APPENDIX A
Northgate Light Rail Station Non-Motorized Access
Benefit – Cost Analysis Executive Summary

CURRENT INFRASTRUCTURE BASELINE

Northgate is one of six Urban Centers established by the *Seattle Comprehensive Plan*. The Northgate area is one of the Puget Sound region's major residential and employment centers with 3,600 households and over 11,000 jobs. The medical, retail and education sectors are the major employers in the center. It is one of Seattle's most affordable communities and has attracted a higher proportion of economically disadvantaged populations than the city as a whole.

The area surrounding the proposed project consists of a collection of pockets of commercial and institutional land uses, separated from each other by Interstate 5 (I-5), high volume wide arterial streets and large parking lots. This "superblock" type development creates an environment that is difficult to safely navigate by any means other than motor vehicles. Even in a car, traveling between the various pockets often requires long, circuitous trips, which can add at least a mile to any single trip. Employees traveling to job and educational opportunities by bus from one side to the other must take a circuitous routing and buses going through the Northgate Way/I-5 interchange are often delayed by significant congestion. The lack of convenient and safe pedestrian and bicycle connections at the two crossings of I-5 also severely impacts the use of active transportation modes. These barriers between residences on either side of the freeway from employment opportunities on the other have hindered job growth and influenced choices of travel mode. Commute trip surveys indicate that the choice of whether to walk or bike to work within Northgate is strongly influenced by the presence of I-5, with residents living on one side of the freeway and working on the other 50% less likely to walk or bike to work.

The Northgate Transit Center is the largest transit center in the King County Metro system. In the near future, the existing transit center will be enhanced by the construction of a light rail station with planned connections to downtown Seattle and as far south at SeaTac International Airport and as far north as Lynnwood, a distance of nearly 30 miles. With planned investments, the transit center will be a catalyst to transform the Northgate area from a district dependent on motorized transportation to a district that has multiple options to meet its transportation needs. The I-5 corridor divides the Northgate District and makes full utilization of the transit center and future light rail station from the west more difficult. Ten lanes of I-5 bisect the neighborhood creating a barrier between homes, jobs, schools, transit stops and vital community services. Currently, the two crossings of I-5 within the urban center are nearly one mile apart. This distance, combined with dangerous freeway entrances and an incomplete network of active transportation facilities makes it difficult or impossible for many people to access the light rail station area without a car or bus transfer. While slated for significant growth as part of both Seattle's Comprehensive Plan and the Puget Sound Regional Council's *Vision 2040* plan, growth in Northgate has lagged behind most other designated growth centers due to this auto-oriented built environment.

DESCRIPTION OF PROPOSED PROJECT

The Northgate Link Light Rail Station Non-motorized Access Project constructs a bicycle and pedestrian bridge crossing Interstate 5, a cycle track on First Avenue NE, and other non-motorized transportation safety improvements at the Northgate Transit Center and within the light rail station area. The project will connect the east and west sides of I-5, providing linkages and improved access to employment centers, neighborhood amenities, the North Seattle College (NSC), retail centers, medical facilities, community services and connections into the surrounding neighborhoods.

The project will extend the reach of the existing King County Metro transit center for pedestrians and bicycles. The transit center serves over 6,000 passengers a day, and the future Sound Transit Link light rail station is expected to service over 15,000 passengers each day. The project will allow large numbers of people to access the Sound Transit system and regional bus connections by walking and biking.

As part of many studies including the *Northgate Urban Design Framework*, the creation of a pedestrian and bicycle friendly connection between the east and west sides of I-5 has been a key component envisioned to improve access to the transit center and other assets of the neighborhoods. The report states that this connection in the form of a pedestrian and bicycle bridge is the single most important non-motorized connectivity infrastructure investment for the Urban Center.

King County Department of Transportation (KCDOT) completed the *Northgate Pedestrian Bridge Feasibility Study Report* in December 2012. The report identifies possible alignments, bridge types and estimated costs for a bridge. The study reported that a bridge would reduce the walking distance from the transit center to NSC from 1.2 miles to approximately 0.25 miles. The Report cites a previous study indicating that a bridge would result in a 30% reduction in average walking time to the Northgate Transit Center and Light Rail Station, and would effectively expand the area walk shed (0.5 miles) to more than 150 buildings and bike shed (3.0 miles) to more than 3,000 additional buildings.

PROJECT COSTS

The estimated design and construction cost of the pedestrian bridge, protected bicycle facilities, and associated improvements is $36.5million. The cost estimates were prepared by KPFF Consulting Engineers in 2014. The model also assumes annual maintenance costs of $29,000 per year.

PROJECT BENEFITS

The Northgate Bicycle and Pedestrian Bridge will be a catalyst for a wide range of benefits to the surrounding neighborhoods and northern Seattle. Even under a conservative benefits analysis framework,

the federal investment in this station area will facilitate an area-wide modal shift of nearly 10 percent for all bike trips and 4 percent for walking trips. This shift will facilitate nearly two million new bicycle and pedestrian trips annually in 2019. The project also provides significant health benefits, encourages physical activity and reduces household transportation costs. The project will also result in numerous qualitative benefits that will improve the quality of life and economic competitiveness of the region. Using conservative figures, the Northgate Light Rail Station Non-Motorized Access proposal will result in $46 million in quantified benefits with an estimated net present value of approximately $29 million, representing an internal rate of return on investment (IRR) of 5%, in line with other previous TIGER grant awards for bicycle and pedestrian infrastructure. The technical documentation for these benefits is included as Appendix B.

Long Term Outcomes	Net Present Value	
	3% Discount Rate	7% Discount Rate
Quality of Life (Livability)		
Household Travel Savings	$ 19,444,000	$ 11,068,000
Travel Time Savings	$ 6,623,000	$ 3,826,000
Improved Health Benefits	$ 5,589,000	$ 3,106,000
Environmental Sustainability		
Reduced Emissions	$ 914,000	$ 526,000
Economic Competitiveness		
Reduced Traffic Congestion Costs	$ 2,459,000	$ 1,437,000
Safety		
Reductions in Collision Savings	$ 7,153,000	$ 4,181,000
State of Good Repair		
Reduction in Road Maintenance Costs	$ 3,353,000	$ 1,960,000

QUALITY OF LIFE (LIVABILITY)

Household Travel Savings – Net Estimated Benefits: $ 19,444,000

The bridge will allow a freer flow of circulation within the area in ways that are separated from traffic. Pedestrians and people using bicycles will be able to find a safe, convenient, and comfortable route across the freeway. The bridge, combined with other improvements to sidewalks and trails, will result in a more complete network of non-motorized mobility. This will result in mode shift towards non-motorized travel, which will reduce vehicle miles traveled, and result in a significant reduction to household transportation spending.

Transportation costs are second only to housing costs as a percentage of household spending in North America. Spending on transportation is disproportionately high among low- and moderate-income families and bicycling and walking presents an affordable transportation option. Using walking and cycling for transportation reduces household spending on transportation, and in some cases, active transportation and transit use can eliminate the need for an extra vehicle. Bicycling, walking and transit

use will likely become even more attractive transportation options as fuel prices rise. The operating cost of a car is nearly $9,000 while walking and bicycling are about $100 and $350 respectively. To put it in perspective, A German study found that a 23-minute commute, versus no commute, had the same effect on well-being as a 19 percent reduction in income (Stuzer). Bridge construction has the potential to significantly reduce travel costs for area residents and provides equitable transportation options consistent with stated city goals and policies.

Travel Time Savings – Net Estimated Benefits: $6,623,000

The bridge will create a safe, convenient, comfortable, and more direct route across the freeway for bicycles. The bridge will reduce the distance from the transit center to NSC from 1.2 miles to approximately 0.25 miles. Based on the distance between the existing crossings, it was assumed that a bicyclist would have to detour approximately one mile out of their way to continue their journey. Transportation planners generally assume urban travel speeds of approximately 10 miles per hour, resulting in approximately six minutes of additional travel time on each bike trip. Additionally, research indicates bicyclists are only willing to add about an additional distance of about 25 percent to any trip. This means that if a bicyclist had to travel one mile out of direction, they would have to be going more than 4 miles to make the trip 'worthwhile.' While these are general rules of thumb, it is an indication of the benefit a direct connection will bring to area bicyclists.

Improved Health Benefits– Net Estimated Benefits: $5,589,000

The pedestrian bridge will enhance the health benefits of non-motorized choices by supporting a walkable and bike-friendly urban environment that can help individuals increase their level of physical activity. The project will increase bicycle and pedestrian activity, which will result in reduced healthcare costs, a reduction in lost productivity, and a reduction in workers compensation costs.

Increasing evidence from experts shows that physical inactivity has become a major public health problem that has expensive economic consequences. The U.S. Centers for Disease Control and Prevention estimated that $147 billion in added annual health costs could be attributed to obesity. Studies have found that employees who get more exercise by bicycling and walking to work take less sick leave than other employees. In the U.K., Sustrans found that absenteeism costs employers $478 per day and that employees who are bicyclists take 2.4 sick days per year, compared with 4.5 sick days taken by other employees. In Denmark, one study estimated that cycling saves $68.7 million in healthcare costs each year (euractiv.com). The Centers for Disease Control and Prevention (CDC) found that workplace health programs can increase productivity.

Quality Bike Products (QBP), a medium-sized employer in the Great Lakes region, encourages employees to bicycle to work with a credit for purchasing the products they sell. This "QBP Health Reward" has been found to improve a variety of health measures in employees. The company's health care costs decreased by 4.4 percent from 2007 to 2011, a period during which companies across the United States experienced an average increase of 24.6 percent in health care costs (StreetsBlog).

Improved Access to Parks and Open Space – Net Estimated Benefits: Qualitative

The pedestrian and bicycle bridge will help connect residents to parks on both sides of Interstate 5, providing opportunities for those on the east to access green spaces on the west and vice versa. The economic value of Seattle parks has been measured by the Trust for Public Land. Although not quantified separately, the improved accessibility of parks and open spaces would result in increased economic value related to property value, direct use, health, and community cohesion.

The Northgate bridge and the greenways it links will connect the Licton Springs Park, Mineral Springs Park, the NSC environmental area, the water quality channel, Northgate Community Center, Olympic View playfield, Thornton Creek Park and two regional trails, the Interurban Trail between Everett and Seattle and the Burke-Gilman Trail.

On the east side of the freeway, the Thornton Creek Water Quality Channel is the centerpiece of the Thornton Place transit-oriented development adjacent to the Northgate Transit Center. On the west, the North Seattle College includes 30 acres of greenbelt, wetlands, and trails that are used by the college as a teaching facility. The bridge design team has identified the opportunity include educational and interpretive way finding along the bridge and structure to narrate the important watershed features, natural features and resources.

Increased Property Values from Accessibility and New Infrastructure – Net Estimated Benefits: Qualitative

Although it is difficult to isolate the effects of the pedestrian bridge from existing transit-oriented development and the increase in transit service, it is reasonable to expect that the bridge will contribute to property value increases and lead to new transit-oriented development on the west side of the freeway. As a result of the project, over 300 properties will be within walking distance of the access point to the light rail station. Research examining the impact of transit-oriented development on property values has found that a good pedestrian environment, defined as including people-serving jobs, connected streets, and flat terrain, located in a transit station area can result in a residential price premium as high as 15%, and there is mutual dependence between pedestrian design and of transit proximity. Station proximity has a significantly stronger impact when coupled with a pedestrian-oriented environment (Duncan).

Improved Access for Disadvantaged Communities – Net Estimated Benefits: Qualitative

The increased connectivity will create more opportunities for economically disadvantaged persons, non-drivers, senior citizens, and persons with disabilities, to access services, amenities, and transportation options. For these residents non-motorized access is an important rung on the ladder of opportunity, providing a low-cost, healthy means of transportation that also builds a sustainable community. This improved access will create value, although not quantified, by increasing social equity in Seattle.

The Northgate community has a higher than average proportion of economically disadvantaged residents. This includes a large percentage of people of color as well as a growing population of elderly, due to the

development of new senior housing in the area. This TIGER project will provide improved access for people to walk or bike to a wide variety of community services. The Northgate Community Center and Library, located on 5th Avenue NE near the transit center, is the community's hub, providing access to a number of educational, social and recreational programs.

The residential area west of I-5 has a median household income well below the median household income for Seattle citywide; the two closest census blocks have median incomes of 39% and 84% of the citywide median of $61,000. In this area 20% of individuals have incomes below the poverty level compared to 15% citywide. The area is racially diverse; 43% of the population consists of people of color, compared to 34% citywide. Approximately 32% of the population in the area west of I-5 speaks a language other than English at home, compared to 21% citywide. Approximately 16% of the population speaks limited English, compared to 10% citywide.

ENVIRONMENTAL SUSTAINABILITY

Reduced Emissions – Net Estimated Benefits: $914,000

The project will result in a mode shift towards non-motorized travel, which will reduce vehicle miles traveled, leading to reduced greenhouse gas (GHG) emissions that impact air quality. The reduction in vehicle miles traveled will result in a reduction in hydrocarbons, particulate matter, and carbon dioxide, and carbon monoxide. Because every vehicle trip causes emissions due to cold starts and hot soak conditions, shorter trips generate respectively higher amounts of emissions (Victoria Transport Policy Institute). As such, trips that are shorter than 3 miles or one-half mile are easily ridden or walked if sufficient facilities exist.

ECONOMIC COMPETITIVENESS

Reduced Travel Congestion Costs – Net Estimated Benefits: $2,459,000

Another advantage to reducing vehicle miles traveled is the reduction in congestion. The project will result in mode shift towards non-motorized travel, which will reduce vehicle miles traveled, leading to improvements to travel circulation and lower vehicular congestion. More travelers and commuters will choose not to travel in their automobiles; instead they will walk or bike to their destinations.

Traffic congestion is a growing problem in Seattle and as housing is developed and the population grows, traffic congestion will continue to increase. However, this need not be the case. The City of Vancouver Transportation Plan Update has shown that traffic volumes entering downtown can be managed by providing alternatives to driving. Despite the growth in employment and population within downtown Vancouver (up 26 percent and 75 percent in the last 15 years, respectively), motor vehicles entering downtown have decreased by 20 percent within that time period and are now at 1965 levels (roughly 175,000 per day). During this period, person-trips entering downtown during the peak periods have increased by 15 percent. This increase has been accommodated by a shift to walking, cycling and transit, which now serve over 52 percent of all work trips to and from downtown Vancouver. Bicycling competes

very effectively with the automobile for trips under 3 miles, and could replace many trips to, from and within the Northgate area.

Improved Access to Job Centers and Employment Services – Net Estimated Benefits: Qualitative
Although not quantified, it is reasonable to assume a job creation benefit from the improved accessibility to job centers, education, and workforce development programs. These benefits are especially valuable for the underserved and underrepresented population of North Seattle.

Access to a quality education is a critical building block to a thriving and successful life. Currently there is established disparity in access to quality higher education opportunities across the region's communities. In the Northgate community Interstate 5 is one such barrier to higher education. This TIGER grant will provide a more direct and safer connection from a major multi-modal transportation hub to North Seattle College. Construction of the bridge would reduce the walking distance from the existing Northgate Transit Center to NSC from 1.2 miles to approximately 0.25 miles, making the college much more accessible to students from throughout the Puget Sound region with a more convenient access to mass transit provided by the pedestrian and bicycle bridge, those seeking higher education will have an option for more options for school commuting. North Seattle College serves more than 14,000 students annually, many of whom are from economically disadvantaged populations. In addition, students and staff at NSC will benefit from easier access to activities on the east side of Interstate 5, such as a new library and community center.

North Seattle College is also home to Washington State's Opportunity Center for Employment and Education, an innovative pilot, combining various state human services, including employment and social services as well as educational services at one location. The Center provided employment services, such as job search assistance, Unemployment Insurance (UI) assistance, and employment and training services for veterans, to 16,643 people in its initial year of operation.

This project will also improve connections between people and job centers of employment. Northgate is a regional employment center with over 11,000 jobs and a growth target of 4,000 new jobs by 2024. Employers include Northwest Hospital, Group Health, North Seattle College, and the Northgate Mall.

Improved Connection of Neighborhoods with Retail Businesses – Net Estimated Benefits: Qualitative
Although not quantified, it is reasonable to assume an increase in retail economic activity for local businesses. The area near the bridge includes both Northgate Mall and other pockets of retail east of I-5.The Northgate Mall is a regional shopping center immediately adjacent to I-5 and the Northgate Transit Center. Northgate opened in 1950 and was the first regional shopping center in the United States to be described as a "mall". The mall underwent a major redevelopment in 2007 and now has over 130 shops and 24 places to eat. Due to the presence of the mall, the Northgate area became a regional shopping destination with several large shopping centers nearby. Smaller amounts of retailing and restaurants are also found along Fifth Avenue NE and in Thornton Place. Within these locations, there is a vast array of choices.

However, west of I-5 are a number of concentrations of higher density housing with no locally available shopping or restaurants. This requires residents to use the congested Northgate Way to fill their needs for goods and services, food and entertainment. Northgate Way is not conducive to walking or biking; a car is necessary to access these businesses. The proposed bridge will link the residential areas on the west with the shopping on the east with a safe, direct, convenient and pleasant route.

SAFETY

Reductions in Collisions – Net Estimated Benefits: $7,153,000

The project will create a safe east-west connection and result in mode shift towards non-motorized travel, which will reduce number of accidents. More travelers and commuters will choose not to travel in their automobiles instead they will walk or bike to their destinations. This will result in reduced loss of life, injuries and property damage.

A significant feature of this project is the inclusion of bike and pedestrian facilities that are completely separated from motor vehicles and provide travel options that are shown to be safe and attractive travel options for people of all ages and abilities. The project includes three protected bike lane facilities. Protected bicycle facilities emphasize comfort for cyclists and makes bicycling more appealing for a wider group, including both younger and older people. Even people who bicycle regularly prefer routes that are considered 'low-stress.' Researchers from Portland State University used global positioning system (GPS) devices to track the behavior of 166 cyclists in the Portland, Oregon region. The study found that a disproportionate share of utilitarian cycling trips occurred on streets with separate paths or bicycle boulevards. The findings support the need for a network of well-connected cycling routes that are protected from motor vehicle traffic as a means to encourage increased use of the bicycle (Broach).

Protected bicycle facilities provide the highest level of protection and are safer than bike lanes (Lusk). This is a key reason why people prefer separated facilities. Although cycle tracks are relatively new in North America, early evidence from cycle track projects in New York City, Minneapolis, and Vancouver show decreases in bicycle crashes following construction. Better safety reduces the severity and frequency of crashes, resulting in decreased human and financial costs.

STATE OF GOOD REPAIR

Reductions in Road Maintenance Costs – Net Estimated Benefits: $3,353,000

This project will improve the condition of the existing roadway facilities by filling gaps in the current non-motorized pathways. More travelers and commuters will choose not to travel in their automobiles; instead they will walk or bike to their destinations. This will result in less wear and tear on the existing roadway system.

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Northgate Light Rail Station Non-Motorized Access – Benefit Cost Analysis Executive Summary Matrix

#	Current Status / Baseline & Problem to be Addressed	Change to Baseline/ Alternatives	Type of Impacts	Population Affected by Impacts	Economic Benefit	Summary of Results	Page Reference in BCA
1	Interstate 5 is a physical and psychological barrier for bicyclists and pedestrians accessing the light rail station, transit nodes, employment centers, North Seattle College, medical facilities, and neighborhood amenities. Existing freeway crossings are limited to a complicated urban interchange and a narrow vehicle bridge linking residential areas.	Non-motorized bridge connects east and west neighborhoods to each other, provides direct access to transit and light rail, and provides a link in the regional bicycle network.	Improved travel times	7,000 persons using the bridge daily	Savings in travel time and household travel time	$6,623,000 + $19,444,000	App. B Page 7
2	Interstate 5 is a physical and psychological barrier for bicyclists and pedestrians accessing the light rail station, transit nodes, employment centers, North Seattle College, medical facilities, and neighborhood amenities. Existing freeway crossings are limited to a complicated urban interchange and a narrow vehicle bridge linking residential areas.	The project will create a safe, direct connection across the freeway, resulting in mode shift and reduce travel times for bicyclists and pedestrians.	Improved health benefits	Nearly 2 million bicycle and pedestrian trips annually from a traveling population of 135,000.	Reduction in medical care costs, lost productivity, and workers compensation costs	$5,589,000	App. B Page 7
3	Traveling between the various pockets crossing Interstate 5 often requires long, circuitous trips. Concentrated congestion impedes the overall area from performing as an integrated district.	The project will result in mode shift towards non-motorized travel, which will reduce vehicle miles traveled, leading to reduced emissions.	Reduced emissions	626,000 Seattle Residents	Reductions in CO2, NOX, and VOC	$914,000	App. B Page 6
4	Traveling between the various pockets crossing Interstate 5 often requires long, circuitous trips. Concentrated congestion impedes the overall area from performing as an integrated district.	The project will create a safe east-west connection and result in mode shift towards non-motorized travel, which will reduce the number of collisions	Reduced collisions	262,000 persons in North Seattle	Reduced loss of life, injuries, and property damage	$7,153,000	App. B Page 6
5	Concentrated congestion occurs at interstate crossings impedes the overall area from performing as an integrated district.	The project will result in mode shift towards non-motorized travel, which will reduce infrastructure maintenance costs.	Reduced maintenance costs	626,000 Seattle Residents	Reduced road maintenance costs	$3,353,000	App. B Page 6

6	Concentrated congestion occurs at interstate crossings impedes the overall area from performing as an integrated district.	The project will result in mode shift towards non-motorized travel, which will reduce travel congestion costs.	Reduced travel congestion costs	262,000 persons in North Seattle	Reduced travel congestion costs	$2,459,000	App. B Page 6
7	The use of park and green space in the area is inhibited by the lack of pedestrian friendly east-west connections over the freeway.	The pedestrian bridge will help connect parks on both sides of Interstate 5 providing opportunities for those on the east to access green spaces on the west and vice versa.	Improved quality of life	6,400 persons in Northgate Neighborhood	Not quantified separately		
8	Properties on the west side of the freeway lack proximity to the light rail station. Transit-oriented development is inhibited.	By improving proximity and access to the light rail station, the bridge will contribute to property value increases and lead to new transit-oriented development on the west side of the freeway.	Property value premiums	342 properties	Not quantified separately		
9	The Northgate community has a higher than average proportion of economically disadvantaged residents. The area west of the freeway has limited access to amenities and transportation options. Access to college, workforce development, and social service assets are hampered by lack of public transportation connections	The increased connectivity will create more opportunities for economically disadvantaged persons, non-drivers, senior citizens, and persons with disabilities, to access services, amenities, and transportation options.	Increased social equity	6,400 persons in Northgate Neighborhood	Not quantified separately		
10	Inconvenient access to mass transit is a barrier for education and workforce development programs at North Seattle College and access to job centers.	Improved accessibility to job centers, education, and workforce development programs.	Economic Competitiveness	262,000 persons in North Seattle	Not quantified separately		

APPENDIX B
Benefit – Cost Analysis Technical Documentation

The Northgate Light Rail Station Non-motorized Access Study Methodology and Results

Executive Summary

The *Northgate Light Rail Station Non-motorized Access* (NGLRT) benefit-cost analysis (BCA) expands on the methodology suggested by National Cooperative Highway Research Program (NCHRP) Report 552: *Guidelines for Analysis of Investments in Bicycle Facilities* by incorporating local demographic information and utilizing new data and research that has become available since the *Guidelines for Analysis* were published in 2006.

One notable enhancement is the consideration of benefits from both bicycling and walking activity, using different impact areas for each mode. By comparison, NCHRP methodology attempts to measure only bicycling benefits, and does not quantify pedestrian benefits for shared-use paths. Another key improvement is the estimate of utilitarian (non-commute) and access to transit in addition to work commute trips. This addition helps capture the full range of walking and bicycling activity in the project area. The *NGLRT* benefit-cost analysis also considers local travel patterns, trip distances and public health data to create a detailed, complete picture of benefits generated by the proposed bicycle and pedestrian facilities.

A major advantage of this benefit-cost analysis approach is the ability to quantify benefits at a line-item level for each distinct type of benefit associated with the project. This allows benefits to be quantified and compared for each TIGER grant selection criterion. This also means the *NGLRT* benefit-cost analysis omits calculation of recreational benefits of the project from the analysis, so that it can be evaluated solely on its merits as a transportation facility in accordance with TIGER grant selection guidelines. By contrast, the standard NCRHP benefit-cost analysis includes recreational benefits that often make up 90% of the calculated value of bicycle projects, due to savings from newly active people. These methodology improvements should be considered when comparing benefit-cost analysis results for this project with other TIGER grant applications.

Economic benefits have been evaluated on the basis of aggregate mode shift to walking and bicycling modes facilitated by the new multimodal transportation network created by the *NGLRT* project. Monetized benefits resulting from this shift has been estimated for the following benefit types:

- Land value increase due to infrastructure investment
- Reduced cost of vehicle emissions
- Reduced external costs of vehicle travel
    - Traffic congestion
    - Traffic crashes
    - Roadway maintenance
- Reduced healthcare costs
    - Reduction in medical care costs
    - Reduction in lost productivity
    - Reduction in workers compensation costs

- Travel time benefit
- Reduced household transportation spending

Monetized economic benefits for future years have been discounted at a 3% and 7% annual rate over a 20 year evaluation period with two years for project construction (2016-2018) and 20 years of project benefits (2019-2038). The residual benefit of the fully-maintained facilities built by the project is claimed as a lump sum at the end of the analysis period in 2038.

Baseline Data Inputs

Demographics

The *NGLRT* benefit-cost analysis considers several population groups within two project impact areas: a half-mile buffer area for walking impacts and a three-mile buffer area for bicycling impacts. These geographies are standard areas of influence used by bicycle and pedestrian planning professionals and were recently acknowledged by the Federal Transit Administration in the *Final Policy Statement on the Eligibility of Pedestrian and Bicycle Improvements Under Federal Transit Law* that went into effect August 19, 2011. Population groups within these areas were quantified using the following sources:

Employed Populations

BCA input: Employed population

Source:

2008-2012 American Community Survey (ACS) 5-Year Estimates, U.S. Census Bureau. *TCRP Report 153: Guidelines for Providing Access to Public Transit Stations, 2012*, Transit Cooperative Research Program. "Average station access mode share by station type"

Method: The number of employed people within the walking and bicycling impact areas was captured at a census block group level for block groups with their geographic center located within a half-mile or three mile buffer of proposed *NGLRT* projects, respectively. This population is used in conjunction with Journey to Work mode split data. A portion of the employed population that journey to work via transit were also assumed to access trips via cycling and walking. The assumed station type used was Urban Neighborhood with Parking.

Student Populations

BCA input: College student population

Source: *2008-2012 American Community Survey (ACS) 5-Year Estimates*, U.S. Census Bureau.

Method: The populations of college-enrolled students living within the walking and bicycling impact area were captured for Census Block Groups with their geographic center located within the project impact areas. The data represent the most recent demographic estimates available for the area.

Travel Patterns – Mode Share

Baseline mode share data was collected for driving, bicycling and walking activity among the different demographic groups listed above. The following data sources were used to estimate mode split for each group:

Employed Populations

BCA input: Mode split of employed population (Journey to Work)

Source: *2008-2012 American Community Survey (ACS) 5-Year Estimates*, U.S. Census Bureau.

Student Populations

BCA input: Mode split of college students

Source: *Data Extraction Tool*, 2009 National Household Travel Survey (NHTS)[1]

Method: College student mode shares were based on travel survey data from the 2009 National Household Transportation Survey. National numbers were used in lieu of local college estimates, which aggregate bicycle and walking trips.

Travel Patterns – Trip Length and Purpose

Area residents will use the *NGLRT* bicycle and pedestrian transportation facilities for more than just work commute trips. To capture the full range of walking and bicycling activity, an estimated number of trips of other purposes were extrapolated from work trips based on data from the 2009 National Household Travel Survey (NHTS).[2] NHTS shows that for every work trip Americans make by bicycle, they also make an average of 1.61 utilitarian (non-commute) trips by bicycle. For walking, this ratio is 4.32.

To accurately estimate the relative benefits resulting from each type of bicycling and walking trip, each trip was weighted according to the average distance for a trip of that mode and purpose. Trip distance multipliers were also provided by NHTS Average trip distances were assigned as follows:

- Bicycling trips:
  - Work commute trips: 3.54 miles
  - College commute trips: 2.09 miles
  - Utilitarian trips: 1.89 miles
- Walking trips:
  - Work commute trips: 0.67 miles
  - College commute trips: 0.56 miles
  - Utilitarian trips: 0.67 miles

Travel Patterns – Trips over the Bridge

Trip generation was calculated as above for the walking and bicycling catchment areas on both the east and west sides of the bridge. Using the trip purpose and mode, a proportion of trips were distributed over the bridge, as given in Table 1. Few commute trips were assumed to cross the bridge, while a larger number of trips to access transit, particularly by walking, are assumed to cross when the bridge opens. The largest group assumed to cross the bridge are college trips, both walking and bicycling, generating from the east side of the bridge. This distribution is expected to increase, and a 3% growth rate was applied from the bridge opening in 2019.

[1] http://nhts.ornl.gov/det/Extraction3.aspx
[2] http://nhts.ornl.gov/tables09/Login.aspx?ReturnUrl=/tables09/ae/TableDesigner.aspx

Table 1. Bridge Trip Distribution

	West		East	
	Bicycling	**Walking**	**Bicycling**	**Walking**
Weekday commute trips				
Bicycling/walking trips	2.00%	1.00%	2.00%	1.00%
Walk- or bike-to-transit trips	1.50%	5.00%	1.00%	3.00%
College bicycle/walking trips	0.00%	5.00%	30.00%	30.00%
Daily utilitarian trips	2.00%	1.00%	2.00%	1.00%

The existing levels of walking and bicycling are likely to be lower than the existing demand due to substandard facilities. Conservatively, it was predicted that 80% of bicycle trips previously occurred without the bridge, while only 20% of pedestrian trips did. Therefore, the project receives high benefits in the first year it is open, while only the increase year-over-year is claimed for benefits in subsequent years.

Forecasts and Assumptions

Demographics

Future estimates were created by using linear growth rates to match Puget Sound Regional Council (PSRC) 2040 population and demographic forecasts by the 934 zone TAZ for the bicycling and walking impact areas. These growth rates were used to create annual estimates for each year evaluation period ending in 2038 through linear extrapolation between the base year (2012) and forecast year (2040).

Travel Patterns

The *NGLRT* project will have a strong influence on travel patterns in the bicycling and walking impact areas. Bicycling and walking mode shift curves were forecasted for each population group.

Employed Population

Mode shift forecasts for work commute trips within the bicycling and walking impact areas was based on mode shares documented by ACS Journey to Work data for other west coast communities that have made comparable investments in bicycling and walking transportation. According to the 2014 Alliance for Biking & Walking *2014 Benchmarking Report* Seattle has the fourth highest bicycling and walking commute levels of large US cities. An future mode share of 10% for cycling commute trips and 4% for walking trips were selected to reflect the changing land use and mode shift goals and targets observed elsewhere. Bicycle access to mode share was assumed to increase over time to levels consistent access mode share seen in other west coast cities as reported in the BART Bicycle Plan: Modeling Access to Transit, 2010, Bay Regional Transit Authority.

College Population

For college students, bicycling and walking growth rates were scaled to match the forecast growth rates for work commute trips.

Estimating Change From Baseline

For each year in the benefit-cost analysis period, forecasted mode shift was multiplied by demographic data to estimate increases over baseline for the following figures for both bicycling and walking modes:

- Work commute bicycling/walking users and number of trips, access to transit trips for work purposes
- College commute bicycling/walking users and number of trips
- Number of utilitarian (non-commute) bicycling/walking trips, based on NHTS trip purpose ratios from number of work and college bicycling/walking users

Trip distances are estimated according to the transportation mode and purpose of the trip from NHTS 2009 data.

Each new bicycling and walking trip was assumed to have a chance to replace a trip of any other mode equal to the baseline mode split for that trip type, with bicycling or walking removed from the total mode split. For example, if baseline drive alone mode share was 80% for college trips, with baseline bicycling mode share at 5%, a trip shifted to bicycling was assumed to have a 80% of out 95% chance (100% mode split – 5% bicycling, removed) of replacing a drive alone trip, or about 84.2%. These assumptions allow estimates for the following figures:

- Reduced vehicle trips
- Reduced VMT

The number of bicycling/walking users and VMT reduced were used in conjunction with benefit multipliers to monetize the benefits of the forecasted mode shift by year.

Benefit Multipliers

Based on available research, the following types of benefits were quantified using the increased number of bicycling/walking users and reduced VMT forecast annually:

- Land value increase due to infrastructure investment
- Reduced cost of vehicle emissions
- Reduced external costs of vehicle travel
    - Traffic congestion
    - Traffic crashes
    - Roadway maintenance
    - Economic costs of oil imports
- Reduced healthcare costs
    - Reduction in medical care costs
    - Reduction in lost productivity
    - Reduction in workers compensation costs
- Travel time benefit
- Reduced household transportation spending

Multipliers used to translate new bicycling/walking users and reduced VMT into the benefits listed above were drawn from the following sources:

Vehicle Emissions Rates

Emission Facts: Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks (EPA report 420-F-05-022).[3]

- Carbon dioxide: 369 g/VMT
- Carbon monoxide: 12.4 g/VMT
- Hydrocarbons: 1.36 g/VMT
- Particulate matter: 0.0052 g/VMT (PM10) and 0.0049 g/VMT (PM2.5)
- Nitrous oxides: 0.95 g/VMT

Emissions Costs

- *From NHTSA Corporate Average Fuel Economy for MY 2011 Passenger Cars and Light Trucks, Table VIII-5*[4]
  Volatile organic compounds: $1,700/ton
- Particulate matter: $168,000/ton
- Nitrous oxides: $4,000/ton

Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 (May 2013: revised November13), page 18

- Carbon dioxide cost appreciation: 2.5%/year

Carbon dioxide: Variable. See Tiger Benefit-Cost Analysis (BCA) Resource Guide for additional information.

External Vehicle Travel Costs

Crashes vs. Congestion – What's the Cost to Society? AAA, 2008. (Figure ES.2, pg ES-4 and Figure ES.3, pg ES-5.).[5]

- Traffic crashes: $0.32/VMT
- Traffic congestion: $0.11/VMT.

Notes: Cost of crashes divided by 7.21, ratio of crash to congestion costs.

Kitamura, R., Zhao, H., and Gubby, A. R. *Development of a Pavement Maintenance Cost Allocation Model*. Institute of Transportation Studies – University of California, Davis.[6]

- Roadway maintenance: $0.15/VMT

Notes: Adjusted to 2013 values using the Bureau of Labor Statistics Inflation Calculator.[7]

Vehicle Operating Costs

Average Cost of Owning and Operating an Automobile. 2011 [most recent data year] Bureau of Transportation Statistics.[8]

- Reduced household transportation cost: $0.596/VMT

[3] https://www.whatcomsmarttrips.org/pdf/Emission%20Facts%202005.pdf
[4] http://www.nhtsa.dot.gov/portal/site/nhtsa/menuitem.d0b5a45b55bfbe582f57529 cdba046a0
[5] http://newsroom.aaa.com/Assets/Files/200835919l0.CrashesVsCongestionFullReport2.28.08.pdf
[6] http://pubs.its.ucdavis.edu/publication_detail.php?id=19
[7] http://www.bls.gov/data/inflation_calculator.htm
[8] http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_03_17.html

2012 National Transportation Statistics (Table 3-17: Average Cost of Owning and Operating an Automobile, 2012). Research and Innovative Technology Administration, Bureau of Transportation Statistics.[9]

- Appreciation: 2.12%/year

Notes: Average annual growth in cost of owning and operating a motor vehicle from 1994-2008; used to approximate the increasing cost of motor vehicle transportation and energy prices.

Cost of Travel Time

TIGER BCA Resource Guide (2014). FHWA. Recommended Hourly Values of Travel Time Savings.

- Hourly monetized value of $12.98 for all surface transportation of all types was used

The distance between freeway bridges is currently 0.9 miles, which is longer than most average pedestrian trips. A travel time savings of 6 minutes per trip was awarded for to each bicycle trip crossing the bridge based on the assumption that a bicyclist traveling at an urban average of ten miles per hours avoid nearly one mile of out of direction travel.

Health Benefits

The health care reduction multiplier includes several factors:

Health Care Reduction Modifier: $1,119.62

Method: The Health Care Reductions Multiplier was derived from the health care figures provided in the report cited above. This report references 1998 Behavioral Risk Factor Surveillance System (BRFSS) data[10] [11] [12]. Detail on these application of these reports is included in the attached BCA spreadsheet.

Residual Benefits

The expected lifespan for the bridge is 75 years before the bridge will require substantial maintenance or replacement. Since this analysis only captures 20 years of benefits from the facility, a residual value of the investment is left over. The yearly maintenance on the bridge retains the facility in good repair, so the value of the investment is retained. Discounted to 2038, this value is worth $4,123,602, which is added as a benefit in the final year of the analysis.

[9] http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_03_17.html

[10] Chenoweth, D. (2005). The Economic Costs of Physical Inactivity, Obesity, and Overweight in California Adults: Health Care, Workers' Compensation, and Lost Productivity. Topline Report. http://www.cdph.ca.gov/healthinfo/healthyliving/nutrition/Documents/CostofObesityToplineReport.pdf

[11] Population Estimates Program, Population Division, U.S. Census Bureau (1999). ST-99-1 State Population Estimates and Demographic Components of Population Change: July 1, 1998 to July 1, 1999. http://www.census.gov/population/estimates/state/st-99-1.txt

[12] Bureau of Labor Statistics. CPI Inflation Calculator. http://www.bls.gov/data/inflation_calculator.htm

Discounting

This prorated stream of benefits was then discounted using the 3% and 7% rate as endorsed in the Federal Register grant announcement, and compared with the stream of construction and maintenance costs associated with the project.

Benefit-Cost Analysis Results

The *NGLRT* project will deliver significant benefits, with an estimated net present value of $30 million, representing an IRR of 5% and a 3% discount rate. The full, 20-year *NGLRT* benefit-cost analysis tables are available on the following pages. The original Excel document used to calculate this estimate is available in a .zip file within the BCA attachment.

Table 2. Summary of Net Benefits

Calendar Year	Project Year	Initial Project Costs (3)	Operations and Maintenance Costs (1)	Benefits (2)	Net Annual Benefits	Cumulative Benefits
2016	-2	$ 12,100,000	$-	$-	$-	$-
2017	-1	$12,100,000	$-	$-	$-	$-
2018	0	$12,100,000	$-	$-	$-	$-
2019	1	$-	$25,766	$1,822,494	$1,797,478	$(31,431,840)
2020	2	$-	$25,016	$1,866,500	$1,842,213	$(29,589,627)
2021	3	$-	$24,287	$1,910,552	$1,886,972	$(27,702,655)
2022	4	$-	$23,580	$1,955,847	$1,932,954	$(25,769,700)
2023	5	$-	$22,893	$2,001,190	$1,978,964	$(23,790,737)
2024	6	$-	$22,226	$2,047,147	$2,025,568	$(21,765,169)
2025	7	$-	$21,579	$2,093,620	$2,072,670	$(19,692,499)
2026	8	$-	$20,950	$2,140,771	$2,120,431	$(17,572,069)
2027	9	$-	$20,340	$2,189,084	$2,169,336	$(15,402,732)
2028	10	$-	$19,748	$2,237,818	$2,218,646	$(13,184,087)
2029	11	$-	$19,172	$2,287,251	$2,268,637	$(10,915,450)
2030	12	$-	$18,614	$2,337,682	$2,319,611	$(8,595,839)
2031	13	$-	$18,072	$2,388,495	$2,370,949	$(6,224,890)
2032	14	$-	$17,545	$2,441,394	$2,424,359	$(3,800,531)
2033	15	$-	$17,034	$2,494,851	$2,478,313	$(1,322,217)
2034	16	$-	$16,538	$2,549,489	$2,533,432	$1,211,214
2035	17	$-	$16,057	$2,605,375	$2,589,786	$3,801,001
2036	18	$-	$15,589	$2,662,450	$2,647,315	$6,448,316
2037	19	$-	$15,135	$2,721,436	$2,706,742	$9,155,058
2038	20	$(17,217,681)	$14,694	$2,781,381	$19,984,796	$29,139,854
					Net Present Value:	**$29,139,854**
					IRR:	**4.68%**

Notes:

(1) Estimated annual maintenance cost of $29,000. This maintenance level will preserve the full value and functionality of the facilities.
(2) Includes all associated benefits of the project, including: one time land value increase, air quality benefits of reduced vehicle emissions; reduced costs of traffic congestion, crashes and road maintenance; healthcare cost savings; and reduced household transportation expenses.
(3) Credit for residual benefit of fully functional, maintained transportation facilities at end of analysis period.

Worksheet for Table 2 in BCACalcs.xls Tab: Table 2

Table 3A: Net Present Value Discounted at 3% and 7%

	Household Travel Savings		Travel Time Savings		Improved Health Benefits	
Year	3%	7%	3%	7%	3%	7%
2019	$ 742,228	$ 613,486	$ 284,090	$ 234,814	$ 146,706	$ 121,259
2020	761,528	605,908	288,339	229,416	163,625	130,188
2021	781,552	598,594	292,744	224,214	179,990	137,855
2022	802,245	591,473	297,221	219,132	195,752	144,323
2023	823,686	584,578	301,814	214,200	210,997	149,747
2024	845,905	577,905	306,520	209,408	225,778	154,247
2025	868,908	571,428	311,334	204,746	240,012	157,842
2026	892,737	565,152	316,255	200,207	253,812	160,677
2027	917,427	559,070	321,295	195,794	267,107	162,772
2028	943,049	553,201	326,471	191,511	280,036	164,272
2029	969,562	547,491	331,741	187,327	292,520	165,180
2030	997,100	541,993	337,171	183,276	304,581	165,561
2031	1,025,625	536,657	342,702	179,319	316,268	165,487
2032	1,055,220	531,502	348,372	175,471	327,588	165,002
2033	1,085,911	526,514	354,172	171,724	338,547	164,148
2034	1,117,758	521,695	360,111	168,076	349,171	162,970
2035	1,150,812	517,043	366,190	164,524	359,471	161,505
2036	1,185,071	512,531	372,390	161,055	369,434	159,776
2037	1,220,622	508,172	378,727	157,672	379,114	157,833
2038	1,257,552	503,975	385,229	154,384	388,493	155,692
TOTAL Value	$ 19,444,000	$ 11,068,000	$ 6,623,000	$ 3,826,000	$ 5,589,000	$ 3,106,000

Worksheet for Table 3A in BCACalcs.xls Tab: Table 3

Table 3B: Net Present Value Discounted at 3% and 7%

	Reduced Emissions		Reduced Traffic Congestion Costs		Reductions in Accident Savings		Reduction in Road Maintenance Costs	
Year	3%	7%	3%	7%	3%	7%	3%	7%
2019	$ 38,126	$31,513	$115,945	$95,834	$337,293	$278,789	$158,106	$130,682
2020	38,787	30,861	116,490	92,685	338,880	269,629	158,850	126,389
2021	38,981	29,855	117,071	89,665	340,571	260,844	159,642	122,271
2022	40,155	29,605	117,676	86,759	342,330	252,391	160,467	118,308
2023	40,862	29,000	118,313	83,968	344,183	244,270	161,336	114,502
2024	41,585	28,410	118,982	81,286	346,129	236,468	162,248	110,844
2025	42,323	27,834	119,680	78,706	348,161	228,964	163,200	107,327
2026	43,079	27,271	120,410	76,226	350,283	221,748	164,195	103,944
2027	44,354	27,029	121,171	73,840	352,497	214,808	165,233	100,691
2028	45,150	26,485	121,969	71,548	354,820	208,140	166,322	97,566
2029	45,963	25,955	122,795	69,340	357,222	201,716	167,448	94,554
2030	46,799	25,438	123,661	67,218	359,742	195,545	168,629	91,662
2031	47,138	24,665	124,558	65,175	362,351	189,600	169,852	88,875
2032	48,529	24,444	125,492	63,209	365,067	183,880	171,125	86,194
2033	49,427	23,965	126,461	61,316	367,886	178,373	172,447	83,612
2034	50,347	23,499	127,467	59,493	370,814	173,071	173,819	81,127
2035	51,291	23,044	128,512	57,739	373,854	167,967	175,244	78,735
2036	52,258	22,601	129,591	56,047	376,991	163,045	176,715	76,427
2037	53,789	22,393	130,707	54,416	380,240	158,302	178,237	74,204
2038	54,811	21,966	131,866	52,847	383,611	153,736	179,818	72,064
TOTAL Value	$914,000	$526,000	$2,459,000	$1,437,000	$7,153,000	$4,181,000	$3,353,000	$1,960,000

Worksheet for Table 3B in BCACalcs.xls Tab: Table 3