WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

MONTLAKE TRIANGLE PROJECT

TIGER DISCRETIONARY GRANTS PROGRAM

ECONOMIC ANALYSIS SUPPLEMENTARY DOCUMENTATION

OCTOBER 26, 2011

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1. Introduction

This document provides detailed technical information on the economic analyses conducted in support of the Grant Application for the Montlake Triangle project.

Section 2, Methodological Framework, introduces the conceptual framework used in the Benefit-Cost Analysis (BCA). Section 3, Project Overview, provides an overview of the project, including a brief description of existing conditions and proposed alternatives; a summary of cost estimates and schedule; and a description of the types of effects that the Montlake Triangle Project is expected to generate. Section 4, General Assumptions, discusses the general assumptions used in the estimation of project costs and benefits, while estimates of travel demand and traffic growth can be found in Section 5, Demand Projections. Specific data elements and assumptions pertaining to the long-term outcome selection criteria are presented in Section 6, Benefits Measurement, Data and Assumptions, along with associated benefit estimates. Estimates of the project's Net Present Value (NPV), its Benefit/Cost ratio (BCR) and other project evaluation metrics are introduced in Section 7, Summary of Findings and BCA Outcomes. Next, Section 8, BCA Sensitivity Analysis, provides the outcomes of the sensitivity analysis. Detailed economic impact estimates can be found in Section 9, Economic Impact Analysis, along with descriptions of the data sources and modeling tools used in the analysis. Additional data tables are provided in Section 10, Supplementary Data Tables, including annual estimates of benefits and costs, as well as intermediate values to assist DOT in its review of the application.[1]

2. Methodological Framework

Benefit-Cost Analysis (BCA) is a conceptual framework that quantifies in monetary terms as many of the costs and benefits of a project as possible. Benefits are broadly defined. They represent the extent to which people impacted by the project are made better-off, as measured by their own willingness-to-pay. In other words, central to BCA is the idea that people are best able to judge what is "good" for them, what improves their well-being or welfare.

BCA also adopts the view that a net increase in welfare (as measured by the summation of individual welfare changes) is a good thing, even if some groups within society are made worse-off. A project or proposal would be rated positively if the benefits to some are large enough to compensate the losses of others.

Finally, BCA is typically a forward-looking exercise, seeking to anticipate the welfare impacts of a project or proposal over its entire life-cycle. Future welfare changes are weighted against today's changes through discounting, which is meant to reflect society's general preference for the present, as well as broader inter-generational concerns.

The specific methodology developed for this application was developed using the above BCA principles and is consistent with the TIGER guidelines. In particular, the methodology involves:

- Establishing existing and future conditions under the build and no-build scenarios;

[1] While the models and software themselves do not accompany this appendix, greater detail can be provided, including spreadsheets presenting additional interim calculations and discussions on model mechanics and coding, if requested.

- Assessing benefits with respect to each of the five long-term outcomes identified in the Notice of Funding Availability (NOFA)[2];
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement;
- Using DOT guidance for the valuation of travel time savings, safety benefits and reductions in air emissions, while relying on industry best practice for the valuation of other effects;
- Discounting future benefits and costs with the real discount rates recommended by the DOT (7 percent, and 3 percent for sensitivity analysis); and
- Conducting a sensitivity analysis to assess the impacts of changes in key estimating assumptions.

3. Project Overview

The Montlake Triangle project is a multi-agency project designed to improve the Montlake Triangle, a key multimodal transportation center in Seattle for drivers, transit riders, bicyclists and pedestrians. The Montlake Triangle is a triangle-shaped area of land located at the south end of the University of Washington campus. It serves as a central connection route to major destination centers for employment, education, medical facilities, athletics, and community and residential areas. Planned transportation investments in this area will increase its use and capacity as a high-volume multimodal transportation hub.

In 2016, the Sound Transit University Link light rail station will open to service, and is projected to serve over 25,000 passengers per day. This will nearly triple the number of travelers[3] in the area, creating potential safety problems due to the high existing volumes of motorized vehicles.

The Montlake Triangle project will provide a number of key improvements to the area:

- A new bridge overcrossing above Montlake Boulevard NE that will provide bicyclists and pedestrians with safe and reliable connections between the University Link light rail station and the Montlake Triangle.
- A land bridge over a lowered NE Pacific Place that will connect bicyclists and pedestrians safely to the University of Washington and the Burke-Gilman regional trail (currently the crosswalk on NE Pacific Place is at-grade).
- At-grade connectivity enhancements, including safer sidewalks and access to improved transit stop locations.
- A new north-south bicycle and pedestrian path to the east of Montlake Boulevard that will connect with the future SR 520 regional bicycle and pedestrian path as well as destinations north of the Montlake Triangle.

[2] U.S. Federal Register, Federal Register / Vol. 76, No. 156 / Friday, August 12, 2011 / Notices, Notice of Funding Availability for the Department of Transportation's National Infrastructure Investments under the Full-Year Continuing Appropriations, 2011; and Request for Comments.

[3] For the purposes of this analysis, "travelers" is used to designate pedestrians and bicycle users present in the Montlake Triangle area. The concept includes students and workers at the University of Washington as well as commuters who use the bus services provided at the Montlake Triangle. It excludes passengers of motorized vehicles that drive through the area.

- Urban design features and amenities that promote a safe and healthy space for bicyclists, pedestrians, motorists, and transit riders, including added bicycle storage, clear signs, walkways, and lighting.

3.1 Base Case and Alternatives

Under the base case, the University Link Station will start operations in 2016, becoming the temporary terminal station for the line. And in 2030 the expansion of the line into Lynnwood will begin operations. As a result, the number of travelers in the Montlake Triangle area will feature two sharp increases under the base case: first, in 2016 due to the opening of the UW Station; and second, in 2030 when induced demand from the expansion of the line brings travelers from farther locations into the area.

Under the base case, the access and land bridges as well as any other improvements featured in the Montlake Triangle project will not be built and thus all travelers will rely on existing pedestrian crosswalks to reach their destinations.

Under the alternative or no build scenario, the University Link Station will also start operations in 2016 and the expansion of the line will also begin operations in 2030. However, the access and land bridges and the other improvements described in the Montlake Triangle project will be built, allowing travelers to reach their destination using the new infrastructure.

Taking a conservative approach, we assume zero induced demand generated by the project. Therefore, the number of travelers in the area will be the same under both cases, and the main difference will be the existence and use of the bridges and other improvements in the alternative.

3.2 Project Cost and Schedule[4]

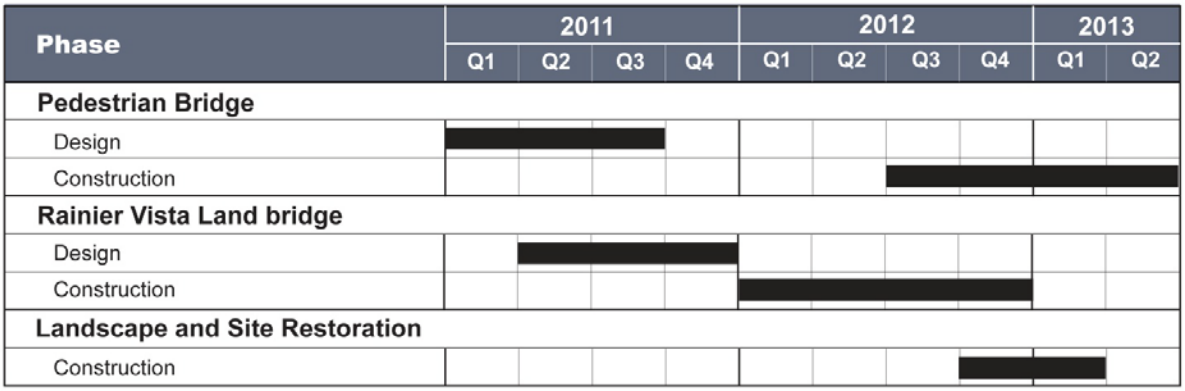
The Montlake Triangle project is comprised of three components:

- A pedestrian bridge between the University Link Station and the Montlake Triangle (over Montlake Boulevard NE),
- A land bridge between the Montlake Triangle and Rainier Vista (over NE Pacific Place), and
- A landscape and site restoration element.

The schedule for each individual component is shown below.

[4] All cost estimates in this section are in millions of dollars of 2011, discounted to 2011 using a 7 percent real discount rate.

Table 1. Project Schedule, by Component



Total project cost is estimated to be $40.6 million dollars. The breakdown by component and expenditure category is shown in the following table.

Table 2. Project Cost by Component and Expenditure Category

Component	Expenditure Category	Value in Dollars of 2011, Undiscounted
Pedestrian Bridge	Design	$1,745,897
	Construction	$8,442,386
	Construction Reserve	$1,460,000
	Administration / Contract Management	$1,173,320
Land Bridge	Design	$2,687,999
	Construction	$15,835,860
	Construction Reserve	$2,870,000
	Administration / Contract Management	$2,307,782
Landscape and Site Restoration	Design	$183,940
	Construction	$3,737,448
	Construction Reserve	$670,000
	Administration / Contract Management	$541,448
Design and Permits	Design and Permits	$1,343,920
TOTAL		**$43,000,000**

Design of the main components has already started, and construction is scheduled to start in the first quarter of 2012. Construction of each bridge will take approximately one year to complete, though they will be built concurrently during the last two quarters of 2012. The landscape and site restoration component is scheduled to be completed in six months and will be performed at the same time as the construction of the bridges. As a result, all the components of the project will be operating by mid-2013.

For the purpose of the analysis, it will be assumed that the project will open in 2014 and thus it will start generating benefits in that year. Benefits are assumed to be generated for a period of 30 years[5].

3.3 Effects on Long-Term Outcomes

The project will primarily increase safety for pedestrians and bicycle users in a high-traffic area by providing a safe connection between the University Link Station and the main campus. However, by providing this option, it will also increase the safety of motorized vehicle users, since the interactions between automobiles and pedestrians at the existing intersections will be considerably reduced. Additionally, the project will transform the Montlake Triangle into a livable space by providing lighting, signage and landscaping to pedestrian walkways. Bus riders will also benefit from the project since they will be provided with sheltered bus stops[6], resulting in improved waiting conditions. Finally, it will improve mobility in the immediate vicinity of the project by providing faster walking times to different destinations in the University of Washington campus.

The main benefit categories associated with the project are mapped into the five long-term outcome criteria set forth by the DOT in the table below.

Table 3: Expected Effects on Long Term Outcomes and Benefit Categories

Long-Term Outcomes	Benefit Categories	Description	Monetized	Quantified	Qualitative
State of Good Repair	Residual value	Value of project infrastructure at the end of period of analysis	Y		
Economic Competitiveness	Reduced wait times at intersections	Reduction in wait time for motorized vehicle users at intersections in Montlake Triangle area (passenger vehicles and trucks)			Y
	Inventory Cost savings	Reduced inventory cost for goods transported by truck due to reduced waiting time at intersections			Y
	Out-of-pocket Vehicle Operating Cost reduction	Reduction in out-of-pocket vehicle operating costs (mainly fuel consumption) due to reduced wait time at intersections			Y
	Pedestrian Mobility	Reduction in walking time to and from different locations in the UW campus	Y		

[5] Since the main traffic on the bridges will consist of pedestrians and bicycle users, which deteriorate transportation infrastructure at a lower rate than motorized vehicles.

[6] Currently bus stops at the Montlake Triangle are not sheltered.

Long-Term Outcomes	Benefit Categories	Description	Monetized	Quantified	Qualitative
	Bicycle Users Mobility	Reduction in travel time to and from different locations in the UW campus			Y
Livability	Journey Ambiance	Enhanced traveling conditions for pedestrians and bicycle users due to improved conditions on a route	Y		
	Improved Waiting Conditions for Bus Riders	Benefits to bus riders from improvements at bus stations that enhance waiting conditions		Y	
	Landscaping and Streetscaping	Improvements to the characteristics that give a "sense of place" or identity			Y
	Accessibility	Improve access to area to individuals with disabilities or physical limitations and hospital patients			Y
Sustainability	Emissions reduction	Reduction in emissions of greenhouse gases due to shorter wait times at intersections			Y
Safety	Accident Cost reduction	Reduction in number and severity of accidents between motorized-vehicle users and pedestrians due to construction of bridges	Y		
	Reduced potential conflicts between pedestrians and bicycle users	Reduced number of potential accidents due to widening of Burke-Gilman trail and separated paths on Montlake Blvd NE			Y
	Improved pedestrian crossings	Reduced number and severity and accidents due to infrastructure improvements at existing pedestrian at-grade crossings			Y

4. General Assumptions

The BCA measures benefits against costs throughout a period of analysis beginning at the start of construction and including 30 years of operations.

The monetized benefits and costs are estimated in 2011 dollars with future dollars discounted in compliance with TIGER requirements using a 7 percent real rate, and sensitivity testing at 3 percent.

The methodology makes several important assumptions and seeks to avoid overestimation of benefits and underestimation of costs. Specifically:

- Input prices are inflated to 2011 dollars;
- The period of analysis begins in 2011 and ends in 2043. It includes project development and construction years (2011 - 2013) and 30 years of operations (2014 - 2043);
- A constant 7 percent real discount rate is assumed throughout the period of analysis. A 3 percent real discount rate is used for sensitivity analysis;
- Opening year demand is an input to the BCA and is assumed to be divided into three stages: 'existing travelers' from 2014 (project opening) until 2015; 'travelers with initial Link operations' from 2016 until 2029, when University Link Station is assumed to be the interim end of the line; and, 'travelers with final Link operations' starting in 2030 when the terminal station in Lynnwood is assumed to be operating.

Unless specified otherwise, the results shown in this document correspond to the effects of the Full Build alternative (construction of access bridge over Montlake Blvd. NE, land bridge over NE Pacific Place and landscape and site restoration).

5. Demand Projections

The potential demand for this project[7] will consist mainly of those pedestrians and bicycle users who want to travel between the University Link Station that is being built on the eastern side of Montlake Boulevard NE (close to Husky Stadium) and different points on the University of Washington (UW) campus, passing through the Montlake Triangle. Though most users will travel beyond the Montlake Triangle, this location hosts three bus stop/transfer areas and therefore will be an intermediate destination for travelers who use it as a multimodal transfer hub.

The volume of pedestrians and bicycle users traveling between different locations on the UW campus and the eastern side of Montlake Boulevard (including those who stop at the Montlake Triangle) was measured in a recent study by Grijalva Engineering for Sound Transit[8]. However, this number is expected to increase considerably in the near future due to the start of operations of the University Link Station. Construction for this facility began in 2011 and is expected to end in 2016.

Analysis of the project's characteristics shows that the large majority of the potential users are non-recreational travelers. They can be categorized into four groups:

1. Existing Pedestrian Travelers
2. Existing Bicycle-User Travelers
3. New Pedestrian Travelers
4. New Bicycle-User Travelers

This categorization is required for identification of user estimates and estimation of the appropriate benefits.

[7] It should be interpreted as "demand" the actual number of users of the access and land bridges.

[8] Grijalva Engineering, 2008. University of Washington Station Pedestrian and Bicycle Evaluation. Study for Sound Transit.

5.1 Methodology

Existing Travelers

Existing Bicycle Users and Pedestrians in the Montlake Triangle area are estimated based in the numbers reported in the study performed in 2008 by Grijalva Engineering for Sound Transit. The study suggests using a compound annual growth rate of 1% to estimate future yearly volumes until the year 2030. It is used in this BCA to estimate yearly number of travelers in the area.

New Travelers

The opening of the University Link Station in UW will result in additional travelers flowing into the area, and thus of potential users of the access and land bridges proposed in the Montlake Triangle project. The number of new travelers is reported in Table 1 of the Technical Memorandum by Heffron Transportation, Inc. which constitutes attachment E of the *NEPA Environmental Re-evaluation Consultation Form for the University of Washington to Sound Transit University-Link Pedestrian Connection Project* (attachment E) submitted by Sound Transit in December 2010.

Timeline of Increase in the Number of Travelers

Sound Transit expects to open the Link Station at UW in 2016 and this will constitute the first sharp increase in the number of travelers in the project area.

Ridership data from Sound Transit reports the expected number of light-rail users in the UW Station in 2016 and 2030. In order to estimate the number of travelers in the project area on a yearly basis, three different time periods will be analyzed:

1. Between the end of the construction of the Montlake Triangle improvements (2014) and the start of operations of the Link Station (2016): the number of travelers in the area will consist only of existing travelers, who will be assumed to grow at a 1% annual compound growth rate (in accordance with the study for Sound Transit).
2. Between the start of operations of the Link Station (2016) and 2029: it will be assumed that the extension of the line into Lynnwood will start operations in 2030 and thus the number of travelers in the area during the 2016-2029 period will consist of existing travelers plus the new ones associated with University Link riders when UW is the terminal station. The total number of travelers will be assumed to grow at a conservative yearly rate of 1%.
3. 2030 and after: In 2030 the number of new travelers will experience another important increase due to induced riders who will use the system after the extension of the line into Lynwood. After 2030, the number of travelers in the area will also be assumed to grow at a conservative 1% annual rate.

Even though completion of the Montlake Triangle Project may generate induced demand (i.e., new pedestrians or cyclists who deviate from other routes due to the generalized travel cost savings the project generates *before* the opening of the Link Station), we will follow a conservative approach and assume that this induced demand is zero. In other words, the only structural changes in the number of travelers in the area will be due to the opening of the Link Station at UW and the extension of the line into Lynwood.

Table 4 shows the number of travelers in the Montlake Triangle area for year 2030. The second column shows a projection of travelers under the assumption that the U-Link Station will not be in operation (i.e., existing travelers growing at a 1% rate annually). The third column displays the number of additional travelers who will be present in the area due to the operation of the University Link Station but assumes the Montlake Triangle project is not built (base case). The last column represents the number of additional travelers flowing into the area due to the University Link Station and assumes the Montlake Triangle project is built (alternative).

Table 4. Estimated Number of Travelers in the Project Area, 2030 (Pedestrians, Cyclists and Bus Riders)

Location	**Year 2030** without U-Link Station	**Year 2030** Additional Travelers with U-Link in Operation	
		No Build	Build
Pedestrian Bridge	0		3940
Montlake Boulevard/Pacific Street			
North Leg	570	4330	1250
West Leg	360	1070	1070
Northwest Leg	310	3260	180
East Leg	410	60	60
Montlake Boulevard/Pacific Place			
South Leg	80	1200	340
West Leg	20	120	0
East Leg	140	300	300
Pacific Street/Pacific Place			
East Leg	560	300	300
North Leg	340	240	0

Source: SR 520 Program Transportation Manager based on U-Link Data from North Link Final Supplemental Environmental Impact Statement Addendum 2010 Proposed Action for University of Washington Station Access via Rainier Vista Technical Memorandum

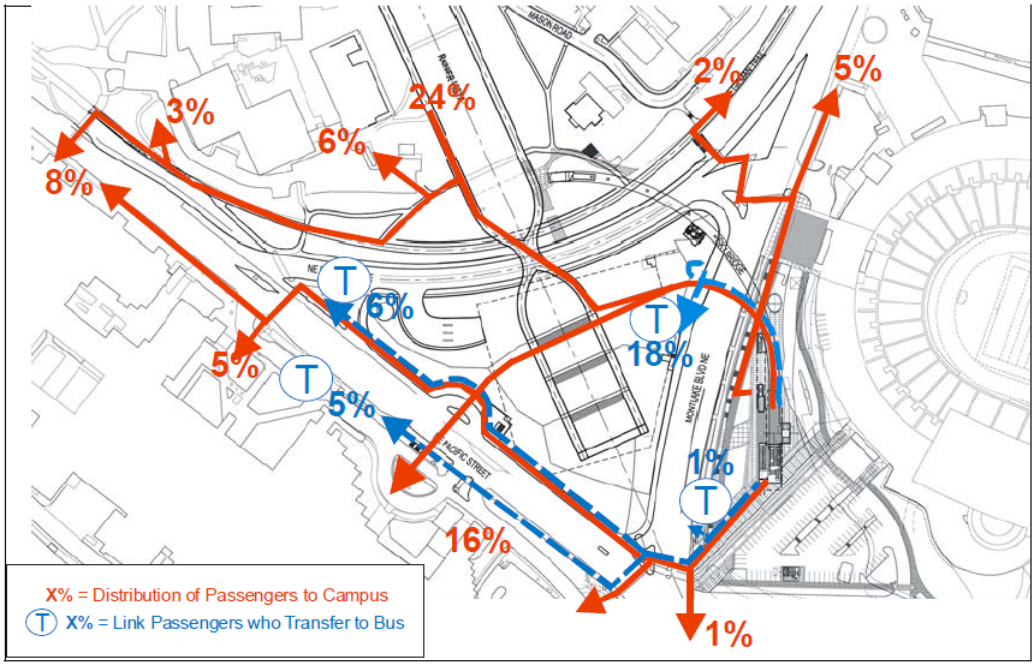
Bus Riders

Detailed bus ridership estimates (alightings and boardings) are available from King County Metro for the year 2011. This number is assumed to grow at the same (conservative) rate as that of existing travelers between 2011 and 2013. However, once the University Link Station begins operations, the improved connectivity created by the light rail is expected to increase the number of bus riders that flow into the area. The NEPA Environmental Reevaluation Form for the Montlake Triangle project estimates that approximately 30 percent of the University Link Station users will transfer to bus. As such, this percentage is used to estimate bus ridership in the project's area of influence.

Determination of the Number of Users of the New Bridges

The number of travelers who will benefit from the construction of the improvements specified in the Montlake Triangle project are estimated based on a Technical Memorandum by Heffron Transportation, Inc. (attachment E). This document estimates how the passenger volume for the new Link Station at UW will disperse to the campus and/or transfer to local King County

Metro bus service. Throughout this analysis it will be assumed that new travelers will behave in the same way as existing travelers.



Source: Sound Transit Link Ridership Forecast and Distribution, January 2009. Reassigned to routes by Heffron Transportation.

Figure 1. Peak distribution pattern for Link Passengers UW Station Terminus

The following structure and logic diagram (Figure 2) shows how these estimates were developed.

Figure 2. Demand Forecasting Framework

5.2 Assumptions

All peak-hour ridership and demand estimates were converted to annual estimates using peak-to-day and day-to-year factors. A complete list of the assumptions used to estimate the number of travelers in the area and total demand is shown below.

Table 5: Assumptions used in the Estimation of Demand

Variable Name	Unit	Value	Source
Growth in the number of travelers (w/o University Link)	Percentage	1%	NEPA Environmental Reevaluation Form, Attachment E (Heffron Transportation Technical Memo, page 6)
Annual growth rate of vehicle traffic	Percentage	1%	Assumption based on growth rate of travelers without construction of the University Link Station
Growth in the number of University Link passengers	Percentage	1%	Assumption based on growth rate of travelers without construction of the University Link Station
% of travelers using Montlake bridge	Percentage	71%	NEPA Environmental Reevaluation Form, Attachment E (Heffron Transportation Technical Memo, page 7)
% of travelers using both bridges	Percentage	37%	
% of travelers transferring to bus	Percentage	30%	
% travelers who are pedestrians	Percentage	85%	HDR Assumption
% of daily travelers in one peak hour	Percentage	20%	HDR Assumption
% of daily traffic in one peak hour	Percentage	8%	HDR Assumption
Daily-to-yearly conversion factor	Days per year	300	HDR Assumption

5.3 Demand Estimates and Projections

The resulting yearly projections for total travelers in the area, at-grade crosswalk users (base case and alternative), access bridge users (alternative), land bridge users (alternative) and bus riders (base case and alternative) are presented in the table below.

Table 6: Yearly Demand Estimates and Projections (Rounded to the closest 100)

	In Project Opening Year (2014)	2016	2030	2043
Total travelers	3,569,100	10,699,700	13,068,600	14,873,200
At-grade crosswalk users (base case)	3,569,100	10,699,700	13,068,600	14,873,200
At-grade crosswalk users (alternative)	1,035,000	3,102,900	4,216,600	4,313,200
Access bridge users (alternative)	2,534,000	7,596,800	8,851,900	10,560,000
Land bridge users (alternative)[9]	1,320,600	3,958,900	4,835,400	5,503,100
Bus riders (base case and alternative)	1,379,300	3,209,900	3,920,600	4,462,000

6. Benefits Measurement, Data and Assumptions

This section describes the measurement approach used for each benefit category identified in Table 3 (Expected Effects on Long Term Outcomes and Benefit Categories) and provides an overview of the associated methodology, assumptions, and estimates.

6.1 State of Good Repair

In the case of this project, the benefits associated with maintaining the existing transportation network in a state of good repair is associated with the residual value or the monetized value of project infrastructure at the end of period of analysis. Since the period of analysis for the generation of benefits from this infrastructure is 30 years, it is expected that the infrastructure will completely depreciate by then, thus leaving a residual value of zero.

6.1.1 Methodology

Using a conservative approach, it was determined that depreciation of the improvements created by the project would occur at 30 years of use.

6.1.2 Assumptions

The assumption used is that the improvements built by the project will be depreciated after 30 years of use, thus leaving no residual value.

6.1.3 Benefit Estimates

These benefits were assumed to be zero in present value.

[9] Land bridge users include those that previously used the access bridge to reach the Montlake Triangle and thus the summation of access bridge users and land bridge users exceeds the total number of travelers.

6.2 Economic Competitiveness

The construction of the access bridge across Montlake Boulevard NE and the land bridge across NE Pacific Place will reduce travel times for pedestrians and bicycle users between the University Link Station and the campus compared to a situation where they must wait at the pedestrian crosswalks for a walk sign. However, it will also reduce wait times for motorized vehicles driving in the project's area since the project will optimize traffic signal timing, thus reducing idling time at the intersections (especially the northern and southern halves of the intersection between Montlake Boulevard NE and NE Pacific Place). As such, the proposed project would contribute to enhancing the economic competitiveness of the Nation through improvements in the mobility of people and goods within and across the study area. In this analysis, two broad measures of mobility are presented: travel-time savings and out-of-pocket transportation cost savings.

Travel time savings are generated for two main groups: motorized-vehicle users and pedestrians and bicycle users. For the motorized-vehicle users, travel time is generated by reduced wait times at the intersections within the project's area of influence. Construction of the two pedestrian bridges will be combined with optimized traffic signal timing, thus reducing idling time at the intersections. This benefit will be accrued by passenger vehicle users, truck drivers as well as cargo transported through trucks (in the form of inventory costs). For pedestrians and bicycle users, the bridges will reduce wait time at the at-grade crosswalks, thus reducing total journey times.

Out-of-pocket vehicle operating costs will decrease for motorized-vehicle users since shorter wait times at the intersections (idling) will represent a reduction in fuel consumption. This benefit will apply to passenger vehicles and trucks.

6.2.1 Methodology

Economic Competitiveness Benefits from Motorized Vehicles

This benefit category comprises travel time savings for passenger vehicle users, truck drivers, inventory costs as well as out-of-pocket vehicle operating costs for passenger vehicles and trucks. Despite the fact that these benefits were neither quantified nor monetized, the high-level approach to their estimation is shown in the following diagram.

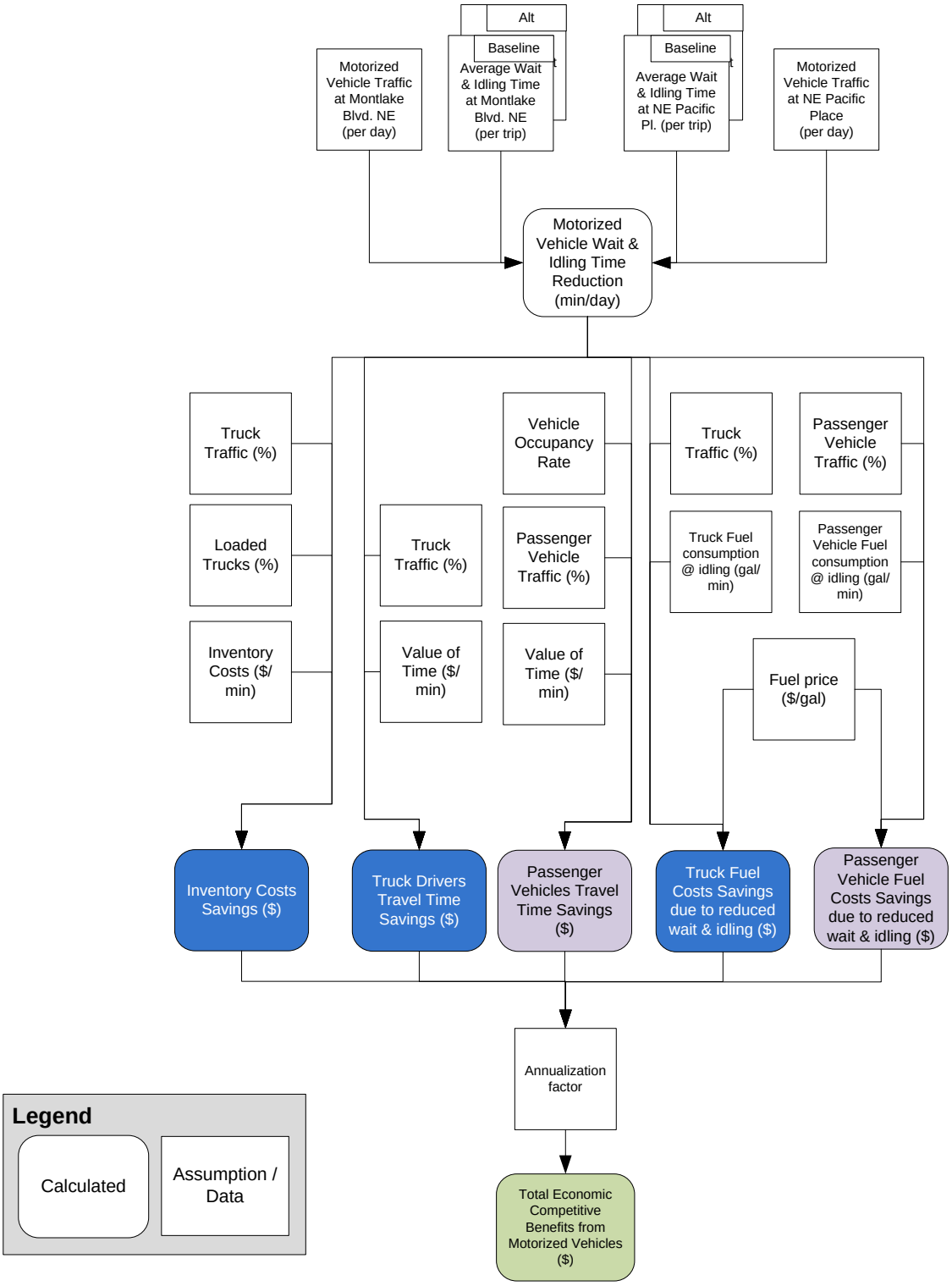


Figure 3. High-level Methodology to Estimate Economic Competitiveness Benefits from Motorized Vehicles

Economic Competitiveness Benefits from Pedestrians and Bicycle Users

The two benefits captured in this category are travel time savings for pedestrians and bicycle users (i.e., mobility). For the purposes of this analysis, only pedestrian travel times were quantified and monetized using the methodology illustrated in the following diagram. It must be noted, however, that a similar methodology can be applied to bicycle users if measurements for travel time savings exist.

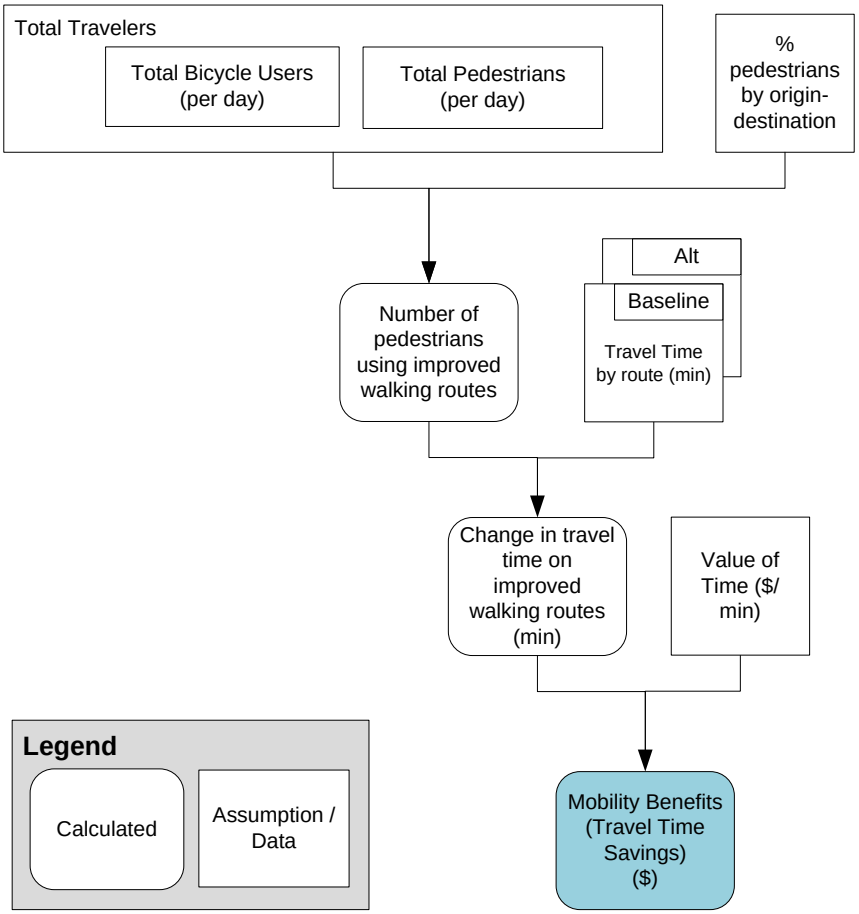


Figure 4. Travel Time Savings Benefits for Pedestrians (Mobility)

To estimate the number of pedestrians who will benefit from this travel time reduction, the total travelers in the area at any given year is combined with the percentage that are pedestrians and the distribution patterns for travelers in the area (taken from attachment E). Those origins and destinations for which travel time data exists are used to determine total travel time under the base case and the alternative. Finally, a value of time is considered for the travel time savings in order to monetize them.

Travel times for two walking routes were measured for the base case and alternative. These routes were: (i) between the University Link Station and Drumheller Fountain (central campus) – labeled in this appendix "Walking Route 1" – and (ii) between the University Link Station and

the Health Sciences complex – labeled "Walking Route 2". These two routes are illustrated in the following figures[10].

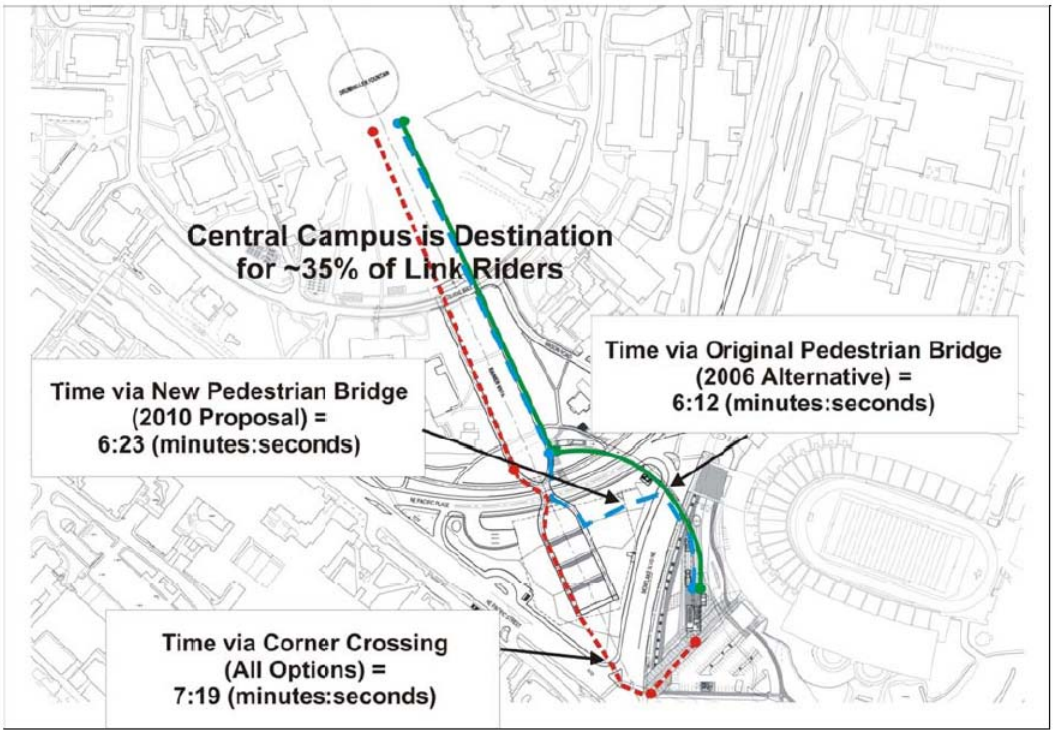


Figure 5. Walking Times Between Link Station and Central Campus (Walking Route 1)

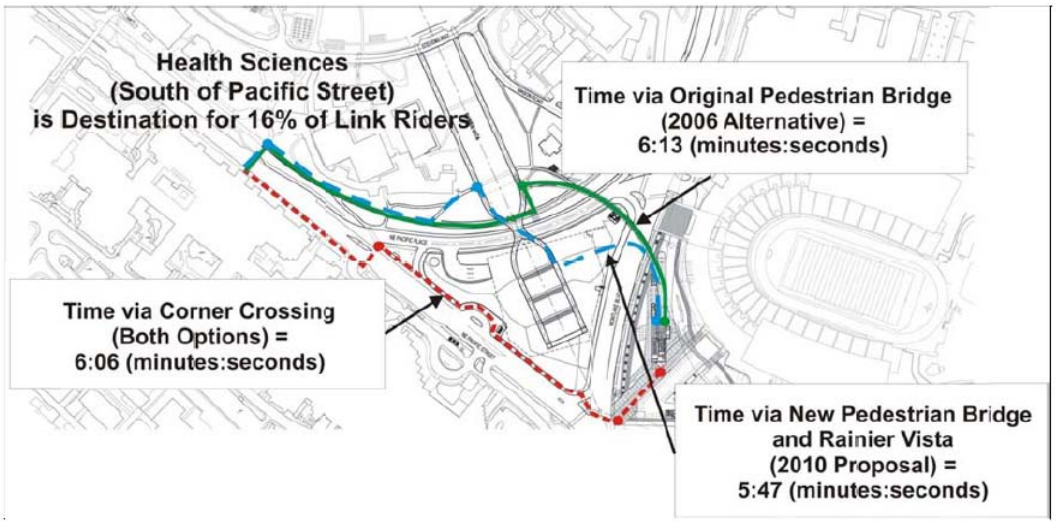


Figure 6. Walking Times Between Link Station and the Health Science Complex (Walking Route 2)

The value of time used to monetize the travel time savings is $24.91, representing personal local-travel savings (100% of the per-person hourly earning rate inflated to 2011 dollars). This amount corresponds to the one suggested by the USDOT in its *Revised Departmental Guidance*

[10] The relevant route in the alternative is the one identified as "2010 proposal".

on Value of Travel Time in Economic Analysis Memorandum dated September 28, 2011. In order to maintain a conservative approach to the estimation of travel time savings, the value of time was not augmented to the suggested 1.6 percent annual rate.

6.2.2 Assumptions

The assumptions used in the estimation of travel time savings are summarized in the table below.

Table 7: Assumptions used in the Estimation of Travel Time Savings (Pedestrian Mobility)

Variable Name	Unit	Value	Source
% pedestrians using Walking Route 1 (central campus)	Percentage	35%	NEPA Environmental Reevaluation Form, Attachment E (Heffron Transportation Technical Memo, page 16)
% pedestrians using Walking Route 2 (health science complex)	Percentage	16%	NEPA Environmental Reevaluation Form, Attachment E (Heffron Transportation Technical Memo, page 17)
Walking time for Walk Route 1 (Base Case)	Seconds	439	NEPA Environmental Reevaluation Form, Attachment E (Heffron Transportation Technical Memo, page 16)
Walking time for Walk Route 1 (Alternative)	Seconds	383	NEPA Environmental Reevaluation Form, Attachment E (Heffron Transportation Technical Memo, page 16)
Walking time for Walk Route 2 (Base Case)	Seconds	366	NEPA Environmental Reevaluation Form, Attachment E (Heffron Transportation Technical Memo, page 16)
Walking time for Walk Route 2 (Alternative)	Seconds	347	NEPA Environmental Reevaluation Form, Attachment E (Heffron Transportation Technical Memo, page 16)
Value of time for pedestrians	Dollars per hour	24.91	USDOT, Revised Guidance on valuation of Travel Time in Economic Analysis, Table 3 (Revision 2) inflated to 2011 dollars

6.2.3 Benefit Estimates

Despite that many of the benefits considered in the economic competitiveness outcome are considered qualitative in this analysis, those that could be monetized (i.e., pedestrian mobility) represent 22% of the total benefits estimated.

Table 8: Estimates of Pedestrian Travel Time Savings, in Millions of 2011 Dollars

Benefit Category	In Project Opening Year (2014)	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
Pedestrian travel time savings	$0.48	$48.26	$15.55

Most of the beneficiaries of pedestrian mobility are students and an important portion of them are under financial assistance programs or belong to minorities. According to information from the UW:

- Close to one quarter of entering UW freshmen are PELL Grant eligible, and 30 percent of all freshmen will be the first in their families to attend college.

- Last year, one quarter of (about 8,000) UW undergraduates were eligible for the Husky Promise program, which through a combination of state, federal and UW local funds provides free tuition students with financial need.
- In 2010-11, 58 percent of UW undergraduates received some form of financial aid totaling over $251 million.
- The number and proportion of under-represented minority students at UW Seattle have increased, comprising 12.4 percent of the 2011 freshman class, compared to 10.4 percent in 2006. With the addition of Asian-American students, students of color comprise 40.5 percent of the 2011 freshman class.

6.3 Livability

The proposed project would contribute to enhancing livability and quality of life in the study area through enhanced journeys for pedestrians and bicycle users, improved waiting conditions for bus riders at bus stops, landscaping and streetscaping improvements, improvements to at-grade pedestrian crossings and by allowing individuals with disabilities or physical limitations to access different locations in the project's area.

6.3.1 Methodology

Monetized Benefits

Of the benefits considered in the livability objective, only journey ambiance for pedestrians and bicycle users can be monetized. The pedestrian journey ambiance is associated with the enhanced walking experience related to the use of the bridges and the improved paths around the Montlake Triangle. The bicycle user journey ambiance is a result of the construction of a segregated bicycle-pedestrian path on the eastern sidewalk of Montlake Boulevard NE.

The United Kingdom's Department of Transport Guidance on Benefit Appraisal includes journey ambiance improvements as part of their Cost Benefit Analysis for walking and cycling facilities. Improvements such as off-road segregated tracks for bicycles and street lighting for pedestrians are considered improvements that enhance the journey for commuters.

The Montlake Triangle project features infrastructure improvements for pedestrian routes and bicycle user routes and therefore these will be considered as benefits and will be monetized using the Department of Transport's suggested approach.

Pedestrian Routes Improvements

Regarding the improvements to pedestrian routes, the Montlake Triangle project will include lighting, informational panels and directional signage as part of the construction of the access bridge across Montlake Boulevard NE and the pedestrian bridge across NE Pacific Place. Based on the guidance by the U.K.'s Department of Transport, a monetized value for these benefits can be estimated.

The length of the journey ambiance improvements considered in the project represents the equivalent to walking between the University Link Station and Rainier Vista just north of the Burke-Gilman Trail. It is assumed to measure 700 feet based on different maps from the area.

To quantify the benefits associated to these improvements, the number of pedestrians who actually enjoy the benefits must be estimated. Pedestrians enjoying the enhanced journey consist on those who use the access bridge over Montlake Boulevard NE and those who use the land bridge over NE Pacific Place. An estimate for the number of each one of these users is based on the total commuters in the area at any given year, the percentage of those travelers that are pedestrians and the distribution patterns for commuters in the area taken from the Heffron Transportation Memorandum (attachment E). For those pedestrians using the access bridge over Montlake Boulevard NE the length of the enhanced journey ambiance is assumed to be 400 feet, while for those using the land bridge over NE Pacific Place the enhanced journey ambiance is assumed to be 300 feet.

Bicycle User Routes

The Montlake Triangle project includes the construction of side-by-side at-grade paths for bicycles and pedestrians located between the University Link Station and Montlake Boulevard NE. Following the U.K. Department of Transport's Guidance on journey ambiance for bicycle users, the appropriate value of benefits for this improvement can be estimated.

The length of the improvements is assumed to be 300 feet based on maps of the area, stretching from the University Link Station to the corner of Montlake Boulevard NE and NE Pacific Place. Since the quantification of benefits is made on a per-minute basis, an average speed of 12 miles per hour has been assumed to estimate the journey ambiance impact for bicycle users.

Bicycle users enjoying the enhanced journey consist on those travelers who go north on Montlake Boulevard NE from the light rail station. An estimate for the number of each one of these users is calculated based on the total travelers in the area at any given year, the percentage that are bicycle users and the distribution patterns for travelers in the area taken from the Heffron Transportation Memorandum (attachment E).

The methodology to monetize the two types of benefits is shown in the diagram shown in Figure 7.

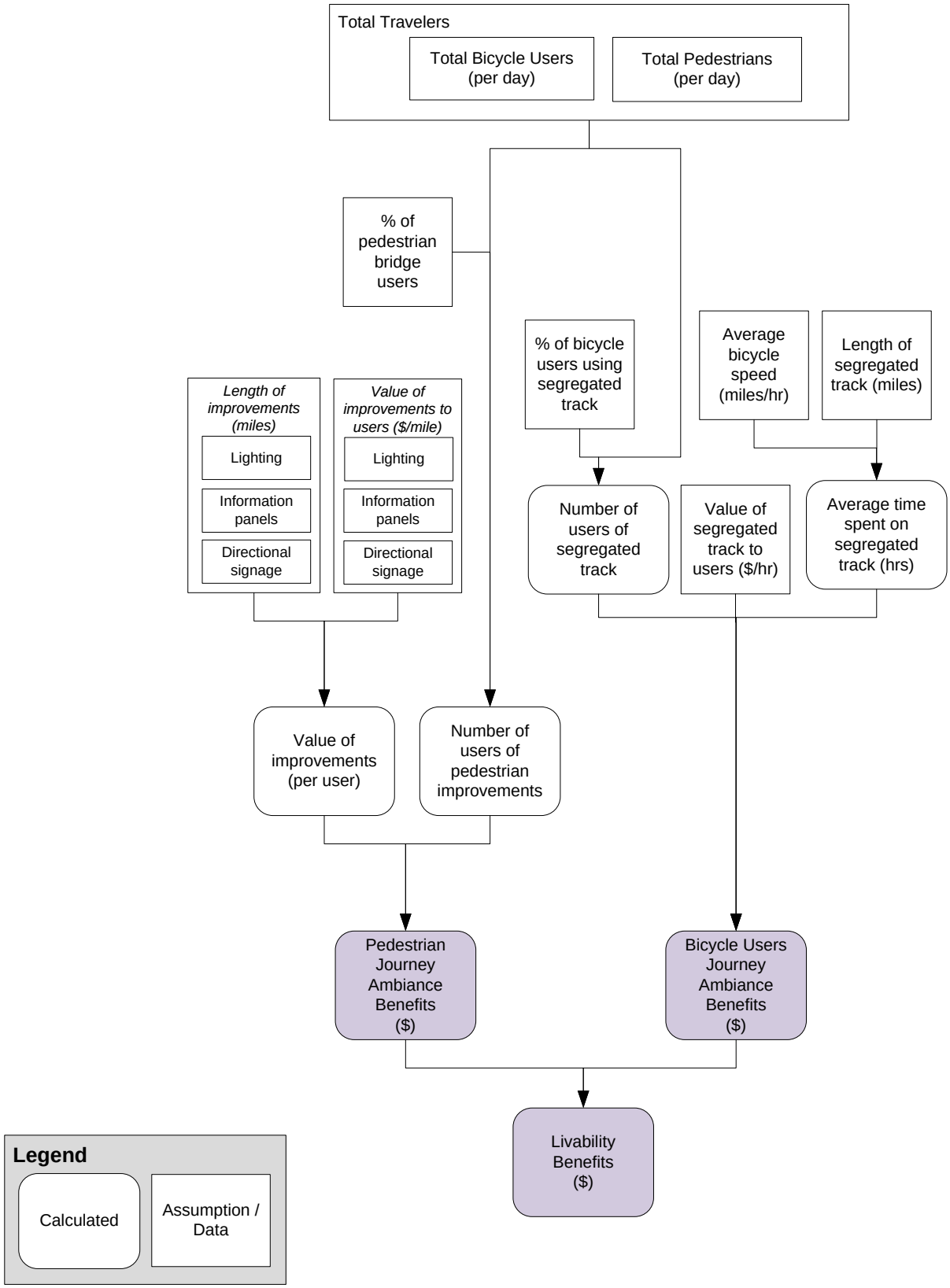


Figure 7. Methodology to Monetize Journey Ambiance Benefits

Quantified Benefits

The project will improve three bus stops in the Montlake Triangle, providing bus riders with sheltered waiting areas. This means riders waiting to board the buses will now be protected against rain and inclement weather, making their wait more comfortable.

Research by the Victoria Transport Institute has found that travel time values are sensitive to waiting area conditions, especially in the case of buses[11]. The report suggests that time spent waiting for the bus should be valued differently for different qualities of waiting conditions. In general, improved waiting conditions should use a reduced value of time to estimate cost of waiting.

Bus riders who benefit from improved waiting conditions are those who wait to board buses at these three bus stops. The benefit is quantified by determining the number of riders who board the buses, the estimated wait time at each bus station (determined by the bus headways) and the value riders give to a sheltered waiting area compared to an unsheltered one. Despite this clear benefit from improvements on waiting conditions, it was difficult to determine a value attributed by riders to the sheltered bus stops. As such, this benefit has not been monetized and will only be incorporated as part of the sensitivity analysis using a reduction in value of time of 10%. The structure and logic diagram for this estimation is shown below.

[11] Litman, 2007. Valuing Transit Service Quality Improvements: Considering Comfort and Convenience In Transport Project Evaluation. Victoria Transport Policy Institute.

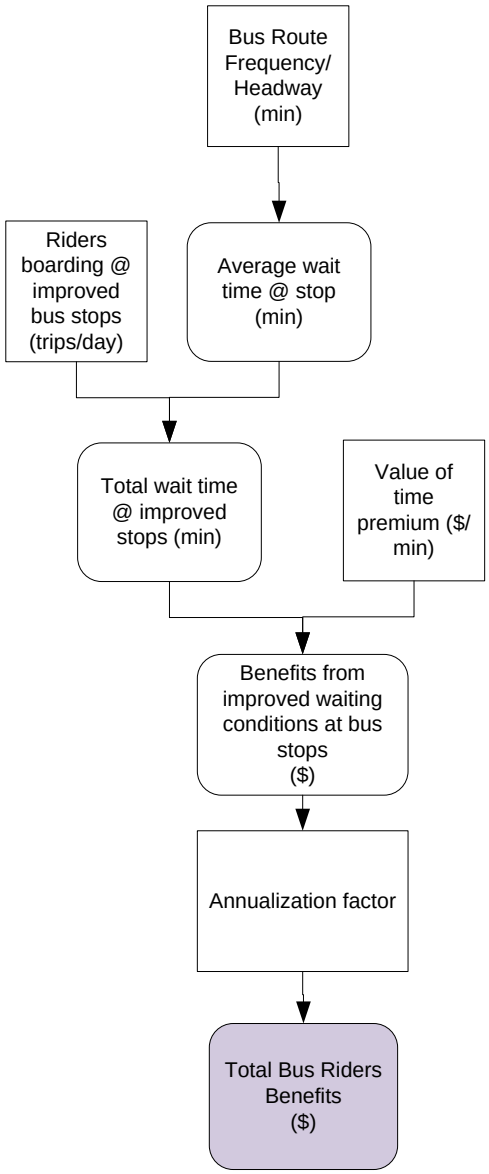


Figure 8. Methodology to Quantify Improved Wait Conditions for Bus Riders

Qualitative Benefits

Landscaping and streetscaping provide a "sense of place" or identity to a location, thus providing benefits to those who travel through it. Despite the fact that the number of travelers who move through the improved area can be estimated, the literature does not provide a value attributed by users to these types of benefits and thus no estimation of its monetized value was performed. A methodology that would allow to quantify these benefits is presented, as an illustration, in the following diagram.

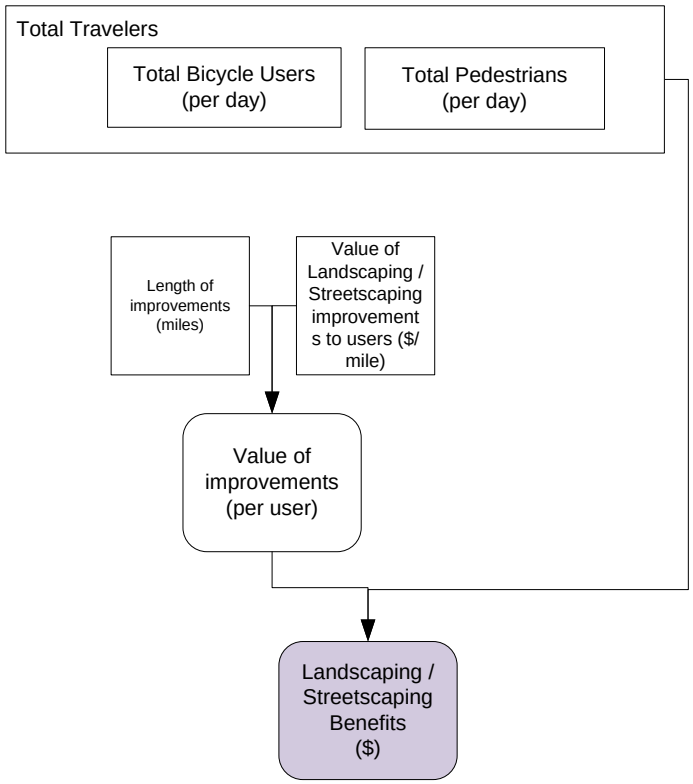


Figure 9. Illustration of Methodology to Quantify Landscaping & Streetscaping Benefits

Finally, the project will improve the accessibility to locations throughout the campus and the Montlake Triangle to individuals with disabilities, physical limitations or even hospital patients. Information from the UW for the academic year 2009-2010 shows that enrollment at the university includes:

- 35 students who are blind/visually impaired
- 41 students who are Deaf/Hard-of-Hearing
- 101 students with mobility impairments

The literature does not provide a value for these benefits, and therefore they were not quantified in this analysis.

6.3.2 Assumptions

The assumptions used in the estimation of livability benefits are summarized in the table below.

Table 9: Assumptions used in the Estimation of Livability Benefits

Variable Name	Unit	Value	Source
Street lighting	Dollars per mile	0.11	Heuman (2005) as reported by UK Department of Transport Guidance*
Information panels	Dollars per mile	0.26	Heuman (2006) as reported by UK Department of Transport Guidance*
Directional signage	Dollars per mile	0.16	Heuman (2006) as reported by UK Department of Transport Guidance*
Off-road segregated cycle track	Dollars per minute	0.10	Hopkinson & Wardman (1996) as reported by UK Department of Transport Guidance*
Average bicycle speed	Miles per hour	12	HDR Assumption
Length of pedestrian improvements in Montlake bridge area	Feet	400	HDR Assumption based on project maps
Length of pedestrian improvements in Pacific Pl bridge area	Feet	300	HDR Assumption based on project maps
Length of segregated ped and bicycle paths on Montlake Blvd NE	Feet	300	HDR Assumption based on project maps

* Values reported in British Pounds are converted to US dollars at the time of the publication and then estimated to 2011 dollars using the CPI.

6.3.3 Benefit Estimates

Pedestrian and bicycle user journey ambiance benefits represent approximately 5% of the benefits monetized for the project. The vast majority of the benefits, however, can be attributed to the pedestrian component of the journey ambiance.

Table 10: Estimates of Livability Benefits, in Millions of 2011 Dollars

	In Project Opening Year	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
Pedestrian Journey Ambiance	$0.12	$12.31	$3.97
Bicycle Users Journey Ambiance	$0.00	$0.11	$0.04

As it was mentioned before, most of these benefits accrue do UW students of which an important portion is under financial aid schemes or belongs to a minority group.

6.4 Environmental Sustainability

The proposed project would contribute to environmental sustainability through a reduction in greenhouse gases emissions as a result of reduced wait times (idling) at the northern and southern halves of the intersection of Montlake Boulevard NE and NE Pacific Place. The reduced wait times mean that fewer pollutants will be released into the atmosphere. For an important number of compounds these reduced emissions can be monetized used standardized values for cost of emissions.

6.4.1 Methodology

This benefit relies on the reduced wait time for motorized vehicles at the intersections. Unfortunately, due to a lack of measurements for wait times in the base case and the alternative, this benefit is not monetized in this analysis.

However, a diagram with a proposed methodology to estimate reductions in emission costs is shown below for illustration purposes.

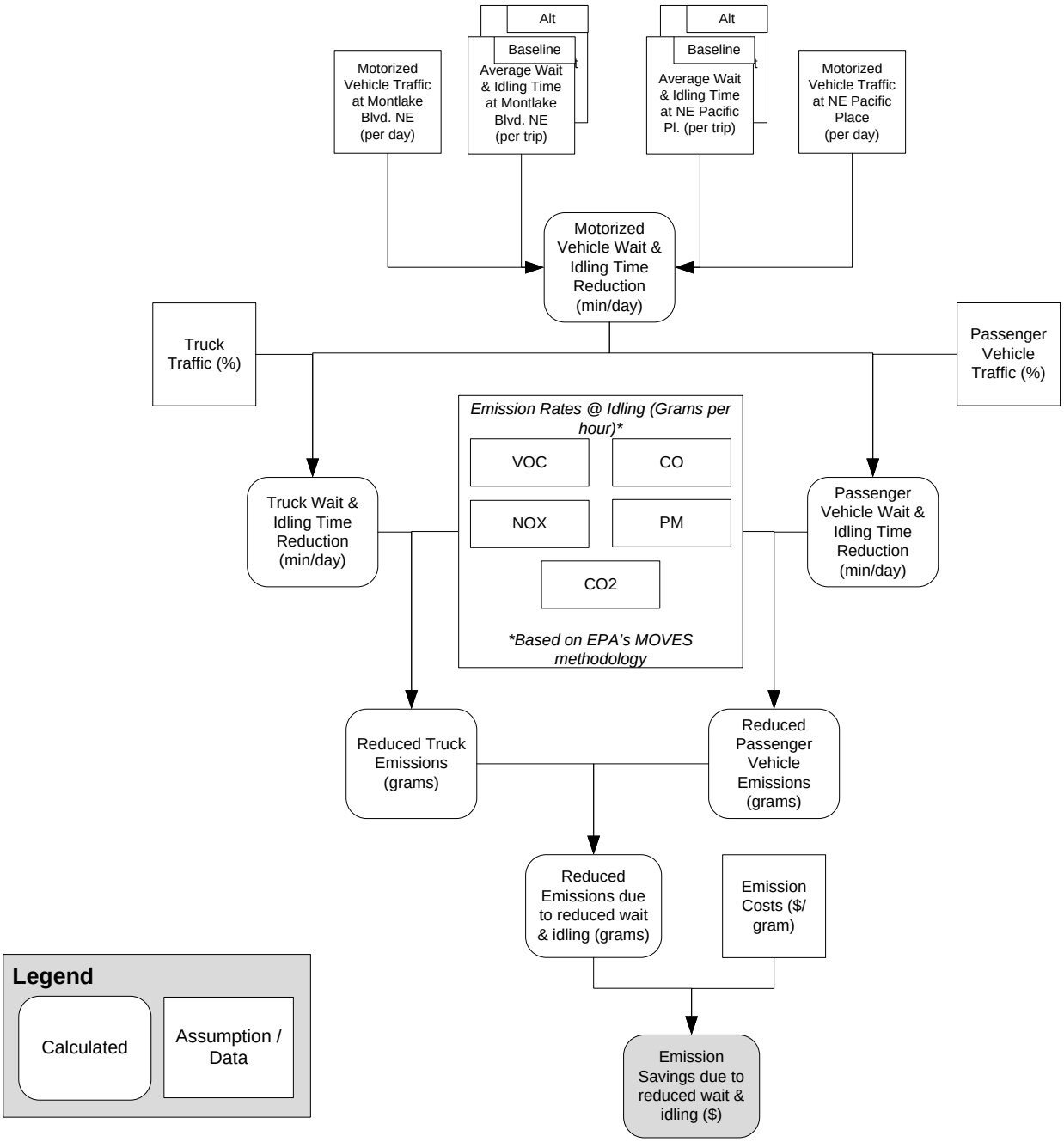


Figure 10. Illustration of Methodology to Estimate Reduction in Emission Costs

6.4.2 Assumptions

Since no quantification or monetization of benefits took place, no assumptions were made.

6.4.3 Benefit Estimates

No benefits were estimated for this outcome.

6.5 Safety

The proposed project would contribute to promoting DOT's safety long-term outcome through a reduction of the estimated number of crashes triggered by large volumes of pedestrians and vehicles in the project's area.

6.5.1 Methodology

The estimation of accident cost reductions is based on the estimation of per-commuter accident rates (per accident type) based on historical reports in the area provided by the Seattle Department of Transportation. These rates are then applied to the forecasted number of travelers in the area to determine the estimated number of accidents (by type) in the base case.

Due to the separation of flows (between pedestrians and cyclists and vehicle users) provided by the bridges for an important number of travelers in the area, it is expected that the Montlake Triangle project improvements will reduce the accidentality rates in the area. In particular, a significant reduction in pedestrian accidents is expected to occur as a result of the project. The reduction factors in accidentality for different types of improvements and accident types are found in Federal Highway Administration's Report number FHWA-SA-07-015[12]. These factors are applied to the base case accidentality rates to calculate the alternative accidentality rates. These rates are used to forecast the number of accidents (by type) in the alternative. The difference in the number of accidents is calculated between the base case and the alternative and each accident is monetized using the values provided in the USDOT's guidance for TIGER grants.

The methodology used is described in the following diagram.

[12] FHWA, 2007. Desktop Reference for Crash Reduction Factors. Report No. FHWA-SA-07-015.

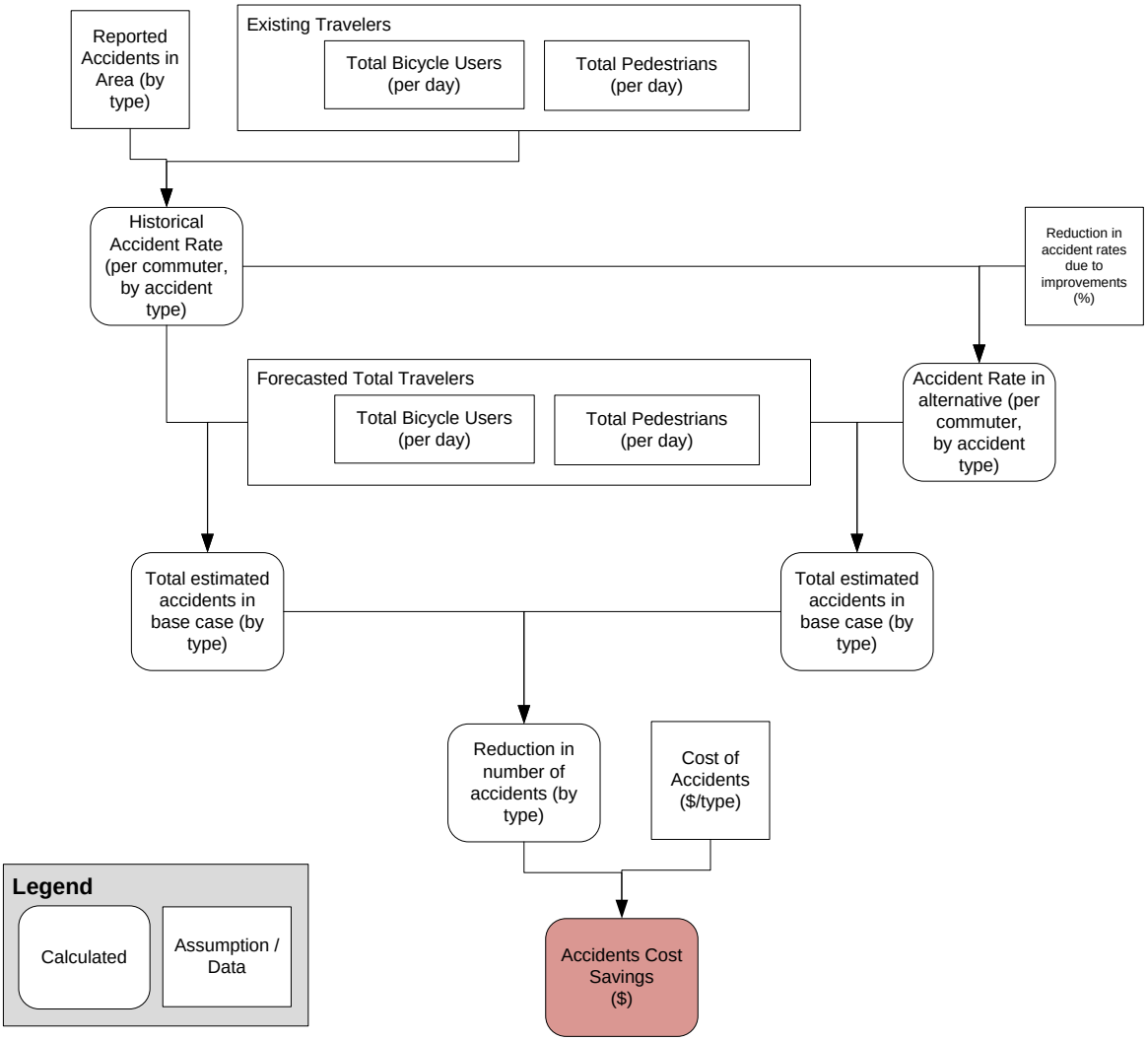


Figure 11. Methodology to Estimate Accident Cost Savings

6.5.2 Assumptions

Due to a lack of detailed data on the nature of the injuries from accidents, it is assumed that all injuries estimated in this analysis correspond to the AIS level 2 (moderate). The rest of the assumptions used in the estimation of safety benefits are summarized in the table below.

Table 11: Assumptions used in the Estimation of Safety Benefits

Variable Name	Unit	Value	Source
Average Yearly Accidents in area	Accidents per year	32.55	Seattle Department of Transportation, collision records 2001-2011
Average Yearly Property Damage Only (PDO) Accidents	Accidents per year	16.09	Seattle Department of Transportation, collision records 2001
Average Yearly Injury Accidents	Accidents per year	11.36	Seattle Department of Transportation, collision records 2001
Average Yearly Fatality Accidents	Accidents per year	0.00	Seattle Department of Transportation, collision records 2001
Average number of injured passengers in injury accidents	Injuries per injury accident	1.39	Seattle Department of Transportation, collision records 2001
Average number of vehicle accidents	Accidents per year	26.91	Seattle Department of Transportation, collision records 2001
Average number of pedalcyclist accidents	Accidents per year	0.36	Seattle Department of Transportation, collision records 2001
Average number of pedestrian accidents	Accidents per year	0.18	Seattle Department of Transportation, collision records 2001
Reduction in vehicle accident rates (all accident types) due to pedestrian bridges	Percentage	30%	FHWA, Desktop Reference for Crash Reduction Factors (Report No. FHWA-SA-07-015)
Reduction in pedalcyclist accident rates (all accident types) due to pedestrian bridges	Percentage	30%	FHWA, Desktop Reference for Crash Reduction Factors (Report No. FHWA-SA-07-015)
Reduction in pedestrian accident rates (all accident types) due to pedestrian bridges	Percentage	90%	FHWA, Desktop Reference for Crash Reduction Factors (Report No. FHWA-SA-07-015)
Property-damage only accident cost	Dollars per accident	3,368.49	US DOT Notice of Funding Availability for the DOT's National Infrastructure Investments Under the Full-Year Continuing Appropriations, 2011. Inflated to 2011 dollars
Value of moderate injury	Dollars per injury	291,400	US DOT Notice of Funding Availability for the DOT's National Infrastructure Investments Under the Full-Year Continuing Appropriations, 2011

6.5.3 Benefit Estimates

The reduction in accident costs constitutes the largest of the monetized benefits for the project, accounting for approximately 73% of the total benefits. This is attributed to the high accident rates present in the base case due to the increased volume of travelers in the area as a result of the start of operations of the University Link Station. During the 30 years of analysis, the improvements are estimated to reduce the total number of accidents by 965. Of those, 565 are considered property-damage only while the remaining 400 are injury accidents. The reduction in injury accidents represents a reduction of 555 injuries.

Table 12: Estimates of Safety Benefits, in Millions of 2011 Dollars

	In Project Opening Year	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
Accident Cost Savings	$1.61	$163.53	$52.69

7. Summary of Findings and BCA Outcomes

The tables below summarize the BCA findings. Annual costs and benefits are computed over the lifecycle of the project (30 years) and include operating and maintenance (O&M) costs. As stated earlier, construction is expected to be completed by 2014. Benefits accrue during the full operation of the project.

Table 13: Overall Results of the Benefit Cost Analysis in Millions of 2011 Dollars unless Specified Otherwise

Project Evaluation Metric	7% Discount Rate	3% Discount Rate
Total Discounted Benefits	$72.24	$131.59
Total Discounted Costs	$41.11	$43.25
Net Present Value	$31.13	$88.34
Benefit / Cost Ratio	1.76	3.04
Internal Rate of Return (%)	12.2%	

Considering all monetized benefits and costs, the estimated internal rate of return of the project is 12.2 percent. With a 7 percent real discount rate, the $41.1 million investment would result in $72.2 million in total benefits and a Benefit/Cost ratio of approximately 1.76.

With a 3 percent real discount rate, the Net Present Value of the project would increase to $88.3 million, for a Benefit/Cost ratio of 3.04.

Table 14: Benefit Estimates by Long-Term Outcome for the Project in Millions of 2011 Dollars

Long-Term Outcomes	Benefit Categories	7% Discount Rate	3% Discount Rate
State of Good Repair	Residual Value	$0.00	$0.00
Economic Competitiveness	Pedestrian Mobility	$15.55	$28.32
Livability	Pedestrian Journey Ambiance	$3.97	$7.23
	Bicycle Users Journey Ambiance	$0.04	$0.07

Long-Term Outcomes	Benefit Categories	7% Discount Rate	3% Discount Rate
Safety	Reduction in Accident Costs	$52.69	$95.97
Total Benefit Estimates		**$72.24**	**$131.59**

As it was discussed in the previous sections of this appendix, most of the beneficiaries of pedestrian mobility are students and an important portion of them are under financial assistance programs or belong to minorities. Relevant statistics about the students are:

- Close to one quarter of entering UW freshmen are PELL Grant eligible, and 30 percent of all freshmen will be the first in their families to attend college.
- Last year, one quarter of (about 8,000) UW undergraduates were eligible for the Husky Promise program, which through a combination of state, federal and UW local funds provides free tuition students with financial need.
- In 2010-11, 58 percent of UW undergraduates received some form of financial aid totaling over $251 million.
- The number and proportion of under-represented minority students at UW Seattle have increased, comprising 12.4 percent of the 2011 freshman class, compared to 10.4 percent in 2006. With the addition of Asian-American students, students of color comprise 40.5 percent of the 2011 freshman class.

In addition to these, students with disabilities of physical limitations will also benefit. According to university records, for the academic year 2009-2010 these included:

- 35 students who are blind/visually impaired
- 41 students who are Deaf/Hard-of-Hearing
- 101 students with mobility impairments

8. BCA Sensitivity Analysis

The BCA outcomes presented in the previous sections rely on a large number of assumptions and long-term projections; both of which are subject to considerable uncertainty.

The primary purpose of the sensitivity analysis is to help identify the variables and model parameters whose variations have the greatest impact on the BCA outcomes: the "critical variables."

The sensitivity analysis can also be used to:

- Evaluate the impact of changes in individual critical variables – how much the final results would vary with reasonable departures from the "preferred" or most likely value for the variable; and

- Assess the robustness of the BCA and evaluate, in particular, whether the conclusions reached under the "preferred" set of input values are significantly altered by reasonable departures from those values.

The outcomes of the quantitative analysis for the alternative using a 7 percent discount rate are summarized in the table below. The table provides the percentage changes in project NPV associated with variations in variables or parameters (listed in row), as indicated in the column headers. For example, a 30 percent reduction in the value of time leads to a 14.9 percent reduction in the project NPV. A 20 percent increase in value of time raises the project NPV by 10 percent.

Table 15: Quantitative Assessment of Sensitivity, Summary

Parameters	Change in Parameter Value	New NPV	Change in NPV	New B/C Ratio
Value of Time	30% Reduction in Recommended Value	$26.43	($4.66)	1.64
	20% Increase in Recommended Value	$34.21	$3.11	1.83
Premium for Improved Wait Time at Bus Stations	10% premium in the Value of Time	$38.89	$7.79	1.95
	15% premium in the Value of Time	$42.78	$11.69	2.04
Percentage of pedestrians	80%	$29.95	($1.15)	1.73
	90%	$32.24	$1.15	1.78
Percentage of daily travelers in one peak hour	15%	$37.60	$6.51	1.91
	25%	$27.19	($3.90)	1.66
Annual O&M Cost Estimate	25% Reduction	$31.31	$0.22	1.77

9. Economic Impact Analysis

The Council of Economic Advisor's (CEA) methodology[13] has been used to estimate the direct, indirect and induced effects of the Montlake Triangle project, in terms of employment generated. Employment effects represent full-time and part-time jobs created for a full year (unless noted otherwise).

9.1 Short-Term Impacts from Capital Expenditures

Estimated spending on project engineering, construction and construction supervision between 2011 and 2014 is used to compute short-term economic impacts.

The project is expected to generate 271.3 direct and indirect job-years during the project development phase. It is also expected to create 152.6 induced job-years. A breakdown of short-term job creation by type of effect (direct, indirect and induced) is provided in the table below.

Table 16: Direct, Indirect and Induced Impacts during Project Development Phase

	Spending (Millions of 2011 Dollars)	Direct	Indirect	Induced	Total
Employment	$39.0	271		153	424

A breakdown of short-term economic impacts in terms of employment (job-hours is provided by quarter in the table below. The majority of jobs will be created in the construction sector.

Table 17: Short-Term Impacts Resulting from Capital Expenditures

Period	Spending (Millions of 2011 Dollars)*	Total Direct and Indirect Job-Years	Total Induced Job-Years
2011 - Q3	$1.2	9	5
2011 - Q4	$0.7	5	3
2012 - Q1	$3.6	25	14
2012 - Q2	$5.4	38	21
2012 - Q3	$7.7	54	30
2012 - Q4	$11.9	83	47
2013 - Q1	$6.1	42	24
2013 - Q2	$2.3	16	9
2013 - Q3	$0.0	0	0
2013 - Q4	$0.0	0	0
Total	**$39.0**	**271**	**153**

*Notes: * includes design, construction, administration costs and reserves*

[13] 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.

9.2 Long-Term Impacts from Incremental Operation and Maintenance Expenditures

In addition to short-term job creation, the operation and maintenance of the Montlake Triangle Project is expected to generate long-term employment opportunities. Unlike those resulting from capital expenditures, these jobs are expected to exist through the useful life of the project (for 30 years). Each year, about one job-year will be created from $80.5 thousand in operation and maintenance spending. Over the useful life of the project, this amounts to 26 job-years.

The table below presents estimates of the long-term employment impacts resulting from the operation and maintenance of the project.

Table 18: Long-Term Employment Impacts

Category	Annually	Total over 30 Years of Operations
Net incremental spending (Millions of 2011 Dollars)	$0.08	$2.42
Total job-years created	0.9	26.3

10. Supplementary Data Tables

This section breaks down all benefits associated with the five long-term outcome criteria (State of Good Repair, Economic Competiveness, Livability, Sustainability, and Safety) in annual form for the Montlake Triangle project under the alternative. Supplementary data tables are also provided for some specific benefit categories. For example, tables providing estimates of accident cost reductions are provided under Safety.

10.1 Annual Estimates of Total Project Benefits and Costs

Calendar Year	Project Year	Total Benefits (2011)	Total Costs (2011)	Undiscounted Net Benefits ($2011)	Discounted Net Benefits at 7%	Discounted Net Benefits at 3%
2011	1	$ -	$ 5,961,756(*)	$ (5,961,756)	$ (6,130,172)	$ (6,033,934)
2012	2	$ -	$ 28,690,943	$ (28,690,943)	$ (26,813,965)	$ (27,855,284)
2013	3	$ -	$ 8,347,301	$ (8,347,301)	$ (7,290,856)	$ (7,868,132)
2014 (opening)	4	$ 2,207,981	$ 80,542	$ 2,127,440	$ 1,736,625	$ 1,945,905
2015	5	$ 2,230,061	$ 80,542	$ 2,149,520	$ 1,639,858	$ 1,908,836
2016	6	$ 6,619,352	$ 80,542	$ 6,538,810	$ 4,662,081	$ 5,637,598
2017	7	$ 6,685,545	$ 80,542	$ 6,605,004	$ 4,401,193	$ 5,528,805
2018	8	$ 6,752,401	$ 80,542	$ 6,671,859	$ 4,154,899	$ 5,422,104
2019	9	$ 6,819,925	$ 80,542	$ 6,739,383	$ 3,922,382	$ 5,317,457
2020	10	$ 6,888,124	$ 80,542	$ 6,807,582	$ 3,702,874	$ 5,214,822
2021	11	$ 6,957,005	$ 80,542	$ 6,876,464	$ 3,495,645	$ 5,114,163
2022	12	$ 7,026,575	$ 80,542	$ 6,946,034	$ 3,300,011	$ 5,015,441
2023	13	$ 7,096,841	$ 80,542	$ 7,016,300	$ 3,115,321	$ 4,918,618
2024	14	$ 7,167,809	$ 80,542	$ 7,087,268	$ 2,940,964	$ 4,823,660
2025	15	$ 7,239,488	$ 80,542	$ 7,158,946	$ 2,776,363	$ 4,730,529
2026	16	$ 7,311,882	$ 80,542	$ 7,231,341	$ 2,620,971	$ 4,639,191
2027	17	$ 7,385,001	$ 80,542	$ 7,304,460	$ 2,474,273	$ 4,549,611
2028	18	$ 7,458,851	$ 80,542	$ 7,378,310	$ 2,335,784	$ 4,461,757
2029	19	$ 7,533,440	$ 80,542	$ 7,452,898	$ 2,205,044	$ 4,375,594
2030	20	$ 8,070,112	$ 80,542	$ 7,989,571	$ 2,209,183	$ 4,554,050
2031	21	$ 8,165,658	$ 80,542	$ 8,085,116	$ 2,089,348	$ 4,474,287
2032	22	$ 8,247,315	$ 80,542	$ 8,166,773	$ 1,972,383	$ 4,387,840
2033	23	$ 8,329,788	$ 80,542	$ 8,249,246	$ 1,861,963	$ 4,303,060
2034	24	$ 8,413,086	$ 80,542	$ 8,332,544	$ 1,757,724	$ 4,219,913
2035	25	$ 8,497,216	$ 80,542	$ 8,416,675	$ 1,659,319	$ 4,138,370
2036	26	$ 8,582,189	$ 80,542	$ 8,501,647	$ 1,566,421	$ 4,058,398
2037	27	$ 8,668,010	$ 80,542	$ 8,587,469	$ 1,478,723	$ 3,979,967
2038	28	$ 8,754,691	$ 80,542	$ 8,674,149	$ 1,395,934	$ 3,903,049
2039	29	$ 8,842,237	$ 80,542	$ 8,761,696	$ 1,317,778	$ 3,827,614
2040	30	$ 8,930,660	$ 80,542	$ 8,850,118	$ 1,243,998	$ 3,753,633
2041	31	$ 9,019,966	$ 80,542	$ 8,939,425	$ 1,174,346	$ 3,681,078
2042	32	$ 9,110,166	$ 80,542	$ 9,029,625	$ 1,108,594	$ 3,609,923
2043	33	$ 9,201,268	$ 80,542	$ 9,120,726	$ 1,046,522	$ 3,540,141
Total		**$ 224,212,644**	**$ 45,416,245**	**$ 178,796,399**	**$ 31,131,532**	**$ 88,278,062**

** = includes expenditures made during 2010.*

10.2 Annual Demand Projections

Calendar Year	Project Year	Total Travelers	Pedestrians	Cyclists	Total Bus Riders	Number of Users of Montlake Bridge	Number of Users of Both Pacific Pl and Montlake Bridges
2014 (opening)	4	3,569,057	3,033,698	535,359	1,379,254	2,534,030	1,320,551
2015	5	3,604,748	3,064,035	540,712	1,393,046	2,559,371	1,333,757
2016	6	10,699,748	9,094,785	1,604,962	3,209,924	7,596,821	3,958,907
2017	7	10,806,745	9,185,733	1,621,012	3,242,024	7,672,789	3,998,496
2018	8	10,914,812	9,277,591	1,637,222	3,274,444	7,749,517	4,038,481
2019	9	11,023,961	9,370,367	1,653,594	3,307,188	7,827,012	4,078,865
2020	10	11,134,200	9,464,070	1,670,130	3,340,260	7,905,282	4,119,654
2021	11	11,245,542	9,558,711	1,686,831	3,373,663	7,984,335	4,160,851
2022	12	11,357,998	9,654,298	1,703,700	3,407,399	8,064,178	4,202,459
2023	13	11,471,578	9,750,841	1,720,737	3,441,473	8,144,820	4,244,484
2024	14	11,586,293	9,848,349	1,737,944	3,475,888	8,226,268	4,286,929
2025	15	11,702,156	9,946,833	1,755,323	3,510,647	8,308,531	4,329,798
2026	16	11,819,178	10,046,301	1,772,877	3,545,753	8,391,616	4,373,096
2027	17	11,937,370	10,146,764	1,790,605	3,581,211	8,475,532	4,416,827
2028	18	12,056,743	10,248,232	1,808,512	3,617,023	8,560,288	4,460,995
2029	19	12,177,311	10,350,714	1,826,597	3,653,193	8,645,891	4,505,605
2030	20	13,068,564	11,108,280	1,960,285	3,920,569	8,851,931	4,835,369
2031	21	13,199,250	11,219,363	1,979,888	3,959,775	9,371,468	4,883,723
2032	22	13,331,243	11,331,556	1,999,686	3,999,373	9,465,182	4,932,560
2033	23	13,464,555	11,444,872	2,019,683	4,039,366	9,559,834	4,981,885
2034	24	13,599,200	11,559,320	2,039,880	4,079,760	9,655,432	5,031,704
2035	25	13,735,192	11,674,914	2,060,279	4,120,558	9,751,987	5,082,021
2036	26	13,872,544	11,791,663	2,080,882	4,161,763	9,849,507	5,132,841
2037	27	14,011,270	11,909,579	2,101,690	4,203,381	9,948,002	5,184,170
2038	28	14,151,383	12,028,675	2,122,707	4,245,415	10,047,482	5,236,012
2039	29	14,292,896	12,148,962	2,143,934	4,287,869	10,147,956	5,288,372
2040	30	14,435,825	12,270,452	2,165,374	4,330,748	10,249,436	5,341,255
2041	31	14,580,184	12,393,156	2,187,028	4,374,055	10,351,930	5,394,668
2042	32	14,725,985	12,517,088	2,208,898	4,417,796	10,455,450	5,448,615
2043	33	14,873,245	12,642,258	2,230,987	4,461,974	10,560,004	5,503,101
Total		**362,448,777**	**308,081,460**	**54,367,317**	**109,354,791**	**256,911,882**	**134,106,047**

10.3 Economic Competitiveness: Annual Benefit Estimates – Discounted at 7%

Calendar Year	Project Year	Pedestrians using Walk Route 1	Pedestrians using Walk Route 2	Total Time Saved in Walking Route 1 (hours)	Total Time Saved in Walking Route 2 (hours)	Value of Time for Travel Time Savings	Discounted Pedestrian Mobility Benefit
2014 (opening)	4	1,061,794	485,392	16,517	2,562	$ 24.91	$ 387,935
2015	5	1,072,412	490,246	16,682	2,587	$ 24.91	$ 366,181
2016	6	3,183,175	1,455,166	49,516	7,680	$ 24.91	$ 1,015,807
2017	7	3,215,007	1,469,717	50,011	7,757	$ 24.91	$ 958,846
2018	8	3,247,157	1,484,414	50,511	7,834	$ 24.91	$ 905,079
2019	9	3,279,628	1,499,259	51,016	7,913	$ 24.91	$ 854,327
2020	10	3,312,425	1,514,251	51,527	7,992	$ 24.91	$ 806,420
2021	11	3,345,549	1,529,394	52,042	8,072	$ 24.91	$ 761,201
2022	12	3,379,004	1,544,688	52,562	8,153	$ 24.91	$ 718,516
2023	13	3,412,794	1,560,135	53,088	8,234	$ 24.91	$ 678,226
2024	14	3,446,922	1,575,736	53,619	8,316	$ 24.91	$ 640,194
2025	15	3,481,392	1,591,493	54,155	8,400	$ 24.91	$ 604,296
2026	16	3,516,205	1,607,408	54,697	8,484	$ 24.91	$ 570,410
2027	17	3,551,367	1,623,482	55,243	8,568	$ 24.91	$ 538,424
2028	18	3,586,881	1,639,717	55,796	8,654	$ 24.91	$ 508,232
2029	19	3,622,750	1,656,114	56,354	8,741	$ 24.91	$ 479,733
2030	20	3,887,898	1,777,325	60,478	9,380	$ 24.91	$ 481,163
2031	21	3,926,777	1,795,098	61,083	9,474	$ 24.91	$ 454,182
2032	22	3,966,045	1,813,049	61,694	9,569	$ 24.91	$ 428,714
2033	23	4,005,705	1,831,179	62,311	9,665	$ 24.91	$ 404,674
2034	24	4,045,762	1,849,491	62,934	9,761	$ 24.91	$ 381,982
2035	25	4,086,220	1,867,986	63,563	9,859	$ 24.91	$ 360,562
2036	26	4,127,082	1,886,666	64,199	9,957	$ 24.91	$ 340,344
2037	27	4,168,353	1,905,533	64,841	10,057	$ 24.91	$ 321,259
2038	28	4,210,036	1,924,588	65,489	10,158	$ 24.91	$ 303,245
2039	29	4,252,137	1,943,834	66,144	10,259	$ 24.91	$ 286,240
2040	30	4,294,658	1,963,272	66,806	10,362	$ 24.91	$ 270,190
2041	31	4,337,605	1,982,905	67,474	10,465	$ 24.91	$ 255,039
2042	32	4,380,981	2,002,734	68,149	10,570	$ 24.91	$ 240,737
2043	33	4,424,790	2,022,761	68,830	10,676	$ 24.91	$ 227,238
Total		**107,828,511**	**49,293,034**	**1,677,332**	**260,158**		**$ 15,549,397**

10.4 Livability: Annual Benefit Estimates – Discounted at 7%

Calendar Year	Project Year	Trips Across Montlake Access Bridge	Trips Across Pacific Place Land Bridge	Value of Montlake Improvements to Pedestrians (per trip)	Value of Pacific Pl Improvements to Pedestrians (per trip)	Discounted Pedestrian Journey Ambiance Benefit	Time Spent by Cyclists in Segregated Track (minutes)	Value of Segregated Track to Cyclists (per minute)	Bicycle Users Journey Ambiance
2014 (opening)	4	2,153,926	1,122,468	$ 0.041	$ 0.030	$ 99,087	638,780	$ 0.105	$ 911
2015	5	2,175,465	1,133,693	$ 0.041	$ 0.030	$ 93,531	645,168	$ 0.105	$ 860
2016	6	6,457,298	3,365,071	$ 0.041	$ 0.030	$ 259,459	1,915,012	$ 0.105	$ 2,385
2017	7	6,521,871	3,398,721	$ 0.041	$ 0.030	$ 244,910	1,934,162	$ 0.105	$ 2,251
2018	8	6,587,089	3,432,709	$ 0.041	$ 0.030	$ 231,176	1,953,503	$ 0.105	$ 2,125
2019	9	6,652,960	3,467,036	$ 0.041	$ 0.030	$ 218,213	1,973,038	$ 0.105	$ 2,005
2020	10	6,719,490	3,501,706	$ 0.041	$ 0.030	$ 205,977	1,992,769	$ 0.105	$ 1,893
2021	11	6,786,685	3,536,723	$ 0.041	$ 0.030	$ 194,427	2,012,696	$ 0.105	$ 1,787
2022	12	6,854,552	3,572,090	$ 0.041	$ 0.030	$ 183,524	2,032,823	$ 0.105	$ 1,687
2023	13	6,923,097	3,607,811	$ 0.041	$ 0.030	$ 173,233	2,053,152	$ 0.105	$ 1,592
2024	14	6,992,328	3,643,889	$ 0.041	$ 0.030	$ 163,519	2,073,683	$ 0.105	$ 1,503
2025	15	7,062,251	3,680,328	$ 0.041	$ 0.030	$ 154,350	2,094,420	$ 0.105	$ 1,419
2026	16	7,132,874	3,717,131	$ 0.041	$ 0.030	$ 145,695	2,115,364	$ 0.105	$ 1,339
2027	17	7,204,203	3,754,303	$ 0.041	$ 0.030	$ 137,525	2,136,518	$ 0.105	$ 1,264
2028	18	7,276,245	3,791,846	$ 0.041	$ 0.030	$ 129,813	2,157,883	$ 0.105	$ 1,193
2029	19	7,349,007	3,829,764	$ 0.041	$ 0.030	$ 122,534	2,179,462	$ 0.105	$ 1,126
2030	20	7,524,141	4,110,063	$ 0.041	$ 0.030	$ 118,835	2,338,976	$ 0.105	$ 1,129
2031	21	7,965,747	4,151,164	$ 0.041	$ 0.030	$ 116,008	2,362,366	$ 0.105	$ 1,066
2032	22	8,045,405	4,192,676	$ 0.041	$ 0.030	$ 109,503	2,385,989	$ 0.105	$ 1,006
2033	23	8,125,859	4,234,603	$ 0.041	$ 0.030	$ 103,362	2,409,849	$ 0.105	$ 950
2034	24	8,207,117	4,276,949	$ 0.041	$ 0.030	$ 97,566	2,433,948	$ 0.105	$ 897
2035	25	8,289,189	4,319,718	$ 0.041	$ 0.030	$ 92,095	2,458,287	$ 0.105	$ 846
2036	26	8,372,081	4,362,915	$ 0.041	$ 0.030	$ 86,931	2,482,870	$ 0.105	$ 799
2037	27	8,455,801	4,406,544	$ 0.041	$ 0.030	$ 82,057	2,507,699	$ 0.105	$ 754
2038	28	8,540,359	4,450,610	$ 0.041	$ 0.030	$ 77,455	2,532,776	$ 0.105	$ 712
2039	29	8,625,763	4,495,116	$ 0.041	$ 0.030	$ 73,112	2,558,104	$ 0.105	$ 672
2040	30	8,712,021	4,540,067	$ 0.041	$ 0.030	$ 69,012	2,583,685	$ 0.105	$ 634
2041	31	8,799,141	4,585,468	$ 0.041	$ 0.030	$ 65,142	2,609,521	$ 0.105	$ 599
2042	32	8,887,132	4,631,322	$ 0.041	$ 0.030	$ 61,490	2,635,617	$ 0.105	$ 565
2043	33	8,976,004	4,677,636	$ 0.041	$ 0.030	$ 58,041	2,661,973	$ 0.105	$ 533
Total		**218,375,099**	**113,990,140**			**$ 3,967,585**	**64,870,093**		**$ 36,501**

10.5 Safety: Annual Benefit Estimates – Discounted at 7%

Calendar Year	Project Year	Projected Number of Total Accidents - Base Case	Projected Number of Total Accidents - Alternative	Estimated Number of PDO Accidents Avoided	Estimated Number of Injury Accidents Avoided	Average Number of Injuries per Injury Accident	Discounted Accident Cost Reduction Benefit
2014 (opening)	4	31	22	6	4	1.39	$ 1,314,438
2015	5	32	22	6	4	1.39	$ 1,240,732
2016	6	94	65	17	12	1.39	$ 3,441,856
2017	7	95	66	17	12	1.39	$ 3,248,855
2018	8	96	67	17	12	1.39	$ 3,066,676
2019	9	97	67	17	12	1.39	$ 2,894,713
2020	10	97	68	17	12	1.39	$ 2,732,393
2021	11	98	69	18	12	1.39	$ 2,579,174
2022	12	99	69	18	13	1.39	$ 2,434,548
2023	13	100	70	18	13	1.39	$ 2,298,031
2024	14	101	71	18	13	1.39	$ 2,169,170
2025	15	102	71	18	13	1.39	$ 2,047,534
2026	16	103	72	18	13	1.39	$ 1,932,719
2027	17	105	73	19	13	1.39	$ 1,824,342
2028	18	106	73	19	13	1.39	$ 1,722,043
2029	19	107	74	19	13	1.39	$ 1,625,479
2030	20	114	80	20	14	1.39	$ 1,630,325
2031	21	116	80	21	15	1.39	$ 1,538,905
2032	22	117	81	21	15	1.39	$ 1,452,611
2033	23	118	82	21	15	1.39	$ 1,371,156
2034	24	119	83	21	15	1.39	$ 1,294,269
2035	25	120	84	21	15	1.39	$ 1,221,693
2036	26	121	85	22	15	1.39	$ 1,153,187
2037	27	123	85	22	15	1.39	$ 1,088,522
2038	28	124	86	22	16	1.39	$ 1,027,484
2039	29	125	87	22	16	1.39	$ 969,868
2040	30	126	88	23	16	1.39	$ 915,483
2041	31	128	89	23	16	1.39	$ 864,147
2042	32	129	90	23	16	1.39	$ 815,690
2043	33	130	91	23	16	1.39	$ 769,951
Total		**3,173**	**2,209**	**565**	**399**		**$ 52,685,995**