Appendix C.

Benefit Cost Analysis and Methodology for I-35W North Tarrant Express (NTE) FASTLANE Grant

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Executive Summary

This memorandum summarizes the approach used for conducting benefit-cost analysis (BCA) for the I-35 W North Tarrant Express (NTE) Project in Tarrant County, Texas. Table 1 summarizes the project matrix for the proposed corridor. The project matrix describes status quo or baseline conditions; proposed improvements; types of impacts to users/population affected by impacts; summary of results; and page reference in this memorandum.

Baseline Condition

Running through the heart of Fort Worth, Texas and the AllianceTexas Global Logistics Hub is Interstate Highway 35W (I-35W), an aging and outdated highway that traverses the middle section of our country. Of particularly importance, I-35W is a direct route from Mexico to Canada and has easy connections to Interstate Highways 20, 30, and 40. I-35W serves as the lifeline for the entire Dallas-Fort Worth-Arlington Census-designated Urbanized Area (ID 22042), connecting one of the world's largest inland ports with major employers, communities and other multimodal transportation systems, including rail and air.

I-35W serves as part of a major thoroughfare for goods traveling from Canada to Mexico, in part due to the North American Free Trade Agreement (NAFTA) and linking East Coast and West Coast destinations, making it an important regional and national intermodal center for distribution by air, rail, and truck. The NTE project is intended to meet future travel demands stemming from projected population growth and traffic volumes and looks to address operational, design, and capacity deficiencies on I-35W, U.S. 81/287, and SH 170.

The I-35W NTE is needed due to projected freight, population, and employment growth in the cities of Fort Worth and Haslet and across the region. If the needed improvements on I-35W are not implemented, freight movement and passenger mobility will be negatively impacted, in addition to the region, state, and nation's economies. According to the project's Environmental Assessment, traffic congestion has and will continue to increase alongside population growth.

Table 1: I-35W North Tarrant Express (NTE) – Project Matrix

Current Status or Baseline	Changes to Baseline	Type of Impact	Population Affected by Impact	Economic Benefit/Costs	Summary of Results		Table Reference in BCA
					Discounted at 3%	Discounted at 7%	
Capacity for existing and future traffic resulting in poor Level of Service (LOS)	Reconstruct and widen from four lanes to eight lanes (divided)	Increased capacity Improved travel speeds and travel time	Corridor users: 73,280 AADT (passenger cars) in 2020; 6,720 AADT (trucks) in 2020; 110,760 AADT (passenger cars) in 2040; 9,240 AADT (trucks) in 2040	Monetized value of reduced travel time	-$613,904,433	-$363,692,780	Table 10
				Monetized value of increased vehicle operating costs	$383,789,100	$228,680,159	Table 13
Safety concerns at critical segments along the corridor	Roadway improvements in critical segments, such as SH 170, Heritage Trace, and North Tarrant Pkwy interchanges	Improved accessibility Addressing high safety issues in certain areas of the I-35W corridor	Local, state, region and national population	Monetized value of increased traffic accidents	$29,723,574	$17,127,828	Table 22
Concerns with major traffic disruptions and lack of economic competitiveness for freight operations	Acquisition of critical ROW for improved accessibility for ultimate configuration of I-35W NTE	Increased air emissions generated by motor vehicles	Local, state, region and national population	Monetized value of increased Social Cost of Carbon Emissions	$7,220,334	$7,220,334*	Table 17
				Monetized value of increased/ Non-Carbon Emission Costs	$10,958,269	$6,473,749	Table 18
		Increased noise pollution generated by motor vehicles.	Local population	Monetized value of increased noise costs	$7,030,126	$4,210,410	Table 24
	U-Turn bridges, IH-820 frontage roads and bridge replacements	Increased pavement maintenance costs.	Government	Monetized value of Increased pavement maintenance costs	$20,074,793	$12,222,769	Table 8
		Job creation in the development, construction and maintenance phases of the project.	Local, state, region and national population	Short-term job-years due to project during development and construction	8,212 Job-Years	8,212 Job-Years	Table 25
				Short-term job-years due to project during development, construction and maintenance	9,010 Job-Years	9,010 Job-Years	Table 25

Current Status or Baseline	Changes to Baseline	Type of Impact	Population Affected by Impact	Economic Benefit/Costs	Summary of Results		Table Reference in BCA
					Discounted at 3%	Discounted at 7%	
		Short-term economic impacts due to project construction expenditures in Tarrant County.	Local/regional population	**Total (direct, indirect and induced) economic impacts generated by the Project during Development and Construction, 2018-2021	Jobs= 2,185 Labor Income = $132 M GRP = $ 183 M Tax Revenue = $38 M	Jobs= 2,185 Labor Income = $132 M GRP = $ 183 M Tax Revenue = $38 M	Table 30
		Long-term economic impacts due to project operations and maintenance expenditures in Tarrant County.	Local/regional population	**Total (direct, indirect and induced) economic impacts generated by the Project during Operations & Maintenance, 2021-2040	Job-s = 547 Labor Income = $33 M GRP = $46 M Tax Revenue = $10 M	Job-s = 547 Labor Income = $33 M GRP = $46 M Tax Revenue = $10 M	Table 31
		Long-term economic impacts due to travel time savings accruing to commuters, business travellers and trucks in Tarrant County.	Local/regional population	**Total (direct, indirect and induced) economic impacts generated over the lifecycle of the Project, 2021-2040	Jobs = 1,520 Labor Income = $87 M GRP = $134 M Tax Revenue = $33 M	Jobs = 1,520 Labor Income = $87 M GRP = $134 M Tax Revenue = $33 M	Table 33

Notes: *The social cost of carbon (SCC) dioxide emissions are to be discounted at a value of 3 percent rather than the 7 percent recommendation for all other non-carbon benefits or costs. **Estimated using the Texas IMPLAN Model based on monetized values in 2015 dollars.

The I-35W NTE corridor will experience significant traffic volume increase from 29.2 million vehicles per year in 2020 to 43.8 Million vehicles per year in 2040, a 50 percent increase in the no-build scenario. The freight volume in the same time period will grow from 2.5 million to 3.4 million trucks per year. The annual traffic volume in the build scenario is anticipated to grow from 30.5 Million vehicles per year in 2020 to 57.9 million vehicles per year in 2040, a 90 percent increase. The freight traffic in the same time period is expected to grow from 2.7 Million trucks per year in 2020 to 4.8 Million trucks per year in 2040. Although the traffic volume increases following the project implementation, the average annual vehicle hours traveled (VHT) will significantly decrease from 2.6 million vehicle-hours to 2.4 million vehicle-hours in 2020 (4 percent decrease) and 7.7 million vehicle-hours to 6 million vehicle-hours in 2040 (21 percent decrease). The truck VHT will decrease from 0.28 million truck-hours to 0.27 million truck-hours in 2020 (3 percent decrease) and a 1.2 million truck-hours to 0.65 million truck-hours in 2040 (45 percent decrease). The freight traffic will significantly benefit from the I-35W NTE project.

Project Background

I-35W NTE is the northernmost portion of the greater NTE project that stretches from the Alliance Airport corridor to U.S. 287. The project will have an interim phase that will reconstruct and widen the roadway to an eight-lane facility consisting of two general purpose lanes in each direction and a barrier-separated, center managed (toll) lane facility with two lanes in each direction. Although the major sections of the highway are currently being improved through a Public Private Partnership (the North Tarrant Express), there are five critical projects that cannot be completed without a Federal grant. These five projects are necessary improvements that will enable this region to create its own “Ladders of Opportunity.”

In 2014, the Dallas-Fort Worth-Arlington region was considered the ninth largest export market in the United States with approximately $28.7 billion in total merchandise exports, much of which utilizes I-35W. Keeping the Metroplex competitive in this market requires mobility and supporting transportation infrastructure. To connect the overall Fort Worth community, and the AllianceTexas community in particular, to the massive economic engine in this region, TxDOT seeks $83 million in FASTLANE grant funding to advance unfunded construction elements of particular importance to stakeholders along the I-35W corridor. These projects are “shovel-ready” and will greatly enhance our ability to revitalize, connect and provide work in the region.

The grant request is for $83 million of the $631,528,000 total I-35W NTE project costs, which is approximately 10 percent of the total future eligible project costs. The I-35W NTE project is anticipated to begin construction in spring 2018. The $83 million NSFHP grant will be used to support three elements of the I-35W NTE project:

- $18 million for ROW acquisition,
- $65 million for the construction of:
  - U-Turn bridges for SH170, Heritage Trace, and North Tarrant Parkway intersections;
  - I-35W/IH820 Interchange frontage road
  - I-35W/IH820 Interchange bridge replacement over Mark IV, Mark IV improvements
  - Golden Triangle intersection improvements

The purpose of the Project is to:

- Improve traffic operations along I-35W to accommodate future traffic projections and provide acceptable level of service (LOS) along the by widening the road, from four to eight lanes.
- Improve traffic operations in the AllianceTexas area, which is an 18,000-acre master-planned, mixed-use community, logistics hub, and freight corridor that plays a large role in the regional, state of Texas, and the nation's economies.
- Improve roadway infrastructure and the existing design and operational deficiencies. The weaving distances between I-35W and SH 170 are currently too short, which cause unsafe driving conditions.
- Improve traffic operations and safety by minimizing the conflicts between the roadway segments and intersecting roadways. Traffic accident rates for IH-35W in the project area from March 2013 through February 2016 showed that I-35W experienced approximately 518 crashes, including six fatalities.[1]

Proposed Alternative Benefit- Cost Analysis

This section describes the method used for estimating benefits and life cycle costs of the I-35 W NTE Project. This analysis emphasizes the importance and full benefits of the Project. In conducting the benefit-cost analysis, CS followed Federal guidance regarding evaluation criteria, discount and monetization rates, and evaluation methods recommended by the U.S. DOT in the Guide to Preparing Benefit-Cost Analyses for FASTLANE Grants[2] and the Notice of

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1 TxDOT (July 2015). Crash Records Information Systems, Retrieved from http://www.txdot.gov/government/enforcement/data-access.html. Accessed March 28, 2016.

2 U.S. DOT Benefit-Cost Analysis (BCA) Resource Guide (November 2016) supplement to the *2016 Benefit-Cost Analysis Guidance for Grant Applicants*, Updated November 17, 2016. Available at https://www.transportation.gov/fastlanegrants/bca-resource-guide.

Funding Availability (NOFA) for the Department of Transportation's Nationally Significant Freight and Highway Projects (FASTLANE Grants) for Fiscal Year 2016.[3]

Travel Patterns

The estimation of the benefits involved establishing the Baseline and Build Scenario and calculating the differences between the Build and the Baseline in the benchmark years. The project team prepared and analyzed the following four model scenarios as part of the I-35 W NTE Traffic and Revenue (T&R) study:[4]

- 2020 Baseline – Baseline plus Committed Projects Only by 2020 (No Build in 2020)
- 2040 Baseline – Baseline plus Committed Projects Only by 2040 (No Build in 2040)
- 2020 Build – Baseline in 2020 plus I-35W NTE Project (Build in 2020)
- 2040 Build – Baseline in 2040 plus I-35W NTE Project (Build in 2040)

The model outputs for each of the study scenarios used in the estimation of the benefits included the following:

- Average Daily Traffic (ADT) by vehicle type (passenger cars and trucks), in 2020 and 2040
- Daily vehicle-miles traveled (VMT) by vehicle type (passenger cars and trucks), trip purpose (commute, business and other trips), in 2020 and 2040
- Daily vehicle-hours traveled (VHT) by vehicle type (passenger cars and trucks), trip purpose (commute, business and other trips), in 2020 and 2040

In generating the VMT for the intermittent analysis years, the model outputs for 2020 and 2040 were interpolated based on Equations 1 and 2, shown below. Changes in VMT between the Baseline and the Build Scenario over the 20-year analysis period were estimated based on Equation 3. Similarly, VHT for the intermittent analysis years as well as the corresponding changes between the Baseline and the Build Scenario over the 20-year analysis period were estimated by substituting VMT with VHT in Equations 1, 2 and 3.

$$VMT_t^{Baseline} = VMT_{2015}^{Baseline} + \frac{(VMT_{2040}^{Baseline} - VMT_{2020}^{Baseline}) * (t - 2020)}{(2040 - 2020)}$$ Equation (1)

$$VMT_t^{Build} = VMT_{2015}^{Build} + \frac{(VMT_{2040}^{Build} - VMT_{2020}^{Build}) * (t - 2020)}{(2040 - 2020)}$$ Equation (2)

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3 Notice of funding availability (NOFA) for the Department of Transportation's Nationally Significant Freight and Highway Projects (FASTLANE Grants) for Fiscal Year 2016. Available at https://www.transportation.gov/build-america/fastlane/fastlane-ii-notice-funding-opportunity.

4 IH-35W North Tarrant Express (NTE), Traffic and Revenue Study (December 6, 2010).

$$\Delta VMT_t = VMT_t^{Build} - VMT_t^{Baseline}$$ Equation (3)

Where: $2020 \leq t \leq 2040$.

Daily VMT and VHT accruing to commute and business trips were annualized by assuming 265 working days a year (i.e., 52 weeks). Daily VMT and VHT for other trips were annualized by multiplying daily VMT and VHT by 315 days. Daily VMT and VHT for and truck trips were annualized by multiplying daily VMT and VHT by 365 days.

Table 2 provides traffic forecasts for the four model scenarios. As shown in the table, in 2020, trucks would save time due to the added capacity provided by the Project. Hours traveled by passenger cars in 2020 would also decrease in spite of the increase in miles traveled. By 2040, trucks using the I-35W NTE Corridor would continue realizing savings in travel time. Passenger cars would also enjoy the benefits of shorter travel time. The 2040 traffic forecasts show the Project will provide sufficient reserve capacity to meet future travel demand. However, in spite of decrease in VHT, auto and truck trip VMT will increase in the short-term by 2020. The VMT will also increase in the long-term by 2040 for both auto and truck trips.

Table 2: Daily Traffic in 2020 and 2040

Scenario	Passenger Cars		Trucks	
	2020 VMT	2020 VHT	2020 VMT	2020 VHT
2020 Build (A)	502,077	7,554	49,050	739
2020 No Build (B)	483,648	7,941	44,352	766
Changes = (A) – (B)	18,429	-387	4,698	-27

Scenario	Passenger Cars		Trucks	
	2040 VMT	2040 VHT	2040 VMT	2040 VHT
2040 Build (C)	961,203	18,645	87,000	1,781
2040 No Build (D)	731,016	22,722	60,984	3,242
Changes = (C) – (D)	230,187	-4,077	26,016	-1,461

Source: North Tarrant Express Mobility Partners Master Development Plan, Segments 2-4, December 06, 2010.

Tables 3 and 4 depict the changes in VMT and VHT, respectively, by trip type over the 20-year analysis period. Overall, the project is expected to have a substantial positive impact on corridor users. Although the VMT increases in the analysis years, the auto and truck trips will enjoy reduced travel times. Tables 5 presents the travel speeds for the four model scenarios estimated based on the outputs of the T&R study. The 2040 results show an impressive increase in overall travel speeds, which is expected considering the improvements in VHT.

Table 3: Changes in Vehicle Miles Traveled (VMT) over the 20-Year Analysis Period

Year	Calendar Year	Reduced/Additional Miles Traveled (Build – No Build)		
		All Auto VMT	Truck VMT	VMT Total
2	2020	5,421,835	1,714,770	7,136,605
3	2021	8,536,796	2,103,824	10,640,620
4	2022	11,651,757	2,492,877	14,144,634
5	2023	14,766,718	2,881,931	17,648,649
6	2024	17,881,679	3,270,984	21,152,663
7	2025	20,996,640	3,660,038	24,656,678
8	2026	24,111,601	4,049,091	28,160,692
9	2027	27,226,562	4,438,145	31,664,707
10	2028	30,341,523	4,827,198	35,168,721
11	2029	33,456,484	5,216,252	38,672,736
12	2030	36,571,445	5,605,305	42,176,750
13	2031	39,686,406	5,994,359	45,680,765
14	2032	42,801,367	6,383,412	49,184,779
15	2033	45,916,328	6,772,466	52,688,794
16	2034	49,031,289	7,161,519	56,192,808
17	2035	52,146,250	7,550,573	59,696,823
18	2036	55,261,211	7,939,626	63,200,837

Year	Calendar Year	Reduced/Additional Miles Traveled (Build – No Build)		
		All Auto VMT	Truck VMT	VMT Total
19	2037	58,376,172	8,328,680	66,704,852
20	2038	61,491,133	8,717,733	70,208,866
21	2039	64,606,094	9,106,787	73,712,881
22	2040	67,721,055	9,495,840	77,216,895
Totals =		**768,000,345**	**117,711,405**	**885,711,750**

Source: North Tarrant Express Mobility Partners Master Development Plan, Segments 2-4, December 06, 2010.

Note: Negative values represent reduced VMT while positive values represent additional VMT.

Table 4: Changes in Vehicle Hours Traveled (VHT) over the 20-Year Analysis Period

Year	Calendar Year	Reduced/Additional Miles Traveled (Build – No Build)		
		All Auto VHT	Truck VHT	VHT Total
2	2020	-106,605	-9,673	-116,278
3	2021	-156,803	-35,852	-192,655
4	2022	-207,000	-62,032	-269,032
5	2023	-257,198	-88,211	-345,409
6	2024	-307,395	-114,391	-421,786
7	2025	-357,593	-140,571	-498,163
8	2026	-407,790	-166,750	-574,540
9	2027	-457,988	-192,930	-650,917
10	2028	-508,185	-219,110	-727,295
11	2029	-558,383	-245,289	-803,672
12	2030	-608,580	-271,469	-880,049
13	2031	-658,778	-297,648	-956,426
14	2032	-708,975	-323,828	-1,032,803
15	2033	-759,173	-350,008	-1,109,180
16	2034	-809,370	-376,187	-1,185,557
17	2035	-859,568	-402,367	-1,261,934

Year	Calendar Year	Reduced/Additional Miles Traveled (Build – No Build)		
		All Auto VHT	Truck VHT	VHT Total
18	2036	-909,765	-428,547	-1,338,312
19	2037	-959,963	-454,726	-1,414,689
20	2038	-1,010,160	-480,906	-1,491,066
21	2039	-1,060,358	-507,085	-1,567,443
22	2040	-1,110,555	-533,265	-1,643,820
Totals =		**-12,780,180**	**-5,700,844**	**-18,481,024**

Source: North Tarrant Express Mobility Partners Master Development Plan, Segments 2-4, December 06, 2010.

Note: Negative values represent reduced VHT while positive values represent additional VHT

Table 5: No Build (Baseline) and Build Scenario – Average Travel Speeds

Vehicle Type, Trip Purpose	Average Speed (VMT/VHT)					
	No Build		Build		Change (Build – No-Build)	
	2020	2040	2020	2040	2020	2040
Auto, Commute to Work	54.5	23.4	64.2	43.4	9.7	20.0
Auto, Business Trips	58.7	26.3	65.7	48.7	7.0	22.4
Auto, All Other Purposes	63.7	39.8	67.4	55.5	3.7	15.7
Truck	57.9	18.8	66.4	48.8	8.4	30.0

Note: Estimated speeds based on the outputs of the model scenarios.

Project Benefits

The primary benefits of the project are:

- Reduced travel time for passengers cars and trucks
- Reduced transportation costs (due to reduced/avoid congestion along the corridor) for freight shippers compared to their goods continuing to travel to market via the congested I-35W or longer routes
- Reduced inventory costs for freight shippers realized from the reduced need to keep stock due to more reliable transit time and/or avoidance of future diversion to longer routes
- Reduced air emissions and noise pollution generated by motor vehicles

- Greater safety for users of motorized and non-motorized transportation modes in the vicinity of the project

Consistent with FASTLANE grant methodology and guidance, the benefits resulting from the I-35W NTE Project (Table 6) are broken down into the following major categories:

A. State of Good Repair;
B. Economic Competitiveness;
C. Livability;
D. Environmental Sustainability; and
E. Safety.

The benefits of the I-35W NTE Project are calculated in 2015 dollars over a time horizon of 20 years, starting in 2020 and ceasing in 2040.

Table 6: Direct Benefits Resulting from the I-35W NTE Project

Benefit Category	Metrics
A. State of Good Repair	Pavement Maintenance Costs
B. Economic Competitiveness	Travel Time Costs Vehicle Operating Costs (VOC)
C. Livability	Noise Costs
D. Environmental Sustainability	Social Cost of Carbon (SCC) Emissions Non-Carbon Emissions Costs
E. Safety	Traffic Accident Costs

State of Good Repair

The expected increase in VMT will lead to an increase in pavement wear and tear over the 20-year analysis period. The method to assess highway system state of good repair (SOGR) impacts involves estimation of the marginal external cost associated with pavement maintenance by vehicle type and highway functional class.

This analysis uses the average external marginal costs for urban highways provided by the Federal Highway Administration (FHWA) (Table 7) which represent the additional spending (or saving) in all costs of maintaining pavements, including resurfacing and reconstruction, resulting from a unit increase/decrease in VMT borne by public agencies responsible for highway maintenance. The marginal pavement cost is multiplied by the annual changes in VMT over the 20-year analysis period. Table 8 summarizes the SOGR benefits/disbenefits.

Table 7: Marginal External Pavement Cost for Urban Highways

Vehicle Class	Urban Highways (Average) in 2000$	Urban Highways (Average) in 2015$
Passenger Cars	0.001	0.0014
Trucks	0.182	0.2498

Source: 1997 Federal Highway Cost Allocation Study, Final Report, Table V-26. Available at http://www.fhwa.dot.gov/policy/hcas/final/five.cfm.

Note: Marginal pavement cost was inflated from 2000 to 2015 dollars based on the Consumer Price Index (CPI) from all South Urban Areas provided by the Bureau of Labor Statistics (BLS).

Table 8: Sate of Good Repair Cost Benefits/Disbenefits

A	B	C	D	E	F	G
		Monetary Value of Reduced/Additional Pavement Maintenance (in 2015$)			NPV of Maintenance Costs Saved/Wasted	
					3%	7%
Year	Calendar Year	Auto Trips	Truck Trips	All Trips	NPV = [E/(1+3%)^A]	NPV = [E/(1+7%)^A]
2	2020	$7,463	$428,380	$435,842	$410,823	$380,682
3	2021	$11,750	$525,572	$537,322	$491,726	$438,615
4	2022	$16,038	$622,764	$638,802	$567,567	$487,339
5	2023	$20,325	$719,957	$740,282	$638,574	$527,811
6	2024	$24,612	$817,149	$841,762	$704,962	$560,901
7	2025	$28,900	$914,342	$943,242	$766,942	$587,403
8	2026	$33,187	$1,011,534	$1,044,721	$824,713	$608,037
9	2027	$37,475	$1,108,726	$1,146,201	$878,468	$623,458
10	2028	$41,762	$1,205,919	$1,247,681	$928,392	$634,258
11	2029	$46,050	$1,303,111	$1,349,161	$974,663	$640,977
12	2030	$50,337	$1,400,304	$1,450,641	$1,017,450	$644,102
13	2031	$54,625	$1,497,496	$1,552,121	$1,056,919	$644,075
14	2032	$58,912	$1,594,688	$1,653,601	$1,093,225	$641,295
15	2033	$63,199	$1,691,881	$1,755,080	$1,126,519	$636,122
16	2034	$67,487	$1,789,073	$1,856,560	$1,156,947	$628,881
17	2035	$71,774	$1,886,266	$1,958,040	$1,184,646	$619,865
18	2036	$76,062	$1,983,458	$2,059,520	$1,209,751	$609,338
19	2037	$80,349	$2,080,650	$2,161,000	$1,232,388	$597,534
20	2038	$84,637	$2,177,843	$2,262,480	$1,252,680	$584,668
21	2039	$88,924	$2,275,035	$2,363,959	$1,270,745	$570,927
22	2040	$93,212	$2,372,228	$2,465,439	$1,286,694	$556,482
Totals =		**$1,057,080**	**$29,406,377**	**$30,463,457**	**$20,074,793**	**$12,222,769**

Note: Negative values represent savings and positive values represent losses.

Travel Time Cost Benefits/Disbenefits

The expected increase in travel speeds along the corridor will result in reduced travel time for highway users. Although there is an increase in VMT due to added capacity, the VHT reduction results in travel time cost savings for more travelers.

The method to assess travel time cost benefits/disbenefits involves estimation of the average vehicle occupancy (AVO) by trip purpose and applying the recommended value of time (VOT) by trip purpose provided in the 2016 Benefit-Cost Analysis (BCA) Resource Guide (Table 9). Annual changes in VHT by trip purpose and trip type over the 20-year analysis period are multiplied by the corresponding AVO and VOT. Travel time cost benefits/ disbenefits resulting from the Project are summarized in Table 10.

Table 9: Average Vehicle Occupancy and Value of Time by Vehicle Type/Trip Purpose

Vehicle Type, Trip Purpose	Average Vehicle Occupancy (AVO)	Value of Time (VOT) in 2015 Dollar
Auto, Commute to Work	1.18	$13.60
Auto, Business Trips	1.81	$25.40
Auto, All Other Purposes	2.20	$14.10
Truck	1.00	$27.20

Sources:

1. AVO for auto commute trips come from American FactFinder 2016. Available at http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_1YR_S0801&prodType=table
2. AVO for auto business and "all other purpose" trips come from, A., N. McGuckin, H. Y. Nakamoto, D. Gray, and Liss (2011). *Summary of Travel trends: 2009 National Household Travel Survey*. Report FHWA-PL-11-022, U.S. Department of Transportation, Washington D.C.
3. AVO for trucks is assumed to be one which provides a conservative estimate of travel time benefits accruing to freight truck movements.
4. The VOT by trip purpose comes from the Benefit-Cost Analysis (BCA) Resource Guide (November 2016) supplement to the *2016 Benefit-Cost Analysis Guidance for Grant Applicants*, Updated 11-17-2016. Available at: https://www.transportation.gov/fastlanegrants/bca-resource-guide.

Table 10: Travel Time Cost Benefits/Disbenefits

A	B	C	D	E	F
Year	Calendar Year	Reduced/Additional Travel Time (in Hours)	Monetary Value of Travel Time Cost Saved/Wasted (in 2015 Dollar)	NPV of Travel Time Cost Saved/Wasted	
				3%	7%
				NPV = [D/(1+3%)^A]	NPV = [D/(1+7%)^A]
2	2020	-222,883	-$6,613,713	-$6,234,059	-$5,776,673
3	2021	-349,457	-$10,469,565	-$9,581,135	-$8,546,283
4	2022	-476,032	-$14,325,416	-$12,727,947	-$10,928,791
5	2023	-602,606	-$18,181,268	-$15,683,321	-$12,962,993
6	2024	-729,181	-$22,037,119	-$18,455,741	-$14,684,263
7	2025	-855,756	-$25,892,971	-$21,053,355	-$16,124,841
8	2026	-982,330	-$29,748,823	-$23,483,995	-$17,314,086
9	2027	-1,108,905	-$33,604,674	-$25,755,185	-$18,278,716
10	2028	-1,235,480	-$37,460,526	-$27,874,149	-$19,043,032
11	2029	-1,362,054	-$41,316,378	-$29,847,830	-$19,629,113
12	2030	-1,488,629	-$45,172,229	-$31,682,893	-$20,057,010
13	2031	-1,615,203	-$49,028,081	-$33,385,737	-$20,344,911
14	2032	-1,741,778	-$52,883,932	-$34,962,509	-$20,509,301
15	2033	-1,868,353	-$56,739,784	-$36,419,108	-$20,565,109
16	2034	-1,994,927	-$60,595,636	-$37,761,197	-$20,525,838
17	2035	-2,121,502	-$64,451,487	-$38,994,210	-$20,403,690
18	2036	-2,248,077	-$68,307,339	-$40,123,363	-$20,209,677
19	2037	-2,374,651	-$72,163,191	-$41,153,659	-$19,953,724
20	2038	-2,501,226	-$76,019,042	-$42,089,901	-$19,644,765
21	2039	-2,627,800	-$79,874,894	-$42,936,691	-$19,290,832
22	2040	-2,754,375	-$83,730,746	-$43,698,448	-$18,899,132
Totals =		**-31,261,204**	**-$948,616,814**	**-$613,904,433**	**-$363,692,780**

Note: Negative values represent savings and positive values represent losses.

Vehicle Operating Costs Benefits/Disbenefits

The reduction in VMT also generates savings in the cost associated with the operation and maintenance of passenger cars and trucks. In contrast, increased VMT would lead to increased vehicle operating costs (VOC). VOC include fuel and non-fuel costs. The non-fuel component is comprised of all the necessary replacement items on the vehicle and regular maintenance (e.g., oil and fluid changes, tire rotations, tire replacements, and wiper replacement) as well as truck/trailer lease or purchase payments, permits and licenses, and other related costs to owners of commercial vehicles.

The method to assess VOC benefits/disbenefits involves estimation of the VOC per vehicle type. Average per-mile VOC for passenger vehicles is estimated based on the VOC for three size categories of sedans (i.e., small, medium and large sedans), four wheel-drive sport utility vehicles (SUV) and minivans provided by the American Automobile Association (AAA) (Table 11). This analysis uses the average auto VOC resulting from 15,000 miles traveled per year. Average per-mile VOC for trucks is estimated using published analyses of the operational costs for trucking based on information provided directly by motor carriers to the American Transportation Research Institute (ATRI) (Table 12). The VOC for autos and trucks are provided in 2015 dollars.

Table 11: Average Marginal Vehicle Operating Cost for Passenger Vehicles

Auto Type	VOC (in Cent per Mile) in 2015 Miles per Year		
	10,000	15,000	20,000
Small Sedan	57.4	43.9	36.9
Medium Sedan	75.8	57.4	47.8
Large Sedan	93.1	69.9	58
Sedan (Composite Average)	75.4	57.1	47.6
4WD Sport Utility Vehicle	90.5	68.4	57.3
Minivan	82.1	61.8	51.5
Average =	**82.7**	**62.4**	**52.1**

Source: American Automobile Association (AAA). *Your Driving Costs, 2016 Edition*. Available at http://exchange.aaa.com/automobiles-travel/automobiles/driving-costs/.

Notes:

1. VOC per mile derived from a popular model of each type listed assuming ownership of more than 5 years or 75,000 miles before replacement.
2. VOC per mile includes costs for fuel, maintenance, tires, full-coverage insurance, fees (license, registration and taxes), depreciation, and financing.

Table 12: Average Marginal Vehicle Operating Cost for Trucks for the Southeast Region (Dollar per Mile)

Operating Cost	VOC (in Dollar per Mile) in 2015
Fuel Costs	$0.401
Truck/Trailer Lease or Purchase Payments	$0.247
Repair & Maintenance	$0.151
Truck Insurance Premiums	$0.065
Permits and Licenses	$0.017
Tires	$0.042
Tolls	$0.025
Total =	**$0.948**

Source: American Transportation Research Institute (ATRI), *An Analysis of the Operational Costs of Trucking: 2016 Update* (ATRI, September 2016), Table 18, p. 29. Available at: http://atri-online.org/2016/09/26/an-analysis-of-the-operational-costs-of-trucking-2016-update.

VOC benefits/disbenefits are estimated by multiplying the average marginal VOC by vehicle type by its corresponding annual changes in VMT over the 20-year analysis period. The results from this estimation are shown in Table 13.

Table 13: Vehicle Operating Cost Benefits/Disbenefits

A	B	C	D	E	F
			Monetary Value of	NPV of Vehicle Operating Cost Saved/Wasted	
		Reduced/	Reduced/	3%	7%
Year	Calendar Year	Additional Miles Traveled	Additional VOC (in 2015 Dollar)	NPV = [D/(1+3%)^A]	NPV = [D/(1+7%)^A]
2	2020	7,136,605	$5,008,827	$4,721,300	$4,374,903
3	2021	10,640,620	$7,321,385	$6,700,105	$5,976,431
4	2022	14,144,634	$9,633,944	$8,559,634	$7,349,690
5	2023	17,648,649	$11,946,502	$10,305,158	$8,517,691
6	2024	21,152,663	$14,259,061	$11,941,739	$9,501,414
7	2025	24,656,678	$16,571,619	$13,474,243	$10,319,971
8	2026	28,160,692	$18,884,177	$14,907,344	$10,990,763
9	2027	31,664,707	$21,196,736	$16,245,533	$11,529,620
10	2028	35,168,721	$23,509,294	$17,493,123	$11,950,933
11	2029	38,672,736	$25,821,852	$18,654,256	$12,267,776
12	2030	42,176,750	$28,134,411	$19,732,910	$12,492,015
13	2031	45,680,765	$30,446,969	$20,732,904	$12,634,410
14	2032	49,184,779	$32,759,528	$21,657,907	$12,704,710
15	2033	52,688,794	$35,072,086	$22,511,437	$12,711,738
16	2034	56,192,808	$37,384,644	$23,296,874	$12,663,472
17	2035	59,696,823	$39,697,203	$24,017,461	$12,567,118
18	2036	63,200,837	$42,009,761	$24,676,307	$12,429,172
19	2037	66,704,852	$44,322,319	$25,276,399	$12,255,491
20	2038	70,208,866	$46,634,878	$25,820,601	$12,051,339
21	2039	73,712,881	$48,947,436	$26,311,659	$11,821,446
22	2040	77,216,895	$51,259,995	$26,752,207	$11,570,056
Totals =		**885,711,750**	**$590,822,627**	**$383,789,100**	**$228,680,159**

Note: Negative values represent savings and positive values represent losses.

Emission Cost Benefits/Disbenefits

This category of project benefits (disbenefits) captures the savings (or additional expenditures) in emission damage costs resulting from reduced (increased) VMT under the Build Scenario (compared to the No Build).

This analysis applies the running emission rates pertain to Carbon Dioxide (CO2), Volatile Organic Compound (VOC), Nitrogen Oxides (NOx), Particular Matter (PM) and Sulfur Dioxide (SOx) for passenger cars and trucks on urban restricted access roads estimated by

Cambridge Systematics (CS) using MOVES2014 (Table 14). The 2015 running emission rates are used to estimate the emission damage costs over the 2015-2024 period and the 2025 running emission rates are used to estimate the emission damage costs over the 2025-2040 period. Travel speeds for the Baseline (No Build) and Build Scenarios presented in Table 5 are utilized in this part of the analysis.

Table 14: Running Emission Rates in 2015 and 2025

2015 Running Emission Rates (g/mile)				2025 Running Emission Rates (g/mile)			
		Light Duty	All Trucks			Light Duty	All Trucks
Pollutant	Speed (mph)	4-Urban Restricted Access	4-Urban Restricted Access	Pollutant	Speed (mph)	4-Urban Restricted Access	4-Urban Restricted Access
CO_2	2.5	2,162.84	9,456.45	CO_2	2.5	1,705.81	8,686.07
CO_2	5	1,202.49	4,810.93	CO_2	5	948.4	4,419.00
CO_2	10	722.51	2,940.60	CO_2	10	569.84	2,701.04
CO_2	15	570.84	2,562.31	CO_2	15	450.21	2,353.57
CO_2	20	476.07	2,299.99	CO_2	20	375.47	2,112.62
CO_2	25	426.12	2,132.28	CO_2	25	336.07	1,958.57
CO_2	30	397.17	2,086.10	CO_2	30	313.24	1,916.15
CO_2	35	388.66	1,796.47	CO_2	35	306.53	1,650.11
CO_2	40	382.29	1,753.86	CO_2	40	301.51	1,610.98
CO_2	45	376.4	1,718.56	CO_2	45	296.86	1,578.56
CO_2	50	366.96	1,645.20	CO_2	50	289.42	1,511.17
CO_2	55	357.99	1,563.87	CO_2	55	282.34	1,436.47
CO_2	60	352.3	1,522.27	CO_2	60	277.85	1,398.26
CO_2	65	356.9	1,588.19	CO_2	65	281.48	1,458.81
CO_2	70	369.37	1,646.27	CO_2	70	291.32	1,512.15
CO_2	75	387.01	1,603.36	CO_2	75	305.23	1,472.74
NOx	2.5	1.43	35.33	NOx	2.5	0.0913	2.7348
NOx	5	1.04	18.82	NOx	5	0.0705	1.4759
NOx	10	0.81	11.15	NOx	10	0.0566	0.8743

2015 Running Emission Rates (g/mile)				2025 Running Emission Rates (g/mile)			
		Light Duty	All Trucks			Light Duty	All Trucks
Pollutant	Speed (mph)	4-Urban Restricted Access	4-Urban Restricted Access	Pollutant	Speed (mph)	4-Urban Restricted Access	4-Urban Restricted Access
NOx	15	0.69	9.27	NOx	15	0.0472	0.7189
NOx	20	0.61	8.04	NOx	20	0.043	0.6142
NOx	25	0.61	7.29	NOx	25	0.044	0.5526
NOx	30	0.63	7.05	NOx	30	0.0467	0.5268
NOx	35	0.67	6.19	NOx	35	0.0534	0.4569
NOx	40	0.71	6.01	NOx	40	0.0582	0.4363
NOx	45	0.73	5.87	NOx	45	0.0616	0.4206
NOx	50	0.74	5.7	NOx	50	0.063	0.4012
NOx	55	0.74	5.52	NOx	55	0.0635	0.3838
NOx	60	0.75	5.48	NOx	60	0.0649	0.3855
NOx	65	0.78	5.78	NOx	65	0.0703	0.4004
NOx	70	0.84	6.04	NOx	70	0.0802	0.4133
NOx	75	0.92	6.34	NOx	75	0.0929	0.4314
$PM_{2.5}$	2.5	0.0759	2.1363	$PM_{2.5}$	2.5	0.0368	0.0862
$PM_{2.5}$	5	0.0455	1.26	$PM_{2.5}$	5	0.0217	0.073
$PM_{2.5}$	10	0.0295	0.7296	$PM_{2.5}$	10	0.014	0.0425
$PM_{2.5}$	15	0.0234	0.582	$PM_{2.5}$	15	0.0113	0.0298
$PM_{2.5}$	20	0.0187	0.4925	$PM_{2.5}$	20	0.0089	0.0228
$PM_{2.5}$	25	0.0162	0.4456	$PM_{2.5}$	25	0.0074	0.0204
$PM_{2.5}$	30	0.0152	0.4107	$PM_{2.5}$	30	0.0066	0.0178
$PM_{2.5}$	35	0.016	0.3295	$PM_{2.5}$	35	0.0063	0.0142
$PM_{2.5}$	40	0.0166	0.3032	$PM_{2.5}$	40	0.0061	0.0125
$PM_{2.5}$	45	0.0168	0.2825	$PM_{2.5}$	45	0.0059	0.0111
$PM_{2.5}$	50	0.0161	0.2507	$PM_{2.5}$	50	0.0054	0.0095

2015 Running Emission Rates (g/mile)				2025 Running Emission Rates (g/mile)			
		Light Duty	All Trucks			Light Duty	All Trucks
Pollutant	Speed (mph)	4-Urban Restricted Access	4-Urban Restricted Access	Pollutant	Speed (mph)	4-Urban Restricted Access	4-Urban Restricted Access
$PM_{2.5}$	55	0.0145	0.216	$PM_{2.5}$	55	0.0048	0.0079
$PM_{2.5}$	60	0.0133	0.1968	$PM_{2.5}$	60	0.0044	0.007
$PM_{2.5}$	65	0.0127	0.1978	$PM_{2.5}$	65	0.0041	0.0069
$PM_{2.5}$	70	0.0126	0.198	$PM_{2.5}$	70	0.004	0.0068
$PM_{2.5}$	75	0.0132	0.2031	$PM_{2.5}$	75	0.0042	0.0068
VOC	2.5	2.38	3.76	VOC	2.5	0.26	0.33
VOC	5	1.28	2.11	VOC	5	0.14	0.19
VOC	10	0.72	1.13	VOC	10	0.08	0.1
VOC	15	0.53	0.8	VOC	15	0.06	0.08
VOC	20	0.42	0.62	VOC	20	0.04	0.06
VOC	25	0.36	0.53	VOC	25	0.04	0.05
VOC	30	0.32	0.47	VOC	30	0.03	0.05
VOC	35	0.3	0.42	VOC	35	0.03	0.04
VOC	40	0.29	0.38	VOC	40	0.03	0.04
VOC	45	0.28	0.36	VOC	45	0.03	0.04
VOC	50	0.26	0.34	VOC	50	0.03	0.03
VOC	55	0.25	0.32	VOC	55	0.03	0.03
VOC	60	0.24	0.3	VOC	60	0.03	0.03
VOC	65	0.24	0.29	VOC	65	0.03	0.03
VOC	70	0.25	0.28	VOC	70	0.03	0.03
VOC	75	0.27	0.27	VOC	75	0.03	0.03
SOx	2.5	0.0427	0.073	SOx	2.5	0.0091	0.0598
SOx	5	0.0237	0.0406	SOx	5	0.005	0.0334
SOx	10	0.014	0.0253	SOx	10	0.003	0.0206

2015 Running Emission Rates (g/mile)				2025 Running Emission Rates (g/mile)			
		Light Duty	All Trucks			Light Duty	All Trucks
Pollutant	Speed (mph)	4-Urban Restricted Access	4-Urban Restricted Access	Pollutant	Speed (mph)	4-Urban Restricted Access	4-Urban Restricted Access
SOx	15	0.0111	0.0224	SOx	15	0.0024	0.0182
SOx	20	0.0093	0.0198	SOx	20	0.002	0.016
SOx	25	0.0083	0.0185	SOx	25	0.0018	0.015
SOx	30	0.0078	0.0182	SOx	30	0.0017	0.0147
SOx	35	0.0076	0.0157	SOx	35	0.0016	0.0126
SOx	40	0.0075	0.0154	SOx	40	0.0016	0.0123
SOx	45	0.0074	0.0152	SOx	45	0.0016	0.0121
SOx	50	0.0072	0.0147	SOx	50	0.0015	0.0116
SOx	55	0.0071	0.0141	SOx	55	0.0015	0.0111
SOx	60	0.007	0.014	SOx	60	0.0015	0.0112
SOx	65	0.0071	0.0149	SOx	65	0.0015	0.0118
SOx	70	0.0073	0.0156	SOx	70	0.0016	0.0123
SOx	75	0.0077	0.0166	SOx	75	0.0016	0.013

Sources: 1) U.S. DOT, Federal Transit Administration. New and Small Starts Evaluation and Rating Process. Final Policy Guidance. August 2013. 2) Emission rates estimated by Cambridge Systematics using MOVES2014.

The emissions rates (in grams per mile) of non-carbon emissions (VOC, NOx, PM and SOx) are multiplied by the annual changes in VMT resulting from the implementation of the I-35W NTE Project, converted to short tons and then, multiplied by the emission cost per short ton depicted in Table 15. The CO2 emissions rates (in grams per mile) are multiplied by the annual changes in VMT resulting from the implementation of the Project, converted to metric tons and then, multiplied by the emission cost per metric ton depicted in Table 16.

It should be noted that the social cost of carbon (SCC) dioxide emissions increases annually and values for these emissions are to be discounted at a value of 3 percent rather than the percent recommendation for all other non-carbon benefits or costs. The expected emission cost benefits/disbenefits are shown in Tables 17 and 18.

Table 15: Emission Damage Costs

Emission Type	Emission Damage Cost (Dollar per Short Ton) in 2015 Dollar Gram per Mile
VOCs	$1,844
NOx	$7,266
PM	$332,405
SOx	$42,294

Source: U.S. DOT Benefit-Cost Analysis (BCA) Resource Guide (November 2016) supplement to the 2016 Benefit-Cost Analysis Guidance for Grant Applicants; Corporate Average Fuel Economy for MY2017-MY2025 Passenger Cars and Light Trucks (August 2012), page 922, Table VIII-16, "Economic Values Used for Benefits Computations (2010 dollars). Available at https://www.transportation.gov/fastlanegrants/bca-resource-guide.

Note: The U.S. DOT Benefit-Cost Analysis (BCA) Resource Guide (November 2016) converts the emission damage cost value into 2015 dollars.

Table 16: Social Cost of Carbon (3 Percent)

Year	3% SCC (Dollar per Metric Tons) in 2015 Dollar	Year	3% SCC (Dollar per Metric Tons) in 2015 Dollar
2020	47	**2031**	58
2021	47	**2032**	59
2022	49	**2033**	60
2023	50	**2034**	61
2024	51	**2035**	62
2025	52	**2036**	63
2026	53	**2037**	64
2027	54	**2038**	66
2028	55	**2039**	67
2029	55	**2040**	68
2030	57		

Source: U.S. DOT Benefit-Cost Analysis (BCA) Resource Guide (November 2016).

Note: Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866 (May 2013; revised August 2016), page 25, Table A1 "Annual SCC Values: 2010-2050 (2007$/metric ton CO2)"; values for 3% discount rate. Available at https://www.transportation.gov/fastlanegrants/bca-resource-guide.

Table 17: Carbon Emission Cost Benefits/Disbenefits

A	B	C	D	E
			NPV of SCC Emissions Saved/Wasted	
		CO Emissions	3%	7%
	Calendar	Damage Cost (3%	NPV =	NPV =
Year	Year	SCC) (in 2015$)	[C/(1+3%)^A]	[C/(1+3%)^A]
2	2020	$124,809	$117,645	N/A
3	2021	$183,649	$168,065	N/A
4	2022	$235,986	$209,670	N/A
5	2023	$280,427	$241,899	N/A
6	2024	$311,560	$260,926	N/A
7	2025	$276,872	$225,123	N/A
8	2026	$315,339	$248,931	N/A
9	2027	$362,348	$277,710	N/A
10	2028	$397,310	$295,636	N/A
11	2029	$436,684	$315,470	N/A
12	2030	$503,731	$353,306	N/A
13	2031	$566,172	$385,535	N/A
14	2032	$557,239	$368,401	N/A
15	2033	$611,918	$392,767	N/A
16	2034	$757,406	$471,990	N/A
17	2035	$790,377	$478,191	N/A
18	2036	$861,493	$506,036	N/A
19	2037	$862,134	$491,663	N/A
20	2038	$892,594	$494,208	N/A
21	2039	$892,031	$479,511	N/A
22	2040	$838,584	$437,651	N/A
Totals =		**$11,058,663**	**$7,220,334**	**N/A**

Notes:

1. Negative values represent savings and positive values represent losses.
2. In accordance with Federal guidance, the social cost of carbon (SCC) dioxide emissions changes over time and are discounted at a lower discount rate of 3%, even in the 7% discount rate benefit-cost analysis.

Table 18: Non-Carbon Emission Cost Benefits/Disbenefits

A	B	C	D	E	F	G	H	I
							NPV of Non-Carbon Emissions Saved/Wasted	
							3%	7%
Year	Calendar Year	VOC Emissions Damage Cost	NOx Emissions Damage Cost	PM Emissions Damage Cost	SOx Emissions Damage Cost	Grand Total	NPV = G/(1+3%)^A]	NPV = [G/(1+7%)^A]
2	2020	$1,716	$90,303	-$38,143	$2,649	$56,526	$53,281	$49,372
3	2021	$3,397	$113,254	-$23,527	$3,830	$96,955	$88,727	$79,144
4	2022	$4,748	$124,409	-$9,219	$4,715	$124,653	$110,752	$95,097
5	2023	$5,485	$141,390	-$13,062	$5,519	$139,331	$120,188	$99,341
6	2024	$5,107	$172,079	-$45,134	$6,212	$138,264	$115,794	$92,131
7	2025	$846	$15,343	$660,516	$54,408	$731,113	$594,462	$455,301
8	2026	$936	$17,695	$682,827	$56,518	$757,976	$598,353	$441,149
9	2027	$1,057	$20,600	$708,378	$58,663	$788,698	$604,471	$428,999
10	2028	$1,078	$22,065	$745,877	$60,930	$829,950	$617,561	$421,904
11	2029	$1,183	$25,181	$771,178	$63,071	$860,612	$621,724	$408,871
12	2030	$1,356	$28,527	$811,822	$65,392	$907,097	$636,220	$402,762
13	2031	$1,537	$30,462	$841,645	$67,583	$941,228	$640,930	$390,576
14	2032	$1,318	$36,628	$846,690	$69,488	$954,123	$630,788	$370,026
15	2033	$1,444	$39,811	$873,842	$71,643	$986,740	$633,351	$357,640
16	2034	$2,116	$39,744	$1,020,473	$74,965	$1,137,298	$708,726	$385,242
17	2035	$2,111	$44,570	$1,049,201	$77,233	$1,173,115	$709,754	$371,378
18	2036	$2,295	$46,595	$1,081,750	$79,453	$1,210,094	$710,802	$358,023
19	2037	$2,093	$52,580	$1,095,370	$81,407	$1,231,450	$702,279	$340,506
20	2038	$1,991	$54,855	$1,115,667	$83,412	$1,255,924	$695,375	$324,555
21	2039	$1,832	$57,249	$1,129,269	$85,476	$1,273,826	$684,744	$307,646
22	2040	$1,389	$57,614	$1,155,994	$87,925	$1,302,922	$679,985	$294,087
Totals =		**$45,034**	**$1,230,954**	**$14,461,415**	**$1,160,491**	**$16,897,894**	**$10,958,269**	**$6,473,749**

Note: Negative values represent savings and positive values represent losses.

Traffic Safety Benefits/Disbenefits

The reduction (or increase) of traffic accidents depends on the reduction (or increase) of vehicle-miles traveled by passenger cars and trucks under the Build Scenario (compared to the No Build). The method to assess safety benefits/disbenefits resulting from the implementation of the I-35W NTE project involves applying the historical regional fatality, injury and property damage crash rates to the annual changes in VMT and then, estimating the dollar value by using comprehensive cost of motor vehicle crashes by injury level.

This analysis uses the historical average fatality, injury and other crash rates in other similar segments of IH-35, estimated based on the reported crash statistics for the last five years (Tables 19 and 20), and the average monetized value of fatalities and injuries prescribed in the 2016 Benefit-Cost Analysis (BCA) Resource Guide (Table 21). The results from this estimation are shown in Table 22.

Table 19: Motor Vehicle Crashes in Similar Segments on IH-35 (One-Half Mile)

Year	Fatalities	Incapacitating Injuries	Non-Incapacitating Injuries	Possible Injuries	Non-Injuries	Unknown Injuries
2011	0	2	9	5	24	0
2012	0	9	9	22	56	0
2013	1	6	19	11	47	1
2014	0	5	15	11	50	2
2015	1	6	11	21	121	4
Average (2011-2015)	**0**	**6**	**13**	**14**	**60**	**1**

Source: TxDOT CRIS DATA (CRIS stands for Crash Reporting Information System).

Table 20: Estimated Motor Vehicle Crash Rates (per 100 Million Vehicle Mile)

	Fatalities	Incapacitating In juries	Non-Incapacitating Injuries	Possible Injuries	Non-Injuries	Unknown Injuries
Average Fatalities/ Injuries	0	6	13	14	60	1
Rates (per 100 Million Vehicle Mile) Build	0.3	3.9	8.8	9.7	41.4	1.0
Rates (per 100 Million Vehicle Mile) No-Build	0.3	4.1	9.2	10.2	43.3	1.0

Source: TxDOT Crash Reporting Information System (CRIS) Data

Table 21: Average Comprehensive Cost of Motor Vehicle Crashes

Average Monetized Value of Accident (for KABCO-Reported and Generic Accident data)		Monetized Value (in 2015$)	Unit
Fatal Accident Cost	K	$9,600,000	$/person
Accident Cost (Incapacitating Injury)	A	$459,120	$/person
Accident Cost (Non-Incapacitating Injury)	B	$125,050	$/person
Accident Cost (Possible Injury)	C	$63,854	$/person
Accident Cost (Injured Severity Unknown)	U	$174,030	$/person
Property Damage Only (PDO) Crashes	O	$8,396	$/crash

Sources: 1) The average comprehensive cost of a fatality in traffic crashes comes from the U.S. DOT Benefit-Cost Analysis (BCA) Resource Guide (November 2016) supplement to the *2016 Benefit-Cost Analysis Guidance for Grant Applicants* and *Guidance on Treatment of the Economic Value of a Statistical Life in U.S. Department of Transportation Analyses* (2016). 2) The average comprehensive cost of injured people in traffic crashes by injury severity are estimated based on the KABCO/Unknown – AIS Data Conversion Matrix developed by the NHTSA (July 2011) and provided in the U.S. DOT Benefit-Cost Analysis (BCA) Resource Guide (November 2016), page 12 of 19. 3) The PDO crash cost comes from the National Highway Traffic Safety Administration (NHTSA), *The Economic and Societal Impact of Motor Vehicle Crashes,* 2010.

Table 22: Traffic Accident Cost Benefits/Disbenefits

A	B	C	D	E	F	G
		Monetary Value of Reduced/Additional Motor Vehicle Crashes (in 2015 Dollar)			NPV of Reduced/Additional Traffic Accidents	
					3%	7%
Year	Calendar Year	Autos	Trucks	Total	NPV = [E/(1+3%)^A]	NPV = [E/(1+7%)^A]
2	2020	-$65,958	$65,958	$0	$0	$0
3	2021	$131,501	$91,075	$222,576	$203,689	$181,688
4	2022	$328,960	$116,192	$445,152	$395,512	$339,605
5	2023	$526,419	$141,309	$667,729	$575,989	$476,081
6	2024	$723,878	$166,427	$890,305	$745,616	$593,248
7	2025	$921,337	$191,544	$1,112,881	$904,874	$693,046
8	2026	$1,118,797	$216,661	$1,335,457	$1,054,222	$777,248
9	2027	$1,316,256	$241,778	$1,558,034	$1,194,103	$847,467
10	2028	$1,513,715	$266,895	$1,780,610	$1,324,941	$905,172
11	2029	$1,711,174	$292,012	$2,003,186	$1,447,144	$951,699
12	2030	$1,908,633	$317,129	$2,225,762	$1,561,105	$988,265
13	2031	$2,106,092	$342,246	$2,448,338	$1,667,199	$1,015,973
14	2032	$2,303,551	$367,364	$2,670,915	$1,765,789	$1,035,827
15	2033	$2,501,010	$392,481	$2,893,491	$1,857,222	$1,048,734
16	2034	$2,698,469	$417,598	$3,116,067	$1,941,830	$1,055,520
17	2035	$2,895,928	$442,715	$3,338,643	$2,019,934	$1,056,929
18	2036	$3,093,388	$467,832	$3,561,220	$2,091,841	$1,053,636
19	2037	$3,290,847	$492,949	$3,783,796	$2,157,846	$1,046,251
20	2038	$3,488,306	$518,066	$4,006,372	$2,218,231	$1,035,323
21	2039	$3,685,765	$543,183	$4,228,948	$2,273,268	$1,021,346
22	2040	$3,883,224	$568,301	$4,451,525	$2,323,217	$1,004,768
Totals =		**40,081,292**	**6,659,715**	**46,741,008**	**$29,723,574**	**$17,127,828**

Note: Negative values represent savings and positive values represent losses.

Noise Cost Benefits/Disbenefits

Noise cost reduction is another benefit of reduced VMT. The underlying theory is that people are willing to pay to avoid high noise levels attributed to motor vehicles and that housing property values reflect proximity to a noisy road. However, when VMT increases the additional noise costs and impacts have to be considered as disbenefits.

The method to assess noise impacts of the I-35W NTE Project involves estimation of the marginal external cost caused by noise emissions of motor vehicles. Federal Highway

Administration (FHWA) provides marginal noise cost for urban highways by vehicle class resulting from a unit increase/decrease in VMT. This analysis uses FHWA medium values (Table 23).

Table 23: Marginal External Noise Cost for Urban Highways

Vehicle Class	Urban Highways (Average) in 2000$	Urban Highways (Average) in 2015$
Passenger Cars	0.0064	0.0089
Trucks	0.0246	0.0339

Source: 1997 Federal Highway Cost Allocation Study, Final Report, Table V-22. Available at http://www.fhwa.dot.gov/policy/hcas/final/five.cfm

Note: Marginal noise cost was inflated from 2000 to 2015 dollars based on the Consumer Price Index (CPI) from all South Urban Areas provided by the Bureau of Labor Statistics (BLS).

The impact of personal travel and truck traffic on noise pollution are estimated by multiplying the marginal external cost of noise by the annual changes in VMT over the 20-year analysis period. Table 24 summarizes the potential noise cost benefits/disbenefits resulting from the Project implementation.

Table 24: Noise Cost Benefits/Disbenefits

A	B	C	D	E	F	G
		Monetary Value of Reduced/Additional Noise Costs (in 2015 Dollar)			NPV of Reduced/Additional Noise Costs	
					3%	7%
Year	Calendar Year	Autos	Trucks	Total	NPV = [E/(1+3%)^A]	NPV = [E/(1+7%)^A]
2	2020	$48,010	$58,061	$106,071	$99,982	$92,647
3	2021	$75,592	$71,235	$146,827	$134,367	$119,854
4	2022	$103,175	$84,408	$187,583	$166,665	$143,106
5	2023	$130,757	$97,581	$228,338	$196,967	$162,802
6	2024	$158,340	$110,754	$269,094	$225,362	$179,309
7	2025	$185,923	$123,927	$309,850	$251,936	$192,959
8	2026	$213,505	$137,100	$350,606	$276,771	$204,056
9	2027	$241,088	$150,274	$391,361	$299,946	$212,875
10	2028	$268,670	$163,447	$432,117	$321,536	$219,666
11	2029	$296,253	$176,620	$472,873	$341,614	$224,659
12	2030	$323,836	$189,793	$513,629	$360,249	$228,057
13	2031	$351,418	$202,966	$554,385	$377,509	$230,050
14	2032	$379,001	$216,140	$595,140	$393,458	$230,806
15	2033	$406,583	$229,313	$635,896	$408,158	$230,478
16	2034	$434,166	$242,486	$676,652	$421,667	$229,205
17	2035	$461,748	$255,659	$717,408	$434,043	$227,113
18	2036	$489,331	$268,832	$758,163	$445,341	$224,313
19	2037	$516,914	$282,006	$798,919	$455,612	$220,908
20	2038	$544,496	$295,179	$839,675	$464,908	$216,988
21	2039	$572,079	$308,352	$880,431	$473,275	$212,636
22	2040	$599,661	$321,525	$921,187	$480,760	$207,924
Totals =		**$6,800,547**	**$3,985,658**	**$10,786,204**	**$7,030,126**	**$4,210,410**

Note: Negative values represent savings and positive values represent losses.

Job Creation

The expenditure of public sector dollars is expected to create short-term jobs in the development and construction phases and maintenance of the I-35W NTE Project (Table 25). The benefit of increase in the job-years as a result of the Project during development and construction was computed as a product of the undiscounted project cost and the value on government dollars spent to create a single job-year (i.e., $76,900 in 2015$). These benefits are not counted in the B/C calculation.

Table 25: Job Creation Benefits

Job Creation	Value
Increase in Short-Term Job-Years due to Project during Development and Construction	8,212 Job-Years
Increase in Short-Term Job-Years due to Project during Development, Construction and Maintenance	9,010 Job-Years
Average # of Short-Term Jobs Created in a Year due to Project during Development and Construction	2,053 Jobs

Note: Estimated using the U.S. DOT Benefit-Cost Analysis (BCA) Resource Guide (November 2016) supplement to the *2016 Benefit-Cost Analysis Guidance for Grant Applicants*, Updated November 17, 2016.

Total Monetized Benefits

Table 26 summarizes the monetized benefits (undiscounted and discounted) for each benefit category.

Table 26: I-35W NTE Project – Total Monetized Benefits by Benefit Category

Project Benefits	Savings	In 2015$	Discounted at 3%	Discounted at 7%
A. State of Good Repair	Pavement Maintenance Cost	-$30,463,457	-$20,074,793	-$12,222,769
B. Economic Competitiveness	Travel Time Costs	$948,616,814	$613,904,433	$363,692,780
	Vehicle Operating Costs	-$590,822,627	-$383,789,100	-$228,680,159
C. Livability	Noise Costs	-$10,786,204	-$7,030,126	-$4,210,410
D. Sustainability	Social Cost of Carbon Emissions	-$11,058,663	-$7,220,334	-$7,220,334
	Non-Carbon Emission Costs	-$16,897,894	-$10,958,269	-$6,473,749
E. Safety	Motor Vehicle Crashes	-$46,741,008	-$29,723,574	-$17,127,828
Total Benefits (B) =		**$241,846,961**	**$155,108,238**	**$87,757,532**

Note: In accordance with Federal interagency Social Cost of Carbon (SCC) guidance, the social cost of carbon dioxide emissions are discounted at a lower discount rate of 3%, even in the 7% discount rate benefit-cost analysis.

Project Life Cycle Cost Analysis

The cost of the I-35W NTE Project consist of capital expenditures, including project support, land acquisition, and construction, as well as operation and maintenance (O&M) and rehabilitation. The Texas Department of Transportation (TxDOT) provided capital cost estimates (in 2015 dollars) and expected construction schedule for the Project (Table 27). The Project is expected to require $631.5 million (in 2015 dollars) in capital expenditures, with initiation in the Spring of 2018 and construction commencing in the Fall of 2018 and completion anticipated by the end of 2021. Phased construction costs over the construction period are allocated as follows: 10 percent in the first construction year, 35 percent in each of the following two construction years, and the remaining 20 percent in the last construction year.

Annual O&M expenditures for the I-35W NTE Project are estimated based on the cost of resurfacing major highways in TxDOT. The O&M and rehabilitation expenditures are estimated for the project's operation period from 2021 to 2040. The total O&M and rehabilitation costs are estimated to be $$28,884,461 and $32,477, respectively (in 2015 dollars). Table 28 presents the life cycle cost of the proposed I-35W NTE Project.

Table 27: I-35W NTE Project – Capital Cost Estimates

Cost Categories	Total (2015$)
Construction	$448,297,000
Right-of-Way	$18,000,000
Design	$30,470,000
Contingencies	$55,593,000
Admin/Miscellaneous	$79,168,000
Total =	**$631,528,000**
Construction Schedule	Begin: Fall 2018 End: Fall 2021

Source: Texas Department of Transportation (TxDOT).

Table 28: I-35W NTE Project – Life Cycle Cost Analysis

A	B	C	D	E	F	G	H	I	J
				NPV of Capital Costs		NPV of O&M Costs		NPV of Total Costs	
				3%	7%	3%	7%	3%	7%
Year	Calendar Year	Capital Costs (in 2015 Dollar)	O&M Costs (in 2015 Dollar)	NPV = [C/(1+3%)^A]	NPV = [C/(1+7%)^A]	NPV = [D/(1+3%)^A]	NPV = [D/(1+7%)^A]	E + G	F + H
0	2018	$150,604,000		$150,604,000	$150,604,000			$150,604,000	$150,604,000
1	2019	$187,026,000		$181,578,641	$174,790,654			$181,578,641	$174,790,654
2	2020	$187,026,000		$176,289,943	$163,355,752			$176,289,943	$163,355,752
3	2021	$106,872,000	$1,206,396	$97,803,019	$87,239,387	$1,104,023	$984,778	$98,907,043	$88,224,165
4	2022		$1,478,009			$1,313,192	$1,127,566	$1,313,192	$1,127,566
5	2023		$1,588,336			$1,370,113	$1,132,462	$1,370,113	$1,132,462
6	2024		$1,506,641			$1,261,788	$1,003,939	$1,261,788	$1,003,939
7	2025		$1,782,875			$1,449,641	$1,110,285	$1,449,641	$1,110,285
8	2026		$1,661,271			$1,311,423	$966,875	$1,311,423	$966,875
9	2027		$1,572,822			$1,205,437	$855,511	$1,205,437	$855,511
10	2028		$2,066,165			$1,537,421	$1,050,334	$1,537,421	$1,050,334
11	2029		$3,306,431			$2,388,636	$1,570,862	$2,388,636	$1,570,862
12	2030		$7,492,282			$5,254,936	$3,326,663	$5,254,936	$3,326,663
13	2031		$5,250,261			$3,575,172	$2,178,672	$3,575,172	$2,178,672
14	2032		$3,388,414			$2,240,141	$1,314,085	$2,240,141	$1,314,085
15	2033		$2,081,874			$1,336,276	$754,567	$1,336,276	$754,567
16	2034		$2,192,061			$1,366,020	$742,527	$1,366,020	$742,527
17	2035		$2,668,276			$1,614,351	$844,708	$1,614,351	$844,708
18	2036		$2,174,460			$1,277,266	$643,344	$1,277,266	$643,344
19	2037		$1,467,015			$836,618	$405,642	$836,618	$405,642
20	2038		$4,475,869			$2,478,180	$1,156,650	$2,478,180	$1,156,650
21	2039		$4,085,864			$2,196,353	$986,790	$2,196,353	$986,790
22	2040		$9,916,879			$5,175,545	$2,238,370	$5,175,545	$2,238,370
Totals =		**$631,528,000**	**$61,362,201**	**$606,275,603**	**$575,989,792**	**$40,292,531**	**$24,394,627**	**$646,568,134**	**$600,384,420**

Summary of Benefit-Cost Results

This memorandum describes the methodology used for conducting benefit-costs analysis (BCA) for the proposed I-35W NTE Project. The analysis quantifies the expected economic benefits/disbenefits to be generated by the Project in terms of additional or reduce pavement maintenance expenditures, travel time costs, vehicle operating costs, emissions, traffic crashes, and noise pollution.

Table 29 summarizes the BCA findings. Annual costs and benefits are computed over the lifecycle of the project (20 years). As stated earlier, construction is expected to be completed by 2021 and benefits to be accrued during the full operation of the project. The Project has a benefit-cost ratio of 0.25 at a real discount rate of 3 percent and 0.17 at a real discount rate of 7 percent. These findings demonstrate that there are significant long-term economic benefits associated with the Project, and is regionally an important project. For instance:

- **Location advantages in terms of travel time savings for highway users**. Improved access to multimodal infrastructure has been used as the core and selling point for logistics parks. Strategically located on the IH- 35W corridor north of Fort Worth, Texas, AllianceTexas provides multimodal freight access through its Fort Worth Alliance Airport (completely industrial), a Burlington Northern Santa Fe (BNSF) intermodal rail yard, two class 1 rail lines (BNSF and UP), and close proximity to three major highways (IH-35W, SH-170, SH-114). In the Burlington Northern Santa Fe (BNSF) intermodal rail yard, containers are loaded, unloaded, or transferred between rail and truck. With nearly 13 double-stacked intermodal trains loaded and unloaded every day, the BNSF rail yard handles approximately 600,000 containers and trailers per year for companies such as Daimler-Chrysler, Japans, Michael's, Hyundai, and Kia. JCPenny distributes merchandise to over 1,000 retail stores from its distribution center near the BNSF Intermodal yard. Travel time savings to be generated by the Project will have a positive impact in the cost of conducting business of key industry clusters (automotive, aerospace/aviation, logistics, e-commerce/electronics, pharmaceutical/healthcare, and consumer goods/services), contributing to the regional economic competitiveness.
- **The proposed I-35W NTE will enhance international freight movements**. Extending from Mexico to Canada, the NAFTA trade corridor (IH-35) splits at Denton, Texas and then makes its way through Fort Worth as IH-35W and Dallas as IH-35E and ultimately converges again as IH-35 in Hillsboro, Texas. Since all imported goods that move north by truck out of Laredo move on the NAFTA trade corridor, the proposed I-35W NTE will facilitate the distribution of Mexican retail goods in the Dallas/Fort Worth Metroplex. In 2014, the Dallas-Fort Worth-Arlington region was considered the ninth largest export market in the United States with approximately $28.7 billion in total merchandise exports, much of which utilizes I-35W. Keeping the Metroplex competitive in this market requires mobility and supporting transportation infrastructure.

- **Enhanced multimodal transportation access and international trade facilitation**. The proposed I-35W NTE Project will benefit a number of large industrial tenants located at AllianceTexas, including 64 from the Fortune 500, Global 500 or Forbes' top list of private firms. The area adjoining I-35W NTE Project is home to many of the largest employers in the region and some of the most recognized brands in the world. Housing construction, healthcare and retail development around the I-35W NTE corridor have accelerated at a pace consistent with job growth in the area. However, local governments have struggled to keep up with infrastructure needed to connect people with opportunities.
- **Enhanced regional and local economy**. Locally, the I-35W NTE Project will provide citizens with reliable, closer and affordable connections to employment, education, healthcare and other critical services in the region. For instance, it will support AllainceTexas community aspects, including retail shopping areas, hospitals, churches, parks, community centers, golf courses, and a number of educational and technical training programs for residents, visitors and/or employees of companies located at Alliance. It will allow more people to realize their economic potential and improve businesses' access to a diverse workforce. It will have a dramatic impact on neighborhoods and the overall region by supporting the regional community features and small and disadvantaged business enterprises.

Table 29: Summary of Benefit-Cost Analysis of I-35 NTE Project

BENEFIT-COST RATIO		Discounted at 3%	Discounted t 7%
(B) / (C) =		0.24	0.15
Project Costs		**Discounted at 3%**	**Discounted at 7%**
Cost Category			
Capital Costs		$606,275,603	$575,989,792
O&M Costs		$40,292,531	$24,394,627
Total Costs (C) =		**$646,568,134**	**$600,384,420**
Project Benefits	**Savings**	**Discounted at 3%**	**Discounted at 7%**
Benefit Category			
A. State of Good Repair	Pavement Maintenance Cost	-$20,074,793	-$12,222,769
B. Economic	Travel Time Costs	$613,904,433	$363,692,780
Competitiveness	Vehicle Operating Costs	-$383,789,100	-$228,680,159
C. Livability	Noise Costs	-$7,030,126	-$4,210,410
D. Sustainability	Social Cost of Carbon Emissions	-$7,220,334	-$7,220,334
	Non-Carbon Emission Costs	-$10,958,269	-$6,473,749
E. Safety	Motor Vehicle Crashes	-$29,723,574	-$17,127,828
Total Benefits (B) =		**$155,108,238**	**$87,757,532**

Note: In accordance with Federal interagency Social Cost of Carbon (SCC) guidance, the social cost of carbon dioxide emissions are discounted at a lower discount rate of 3%, even in the 7% discount rate benefit-cost analysis.

Economic Benefits Resulting from Project Spending on Construction, Operations and Maintenance

Economic impacts from the proposed Project initially occur as a result of the actual construction of the project. Expenditures on construction are of economic value because infrastructure development disbursement increases the Gross Regional Product (GRP) and supports the creation and retention of construction related jobs. Once the construction phase is completed, subsequent expenditures on operations and maintenance activities are required, which also results in additional economic impacts.

In analysing the economic impacts of the I-35 W North Tarrant Express (NTE) Project, the estimated construction, operations, and maintenance expenditures serve as inputs into the Texas IMPLAN Model for analysing the economic impacts on the primary impact area (i.e., Tarrant County). Construction costs presented in this analysis captures only the hard costs (e.g., site preparation activities, structures, earthwork, etc.) and this analysis does not include planning, engineering, and land or building acquisition costs since these costs do not contribute to the construction industry. In estimating the economic impacts resulting from investment spending on construction, operations and maintenance (O&M), the following assumptions are made:

- Only construction expenditures within the primary impact area results in economic impacts within Tarrant County. Any spending beyond Tarrant County is considered expenditure leakages, and, consequently, have no economic value for the primary project area. This analysis assumes that about 50 percent of the total construction spending (i.e., 448,297,000 over the construction period) is expended outside the project area. As a result, project construction costs are reduced by 50 percent to reflect the revised allocation of construction costs within the project primary impact area.
- This analysis assumes that about 20 percent of the total spending on project operations and maintenance is expended outside the project area. As a result, these costs are reduced by 20 percent to reflect the revised allocation of O&M costs within the project primary impact area.

Table 28 and **Table 29** displays the total (direct, indirect, and induced) effects on employment, labor income, GRP (or value added), and tax revenues generated by the project construction spending and O&M, respectively.

Table 30: I-35W NTE Project - Total Economic Benefits Resulting from Construction Expenditures

Impact Type	Employment	Labor Income (in 2016$)	GRP (in 2016$)
Direct Effect	2,458	158,082,819	195,183,050
Indirect Effect	713	51,024,217	77,029,241
Induced Effect	1,199	55,649,109	94,600,929
Total Effect =	**4,369**	**$264,756,146**	**$366,813,220**

Tax Revenue Type	Federal Tax Revenues (in 2016$)	State & Local Tax Revenue (in 2016$)	Total (in 2016$)
Tax on Production and Imports	$2,517,664	$17,125,700	$19,643,364
Social Security Contributions	$20,753,777	$276,464	$21,030,241
Personal Income Tax	$27,178,692	N/A	$27,178,692
Corporate Profits and Dividend Taxes	$6,495,346	$84,225	$6,579,571
Personal Sales and Property Taxes	N/A	$2,120,398	$2,120,398
Total =	**$56,945,479**	**$19,606,787**	**$76,552,266**

Note: Estimated using the Texas IMPLAN Model.

Table 31: I-35W NTE Project - Total Economic Benefits Resulting from Operations and Maintenance Expenditures

Impact Type	Employment	Labor Income (in 2016$)	GRP (in 2016$)
Direct Effect	292	19,267,747	23,968,765
Indirect Effect	105	7,071,516	9,784,240
Induced Effect	150	6,984,190	11,876,577
Total Effect =	**547**	**$33,323,452**	**$45,629,581**

Tax Revenue Type	Federal Tax Revenues (in 2016$)	State & Local Tax Revenue (in 2016$)	Total (in 2016$)
Tax on Production and Imports	$316,858	$2,155,337	$2,472,196
Social Security Contributions	$2,459,439	$32,763	$2,492,201
Personal Income Tax	$3,489,223	$0	$3,489,223
Corporate Profits and Dividend Taxes	$775,051	$10,050	$785,101
Personal Sales and Property Taxes	0	$267,729	$267,729
Total =	**$7,040,570**	**$2,465,879**	**$9,506,450**

Note: Estimated using the Texas IMPLAN Model.

Long-Term Economic Benefits Resulting from Reduced Costs of Conducting Business in the Region

This section presents the long-term economic impacts resulting from the direct benefits generated by the Project over the 20-year analysis period. As shown, the project will generate travel time savings to commuters, business travellers, and trucks. The economic impacts are estimated by applying the monetized net travel time savings as inputs into IMPLAN and then running the model (Table 32).

Table 32: I-35W NTE Project - IMPLAN Input Variables

Direct Benefit	Economic Input	IMPLAN Input Variable
Travel time savings in business and truck trips	Reduced costs of conducting business accrue to individual industries based on (1) the proportion of each respective industries' output share of total industry output in the study region; (2) the value of the transportation services each respective industry consumes in order to produce one dollar of output based on the Transportation Satellite Accounts (TSA) coefficients and the economic output by industry within the study region as reported by the IMPLAN model in the year 2015; (3) the output elasticities with respect to freight (truck and rail) costs and ground (car and passenger train) travel costs for the good sector and the service sector, and (4) the price elasticities of freight (truck and rail) transport demand	Industry Change in Output
Travel time savings in commute trips	Increased in household income in the form of changes in disposable income, apportioned to the distribution of households by income range within the study region as reported by the IMPLAN model in the year 2015.	Household Income Change

Table 33 presents the total (*direct, indirect,* and *induced*) effects on employment, labor income, GRP (or value added) and tax revenues generated by the project over the 20-year analysis period. Table 34 indicates the ten industry sectors in Presidio County most impacted by the project in terms of job creation.

Table 33: I-35W NTE Project –Economic Impacts Generated over the 20-Year Analysis Period

Impact Type	Employment	Labor Income (in 2016$)	GRP (in 2016$)
Direct Effect	868	$54,971,501	$81,899,713
Indirect Effect	257	$13,612,375	$20,638,311
Induced Effect	395	$18,342,911	$31,168,723
Total Effect =	**1,519**	**$86,926,787**	**$133,706,746**

Tax Revenue Type	Federal Tax Revenues (in 2016$)	State & Local Tax Revenue (in 2016$)	Total (in 2016$)	Total (%)
Tax on Production and Imports	$1,714,547	$11,662,720	$13,377,267	41%
Social Security Contributions	$7,354,822	$97,975	$7,452,796	23%
Personal Income Tax	$8,681,380	N/A	$8,681,380	26%
Corporate Profits and Dividend Taxes	$2,632,597	$34,137	$2,666,733	8%
Personal Sales and Property Taxes	N/A	$693,191	$693,191	2%
Total =	**$20,383,345**	**$12,488,022**	**$32,871,368**	**100%**

Note: Estimated using the Texas IMPLAN Model.

Table 34: Economic Sectors Most Impacted by the I-35W NTE Project in Terms of Employment

Sector	Description	% of Total Employment
395	Wholesale trade	6%
464	Employment services	6%
440	Real estate	3%
501	Full-service restaurants	3%
502	Limited-service restaurants	3%
20	Extraction of natural gas and crude petroleum	3%
405	Retail - General merchandise stores	3%
468	Services to buildings	2%
482	Hospitals	2%
465	Business support services	2%
	Subtotal =	**33%**
	Total =	**100%**

Note: Estimated using the Texas IMPLAN Model.