Appendix

12

Benefit-cost analysis

Inner Loop North
Transformation
Planning Study

INNER LOOP NORTH

Envision. Invest. Transform.

Rochester Inner Loop North Transformation Planning Study

Benefit Cost Analysis (DRAFT)

January 2022

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Glossary of Acronyms

Benefit Cost Analysis:	BCA
Benefit Cost Ratio:	BCR
Net Present Value:	NPV
Property Damage Only:	PDO
United States Department of Transportation:	USDOT
Real Estate Information Service:	REIS
Vehicle Hours of Travel:	VHT

Executive Summary

This memorandum summarizes the assumptions, methodologies, and results of the benefit-cost analysis (BCA) completed for the Rochester Inner Loop North Transformation Planning Study. The BCA provides a means to measure a project's potential overall benefit by developing a uniform measurement of the impact the project has on society. This is accomplished by assigning a monetary value to potential benefits that can be compared to the estimated construction costs and other related costs. In the BCA, the estimated capital costs of constructing and maintaining the project are compared to the potential net benefit the project provides to the region. It is noted that a BCA does not provide an absolute measure of a projects benefits and costs; there are many elements of a project and many other that are subject to future market conditions and values and many other elements that provide value that are not readily monetized. As such BCAs provide a tool to weigh a subset of project factors and then make a general statement about the overall value of the project. To be consistent with current federal reporting requirements for competitive grant applications the costs and benefits are discounted to compare all costs and benefits with a common measure such as using 2019 dollars.

Following the recent completion of the Inner Loop East project, the City of Rochester is moving forward with initial planning phases to investigate the feasibility of reconfiguring the northern segment of the Inner Loop. This transformation of the Inner Loop North would reconnect Downtown Rochester with nearby residential neighborhoods, as well as local destinations including the Public Market and High Falls. A successful transformation of the Inner Loop North will foster opportunities for economic and community development while minimizing displacement of existing residents and businesses. This BCA is a critical tool in initial planning phases to ensure communicate how the local and regional outcomes of the project will be shared by all members of the community and to establish the worthiness of local, state, federal, and private investment into this planning effort.

The BCA will focus exclusively on the costs and benefits associated with main components of the preferred alternative for this project, which are listed below:

- Converting Inner Loop North to a modern at-grade neighborhood-oriented urban boulevard with multimodal accommodations
- Creating developable space to restore and rebuild historically impacted neighborhoods and stimulate future residential and commercial activity
- Restoring or creating urban scale open and green spaces and recreational areas
- Calming traffic, reducing vehicular speeds, and promoting multimodal commuting and recreational travel
- Restoring the street grid to connect schools, homes, and historic communities with economic opportunities

This project will contribute quantifiable benefits in several areas, the greatest of which are benefits to multimodal connectivity and accessibility (e.g., making it more viable and appealing to walk and bike for commuting and recreational uses); property value increase and development potential; and maintenance and state of good repair savings. Among others, these areas of quantifiable benefit are the subject of this BCA. The substantial positive impacts of the project are in 2019 dollars and assumes a 7-percent discount rate monetized at $68.3M in benefits, compared to a discounted project cost in 2019 dollars of $30.3M. As a result, the project

has a benefit-cost ratio (BCR) of 2.25 (at a 7-percent discount), which represents a favorable investment of funds and a significant benefit to the community.

BCA Detailed Summary

Table 1: BCA Summary

Possible Societal Benefits for Consideration	Key Benefits Quantified	Total Benefits	Present Value (7% Discount Rate)
Economic Competitiveness			
Travel Time and Delay	Increased travel time due to reduced speeds	-$127,122,399	-$28,152,696
Property Value	Increase in property value due to improved grid connection, open space, and community development	$29,590,138	$13,138,375
Safety			
Crash Savings	Reduction in injury and property damage only (PDO) crashes due to reduction in vehicle speeds	$27,735,000	$6,142,230
Environmental Sustainability			
Peak Hour Vehicle Emissions Savings/-Costs	Increase in CO_2, VOC, NO_X, $PM_{2.5}$, SO_2 emissions due to increase vehicle hour traveled (as a function of delay)	-$4,540,039	-$994,504
Urban Street Canopy	Net societal benefits of urban street trees	$2,374,909	$525,950
Multimodal Connection			
Pedestrian Benefits	Health and recreation benefits associated with addition/improvement of pedestrian facilities	$104,416,094	$22,914,902
Bicycle Benefits	Health and recreation benefits associated with addition/improvement of bicycle facilities	$42,852,717	$9,404,353
Open Space	Health, recreation, and community benefits related to restoration of Franklin and Anderson Park	$5,319,300	$2,361,833
Other			
Residual Value	Residual value of assets at the end of the analysis period	$12,450,874	$1,089,893
Maintenance Costs & State of Good Repair Savings	Change in cost of regular maintenance and inspection of assets, including savings due to state of good repair	$121,048,841	$41,862,811
Total Benefits		**$214,125,434**	**$68,293,147**
Total Costs		**-$58,879,946**	**-$30,336,674**
Benefit / Cost Ratio		**3.64**	**2.25**

Introduction

In partnership with Bergmann, Kimley-Horn prepared this benefit-cost analysis (BCA) as part of the Inner Loop North Transformation Planning Study. This analysis documents the methodology used to quantify, assess, and monetize the potential cost and benefits associated with planning, constructing, operating, and maintaining the transformation of the Rocher Inner Loop North.

Data presented in this document is intended to provide a foundation for estimating the future incremental benefits that will be shared by all members of the community because of investment in the Inner Loop North corridor. A market study and value capture analysis to further underscore the potential economic value and opportunities of this project have been conducted in separate phases of the Rochester Inner Loop North Transformation Planning Study.

BCA Overview

As quoted from the US Department of Transportation, BCA is a systematic process for identifying, quantifying, and comparing expected economic benefits and costs of a proposed infrastructure project. BCAs weigh the project's benefits against the project's costs and provide assessment of the value that the successful implementation of creates for individuals, communities, and regions. BCAs considers the direct and indirect impacts that a project has on many different community aspects:

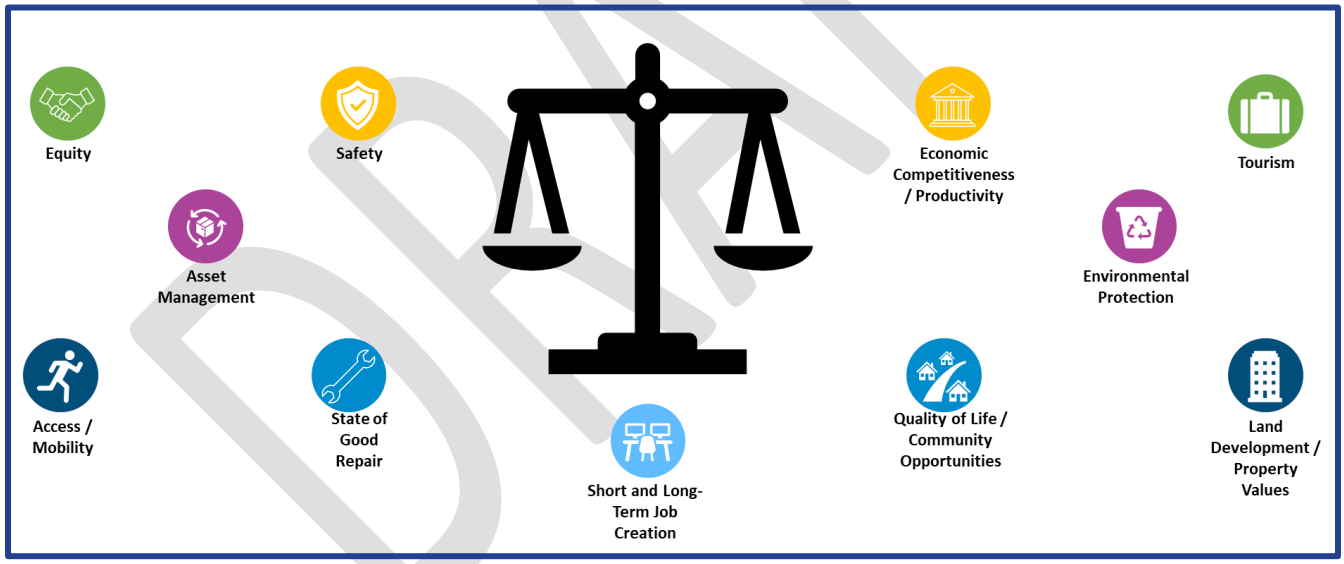

Figure 1: Direct and Indirect Project Impacts

BCAs provide a quantitative assessment of project costs and benefits over time (e.g., the analysis period) and assign a dollar value to the various impacts of a project, weighting or discounting the value of benefits and costs by how far in the future they are anticipated to be incurred. Typical project costs that are readily monetized in a BCA include:

- Preliminary Engineering
- Construction
- Activation / Initiation
- Annual Maintenance
- Periodic Repair and Rehabilitation
- Modernization
- Decommissioning
- Societal Impacts / Disbenefits of the Project

Typical project benefit that are readily monetized in a BCA include:

- Travel Time Savings and Reliability
- Emissions Reductions
- Crash and Injury Reductions
- User Costs
- Access to Jobs and Opportunity
- Economic Activity and Tourism
- Strategic Reinvestment
- Residual/Salvage Value

The outcome of a BCA is typically a benefit cost ratio (BCR) as well as the net present value (NPV) of the project. The BCR is calculated as the project benefits divided by project costs and provides a relative scale of how project benefits compare to costs. NPV is the value created by the project in constant, current year dollars. Both measures together allow stakeholders to compare alternatives and to evaluate the comprehensive value and return on investment of a project over its lifecycle.

Alternatives

Consistent with the direction provided by the US Department of Transportation (USDOT), the BCA for the Rochester Inner Loop North Transformation Planning Study compares a No-Build Alternative and a single preferred concept.

NO-BUILD ALTERNATIVE

The No-Build Alternative considers the existing surface street, highway, and interchange conditions in the study area to continue. This develops a baseline to compare the benefits that result from transforming and reconstructing the Rochester Inner Loop North corridor.

PREFFERED CONCEPT

The preferred concept compares the benefits and costs of implementing the proposed the project location and completing the improvements consistent with the "Concept 6" improvements that have been shared with the community.

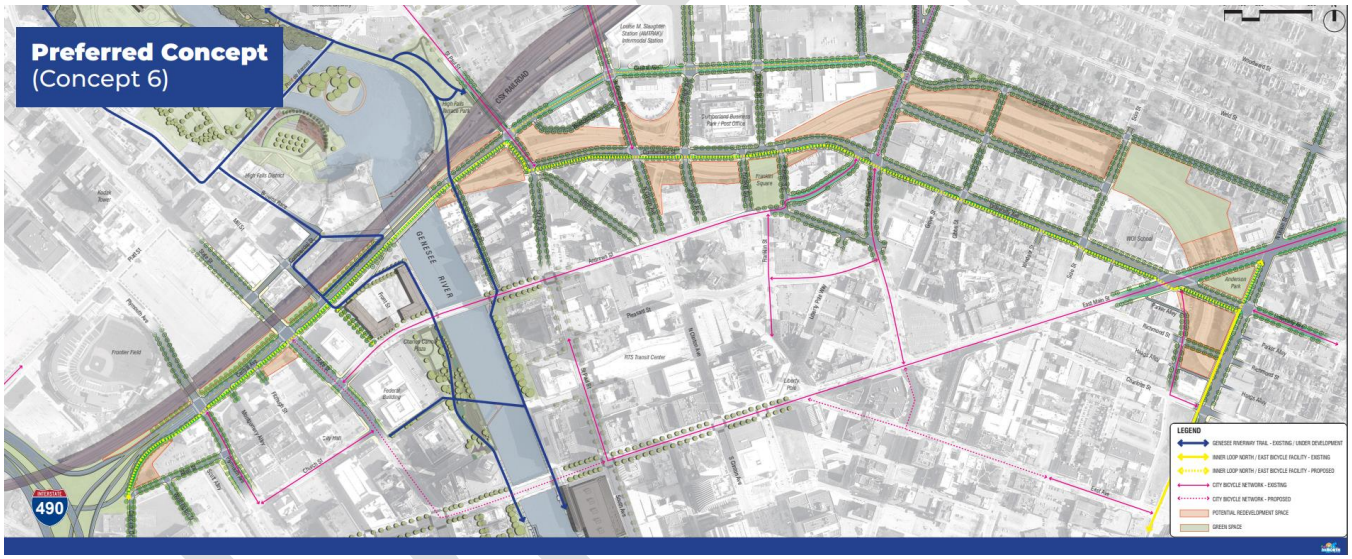

Figure 2: Preferred Concept 6

BCA Methodology

The BCA was developed using the updated 2021 guidance for BCAs as provided by the USDOT. Analysis was completed as necessary to develop the benefits and costs of the No-Build and preferred concept alternatives. Major components of the analysis include:

- Initial capital costs
- Maintenance and state of good repair savings from replacing obsolete infrastructure
- Residual capital value at the end of the BCA period
- Safety benefits associated with interchange and multimodal infrastructure improvements
- Health benefits from increased activity of pedestrians and cyclists
- Travel time impacts due to slower speeds along urban boulevards
- Environmental disbenefits due to increase delay/vehicle hours of travel
- Property value increases due to restoration of the street grid, additional community developments, and green space

The specific benefits above map to key long-term benefits for the corridor and community:

- **State of Good Repair**: The Inner Loop is in a deteriorated condition. Conversion to an urban boulevard offers life-cycle costs savings by avoiding the costs of unnecessary repair, rehabilitation, and replacement of streets and supporting infrastructure.
- **Economic Competitiveness**: Reconstructing this portion of the Inner Loop will unlock over 13 acres of development land and create the opportunity to restore two urban parks that were impacted by the original design and construction of Inner Loop North. Both factors will increase existing property valued in the adjacent communities and stimulate the economic activity of the area by making it more appealing, attractive, and inviting.
- **Quality of Life**: Reconstructing the Inner Loop North into an urban boulevard will re-establish the grid network and strengthen connections between Downtown Rochester, nearby residential neighborhoods, and local destinations including the Public Market and High Falls Downtown. These connectivity and accessibility improvements will directly benefit low-income communities and enable the City to further the Rochester 2034 polices of healthy living, equity, resilience, prosperity, and partnership.
- **Safety**: Reconstructing the Inner Loop North will create multimodal travel options that and create an urban boulevard, both which have lower crash likelihood and severities relative to and urban expressway
- **Environmental Sustainability**: The project will create multimodal travel options and bring more community and economic activity (e.g., jobs, retail options) to the local community, reducing the reliance on vehicles for commute and recreational trips.

In addition to these main benefits areas, unquantified benefits were also identified. These benefits were not developed into monetized results but describe the value of constructing the project beyond the quantified results of the BCA. These broader benefits have been discussed at length during the community process and are generally discussed the Factors Not Quantified section of this report.

The BCA spreadsheet begins with table of contents tab that outlines the organization of the analysis. A ‘General Inputs’ tab containing key information about the project. This tab also includes many of the inputs and

assumptions discussed below and provides source information as appropriate. A 'Detailed Annual Model tab' demonstrates the resulting costs and benefits over the entire analysis period. A 'Project Matrix' tab contains the output summary table which is shown above as Table 1. The Summary tab includes all the costs and benefits (annualized) and calculates the BCA results. The remaining tabs calculate the individual costs and benefits for each subject area, including construction costs and residuals, safety impacts, pedestrian and cyclist health benefit, travel time, and more. These tabs reference information from the Inputs tab and include additional inputs and sources as necessary.

Analysis Period

The BCA analysis was completed for a 30-year period starting in 2026 and covered the 5-year engineering and construction of the project as well as a 25-year operating period during which project benefits will be accrued. This analysis period was used to capture the benefits of the project while staying within USDOT guidance. The present value of all benefits and costs was calculated using 2019 dollars. 30 years is an appropriate operating period because this project represents a significant highway reconstruction project. The BCA is based on project schedule and construction duration assumptions. This assumes funds for the project will be amassed in by 2025 and construction will begin in December 2026. An estimate 5-year Construction was considered to delay any project benefits until 2030. These are assumed dates for the purposes of this specific analysis and are subject to change and do not represent a statement of commitment from the City. Any temporary net benefits or indirect costs caused by the construction of the project, including jobs created by the construction or travel time delays due to construction, are assumed to be minimal and were excluded from the analysis. 2030 is the first full year that benefits from the project will begin.

Project Costs

The reconstruction of Inner Loop North has an estimated cost of $81.1M (2021$), which equates to $58.9M in 2019 dollars. These costs included the cost of highway items, structures, utilities, landscaping, common items, engineering, inspections, and contingencies. In addition to the capital construction costs, annual maintenance and operation costs totaling $15.4M ($2019) over 30 years will be incurred to maintain the new infrastructure. These coasts were developed based on a proportional relationship of the maintenance costs assumed for the Inner Loop East project, scaled by length of the Inner Loop North project.

Based on the analysis period, the project costs will be $58.9M undiscounted and $30.3M using a 7-percent discount rate.

Travel Time

The primary objective of the Inner Loop North Transportation Planning Study is to develop a concept that deemphasizes vehicle throughput and speeds through this community in favor of multimodal operations, reduced speeds, and community character and opportunity. For this reason, travel time is not anticipated to reduce; rather, travel time is estimated to increase slightly due to the slower speeds and longer travel times for vehicles along urban boulevards rather that highways.

The travel time impacts of the project (quantified as off-peak hour travel time along 6 key corridors) were calculated as part of the transportation analysis conducted under a separate phase of this planning study. The analysis compared existing and future travel times for both the preferred concept and No-

Build Alternatives. The analysis found that with the proposed improvements travel time on the inner loop increased by 4 minutes while travel time on parallel roadways increase be 2-4 minutes.

Travel time impacts were monetized using standard BCA values of $17.90 per hour for all vehicle travel and the forecasted annual daily traffic on each of the key corridor where travel time studies were completed. The BCA resulted in a net travel time disbenefit for commercial and non-commercial trips of -$127.1M undiscounted in 2019 dollars, or -$28.2M at a 7-percent discount rate.

Safety Analysis

Although the amount of traffic moving through the area is not anticipated to decrease, the boulevard will have a lower design speed than the existing expressway. For these reasons, it was assumed that the severity of the accidents will be reduced. Based on a review of the 5-year crash history, approximately 360 crashes occurred along or within the influence area of the Inner Loop North. Based on an assumption that approximately 35 percent of area expressway crashes result in injury and 10 percent of area surface street crashes result in injury, an estimated annual reduction in crash costs was calculated.

Crashes were categorized as fatal crashes, injury crashes, or PDO crashes and monetized according to the prescribed values for each given crash's severity level, which are provided in the USDOT guidance. Based on the preferred concept and No-Build predicted crash values for each segment, the annual monetized value of crashes was calculated for each year of project use. The change in the monetized value of crashes was then calculated during the analysis period.

The Inner Loop has an annual monetized crash cost of $1.6M in 2019 dollars in the No-Build condition and an annual crash cost of $552K in the preferred alternative. This represents an annual safety benefit of $1.11M. The total safety benefit of the project in terms of the monetized value of decreased crashes was $27.7M undiscounted, or $6.1M discounted at 7 percent.

Residual Capital Value

Many of the components of the project have service lives beyond the analysis period, so the residual capital value is calculated for the preferred concept. This residual value is applied as a benefit in the BCA. Consistent with BCA's completed for other similar infrastructure project, major structural components were assumed to have a 75-year design life, utilities components were assumed to have a design life of 50-years, and roadway components were assumed to have a 30-year design life. The total benefit associated with the residual values was $12.5M undiscounted, or $1.1M at a 7-percent discount.

To be conservative, soft costs associated with construction, such as engineering costs and mobilization, are given no residual values.

Maintenance and State of Good Repair

Maintaining the reconfigured urban boulevard created by the removal of the Inner Loop North is estimated to be significantly less expensive than continuing to maintain and repair (and ultimately rehabilitate and replace) the current infrastructure. The lifecycle costs of maintaining either the No-Build or preferred alternative were developed by comparing the lifecycle costs of from the Inner Loop East Study and scaling the values based on the larger improvement area and traffic volumes of Inner Loop North compared to Inner Loop East. Costs in the

No-Build alternative are related to the potential need for full depth pavement reconstruction and significant maintenance and repair work.

The total benefit associated with maintenance and inspection during the analysis period was $121M undiscounted, or $41.9M at a 7-percent discount.

Property Values and Open Space

Several case studies have demonstrated that urban areas can be revitalized by highway removals; a synthesis of these studies suggests that, among other improvements, area property values can rise by as much as and 25 percent due to these renewal project. To conservatively assess the impacts on property values, the latest study area tax assessment was collected, and a 5 percent premium was applied to the entire study area. This is consistent with the methodology used in the Inner Loop East study.

The total benefit associated property value increases related to urban renewal was $29.6M undiscounted, or $13.1M at a 7-percent discount.

Similar case studies suggest that an urban park can increase property values within 500 feet by another 5 percent. Considering the preferred concept alternative includes the potential restoration of Franklin and Anderson Parks, the additional 5 percent premium as also applied to property within 500 feet of each park.

The total benefit associated property value increases related to renew green spaces was $5.3M undiscounted, or $2.4M at a 7-percent discount.

Environmental Impacts

EMISSIONS

The increase in travel times will result in potential emissions increases. The VHT costs calculated in the 'Delay' tab was also used to determine the environmental costs associated with increased emissions. Average in-use emission rates for both passenger cars and heavy-duty trucks from Environmental Protection Agency (EPA) documentation were used for volatile organic compounds (VOCs), nitrogen oxides (NOx), and fine particulate matter (PM2.5). Average in-use carbon dioxide (CO_2) emissions rates for passenger cars were from EPA documentation while (CO_2) emissions rates for heavy-duty vehicles were calculated using EPA documentation and FHWA statistics on heavy-duty vehicles. Sulfur dioxide (SO_2) emissions rates for both passenger cars and heavy-duty trucks were based on a University of Nebraska-Lincoln study. Damage costs for pollutant emissions from USDOT guidance were used to calculate the savings in the preferred concept.

The disbenefit associated with the increased emissions was -$4.5M undiscounted or -$995K at a 7-percent discount in $2019 dollars.

URBAN STREET CANOPY

The project will significantly increase green spaces and the urban tree canopy in the study area. Based on a comparative analysis with Inner Loop East, it is anticipated that the project could result in over 400 additional new urban street trees. Based on data from the national forestry service the net annual benefit of an urban tree is calculated at $100 in $2019 dollars.

The total benefit associated with a renewed urban tree canopy during the analysis period was calculated as $2.4M undiscounted or $525M at a 7-percent discount in $2019 dollars.

Bicycle Network Improvement Benefits

In addition to benefits associated with improvements to the roadway network, the preferred concept provides a multitude of benefits associated with improvements to the bicycle network including protected and shared lanes. This expansion of the bicycle network in the Build scenario will increase the number of cyclists in the Inner Loop North area, thereby producing associated health, recreation, and reduced auto benefits.

The National Cooperative Highway Research Program (NCHRP) published guidelines for the analysis of such improvements. According the NCHRP guidelines, each new cyclist added to a bicycle network provides $128 in health benefits, $10/day in recreation benefits, and roughly $30 in benefits associated with the reduction in automobile usage. To be conservative, only benefits related to health and recreation benefits were tallied.

To estimate the number of new cyclists added to the network in the preferred concept alternative, cyclists were broken into commuter and recreational populations and assumptions were made for each group respectively. The existing population of commuter cyclists in the study area was taken as a percentage of the general working population, values which were provided in Rochester census data. According to a survey conducted by Breakaway Research Group for People for Bikes, 46 percent of respondents report they would bike more often if they had safe facilities separated from vehicle traffic. The survey also reported that 14 percent of respondents biked at least twice a week, and this value was assumed to represent commuter cyclists in the survey population. To be conservative, the increase in future commuter cyclists was scaled down in accordance with the ratio of existing commuter cyclists in the survey and study area populations. Research conducted by Forbes suggests that recreational cyclists account for 17 percent of the cyclist population, so the number of recreational cyclists was extrapolated accordingly.

In both the No-Build and preferred concept alternatives, the respective commuter and recreational cyclists populations were assumed to grow proportionally with the general population, whose growth was estimated using historical census data. In each year, the number of new recreational and commuter cyclists was taken as the difference between No-Build and Build cyclists in each population. The monetary rate associated with health benefits was applied to both recreational and commuter cyclists. The recreation rate was applied only to the recreational cyclists, and the reduced auto rate was applied only to commuter cyclists.

The total benefit associated with improvements to the bicycle network during the analysis period was roughly $104.4M, or $22.9M at a 7-percent discount.

Pedestrian Network Improvement Benefits

According to the NCHRP guidelines cited in the Bicycle Network Improvements section, the same health and recreation benefits which can be applied to cyclists can be applied in similar fashion to pedestrians due to improvements in the pedestrian network. The same $128 health benefit and $10/day recreation benefit can be applied to new pedestrians added to the network in the Build alternative.

The No-Build and preferred concept populations of commuter and recreational pedestrians were estimated in a manner similar to that of the equivalent bicyclist populations. The existing commuter pedestrian population was derived from study area 7 census data, and the recreational pedestrian population was extrapolated from that

based on finding from an FHWA case study. The case study also provided estimates for increases in pedestrian populations based on improvements to the network, and those increases were scaled according to the study area specific data.

In both the No-Build and preferred concept alternatives, the respective commuter and recreational pedestrian populations were assumed to grow proportionally with the general population, whose growth was estimated using historical census data. In each year, the number of new recreational and commuter pedestrians was taken as the difference between No-Build and preferred concept pedestrian populations in each population. The monetary rate associated with health benefits was applied to both recreational and commuter pedestrians, and the recreation rate was applied only to the recreational pedestrians.

The total benefit associated with improvements to the pedestrian network during the analysis period was roughly $42.9M undiscounted, or $9.4M at a 7-percent discount.

Economic Output

Construction of the project and an injection of new federal money in the region is anticipated to create short-term spending, earning, and employment gains. Although these benefits are not included in the overall BCR, this quantification is still represented in the Economic Output tab to demonstrate the short-term economic benefits of this project. These benefits are quantified using the Bureau of Economic Analysis's Regional Input-Output Modeling System (RIMS II) to determine the regional economic output, household earnings, and employment multipliers. These multipliers provide an estimate of the total economic gains in all industries in the region per dollar of expenditure for specific industries. Based on RIMS II, the project results in a total economic benefit of approximately $88.6M. Based on the multiplier, the construction activities, and injection of federal money will result in the creation of almost 109 new jobs across all industries.

As an alternative analysis, the 2011 Council of Economic Advisers estimated that $76,923 in transportation infrastructure spending creates one job-year. Based on this, the project expenditures would create 765 job-years, supporting economic growth in the study area and in the City of Rochester.

Factors Not Quantified

Several factors were not quantified as part of the analysis but provide additional benefits beyond those quantified above. Some unquantified factors are:

- **Increased Access —** As the redesign will reconnect the street grid, the community will more easily be able to access employment and services in the greater metropolitan region.
- **Emission savings due to Mode Split —** The new design will increase safety and comfort for pedestrians and cyclists, increasing transportation options and public health. This could also have long term implications on car use and ownership. Reductions in these two trends would have a positive impact of reducing study area emissions.
- **Racial and Economic Equity —** Redesigning this corridor will provide access to historically underinvested communities.
- **Short Term Economic Impact —** Project construction creates temporary quality jobs during construction, increasing wages in the local economy and providing economic benefits to local suppliers and contractors.

BCA Results

The results of the BCA conducted for the Rochester Inner Loop North Transformation Planning Study are presented in terms of a BCR and a net present value (NPV). A BCR greater than 1.0 and NPV greater than 0 mean that the project benefits outweigh the project costs. The larger the BCR and NPV, the greater the expected benefits of the project. The BCR provides the amount of benefit per unit cost, which can be useful for determining the highest dollar-for-dollar benefit when comparing projects. The results of the BCA for the project, calculated using the methodology described above, are presented in Table 2. The results are shown both without any discount applied and with a 7-percent discount. As can be seen in the table, there are substantial benefits associated with the Rochester Inner Loop North Transformation Planning Study.

Table 2: BCR Summary

	Undiscounted	**7-Percent Discount**
Benefits	$214,125,434	$68,293,147
Costs	$58,879,946	$30,336,674
BCR	3.64	2.25
NPV	$155,245,489	$37,956,472

Conclusion

This document presented an analysis of the benefits and cost associated with the Rochester Inner Loop North Transformation Planning Study.

This likely underestimates the project's true net benefits as several additional categories of benefits are not easily quantifiable and have instead been described qualitatively during the community process. Despite this a positive NPV and BCR were developed which demonstrate that the project benefits outweigh its costs and that investing in the Rochester Inner Loop North Transformation Planning Study would be a worthy use of public and private funds.

Combined with the previously completed market analysis and a future value capture analysis, this BCA serves as a key tool to better understand, communicate, and establish strategies for the implementation of the preferred concept alternative.