle in transport that occurs or originates on a traffic way, results in injury to or death of any person, or damage to the property of any one person to the apparent extent of $1,000
   i. A trafficway is defined as any land way open to the public as a matter of right or custom for moving persons or property from one place to another
4. Source: TxDOT's Crash Records Information System (CRIS) - 2014 January Extract - all TxDOT disclaimers apply to this information
5. Daily volume is forecast using the NCTCOG DFX Regional Travel Demand Model

Link: http://www.txdot.gov/government/enforcement/crash-statistics.html

Year 2019 Crash Reduction

KABCO Accident Classification System

KABCO Type →	**O**		**C**		**B**		**A**		**K**		**U**		
	No Injury		**Possible Injury**		**Non-Incapacitating**		**Incapacitating**		**Killed**		**Injured Severity Unknown**		
AIS Rating System	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Annual Crash Reduction**
0		0.92534		0.23437		0.08347		0.03437		0.00000		0.21538	-0.25278
1		0.07257		0.68946		0.76843		0.55449		0.00000		0.62728	-0.14188
2		0.00198		0.06391		0.10898		0.20908		0.00000		0.10400	-0.01864
3	-0.24259	0.00008	-0.08901	0.01071	-0.05585	0.03191	-0.02618	0.14437	-0.00524	0.00000	-0.00873	0.03858	-0.00687
4		0.00000		0.00142		0.00620		0.03986		0.00000		0.00442	-0.00155
5		0.00003		0.00013		0.00101		0.01783		0.00000		0.01034	-0.00063
Fatal		0.00000		0.00000		0.00000		0.00000		1.00000		0.00000	-0.00524

Source: National Highway Traffic Safety Administration, July 2011.

Year 2035 Crash Reduction

KABCO Accident Classification System

KABCO Type →	**O**		**C**		**B**		**A**		**K**		**U**		
	No Injury		**Possible Injury**		**Non-Incapacitating**		**Incapacitating**		**Killed**		**Injured Severity Unknown**		
AIS Rating System	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Annual Crash Reduction**
0		0.92534		0.23437		0.08347		0.03437		0.00000		0.21538	-0.05819
1		0.07257		0.68946		0.76843		0.55449		0.00000		0.62728	-0.03266
2		0.00198		0.06391		0.10898		0.20908		0.00000		0.10400	-0.00429
3	-0.05585	0.00008	-0.02049	0.01071	-0.01286	0.03191	-0.00603	0.14437	-0.00121	0.00000	-0.00201	0.03858	-0.00158
4		0.00000		0.00142		0.00620		0.03986		0.00000		0.00442	-0.00036
5		0.00003		0.00013		0.00101		0.01783		0.00000		0.01034	-0.00015
Fatal		0.00000		0.00000		0.00000		0.00000		1.00000		0.00000	-0.00121

Source: National Highway Traffic Safety Administration, July 2011.

Crash Reduction - Ramp

[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]	[L]	[M]	[N]	[O]	[P]	[Q]	[R]	[S]
Column Source	{1,2}	{1,2}	{1,2}	{1,2}	{1,2}	{1,2}	{1,2}											
Constant Source								{3}	{4}	{5}	{6}	{7}	{8}	{9}				
								$ 4,071	$ 28,200	$ 441,800	$ 987,000	$ 2,500,400	$ 5,574,200	$ 9,400,000				
Equation								[B] x {3}	[C] x {4}	[D] x {5}	[E] x {6}	[F] x {7}	[G] x {8}	[H] x {9}	SUM([I:O])	[P] / (1.07^[S])	[P] / (1.03^[S])	
	ANNUAL REDUCTION IN CRASHES (BY AIS Rating Category)							ANNUAL CRASH REDUCTION BENEFIT (BY AIS Rating Category)								7% NPV	3% NPV	Year
															Total Crash Reduction Benefit	Maintenance Cost Reduction	Maintenance Cost Reduction	
YEAR	**0**	**1**	**2**	**3**	**4**	**5**	**Fatal**	**0**	**1**	**2**	**3**	**4**	**5**	**Fatal**				
2015								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			0
2016								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			1
2017								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			2
2018								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			3
2019	-0.25278	-0.14188	-0.01864	-0.00687	-0.00155	-0.00063	-0.00524	$ 1,029	$ 4,001	$ 8,235	$ 6,781	$ 3,876	$ 3,512	$ 49,256	$ 76,689	$ 58,506	$ 68,137	4
2020	-0.24062	-0.13505	-0.01774	-0.00654	-0.00148	-0.00060	-0.00499	$ 980	$ 3,809	$ 7,839	$ 6,454	$ 3,690	$ 3,345	$ 46,888	$ 73,004	$ 52,051	$ 62,974	5
2021	-0.22846	-0.12823	-0.01685	-0.00621	-0.00140	-0.00057	-0.00474	$ 930	$ 3,616	$ 7,443	$ 6,128	$ 3,504	$ 3,177	$ 44,521	$ 69,318	$ 46,190	$ 58,053	6
2022	-0.21629	-0.12140	-0.01595	-0.00588	-0.00133	-0.00054	-0.00448	$ 881	$ 3,424	$ 7,046	$ 5,802	$ 3,318	$ 3,010	$ 42,153	$ 65,633	$ 40,873	$ 53,366	7
2023	-0.20413	-0.11458	-0.01505	-0.00555	-0.00125	-0.00051	-0.00423	$ 831	$ 3,231	$ 6,650	$ 5,475	$ 3,132	$ 2,843	$ 39,786	$ 61,948	$ 36,054	$ 48,902	8
2024	-0.19197	-0.10775	-0.01416	-0.00522	-0.00118	-0.00048	-0.00398	$ 782	$ 3,039	$ 6,254	$ 5,149	$ 2,946	$ 2,676	$ 37,418	$ 58,262	$ 31,691	$ 44,653	9
2025	-0.17981	-0.10092	-0.01326	-0.00489	-0.00110	-0.00045	-0.00373	$ 732	$ 2,846	$ 5,858	$ 4,823	$ 2,760	$ 2,508	$ 35,050	$ 54,577	$ 27,744	$ 40,610	10
2026	-0.16765	-0.09410	-0.01236	-0.00456	-0.00103	-0.00042	-0.00348	$ 682	$ 2,654	$ 5,461	$ 4,496	$ 2,574	$ 2,341	$ 32,683	$ 50,892	$ 24,178	$ 36,765	11
2027	-0.15549	-0.08727	-0.01147	-0.00423	-0.00096	-0.00039	-0.00323	$ 633	$ 2,461	$ 5,065	$ 4,170	$ 2,388	$ 2,174	$ 30,315	$ 47,206	$ 20,960	$ 33,109	12
2028	-0.14332	-0.08044	-0.01057	-0.00389	-0.00088	-0.00036	-0.00297	$ 583	$ 2,269	$ 4,669	$ 3,844	$ 2,202	$ 2,007	$ 27,947	$ 43,521	$ 18,060	$ 29,635	13
2029	-0.13116	-0.07362	-0.00967	-0.00356	-0.00081	-0.00033	-0.00272	$ 534	$ 2,076	$ 4,273	$ 3,517	$ 2,016	$ 1,839	$ 25,580	$ 39,835	$ 15,449	$ 26,336	14
2030	-0.11900	-0.06679	-0.00877	-0.00323	-0.00073	-0.00030	-0.00247	$ 484	$ 1,884	$ 3,877	$ 3,191	$ 1,830	$ 1,672	$ 23,212	$ 36,150	$ 13,102	$ 23,203	15
2031	-0.10684	-0.05996	-0.00788	-0.00290	-0.00066	-0.00027	-0.00222	$ 435	$ 1,691	$ 3,480	$ 2,865	$ 1,644	$ 1,505	$ 20,845	$ 32,465	$ 10,997	$ 20,231	16
2032	-0.09468	-0.05314	-0.00698	-0.00257	-0.00058	-0.00024	-0.00197	$ 385	$ 1,499	$ 3,084	$ 2,538	$ 1,458	$ 1,338	$ 18,477	$ 28,779	$ 9,111	$ 17,412	17
2033	-0.08251	-0.04631	-0.00608	-0.00224	-0.00051	-0.00021	-0.00171	$ 336	$ 1,306	$ 2,688	$ 2,212	$ 1,272	$ 1,171	$ 16,109	$ 25,094	$ 7,424	$ 14,740	18
2034	-0.07035	-0.03949	-0.00519	-0.00191	-0.00043	-0.00018	-0.00146	$ 286	$ 1,114	$ 2,292	$ 1,886	$ 1,086	$ 1,003	$ 13,742	$ 21,408	$ 5,920	$ 12,209	19
2035	-0.05819	-0.03266	-0.00429	-0.00158	-0.00036	-0.00015	-0.00121	$ 237	$ 921	$ 1,895	$ 1,559	$ 900	$ 836	$ 11,374	$ 17,723	$ 4,580	$ 9,813	20
2036	-0.04603	-0.02583	-0.00339	-0.00125	-0.00029	-0.00012	-0.00096	$ 187	$ 729	$ 1,499	$ 1,233	$ 714	$ 669	$ 9,006	$ 14,038	$ 3,390	$ 7,546	21
2037	-0.03387	-0.01901	-0.00250	-0.00092	-0.00021	-0.00009	-0.00071	$ 138	$ 536	$ 1,103	$ 907	$ 528	$ 502	$ 6,639	$ 10,352	$ 2,337	$ 5,403	22
2038	-0.02170	-0.01218	-0.00160	-0.00059	-0.00014	-0.00006	-0.00045	$ 88	$ 344	$ 707	$ 580	$ 342	$ 334	$ 4,271	$ 6,667	$ 1,406	$ 3,378	23
2039	-0.00954	-0.00536	-0.00070	-0.00026	-0.00006	-0.00003	-0.00020	$ 39	$ 151	$ 310	$ 254	$ 156	$ 167	$ 1,904	$ 2,981	$ 588	$ 1,467	24
20-Year Project Life	**Present through 2039**														**$ 430,610**	**$ 617,942**		

Sources:

{1} The annual crash reduction benefits by AIS Rating for year 2019 are taken from cells O27 to O33 in the [Crash Reduction - Ramp] tab.

{2} The annual crash reduction benefits by AIS Rating for year 2035 are taken from cells O41 to O47 in the [Crash Reduction - Ramp] tab.

{3} Value of Property Damage Only Crashes *The Economic Impact of Motor Vehicle Crashes 2000*
Note: Value adjusted from 2010$ to 2015$ using the BLS GDP deflator method
Link: http://www.nhtsa.gov/DOT/NHTSA/Communication%20&%20Consumer%20Information/Articles/Associated%20Files/EconomicImpact2000.pdf

{4} Value of AIS Type 1 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*
Link: http://www.dot.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

{5} Value of AIS Type 2 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*
Link: http://www.dot.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

{6} Value of AIS Type 3 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*
Link: http://www.dot.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

{7} Value of AIS Type 4 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*
Link: http://www.dot.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

{8} Value of AIS Type 5 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*
Link: http://www.dot.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

{9} Value of AIS Type 6 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*
Link: http://www.dot.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

Crashes on IH 35W from IH 30 to Alliance Airport

	# Not Injured	# of Possible Injury Crashes	# of Non-Incapacitating Injury Crashes	# of Incapacitating Injury Crashes	# Fatality Crashes	# Unknown Injury Crashes
Total Crashes (2013-2014)	1103	281	192	72	13	20
Crashes Per Year	551.50000	140.50000	96.00000	36.00000	6.50000	10.00000
Daily Volume (2014)	47,346	Daily VMT (2014)	1,831,362	Total VMT (2014)	668,447,074	
No Build Crashes per HMVMT	82.50466	21.01887	14.36165	5.38562	0.97240	1.49600
Daily Volume (2019)	51,821	Daily VMT (2019)	2,004,419	Total VMT (2019)	731,612,889	
Transit Ridership Expectations		Estimated number of trips reduced with Express Bus service			3000	
Estimated Daily Volume (2019) [Daily Volume - 3000]	48,821	Daily VMT (2019)	1,888,379	Total VMT (2019)	689,258,289	
Volume and VMT Difference [With Express Bus - Without Express Bus]	-3,000		-116,040		-42,354,600	
Estimated Crashes per HMVMT*	82.50466	21.01887	14.36165	5.38562	0.97240	1.49600
With Express Bus - Crash Reduction [VMT Differnce (Row 11) x Estimated Crash Rate (Row 10)/100,000,000}	-34.94452	-8.90246	-6.08282	-2.28106	-0.41186	-0.63363
Daily Volume (2035)	79,337	Daily VMT (2035)	3,068,746	Total VMT (2035)	1,120,092,386	
Transit Ridership Expectations		Estimated number of trips reduced with Express Bus service			3000	
Estimated Daily Volume (2035) [Daily Volume - 3000]	76,337	Daily VMT (2035)	2,952,706	Total VMT (2035)	1,077,737,786	
Volume and VMT Difference [With Express Bus - Without Express Bus]	-3,000		-116,040		-42,354,600	
Estimated Crashes per HMVMT*	82.50466	21.01887	14.36165	5.38562	0.97240	1.49600
With Express Bus - Crash Reduction [VMT Differnce (Row 11) x Estimated Crash Rate (Row 10)/100,000,000}	-34.94452	-8.90246	-6.08282	-2.28106	-0.41186	-0.63363

2. This data consist of all crash types that occurred within 100 feet of the limits of the S. M. Wright Project
3. This data is composed of TxDOT "Reportable Crashes" only
   a. A "Reportable Motor Vehicle Traffic Crash" is defined by TxDOT as: any crash involving motor vehicle in transport that occurs or originates on a traffic way, results in injury to or death of any person, or damage to the property of any one person to the apparent extent of $1,000
   i. A trafficway is defined as any land way open to the public as a matter of right or custom for moving persons or property from one place to another
4. Source: TxDOT's Crash Records Information System (CRIS) - 2013 January Extract - all TxDOT disclaimers apply to this information Link: http://www.txdot.gov/government/enforcement/crash-statistics.html
5. Daily volume is forecast using the NCTCOG DFX Regional Travel Demand Model

Year 2019 & 2035 Crash Reduction

KABCO Accident Classification System

KABCO Type →	O		C		B		A		K		U		
	No Injury		Possible Injury		Non-Incapacitating		Incapacitating		Killed		Injured Severity Unknown		
AIS Rating System	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Annual Crash Reduction**
0		0.92534		0.23437		0.08347		0.03437		0.00000		0.21538	-35.14463
1		0.07257		0.68946		0.76843		0.55449		0.00000		0.62728	-15.01032
2		0.00198		0.06391		0.10898		0.20908		0.00000		0.10400	-1.84387
3	-34.94452	0.00008	-8.90246	0.01071	-6.08282	0.03191	-2.28106	0.14437	-0.41186	0.00000	-0.63363	0.03858	-0.64601
4		0.00000		0.00142		0.00620		0.03986		0.00000		0.00442	-0.14408
5		0.00003		0.00013		0.00101		0.01783		0.00000		0.01034	-0.05557
Fatal		0.00000		0.00000		0.00000		0.00000		1.00000		0.00000	-0.41186

Source: National Highway Traffic Safety Administration, July 2011.

Crash Reduction - Express Bus

[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]	[L]	[M]	[N]	[O]	[P]	[Q]	[R]	[S]
Column Source	{1,2}	{1,2}	{1,2}	{1,2}	{1,2}	{1,2}	{1,2}											
Constant Source								{3}	{4}	{5}	{6}	{7}	{8}	{9}				
								$ 4,071	$ 28,200	$ 441,800	$ 987,000	$ 2,500,400	$ 5,574,200	$ 9,400,000				
Equation								[B] x {3}	[C] x {4}	[D] x {5}	[E] x {6}	[F] x {7}	[G] x {8}	[H] x {9}	SUM([I:O])	[P] / (1.07^[S])	[P] / (1.03^[S])	
	ANNUAL REDUCTION IN CRASHES (BY AIS Rating Category)							ANNUAL CRASH REDUCTION BENEFIT (BY AIS Rating Category)								7% NPV	3% NPV	Year
YEAR	0	1	2	3	4	5	Fatal	0	1	2	3	4	5	Fatal	Total Crash Reduction Benefit	Maintenance Cost Reduction	Maintenance Cost Reduction	
2015								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			0
2016								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			1
2017								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			2
2018								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			3
2019	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 5,004,668	$ 5,828,562	4
2020	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 4,677,259	$ 5,658,798	5
2021	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 4,371,271	$ 5,493,979	6
2022	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 4,085,300	$ 5,333,960	7
2023	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 3,818,037	$ 5,178,602	8
2024	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 3,568,259	$ 5,027,769	9
2025	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 3,334,821	$ 4,881,329	10
2026	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 3,116,655	$ 4,739,155	11
2027	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 2,912,762	$ 4,601,121	12
2028	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 2,722,208	$ 4,467,108	13
2029	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 2,544,119	$ 4,336,998	14
2030	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 2,377,682	$ 4,210,678	15
2031	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 2,222,132	$ 4,088,036	16
2032	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 2,076,759	$ 3,968,967	17
2033	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 1,940,896	$ 3,853,366	18
2034	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 1,813,922	$ 3,741,132	19
2035	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 1,695,254	$ 3,632,167	20
2036	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 1,584,350	$ 3,526,376	21
2037	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 1,480,701	$ 3,423,666	22
2038	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 1,383,832	$ 3,323,948	23
2039	-35.14463	-15.01032	-1.84387	-0.64601	-0.14408	-0.05557	-0.41186	$ 143,074	$ 423,291	$ 814,622	$ 637,612	$ 360,258	$ 309,758	$ 3,871,484	$ 6,560,098	$ 1,293,301	$ 3,227,134	24
20-Year Project Life	**Present through 2039**															**$ 58,024,188**	**$ 92,542,854**	

Sources:

{1} The annual crash reduction benefits by AIS Rating for year 2019 and 2035 are taken from cells O27 to O33 in the [Crash Reduction Analysis] tab.

{2} Value of Property Damage Only Crashes *The Economic Impact of Motor Vehicle Crashes 2000*

Note: Value adjusted from 2010$ to 2015$ using the BLS GDP deflator method

Link: http://www.nhtsa.gov/DOT/NHTSA/Communication%20&%20Consumer%20Information/Articles/Associated%20Files/EconomicImpact2000.pdf

{3} Value of AIS Type 1 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*

Link: http://www.dot.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

{4} Value of AIS Type 2 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*

Link: http://www.dot.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

{5} Value of AIS Type 3 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*

Link: http://www.dot.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

{6} Value of AIS Type 4 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*

Link: http://www.dot.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

{7} Value of AIS Type 5 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*

Link: http://www.dot.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

{8} Value of AIS Type 6 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*

Link: http://www.dot.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

Regional Crash Reduction Data

TABLE 1 - IOWA CRASH RATE DATA

Crash Rate Code [a]	Roadway Type [b]	Crash Rates per 100 Million Vehicle Miles of Travel (crashes/HMVMT) Fatal Crash Rate [c]	Major Injury Crash Rate [d]	Minor Injury Crash Rate [e]	Possible/ Unknown Injury Crash Rate [f]	Property Damage Only Crash Rates [g]
A	Urban Interstates [1]	0.53	2.08	7	13	52
B	Urban Freeways [1]	0.61	2.26	7	12	58
C	Urban Expressways [1]	0.63	3.29	13	25	83
D	Principal Arterial [2]	1.86	9.28	27	40	205
E	Minor Arterial [2]	2.09	7.71	23	35	146
F	Major Collector [2]	2.75	8.42	20	24	106
G	Minor Collector [2]	4.43	14.58	39	44	163
H	Local [2]	5.97	22.08	62	74	253

[1] Crash Rates and Crash Densities on Mainline, Divided Roads in Iowa 2001-2009, Iowa Department of Transportation, July 6, 2010, page 11
[2] Crash Rates and Crash Densities on Secondary Roads in Iowa by Functional Class 2002-2011, Iowa Department of Transportation, February 18, 2013, Page 12

TABLE 2 - YEAR 2019 CRASH RATE REDUCTION CALCULATIONS (KABCO)

Crash Rate Code [a]	Roadway Type [b]	Year 2019 No Build Condition Daily VMT [c]	Build Condition (Ramp) Daily VMT [d]	Build Condition (Express Bus) Daily VMT [e]	Daily VMT Difference (Build - No Build) [f]	Annual VMT Differential [g]	Regional Crash Rate Differential (crashes/HMVMT) Fatal Crash Rate [h]	Major Injury Crash Rate [i]	Minor Injury Crash Rate [j]	Possible/ Unknown Injury Crash Rate [g]	Property Damage Only Crash Rates [l]
				[d] - 3000 trips	[c] - [e]	[f] x 365	[g] x TABLE1[c] ROW[a]=TABLE	[g] x TABLE1[d] ROW[a]=TABLE	[g] x TABLE1[e] ROW[a]=TABLE	[f] x TABLE1[f] ROW[a]=TABLE	[f] x TABLE1[g] ROW[a]=TABLE
C	FREEWAYS	96,264,335.04	96,279,948.02	96,163,908.02	-100,427.02	-36,655,862.30	-0.230931932	-1.20597787	-4.765262099	-9.163965575	-30.42436571
D	PRINCIPAL ARTERIALS	41,592,775.09	41,587,544.74	41,587,544.74	-5,230.35	-1,909,077.75	-0.035508846	-0.177162415	-0.515450993	-0.7636311	-3.913609388
E	MINOR ARTERIALS	38,721,451.80	38,715,800.95	38,715,800.95	-5,650.85	-2,062,560.25	-0.043107509	-0.159023395	-0.474388857	-0.721896087	-3.011337965
F	COLLECTORS	14,105,993.98	14,092,118.83	14,092,118.83	-13,875.15	-5,064,429.75	-0.139271818	-0.426424985	-1.01288595	-1.21546314	-5.368295535
C	FREEWAY RAMPS	7,674,378.17	7,651,590.23	7,651,590.23	-22,787.94	-8,317,598.10	-0.052400868	-0.273648977	-1.081287753	-2.079399525	-6.903606423
D	FRONTAGE ROADS	8,092,480.84	8,064,497.15	8,064,497.15	-27,983.69	-10,214,046.85	-0.189981271	-0.947863548	-2.757792649	-4.08561874	-20.93879604
C	HOV LANES	2,046,211.94	2,100,550.71	2,100,550.71	54,338.77	19,833,651.05	0.124952002	0.65252712	2.578374637	4.958412763	16.46193037
TOTALS		208,497,626.86	208,492,050.63	208,376,010.63	-121,616.23		-0.566250	-2.537574	-8.028694	-13.071561	-54.098081
					Crash Rate Reduction (crashes/HMVMT)		-7.44091E-12	-3.33454E-11	-1.05502E-10	-1.71769E-10	-7.10885E-10
					KABCO Severity Level		K	A	B	U*	O

*Used Unknown Severity instead of Possible Injury because it has smaller factors when converting to the AIS Rating System

TABLE 3 - YEAR 2019 CRASH RATE REDUCTION CALCULATIONS (AIS)

KABCO Type →	KABCO Accident Classification System												
	O No Injury		C Possible Injury		B Non-Incapacitating		A Incapacitating		K Killed		U Injured Severity Unknown		
AIS Rating System	Number	Factor	Number	Factor	Number	Factor	Number	Factor	Number	Factor	Number	Factor	Crash Rate Reduction (crashes/HMVMT)
0		0.92534		0.23437		0.08347		0.03437		0.00000		0.21538	-53.63184
1		0.07257		0.68946		0.76843		0.55449		0.00000		0.62728	-19.70198
2		0.00198		0.06391		0.10898		0.20908		0.00000		0.10400	-2.87208
3	-54.09808	0.00008	0.00000	0.01071	-8.02869	0.03191	-2.53757	0.14437	-0.56625	0.00000	-13.07156	0.03858	-1.13117
4		0.00000		0.00142		0.00620		0.03986		0.00000		0.00442	-0.20870
5		0.00003		0.00013		0.00101		0.01783		0.00000		0.01034	-0.19014
Fatal		0.00000		0.00000		0.00000		0.00000		1.00000		0.00000	-0.56625

Source: National Highway Traffic Safety Administration, July 2011.

TABLE 4 - YEAR 2035 CRASH RATE REDUCTION CALCULATIONS (KABCO)

Crash Rate Code [a]	Roadway Type [b]	Year 2035 No Build Condition Daily VMT [c]	Build Condition (Ramp) Daily VMT [d]	IH 30/IH 35W Managed Lane Access Ramp Build Condition (Express Bus) Daily VMT [e]	Daily VMT Difference (Build - No Build) [f]	Annual VMT Differential [g]	Regional Crash Rate Differential (crashes/HMVMT) Fatal Crash Rate [h]	Major Injury Crash Rate [i]	Minor Injury Crash Rate [j]	Possible/ Unknown Injury Crash Rate [k]	Property Damage Only Crash Rates [l]
				[d] - 3000 trips	[c] - [e]	[f] x 365	[g] x TABLE1[c] ROW[a]=TABLE	[g] x TABLE1[d] ROW[a]=TABLE	[g] x TABLE1[e] ROW[a]=TABLE	[f] x TABLE1[f] ROW[a]=TABLE	[f] x TABLE1[g] ROW[a]=TABLE
C	FREEWAYS	125,637,648.04	125,635,568.62	125,519,528.62	-118,119.42	-43,113,588.30	-0.271615606	-1.418437055	-5.604766479	-10.77839708	-35.78427829
D	PRINCIPAL ARTERIALS	55,450,162.01	55,438,594.07	55,438,594.07	-11,567.94	-4,222,298.10	-0.078534745	-0.391829264	-1.140020487	-1.68891924	-8.655711105
E	MINOR ARTERIALS	54,757,527.81	54,758,700.23	54,758,700.23	1,172.42	427,933.30	0.008943806	0.032993657	0.098424659	0.149776655	0.624782618
F	COLLECTORS	20,631,759.38	20,633,987.85	20,633,987.85	2,228.47	813,391.55	0.022368268	0.068487569	0.16267831	0.195213972	0.862195043
C	FREEWAY RAMPS	10,342,214.90	10,348,191.95	10,348,191.95	5,977.05	2,181,623.25	0.09664591	0.31808067	0.850833067	0.95991423	3.556045897
D	FRONTAGE ROADS	11,142,795.87	11,152,623.29	11,152,623.29	9,827.42	3,587,008.30	0.214144396	0.792011433	2.223945146	2.654386142	9.075130999
C	HOV LANES	3,618,473.40	3,621,668.22	3,621,668.22	3,194.82	1,166,109.30	0	0	0	0	0
TOTALS		281,580,581.41	281,589,334.23	281,473,294.23	-107,287.18		-0.008048	-0.598693	-3.408906	-8.508025	-30.321835
					Crash Rate Reduction (crashes/HMVMT)		-1.05756E-13	-7.83028E-14	-5.82499E-12	-3.31670E-11	-8.27789E-11	-2.95017E-10
					KABCO Severity Level		K	A	B	U*	O

*Used Unknown Severity instead of Possible Injury because it has smaller factors when converting to the AIS Rating System

TABLE 5 - YEAR 2035 CRASH RATE REDUCTION CALCULATIONS (AIS)

KABCO Type →	KABCO Accident Classification System												
	O No Injury		C Possible Injury		B Non-Incapacitating		A Incapacitating		K Killed		U Injured Severity Unknown		
AIS Rating System	Number	Factor	Number	Factor	Number	Factor	Number	Factor	Number	Factor	Number	Factor	Crash Rate Reduction (crashes/HMVMT)
0		0.92534		0.23437		0.08347		0.03437		0.00000		0.21538	-30.19558
1		0.07257		0.68946		0.76843		0.55449		0.00000		0.62728	-10.48884
2		0.00198		0.06391		0.10898		0.20908		0.00000		0.10400	-1.44155
3	-30.32183	0.00008	0.00000	0.01071	-3.40891	0.03191	-0.59869	0.14437	-0.00805	0.00000	-8.50803	0.03858	-0.52588
4		0.00000		0.00142		0.00620		0.03986		0.00000		0.00442	-0.08260
5		0.00003		0.00013		0.00101		0.01783		0.00000		0.01034	-0.10300
Fatal		0.00000		0.00000		0.00000		0.00000		1.00000		0.00000	-0.00805

Source: National Highway Traffic Safety Administration, July 2011.

Regional Crash Reduction

[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]	[L]	[M]	[N]	[O]	[P]	[Q]	[R]	[S]
Column Source	{1,2}	{1,2}	{1,2}	{1,2}	{1,2}	{1,2}	{1,2}											
Constant Source								{3}	{4}	{5}	{6}	{7}	{8}	{9}				
								$ 4,071	$ 28,200	$ 441,800	$ 987,000	$ 2,500,400	$ 5,574,200	$ 9,400,000				
Equation								[B] x {3}	[C] x {4}	[D] x {5}	[E] x {6}	[F] x {7}	[G] x {8}	[H] x {9}	SUM([I:O])	[P] / (1.07^[S])	[P] / (1.03^[S])	
	CRASH RATE REDUCTION (BY AIS Rating Category)							ANNUAL CRASH REDUCTION BENEFIT (BY AIS Rating Category)								7% NPV	3% NPV	Year
YEAR	**0**	**1**	**2**	**3**	**4**	**5**	**Fatal**	**0**	**1**	**2**	**3**	**4**	**5**	**Fatal**	**Total Crash Reduction Benefit**	**Maintenance Cost Reduction**	**Maintenance Cost Reduction**	
2015								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0
2016								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1
2017								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	2
2018								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	3
2019	-53.63184	-19.70198	-2.87208	-1.13117	-0.20870	-0.19014	-0.56625	$ 218,335	$ 555,596	$ 1,268,885	$ 1,116,469	$ 521,838	$ 1,059,861	$ 5,322,752	$ 10,063,735	$ 7,677,576	$ 8,941,499	4
2020	-52.16708	-19.12615	-2.78267	-1.09334	-0.20082	-0.18469	-0.53136	$ 212,372	$ 539,358	$ 1,229,384	$ 1,079,129	$ 502,132	$ 1,029,503	$ 4,994,808	$ 9,586,688	$ 6,835,176	$ 8,269,561	5
2021	-50.70231	-18.55033	-2.69326	-1.05551	-0.19294	-0.17924	-0.49647	$ 206,409	$ 523,119	$ 1,189,884	$ 1,041,790	$ 482,427	$ 999,146	$ 4,666,865	$ 9,109,640	$ 6,070,138	$ 7,629,180	6
2022	-49.23754	-17.97451	-2.60386	-1.01768	-0.18506	-0.17380	-0.46159	$ 200,446	$ 506,881	$ 1,150,383	$ 1,004,451	$ 462,721	$ 968,789	$ 4,338,921	$ 8,632,592	$ 5,375,944	$ 7,019,087	7
2023	-47.77278	-17.39869	-2.51445	-0.97985	-0.17718	-0.16835	-0.42670	$ 194,483	$ 490,643	$ 1,110,883	$ 967,112	$ 443,015	$ 938,432	$ 4,010,977	$ 8,155,544	$ 4,746,601	$ 6,438,062	8
2024	-46.30801	-16.82287	-2.42504	-0.94202	-0.16930	-0.16291	-0.39181	$ 188,520	$ 474,405	$ 1,071,382	$ 929,772	$ 423,309	$ 908,074	$ 3,683,033	$ 7,678,496	$ 4,176,593	$ 5,884,928	9
2025	-44.84325	-16.24705	-2.33563	-0.90419	-0.16142	-0.15746	-0.35692	$ 182,557	$ 458,167	$ 1,031,882	$ 892,433	$ 403,603	$ 877,717	$ 3,355,089	$ 7,201,448	$ 3,660,851	$ 5,358,553	10
2026	-43.37848	-15.67123	-2.24622	-0.86636	-0.15353	-0.15201	-0.32204	$ 176,594	$ 441,929	$ 992,381	$ 855,094	$ 383,897	$ 847,360	$ 3,027,145	$ 6,724,400	$ 3,194,714	$ 4,857,850	11
2027	-41.91371	-15.09541	-2.15681	-0.82853	-0.14565	-0.14657	-0.28715	$ 170,631	$ 425,691	$ 952,881	$ 817,755	$ 364,191	$ 817,003	$ 2,699,202	$ 6,247,352	$ 2,773,899	$ 4,381,767	12
2028	-40.44895	-14.51959	-2.06741	-0.79069	-0.13777	-0.14112	-0.25226	$ 164,668	$ 409,452	$ 913,380	$ 780,415	$ 344,486	$ 786,645	$ 2,371,258	$ 5,770,304	$ 2,394,471	$ 3,929,296	13
2029	-38.98418	-13.94377	-1.97800	-0.75286	-0.12989	-0.13568	-0.21737	$ 158,705	$ 393,214	$ 873,880	$ 743,076	$ 324,780	$ 756,288	$ 2,043,314	$ 5,293,256	$ 2,052,816	$ 3,499,466	14
2030	-37.51941	-13.36795	-1.88859	-0.71503	-0.12201	-0.13023	-0.18249	$ 152,742	$ 376,976	$ 834,379	$ 705,737	$ 305,074	$ 725,931	$ 1,715,370	$ 4,816,208	$ 1,745,615	$ 3,091,341	15
2031	-36.05465	-12.79213	-1.79918	-0.67720	-0.11413	-0.12478	-0.14760	$ 146,778	$ 360,738	$ 794,879	$ 668,397	$ 285,368	$ 695,573	$ 1,387,426	$ 4,339,160	$ 1,469,824	$ 2,704,021	16
2032	-34.58988	-12.21631	-1.70977	-0.63937	-0.10625	-0.11934	-0.11271	$ 140,815	$ 344,500	$ 755,378	$ 631,058	$ 265,662	$ 665,216	$ 1,059,482	$ 3,862,112	$ 1,222,646	$ 2,336,641	17
2033	-33.12512	-11.64049	-1.62037	-0.60154	-0.09837	-0.11389	-0.07782	$ 134,852	$ 328,262	$ 715,877	$ 593,719	$ 245,956	$ 634,859	$ 731,539	$ 3,385,064	$ 1,001,518	$ 1,988,368	18
2034	-31.66035	-11.06467	-1.53096	-0.56371	-0.09049	-0.10845	-0.04294	$ 128,889	$ 312,024	$ 676,377	$ 556,380	$ 226,250	$ 604,502	$ 403,595	$ 2,908,016	$ 804,091	$ 1,658,401	19
2035	-30.19558	-10.48884	-1.44155	-0.52588	-0.08260	-0.10300	-0.00805	$ 122,926	$ 295,785	$ 636,876	$ 519,040	$ 206,545	$ 574,144	$ 75,651	$ 2,430,968	$ 628,208	$ 1,345,968	20
2036	-28.73082	-9.91302	-1.35214	-0.48805	-0.07472	-0.09755	0.02684	$ 116,963	$ 279,547	$ 597,376	$ 481,701	$ 186,839	$ 543,787	$ (252,293)	$ 1,953,920	$ 471,897	$ 1,050,329	21
2037	-27.26605	-9.33720	-1.26273	-0.45021	-0.06684	-0.09211	0.06173	$ 111,000	$ 263,309	$ 557,875	$ 444,362	$ 167,133	$ 513,430	$ (580,237)	$ 1,476,872	$ 333,350	$ 770,769	22
2038	-25.80129	-8.76138	-1.17332	-0.41238	-0.05896	-0.08666	0.09661	$ 105,037	$ 247,071	$ 518,375	$ 407,023	$ 147,427	$ 483,073	$ (908,181)	$ 999,825	$ 210,910	$ 506,603	23
2039	-24.33652	-8.18556	-1.08392	-0.37455	-0.05108	-0.08122	0.13150	$ 99,074	$ 230,833	$ 478,874	$ 369,683	$ 127,721	$ 452,715	$ (1,236,124)	$ 522,777	$ 103,064	$ 257,171	24
20-Year Project Life	**Present through 2039**														**$ 56,949,900**	**$ 81,918,860**		

Sources:

{1} The annual crash reduction benefits by AIS Rating for year 2019 are taken from cells N38 to N44 in the [REGIONAL CRASH REDUCTION DATA] tab.

{2} The annual crash reduction benefits by AIS Rating for year 2035 are taken from cells N70 to N76 in the [REGIONAL CRASH REDUCTION] tab.

{3} Value of Property Damage Only Crashes *The Economic Impact of Motor Vehicle Crashes 2000*
Note: Value adjusted from 2010$ to 2015$ using the BLS GDP deflator method
Link: http://www.nhtsa.gov/DOT/NHTSA/Communication%20&%20Consumer%20Information/Articles/Associated%20Files/EconomicImpact2000.pdf

{4} Value of AIS Type 1 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*
Link: http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life

{5} Value of AIS Type 2 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*
Link: http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life

{6} Value of AIS Type 3 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*
Link: http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life

{7} Value of AIS Type 4 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*
Link: http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life

{8} Value of AIS Type 5 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*
Link: http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life

{9} Value of AIS Type 6 Crashes *TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE*
Link: http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life

Summary

[A]	[B]	[C]	[D]	[E]	[G]	[H]	[I]	[J]	[K]
Column Source		{1}	{2}	{3}	{4}	{5}			
Equation							SUM([C]:[H])	[I] / (1.07^[A])	[I] / (1.03^[A])

Project Year	Calendar Year	Project Costs	Direct User Cost Paid in Tolls	Travel Time Benefits (Costs)	Geometric Crash Reduction Benefits (Costs)	Regional Crash Reduction Benefits (Costs)	Net Benefits (Costs)	7% NPV Total Net Benefits (Costs)	3% NPV Total Net Benefits (Costs)
0	2015	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1	2016	$ (11,028,601)	$ -	$ -	$ -	$ -	$ (11,028,601)	$ (10,307,104)	$ (10,707,380)
2	2017	$ (10,407,505)	$ -	$ -	$ -	$ -	$ (10,407,505)	$ (9,090,318)	$ (9,810,071)
3	2018	$ (11,563,894)	$ -	$ -	$ -	$ -	$ (11,563,894)	$ (9,439,582)	$ (10,582,601)
4	2019	$ -	$ (12,290,691)	$ 7,954,450	$ 6,636,788	$ 10,063,735	$ 12,364,282	$ 9,432,652	$ 10,985,505
5	2020	$ -	$ (12,242,637)	$ 7,829,244	$ 6,633,102	$ 9,586,688	$ 11,806,397	$ 8,417,798	$ 10,184,302
6	2021	$ -	$ (12,194,583)	$ 7,704,039	$ 6,629,417	$ 9,109,640	$ 11,248,512	$ 7,495,359	$ 9,420,452
7	2022	$ -	$ (12,146,529)	$ 7,578,833	$ 6,625,731	$ 8,632,592	$ 10,690,627	$ 6,657,585	$ 8,692,458
8	2023	$ -	$ (12,098,475)	$ 7,453,628	$ 6,622,046	$ 8,155,544	$ 10,132,742	$ 5,897,348	$ 7,998,880
9	2024	$ -	$ (12,050,421)	$ 7,328,422	$ 6,618,361	$ 7,678,496	$ 9,574,857	$ 5,208,088	$ 7,338,331
10	2025	$ -	$ (12,002,367)	$ 7,203,216	$ 6,614,675	$ 7,201,448	$ 9,016,972	$ 4,583,771	$ 6,709,474
11	2026	$ -	$ (11,954,314)	$ 7,078,011	$ 6,610,990	$ 6,724,400	$ 8,459,087	$ 4,018,851	$ 6,111,025
12	2027	$ -	$ (11,906,260)	$ 6,952,805	$ 6,607,305	$ 6,247,352	$ 7,901,202	$ 3,508,228	$ 5,541,744
13	2028	$ -	$ (11,858,206)	$ 6,827,600	$ 6,603,619	$ 5,770,304	$ 7,343,317	$ 3,047,216	$ 5,000,442
14	2029	$ -	$ (11,810,152)	$ 6,702,394	$ 6,599,934	$ 5,293,256	$ 6,785,432	$ 2,631,508	$ 4,485,970
15	2030	$ -	$ (11,762,098)	$ 6,577,189	$ 6,596,248	$ 4,816,208	$ 6,227,547	$ 2,257,150	$ 3,997,225
16	2031	$ -	$ (11,714,044)	$ 6,451,983	$ 6,592,563	$ 4,339,160	$ 5,669,662	$ 1,920,511	$ 3,533,146
17	2032	$ -	$ (11,665,990)	$ 6,326,778	$ 6,588,878	$ 3,862,112	$ 5,111,777	$ 1,618,258	$ 3,092,709
18	2033	$ -	$ (11,617,937)	$ 6,201,572	$ 6,585,192	$ 3,385,064	$ 4,553,892	$ 1,347,332	$ 2,674,932
19	2034	$ -	$ (11,569,883)	$ 6,076,367	$ 6,581,507	$ 2,908,016	$ 3,996,007	$ 1,104,929	$ 2,278,867
20	2035	$ -	$ (11,521,829)	$ 5,951,161	$ 6,577,821	$ 2,430,968	$ 3,438,122	$ 888,476	$ 1,903,605
21	2036	$ -	$ (11,473,775)	$ 5,825,956	$ 6,574,136	$ 1,953,920	$ 2,880,237	$ 695,615	$ 1,548,269
22	2037	$ -	$ (11,473,775)	$ 5,700,750	$ 6,570,451	$ 1,476,872	$ 2,274,298	$ 513,339	$ 1,186,939
23	2038	$ -	$ (11,473,775)	$ 5,575,545	$ 6,566,765	$ 999,825	$ 1,668,359	$ 351,935	$ 845,344
24	2039	$ -	$ (11,473,775)	$ 5,450,339	$ 6,563,080	$ 522,777	$ 1,062,420	$ 209,453	$ 522,640
20-Year Project Life	**Present through 2039**							**$ 42,968,397**	**$ 72,952,206**

Sources: {1} Data from [Project Cost : Column H]
{2} Data from [Direct User Cost : Column L]
{3} Data from [Travel Time : Column F]
{4} Data from [Geometric Crash Reduction : Column P]
{5} Data from [Regional Crash Reduction : Column P]