Improved US 70 with Railroad Grade Separation (Highway Overpass)
Valliant, Oklahoma

2012 TIGER Grant Application
Benefit Cost Analysis Technical Memo

March 19, 2012

Project Summary

The "Improved US 70 with Highway Overpass" project in southeast Oklahoma is a multimodal project that widens and improves part of the National Highway System, creates a grade separation that will improve operational efficiency and safety for two Class III railroads and the highway, and adds bicycle and pedestrian facilities on this main thoroughfare through the City of Valliant.

The US 70 corridor is a transcontinental highway; and in Oklahoma serves an important function connecting the agricultural economy in southwest Oklahoma, the warehousing and distribution centers in the center of the state at Ardmore and I-35, and farming, timber and tourism industries in southeast Oklahoma.

The proposed project will improve a transportation corridor in southeast Oklahoma where both rail and highway modes suffer because of safety problems and travel delays. The Texas Oklahoma and Eastern Railroad (TO&E) crosses US 70 at the western edge of the town of Valliant in McCurtain County, bringing traffic to a standstill on this major commercial arterial for 15 to 20 minutes at a time.

The proposed project will improve five and one-half miles of US 70 in McCurtain County, in the southeastern corner of Oklahoma. The project will replace the current two lane facility with a five lane facility consisting of four through lanes and a center turn lane. It will include a bridge elevating US 70 over the Texas Oklahoma & Eastern Railroad and its related switching operation. The project will incorporate sidewalks, a bike path and three enhanced pedestrian crossings.

Anticipated benefits are summarized in the project matrix, **Table BCA-1.** Note that the valuation of two benefits, travel time and accident reductions, are broken out in this table to show how much of each benefit is due to the road widening component of the project, and how much is a result of the rail grade separation.

Table BCA-1: Project Matrix

Current Status/Baseline & Problem to be Addressed	Change to Baseline	Type of Impact	Population Affected by Impacts	Economic Benefits and Summary of Results (Present Value at 7% discount rate)	Page Reference in BCA Tech Memo
At-Grade Rail Crossing causing lengthy delays on a major thoroughfare	Grade separation will eliminate rail-related delays	• Improved travel time • Improved safety (fewer rail-crossing-related accidents) • Reduced emissions • Reduced fuel use	• Local residents • Regional travelers • Commuters (US 70 in Valliant is the location of a major regional employer) • Truck drivers (and the businesses/farms they are receiving or delivering goods for)	• Travel time savings ($43.7m) • Reduced rail-crossing-related vehicle accidents ($1.2m) • Reduced emissions ($3.7m) • Reduced fuel use (net of increase in VMT)	• Travel time savings pp 8-10 • Safety pp 20-22 • Emissions pp 16-169 • Fuel use pp 11-15
Safety problems and delays caused by high levels of traffic, particularly truck traffic, on a mostly two-lane road with numerous access points	Road will be widened to five lanes, two lanes in each direction, with a center turn lane	• Improved travel time from increased capacity and reduction in turn-related delays • Improved safety (fewer turn-related accidents)	• Local residents • Commuters • Regional & long-distance travelers • Truck drivers (and the businesses/farms they are receiving or delivering goods for)	• Improvements in travel times resulting from the widening and addition of a turn lane ($18.7m) • Reduction in accidents from the widening and addition of a turn lane ($2.6m)	• Travel time savings pp 8-10 • Safety pp 20-22
Corridor lacks sidewalks and bike paths	Project would add a five-foot-wide sidewalk and eight-foot-wide bike path along the alignment	• Improved safety (not assessed in BCA) • Enhanced livability & sustainability, (not assessed in BCA) • Economic benefit of adding vitality to this major commercial thoroughfare (not assessed in BCA) • Health benefits of using active transportation modes	• Local residents • Local business owners • Visitors	These benefits were not assessed in the BCA due to lack of data on ped/bike use.	• Discussed in "Non-Quantifiable Benefits" discussion on pp 23-24.
Road traffic damages rail line, requiring replacement of crossing safety equipment as well as pavement repair	Project would eliminate vehicular traffic crossing over rail line	• Reduced maintenance costs • Reduced operating costs (no need to operate safety equipment)	• Two class III railroads use this rail line, although the primary beneficiary would be the TO&E railroad, which owns the line	• Annual reduction in operating and maintenance costs and the longer-term capital improvement costs of maintaining the grade crossing ($257,800).	• Page 8

Benefit Cost Analysis

The formal benefit-cost analysis (BCA) was conducted for this project using best practices for BCA in transportation planning, and reflecting all current TIGER grant application guidelines. As noted in the application, it is important to note that a formal BCA is not a comprehensive measure of a project's total economic impact, as many benefits cannot be readily quantified or occur under conditions of uncertainty. This broader set of economic benefits and impacts on local and regional economic well-being and competitiveness are described in other sections of the application, particularly section IV.A.ii Economic Competitiveness.

To the maximum extent possible given the available data, the formal BCA prepared in connection with this TIGER grant application reflects quantifiable economic benefits. It covers all five of the primary long-term impact areas identified in the TIGER grant application guidelines:

- State of Good Repair: As US 70 traffic crosses over the Texas Oklahoma & Eastern (TO&E) railroad, damage is caused that requires thousands of dollars annually to repair. This damage will be eliminated by the project, as will TO&E's cost to operate the safety equipment at the crossing. Highway maintenance cost impacts are also calculated in the BCA.
- Economic Competitiveness: Reducing travel times (for highway) and costs (for both rail and highway) will allow local industry and regional forestry and agricultural enterprises to reduce transportation costs, improve their logistics practices, and expand markets for both domestic and international shipments.
- Livability: Reduction of travel times will improve livability for the many individuals in and around Valliant, Oklahoma, who rely on this road for their daily commute, as well as for trips for education, shopping, medical appointments, and other services.
- Environmental Sustainability: Eliminating idling at the rail crossings will reduce fuel consumption and vehicle emissions. as cars and trucks will no longer have to wait for a train to pass
- Safety: The current configuration of the road leads to a substantial number of accidents each year. With no center turn lane, high traffic levels for a two-lane road, and an at-grade intersection with a railroad, collisions are quite prevalent. All of these issues will be removed with the project, which will substantially reduce the potential for accidents and injuries.

Given the limitations described above, the computed benefit-cost ratio for the Valliant project is, 1.79 to 1.0 using a discount rate of seven percent and 3.45 to 1.0 using a three percent discount rate. The cost-benefit analysis compares the project's capital and maintenance costs to the quantifiable benefits of the project for a period of 40 years after construction.

The quantified project benefits are:

1. Avoided No Build highway maintenance costs
2. Rail maintenance cost savings
3. Travel time savings for vehicles
4. Fuel cost savings for vehicles
5. Emissions reduction benefits from reduced vehicle idling at grade crossings
6. Safety benefits (reduced vehicle crashes)

Discount Rates
Federal TIGER guidance recommends[1] that applicants discount future benefits and costs to 2012 present values using a real discount rate of seven percent to represent the opportunity cost of money in the private sector. TIGER guidance also allows for an alternate present value analysis using a three percent discount rate when the funds currently dedicated to the project would be other public expenditures. This is the case for this project, which would be 100% publicly funded. BCA results using both discount rates are shown throughout this document.

Cost Benefit Results
Table BCA-2 summarizes the cost and the quantifiable benefits of the project in terms of Present Value. As shown in the table, the present value of the project's capital and maintenance costs is valued at $40.5 million using a 7% discount rate and $43.7 million using a 3% discount rate. The benefits have an estimated present value of $32.2 million at a 7% discount rate and $107.2 million at a 3% discount rate, yielding benefit-cost ratios of 1.79 and 3.45, respectively. Note that the social cost of carbon (SCC) was assessed at a 3% discount rate in both the 7% and the 3% analysis.

Benefit Calculation Assumptions

The benefits of the project are derived by comparing conditions under a Build and No Build scenario. These two scenarios are defined as follows:

No Build
Under the No Build, US 70 would remain in its current configuration through Valliant, at 2 to 4 lanes with an at-grade railroad crossing. Major rehabilitation costing $848,216 would be required in the near future (2012-3).

Build
The proposed project will improve five and one-half miles of US 70, replacing the current (predominantly) two-lane facility with a five-lane facility consisting of four through lanes and a center turn lane. It will include a bridge elevating US 70 over the TO&E railroad and its related switching operation in Valliant, Oklahoma. The project will incorporate sidewalks and a bike path, and three enhanced pedestrian crossings.

[1] Source: TIGER Notice of Funding Availability (Federal Register/Vol 77, No. 20, 3/31/2012, page 4878):
Applicants should discount future benefits and costs to present values using a real discount rate (i.e., a discount rate that reflects the opportunity cost of money net of the rate of inflation) of 7 percent, following guidance provided by OMB in Circulars A–4 and A– 94 (http://www.whitehouse.gov/omb/ circulars_default/). Applicants may also provide an alternative analysis using a real discount rate of 3 percent. They should use the latter approach when the alternative use of funds currently dedicated to the project would be for other public expenditures, rather than private investment. In presenting these year-by-year streams, applicants should measure them in constant (or ''real'') dollars prior to discounting. Applicants should not add in the effects of inflation to the estimates of future benefits and costs prior to discounting.

Table BCA-2: Benefit Cost Analysis Summary Table
Figures in thousands of 2012$, discounted to 2012

Category	Present Value at 7%	Present Value at 3%
Costs		
Construction Cost	$39,869	$42,050
Maintenance Costs (Build – 5 lane US 70)	$602	$1,657
TOTAL COSTS	**$40,472**	**$43,707**
Evaluated Benefits		
Maintenance Costs Avoided (No Build – 3-lane US 70)	$1,096	$1,546
Rail Maintenance Cost Savings	$258	$490
Vehicle Travel Time Savings	$62,475	$131,399
Vehicle Fuel Cost Savings	$4,716	$9,632
Emissions Savings	$316*	$382
Safety Benefits	$3,772	$7,477
TOTAL EVALUATED BENEFITS	**$72,633**	**$150,927**
NET PRESENT VALUE	**$32,162**	**$107,219**
BENEFIT/COST RATIO	**3.49**	**1.94**

** The social cost of carbon was broken out from the other benefits and assessed at a 3% discount rate as per TIGER guidance.*

Traffic

Traffic projections for US 70 through Valliant with and without the project were completed in September 2011, examining the effect on traffic of the railroad overpass and the additional lanes. In addition to the background traffic growth, the project is expected to attract an additional 5% induced traffic demand, and reduce the number of vehicles using the south bypass (along NS4450, Old OK Highway 298 and Section Line Road). This additional traffic is due to the project's center turn lane and the overpass removing the substantial delay factors along this road. The induced growth is assumed to come from two sources:

1. Local and regional trips that would not be made in the No Build due to drivers' reluctance to risk delays on US 70 as it exists now.
2. Diversions from other east-west routes, such as the sometimes-congested I-40 or State Route 3.

The resulting traffic flows were input into a traffic modeling program to determine likely travel time savings over the course of a day, given the typical rail delays:

Rail Delay at TO&E Crossing of US 70

Time of Day	Duration
10:00 AM	10 minutes
2:00 PM	10 minutes
10:00 PM	10 minutes
Midnight	15 minutes
2:00 AM	two 10-minute blockages

In addition, there are an average of two other crossings per day at 10 minutes each, times vary. Further occasional switching activity may require blocking US 70 for up to an hour at a time.

The results of the traffic modeling were annualized and are attached in Appendix A, and summarized in **Table BCA-3**.

Changes in vehicle miles traveled (VMT) were also analyzed because it was expected that substantially fewer vehicles would use the "south bypass" around the TO&E rail grade crossing (along NS4450, Old OK Highway 298 and Section Line Road) once the project was completed – a route that is 2.7 miles longer than traveling along US 70 through Valliant. The results of this analysis for 2012 and 2035 are presented in Appendix B. As it shows, while there is some VMT savings in the early years (152,570 VMT annually), as traffic continues to grow, the additional VMT added with the induced traffic overwhelms the comparatively small VMT saved with the reduced bypass usage. In 2035, the annual VMT for the Build scenario is 93,331 miles higher than in the No Build.

Table BCA-3: Travel Time Savings

Scenario	Total Network Travel Time (hours annually)	Difference (hours annually)
2012 No Build	388,776	
2012 Build	123,853	201,558
2035 No Build	510,647	
2035 Build	175,126	335,521

Highway Maintenance

No Build

US 70 is overdue for a major rehabilitation, so it is assumed that without the project an $840,480 rehabilitation would take place between 2012-13. Regular preservation under the No Build scenario would take place every seven years at a cost of $79,104. In 2040 the cycle would begin again, with an $848,216 reconstruction followed by regular maintenance (assumed to be $79,104 divided evenly over seven years).

Build

The project would be built between 2012 and 2015, during which no maintenance work is expected. Regular preservation would continue to take place in a seven-year cycle, as with the No Build, but the first year of the cycle would be 2021, seven years after construction is completed. The cost of regular preservation work would be higher than in the No Build ($197,760 versus $79,104), as there would be a much larger roadway surface to maintain because of the widening. In addition, the bridge structure over the railroad would require $30,000 in maintenance in 2034, and a further $80,000 in 2051.

As with any road, major rehabilitation would be needed after a few decades. The presumed year for the Build scenario is 2042, and the cost, again, would be larger, at $2.1 million in 2012$.

These costs are shown in **Table BCA-4**. As with the out-years for the No Build, maintenance after 2042 for the Build is assumed to be the cost of the seven-year preservation treatment divided by seven.

Table BCA-4: Highway Maintenance Costs, Build vs. No Build

Year	No Build			Build				
	Maintenance Costs	Present Value at 7%	Present Value at 3%	Maintenance Costs	Maintenance Costs	Maintenance Costs	Present Value at 7%	Present Value at 3%
	Highway	in 2012 $	in 2012 $	Highway	Bridge	TOTAL	in 2012 $	in 2012 $
2012	$ 424,108	$424,108	$424,108			$ -	$0	$0
2013	$ 424,108	$396,362	$411,755			$ -	$0	$0
2014		$0	$0			$ -	$0	$0
2015		$0	$0			$ -	$0	$0
2016		$0	$0			$ -	$0	$0
2017		$0	$0			$ -	$0	$0
2018		$0	$0			$ -	$0	$0
2019	$ 79,832	$49,715	$64,911			$ -	$0	$0
2020		$0	$0			$ -	$0	$0
2021		$0	$0	$ 199,580		$ 199,580	$108,558	$152,962
2022		$0	$0			$ -	$0	$0
2023		$0	$0			$ -	$0	$0
2024		$0	$0			$ -	$0	$0
2025		$0	$0			$ -	$0	$0
2026	$ 79,832	$30,960	$52,778			$ -	$0	$0
2027		$0	$0			$ -	$0	$0
2028		$0	$0	$ 199,580		$ 199,580	$67,605	$124,372
2029		$0	$0			$ -	$0	$0
2030		$0	$0			$ -	$0	$0
2031		$0	$0			$ -	$0	$0
2032		$0	$0			$ -	$0	$0
2033	$ 79,832	$19,280	$42,914			$ -	$0	$0
2034		$0	$0		$30,000	$ 30,000	$6,771	$15,657
2035		$0	$0	$ 199,580		$ 199,580	$42,101	$101,126
2036		$0	$0			$ -	$0	$0
2037		$0	$0			$ -	$0	$0
2038		$0	$0			$ -	$0	$0
2039		$0	$0			$ -	$0	$0
2040	$ 848,216	$127,574	$370,735			$ -	$0	$0
2041	$ 36,257	$5,096	$15,386			$ -	$0	$0
2042	$ 36,257	$4,763	$14,937	$ 2,120,539		$ 2,120,539	$278,569	$873,634
2043	$ 36,257	$4,451	$14,502	$ 90,643		$ 90,643	$11,128	$36,256
2044	$ 36,257	$4,160	$14,080	$ 90,643		$ 90,643	$10,400	$35,200
2045	$ 36,257	$3,888	$13,670	$ 90,643		$ 90,643	$9,720	$34,175
2046	$ 36,257	$3,634	$13,272	$ 90,643		$ 90,643	$9,084	$33,179
2047	$ 36,257	$3,396	$12,885	$ 90,643		$ 90,643	$8,490	$32,213
2048	$ 36,257	$3,174	$12,510	$ 90,643		$ 90,643	$7,934	$31,275
2049	$ 36,257	$2,966	$12,145	$ 90,643		$ 90,643	$7,415	$30,364
2050	$ 36,257	$2,772	$11,792	$ 90,643		$ 90,643	$6,930	$29,479
2051	$ 36,257	$2,591	$11,448	$ 90,643	$50,000	$ 140,643	$10,050	$44,408
2052	$ 36,257	$2,421	$11,115	$ 90,643	$2,286	$ 92,928	$6,206	$28,488
2053	$ 36,257	$2,263	$10,791	$ 90,643	$2,286	$ 92,928	$5,800	$27,658
2054	$ 36,257	$2,115	$10,477	$ 90,643	$2,286	$ 92,928	$5,420	$26,853
TOTAL	**$2,443,526**	**$1,095,690**	**$1,546,211**	**$3,806,992**	**$86,857**	**$3,893,849**	**$602,183**	**$1,657,297**

Source: Oklahoma Department of Transportation, 2011, costs updated to 2012 using current CPI-U of 0.77%

Interestingly, the net savings is negative (an additional cost) using the 3% discount rate, and positive (a net savings) using the 7% discount rate. The difference is largely due to the higher discount rate placing more value on the early-year maintenance savings, and placing less emphasis on the higher out-year preservation costs.

Rail Maintenance

Rail maintenance costs were developed in cooperation with the TO&E railroad, and include the following components:

Table BCA-5: Rail Maintenance Costs (2012 $)

Rail Maintenance Component	Cost/Schedule
Signal operations	$8,666/year
Crossing repair (replacement of missing gate arms)	$7,255/year
Crossing Surface Maintenance (major)	$31,238 every six years ($5,207 annual average cost)
Surface Maintenance (annual)	$1,512/year
Total Average Annual Cost	**$22,639**

Source: TO&E Railroad, 2011, costs updated to 2012 using current CPI-U of 0.77%

These costs were discounted to 2012 present values, after a $10 annual track maintenance cost was subtracted out to account for the Build rail maintenance costs.

Using a discount rate of 7%, the rail maintenance savings is $257,800 over the analysis period. Using a 3% discount rate, the value of the rail maintenance savings is $490,000, enough to outweigh the additional highway maintenance costs of the project.

Vehicle Travel Time Savings

Travel time savings from the project will result from two factors:

1. Removal of grade crossing – Trains block US 70 on the TO&E track for an average of over 40 hours each month (more than one hour a day). Usually the blockages are 10-15 minutes each, but some are longer.
2. The addition of a center turn lane – Homes and businesses line both sides of US 70 through the project area, and turning movements to and from US 70 frequently delay traffic, particularly in the two-lane sections of the road.

The data in **Table BCA-3** was used to develop travel time savings for each of the years between 2012 and 2035. Straight-line percentage growth was assumed, using 1.03% annual growth. After 2035, it was assumed that traffic levels would remain constant. Because the project is not scheduled to be built until the third quarter of 2015, any project benefits for 2012-2014 are zeroed out, and 2015 benefits are assumed to be 25% of the whole-year amounts.

Traffic Composition
Heavy truck traffic is 15% of the traffic flow in all years.

Value of Travel Time
Travel time was valued following TIGER website guidance, which recommended use of the 9/28/2011 memo "Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis." This provided the source of the time values below as well as a recommendation that travel time values be increased at a real annual growth rate of 1.6%. Note that the figures from this source are in 2011 dollars, which were updated to 2012 dollars using the BLS CPI calculator (http://www.bls.gov/data/inflation_calculator.htm, accessed in March 2012) figure of 0.767%.

- The hourly rate of time for trucks is $23.88
- The hourly rate of time for auto trips (all purposes) is $12.60

Table BCA-6 shows the calculation of the value of travel time based on the above assumptions. The present value of auto travel time savings from 2015 (the opening year) to 2054 is $62.5 million using a 7% discount rate, and $131.4 million using a 3% discount rate.

Table BCA-6: Travel Time Savings

Year	ANNUAL Travel Time Saved in hours all vehicles	TRUCK Travel Time Saved (15%) in hours	Auto Travel Time Saved (85%) in hours	Value of Auto Travel Time Savings (All Purposes) $ 12.60	Value of TRUCK Travel Time Saved $ 23.88	Total Value of Travel Time Savings	Present Value at 7%	Present Value at 3%
2012	0							
2013	0							
2014	0							
2015	68,303	10,246	58,058	$ 766,956	$ 256,614	$ 1,023,570	$835,538	$936,712
2016	276,034	41,405	234,629	$ 3,149,089	$ 1,053,648	$ 4,202,737	$3,206,248	$3,734,077
2017	278,884	41,833	237,051	$ 3,232,507	$ 1,081,559	$ 4,314,066	$3,075,870	$3,721,351
2018	281,763	42,265	239,499	$ 3,318,136	$ 1,110,209	$ 4,428,345	$2,950,793	$3,708,669
2019	284,672	42,701	241,972	$ 3,406,032	$ 1,139,618	$ 4,545,650	$2,830,802	$3,696,030
2020	287,612	43,142	244,470	$ 3,496,257	$ 1,169,806	$ 4,666,063	$2,715,691	$3,683,433
2021	290,581	43,587	246,994	$ 3,588,872	$ 1,200,794	$ 4,789,666	$2,605,261	$3,670,880
2022	293,581	44,037	249,544	$ 3,683,940	$ 1,232,603	$ 4,916,543	$2,499,321	$3,658,369
2023	296,612	44,492	252,120	$ 3,781,526	$ 1,265,254	$ 5,046,780	$2,397,689	$3,645,901
2024	299,675	44,951	254,723	$ 3,881,698	$ 1,298,770	$ 5,180,468	$2,300,190	$3,633,476
2025	302,769	45,415	257,353	$ 3,984,523	$ 1,333,174	$ 5,317,697	$2,206,655	$3,621,093
2026	305,895	45,884	260,010	$ 4,090,071	$ 1,368,490	$ 5,458,561	$2,116,924	$3,608,752
2027	309,053	46,358	262,695	$ 4,198,416	$ 1,404,741	$ 5,603,157	$2,030,842	$3,596,453
2028	312,244	46,837	265,407	$ 4,309,631	$ 1,441,952	$ 5,751,583	$1,948,260	$3,584,196
2029	315,467	47,320	268,147	$ 4,423,792	$ 1,480,149	$ 5,903,941	$1,869,036	$3,571,981
2030	318,724	47,809	270,916	$ 4,540,977	$ 1,519,357	$ 6,060,334	$1,793,034	$3,559,808
2031	322,015	48,302	273,713	$ 4,661,266	$ 1,559,605	$ 6,220,871	$1,720,123	$3,547,676
2032	325,340	48,801	276,539	$ 4,784,741	$ 1,600,918	$ 6,385,660	$1,650,176	$3,535,585
2033	328,699	49,305	279,394	$ 4,911,488	$ 1,643,326	$ 6,554,814	$1,583,073	$3,523,535
2034	332,092	49,814	282,278	$ 5,041,592	$ 1,686,857	$ 6,728,449	$1,518,699	$3,511,527
2035	335,521	50,328	285,193	$ 5,175,142	$ 1,731,542	$ 6,906,683	$1,456,943	$3,499,560
2036	335,521	50,328	285,193	$ 5,257,944	$ 1,759,246	$ 7,017,190	$1,383,415	$3,451,993
2037	335,521	50,328	285,193	$ 5,342,071	$ 1,787,394	$ 7,129,465	$1,313,598	$3,405,072
2038	335,521	50,328	285,193	$ 5,427,544	$ 1,815,992	$ 7,243,537	$1,247,304	$3,358,790
2039	335,521	50,328	285,193	$ 5,514,385	$ 1,845,048	$ 7,359,433	$1,184,356	$3,313,136
2040	335,521	50,328	285,193	$ 5,602,615	$ 1,874,569	$ 7,477,184	$1,124,585	$3,268,103
2041	335,521	50,328	285,193	$ 5,692,257	$ 1,904,562	$ 7,596,819	$1,067,830	$3,223,683
2042	335,521	50,328	285,193	$ 5,783,333	$ 1,935,035	$ 7,718,368	$1,013,940	$3,179,866
2043	335,521	50,328	285,193	$ 5,875,867	$ 1,965,996	$ 7,841,862	$962,769	$3,136,644
2044	335,521	50,328	285,193	$ 5,969,880	$ 1,997,452	$ 7,967,332	$914,181	$3,094,010
2045	335,521	50,328	285,193	$ 6,065,398	$ 2,029,411	$ 8,094,809	$868,044	$3,051,956
2046	335,521	50,328	285,193	$ 6,162,445	$ 2,061,882	$ 8,224,326	$824,237	$3,010,473
2047	335,521	50,328	285,193	$ 6,261,044	$ 2,094,872	$ 8,355,916	$782,640	$2,969,554
2048	335,521	50,328	285,193	$ 6,361,221	$ 2,128,390	$ 8,489,610	$743,142	$2,929,191
2049	335,521	50,328	285,193	$ 6,463,000	$ 2,162,444	$ 8,625,444	$705,638	$2,889,377
2050	335,521	50,328	285,193	$ 6,566,408	$ 2,197,043	$ 8,763,451	$670,026	$2,850,103
2051	335,521	50,328	285,193	$ 6,671,471	$ 2,232,196	$ 8,903,666	$636,212	$2,811,364
2052	335,521	50,328	285,193	$ 6,778,214	$ 2,267,911	$ 9,046,125	$604,104	$2,773,152
2053	335,521	50,328	285,193	$ 6,886,666	$ 2,304,197	$ 9,190,863	$573,616	$2,735,458
2054	335,521	50,328	285,193	$ 6,996,852	$ 2,341,064	$ 9,337,917	$544,667	$2,698,277
TOTAL	**12,540,435**	**1,881,065**	**10,659,370**	**198,105,266**	**66,283,691**	**$264,388,957**	**$62,475,473**	**$131,399,266**

Vehicle Fuel Cost Savings

In addition to travel time savings, vehicle operators will benefit from the reduced fuel usage due to reduced delay and less time spent idling at rail crossings. The fuel savings were calculated using a conservative assumption that 70% of the travel time savings shown in Table **BCA-6** was due to idling. (The remaining 30% was assumed to come from delays related to the lack of a center turning lane, or decelerating or accelerating after a train has passed.)

Based on a number of sources[2], it was assumed that most vehicles use 0.4 gallons of gasoline per hour while idling, and 0.6 gallons of diesel fuel are used per hour while trucks are idling.

As shown in Table **BCA-7**, calculations show that an estimated 3.8 million gallons of gasoline would be saved during the 40-year analysis period.

The potential fuel savings from changes in VMT were also analyzed, as shown in **Table BCA-8**. The project would result in some additional fuel savings in the early years from reduced VMT, but this was balanced out by the increased fuel usage resulting from the induced travel on US 70 in the years after 2026. The net result of these two changes in VMT is an additional 43,400 gallons of fuel used over 40 years.

The combined value of the fuel use changes due to idling and those resulting from changes in VMT are shown in **Table BCA-9**, using per-gallon fuel cost projections derived from the U.S. Energy Information Administration. The EIA provides estimates for the price of fuel through 2035. The Fuel prices and taxes used can be found in the table produced by EIA, titled "Components of Selected Petroleum Product Prices."[3] All dollars were reported in real 2010 dollars by the EIA. These dollar amounts were subsequently converted to 2012 dollars using the U.S. Bureau of Labor Statistics Consumer Price Index adjustment "motor fuel" between 2010 and 2011,[4] and then were converted to 2012 dollars using the CPI-U.

Because fuel taxes are considered a pecuniary benefit, or transfer payment, they cannot be accurately included in benefit calculations of a BCA. Thus, the federal and state taxes estimated by the EIA were subtracted out of the end user fuel prices shown in Table BCA-9.

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[2] Estimation of Fuel Use by Idling Commercial Trucks by Gaines, Vyas & Anderson, 2006, http://www.transportation.anl.gov/pdfs/TA/373.pdf
Hamilton County Department of Environmental Services (Cincinnati OH) http://www.hcdoes.org/airquality/anti-idling/idlefaq.htm
Fueleconomy.gov http://fueleconomy.gov/feg/driveHabits.shtml
Anti-Idling Primer: Every minute counts, Hinckle Charitable Foundation, http://www.thehcf.org/antiidlingprimer.html .

[3] Energy Information Administration (Producer). (2012). Annual Energy Outlook 2012 Early Release. *Components of Selected Petroleum Product Prices, United States, Reference case.* [Microsoft Excel] Retrieved from http://www.eia.gov/oiaf/aeo/tablebrowser/

[4] U.S. Bureau of Labor Statistics. Consumer Price Index, All Urban Consumers, U.S. City Average, Motor Fuel. Series CUUR0000SETB. 1982-1984=100, 2010=240.724; 2011=301.448

Finally, the EIA only provides estimates through 2035; however the analysis period relevant for this project stretches beyond this timeframe and thus estimated fuel prices in those future years are also necessary. In order to do estimate fuel prices that extend beyond 2035, the compound annual growth rate (CAGR) for 2010-2035 was calculated and then used to continue the series through the end of the analysis period.

Fuel efficiency assumptions were derived from Energy Information Administration (Producer). (2012). Annual Energy Outlook 2012 Early Release. *Components of Selected Petroleum Product Prices, United States, Reference case.* [Microsoft Excel] Retrieved from http://www.eia.gov/oiaf/aeo/tablebrowser/

Overall, 3.7 million gallons of fuel would be saved over the 40-year analysis period, with a resulting present value of $4.7 million using a 7% discount rate and $9.6 million using a 3% discount rate.

Table BCA-7: Fuel Savings from Reduced Idling

Year	Total Annual Vehicle Time Savings (hours)	Hours of Idling Saved (70% of total TTS)	Truck Idling (15%)	Other Vehicles Idling (85%)	Diesel Fuel Saved from Truck Idling Reduction (calculated at 0.6 gallons/hr)	Gasoline Saved from Other Vehicles Idling Reduction (calculated at 0.4 gallons/hr)	Total Fuel Savings from Elimination of Idling
	(hours)	(hours)	(hours)	(hours)	(gallons)	(gallons)	(gallons)
2012-4	0	0	0	0	0	0	0
2015	68,303	47,812	7,172	40,640	4,303	16,256	20,559
2016	276,034	193,224	28,984	164,240	17,390	65,696	83,086
2017	278,884	195,219	29,283	165,936	17,570	66,374	83,944
2018	281,763	197,234	29,585	167,649	17,751	67,060	84,811
2019	284,672	199,271	29,891	169,380	17,934	67,752	85,686
2020	287,612	201,328	30,199	171,129	18,120	68,452	86,571
2021	290,581	203,407	30,511	172,896	18,307	69,158	87,465
2022	293,581	205,507	30,826	174,681	18,496	69,872	88,368
2023	296,612	207,629	31,144	176,484	18,687	70,594	89,280
2024	299,675	209,772	31,466	178,306	18,879	71,323	90,202
2025	302,769	211,938	31,791	180,147	19,074	72,059	91,133
2026	305,895	214,126	32,119	182,007	19,271	72,803	92,074
2027	309,053	216,337	32,451	183,886	19,470	73,555	93,025
2028	312,244	218,570	32,786	185,785	19,671	74,314	93,985
2029	315,467	220,827	33,124	187,703	19,874	75,081	94,956
2030	318,724	223,107	33,466	189,641	20,080	75,856	95,936
2031	322,015	225,411	33,812	191,599	20,287	76,640	96,927
2032	325,340	227,738	34,161	193,577	20,496	77,431	97,927
2033	328,699	230,089	34,513	195,576	20,708	78,230	98,938
2034	332,092	232,465	34,870	197,595	20,922	79,038	99,960
2035	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2036	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2037	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2038	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2039	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2040	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2041	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2042	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2043	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2044	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2045	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2046	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2047	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2048	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2049	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2050	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2051	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2052	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2053	335,521	234,865	35,230	199,635	21,138	79,854	100,992
2054	335,521	234,865	35,230	199,635	21,138	79,854	100,992
TOTAL	**12,540,435**	**8,778,304**	**1,316,746**	**7,461,559**	**790,047**	**2,984,624**	**3,774,671**

Table BCA-8: Fuel Savings (Use) from Changes in VMT

Year	RAW VMT Reduction Source Data	Reduced VMT	LARGE TRUCK VMT reduction (growth)	OTHER VEHICLE VMT reduction (growth)	TRUCK mpg	OTHER VEHICLE MPG	TRUCK Gallons saved (used)	OTHER VEHICLE Gallons saved (used)	TOTAL GALLONS SAVED (Additional Gallons Used)
					Source: Energy Information Administgrtion				
2012-4		-	-	-	6.8	21.1	-	-	-
2015	120,496	90,372	13,556	76,816	6.9	21.4	1,965	3,590	5,554
2016	109,805	82,353	12,353	70,000	7.1	21.8	1,740	3,211	4,951
2017	99,113	74,335	11,150	63,185	7.2	22.2	1,549	2,846	4,395
2018	88,422	66,316	9,947	56,369	7.3	22.6	1,363	2,494	3,857
2019	77,731	58,298	8,745	49,553	7.3	23.0	1,198	2,154	3,352
2020	67,039	50,279	7,542	42,738	7.4	23.4	1,019	1,826	2,846
2021	56,348	42,261	6,339	35,922	7.5	23.8	845	1,509	2,355
2022	45,657	34,242	5,136	29,106	7.6	24.2	676	1,203	1,879
2023	34,965	26,224	3,934	22,290	7.7	24.6	511	906	1,417
2024	24,274	18,205	2,731	15,475	7.7	25.0	355	619	974
2025	13,582	10,187	1,528	8,659	7.8	25.3	196	342	538
2026	2,891	2,168	325	1,843	7.9	25.6	41	72	113
2027	(7,800)	(5,850)	(878)	(4,973)	7.9	26.0	(111)	(191)	(302)
2028	(18,492)	(13,869)	(2,080)	(11,788)	8.0	26.3	(260)	(448)	(708)
2029	(29,183)	(21,887)	(3,283)	(18,604)	8.0	26.5	(410)	(702)	(1,112)
2030	(39,874)	(29,906)	(4,486)	(25,420)	8.1	26.8	(554)	(949)	(1,502)
2031	(50,566)	(37,924)	(5,689)	(32,236)	8.1	27.0	(702)	(1,194)	(1,896)
2032	(61,257)	(45,943)	(6,891)	(39,051)	8.1	27.2	(851)	(1,436)	(2,287)
2033	(71,948)	(53,961)	(8,094)	(45,867)	8.1	27.4	(999)	(1,674)	(2,673)
2034	(82,640)	(61,980)	(9,297)	(52,683)	8.2	27.6	(1,134)	(1,909)	(3,043)
2035	(93,331)	(69,998)	(10,500)	(59,499)	8.2	27.8	(1,280)	(2,140)	(3,421)
2036	(93,331)	(69,998)	(10,500)	(59,499)	8.3	28.1	(1,270)	(2,115)	(3,385)
2037	(93,331)	(69,998)	(10,500)	(59,499)	8.3	28.5	(1,260)	(2,090)	(3,350)
2038	(93,331)	(69,998)	(10,500)	(59,499)	8.4	28.8	(1,250)	(2,065)	(3,315)
2039	(93,331)	(69,998)	(10,500)	(59,499)	8.5	29.2	(1,240)	(2,041)	(3,281)
2040	(93,331)	(69,998)	(10,500)	(59,499)	8.5	29.5	(1,230)	(2,016)	(3,247)
2041	(93,331)	(69,998)	(10,500)	(59,499)	8.6	29.9	(1,221)	(1,992)	(3,213)
2042	(93,331)	(69,998)	(10,500)	(59,499)	8.7	30.2	(1,211)	(1,969)	(3,180)
2043	(93,331)	(69,998)	(10,500)	(59,499)	8.7	30.6	(1,201)	(1,945)	(3,147)
2044	(93,331)	(69,998)	(10,500)	(59,499)	8.8	31.0	(1,192)	(1,922)	(3,114)
2045	(93,331)	(69,998)	(10,500)	(59,499)	8.9	31.3	(1,182)	(1,900)	(3,082)
2046	(93,331)	(69,998)	(10,500)	(59,499)	9.0	31.7	(1,173)	(1,877)	(3,050)
2047	(93,331)	(69,998)	(10,500)	(59,499)	9.0	32.1	(1,164)	(1,855)	(3,018)
2048	(93,331)	(69,998)	(10,500)	(59,499)	9.1	32.5	(1,154)	(1,833)	(2,987)
2049	(93,331)	(69,998)	(10,500)	(59,499)	9.2	32.9	(1,145)	(1,811)	(2,956)
2050	(93,331)	(69,998)	(10,500)	(59,499)	9.2	33.2	(1,136)	(1,790)	(2,926)
2051	(93,331)	(69,998)	(10,500)	(59,499)	9.3	33.6	(1,127)	(1,768)	(2,896)
2052	(93,331)	(69,998)	(10,500)	(59,499)	9.4	34.0	(1,118)	(1,747)	(2,866)
2053	(93,331)	(69,998)	(10,500)	(59,499)	9.5	34.5	(1,109)	(1,727)	(2,836)
2054	(93,331)	(69,998)	(10,500)	(59,499)	9.5	34.9	(1,101)	(1,706)	(2,807)
TOTAL	**(1,062,421)**	**(1,116,043)**	**(167,406)**	**(948,636)**	**N.A.**	**N.A.**	**(17,332)**	**(26,038)**	**(43,371)**

Table BCA-9: Total (Net) Value of Fuel Savings

Year	Truck Total Fuel Use Reduction	Other Vehicle Total Fuel Use Reduction	Average Projected Diesel Cost per Gallon	Average Projected Gasoline Cost per Gallon	Annual Fuel Cost Savings	Present Value at 3%	Present Value at 7%
	(Gallons)	(Gallons)	(2012$)	(2012$)	(2012$)	(2012$)	(2012$)
2012	-	-	$ 4.20	$ 3.63	$0	$0	$0
2013	-	-	$ 4.15	$ 3.61	$0	$0	$0
2014	-	-	$ 3.75	$ 3.77	$0	$0	$0
2015	6,268	19,846	$ 3.99	$ 3.92	$102,875	$94,145	$83,976
2016	19,130	68,907	$ 4.18	$ 3.97	$353,798	$314,345	$269,911
2017	19,118	69,221	$ 4.25	$ 4.06	$362,557	$312,744	$258,498
2018	19,114	69,554	$ 4.34	$ 4.09	$367,335	$307,637	$244,771
2019	19,132	69,907	$ 4.37	$ 4.19	$376,397	$306,045	$234,401
2020	19,139	70,278	$ 4.43	$ 4.24	$382,736	$302,135	$222,756
2021	19,152	70,668	$ 4.48	$ 4.27	$387,196	$296,754	$210,609
2022	19,171	71,075	$ 4.52	$ 4.29	$391,541	$291,344	$199,040
2023	19,197	71,500	$ 4.56	$ 4.29	$394,208	$284,784	$187,285
2024	19,234	71,942	$ 4.64	$ 4.33	$400,693	$281,038	$177,912
2025	19,270	72,401	$ 4.68	$ 4.39	$408,147	$277,929	$169,367
2026	19,313	72,875	$ 4.76	$ 4.45	$416,485	$275,346	$161,520
2027	19,359	73,363	$ 4.82	$ 4.49	$422,882	$271,432	$153,272
2028	19,411	73,866	$ 4.86	$ 4.52	$427,989	$266,709	$144,975
2029	19,464	74,379	$ 4.91	$ 4.57	$435,301	$263,364	$137,805
2030	19,526	74,908	$ 4.97	$ 4.63	$443,978	$260,790	$131,357
2031	19,585	75,446	$ 5.03	$ 4.53	$440,380	$251,143	$121,769
2032	19,646	75,995	$ 4.98	$ 4.53	$442,185	$244,827	$114,269
2033	19,709	76,556	$ 5.00	$ 4.59	$450,120	$241,962	$108,710
2034	19,788	77,129	$ 5.05	$ 4.66	$459,013	$239,555	$103,605
2035	19,857	77,714	$ 5.12	$ 4.71	$467,511	$236,884	$98,620
2036	19,868	77,739	$ 5.19	$ 4.79	$475,536	$233,932	$93,750
2037	19,878	77,764	$ 5.28	$ 4.88	$484,279	$231,294	$89,228
2038	19,888	77,789	$ 5.38	$ 4.97	$493,154	$228,673	$84,919
2039	19,898	77,813	$ 5.47	$ 5.05	$502,164	$226,069	$80,814
2040	19,907	77,838	$ 5.57	$ 5.14	$511,312	$223,483	$76,902
2041	19,917	77,862	$ 5.67	$ 5.24	$520,599	$220,914	$73,177
2042	19,927	77,885	$ 5.77	$ 5.33	$530,027	$218,364	$69,628
2043	19,936	77,909	$ 5.87	$ 5.42	$539,600	$215,833	$66,248
2044	19,946	77,932	$ 5.98	$ 5.52	$549,320	$213,321	$63,030
2045	19,955	77,954	$ 6.08	$ 5.62	$559,189	$210,829	$59,964
2046	19,965	77,977	$ 6.19	$ 5.71	$569,210	$208,356	$57,046
2047	19,974	77,999	$ 6.30	$ 5.81	$579,385	$205,904	$54,267
2048	19,983	78,021	$ 6.41	$ 5.92	$589,717	$203,472	$51,621
2049	19,993	78,043	$ 6.52	$ 6.02	$600,209	$201,060	$49,102
2050	20,002	78,064	$ 6.64	$ 6.12	$610,863	$198,669	$46,705
2051	20,011	78,086	$ 6.75	$ 6.23	$621,682	$196,298	$44,422
2052	20,020	78,107	$ 6.87	$ 6.34	$632,669	$193,949	$42,250
2053	20,028	78,127	$ 6.99	$ 6.45	$643,826	$191,621	$40,182
2054	20,037	78,148	$ 7.11	$ 6.56	$655,157	$189,314	$38,214
TOTAL	**772,715**	**2,958,585**	**N.A.**	**N.A.**	**$ 19,001,223**	**$ 9,632,265**	**$ 4,715,898**

Emissions Reductions

The change in emissions was calculated based on the assumption that 70% of the travel demand savings was due to the elimination of idling at the grade crossing. The emissions impact of the changes in VMT was assumed to be minimal as VMT growth in the later years would balance out the savings in the first 12 years. Emissions reductions from smoother and faster traffic flow (due to the widening) were also not calculated.

An estimate of the emissions reduction resulting from reduced idling delay was developed using the following factors derived from MOBILE6.2 Vehicle Emissions Modeling Software for a recent High Speed Rail project in Tulsa. These are presented in **Table BCA-10**.

The resulting reduction in emissions for each of these compounds is shown in **Table BCA-11**.

Values were assigned to the emissions levels using current TIGER guidance. Specifically, for non-CO_2 pollutants, the National Highway Traffic and Safety Administration's CAFE standards for MY2012-MY2016[5] were used. The per-ton costs of carbon emissions were derived from the Interagency Working Group on the Social Cost of Carbon[6] as well as the analysis conducted by the US DOT in the Tiger Benefit –Cost Analysis Resource Guide.[7] As recommended by the TIGER guidance,[8] the values used for the CO_2 reduction were discounted at a 3% rate (for both the 7% and the 3% analysis shown in this document).

The resulting present value of the emissions reductions over the 2015-2054 analysis period, shown in **Table BCA-12**, is $316,500 using a 7% discount rate (although a 3% rate for CO_2) and $381,800 using a 3% discount rate.

[5] National Highway Traffic and Safety Administration (March 2010), *Corporate Average Fuel Economy for MY2012-MY2016 Passenger Cars and Light Trucks*, page 403, Table VIII-8, "Economic Values for Benefits Computations (2007 Dollars)", (http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/CAFE_2012-2016_FRIA_04012010.pdf)

[6] U.S. Environmental Protection Agency, Interagency Working Group on Social Cost of Carbon (2010), *Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*, p.2., Table 19, (http://www.epa.gov/oms/climate/regulations/scc-tsd.pdf).

[7] U.S. Department of Transportation, *Tiger Benefit-Cost Analysis (BCA) Resource Guide*, p.6. (http://www.dot.gov/tiger/docs/tiger-12_bca-resourceGuide.pdf)

[8] U.S. Department of Transportation (2011), *Tiger Benefit-Cost Analysis (BCA) Resource Guide*, p.7-9. (http://www.dot.gov/tiger/docs/tiger-12_bca-resourceGuide.pdf)

Table BCA-10: Emissions Reduction Factors

		Year																					
Speed	Pollutant	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
2.5	VOC	3.908	3.611	3.371	3.18	3.026	2.9	2.796	2.714	2.575	2.508	2.441	2.415	2.404	2.385	2.378	2.372	2.36	2.356	2.354	2.351	2.349	2.348
(grams/mile)	CO	22.903	21.92	21.134	20.497	19.951	19.512	19.103	18.819	18.586	18.402	18.259	18.139	18.037	17.893	17.82	17.761	17.613	17.602	17.582	17.563	17.559	17.552
	Nox	1.794	1.614	1.45	1.318	1.207	1.112	1.028	0.965	0.914	0.871	0.829	0.796	0.77	0.743	0.722	0.705	0.682	0.672	0.663	0.652	0.649	0.647
	CO2	557.07	558.65	561.11	561.11	562.25	563.23	564.22	565.16	565.92	565.97	565.96	566.03	566.04	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09
	SO2	0.0091	0.0091	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093
	SO4	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
	Sox	0.0097	0.0097	0.0098	0.0098	0.0098	0.0098	0.0098	0.0098	0.0098	0.0098	0.0098	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099
	PM10	0.0371	0.0356	0.0337	0.0324	0.0316	0.0308	0.0298	0.0294	0.0291	0.0288	0.0286	0.0284	0.0282	0.0281	0.028	0.0279	0.0278	0.0277	0.0277	0.0274	0.0274	0.0274
	PM2.5	0.0215	0.0201	0.0184	0.0172	0.0165	0.0157	0.0148	0.0145	0.0142	0.0139	0.0137	0.0135	0.0134	0.0133	0.0132	0.0131	0.013	0.0129	0.0129	0.0126	0.0126	0.0126
Idle	VOC	9.77	9.0275	8.4275	7.95	7.565	7.25	6.99	6.785	6.4375	6.27	6.1025	6.0375	6.01	5.9625	5.945	5.93	5.9	5.89	5.885	5.8775	5.8725	5.87
(grams/hour)	CO	57.2575	54.8	52.835	51.2425	49.8775	48.78	47.7575	47.0475	46.465	46.005	45.6475	45.3475	45.0925	44.7325	44.55	44.4025	44.0325	44.005	43.955	43.9075	43.8975	43.88
	Nox	4.485	4.035	3.625	3.295	3.0175	2.78	2.57	2.4125	2.285	2.1775	2.0725	1.99	1.925	1.8575	1.805	1.7625	1.705	1.68	1.6575	1.63	1.6225	1.6175
	CO2	1392.675	1396.625	1402.775	1402.775	1405.625	1408.075	1410.55	1412.9	1414.8	1414.925	1414.9	1415.075	1415.1	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225
	Sox	0.02425	0.02425	0.0245	0.0245	0.0245	0.0245	0.0245	0.0245	0.0245	0.0245	0.0245	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475
	PM10	0.09275	0.089	0.08425	0.081	0.079	0.077	0.0745	0.0735	0.07275	0.072	0.0715	0.071	0.0705	0.07025	0.07	0.06975	0.0695	0.06925	0.06925	0.0685	0.0685	0.0685
	PM2.5	0.05375	0.05025	0.046	0.043	0.04125	0.03925	0.037	0.03625	0.0355	0.03475	0.03425	0.03375	0.0335	0.03325	0.033	0.03275	0.0325	0.03225	0.03225	0.0315	0.0315	0.0315

		Year																				
Speed	Pollutant	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054
2.5	VOC	2.348	2.348	2.348	2.348	2.348	2.348	2.348	2.348	2.348	2.348	2.348	2.348	2.348	2.348	2.348	2.348	2.348	2.348	2.348	2.348	2.348
(grams/mile)	CO	17.552	17.552	17.552	17.552	17.552	17.552	17.552	17.552	17.552	17.552	17.552	17.552	17.552	17.552	17.552	17.552	17.552	17.552	17.552	17.552	17.552
	Nox	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
	CO2	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09	566.09
	SO2	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093	0.0093
	SO4	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
	Sox	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099
	PM10	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274
	PM2.5	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126	0.0126
Idle	VOC	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87
(grams/hour)	CO	43.88	43.88	43.88	43.88	43.88	43.88	43.88	43.88	43.88	43.88	43.88	43.88	43.88	43.88	43.88	43.88	43.88	43.88	43.88	43.88	43.88
	Nox	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
	CO2	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225	1415.225
	Sox	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475	0.02475
	PM10	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685	0.0685
	PM2.5	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315	0.0315

Source: Parsons Brinckerhoff, 2012, Oklahoma Emission factors and Rates based on MOBILE 6.2 data for Tulsa, OK.

Table BCA-11: Emissions Reductions (Amount)

Year	Total Annual Auto & Truck Time Spent Idling	Vehicular Emissions in Pounds Per Year							
		VOC	CO	NOx	CO2	SOx	PM10	PM2.5	TOTAL
UNIT:	(hours/year)	(lbs/year)	(lbs/year)	(lbs/year)	(lbs/year)	(lbs/year)	(lbs/year)	(lbs/year)	(lbs/year)
2012-4	-	-	-	-	-	-	-	-	-
2015	47,812	839	5,408	347.77	148,057	2.59	8.55	4.54	154,668.27
2016	193,224	3,227	21,275	1,287.09	599,559	10.45	33.70	17.59	625,409.82
2017	195,219	3,124	21,022	1,198.03	606,805	10.56	33.18	16.91	632,209.90
2018	197,234	3,043	20,793	1,118.97	614,148	10.67	32.44	16.11	639,162.86
2019	199,271	2,985	20,696	1,061.24	621,522	10.78	32.33	15.95	646,323.10
2020	201,328	2,861	20,651	1,015.53	628,784	10.89	32.33	15.78	653,369.83
2021	203,407	2,815	20,657	977.74	635,332	11.00	32.33	15.60	659,840.98
2022	205,507	2,768	20,708	940.20	641,880	11.11	32.44	15.54	666,355.91
2023	207,629	2,767	20,785	912.10	648,587	11.34	32.54	15.47	673,110.47
2024	209,772	2,783	20,881	891.42	655,295	11.46	32.65	15.51	679,910.32
2025	211,938	2,790	20,928	869.04	662,119	11.58	32.87	15.56	686,766.07
2026	214,126	2,810	21,058	853.20	668,955	11.70	33.09	15.60	693,737.01
2027	216,337	2,832	21,205	841.71	675,862	11.82	33.31	15.64	700,801.36
2028	218,570	2,847	21,245	822.65	682,840	11.94	33.53	15.68	707,815.81
2029	220,827	2,871	21,451	818.96	689,890	12.07	33.76	15.72	715,092.95
2030	223,107	2,898	21,648	816.34	697,013	12.19	34.11	15.88	722,437.76
2031	225,411	2,925	21,848	811.08	704,209	12.32	34.09	15.67	729,854.78
2032	227,738	2,952	22,069	815.68	711,479	12.44	34.44	15.84	737,378.86
2033	230,089	2,982	22,288	821.57	718,825	12.57	34.79	16.00	744,979.24
2034	232,465	3,012	22,518	821.07	726,247	12.70	35.15	16.16	752,661.80
2035	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2036	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2037	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2038	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2039	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2040	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2041	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2042	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2043	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2044	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2045	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2046	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2047	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2048	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2049	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2050	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2051	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2052	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2053	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
2054	234,865	3,043	22,750	829.54	733,745	12.83	35.51	16.33	760,432.66
TOTAL	**8,778,304.41**	**117,000**	**864,140**	**34,632.27**	**27,412,304**	**478.81**	**1,351.91**	**633.39**	**28,430,540.38**

Table BCA-12: Value of Emissions Reductions (2012$)

Year	VOC	CO	NOx	SOx	PM10	PM2.5	Non-CO2 Pollutants			C02			TOTAL	
	$ 1,399	$0.00	$ 5,703.17	$ 33,360	$0.00	$ 312,072	Total Value of Emissions Reductions	Present Value (7% Discount Rate)	Present Value (3% Discount Rate)	Value of CO2 per long ton	Annual Value of CO2 reduction	Present Value (3% Discount Rate)	Present Value (7% Discount Rate) WITH CARBON at 3%	Present Value (3% Discount Rate)
2012-4	-	-	-	-	-	-	$ -			$ 25.47	$ -			
2015	524.16	-	885.45	38.51	-	632.29	$ 2,080	$ 1,698	$ 1,904	$ 26.02	$ 1,747	$ 1,599	$ 3,297	$ 3,503
2016	2,015.71	-	3,277.01	155.63	-	2,451.28	$ 7,900	$ 6,027	$ 7,019	$ 26.56	$ 7,223	$ 6,418	$ 12,444	$ 13,436
2017	1,951.72	-	3,050.26	157.24	-	2,356.51	$ 7,516	$ 5,359	$ 6,483	$ 27.11	$ 7,461	$ 6,436	$ 11,794	$ 12,919
2018	1,901.16	-	2,848.96	158.86	-	2,244.36	$ 7,153	$ 4,767	$ 5,991	$ 27.66	$ 7,703	$ 6,451	$ 11,218	$ 12,442
2019	1,864.46	-	2,701.97	160.50	-	2,221.57	$ 6,949	$ 4,327	$ 5,650	$ 28.20	$ 7,950	$ 6,464	$ 10,791	$ 12,114
2020	1,787.23	-	2,585.60	162.16	-	2,198.07	$ 6,733	$ 3,919	$ 5,315	$ 28.75	$ 8,199	$ 6,472	$ 10,391	$ 11,787
2021	1,758.70	-	2,489.39	163.84	-	2,173.85	$ 6,586	$ 3,582	$ 5,047	$ 29.52	$ 8,505	$ 6,518	$ 10,100	$ 11,565
2022	1,729.39	-	2,393.82	165.53	-	2,164.69	$ 6,453	$ 3,281	$ 4,802	$ 29.08	$ 8,465	$ 6,299	$ 9,579	$ 11,101
2023	1,728.63	-	2,322.26	168.94	-	2,155.11	$ 6,375	$ 3,029	$ 4,605	$ 30.94	$ 9,100	$ 6,574	$ 9,603	$ 11,179
2024	1,738.53	-	2,269.60	170.69	-	2,161.23	$ 6,340	$ 2,815	$ 4,447	$ 31.59	$ 9,389	$ 6,585	$ 9,400	$ 11,032
2025	1,742.59	-	2,212.62	172.45	-	2,167.25	$ 6,295	$ 2,612	$ 4,287	$ 32.36	$ 9,717	$ 6,617	$ 9,229	$ 10,903
2026	1,755.42	-	2,172.29	174.23	-	2,173.16	$ 6,275	$ 2,434	$ 4,149	$ 33.01	$ 10,016	$ 6,622	$ 9,055	$ 10,770
2027	1,769.07	-	2,143.04	176.03	-	2,178.97	$ 6,267	$ 2,271	$ 4,023	$ 33.78	$ 10,354	$ 6,646	$ 8,917	$ 10,668
2028	1,778.29	-	2,094.53	177.85	-	2,184.66	$ 6,235	$ 2,112	$ 3,886	$ 34.44	$ 10,664	$ 6,645	$ 8,758	$ 10,531
2029	1,793.60	-	2,085.12	179.68	-	2,190.23	$ 6,249	$ 1,978	$ 3,781	$ 35.09	$ 10,979	$ 6,643	$ 8,621	$ 10,423
2030	1,810.58	-	2,078.44	181.54	-	2,212.85	$ 6,283	$ 1,859	$ 3,691	$ 35.86	$ 11,334	$ 6,658	$ 8,517	$ 10,349
2031	1,826.95	-	2,065.06	183.41	-	2,183.70	$ 6,259	$ 1,731	$ 3,569	$ 36.51	$ 11,661	$ 6,650	$ 8,381	$ 10,220
2032	1,844.24	-	2,076.78	185.31	-	2,206.25	$ 6,313	$ 1,631	$ 3,495	$ 37.28	$ 12,028	$ 6,660	$ 8,291	$ 10,155
2033	1,862.48	-	2,091.75	187.22	-	2,229.03	$ 6,370	$ 1,539	$ 3,424	$ 37.93	$ 12,366	$ 6,647	$ 8,186	$ 10,072
2034	1,881.71	-	2,090.48	189.15	-	2,252.04	$ 6,413	$ 1,448	$ 3,347	$ 38.70	$ 12,746	$ 6,652	$ 8,100	$ 9,999
2035	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 1,367	$ 3,283	$ 39.35	$ 13,096	$ 6,636	$ 8,002	$ 9,919
2036	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 1,277	$ 3,188	$ 40.12	$ 13,351	$ 6,568	$ 7,845	$ 9,755
2037	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 1,194	$ 3,095	$ 40.78	$ 13,569	$ 6,481	$ 7,674	$ 9,575
2038	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 1,116	$ 3,005	$ 41.43	$ 13,787	$ 6,393	$ 7,509	$ 9,398
2039	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 1,043	$ 2,917	$ 42.20	$ 14,042	$ 6,321	$ 7,364	$ 9,238
2040	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 975	$ 2,832	$ 42.85	$ 14,260	$ 6,233	$ 7,207	$ 9,065
2041	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 911	$ 2,750	$ 43.51	$ 14,478	$ 6,144	$ 7,055	$ 8,893
2042	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 851	$ 2,670	$ 44.16	$ 14,696	$ 6,055	$ 6,906	$ 8,724
2043	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 796	$ 2,592	$ 44.71	$ 14,878	$ 5,951	$ 6,747	$ 8,543
2044	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 743	$ 2,516	$ 45.37	$ 15,097	$ 5,863	$ 6,606	$ 8,379
2045	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 695	$ 2,443	$ 46.02	$ 15,315	$ 5,774	$ 6,469	$ 8,217
2046	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 649	$ 2,372	$ 46.57	$ 15,497	$ 5,673	$ 6,322	$ 8,044
2047	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 607	$ 2,303	$ 47.23	$ 15,715	$ 5,585	$ 6,192	$ 7,888
2048	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 567	$ 2,236	$ 47.88	$ 15,933	$ 5,498	$ 6,065	$ 7,733
2049	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 530	$ 2,171	$ 48.54	$ 16,152	$ 5,411	$ 5,941	$ 7,581
2050	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 495	$ 2,107	$ 49.08	$ 16,333	$ 5,312	$ 5,807	$ 7,419
2051	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 463	$ 2,046	$ 49.76	$ 16,557	$ 5,228	$ 5,691	$ 7,274
2052	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 433	$ 1,986	$ 50.44	$ 16,783	$ 5,145	$ 5,578	$ 7,131
2053	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 404	$ 1,929	$ 51.12	$ 17,012	$ 5,063	$ 5,468	$ 6,992
2054	1,901.14	-	2,112.07	191.10	-	2,275.29	$ 6,480	$ 378	$ 1,872	$ 51.82	$ 17,245	$ 4,983	$ 5,361	$ 6,855
TOTAL	**73,087**	**-**	**88,175.78**	**7,130.85**	**-**	**88,242.90**	**$ 256,637**	**$ 73,911**	**$ 139,224**	**$ 1,553**	**$ 491,403**	**$ 242,569**	**$ 316,480**	**$ 381,794**

Safety Benefits

The project will improve safety, that is, reduce accidents, in two ways. First, by eliminating the at-grade rail crossing, and second by adding a center turn lane that will reduce accidents caused by drivers turning to or from US 70 from the many businesses and residences along this highway. The accident analysis has therefore been completed in two sections, as described below.

Safety Benefit from Eliminated Rail Grade Crossing

To estimate the benefit of the grade separation, it was assumed that 80 percent of the accidents that currently occur near the rail line (specifically within 0.5 miles to the west and 0.75 miles to the east of the crossing) would be eliminated by the overpass. The 1.25-mile range was due to the long backups often caused by the train traffic. Rail-vehicle crashes are rare here, but the presence of a grade separation can cause crashes between vehicles. Cars, trucks and buses must often stop or slow down at the crossing, often in a manner not anticipated by surrounding drivers.

To establish a No Build baseline accident rate, local and state crash data from 2006-2010 were examined. Over the past five years, 19 crashes were observed along this 1.25-mile section of US 70. Of these 19, 14 were "property damage only" (PDO), three were "possible injury" (2-PI using the KABCO scale), and three involved injuries, but the severity was not known or not recorded.

Safety Benefit from Widening

As noted above, the center turn lane will provide protection for drivers entering or exiting US 70 from the many commercial and residential driveways lining the road. In a study[9] of a similar roadway in Florida where additional through lanes and turning lanes were added, an accident reduction rate of 56.8% was observed.

For the 4.25 miles of the project length that is not within the 0.5 miles west and 0.75 east threshold of the rail crossing, the current accident rate is therefore assumed to be reduced by 56.8%.

Local and state crash data from 2006-2010 indicated that there were 25 crashes on this 4.25-mile segment of US 70. Of these, 14 were "property damage only" (PDO), three were "possible injury" (2-PI using the KABCO scale), four were "Non-Incapacitating Injuries" (3-NII on the KABCO scale), and four were Incapacitating Injuries (4-II on the KABCO scale).

Valuation

The value for each crash type is derived from the Maximum Abbreviated Injury Scale (MAIS) scale using the KABCO-to-MAIS conversion table factors in the TIGER Notice of Funding Availability. The MAIS values are also from the NOFA, which cites the original source as *Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses –*

[9] Gan, Albert, Joan Shen and Adriana Rodriguez, April 2005, "Update of Florida Crash Reduction Factors and Countermeasures to Improve the Development of District Safety Improvement Projects: Final Report." Florida Department of Transportation, Tallahassee, FL. Accessed October 2011. http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_SF/FDOT_BD015_04_rpt.pdf.

2011 Revisions (http://ostpxweb.dot.gov/policy). These factors were updated to 2012 using the CPI-U rate of 0.767%.

Table BCA-13 shows the calculations used to evaluate accident reduction over the 40-year analysis period. The No Build baseline accident data examined over the five-year (2006-2010) period were divided by five to provide an average annual accident rate at current traffic levels. These rates were reduced as noted above: 80% reduction for accidents near the rail crossing, and 56.8% reduction for other segments of US 70 in the project area. The sum of the reduction in these rates, that is, the difference between No Build accidents and expected Build accidents, is shown in the row labeled "Reduction (Annual)" of **Table BCA-13**.

The values from MAIS (converted from the KABCO data) are also shown in the table, along with the resulting annual cost of the accident reduction at current traffic levels ($281,738).

Table BCA-13: Calculation of Baseline Annual Safety Benefit (2012$)

Accident Type>	**PDO**	**2-PI**	**3-NII**	**4-II**	**SUI**
Current annual rate near RR	2.6	0.6	0	0	0.6
New rate (Reduce 80%)	0.52	0.12	0	0	0.12
Current annual rate not near RR	2.8	0.6	0.8	0.8	0
New rate (Reduce 56.8%)	1.2	0.26	0.35	0.35	0
Reduction (Annual)	3.67	0.82	0.45	0.45	0.48
Value of accident type	$5,265	$42,356	$81,666	$298,907	$113,992
Annual Value of Crash Reduction	$19,324	$34,766	$37,109	$135,823	$54,716
TOTAL VALUE OF ANNUAL ACCIDENT REDUCTION (2016 base year)					**$281,738**

PDO = Property Damage Only
PI = Possible Injury
NII = Non-Incapacitating Injury
II = Incapacitating Injury
SUI = Injury, severity unknown

The accident reduction value was then increased each year by the 1.41% annual No Build traffic growth rate[10]. No Build growth was used because there can be no safety reduction benefits for induced travel (trips that would not be taken in the absence of the project).

Traffic growth is assumed to level off after 2035, so the annual safety benefits do not increase after that year. In addition, as with the other benefit calculations, there are no benefits assumed before construction is complete in the third quarter of 2015, and 2015 benefits are reduced to 25% of the whole-year benefit level.

The resulting present value, as shown in **Table BCA-14,** is $3.8 million using the 7% discount rate, and $7.8 million using a 3% discount rate.

[10] This rate was developed by subtracting No Build 2012 traffic counts from No Build 2035 traffic levels.

Table BCA-14: Value of Crash Reduction (2012$)

Year	Accident Reduction	Present Value at 7%	Present Value at 3%
2012-14		$ 0.00	$ 0.00
2015	$ 73,460	$ 59,966	$ 67,227
2016	$ 297,991	$ 227,336	$ 264,761
2017	$ 302,198	$ 215,463	$ 260,679
2018	$ 306,465	$ 204,210	$ 256,659
2019	$ 310,792	$ 193,546	$ 252,702
2020	$ 315,180	$ 183,438	$ 248,806
2021	$ 319,630	$ 173,858	$ 244,970
2022	$ 324,143	$ 164,778	$ 241,193
2023	$ 328,720	$ 156,173	$ 237,474
2024	$ 333,361	$ 148,016	$ 233,813
2025	$ 338,068	$ 140,286	$ 230,208
2026	$ 342,842	$ 132,960	$ 226,659
2027	$ 347,682	$ 126,016	$ 223,164
2028	$ 352,591	$ 119,435	$ 219,723
2029	$ 357,570	$ 113,197	$ 216,336
2030	$ 362,619	$ 107,286	$ 213,000
2031	$ 367,739	$ 101,683	$ 209,716
2032	$ 372,931	$ 96,372	$ 206,483
2033	$ 378,196	$ 91,339	$ 203,299
2034	$ 383,536	$ 86,569	$ 200,165
2035	$ 388,952	$ 82,048	$ 197,079
2036	$ 388,952	$ 76,680	$ 191,338
2037	$ 388,952	$ 71,664	$ 185,765
2038	$ 388,952	$ 66,976	$ 180,355
2039	$ 388,952	$ 62,594	$ 175,102
2040	$ 388,952	$ 58,499	$ 170,002
2041	$ 388,952	$ 54,672	$ 165,050
2042	$ 388,952	$ 51,095	$ 160,243
2043	$ 388,952	$ 47,753	$ 155,576
2044	$ 388,952	$ 44,629	$ 151,044
2045	$ 388,952	$ 41,709	$ 146,645
2046	$ 388,952	$ 38,980	$ 142,374
2047	$ 388,952	$ 36,430	$ 138,227
2048	$ 388,952	$ 34,047	$ 134,201
2049	$ 388,952	$ 31,820	$ 130,292
2050	$ 388,952	$ 29,738	$ 126,497
2051	$ 388,952	$ 27,793	$ 122,813
2052	$ 388,952	$ 25,974	$ 119,236
2053	$ 388,952	$ 24,275	$ 115,763
2054	$ 388,952	$ 22,687	$ 112,391
TOTAL	**$ 14,294,747**	**$ 3,771,991**	**$ 7,477,030**

Other Non-Quantifiable Costs and Benefits

There are a number of other project benefits, as well as costs, that could not be reasonably quantified for the benefit-cost analysis. Among these are:

- Noise reduction – Safety demands that for a busy road like US 70, "active" crossing protection be in place, including a crossing gate, bells and lights at the crossing to indicate the approach of a train, and the train is required to sound its horn. Train horns can sometimes be heard at the far other end of Valliant, as train horns are designed to be loud at a distance of a quarter mile, but can often be heard a mile or more away. The sound of the bells and the train horn would be eliminated with the project, as would the engine noise from cars and trucks starting up at the crossing after a train has cleared the tracks.
- Benefits to employers – Businesses would gain from increased worker productivity from reduced commute and work trip travel times as well as the ability to recruit workers from further away, and possibly reduced employee lateness as well. Some of this benefit is accounted for in the BCA within the value of travel time valuation.
- Increased sales – Local businesses are likely to experience additional sales resulting from increased pedestrian and auto traffic.
- Health & Livability benefits – Adding bike lanes and sidewalks to this corridor (which currently does not have such facilities) will improve livability and sustainability for local residents. These facilities will also make it more likely that local residents will use these modes and realize the related exercise and health benefits.
- Impacts on relocated businesses – Eight businesses will need to be relocated to make room for the overpass. Changes of location, particularly when involuntary, always involve costs in reduced productivity, as well as lost sales as customers adjust to new locations. However, due to the lack of suitable vacant commercial structures in the vicinity of this project, the commercial relocations for this project will result in new, possibly custom-designed, structures for each of the relocated businesses. This improvement in the visual appeal of these businesses, as well as the likely reduction in maintenance and energy costs from more modern structures, could have a long term economic benefit for these businesses. Benefits may even spill over to neighboring businesses, as many are currently located near vacant lots or dilapidated buildings (see photo).

- Improved emergency access – It is likely that over the many decades that the US 70 overpass project will serve the area, that faster and more reliable travel times for police,

fire and ambulance services needing to travel from one side of the railroad to the other will save lives and reduce property damage and injuries.

Because transportation is involved in so many aspects of our lives, the benefits of the project are potentially far-reaching, making trips for any purpose easier, safer and more reliable, whether for work, recreation, shopping, higher education, or to visit an elderly relative or sick friend. While most of this value is measured in the travel time savings calculations, there are some aspects that do not make it into the benefit-cost ratio. The project's measurable reduction in travel costs has a similar potential, as funds not spent on fuel purchases could be used for a wide range of purposes, from making local manufacturing, forestry and agricultural businesses more competitive to increasing disposable income for residents of a county with a 28% poverty rate.

Changes since 2011 TIGER Application

An application for the Valliant project was submitted for the 2011 TIGER grants, and a number of updates were made to the original benefit cost analysis to reflect new data and to ensure that the analysis meets current TIGER BCA guidance, including:

- The assumptions for the value of travel time were updated and commute time has been assigned as "all purposes" travel time rather than business travel.
- The emissions impacts resulting from the reduced idling were updated to reflect the new MOBILE 6.2 factors available from a recent air quality impact analysis for another study in Oklahoma.
- The monetized values of various emissions types were updated to meet current TIGER guidance.
- The project benefits for 2015 were reduced to reflect a change in the construction schedule from a first quarter 2015 completion date to a third quarter 2015 completion date.
- The present value analysis was adjusted to a base year of 2012.
- Dollar figures were revised to 2012 dollars using the national consumer price index adjustment for all urban consumers (CPI-U).
- Other minor adjustments were made to reflect the latest TIGER guidance (e.g., projected fuel costs and vehicle fleet fuel efficiency assumptions).

APPENDIX A: Travel Model Results

Source: Parsons Brinckerhoff, 10/17/2011

Estimate of VMT saving - US 70 in Valliant Annual				
Scenarios	Approx Distance miles	AADT Vehicles	VMT	VMT Savings
No Build 2012	2	7196	5,253,080	152,570
	4.7	300	514,650	
Alternative 2 2012	2	7504	5,477,920	
	4.7	80	137,240	
No Build 2035	2	10175	7,427,750	(93,331)
	4.7	368	631,304	
Alternative 2 2035	2	10935	7,982,550	
	4.7	99	169,835	
			Total Savings	245,901

Estimate of average delay and travel time saving - US 70 in Valliant Annual		
Scenarios	Overall Network Avg Delay /veh (minutes)	Overall Network Total Travel Time (hours)
No Build 2012 - 2 lanes (Do Nothing)	21,927	388,776
Alternative 2 2012 - 2 lanes (RR Grade Sep)	1,179	187,218
Reduction	20,748	201,558
No Build 2035 - 2 lanes (No RR Grade Sep)	24,044	510,647
Alternative 2 2035 - 2 lanes (RR Grade Sep)	1,652	175,126
Reduction	22,392	335,522

Note that the 187,218 Overall Network Travel Time for 2012 with railroad grade separation was not used in the BCA analysis because it assumed a two-lane US 70 in 2012 (the Build would be five lanes). Instead the 2035 Overall Network Travel Time (175,126) was adjusted to 2012 traffic levels, resulting in an Overall Network Travel Time for the 2012 Build of 175,126.