6 Financial Analysis[1]

6.1 Benefit-Cost Analysis

A benefit-cost analysis is a systematic evaluation of the economic advantages (benefits) and disadvantages (costs) of a set of investment alternatives. Typically, a "Base Case" is compared to one or more Alternatives (which have some significant improvement compared to the Base Case). The analysis evaluates incremental differences between the Base Case and the Alternative(s). In other words, a benefit-cost analysis tries to answer the question: What additional benefits will result if this Alternative is undertaken, and what additional costs are needed to bring it about?

The objective of a benefit-cost analysis is to translate the effects of an investment into monetary terms and to account for the fact that benefits generally accrue over a long period of time while capital costs are incurred primarily in the initial years. The primary transportation-related elements that can be monetized are travel time costs, vehicle operating costs, safety costs, ongoing maintenance costs, and remaining capital value (a combination of capital expenditure and salvage value). For some kinds of projects, such as bypasses, travel times and safety may improve, but operating costs may increase due to longer travel distances. A properly conducted benefit-cost analysis would indicate whether travel time and safety savings exceed the costs of design, construction, and the long-term increased operating costs.

6.2 Highway User Benefits

Benefits of a transportation investment are the direct, positive effects of that project; that is to say, the desirable things we obtain by directly investing in the project. For example, the improvement may reduce the number or severity of crashes, eliminate long delays during peak hours, or reduce circuitry of travel (provide a shorter route). In highway benefit cost analysis, the usual procedure is that benefits are first estimated in physical terms and then valued in economic terms. This means that the analyst has to first estimate the number of crashes eliminated, the travel time saved, and/or vehicle-miles reduced before assigning or calculating monetary values.

The benefits of a transportation investment are typically estimated by comparing the amount of travel time, vehicle miles traveled and expected number of crashes for the Alternative to the Base Case. The physical projection of the change brought about by each alternative is usually accomplished by engineering analysis.

The second step is translating these physical benefits into monetary values.

[1] Financial Analysis chapter is taken from Mn/DOT Office of Investment Management Website http://www.oim.dot.state.mn.us/EASS/

6.2.1 Travel-Time Savings

Travel-time savings typically generate the greatest amount of benefit. These savings are calculated based on the difference in travel time between the Base Case and an Alternative. Travel time is often expressed as vehicle-hours traveled (VHT) and can be estimated using computer models, spreadsheets, and/or travel time runs, depending on the level of analysis needed and data availability.

The estimation of travel time savings should include both the driver and passengers in the vehicle (i.e., vehicle occupancy rates). In many cases, vehicle occupancy rates vary between peak and off-peak hours as well as between alternatives. Several vehicle occupancy rates may be used to represent different conditions.

The valuation of travel time savings is calculated using standardized cost-per-hour-per-person figures for different vehicles (auto or truck).

6.2.2 Vehicle Operating Cost Savings

When transportation improvements are made, the cost of operating vehicles along a particular facility or set of facilities can change. Operating costs can change because the number of miles driven changes, as in the case of a shorter bypass or a reduction in circuitry or diversion of trips, or it can change because of changes in the number of stops or speed-cycle changes.

The number of vehicle-miles traveled (VMT) is the most common variable that affects vehicle operating costs. Once the change in vehicle miles is estimated, the valuation of vehicle operating costs is calculated using standardized cost-per-mile figures for different vehicles (auto or truck). However, if significant benefits are expected from other types of changes in travel characteristics, such as reducing the number of vehicle stops, reducing the number of speed-cycle changes, and possibly changes in pavement condition, those benefits can also be estimated.

6.2.3 Safety Benefits

Safety benefits are one of the principal benefits that can result from transportation improvements. Benefits occur when the number of crashes is reduced and/or the severity of the crashes is reduced on a facility or set of facilities because of the transportation improvement. Standard engineering methods can be used to evaluate both the potential crash reductions and/or changes in severity.

6.2.4 Air Quality Benefits[2]

Air pollution is a commonly recognized external transportation cost. Compared with some other emissions sources, such as electricity generation plants and factories, mobile (motor vehicle) emissions tend to be relatively difficult to control. Emissions are numerous and dispersed, and have relatively high damage costs because motor vehicles operate close to people.

Unit pollution costs can be calculated based on emission reduction (often called control or avoidance) costs, that is, the marginal cost of reducing a unit of emissions.

[2] Litman, Todd - Transportation Cost and Benefit Analysis – Air Pollution Costs
Victoria Transport Policy Institute (www.vtpi.org)

6.3 Costs

In economic terms, the cost of a transportation investment is the value of the resources that must be consumed to bring the project about. The total value of construction and any additional maintenance costs must be estimated. It is important to note that the analysis does not emphasize who incurs the cost but rather aims to include any and all costs that are involved in bringing about the project.

6.3.1 Capital Costs

Capital costs make up the total investment required to prepare a highway improvement for service, from engineering through landscaping. When possible, capital costs should be grouped into similar life-cycle categories. These include: engineering, right of way, major structures, grading and drainage, subbase and base, surfacing, and miscellaneous items. These life-cycle groupings make it easier to calculate remaining capital value. Estimates of capital cost, ranging from detailed engineer's estimates to planning-level cost estimates, should be as refined as appropriate for the project's stage in the project development process.

6.3.2 Major Rehabilitation Costs

Within a benefit-cost analysis period, future investments may be needed to maintain the serviceability of a major transportation facility. For example, with a new or reconstructed highway, pavement overlays may be required 8, 12 or 15 years after the initial construction year. The cost of overlays or other major preservation activities should be included in the analysis and allocated to the year when they are anticipated to occur.

6.3.3 Routine Annual Maintenance Costs

When evaluating transportation investments, it is important to account for the future operating and maintenance costs of the facility. Bridges require preventive maintenance, and roadway lanes have to be plowed and patched each year. In the case of an upgraded roadway, it is necessary to estimate the marginal or additional maintenance costs that would be required for the Alternative as compared to the Base Case. For a new facility (new alignment), the entire additional maintenance costs should be included as the incremental increase in costs.

6.3.4 Remaining Capital Value (RCV)

Many components of a project retain some residual useful life beyond the benefit-cost analysis period (typically 20 years). At the end of the analysis period, the infrastructure that has been put in place generally has not been completely worn out, and will continue to provide benefits to drivers and travelers into the future. It is important to reflect this value in the analysis.

The remaining capital value is calculated by determining the percentage of useful life remaining beyond the analysis period, and multiplying that percentage by the construction cost for that component. The estimate of the remaining capital value at the end of the analysis period is then converted to a present value and subtracted from the initial capital cost.

6.4 Discounting

For most transportation investments, costs are incurred in the initial years, while the benefits from the investment accrue over many years into the future. When assessing the costs and

benefits of a project, it is necessary to take into account the time value of money by converting the costs and benefits that take place in different years into a common year. This process is known as discounting. Discounting converts future costs and benefits that occur in different years into a value for a common year (present value).

In general, economic analysis of transportation investment uses constant dollars; inflation is not included in the estimates of costs and benefits. In an economic analysis all costs and benefits are given in constant dollars (no inflation) and are discounted to the year of analysis. The year of analysis is usually the current year.

6.5 Assumptions

6.5.1 Analysis Timeframe

The analysis timeframe is the period of time for which project benefits and related costs are compared and evaluated. The general principles for selecting an analysis period are:

- The timeframe should be long enough to capture the majority of benefits, but not so long as to exceed capabilities to develop good traffic information.
- The analysis timeframe should be consistent with that used for other analyses being under-taken for the project, such as transportation demand forecasts or life-cycle cost models.
- The timeframe should be consistent for all alternatives.
- All benefits and costs occurring or accruing over this timeframe should be included in the analysis.

An analysis period of 40 years, from year 2006 to 2045, is used in this analysis.

6.5.2 Years of Construction

Construction costs in a benefit-cost analysis are assigned to the year or years in which they are anticipated to occur. If the timing of incurred costs is not known, the construction cost should be divided evenly over the years of construction. For this analysis, costs were divided over five years of 2025 through 2029 in equal amounts to reflect the construction period. Construction costs are then discounted to the year of analysis, which is 2007.

6.5.3 First Year of Benefits

The first year of benefits is the first full year after construction of the Alternative is complete. For example, if construction is scheduled to be completed in fall of 2029, the first year of benefits is 2030.

6.5.4 Final Year of Analysis/Year of Remaining Capital Value (RCV)

The final year of analysis and year of remaining capital value are the same. For example, if the study has a 40-year benefit-cost analysis (2006 to 2045), the final year of analysis and year of remaining capital value is 2045.

The final year of analysis is defined as the final year of the benefit-cost analysis. The year of remaining capital value is defined as the year in which the remaining capital value (salvage value) of a transportation investment is assessed.

6.5.5 Number of Days in a Year

The number of days in a year over which benefits accrue depends on the traffic characteristics and the proposed improvement. A typical capacity improvement done in an area with a high-level of commuter traffic (trips between home and work) should use 260 days, the number of weekdays (Monday through Friday) in a year. Weekday effects for this example are chosen because traffic volumes are consistently highest at these times throughout the year. However, if this same example were used with the improvement being a new roadway that reduced trip length for all users by two-miles, benefits would accrue over the 365 days in the year. Also, substantial benefits may occur on weekends for projects in some areas (especially where recreational trip patterns exist). In these cases, weekend benefits can be assessed separately and added to the weekday analysis. In areas with lower commuter volumes, 365 days should be used. The number of days assumed in a year should always be noted in the analysis documentation.

6.5.6 Discount rate[3]

Nominal discount rates include inflation, while those that are net of inflation are called real discount rates. Selecting the correct discount rate is particularly important when evaluating impacts that occur many years in the future, such as the benefits of a highway improvement after 20 years. The higher the rate, the more weight is given to present over future benefits. Capital investment discount rates are typically 6-10%. These rates reflect the return capital could earn in typical alternative investments. For this analysis, a discount rate of 7% was used.

6.5.7 Accident Rates and Costs

Accident rates are based on existing three year historical crash data for the study area. For the No Build scenario, it is assumed that accident rates will be static into the future. For Alternative 6 it is assumed that the consolidation of the closely space exit ramps at Interchanges 21 and 22 in the eastbound direction of I-84 will result in a 5% reduction to the accident rate.

For Alternatives 7 and 8, it is assumed that a greater reduction in accident rates will be realized from the geometric improvements to the interchange. Research indicates that it would be appropriate to show a 23.7% reduction in accident rate for major geometric improvements to an interchange. One particular study published by the Transportation Research Board (TRB) looked at many types of urban and suburban freeway-arterial interchanges with major geometric, minor ramp, or minor crossroad modifications. Modifications to diamond interchanges included lengthening of acceleration and deceleration lanes, adding ramp lanes, and optimizing traffic signals. Modifications to cloverleaf interchanges included addition of collector-distributor roads, lengthening of weave areas, and lengthening of acceleration and deceleration lanes. The before

[3] Litman, Todd - Transportation Cost and Benefit Analysis – Air Pollution Costs
Victoria Transport Policy Institute (www.vtpi.org) – pp. 1-11

and after accident histories were analyzed and percent reductions in accidents determined to a statistically significant at a 95% confidence level.[4]

Although the scope of this research was for freeway-arterial interchanges, the authors note that "it is recognized that many of the results from this project are applicable to freeway-freeway interchanges".

Costs per accident are based on FHWA research and include both the cost of the accident in terms of casualty and damages as well as the costs associated with delay to other motorists.

6.5.8 Emission Rates and Costs

Emission rates by average vehicle speed were taken from 2023 modeled values as determined by the California Department of Transportation. Future year rate information is used because vehicles are projected to produce fewer emissions than they do today. Average vehicle speeds were determined from the VISSIM model developed for this study.

Health costs associated with vehicle emissions was estimate by the CalDOT.

6.5.9 Vehicle Occupancy

Vehicle Occupancy is assumed to be 1.2 persons per vehicle. It is possible that the occupancy rate could be higher in 25 years as congestion becomes more severe.

6.5.10 Value of Time

Value of time for the analysis is derived from the statewide average wage of $24.74 per hour and is estimated at $12.37 for automobiles and $27.83 for trucks.

6.5.11 Vehicle Operating Cost

The following vehicle operating costs for automobiles and trucks in Waterbury, CT were used:

- Fuel Cost Per Gallon (Excludes Taxes) $2.55 /gal
- Non-Fuel Cost Per Mile
  - Automobile $0.173/mi
  - Truck $0.299/mi

Fuel consumption rates by average vehicle speed were taken from 2003 modeled values as determined by the California Department of Transportation. Once again, average vehicle speeds were determined from the VISSIM model developed for this study.

6.5.12 Truck Percentage

Trucks were estimated to be 5% of total vehicles on average for the study area.

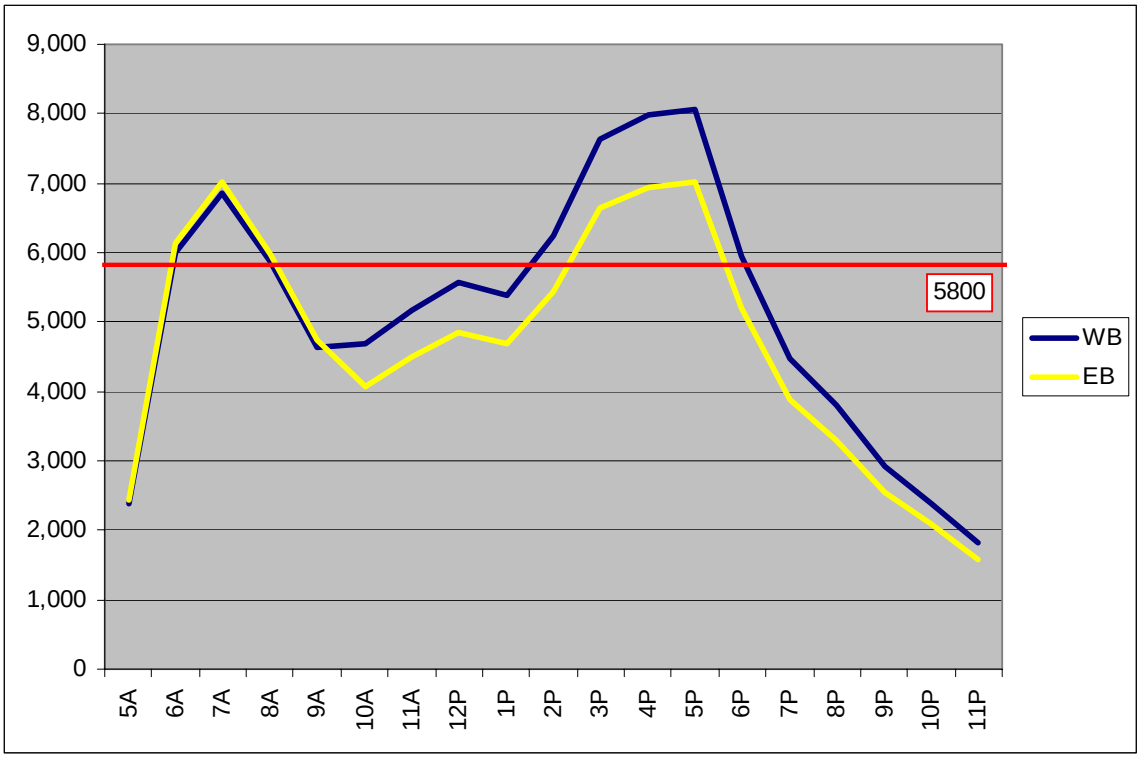
[4] D. W. Harwood and J.L. Graham. Rehabilitation of Existing Freeway-Arterial Highway Interchanges. Transportation Research Record 923, TRB, National Research Council, Washington, D.C., 1983, pp. 18-25.

6.5.13 Peak Period Duration

To properly assess the total benefits that can be realized by a transportation improvement, one must consider the duration of congestion in the No Build scenario and accrue delay over that entire period. For this study, the VISSIM microsimulation model was used to determine the delay experienced in the peak hour of the day. With this model it was determined that the total interchange system could handle a maximum vehicle throughput of approximately 5,800 vehicles per hour. As illustrated by Figure 6-1 below, the actual unconstrained demand for the interchange in year 2030 is significantly higher than the system's capacity during the morning and afternoon peaks.

When demand exceeds capacity, three events may occur: 1) people may choose to use an alternate route (diversion), 2) people may choose not to make the trip – or use another mode, and 3) people may alter their travel times to make use of the excess highway capacity in the off-peak times of the day. For the purpose of this analysis we will make the assumption that people will choose option 3; that is, vehicles will spread to the shoulder hours of the peaks and congestion will be distributed over the course of the entire day. This option is valid because there are no viable alternate routes in the region and we cannot arbitrarily assume that a specific number of trips will simply 'disappear' due to extreme congestion throughout the day. In reality, trips may reduce due to jobs leaving the region and the positive impact of Travel Demand Management (TDM) strategies like telecommuting; however, to make this a fair comparison to the Build alternative we will not be making these assumptions.

Figure 6-1
Daily Vehicle Demand



The demand curve in Figure 6-1 was created by taking the daily traffic variations from the ConnDOT permanent count station in the neighboring town of Middlebury and factoring it to account for the higher demand experienced in the City of Waterbury.

By taking the area of the shapes above the 5,800 capacity line and redistributing the volume to the surplus capacity areas below the line, we can make an assumption that congestion experienced in the peak hour simulation will be experienced for most of the day. For the purpose of this analysis, we assumed that the No Build scenario would result in 10 hours of peak congestion.

For Alternatives 7 and 8, the VISSIM model resulted in peak hour delays that are lower than those experienced today in the absence of a traffic accident; that is to say, the traffic demand can be easily accommodated by the added system capacity of the new interchange alternatives. For this reason the assumption was made to extend the peak hour VISSIM statistics over a three hour period as opposed to the ten hours experienced under the No Build and Alternative 6.

For the remaining off peak hours, a VISSIM model was run to reflect an un-congested traffic condition and the delay reported by the model was multiplied the number of off-peak hours in the day. For the purpose of this analysis, the day was assumed to be sixteen hours long and the remaining eight hours in an actual day – namely the hours between 10:00 P.M. and 6:00 A.M – were assumed to be the same for all scenarios since the traffic volume decreases to very low levels over that period.

6.5.14 Capital Costs

Capital Costs are based on the conceptual construction cost estimates presented in the previous chapter.

6.5.15 Maintenance Costs

Maintenance costs include the costs associated with keeping the interchange system in safe and efficient working condition over the useful life of the infrastructure. Since a detailed life cycle analysis was not performed as part of this study, maintenance costs cannot be accurately determined. It is certain that such costs would be very low for new structures since the useful lives of those structures are much greater than the analysis period used; however, the maintenance of existing structures that are to be repaired in the No Build scenario and in Alternative 6 are much more difficult to predict without performing a life cycle analysis. It is anticipated that these costs may be added to the analysis based on estimates derived from other structures in the state currently maintained by ConnDOT. At this time no maintenance costs are used in the analysis.

6.6 Benefit Cost Ratio

Based on the assumptions listed above and the performance measures reported by the VISSIM model, benefit-cost ratios were calculated for each of the three Alternatives. The calculation for B/C is simply the total discounted benefits divided by the total discounted costs. Conceptual Alternative 8 had the highest B/C ratio with a value of 1.03. Conceptual Alternative 7 had a B/C value of 0.95 and Conceptual Alternative 6 came in at 0.29. According to this analysis,

Conceptual Alternative 8 is the most cost effective project of the three Alternatives. Given that the B/C ratio is over a value of 1.0, the ratio also indicates that the benefits outweigh the costs and the project is economically justifiable.

It should be noted that although the full build alternatives yield relatively high B/C ratios and indicate strong economic justification for a new interchange, the total cost of such a project is enormous. The main reason that the benefits outweigh the costs for Conceptual Alternative 8 is the substantial time savings that would be realized by the millions of vehicles that use the interchange per year as a result of additional capacity and improved safety. It should also be noted; however, that the existing structure cannot be maintained forever. There will be a point in time in which a major rehabilitation, or complete replacement, would be necessary. Such a situation could indefinitely take the structure off-line, resulting in major disruption to traffic, quality of life, the environment, and economic growth – not to mention a significant financial investment.

Tables 6-1, 6-2, and 6-3 list the results of the analyses.

Table 6-1
Benefit-Cost Calculations for Alternative 6

Year	Benefits					Costs			Discount Factor	Discounted Total Benefits	Discounted Total Costs
	Travel Time	Safety	Operating	Emission	Total Benefits	Capital	Maintenance	Total Costs			
2007					$0	$0	$0	$0	1.00	$0	$0
2008					$0	$0	$0	$0	0.94	$0	$0
2009					$0	$0	$0	$0	0.88	$0	$0
2010					$0	$0	$0	$0	0.83	$0	$0
2011					$0	$0	$0	$0	0.78	$0	$0
2012					$0	$0	$0	$0	0.73	$0	$0
2013					$0	$0	$0	$0	0.69	$0	$0
2014					$0	$0	$0	$0	0.64	$0	$0
2015					$0	$0	$0	$0	0.60	$0	$0
2016					$0	$0	$0	$0	0.57	$0	$0
2017					$0	$0	$0	$0	0.53	$0	$0
2018					$0	$0	$0	$0	0.50	$0	$0
2019					$0	$0	$0	$0	0.47	$0	$0
2020					$0	$0	$0	$0	0.44	$0	$0
2021					$0	$0	$0	$0	0.41	$0	$0
2022					$0	$0	$0	$0	0.39	$0	$0
2023					$0	$0	$0	$0	0.37	$0	$0
2024					$0	$0	$0	$0	0.34	$0	$0
2025					$0	$76,847,102	$37,561	$76,884,663	0.32	$0	$24,748,380
2026					$0	$76,847,102	$37,561	$76,884,663	0.30	$0	$23,237,916
2027					$0	$76,847,102	$37,561	$76,884,663	0.28	$0	$21,819,639
2028					$0	$76,847,102	$37,561	$76,884,663	0.27	$0	$20,487,924
2029					$0	$76,847,102	$37,561	$76,884,663	0.25	$0	$19,237,487
2030	$1,169,952	$136,868	$11,626,083	$28,257	$12,961,159	$0	$37,561	$37,561	0.23	$3,045,109	$8,825
2031	$1,158,368	$135,513	$11,510,973	$27,977	$12,832,831	$0	$37,561	$37,561	0.22	$2,830,948	$8,286
2032	$1,146,900	$134,171	$11,397,003	$27,700	$12,705,773	$0	$37,561	$37,561	0.21	$2,631,849	$7,780
2033	$1,135,544	$132,842	$11,284,162	$27,426	$12,579,974	$0	$37,561	$37,561	0.19	$2,446,752	$7,305
2034	$1,124,301	$131,527	$11,172,437	$27,154	$12,455,419	$0	$37,561	$37,561	0.18	$2,274,673	$6,860
2035	$1,113,169	$130,225	$11,061,819	$26,885	$12,332,099	$0	$37,561	$37,561	0.17	$2,114,696	$6,441
2036	$1,102,148	$128,936	$10,952,296	$26,619	$12,209,999	$0	$37,561	$37,561	0.16	$1,965,970	$6,048
2037	$1,091,236	$127,659	$10,843,857	$26,355	$12,089,107	$0	$37,561	$37,561	0.15	$1,827,705	$5,679
2038	$1,080,431	$126,395	$10,736,493	$26,095	$11,969,413	$0	$37,561	$37,561	0.14	$1,699,163	$5,332
2039	$1,069,734	$125,144	$10,630,191	$25,836	$11,850,904	$0	$37,561	$37,561	0.13	$1,579,662	$5,007
2040	$1,059,142	$123,905	$10,524,941	$25,580	$11,733,569	$0	$37,561	$37,561	0.13	$1,468,565	$4,701
2041	$1,048,656	$122,678	$10,420,734	$25,327	$11,617,395	$0	$37,561	$37,561	0.12	$1,365,281	$4,414
2042	$1,038,273	$121,463	$10,317,558	$25,076	$11,502,371	$0	$37,561	$37,561	0.11	$1,269,261	$4,145
2043	$1,027,993	$120,261	$10,215,404	$24,828	$11,388,486	$0	$37,561	$37,561	0.10	$1,179,995	$3,892
2044	$1,017,815	$119,070	$10,114,262	$24,582	$11,275,729	$0	$37,561	$37,561	0.10	$1,097,006	$3,654
2045	$1,007,738	$117,891	$10,014,120	$24,339	$11,164,088	-$55,392,697	$0	-$55,392,697	0.09	$1,019,854	-$5,060,197
Totals	$17,391,401	$2,034,546	$172,822,333	$420,036	$192,668,316	$328,842,815	$751,220	$329,594,035		$29,816,489	$104,559,518

Benefit/cost ratio= 0.29

Table 6-2
Benefit-Cost Calculations for Alternative 7

Year	Benefits					Costs			Discount Factor	Discounted Total Benefits	Discounted Total Costs
	Travel Time	Safety	Operating	Emission	Total Benefits	Capital	Maintenance	Total Costs			
2007					$0	$0	-$793,393	-$793,393	1.00	$0	-$793,393
2008					$0	$0	-$1,221,508	-$1,221,508	0.94	$0	-$1,146,956
2009					$0	$0	-$1,707,109	-$1,707,109	0.88	$0	-$1,505,088
2010					$0	$0	-$2,244,053	-$2,244,053	0.83	$0	-$1,857,737
2011					$0	$0	-$2,827,830	-$2,827,830	0.78	$0	-$2,198,138
2012					$0	$0	-$3,454,946	-$3,454,946	0.73	$0	-$2,521,699
2013					$0	$0	-$4,122,589	-$4,122,589	0.69	$0	-$2,825,351
2014					$0	$0	-$4,828,433	-$4,828,433	0.64	$0	-$3,107,127
2015					$0	$0	-$5,570,514	-$5,570,514	0.60	$0	-$3,365,878
2016					$0	$0	-$6,347,140	-$6,347,140	0.57	$0	-$3,601,071
2017					$0	$0	-$7,156,839	-$7,156,839	0.53	$0	-$3,812,635
2018					$0	$0	-$7,998,311	-$7,998,311	0.50	$0	-$4,000,853
2019					$0	$0	-$8,870,398	-$8,870,398	0.47	$0	-$4,166,274
2020					$0	$0	-$9,772,062	-$9,772,062	0.44	$0	-$4,309,643
2021					$0	$0	-$10,702,362	-$10,702,362	0.41	$0	-$4,431,851
2022					$0	$0	-$11,660,441	-$11,660,441	0.39	$0	-$4,533,889
2023					$0	$0	-$12,645,518	-$12,645,518	0.37	$0	-$4,616,820
2024					$0	$0	-$13,656,872	-$13,656,872	0.34	$0	-$4,681,747
2025					$0	$292,853,476	$30,191	$292,883,667	0.32	$0	$94,276,231
2026					$0	$292,853,476	$30,191	$292,883,667	0.30	$0	$88,522,283
2027					$0	$292,853,476	$30,191	$292,883,667	0.28	$0	$83,119,515
2028					$0	$292,853,476	$30,191	$292,883,667	0.27	$0	$78,046,493
2029					$0	$292,853,476	$30,191	$292,883,667	0.25	$0	$73,283,092
2030	$79,611,811	$6,178,230	$41,386,721	$936,800	$128,113,562	$0	$30,191	$30,191	0.23	$30,099,143	$7,093
2031	$78,823,575	$6,117,059	$40,976,952	$927,525	$126,845,111	$0	$30,191	$30,191	0.22	$27,982,283	$6,660
2032	$78,043,143	$6,056,494	$40,571,239	$918,342	$125,589,219	$0	$30,191	$30,191	0.21	$26,014,301	$6,254
2033	$77,270,439	$5,996,529	$40,169,544	$909,249	$124,345,761	$0	$30,191	$30,191	0.19	$24,184,727	$5,872
2034	$76,505,385	$5,937,157	$39,771,826	$900,247	$123,114,615	$0	$30,191	$30,191	0.18	$22,483,825	$5,514
2035	$75,747,906	$5,878,374	$39,378,045	$891,334	$121,895,658	$0	$30,191	$30,191	0.17	$20,902,548	$5,177
2036	$74,997,927	$5,820,172	$38,988,164	$882,508	$120,688,771	$0	$30,191	$30,191	0.16	$19,432,480	$4,861
2037	$74,255,373	$5,762,546	$38,602,142	$873,771	$119,493,832	$0	$30,191	$30,191	0.15	$18,065,802	$4,564
2038	$73,520,171	$5,705,491	$38,219,943	$865,120	$118,310,725	$0	$30,191	$30,191	0.14	$16,795,242	$4,286
2039	$72,792,249	$5,649,001	$37,841,527	$856,554	$117,139,332	$0	$30,191	$30,191	0.13	$15,614,040	$4,024
2040	$72,071,534	$5,593,071	$37,466,859	$848,073	$115,979,536	$0	$30,191	$30,191	0.13	$14,515,912	$3,779
2041	$71,357,954	$5,537,694	$37,095,900	$839,677	$114,831,224	$0	$30,191	$30,191	0.12	$13,495,014	$3,548
2042	$70,651,440	$5,482,865	$36,728,614	$831,363	$113,694,281	$0	$30,191	$30,191	0.11	$12,545,915	$3,332
2043	$69,951,920	$5,428,579	$36,364,964	$823,132	$112,568,595	$0	$30,191	$30,191	0.10	$11,663,566	$3,128
2044	$69,259,327	$5,374,831	$36,004,915	$814,982	$111,454,055	$0	$30,191	$30,191	0.10	$10,843,273	$2,937
2045	$68,573,591	$5,321,615	$35,648,431	$806,913	$110,350,549	-$556,337,166	$30,191	-$556,306,975	0.09	$10,080,670	-$50,819,386
Totals	$1,183,433,745	$91,839,709	$615,215,785	$13,925,589	$1,904,414,828	$907,930,214	-$114,946,307	$792,983,907		$294,718,742	$309,023,110

Benefit/cost ratio= 0.95

Table 6-3
Benefit-Cost Calculations for Alternative 8

Year	Benefits					Costs			Discount Factor	Discounted Total Benefits	Discounted Total Costs
	Travel Time	Safety	Operating	Emission	Total Benefits	Capital	Maintenance	Total Costs			
2007					$0	$0	-$852,097	-$852,097	1.00	$0	-$852,097
2008					$0	$0	-$1,311,889	-$1,311,889	0.94	$0	-$1,231,820
2009					$0	$0	-$1,833,420	-$1,833,420	0.88	$0	-$1,616,452
2010					$0	$0	-$2,410,093	-$2,410,093	0.83	$0	-$1,995,194
2011					$0	$0	-$3,037,065	-$3,037,065	0.78	$0	-$2,360,781
2012					$0	$0	-$3,710,582	-$3,710,582	0.73	$0	-$2,708,282
2013					$0	$0	-$4,427,624	-$4,427,624	0.69	$0	-$3,034,402
2014					$0	$0	-$5,185,695	-$5,185,695	0.64	$0	-$3,337,027
2015					$0	$0	-$5,982,684	-$5,982,684	0.60	$0	-$3,614,924
2016					$0	$0	-$6,816,774	-$6,816,774	0.57	$0	-$3,867,519
2017					$0	$0	-$7,686,383	-$7,686,383	0.53	$0	-$4,094,737
2018					$0	$0	-$8,590,117	-$8,590,117	0.50	$0	-$4,296,882
2019					$0	$0	-$9,526,731	-$9,526,731	0.47	$0	-$4,474,542
2020					$0	$0	-$10,495,110	-$10,495,110	0.44	$0	-$4,628,519
2021					$0	$0	-$11,494,243	-$11,494,243	0.41	$0	-$4,759,769
2022					$0	$0	-$12,523,213	-$12,523,213	0.39	$0	-$4,869,357
2023					$0	$0	-$13,581,177	-$13,581,177	0.37	$0	-$4,958,424
2024					$0	$0	-$14,667,362	-$14,667,362	0.34	$0	-$5,028,155
2025					$0	$282,759,867	$65,347	$282,825,214	0.32	$0	$91,038,519
2026					$0	$282,759,867	$65,347	$282,825,214	0.30	$0	$85,482,178
2027					$0	$282,759,867	$65,347	$282,825,214	0.28	$0	$80,264,955
2028					$0	$282,759,867	$65,347	$282,825,214	0.27	$0	$75,366,155
2029					$0	$282,759,867	$65,347	$282,825,214	0.25	$0	$70,766,343
2030	$77,560,712	$6,178,230	$40,385,634	$886,611	$125,011,187	$0	$65,347	$65,347	0.23	$29,370,267	$15,353
2031	$76,792,785	$6,117,059	$39,985,776	$877,832	$123,773,452	$0	$65,347	$65,347	0.22	$27,304,669	$14,416
2032	$76,032,460	$6,056,494	$39,589,877	$869,141	$122,547,972	$0	$65,347	$65,347	0.21	$25,384,343	$13,536
2033	$75,279,663	$5,996,529	$39,197,898	$860,536	$121,334,626	$0	$65,347	$65,347	0.19	$23,599,074	$12,710
2034	$74,534,320	$5,937,157	$38,809,800	$852,016	$120,133,293	$0	$65,347	$65,347	0.18	$21,939,361	$11,934
2035	$73,796,357	$5,878,374	$38,425,545	$843,580	$118,943,855	$0	$65,347	$65,347	0.17	$20,396,375	$11,206
2036	$73,065,700	$5,820,172	$38,045,094	$835,227	$117,766,193	$0	$65,347	$65,347	0.16	$18,961,907	$10,522
2037	$72,342,277	$5,762,546	$37,668,410	$826,958	$116,600,191	$0	$65,347	$65,347	0.15	$17,628,324	$9,880
2038	$71,626,017	$5,705,491	$37,295,455	$818,770	$115,445,733	$0	$65,347	$65,347	0.14	$16,388,532	$9,277
2039	$70,916,848	$5,649,001	$36,926,193	$810,664	$114,302,706	$0	$65,347	$65,347	0.13	$15,235,933	$8,710
2040	$70,214,701	$5,593,071	$36,560,587	$802,637	$113,170,996	$0	$65,347	$65,347	0.13	$14,164,397	$8,179
2041	$69,519,506	$5,537,694	$36,198,601	$794,690	$112,050,491	$0	$65,347	$65,347	0.12	$13,168,221	$7,680
2042	$68,831,194	$5,482,865	$35,840,199	$786,822	$110,941,081	$0	$65,347	$65,347	0.11	$12,242,106	$7,211
2043	$68,149,697	$5,428,579	$35,485,346	$779,032	$109,842,654	$0	$65,347	$65,347	0.10	$11,381,124	$6,771
2044	$67,474,948	$5,374,831	$35,134,006	$771,319	$108,755,103	$0	$65,347	$65,347	0.10	$10,580,694	$6,358
2045	$66,806,879	$5,321,615	$34,786,144	$763,682	$107,678,320	-$681,583,000	150000	-$681,433,000	0.09	$9,836,558	-$62,249,815
Totals	$1,152,944,064	$91,839,709	$600,334,564	$13,179,516	$1,858,297,853	$732,216,335	-$122,675,319	$609,541,016		$287,581,885	$279,093,192

Benefit/cost ratio= 1.03