Washington State Department of Transportation

Appendix B: Benefit-Cost Analysis and Economic Impact Analysis

United States Department of Transportation (USDOT) guidance (CFR Vol. 74 No. 115 Docket No. OST-2009-0115) indicates that benefit-cost analyses in support of TIGER funding requests are to be performed with defensible and robust methods, data and assumptions. The following benefit-cost analysis (BCA) measures benefits against costs throughout the study period beginning at the start of construction and including benefits over four years of construction and 30 years of full operations (2010 to 2042). The monetized benefits and costs are estimated in 2009 dollars with future dollars discounted in compliance with TIGER requirements at a real 7 percent rate and also at 3 percent.

I. Framework

The BCA framework is structured around a fundamental relationship between the demand for travel and the cost of trip making. Though each travel benefit is estimated separately, the BCA assumes a relationship between the quantity of travel demanded, the generalized costs of trip-to-trip makers and the benefits to existing and new travelers.

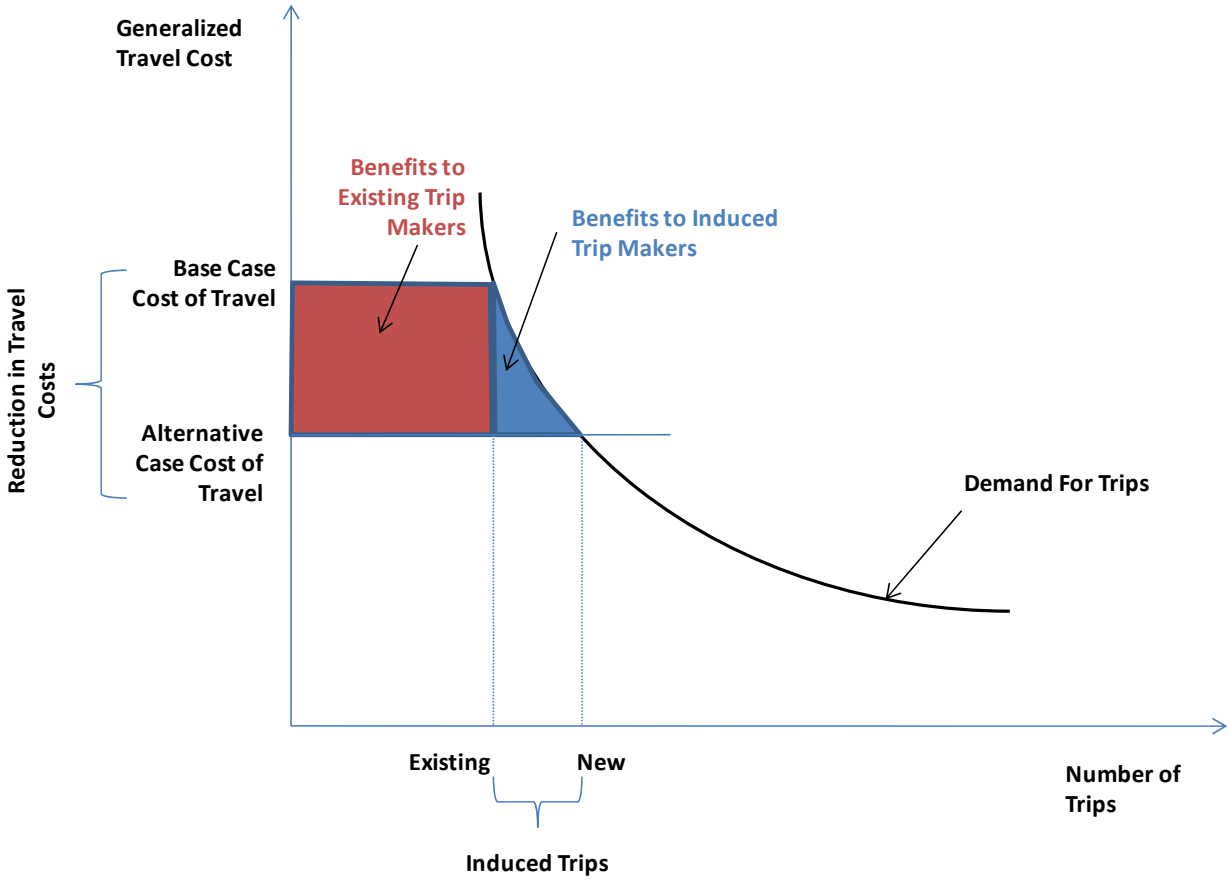
The BCA framework is a comparison of values – the costs to build and operate the roadway facility represent foregone value that could alternatively be invested elsewhere and the benefits of the SR 520 Medina to SR 202: Eastside Transit and HOV Project (Eastside Project) represent the improvement in social well-being delivered by the project. To be deemed economically feasible, projects must pass one or more value benchmarks: the total benefits must exceed the total costs of the project on a present value basis and/or the rate of return on the funds invested should exceed the cost of raising capital, often defined as the long-term treasury rate or the social discount rate.

Benefits are estimated for current and future users on an incremental basis – as the change in welfare that consumers and, more generally, society derive from the improved roadway and expanded high occupancy vehicle (HOV) system in comparison with an estimated no-build condition. As with most transportation projects, the benefits derived from implementation, are primarily a reduction in the costs associated with transportation activities. The estimated reduction in costs accounts for user preferences and the way the project affects the availability of specific transportation options and associated costs. These travel cost reductions include time saved by users and reduced costs of unreliability – the primary costs to users in this circumstance – as well as reduced travel costs, mobility enhancements, job creation, reduction of pollution and accidents, or a combination of these outcomes.

Exhibit 1 presents this general framework. The red square represents the benefit of reduced travel cost accruing to existing trip makers. The blue triangle represents the benefit resulting from new trips. Readers should note that the change in generalized cost from no-build to build represents only the change in user cost, which is specific to travel time and monetary trip costs. The demand for trips is downward sloping: as the generalized cost of travel decreases, the number of trips increases. Investment in transportation facilities can be evaluated by estimating the change in the generalized price of travel brought about by the investment, and the associated change in trip making.

Social costs, including marginal congestion externalities, marginal emissions, and marginal accident occurrences, are assumed in this analysis to not affect trip making or modal decisions.

Exhibit 1. Consumer Surplus from Reduction in Travel Cost



Within this framework, the benefit-cost analysis estimates lifecycle benefits and costs accruing to roadway users as well as more widely experienced benefits including emissions reductions, economic development effects, and short-term job creation.

The following principles guide the estimation of benefits and costs:

- Only incremental benefits and costs are measured.
    - The incremental benefits of the project include the transportation cost savings for the users of the roadway, whether from faster travel times or improved reliability in arrival time.
    - The incremental costs of implementation of the project include initial and recurring costs. Initial costs refer to the capital costs incurred for design, right of way, rolling stock and construction of the facility. Recurring costs include incremental operating costs in addition to administration and marketing expenses. Only additions in costs to the current operations and planned investments are considered in this analysis.

    - The creation of new jobs may or may not be an incremental benefit depending on the types of jobs, the population filling those jobs and the likely level of local or regional unemployment at the time those jobs are created. Given the current economic situation and the purpose of the TIGER program, this analysis assumes that short-term job creation represents net new employment that can be counted as a project benefit. Long-term job creation is not included in the measurement of project benefits and costs.

- Benefits and costs are valued relative to the "no-build" scenario, i.e. making no changes to the Eastside portion of SR 520.
- All benefits and costs are estimated in 2009 dollars. The valuation of benefits makes use of a number of assumptions that are required to produce monetized values for all these non-pecuniary benefits. The different components of time, for instance, are monetized by using a "value of time" that is assumed to be equivalent to the user's willingness to pay for time savings in transit. These, as with many other values used in the analysis, are taken from USDOT guidance on the preparation of TIGER applications. Where USDOT has not provided a valuation guidance or a reference to guidance, standard industry practice has been applied. Estimates used in the monetization of benefits include the cost of operating a vehicle, including maintenance, repair, and depreciation. A summary of values applied in the economic analysis can be found at the end of this appendix.
- Annual costs and benefits are computed over a long-run planning horizon and summarized through a lifecycle cost analysis. The project is assumed to have a useful life of at least 30 years. Construction costs are incurred within the first four years. Benefits accrue for 30 years of operations after construction is complete.
- The opportunity cost associated with the delayed consumption of benefits and the alternative uses of the capital for the implementation of the project is measured by the discount rate. All benefits and costs are discounted to reflect the opportunity costs of committing resources to the project. Calculated real discount rates are applied to all future costs and benefits as a representation of how the public sector evaluates investments. Results are presented under a 7 percent real discount rate and again under a 3 percent real discount rate.

Travel demand forecast

Anticipated changes in travel patterns due to construction of the Eastside Project were derived from roadway travel forecasts from the Puget Sound Regional Council's (PSRC) regional travel demand model (EMME/2). The PSRC is the Metropolitan Planning Organization for the four-county region of Snohomish, King, Kitsap, and Pierce counties and works with the state, ports, transit agencies, tribes, local governments, and businesses to develop and update the regional transportation plan and the EMME/2 travel demand model. For the Eastside Project, the PSRC model was further updated, refined, and validated along the SR 520 corridor to ensure reasonable travel demand modeling. Travel demand modeling produced for the project included updates to jurisdictional population and employment estimates combined with planned and programmed roadway projects to help planners estimate future traffic volumes for the SR 520 corridor.

II. Input categories

Input values used in this analysis are taken from the USDOT guidance on the preparation of benefit-cost analyses, including the recently published guidelines for the TIGER grant applications. Where USDOT has not provided valuation guidance or a reference to guidance, standard industry practice has been applied.

Estimates used in the monetization of benefits include the cost of operating a vehicle, including maintenance, repair, and depreciation. Exhibit 2 lists input variables used in this analysis and the dollar year listed from the source. Input variables are adjusted to 2009 dollars for the analysis.

External costs are estimated based on the reduction in the amount of emissions produced, as well as regional accidents avoided. Internal costs include time and operating costs, both for passenger vehicles as well as transit users.

The value of time for commuters is estimated at $11.20 per hour (2000 dollar), based on the revised USDOT 2003 *Departmental Guidance: Valuation of Travel Time in Economic Analysis*, and inflated to 2009 dollars ($14.11) as per Department guidance.[1] A congestion premium of 2.5 was then applied to account for the value of non-congested peak-time travel relative to congested peak-time travel. The 2.5 premium follows recommendations from the National Cooperative Highway Research Program's "Valuation of Travel-Time Savings and Predictability in Congested Conditions for Highway User-Cost Estimation."

Meanwhile emission costs are expressed as dollars per ton and are based on the benefits associated with recently-adopted regulations that limit emissions of air pollutants from mobile sources, a category that includes passenger cars, light trucks, and other highway vehicles.

[1] Inflated as per "Responses to Questions and Requests for Clarifications Submitted to the Department of Transportation Regarding the TIGER Discretionary Grants Program, August 28, 2009", on Department website, "OST Information Related to the American Recovery and Reinvestment Act of 2009," http://www.dot.gov/recovery/ost/responses090828.htm

Exhibit 2. Input Variables used in the Cost Benefit Analysis

Category	Value	Source
Value of Time (per auto GP rider)	$11.20	TIGER Guidelines Local Business Travel, 2000
Value of Time (per auto HOV rider)	$11.20	TIGER Guidelines Local Business Travel, 2000
Value of Time (per bus HOV rider)	$11.20	TIGER Guidelines Local Business Travel, 2000
Congestion Premium	2.5	NCHRP, Report 431
Fuel Cost Auto, Gallons	$3.33	TIGER Guidelines, 2009
Oil Cost Auto, Quarts	$6.18	FHWA, HERS 2002 report, 2007
Tire Cost Auto, 4 Tires	$79.07	FHWA, HERS 2002 report, 2007
M&R Cost Auto, per Repair Visit	$93.10	HERS Tech 2003 Memo, 1997
Depreciable Value Auto	$20,000.63	FHWA, HERS 2002 report, 2007
Fatal Accident Cost	$6,000,000.00	TIGER Guidelines, 2009
Injury Accident Cost	$64,000.33	Oregon DOT, 2007
PDO Accident Cost	$41,000.88	Oregon DOT, 2007
VOCCost	$1,700.00	TIGER Guidelines, 2007
COCost	$500.00	Victoria Transportation Policy Institute. 2007
NOXCost	$4,000.00	TIGER Guidelines, 2007
SOXCost	$16,000.00	TIGER Guidelines, 2007
PM10Cost	$168,000.00	TIGER Guidelines, 2007
PM25Cost	$168,000.00	TIGER Guidelines, 2007
CO2Cost	$33.00	TIGER Guidelines (World Mean Value), 2007
Avg. Fare -- Bus	$2.50	King County Metro Bus Fares for 2 zone trips during Peak times, 2009

III. Project life cycle costs

The full project cost, independent of funding source, is used for comparison with total benefits. The costs of the project consist of $776 million for construction, right-of-way, and other expenses. Costs will be incurred over the five years of construction, 2010 to 2015. The project schedule and the associated schedule of expenditures have been tracked to produce total discounted construction costs (at 7 percent) of $612.9 million ($673.1 million when discounted at 3 percent).

IV. Benefits

This section describes the measurement approach for each category of benefit estimated in this analysis and provides an overview of the data and assumptions used in the analysis.

Key benefit categories from the Eastside Project are due to congestion management impacts, the savings resulting from reductions in travel time, vehicle operating costs, accident costs and emission costs due to less congestion and fewer miles traveled by personal vehicles resulting from the implementation of the project. The availability of

transit and improved HOV facilities can result in social cost savings associated with savings resulting from increasing transit use, reductions in automobile use relative to the base case, leading to travel time savings, vehicle operating cost savings, emission cost savings, and accident cost savings.

Exhibit 3 describes each of the benefits which were able to be monetized in this analysis, categorized based upon criteria noted in the TIGER grants guidance.

Exhibit 3: Benefits and Description by Evaluation Criteria

Criteria	Benefit(s)	Description
State of Good Repair	Pavement Maintenance Savings	Operations and maintenance cost savings on existing lane
Economic Competitiveness	Short Term Employment	Value of new short-term jobs created
Livability	Vehicle Operating Cost Savings	Reductions in monetary costs due to reduced congestion
	Travel Time Savings	Door-to-door trip time savings
	Travel Reliability	Value of improved arrival time reliability
Sustainability	Emissions Reductions	Reductions in pollutants and green house gasses due to auto use reductions relative to the no-build condition
Safety	Accident Reduction	Reductions in property losses and injuries and deaths due to reductions in automobile use

** Additional jobs generated in non-construction sectors, expected as jobs market recover slower than rest of economy as it has in most recent recessions.*

Total expected congestion management benefits resulting from the Eastside Project are estimated to total $744.9 million when discounted at 7 percent, $1,206.8 million when discounted at 3 percent. In addition, some jobs through 2014 will be generated in addition to those directly due to the construction of the project. These additional jobs are assumed to be net to the local economy (new, and not diverting workers from other employment options) due to the fact the region has suffered significant recent job losses and due to recent patterns of slow post-recessionary labor marker recovery.

Benefits are discussed in greater detail below.

Pavement maintenance savings

The savings in pavement maintenance are due to the ability to delay scheduled repaving on SR 520. The roadway was repaved in 1961, 1973, 1984 and 1997, and is currently scheduled for repaving in 2020, if the Eastside Project does not get constructed.[2] The

[2] The increase in schedule time between repaving is due to improvements in the materials used.

total cost of repaving is $11.5 million, costs which will no longer be incurred under the proposed project.

Increased short- and long-term employment output and income

The Eastside Project is expected to generate significant economic impacts and job creation. These impacts are assessed, according to TIGER application guidelines for short- and long-term impacts. These include:

- **Short-term—**Economic impacts and jobs that are associated with construction in the period before Feb. 17, 2012.
- **Long-term—**Economic development impacts due to reduced transportation costs savings being directed to other purchase opportunities in the community.

Typically, economic impact analysis involves the estimation of three distinct effects: direct effect, indirect effect, and induced effect. The total economic impact is simply the sum of the direct, indirect and induced effects. These effects are defined as follows:

- The **direct effect** represents the initial expenditures (e.g., construction expenditures) that are received by businesses located in the study area.
- The **indirect effect** represents the impact of the additional business spending that is generated as these businesses sell more output and in turn purchase additional inputs from their suppliers (e.g., machinery manufacturers).
- The **induced effect** represents the increase in economic activity – over and above the direct and indirect effects – associated with increased labor income that accrue to workers and is spent on household goods and services purchased from businesses in the area.

Two methods are employed to estimate job impacts from the Eastside Project. One method applies a value of one job per $92,000 expenditures – a value that was developed by White House Council of Economic Advisers (CEA) for estimating jobs for the American Recovery and Reinvestment Act (ARRA) of 2009.[3] For comparison purposes, The Minnesota IMPLAN Group's input-output model is used to estimate direct, indirect and induced employment, value added and labor income. Employment represents full time and part time jobs created for a full year. *Value added* represents total business sales (output) minus the cost of purchasing intermediate products which is roughly equivalent to gross regional/domestic product. *Labor income* consists of employee compensation (wage and salary payments as well as health and life insurance, retirement payments, and any other non-cash compensation) and *proprietary income* (payments received by self-employed individuals as income). The IMPLAN analysis results are provided by industry and type of effect (direct, indirect and induced) and expressed in terms of employment (jobs), value added (gross regional product) and labor income (employee compensation and payments received by self-employed individuals). The following two adjustments were made to the IMPAN data:

[3] Executive Office of the President, Council of Economic Advisers, "Estimates of Job Creation from the American Recovery and Reinvestment Act of 2009," Washington, D.C., May 11, 2009.

- Since the most recent datasets are for 2007, the results were adjusted for inflation to be expressed in 2009 dollars.[4]
- Social Accounting Matrix (Type SAM) multipliers[5] used for estimating indirect and induced effects were modified with Regional Purchase Coefficients (RPC)[6] to ensure that imports would not be counted.

Short-term impacts

Short-term job creation is estimated based on the incremental forecast project expenditures by quarter that will occur through the second quarter of 2014. Only those jobs that would be generated by the first quarter of 2012 are included in the benefit-cost ratio.

Using methodology to assess the job creation impact of direct government spending detailed by the CEA, the Eastside Project is expected to generate 6,906 total job years (Exhibit 4).[7]

[4] Deflators derived from the most current Bureau of Labor Statistics (BLS) Growth Model are used to convert the cash flows to current dollars. These deflators are applied at the commodity level and vary for different goods and services.

[5] Type SAM multipliers are the direct, indirect and induced effects where the induced effect is based on social accounting matrix information. Type SAM multipliers capture inter-institutional transfers (in addition to all commodity flows).

[6] RPCs are ratios indicating what fraction of total demand for goods and services within a region (both by business and household) is satisfied from within the region; all remaining demand is satisfied by imports, which provide no direct economic benefit to the region. In other words, they filter-out economic leakages from the region.

[7] Using the White House Council of Economic Advisers (CEA) estimate that $92,136 of government spending creates one job-year.

Exhibit 4. Estimating Economic Impacts of Construction Using CEA Guidance8

Date	Construction Cost ($ million)	Direct Jobs	Indirect Jobs	Induced Jobs	Total Jobs	Cumulative Jobs Years
2010 Q3	$0.4	2	1	1	4	4
2010 Q4	$26.0	126	53	102	281	285
2011 Q1	$29.2	14	61	114	317	602
2011 Q2	$52.4	25	108	204	567	1,169
2011 Q3	$64.1	312	134	250	696	1,865
2011 Q4	$63.3	308	132	247	687	2,552
2012 Q1*	$62.7	304	130	245	679	3,231
2012 Q2	$58.6	284	122	228	634	3,865
2012 Q3	$58.7	285	122	229	636	4,501
2012 Q4	$51.4	251	107	201	559	5,060
2013 Q1	$55.1	268	114	215	597	5,657
2013 Q2	$53.1	258	111	207	576	6,233
2013 Q3	$31.6	152	65	123	340	6,573
2013 Q4	$14.9	72	30	58	160	6,733
2014 Q1	$10.8	52	21	41	114	6,847
2014 Q2	$5.6	27	11	21	59	6,906

**Feb. 17, 2012 goal of substantial completion of elements using TIGER grant funds and full expenditure of award.*

Estimates of cumulative job creation from construction spending through the second quarter of 2014 using IMPLAN and its region-specific database are higher than the estimates using the CEA report as guidance – 11,567 compared to 6,906 (Exhibit 5).

[8] Using the White House Council of Economic Advisers estimate that $92,136 of government spending creates one job-year. The IMPLAN input-output model was used to estimate direct, indirect and induced jobs figures.

Exhibit 5: Estimating Economic Impacts of Construction Using IMPLAN

	Job Years		Labor Income ($million)		Value Added ($million)	
Period	Quarterly	Cumulative	Quarterly	Cumulative	Quarterly	Cumulative
2010 - Q3	7	7	$0.4	$0.4	$0.6	$0.6
2010 - Q4	472	479	$24.5	$24.9	$36.2	$36.7
2011 - Q1	530	1,009	$27.5	$52.3	$40.6	$77.3
2011 - Q2	949	1,958	$49.2	$101.5	$72.7	$150.0
2011 - Q3	1,163	3,121	$60.3	$161.8	$89.1	$239.1
2011 - Q4	1,147	4,269	$59.5	$221.3	$87.9	$327.0
2012 - Q1	1,136	5,405	$58.9	$280.2	$87.0	$414.0
2012 - Q2	1,063	6,467	$55.1	$335.2	$81.4	$495.4
2012 - Q3	1,065	7,532	$55.2	$390.4	$81.6	$576.9
2012 - Q4	932	8,464	$48.3	$438.7	$71.4	$648.3
2013 - Q1	1,000	9,464	$51.8	$490.6	$76.6	$724.9
2013 - Q2	964	10,428	$50.0	$540.5	$73.8	$798.7
2013 - Q3	572	11,000	$29.7	$570.2	$43.8	$842.5
2013 - Q4	270	11,270	$14.0	$584.2	$20.7	$863.2
2014 - Q1	195	11,465	$10.1	$594.3	$14.9	$878.2
2014 - Q2	102	11,567	$5.3	$599.6	$7.8	$886.0

IMPLAN can also generate estimates of the short-term jobs impacts by industry or sector. The largest portion of total short-term jobs created are in construction but other industries are impacted, as well. Several industries which have a higher proportion of low and moderate wage jobs will also see an expected impact on jobs, which in turn increase economic opportunities for low and moderate income workers in the area (Exhibit 6 and Exhibit 7).

Exhibit 6: Top 10 Industries Indirectly Impacted By Construction Activity

	Job Years	Labor Income ($Million)	Value Added ($Million)
Architectural and engineering services	132	$9.7	$9.7
Employment services	79	$2.2	$2.1
Truck transportation	71	$3.3	$4.4
Wholesale trade	57	$4.2	$7.5
Real estate	36	$1.1	$4.8
Ready-mix concrete manufacturing	36	$2.4	$3.6
Services to buildings and dwellings	28	$0.7	$0.8
Stone mining and quarrying	27	$2.0	$3.4
Food services and drinking places	22	$0.4	$0.6
Management of companies and enterprises	20	$2.3	$3.0

Exhibit 7: Top 10 Industries Employing Low-Income People

	Job Years	Labor Income ($Million)	Value Added ($Million)
Agriculture, forestry, fishing and hunting	62	$1.3	$2.1
Construction	2,653	$139.6	$168.5
Retail trade	461	$14.2	$23.1
Truck transportation	93	$4.4	$5.7
Administrative and support and waste management and remediation services	289	$9.0	$11.1
Nursing and residential care facilities, home health care services	203	$0.4	$0.5
Accommodation and food services	291	$6.2	$9.5
Personal and laundry services	48	$1.1	$1.9
TOTAL	4,100	$176	$222

Long-term impacts

Economic development reflects new and expanded business activity as an indirect result of vehicle cost savings to users (see below). As the improved condition of the roadway leads to lower vehicle operating costs, a portion of those monies that previously would have gone towards auto operations and maintenance will be redirected to other purchases in the community. These purchases can, in turn, support additional employment, often in certain key industries. Exhibit 8 presents long term job creation resulting from the portion of vehicle operating cost savings that is re-spent by users. Therefore, the expected savings in vehicle operating costs for households due to the Eastside Project can be redirected to other purchases of goods and services, supporting 1,010 jobs through 2042.

Exhibit 8: Economic Impacts of Vehicle Operating Cost (VOC) Savings

Period	VOC Savings		Direct & Indirect Job Years		Induced Job Years		Total Job Years	
	Yearly	Cumul.	Yearly	Cumul.	Yearly	Cumul.	Yearly	Cumul.
2013	$3.6	$3.6	28	28	15	15	43	43
2022	$4.1	$39.5	32	310	17	162	48	472
2032	$4.5	$81.1	35	637	18	332	54	969
2042	$5.0	$128.7	39	1,010	20	527	59	1,537
TOTAL	$128.7	$128.7	1,010	1,010	527	527	1,537	1,537

Savings in vehicle operating costs

Vehicle operating costs are an integral element of computing travel user costs and include the out-of-pocket expenses associated with owning, operating, and maintaining a vehicle. The cost components of vehicle operating costs measured in this analysis include fuel consumption, oil consumption, maintenance and repairs, tire wear, and vehicle depreciation. Vehicle cost savings are estimated based on projections of total vehicle miles traveled. Vehicle operating cost benefits from the Eastside Project are projected to be $41.6 million, when discounted at 7 percent ($75.4 million at a 3 percent discount rate).

Travel time savings

Travel time savings accrue to both diverted auto trips and auto trips already undertaken on the roadway. Travel time savings are driven by changes in average travel times in minutes per trip between the base case and alternate cases. Travel time savings are estimated by measuring the difference between projected travel time, in user costs, before and after the project is complete.

Approximately 1.4 million hours of annual travel time are expected to be saved after construction of the Eastside Project. Using TIGER guidance for the estimated value of time, the project is projected to generate $476.2 million (at a 7 percent discount rate) in travel time savings ($860.1 million at 3 percent discount)[9].

Sustainability—reduction in greenhouse gas emissions

Similar to the variable costs in vehicle operating costs, emissions costs are dependant on the changes in vehicle miles traveled (VMT) and vehicle speeds due to the project. The consumption values were produced using the EPA's Mobile 6.2 model and take into account future regulations and trends. Per-unit costs were then applied to the total change in emissions calculated by consumption rates and VMT levels in the base and build cases. There are three types of emissions for which measurable changes are estimated: Nitrogen oxides (NOX), carbon monoxide (CO), and volatile organic compounds (VOC). Due to differing emission rates by emission type depending on varying vehicle speed, some emission types such as VOC and NOX show an aggregate reduction in overall pollutant volume, while CO reveals an increase over the analysis period (Exhibit 9). The Eastside Project is projected to lead to $0.2 million in emission cost savings at a 7 percent discount rate ($0.3 million at a 3 percent discount rate).

Exhibit 9: Changes in Emissions

Type of Emissions	Change in emissions, tons
Volatile Organic Compounds (VOC)	-195
Carbon Monoxide (CO)	+459
Nitrous Oxides (NOX)	-52

Safety—reduced accident costs

WSDOT has calculated likely reductions in accident rates for the Eastside Project portion of the entire SR 520 Bridge Replacement and HOV Program, presented in the 2006 draft environmental impact statement.[10] These declines are expected primarily due to reduced weaving as outside HOV lanes are relocated to the inside lanes. These rates are used to estimate the number of avoided accidents by applying those rates to the appropriate total that would lead to final accident rates in line with the national estimates as per FHWA

[9] Estimated hours are valued and inflated to 2009 dollars as per the TIGER guidance ($186.9 million at a 7 percent discount rate and $344 million at a 3 percent discount rate) and multiplied by the 2.5 congestion premium.
[10] Federal Highway Administration, Washington State Department of Transportation, and Sound Transit "Draft Environmental Impact Statement: SR 520 Bridge Replacement and HOV Project," August 18, 2006, pp. 1-4. http://www.wsdot.wa.gov/projects/sr520bridge/DraftEIS.htm

Highway Economic Requirements System (HERS) model. Values per accident by type from USDOT guidelines (Exhibit 1) are then applied for fatal, injury, and property damage only accidents to calculate a value for each avoided accident. In the analysis, an estimated 15 accidents are avoided annually with the completion of the Eastside Project, resulting in net accident savings throughout the study period of $11.9 million at a 7 percent discount rate and $21.4 million when using a 3 percent discount rate.

V. Findings

Exhibit 10 summarizes the BCA findings. At a 7 percent discount rate, a $607.40 million lifecycle cost results in over $90 million net benefits and a benefit to cost ratio of 1.15, if the economic benefits of short-term jobs creation are included. (Note that there is debate regarding the appropriateness of including the economic impact of short-term job creation in benefit-cost analysis. Results are presented both with and without short-term jobs.) If the discount rate is reduced to 3 percent, a $664.80 million cost results in almost $450 million in net benefits and a benefit-cost ratio of 1.68. The estimated rate of return is 10.4 percent when using a 7 percent discount rate, 7.8 percent when using 3 percent as the discount rate.

Excluding short-term jobs, a $607.40 million lifecycle cost results in -$133 million net benefits and a benefit to cost ratio of 0.78. If the discount rate is reduced to 3 percent, a $664.80 million cost results in over $200 million in net benefits and a benefit-cost ratio of 1.3.

Exhibit 10: Overall Results of the Benefit-Cost Analysis (BCA)

Category	Discounted Values (7% Real Discount Rate)	Discounted Values (3% Real Discount Rate)
Total Congestion Management Benefits	$520.8	$957.1
Travel Time Savings	$567.2	$860.1
Reliability Savings	$66.3	$116.7
Vehicle Operation Cost Savings	$41.6	$75.4
Accident Cost Savings	$11.9	$21.4
Emission Cost Savings	$0.2	$0.3
Short-Term Jobs Creation	$224.1	$249.8
Total Benefits ($)	$744.9	$1,206.8
Construction Costs	$612.9	$673.1
Total O&M Costs (repaving savings)*	($5.5)	($8.3)
Total Costs ($)	$607.40	$664.8
B/C Ratio	1.23	1.82
NPV	$137.5	$542.1
Economic Rate of Return (Nominal)	10.67%	8.04%

* *Since the repaving savings are a cost which is now avoided, the value is a negative figure in the cost category (a negative cost being a savings or benefit overall in the analysis).*