Benefit Cost Analysis

The Benefit Cost Analysis (BCA) was performed in accordance with the ARRA guidance provided in the Federal Register. These benefits and costs were quantified in accordance with the Federal Register (Volume 74, Number 115) and Circulars A-4 and A-94
(See http://www.whitehouse.gov/omb/circulars/).

The purpose of the BCA is to systematically compare the benefits and costs of constructing the Bypass and evaluate the effects of an aggressive funding schedule. The BCA compared the Bypass as an Interstate-type toll facility with the existing four-lane divided Highway 71 facility for the first twenty years the facility is open (2013 through 2033). The BCA compared benefits and costs for two scenarios: 1) Building the Bypass as a toll facility, and 2) No-Build for the Bypass, where motorists would continue to use existing Highway 71.

The analysis considered standard features of roadway and toll facility construction costs in Arkansas and Missouri, and toll operation and maintenance costs in Arkansas. Table 1 summarizes the findings of the BCA analysis. Road User Benefits that were considered include:

- Value of Time saved while traveling on the Bypass,
- Operating Costs of vehicles on the highway network,
- Costs Savings by Greenhouse Gas Reduction,
- Value to Society of Enhancing Safety with an improved highway network, and
- Cost of Tolls to drivers (Negative Benefit).

Table 1
Benefit Cost Analysis Summary

Bella Vista Bypass Benefit Cost Evaluation Summary [1.]	2009 Present Worth		2009 Present Worth Construction, O&M Costs
	No-Build	Build with Tolls	
Arkansas		$ 261,500,000.00	$ 261,500,000.00
Arkansas - Toll O&M Costs		$ 85,300,000.00	$ 85,300,000.00
Missouri		$ 66,000,000.00	$ 66,000,000.00
			$ 412,800,000.00
Road User Cost			**Road User Cost Savings**
Value of Time	$ 1,621,366,000.00	$ 1,280,987,000.00	$ 340,379,000.00
Value of Operating Costs	$ 3,082,087,000.00	$ 3,083,559,000.00	$ (1,472,000.00)
Value of Greenhouse Gases			$ 4,538,000.00
Value of Safety Improvements	$ 599,300,000.00	$ 359,580,000.00	$ 239,720,000.00
Cost of Tolls to Drivers	$ -	$ (62,300,000.00)	$ (62,300,000.00)
Total			**$ 520,865,000.00**

1. Costs in 2009 dollars include Construction of Grading, Structures, Pavement, Special Features, Toll Facility, Purchase of Right-of-Way, Engineering, and Contingencies.

Benefit Cost Ratio =	**1.26**

The BCA showed a cost savings of $108 million to drivers over the twenty-year study period. Similar additional cost savings are expected to continue well beyond the twenty-year study horizon, and will increase as traffic on the existing roadway network grows.

The BCA was calculated using the following key factors for evaluation:

- Construction Cost
- Project Financing Costs
- Operations and Maintenance Costs
- Highway Geometry
- Highway Traffic Control Devices
- Forecast Traffic
- Travel Speeds and Congestion
- Historic Crash Data
- Vehicle Miles Traveled
- Traffic Distribution by Vehicle Type
- Benefit of Emission Reduction
- Value of Time

Construction Cost Estimates for portions of the Bypass in the States of Arkansas and Missouri are shown in **Attachment 1**. These costs reflect basic construction costs that would be incurred if the project were built using traditional construction methods and schedules. If TIGER grant financing is approved, additional features, such as Intelligent Transportation System elements and toll credits, may be added to enhance the benefit of the project.

Attachment 2 includes **Toll Revenue Operation and Maintenance Costs** and was based upon **Jacob's August 2009 Traffic and Revenue Report**. Toll facility operation and maintenance cost includes the cost to maintain the toll road facility, provide operating and administrative staff, and maintain ancillary structures. The Arkansas Highway Commission will be the tolling authority, and Arkansas State Highway and Transportation Department (AHTD) staff will supplement toll facility operations with in-house resources.

The BCA **Value of Time** analysis quantifies the impact of an improvement to road user savings in terms of travel time by first determining travel time savings, then assigning a dollar value to time. This includes differentiating time valuations by trip type, assuming passenger vehicle trips have several purposes, including work and pleasure, with a value of time at 50% of the standard wage rate in the area. A vehicle occupancy rate of 1.5 persons per vehicle was used, per the Northwest Arkansas Regional Travel Demand Model. Trucks and commercial vehicles were assumed to operate at 100% of a driver's appropriate standard wage rate. Trucks and buses in the existing corridor average about 13.6% of all vehicles. It is expected that trucks would average about 20% of vehicles on the Bypass. Time savings for road users on the Bypass was estimated to be between eight minutes and fifteen minutes based upon **Jacob's August 2009 Traffic and Revenue Report**. Time savings on the existing route was estimated to be between four and six minutes due to a reduction of traffic on the existing facility. Detailed worksheets showing factors considered are included in **Attachment 3**.

The **Operating Cost** analysis quantified the cost of owning and operating a vehicle, and compared the Road User Operating Costs for alternatives both with and without the Bypass. With the tolled Bypass, the existing route would also see benefits by reduced traffic volumes, reduced truck traffic, and lower levels of congestion. See **Attachment 4** for detailed information regarding operating cost calculations. Operating costs on the Bypass are slightly higher than on

the existing route due to an approximate three-mile increase in trip length and higher travels speeds. This expense is offset by the value of time savings and other factors.

Reduction in Greenhouse Gas Emissions was calculated for the Existing No-Build Alternative versus the Bypass Alternative. Greenhouse gas emissions would be reduced by a value of $4.5 million in the twenty-year study period. Greenhouse gas reductions are attributed to idling and delay on the Bypass for trucks and heavy vehicles. **Attachment 5** shows detailed calculations.

The **Value of Safety Improvements** considers statistical cost savings that can be attributed to safety features of an Interstate-type facility as compared to driving on a four-lane arterial. **Attachment 6** shows these calculations. The Safety Analysis discusses specific existing safety conditions within the corridor. For the BCA, the Value to Society of lost resources and lives resulting from crashes was calculated from two years of crash data, and was then averaged. The average crash rate on Highway 71 in Arkansas is below the Statewide Average Rate for similar facilities. Per the guidance, the crash rate for the existing facility was adjusted up by a factor of 1.3 based upon the assumption that over time, facilities would tend to become more similar to the statewide average. The assumed future crash rate was still less than the Statewide average rate. The crash rate on the improved roadway network, including the Bypass and the existing facility, was found to be reduced by a factor of 60% compared to the expected future crash rate. As a standard for quality control, the crash rates and statistics were checked for existing Highway 71, and fall under the statewide average crash rates.

Cost of Tolls to Drivers is a negative benefit to road users, in that they must pay a fee to use the Bypass. The Cost of Tolls was calculated over the twenty-year study period, and was adjusted to present worth of year 2009 dollars by applying a 7% discount rate, as shown in **Attachment 7**. It was assumed that the toll fees would not be adjusted for inflation. For the entire 14.6 mile tolled trip, a toll rate for two-axle (passenger) vehicles of $1.50 was assumed at the mainline toll plaza. This equates to approximately 10 cents per mile for a passenger vehicle.

References

User Benefit Analysis for Highways, August 2003, AASHTO
Bella Vista Bypass Traffic and Revenue Report, August 27, 2009, Jacobs Engineering Group, Inc., and Stantec
Manual on User Benefit Analysis for Highway and Bus Transit Improvements, 1977, AASHTO
Chapter VIII of the Final Regulatory Impact Analysis of the National Highway Traffic Safety Administration's rulemaking on Corporate Average Fuel Economy for MY 2011 Passenger Cars and Light Trucks
Circular A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, Office of Management and Budget
BCA.Net-Highway Project Benefit-Cost Analysis System User's Manual, Federal Highway Administration
Memorandum: Departmental Guidance for the Valuation of Travel Time in Economic Analysis, Guidance for Conducting Economic Evaluations, April 9, 1997, U.S. Department of Transportation
Memorandum to: Secretarial Officers Modal Administrators Re: Treatment of the Economic Value of a Statistical life in Departmental Analyses – 2009 Annual Revision, March 18, 2009
Circular A-4: To the Heads of Executive Agencies and Establishments; Subject: Regulatory Analysis, September 17, 2003, Office of Management and Budget
Federal Register (Volume 74, Number 115); Notice of Funding Availability for Supplemental Discretionary Grants for Capital Investments in Surface Transportation Infrastructure Under the American Recovery and Reinvestment Act; Page 28760; June 17, 2009

ATTACHMENT 1

Table 1 - Bella Vista Bypass Project Cost Estimate

Arkansas Segment		
Preliminary Engineering	$	6,800,000.00
Right of Way and Utilities	$	23,000,000.00
Roadway and Brdge Construction	$	199,000,000.00
Toll Plaza and Customer Center	$	12,700,000.00
Construction Engineering	$	20,000,000.00
TOTAL	**$**	**261,500,000.00**
Missouri Segment		
Preliminary Engineering	N/A	
Right of Way and Utilities	$	6,600,000.00
Roadway and Bridge Construction	$	55,400,000.00
Construction Engineering	$	4,300,000.00
MISSOURI TOTAL COSTS	**$**	**66,300,000.00**

ATTACHMENT 2

Bella Vista Bypass Toll Facility O&M

Year	E&C with Staff	ETO	O&M Costs
2014	$ 4,526,223.64	$ 1,754,276.47	$ 2,771,947.17
2015	$ 4,752,428.68	$ 1,671,141.00	$ 3,081,287.69
2016	$ 4,972,682.25	$ 1,742,825.30	$ 3,229,856.95
2017	$ 5,277,970.98	$ 1,822,843.92	$ 3,455,127.05
2018	$ 5,399,763.92	$ 1,970,861.46	$ 3,428,902.46
2019	$ 5,489,767.89	$ 1,916,868.30	$ 3,572,899.59
2020	$ 5,674,868.51	$ 1,983,968.62	$ 3,690,899.89
2021	$ 5,912,776.84	$ 2,059,215.76	$ 3,853,561.08
2022	$ 6,084,112.39	$ 2,100,428.99	$ 3,983,683.40
2023	$ 6,278,871.31	$ 2,161,021.64	$ 4,117,849.67
2024	$ 6,484,893.40	$ 2,227,522.95	$ 4,257,370.46
2025	$ 6,745,701.94	$ 2,295,885.32	$ 4,449,816.62
2026	$ 6,971,954.78	$ 2,367,415.53	$ 4,604,539.25
2027	$ 7,187,678.00	$ 2,430,623.15	$ 4,757,054.85
2028	$ 7,418,879.25	$ 2,504,218.20	$ 4,914,661.04
2029	$ 7,657,920.07	$ 2,579,739.85	$ 5,078,180.22
2030	$ 7,904,370.80	$ 2,657,559.03	$ 5,246,811.77
2031	$ 8,159,313.18	$ 2,734,470.81	$ 5,424,842.37
2032	$ 8,408,513.59	$ 2,809,972.46	$ 5,598,541.13
2033	$ 8,676,517.37	$ 2,892,933.48	$ 5,783,583.88
			$ 85,301,416.55

Assumes cost of toll facility maintenance is included in the financing costs.
Future O&M costs are those carried by AHTD only.
Assumes 20 year O&M, beginning in Year 2014
Sources: O&M forecast with staffing: Jacobs July 18, 2009 spreadsheet.
O&M forecast with no staffing: Jacobs August 10, 2009 spreadsheet

Value of Time - Existing Route - No Build versus Build

General Information	
Analyst	KKR
Agency/Company	AHTD
Project	BYPASS
Date Performed	8/8/2009

Site Information	
Facility	Bella Vista Bypass
Segment	Ex US 71
Analysis Time Period	Peak Hour
Analysis Year	2009
Segment Length (mi.)	16.2

Inputs

Autos		Trucks	
Percentage of hourly wage (Table 5-1)	50%	Percentage of compensation (Table 5-1)	100%
Average hourly wage (Table 5-2)	$18.56	Average hourly compensation (Table 5-2)	$20.23
Average vehicle occupancy	1.5	Average vehicle occupancy	1.05
Speed without Improvement (mph)	41	Speed without Improvement (mph)	40
Speed with Improvement (mph)	47	Speed with Improvement (mph)	46
or		or	
Delay without improvement (min.)		Delay without improvement (min.)	
Delay with improvement (min.)		Delay with improvement (min.)	

Calculations

Autos		Trucks	
Value of time per hour (wage X percentage X occupancy)	$13.92	Value of time per hour (wage X percentage X occupancy)	$21.24
For speed change:		For speed change:	
Time without improvement (min.)	23.707	Time without improvement (min.)	24.300
Time with improvement (min.)	20.681	Time with improvement (min.)	21.130
(1 / speed) X length X 60		(1 / speed) X length X 60	
Travel time saved per vehicle (min.):	3.026	Travel time saved per vehicle (min.):	3.170
or		or	
For delay change:		For delay change:	
Travel time saved per vehicle (min.): (delay without - delay with)	0.000	Travel time saved per vehicle (min.): (delay without - delay with)	0.000
Value of time saved per vehicle (VOT per hour * time saved / 60)	$0.7021	Value of time saved per vehicle (VOT per hour * time saved / 60)	$1.1221
Value of time saved per VMT (VOT per vehicle / length)	$0.0433	Value of time saved per VMT (VOT per vehicle / length)	$0.0693

Value of Time - Bypass with Tolls

General Information	
Analyst	KKR
Agency/Company	AHTD
Project	BYPASS
Date Performed	8/8/2009

Site Information	
Facility	Bella Vista Bypass
Segment	Ex US 71
Analysis Time Period	Peak Hour
Analysis Year	2009
Segment Length (mi.)	18.5

Inputs

Autos		Trucks	
Percentage of hourly wage (Table 5-1)	50%	Percentage of compensation (Table 5-1)	100%
Average hourly wage (Table 5-2)	$18.56	Average hourly compensation (Table 5-2)	$20.23
Average vehicle occupancy	1.5	Average vehicle occupancy	1.05
Speed without Improvement (mph)	67	Speed without Improvement (mph)	67
Speed with Improvement (mph)	67	Speed with Improvement (mph)	67
or		or	
Delay without improvement (min.)		Delay without improvement (min.)	
Delay with improvement (min.)		Delay with improvement (min.)	

Calculations

Autos		Trucks	
Value of time per hour (wage X percentage X occupancy)	$13.92	Value of time per hour (wage X percentage X occupancy)	$21.24
For speed change:		For speed change:	
Time without improvement (min.)	16.567	Time without improvement (min.)	16.567
Time with improvement (min.) (1 / speed) X length X 60	16.567	Time with improvement (min.) (1 / speed) X length X 60	16.567
Travel time saved per vehicle (min.):	0.000	Travel time saved per vehicle (min.):	0.000
or		or	
For delay change:		For delay change:	
Travel time saved per vehicle (min.): (delay without - delay with)	0.000	Travel time saved per vehicle (min.): (delay without - delay with)	0.000
Value of time saved per vehicle (VOT per hour * time saved / 60)	$0.0000	Value of time saved per vehicle (VOT per hour * time saved / 60)	$0.0000
Value of time saved per VMT (VOT per vehicle / length)	$0.0000	Value of time saved per VMT (VOT per vehicle / length)	$0.0000

ATTACHMENT 3

Value of Time in 2009 Dollars for Existing No-Build Network - Improved Network with Bypass																				
YEAR	YEAR SINCE PRESENT	WAADT - Bypass	WAADT - US 71 Existing/ US 71B No Bypass	WAADT - US 71 Existing/ US 71B With Bypass	Bypass Truck Percent	Existing Route Truck Percent	Travel Time @ 67.5 mph - Bypass (Hours)	Travel Speed on US 71 without Bypass	Travel Time - Existing Without Bypass (Hours)	Travel Speed on US 71 with Bypass	Travel Time Existing No Build (Hours)	Travel Time Savings No Build versus Build on Bypass	Travel Time Savings Existing- Build Versus Bypass	Travel Time Savings No-Build versus Build on US 71B	Daily Value of Time on Existing	TOTAL Annual Value of Time on Existing	TOTAL Daily Value of Time on Bypass	TOTAL Daily Value of Existing w/ Bypass	TOTAL Daily Value of Time on Improved Network	Total Annual VOT on Improved Network
2009	0	0	29,100	29,100	0%	13.6%				40.0	0.41				$ 176,003.88	$ 64,285,417.82				
2010	1	*0*	*29,300*	29,300	0%	13.6%				39.7	0.41				$ 178,687.70	$ 65,265,683.89				
2011	2	*0*	*29,500*	29,500	0%	13.6%				39.3	0.41				$ 181,416.55	$ 66,262,395.70				
2012	3	*0*	*29,700*	29,700	0%	13.6%				39.0	0.42				$ 184,191.57	$ 67,275,970.62				
2013	4	*0*	*29,900*	29,900	0%	13.6%				38.7	0.42				$ 187,013.94	$ 68,306,840.26				
2014	5	*4,800*	*30,100*	25,300	20%	13.6%	0.272	44.35	0.37	38.4	0.42	0.151	0.09	0.06	$ 189,884.88	$ 69,355,451.06	$ 20,089.69	$ 142,346.57	$ 162,436.27	$ 59,329,846.82
2015	6	*6,400*	*30,300*	23,900	20%	13.6%	0.272	44.02	0.37	38.0	0.43	0.155	0.10	0.06	$ 192,805.65	$ 70,422,265.00	$ 26,786.26	$ 135,477.75	$ 162,264.01	$ 59,266,930.19
2016	7	*7,800*	*30,500*	22,700	20%	13.6%	0.272	43.69	0.37	37.7	0.43	0.158	0.10	0.06	$ 195,777.58	$ 71,507,760.21	$ 32,645.75	$ 129,647.44	$ 162,293.19	$ 59,277,587.40
2017	8	*8,500*	*30,700*	22,200	20%	13.6%	0.272	43.36	0.37	37.4	0.43	0.162	0.10	0.06	$ 198,802.00	$ 72,612,431.73	$ 35,575.50	$ 127,756.74	$ 163,332.24	$ 59,657,100.74
2018	9	*9,500*	*30,900*	21,400	20%	13.6%	0.272	43.03	0.38	37.0	0.44	0.166	0.10	0.06	$ 201,880.33	$ 73,736,792.24	$ 39,760.85	$ 124,097.36	$ 163,858.21	$ 59,849,212.88
2019	10	*9,800*	*31,100*	21,300	20%	13.6%	0.272	42.70	0.38	36.7	0.44	0.170	0.11	0.06	$ 205,014.03	$ 74,881,372.85	$ 41,016.46	$ 124,472.05	$ 165,488.51	$ 60,444,678.61
2020	11	*10,300*	*31,300*	21,000	20%	13.6%	0.272	42.37	0.38	36.4	0.45	0.174	0.11	0.06	$ 208,204.58	$ 76,046,723.97	$ 43,109.14	$ 123,674.72	$ 166,783.86	$ 60,917,804.82
2021	12	*10,500*	*31,500*	21,000	20%	13.6%	0.272	42.04	0.39	36.0	0.45	0.178	0.11	0.06	$ 211,453.57	$ 77,233,416.15	$ 43,946.21	$ 124,645.53	$ 168,591.74	$ 61,578,131.52
2022	13	*10,600*	*31,700*	21,100	20%	13.6%	0.272	41.71	0.39	35.7	0.45	0.182	0.12	0.07	$ 214,762.60	$ 78,442,041.03	$ 44,364.74	$ 126,229.94	$ 170,594.68	$ 62,309,708.44
2023	14	*10,900*	*31,900*	21,000	20%	13.6%	0.272	41.38	0.39	35.4	0.46	0.186	0.12	0.07	$ 218,133.37	$ 79,673,212.33	$ 45,620.35	$ 126,633.59	$ 172,253.94	$ 62,915,751.62
2024	15	*11,100*	*32,100*	21,000	20%	13.6%	0.272	41.05	0.40	35.1	0.46	0.191	0.12	0.07	$ 221,567.60	$ 80,927,566.88	$ 46,457.42	$ 127,651.60	$ 174,109.02	$ 63,593,317.81
2025	16	*11,300*	*32,300*	21,000	20%	13.6%	0.272	40.72	0.40	34.7	0.47	0.195	0.13	0.07	$ 225,067.12	$ 82,205,765.73	$ 47,294.49	$ 128,686.10	$ 175,980.59	$ 64,276,910.64
2026	17	*11,400*	*32,500*	21,100	20%	13.6%	0.272	40.39	0.40	34.4	0.47	0.200	0.13	0.07	$ 228,633.80	$ 83,508,495.30	$ 47,713.02	$ 130,355.31	$ 178,068.33	$ 65,039,458.43
2027	18	*11,600*	*32,800*	21,200	20%	13.6%	0.272	40.06	0.40	34.1	0.48	0.204	0.13	0.07	$ 232,979.90	$ 85,095,907.34	$ 48,550.09	$ 132,052.02	$ 180,602.11	$ 65,964,920.86
2028	19	*11,700*	*33,100*	21,400	20%	13.6%	0.272	39.73	0.41	33.7	0.48	0.209	0.14	0.07	$ 237,411.03	$ 86,714,380.51	$ 48,968.63	$ 134,404.97	$ 183,373.60	$ 66,977,207.31
2029	20	*11,900*	*33,400*	21,500	20%	13.6%	0.272	39.40	0.41	33.4	0.49	0.214	0.14	0.07	$ 241,929.73	$ 88,364,835.49	$ 49,805.70	$ 136,164.02	$ 185,969.72	$ 67,925,439.60
2030	21	*12,100*	*33,700*	21,600	20%	13.6%	0.272	39.07	0.42	33.1	0.49	0.218	0.14	0.08	$ 246,538.62	$ 90,048,229.69	$ 50,642.77	$ 137,952.78	$ 188,595.55	$ 68,884,525.35
2031	22	*12,300*	*34,000*	21,700	20%	13.6%	0.272	38.74	0.42	32.7	0.50	0.223	0.15	0.08	$ 251,240.41	$ 91,765,559.15	$ 51,479.84	$ 139,772.02	$ 191,251.86	$ 69,854,741.93
2032	23	*12,400*	*34,300*	21,900	20%	13.6%	0.272	38.41	0.42	32.4	0.50	0.228	0.15	0.08	$ 256,037.95	$ 93,517,860.45	$ 51,898.38	$ 142,272.16	$ 194,170.54	$ 70,920,788.89
2033	24	*12,500*	*34,600*	22,100	20%	13.6%	0.272	38.08	0.43	32.1	0.51	0.234	0.15	0.08	$ 260,934.19	$ 95,306,212.84	$ 52,316.91	$ 144,815.64	$ 197,132.55	$ 72,002,662.97
																$ 1,621,366,279.98			$ 3,507,150.52	**$ 1,280,986,726.84**

2009 Dollar Value of Time Autos $ 13.92

Cost of Time No-Build - Cost of Time Improved Network = $ 340,379,553.14

Operating and Ownership Cost

Analyst	KKR	Facility	Existing US 71
Agency/Company	AHTD	Segment	existing vs w/bypass
Project	Bella Vista Bypass	Analysis Time Period	peak hour
Date Performed	8/8/2009	Analysis Year	2013
		Segment Length (mi.)	18.9

Site Information

Inputs

Finance Rate: 7.0%

Autos		Trucks	
Speed (mph):		Speed (mph):	
without improvement	68	without improvement	68
with improvement	68	with improvement	68
Fuel Cost Per Gallon	$2.45	Fuel Cost Per Gallon	$2.50
Fuel Consumption per Mile (Table 5-5):		Fuel Consumption per Mile (Table 5-5):	
without improvement	0.039	without improvement	0.158
with improvement	0.039	with improvement	0.158
Other Operating Costs per Mile (Table 5-4) (tires, maintenance, etc.)	$0.114	Other Operating Costs per Mile (tires, maintenance, etc.)	$0.114
Vehicle Life (years)	10	Vehicle Life (years)	8
Vehicle Cost	$20,000	Vehicle Cost	$60,000
Salvage Value at End of Life	$2,000	Salvage Value at End of Life	$5,000
Miles per Year	15,000	Miles per Year	50,000
		Cargo Value	$350,000
Insurance per Year (Table 5-3)	$1,000	Insurance per Year	$1,500

Calculations

Autos		Trucks	
Fuel Cost per VMT (Equation 5-3):		Fuel Cost per VMT (Equation 5-3):	
without improvement	$0.0956	without improvement	$0.3950
with improvement	$0.0956	with improvement	$0.3950
(cost per gallon X gallons per mile)		(cost per gallon X gallons per mile)	
Total Operating Cost per VMT:		Total Operating Cost per VMT:	
without improvement	$0.2096	without improvement	$0.5090
with improvement	$0.2096	with improvement	$0.5090
(fuel cost per VMT + other oper. cost)		(fuel cost per VMT + other oper. cost)	
Amortized Vehicle Cost Per Year:	$2,703	Amortized Vehicle Cost Per Year:	$9,561
	(Equation 5-6)		(Equation 5-6)
		Inventory Cost per Hour	$2.7968
			(Equation 5-10)
		Inventory Cost per Mile:	
		without improvement	$0.0411
		with improvement	$0.0411
		(cost per hour / miles per hour)	
Amortized Vehicle Cost per VMT	$0.1802	Vehicle Cost per VMT	$0.1912
Insurance Cost per VMT	$0.0667	Insurance Cost per VMT	$0.0300
Ownership Cost per VMT		Ownership Cost per VMT	
without improvement	$0.2469	without improvement	$0.7302
with improvement	$0.2469	with improvement	$0.7302
(vehicle + insurance)		(vehicle + insurance + inventory)	
Oper. and Ownership Cost per VMT		Oper. and Ownership Cost per VMT	
without improvement	$0.4564	without improvement	$1.2392
with improvement	$0.4564	with improvement	$1.2392
(operating + ownership)		(operating + ownership)	
Oper. and Ownership Savings / VMT (without - with)	$0.0000	Oper. and Ownership Savings / VMT (without - with)	$0.0000

For single trip	Trucks	Autos
On Bypass	$24.1985	$8.6260
On Existing with Bypass		
On Existing no Bypass		

Bella Vista Bypass Operating and Ownership Cost

Analyst	KKR
Agency/Company	AHTD
Project	Bella Vista Bypass
Date Performed	8/12/2009

Site Information

Facility	Existing US 71
Segment	existing vs w/bypass
Analysis Time Period	peak hour
Analysis Year	Mid-Year (2023)
Segment Length (mi.)	16.5

Inputs

Finance Rate: 7.0%

Autos		**Trucks**	**mid-year**
Speed (mph):		Speed (mph):	
without improvement	35	without improvement	35
with improvement	50	with improvement	50
Fuel Cost Per Gallon	$2.45	Fuel Cost Per Gallon	$2.50
Fuel Consumption per Mile (Table 5-5):		Fuel Consumption per Mile (Table 5-5):	
without improvement	0.045	without improvement	0.182
with improvement	0.041	with improvement	0.166
Other Operating Costs per Mile (Table 5-4) (tires, maintenance, etc.)	$0.124	Other Operating Costs per Mile (tires, maintenance, etc.)	$0.645
Vehicle Life (years)	10	Vehicle Life (years)	8
Vehicle Cost	$20,000	Vehicle Cost	$60,000
Salvage Value at End of Life	$2,000	Salvage Value at End of Life	$5,000
Miles per Year	15,000	Miles per Year	50,000
		Cargo Value	$350,000
Insurance per Year (Table 5-3)	$1,000	Insurance per Year	$1,500

Calculations

Autos		**Trucks**	
Fuel Cost per VMT (Equation 5-3):		Fuel Cost per VMT (Equation 5-3):	
without improvement	$0.1103	without improvement	$0.4550
with improvement	$0.1005	with improvement	$0.4150
(cost per gallon X gallons per mile)		(cost per gallon X gallons per mile)	
Total Operating Cost per VMT:		Total Operating Cost per VMT:	
without improvement	$0.2343	without improvement	$1.0998
with improvement	$0.2245	with improvement	$1.0598
(fuel cost per VMT + other oper. cost)		(fuel cost per VMT + other oper. cost)	
Amortized Vehicle Cost Per Year:	$2,703	Amortized Vehicle Cost Per Year:	$9,561
	(Equation 5-6)		(Equation 5-6)
		Inventory Cost per Hour	$2.7968
			(Equation 5-10)
		Inventory Cost per Mile:	
		without improvement	$0.0799
		with improvement	$0.0559
		(cost per hour / miles per hour)	
Amortized Vehicle Cost per VMT	$0.1802	Vehicle Cost per VMT	$0.1912
Insurance Cost per VMT	$0.0667	Insurance Cost per VMT	$0.0300
Ownership Cost per VMT		Ownership Cost per VMT	
without improvement	$0.2469	without improvement	$1.3210
with improvement	$0.2469	with improvement	$1.2810
(vehicle + insurance)		(vehicle + insurance + inventory)	
Oper. and Ownership Cost per VMT		Oper. and Ownership Cost per VMT	
without improvement	$0.4811	without improvement	$2.4208
with improvement	$0.4713	with improvement	$2.3408
(operating + ownership)		(operating + ownership)	
Oper. and Ownership Savings / VMT (without - with)	$0.0098	Oper. and Ownership Savings / VMT (without - with)	$0.0800

Highway 71

	2012	2022	2032
no build	29100	31500	33900
E&C	23000	22000	21000

Bypass

	2012	2022	2032
E&C	6100	9500	12900

Build Network	$	3,083,559,180.19
No Build Network	$	3,082,086,959.92
Net Savings =	$	(1,472,220.27)

Calculations based upon mid-year traffic
Assumes current dollars (7% finance rate, 7% inflation)

Disaggregate values for Road Users - Not included in BCA

	Per Trip		Per year		Per 20 Year	
For single trip	Trucks	Autos	trucks	autos	trucks	autos
On Bypass	$ 24.20	$ 8.63	$ 16,781,660.91	$ 23,928,570.50	$ 335,633,218.30	$ 478,571,409.95
On Existing with Bypass	$ 39.55	$ 7.78	$ 63,511,494.46	$ 49,956,233.13	$ 1,270,229,889.24	$ 999,124,662.70

On Existing no Bypass	$ 41.26	$ 7.94	$ 77,803,088.32	$ 76,301,259.68	$ 1,556,061,766.41	$ 1,526,025,193.50

Reference User Benefit Analysis for Highways Page 5-14

Fuel Consumption (Gallons) per Minute of Delay by Vehicle Type (i.e. Signals, Queues)

Free Flow Speed	**Small Car**	**Large Car**	**SUV**	**2-Axle SU**	**3-Axle SU**	**Combo**		
20	0.011	0.22	0.023	0.074	0.102	0.198		
25	0.013	0.026	0.027	0.097	0.133	0.242		
30	0.015	0.03	0.032	0.122	0.167	0.284		
35	0.018	0.034	0.037	0.149	0.203	0.327		
40	0.021	0.038	0.043	0.177	0.241	0.369		
45	0.025	0.043	0.049	0.206	0.28	0.411		
50	0.028	0.048	0.057	0.235	0.321	0.453	average =	0.336333333
55	0.032	0.054	0.065	0.266	0.362	0.495		
60	0.037	0.06	0.073	0.297	0.404	0.537		
65	0.042	0.066	0.083	0.328	0.447	0.578		
70	0.047	0.073	0.094	0.36	0.49	0.62		
75	0.053	0.08	0.105	0.392	0.534	0.661		
	0.25	0.27	0.29	0.05	0.07	0.07	Distribution	

No Build Additional Fuel Consumption per Day

10 signals								
assume 8 stops								
1 @ 65 & LOS D	1217.16	1912.68	2405.34	9505.44	12954.06	16750.44		
2 @ 55 & LOS D	1854.72	3129.84	3767.4	15417.36	20981.52	28690.2		
5 @ 45 & LOS F or worse	5236.875	9007.425	10264.275	43151.85	58653	86094.225		
	8308.755	14049.95	16437.015	68074.65	92588.58	131534.865	330,994	

No Build Additional Fuel Consumption per Day

10 signals								
assume 8 stops								
1 @ 65 & LOS C	462	726	913	3608	4917	6358		0.42 s decrease in delay
2 @ 55 & LOS C	704	1188	1430	5852	7964	10890		0.42 s decrease in delay
5 @ 45 & LOS E/F	2750	4730	5390	22660	30800	45210		0.33 s decrease in delay
	3916	6644	7733	32120	43681	62458	156,552	

Fuel Savings on US 71 By Traffic Reduction =	174,442
Gallons/Year =	63,714,871.10
Gallons/20 Years =	1,274,297,422.05

Gallons/Trip due to Delay	Gallons No Build	Cost No Build		
Small Car	0.26377	$0.65	average for pc	
Large Car	0.44603	$1.09	$1.01	
SUV	0.52181	$1.28		
2-Axle SU	2.1611	$5.29	average for truck	
3-Axle SU	2.93932	$7.20	$7.58	3.557515
Combo	4.17571	$10.23		

Gallons/Trip due to Delay	Gallons Build	Cost Build		
Small Car	0.178	$0.44	average for truck	
Large Car	0.302	$0.74	$0.68	
SUV	0.3515	$0.86		
2-Axle SU	1.46	$3.58	average for truck	
3-Axle SU	1.9855	$4.86	$5.13	
Combo	2.839	$6.96		2.41225

ATTACHMENT 5

SUSTAINABILITY BENEFITS for BELLA VISTA BYPASS BASED ON

PROJECTED TRUCK TRANSACTIONS AND ESTIMATED CO2 SAVINGS

$31.44 2009 value to measure the global benefits of ruecion US CO2 emissions
This is based on the estimate of $33 per metric ton of carbon cited on page VIII-45 of the Final Regulatory Impact Analysis of the National Nighway Traffic Safety Administration's rulemaking on Corproate Average Fuel Ecnomony for MY2011 Passenger Cars and Light Trucks. This value was reduced by the given 2.4% for the annual growth of the social costs of carbon.

$33.00 *2011 value per metric ton*
2.4% annual growth thereafter for the Social Cost of Carbon

Bella Vista Bypass Northbound AADT

	PV	LT	HT	Total
2013	*200*	*0*	*0*	*200*
2014	*2,100*	*100*	*200*	*2,400*
2015	*2,900*	*100*	*300*	*3,300*
2016	*3,600*	*100*	*400*	*4,100*
2017	*3,900*	*100*	*400*	*4,400*
2018	4,400	100	400	4,900
2019	4,500	100	400	5,000
2020	4,600	100	400	5,100
2021	4,700	100	400	5,200
2022	4,700	100	400	5,200
2023	4,800	100	500	5,400
2024	4,900	100	500	5,500
2025	5,000	100	500	5,600
2026	5,100	100	500	5,700
2027	5,200	100	500	5,800
2028	5,200	100	500	5,800
2029	5,300	100	500	5,900
2030	5,400	100	500	6,000
2031	5,500	100	500	6,100
2032	5,500	100	500	6,100
2033	5,600	100	500	6,200
2034	5,600	100	500	6,200
2035	5,700	100	500	6,300
2036	5,700	100	500	6,300
2037	5,800	100	500	6,400
2038	5,800	100	500	6,400
2039	5,900	100	500	6,500
2040	5,900	100	500	6,500
2041	6,000	200	500	6,700
2042	6,100	200	500	6,800
2043	6,100	200	500	6,800
2044	6,400	200	500	7,100
2045	6,500	200	600	7,300
2046	6,500	200	600	7,300
2047	6,600	200	600	7,400
2048	6,700	200	600	7,500
2049	6,700	200	600	7,500
2050	6,800	200	600	7,600

Bella Vista Bypass Southbound AADT

	PV	LT	HT	Total
2013	*200*	*0*	*0*	*200*
2014	*2,100*	*100*	*200*	*2,400*
2015	*2,700*	*100*	*300*	*3,100*
2016	*3,300*	*100*	*300*	*3,700*
2017	*3,600*	*100*	*400*	*4,100*
2018	4,100	100	400	4,600
2019	4,300	100	400	4,800
2020	4,700	100	400	5,200
2021	4,800	100	400	5,300
2022	4,900	100	400	5,400
2023	5,000	100	400	5,500
2024	5,100	100	400	5,600
2025	5,200	100	400	5,700
2026	5,200	100	400	5,700
2027	5,300	100	400	5,800
2028	5,400	100	400	5,900
2029	5,500	100	400	6,000
2030	5,600	100	400	6,100
2031	5,600	100	500	6,200
2032	5,700	100	500	6,300
2033	5,700	100	500	6,300
2034	5,800	100	500	6,400
2035	5,800	100	500	6,400
2036	5,900	100	500	6,500
2037	5,900	100	500	6,500
2038	6,000	100	500	6,600
2039	6,100	100	500	6,700
2040	6,100	100	500	6,700
2041	6,200	100	500	6,800
2042	6,200	100	500	6,800
2043	6,300	100	500	6,900
2044	6,400	100	500	7,000
2045	6,400	100	500	7,000
2046	6,500	100	500	7,100
2047	6,600	100	500	7,200
2048	6,700	100	500	7,300
2049	6,700	100	500	7,300
2050	6,800	100	500	7,400

Bella Vista Bypass TOTAL AADT

	PV	LT	HT	Total	Using AHTD 20% for trucking
2013	*200*	*0*	*0*	*400*	**2013**
2014	*2,100*	*100*	*200*	*4,800*	**2014** 960
2015	*2,700*	*100*	*300*	*6,400*	**2015** 1280
2016	*3,300*	*100*	*300*	*7,800*	**2016** 1560
2017	*3,600*	*100*	*400*	*8,500*	**2017** 1700
2018	4,100	100	400	*9,500*	**2018** 1900
2019	4,300	100	400	*9,800*	**2019** 1960
2020	4,700	100	400	*10,300*	**2020** 2060
2021	4,800	100	400	*10,500*	**2021** 2100
2022	4,900	100	400	*10,600*	**2022** 2120
2023	5,000	100	400	*10,900*	**2023** 2180
2024	5,100	100	400	*11,100*	**2024** 2220
2025	5,200	100	400	*11,300*	**2025** 2260
2026	5,200	100	400	*11,400*	**2026** 2280
2027	5,300	100	400	*11,600*	**2027** 2320
2028	5,400	100	400	*11,700*	**2028** 2340
2029	5,500	100	400	*11,900*	**2029** 2380
2030	5,600	100	400	*12,100*	**2030** 2420
2031	5,600	100	500	*12,300*	**2031** 2460
2032	5,700	100	500	*12,400*	**2032** 2480
2033	5,700	100	500	*12,500*	**2033** 2500
2034	5,800	100	500	*12,600*	**2034** 2520
2035	5,800	100	500	*12,700*	**2035** 2540
2036	5,900	100	500	*12,800*	**2036** 2560
2037	5,900	100	500	*12,900*	**2037** 2580
2038	6,000	100	500	*13,000*	**2038** 2600
2039	6,100	100	500	*13,200*	**2039** 2640
2040	6,100	100	500	*13,200*	**2040** 2640
2041	6,200	100	500	*13,500*	**2041** 2700
2042	6,200	100	500	*13,600*	**2042** 2720
2043	6,300	100	500	*13,700*	**2043** 2740
2044	6,400	100	500	*14,100*	**2044** 2820
2045	6,400	100	500	*14,300*	**2045** 2860
2046	6,500	100	500	*14,400*	**2046** 2880
2047	6,600	100	500	*14,600*	**2047** 2920
2048	6,700	100	500	*14,800*	**2048** 2960
2049	6,700	100	500	*14,800*	**2049** 2960
2050	6,800	100	500	*15,000*	**2050** 3000

cumulative truck traffic present - 2033: 41480 AADT
this is from Sustainabiliy calculation - BVB

(395.47) 9.53 tpd CO2 reduction / 1000 trucks

2009 value of tpd reduction $ 31.44

365 days/year

Total value of CO2 reductions using global impact over the life of the project (2009) $ (4,537,522.40)

CARBON DIOXIDE REDUCTION CALCULATION FOR 1,000 TRUCKS ALONG BELLA VISTA BYPASS

Partial Use of the Bypass

Category	Current Miles No Stoplights	Current Miles With Stoplights	Current Total Miles	Future Miles on ByPass	Future Miles NOT on ByPass	Future Total Miles	Diff
Miles	12.10	16.50	28.60	12.76	12.10	24.86	(3.74)
MPG	6.8	3.6		6.8	5		
Gallons Consumed	1.78	4.58	6.36	1.88	2.42	4.30	(2.07)

weekly trips 767 | daily trips 109.58

(226.41) daily gallons saved

Full Use of the Bypass

Category	Current Miles No Stoplights	Current Miles With Stoplights	Current Total Miles	Future Miles on ByPass	Future Miles NOT on ByPass	Future Total Miles	Diff
Miles	4.80	11.20	16.00	19.27	-	19.27	3.27
MPG	6.1	3.6		6.1	3.6		
Gallons Consumed	0.79	3.11	3.90	3.16	-	3.16	(0.74)

weekly trips 286 | daily trips 40.91

(30.23) daily gallons saved

	Partial West	Full Use of the Bypass
Gallons saved	(2,066.27)	(738.98)
CO2 tpd saved	(21.00)	(7.51)

Assume 1000 trucks on Bypass:		**gallons saved**	**CO2 tpd saved**
10%	are bound for west of bypass - using a portion	(2,066.27)	(21.00)
85%	have destinations south of the bypass	(738.98)	(7.51)
5%	have destinations along the bypass	(2,066.27)	(21.00)
100%	percent		

weighted average:

(2.10) tpd CO2 reductions (partial west)
(6.38) tpd CO2 reductions using the entire bypass
(1.05) tpd CO2 reductions (partial east)
(9.53) total weighted DAILY TPD CO2 reductions for 1,000 trucks on bypass

Cost of Crashes and Comparison of Benefits that could be Anticipated by Improved Facilities ::::: Existing Highway 71 with and without Bypass

General Information	
Analyst	KKR
Agency/Company	AHTD
Project	BVB
Date Performed	8/1/2009

Site Information	
Facility	HIGHWAY 71
Segment	EXISTING ROUTE
Analysis Time Period	All
Analysis Year	2006-2007
Segment Length (mi.)	16

Inputs

Accident Cost (net of insurance reimbursement):	
Fatal	$6,000,000
Injury	$11,000
Property Damage Only	$3,000

Without Improvement		With Improvement	
Annual Traffic Volume	11,497,500	Annual Traffic Volume	9,800,250
# of Accidents		# of Accidents	
Accidents can be calculated from the following:			
Number of Fatalities per Year	4.5	Number of Fatal Accidents per Year	2.5
Number of Injuries per Year	210.0	Number of Injury Accidents per Year	108.0
Number of P.D.O. Accidents per Year	250.0	Number of P.D.O. Accidents per Year	92.0

Calculations

Annual VMT (traffic * length)	183,960,000			Annual VMT (traffic * length)	156,804,000
Accidents per Million VMT:		**Avg Crash Rate**	**Statewide Avg Similar Facilities**	Accidents per Million VMT:	**Avg Crash Rate**
Fatality (rate of 1 fatality/1 fatal crash)	0.0244	1.8685	**2.5 crashes/mvm**	Fatal	0.0159
Injury (Rate of 2.35 injuries per Injury Crash)	1.1416			Injury	0.6888
Property Damage Only	1.3590			Property Damage Only	0.5867
(accidents per year*1000000/VMT)				(accidents per year*1000000/VMT)	
Accident Cost per VMT		Existing Conditions		Accident Cost per VMT	
Fatal	$0.1463	$26,905,200.00		Fatal	$0.0953
Injury	$0.0126	$2,310,000.00		Injury	$0.0076
Property Damage Only	$0.0041	$750,000.00		Property Damage Only	$0.0018
(acc. per mm #VMT * cost / 1000000)				(acc. per mm #VMT * cost / 1000000)	
Accident Cost per VMT (all types)	$0.1629	$29,965,200.00		Accident Cost per VMT (all types)	$0.1046
(fatal + injury + P.D.O.)		$599,304,000.00		(fatal + injury + P.D.O.)	
		- 20 years (2009$$)			
Accident Cost Savings per VMT:				On existing Highway 71 with Bypass in Place	
Fatal			$0.050977526	$0.00608698	
Injury			$0.004980740	$0.00292326	
Property Damage Only			$0.002316814	$0.00016581	
All Accidents			$0.009176048		
(without - with)					

Value of Safety Improvements :::	Existing Highway 71	$	599,300,000.00
	Existing Highway 71 with traffic diverted by Bypass		$328,080,000.00
	Bypass		$31,500,000.00
Value of Safety Improvements in terms of Statistical Crash Outcome Improvements		$	239,720,000.00

Avg Crash Rate	1.2914
$14,940,000.00	
$1,188,000.00	
$276,000.00	
$16,404,000.00	
$328,080,000.00	
- 20 years (2009$$)	
$359,580,000.00	
$ 359,580,000.00	

Cost of Crashes and Comparison of Benefits that could be Anticipated by Improved Facilities ::::: Bypass

General Information	
Analyst	KKR
Agency/Company	AHTD
Project	BVB
Date Performed	8/1/2009

Site Information	
Facility	HIGHWAY 71
Segment	EXISTING ROUTE
Analysis Time Period	All
Analysis Year	2006-2007
Segment Length (mi.)	18.9

Inputs

Accident Cost (net of insurance reimbursement):	From Table 5-17
Fatal	$6,000,000
Injury	$11,000
Property Damage Only	$3,000

With Improvement

Annual Traffic Volume	1,697,250

# of Accidents

Accidents can be calculated from the following:

Number of Fatal Accidents per Year	0.2400
Number of Injury Accidents per Year	6.0000
Number of P.D.O. Accidents per Year	23.0000

Calculations

Annual VMT (traffic * length)	32,078,025	
Accidents per Million VMT:		**Avg Crash Rate**
Fatal	0.0075	0.9115
Injury	0.1870	
Property Damage Only	0.7170	
(accidents per year*1000000/VMT)		
Accident Cost per VMT		
Fatal	$0.0449	$1,440,000.00
Injury	$0.0021	$66,000.00
Property Damage Only	$0.0022	$69,000.00
(acc. per mm #VMT * cost / 1000000)		
Accident Cost per VMT (all types)	$0.0491	$1,575,000.00
(fatal + injury + P.D.O.)		$31,500,000.00
		- 20 years (2009$$)

Present Worth of Value of Toll Revenue

YEAR	YEAR SINCE PRESENT	DISCOUNT FACTOR FOR 7% RATE	VALUE OF TOLLS (2009 DOLLARS)	PW Value of Tolls in 2009 Dollars
2009	0	1		
2010	1	0.9346		
2011	2	0.8734		
2012	3	0.8163		
2013	4	0.7629	$ 3,540,000.00	$ 2,700,649.05
2014	5	0.7130	$ 3,700,000.00	$ 2,638,048.86
2015	6	0.6663	$ 4,870,000.00	$ 3,245,086.63
2016	7	0.6227	$ 6,040,000.00	$ 3,761,408.44
2017	8	0.5820	$ 6,530,000.00	$ 3,800,519.45
2018	9	0.5439	$ 7,400,000.00	$ 4,025,109.70
2019	10	0.5083	$ 7,610,000.00	$ 3,868,538.11
2020	11	0.4751	$ 7,920,000.00	$ 3,762,734.95
2021	12	0.4440	$ 8,060,000.00	$ 3,578,736.39
2022	13	0.4150	$ 8,190,000.00	$ 3,398,558.83
2023	14	0.3878	$ 8,320,000.00	$ 3,226,639.45
2024	15	0.3624	$ 8,460,000.00	$ 3,066,293.33
2025	16	0.3387	$ 8,590,000.00	$ 2,909,730.20
2026	17	0.3166	$ 8,700,000.00	$ 2,754,197.20
2027	18	0.2959	$ 8,820,000.00	$ 2,609,519.74
2028	19	0.2765	$ 8,920,000.00	$ 2,466,454.33
2029	20	0.2584	$ 9,070,000.00	$ 2,343,860.36
2030	21	0.2415	$ 9,190,000.00	$ 2,219,505.27
2031	22	0.2257	$ 9,280,000.00	$ 2,094,618.17
2032	23	0.2109	$ 9,380,000.00	$ 1,978,681.77
2033	24	0.1971	$ 9,480,000.00	$ 1,868,949.96
				$ 62,317,840.17

7% discount rate applied but inflation rate not applied, assuming that toll rate is not adjusted for inflation.
Cost of Tolls from Jacobs Traffic and Maintenance Study.