

# Benefit-Cost Analysis of the Proposed Mariemont Connector

Prepared for the:



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## Executive Summary

The Village of Mariemont, located in southeastern Hamilton County, is currently interested in constructing a multi-use pathway, known as the Mariemont Connector, and is exploring two possible routes. The first route (Alternative B) will run through the Village Center, while the second route (Alternative C) will run along Murray Avenue in the northern part of the community. This study evaluates the benefits and costs of the construction and implementation for both route options of the Mariemont Connector in order to assist in garnering grant funding. All values are reported in 2022 dollars unless otherwise mentioned.<sup>1</sup>

The first step in calculating the benefits and costs is to estimate both current and anticipated demand of bicycling in the Village of Mariemont. Next, the benefits of increased bicycle usage through reduced vehicle miles traveled, recreation, and health were calculated using the guidelines provided by the National Cooperative Highway Research Program (NCHRP) Guidelines for Analysis of Investments in Bicycle Facilities and the U.S. Department of Transportation Benefit-Cost Analysis Guidance for Discretionary Grant Programs. Last, costs for construction and annual operation and maintenance costs were projected over the Mariemont Connector’s 20-year useful life.<sup>2</sup> Net present value calculations for this study are discounted at rates of 7.0 percent and 3.0 percent. A summary of the benefits and costs can be found in Table 1. Alternative C yields the strongest Benefit-Cost Ratios for undiscounted, discounted at 3.0 percent, and discounted at 7.0 percent compared to Alternative B. All scenarios, accounting for variations in the discount rate and the route option being analyzed, yield a Benefit-Cost Ratio (BCR) above 1.0, meaning that the benefits outweigh the costs.

**Table 1: Benefit Cost Analysis Summary (2022\$)**

Category	Net Benefits	Local Costs	Benefit-Cost Ratio
Alternative B Undiscounted	\$1,244,984	\$497,500	<b>2.50</b>
Alternative C Undiscounted	\$1,248,242	\$437,500	<b>2.85</b>
Alternative B at 3.0%	\$920,483	\$483,010	<b>1.91</b>
Alternative C at 3.0%	\$922,139	\$424,757	<b>2.17</b>
Alternative B at 7.0%	\$644,775	\$464,953	<b>1.39</b>
Alternative C at 7.0%	\$645,184	\$408,879	<b>1.58</b>

Source: Economics Center calculations.

<sup>1</sup> 2022 dollars were calculated using the most recently available data for the Consumer Price Index through October 2022.

<sup>2</sup> It is anticipated that the Village of Mariemont will receive approximately 75.0 percent of the construction costs through non-local grant sources. Therefore, the Economics Center is using the remaining 25.0 percent of the construction costs in this benefit cost analysis.

## Introduction

The benefits that come with enabling pedestrian and bicycle friendly spaces are well-known. People are happier, healthier, and breathe easier. Communities are drawn closer together. Communities throughout Greater Cincinnati have seen this happen, along with many other cities across the U.S., and the Village of Mariemont wants to encourage cycling via a dedicated bicycle trail so that residents can further experience those benefits. A recent proposal aimed to help achieve that goal is the Mariemont Connector. The Economics Center was asked to conduct an analysis to determine whether the benefits of this project outweigh its costs.

As shown in Figure 1, the Mariemont Connector has two route options that are being considered for construction, and differences in the calculations are highlighted in the following sections. The first route (Alternative B) is planned to be built through the Village Center and the second route (Alternative C) is planned to be built in the northern part of the Village along Murray Avenue. The Economics Center was asked to conduct a benefit-cost analysis (BCA) to see if the Mariemont Connector is a sound investment.

**Figure 1: Proposed Mariemont Connector Route Options**



Source: Economics Center.

This analysis follows the methodology defined by the National Cooperative Highway Research Program (NCHRP) Guidelines for Analysis of Investments in Bicycle Facilities and the U.S. Department of Transportation (USDOT) Benefit-Cost Analysis Guidance for Discretionary Grant Programs, referred to as the NCHRP Guidelines and the USDOT Guidance, respectively. First, the demand for the Mariemont Connector was calculated, considering both existing

bicycle use in the Village of Mariemont and anticipated bicycle use if the trail is built. Next, the benefits of increased cycling use were quantified. These calculations are in terms of benefits accruing to trail users through commuting and recreational usage as well as improved health. Finally, the anticipated costs were calculated, including the expected costs to maintain the Mariemont Connector for 20 years.

## Mariemont Connector Demand

The 2020 population estimate for the Village of Mariemont was acquired from the American Community Survey, which is produced by the U.S. Census Bureau. For purposes of this analysis and consistent with NCHRP guidelines, the Economics Center isolated and included the population of working-age people, ages 16-64 within the Village of Mariemont. Age groups older and younger than the working-age population were excluded from the analysis. Table 2 distinguishes the difference between the total population and the working-age population of the Village of Mariemont in 2020.

**Table 2: Population of the Village of Mariemont, 2020**

Parameter	Total
Total Population	<b>3,445</b>
Working-Age Population (16-64)	<b>2,227</b>

*Source: American Community Survey, 2020 5-Year Estimates, Table S0101.*

A study completed by Dill and Carr found that the construction of new bicycle pathways resulted in increased commuters via bicycle. Dill and Carr concluded that the share of bicycle commuters increased by one percentage point for approximately each mile of pathway constructed.<sup>3</sup> According to the American Community Survey, 2020 5-year estimates, there are approximately 308 individuals that live and work within the Village of Mariemont and are therefore the population most likely to utilize the Mariemont Connector to commute to work via bicycle. Currently, there are no bicycle commuters within the Village of Mariemont, according to the American Community Survey, 2020 5-year estimates. Using the findings of Dill and Carr, an estimated three individuals will commute to work via bicycle upon completion of the Mariemont Connector, as shown in Table 3.

**Table 3: Estimated New Commuters**

Parameter	Total
Individuals Living and Working in Village of Mariemont	<b>308</b>
Estimated New Commuters	<b>3</b>

*Source: American Community Survey, 2020 5-year estimates, Table B08008 and Economics Center estimates using findings from Dill and Carr.*

<sup>3</sup> [Dill Carr TRR 1828.pdf \(pdx.edu\)](#)

The existing and new bicycle use were estimated based the NCHRP Guidelines. According to the NCHRP Guidelines, the total adult bicycling rate ranges from the U.S. Census Bureau commuter rate at the low end to 0.6 percent plus three times the existing commuter rate. The total adult bicycling rate is then multiplied by the adult population.<sup>4</sup>

$$\text{Demand} = (0.6\% + 3 * \text{commuter share}) * \text{adult population}$$

When the number of existing commuters is subtracted, the remainder is the estimate of existing adult recreational bicycle users.

According to NCHRP, the people who live near a facility are more likely to bike compared to the ones that do not. The likelihood multipliers for new cyclists developed by NCHRP were used to estimate the number of induced bicyclists.

$$\begin{aligned} \text{New adult cyclists} &= \sum (\text{Existing adult cyclists} * (L_d - 1)) \\ \text{For } d &= 400\text{m (or approximately 0.25 miles)} \\ \text{Where, } L_{400\text{m}} &= 2.93 \end{aligned}$$

Research indicates that new bike trails are associated with an increase in bicycle ridership.<sup>5</sup> Table 4 provides the estimation of existing recreational bicyclists and the estimated new recreational cyclists.

**Table 4: Estimation of Existing Recreational Cyclists**

Type of User	Total
Current Recreational User	<b>12</b>
New Recreational User <sup>6</sup>	<b>23</b>

*Note: There are no commuters via American Community Survey Table B08301.*

*Source: Economics Center calculations using data from the ACS and NCHRP Guidelines.*

## Benefits of Using the Mariemont Connector

The Economics Center divided the benefits of the Mariemont Connector into three categories. First, the Mariemont Connector would enhance sustainability by reducing vehicle miles traveled, reducing CO<sub>2</sub> emissions, and increasing mobility of residents. It would also increase the area’s economic competitiveness, primarily by lowering total vehicle operating costs. The area would become more livable as well, since the Mariemont Connector will reduce health care costs and add to the recreational options for residents.

<sup>4</sup> According to the American Community Survey, 2020 5-year estimates, there are no bicycle commuters residing within the Village of Mariemont.

<sup>5</sup> Active Living Research, “The Power of Trails for Promoting Physical Activity in Communities”. <http://www.clintonhealth.org/pdf%20files/poweroftrails.pdf> Ralph Buehler & John Pucher, “Cycling to work in 90 large American cities: new evidence on the role of bike paths and lanes” <https://link.springer.com/article/10.1007/s11116-011-9355-8>

<sup>6</sup> Based on population the growth rate of the Village of Mariemont, the number of recreation cyclists is expected to increase to 24 in 2031 and is reflected in the overall BCA.



## Reduction in Vehicle Miles Traveled

The total reduction in the vehicle miles traveled (VMT) as a result of the new bicycle commuters on the Mariemont Connector was estimated using the formula below.

$$\text{Reduction in VMT} = \text{average round trip length} * \text{estimated work days} * \text{new commuters}$$

The average round trip length was calculated by assuming the average number of miles commuters would travel to and from work. This assumes that the new commuters would be distributed throughout the zones around the Mariemont Connector. To estimate the total number of vehicles miles reduced for both Alternative B and Alternative C, the average distance that workers commute via bicycle was estimated by multiplying each trail length by two, assuming commuters use the same route to get to and from work. For Alternative B, the average roundtrip length is 1.48 miles, while the average roundtrip for Alternative C is 1.36 miles.

As previously displayed in Table 3, the total number of new commuters is expected to be 3. The total number of days commuters are expected to bike to work is 142 (261 working days, less holidays, vacation, sick, rainy days, and cold days). Calculations assumed 11 holidays, 10 vacation days, and 5 sick days. According to Heinen, Maat, and Wee, there is a negative effect of low temperatures (in between 17.6°F and 32.0°F).<sup>7</sup> Using data from Wunderground.com, any day that had an average temperature less than 32.0°F, observed at the Greater Cincinnati Northern Kentucky International Airport in 2021 was counted as a snow day.<sup>8</sup> From Weatherspark.com, there were 66 days that had precipitation<sup>9</sup>, in 2021, which makes up the rainy days component of the estimated bicycle work days calculation. Therefore, the total number of reduced miles would be the multiplication of average miles traveled, number of commuting days, and number of new commuters using the Mariemont Connector to commute to work, which produces an estimate of 630 miles and 579 miles for Alternatives B and C, respectively, as shown below.

$$\text{Reduction in VMT for Alternative B} = 1.48 * 142 * 3 = \mathbf{630 \text{ miles}}$$

$$\text{Reduction in VMT for Alternative C} = 1.36 * 142 * 3 = \mathbf{579 \text{ miles}}$$

Applying the 2022 IRS value of \$0.605 per mile<sup>10</sup>, this results in a total estimated annual vehicle operating cost savings of \$381 for Alternative B and \$351 for Alternative C in 2022 dollars due to a reduction in VMT.

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<sup>7</sup> Heinen, Maat, and Wee. "Day-to-Day Choice to Commute or Not by Bicycle" <https://journals.sagepub.com/doi/10.3141/2230-02>

<sup>8</sup> Wunderground. "Erlanger, KY Weather History" <https://www.wunderground.com/history/daily/us/oh/cincinnati>

<sup>9</sup> Weatherspark. "Weather History at Cincinnati/Northern Kentucky International Airport" <https://weatherspark.com/h/m/146655/2021/1/Historical-Weather-in-January-2021-at-Cincinnati-Northern-Kentucky-International-Airport-Kentucky-United-States#Figures-PrecipitationProbability>

<sup>10</sup> IRS. First half of 2022 rate was \$0.585 and was increased to \$0.625 for the remaining six months of 2022. "IRS Issues Standard Mileage Rates for 2022" <https://www.irs.gov/newsroom/irs-issues-standard-mileage-rates-for-2022>.

## Reduction of Vehicle Emissions

There will be benefits associated with the reduction of vehicle emissions, specifically, carbon dioxide, nitrogen oxides, particulate matter, and sulfur dioxide. Emission rates in grams per mile for light-duty passenger vehicles were obtained from the Environmental Protection Agency’s (EPA’s) latest version of the Motor Vehicle Emission Simulator (MOVES3)<sup>11</sup>. Emission rates were calculated by dividing the total emissions by the distance traveled in miles for a given year for urban roads in Hamilton County, Ohio. Monetized values per metric ton were obtained from the USDOT Guidance for 2021 through 2050.<sup>12</sup> Monetized values for carbon dioxide increased annually between 2021 and 2043. Monetized values for nitrogen oxides, 2.5 micrometer particulate matter, and sulfur dioxide remained constant between 2030 and 2043. Monetized values were converted into costs per gram before applying the emission rates in grams per mile. Table 5 displays the total reduction in emissions for the Mariemont Connector’s operation for Alternative B and Alternative C by adding the reduction benefit from each pollutant.

**Table 5: Value of Reduction in Emissions<sup>13</sup> (2022\$)**

Pollutant	Grams per Mile	Cost per Metric Ton	Cost per Gram	Cost per Mile	Total Alternative B	Total Alternative C
Carbon Dioxide (CO <sub>2</sub> )	341	\$55	\$0.000055	\$0.01877	<b>\$276.50</b>	<b>\$254.08</b>
Nitrogen Oxides (NO <sub>x</sub> )	0.15579	\$16,200	\$0.0162	\$0.00252	<b>\$11.75</b>	<b>\$10.80</b>
Particulate Matter (PM <sub>2.5</sub> )	0.00768	\$788,100	\$0.7881	\$0.00605	<b>\$77.19</b>	<b>\$70.93</b>
Sulfur Dioxide (SO <sub>2</sub> )	0.00222	\$44,000	\$0.0440	\$0.00010	<b>\$1.32</b>	<b>\$1.21</b>
<b>Total</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>\$366.76</b>	<b>\$337.02</b>

Note: The values in the Alternative B and C columns were converted to \$2022 as the data was in \$2020.

Note: Carbon Dioxide emissions are always discounted per USDOT Guidance.

Source: Economic Center calculations using data from EPA MOVES 3.

## Cyclist Mobility Benefits

Bicycle commuters are willing to spend on average 20.38 extra minutes per trip to travel on an off-street bicycle trail when the alternative is riding on a street with parked cars, according to the NCHRP.<sup>14</sup> According to the USDOT Guidance, the value of time for personal travel (used because biking is a personal choice) in 2020 Dollars is \$16.20 per hour, which is \$18.66 in 2022 Dollars. Multiply the per-trip benefit for the amount of time using the trail by the number

<sup>11</sup> Environmental Protection Agency. <https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves>

<sup>12</sup> U.S. Department of Transportation. “Benefit Cost Analysis Guidance for Discretionary Grant Programs” <https://www.transportation.gov/sites/dot.gov/files/2022-03/Benefit%20Cost%20Analysis%20Guidance%202022%20%28Revised%29.pdf>

<sup>13</sup> Grams per mile, cost per metric ton, cost per gram, and cost per mile are presented for the first year of the Mariemont Connector’s operation. These values are not constant over time. Totals presented for Alternative B and C represent the total value of emissions reduction during the Mariemont Connector’s anticipated useful life.

<sup>14</sup> NCHRP. “Guidelines for Analysis of Investments in Bicycle Facilities” <https://www.americantrails.org/resources/guidelines-for-analysis-of-investments-in-bicycle-facilities>



of daily induced commuters, then double it to include trips both to and from work to determine the mobility benefits.

$$\text{Annual mobility benefit} = M * (V/60) * (\text{new commuters}) * 142 * 2$$

Where:

- o M is the number of minutes commuters spend to travel on an off-street facility
- o V is the value of time for personal mobility per hour (translated to minutes by dividing by 60)
- o 3 is the estimated number of new commuters
- o 142 is the estimated number of bicycle commuting days
- o 2 is the number of daily trips the commuter spends time traveling on the off-street facility

$$\text{Annual mobility benefit} = 20.38 * (\$18.66/60) * 3 * 142 * 2 = \underline{\underline{\$5,399}}$$

## Travel Time Savings and Other External Benefits

As the number of vehicle miles traveled is reduced, the remaining motorists benefit in several ways. According to the U.S. National Highway Traffic Safety Administration (NHTSA), research developed by the Federal Highway Administration provides authoritative cost calculations for these marginal external benefits that accrue to the motorists who continue to follow the commuting routes formerly used by new bicycle commuters.<sup>15</sup> This research includes benefits associated with reductions in congestion, noise, and accidents that can be attributed to the reduction in VMT. The USDOT Guidance provides updated cost estimates for noise and congestion, whereas cost estimates for accident reductions reflect values presented by the NHTSA and inflation adjusted to 2022 Dollars. The resulting externality benefits, in 2022 dollars, are summarized in the Table 6 for Alternative B and Alternative C.

**Table 6: Total Externality Benefits (2022\$)**

Externality	Rate per Vehicle Mile	Total Alternative B	Total Alternative C
Congestion (travel time savings)	\$0.1428	<b>\$1,800.79</b>	<b>\$1,654.78</b>
Noise reduction benefits	\$0.0020	<b>\$24.69</b>	<b>\$22.69</b>
Accident reduction benefits	\$0.03	<b>\$428.88</b>	<b>\$394.10</b>

Source: Economics Center calculations using USDOT Guidance and data from the NHTSA.

## Recreational Benefits

The “typical” day in which a person is engaged in bicycle riding for about one hour of total bicycling activity is valued at \$10 in 2004 dollars, based on the NCHRP Guidelines, which is \$15.78 in 2022 dollars.<sup>16</sup> Based on a 2014 study for the Michigan Department of Transportation, recreational use is estimated to average 150 days per year.<sup>17</sup> As shown in Table 7, the number of estimated new recreational users is 26 and the benefits that come

<sup>15</sup> National Highway Traffic Safety Administration. [https://www.nhtsa.gov/sites/nhtsa.gov/files/deis\\_appx\\_c.pdf](https://www.nhtsa.gov/sites/nhtsa.gov/files/deis_appx_c.pdf)

<sup>16</sup> NCHRP. 2006. “Guidelines for Analysis of Investments in Bicycle Facilities” <https://www.americantrails.org/resources/guidelines-for-analysis-of-investments-in-bicycle-facilities>

<sup>17</sup> BBC Research & Consulting. “Community and Economic Benefits of Bicycling in Michigan” [https://headwaterseconomics.org/wp-content/uploads/Trail\\_Study\\_85-MI-Cycling-Impact.pdf](https://headwaterseconomics.org/wp-content/uploads/Trail_Study_85-MI-Cycling-Impact.pdf)

with this increase in ridership during the first year of operation of the Mariemont Connector is \$61,534.

Based on the estimation for new cyclists as calculated in the Demand section:

$$\text{Annual recreational benefit per user} = \$15.78 * 150 = \underline{\underline{\$2,367}}$$

**Table 7: Recreation Benefits (2022\$)**

Operation Year 1	Total
Recreational Users	<b>26</b>
Benefits	<b>\$61,534</b>

Source: Economics Center calculations using NCHRP Guidelines.

## Health Benefits

Based on the estimates for new cyclists as calculated in the Demand section, Table 8 shows the total health benefits for the Village of Mariemont’s residents. According to the NCHRP Guidelines, pedestrian facilities generate \$128 in 2006 dollars (\$189.28 in 2022 dollars) per year in health benefits.<sup>18</sup> The value of \$189.28 was multiplied by the number of recreational users. The health benefits during the first year of the Mariemont Connector’s operation totals \$4,921.

**Table 8: Health Benefits (2022\$)**

Operation Year 1	Total
Users	<b>26</b>
Benefits	<b>\$4,921</b>

Source: Economics Center calculations using NCHRP Guidance.

## Costs of the Mariemont Connector

The costs of the Mariemont Connector include construction and operation and maintenance for both of the trail options. Therefore, the net costs are trail construction and annual trail operation/maintenance.

The estimated cost of constructing Alternative B is \$1,990,000, and the cost of constructing Alternative C is \$1,750,000. The Village of Mariemont is seeking grant funding to support approximately 75.0 percent of the costs associated with construction of either Alternative B or Alternative C. As these grant dollars are not local to the Village of Mariemont, the Economics Center has removed the non-local share of the construction costs from the BCA. Under the Alternative B route option, the Economics Center has assumed the local share for construction to be \$497,500. The local share of construction costs under the Alternative C route option to be \$437,500. The Village of Mariemont has also estimated its anticipated annual costs for operation and maintenance of the Mariemont Connector for Alternative B to be \$2,000, along

<sup>18</sup> NCHRP. “Guidelines for Analysis of Investments in Bicycle Facilities”  
<https://www.americantrails.org/resources/guidelines-for-analysis-of-investments-in-bicycle-facilities>

with the second, fifth, 10th, and 15th years having an additional \$10,000 allocated for crack seal and replacement of dead plants and broken items, and the 20th year having \$140,000 allocated for resurfacing. The operations and maintenance costs for Alternative B accumulate to \$220,000 over 20 years. For Alternative C, the annual costs are \$2,500, the second and fifth year have \$10,000 for crack seal and replacement of dead plants and broken items, the 10th and 15th years have \$3,000 for crack seal, and the 20th year has \$140,000 for resurfacing, totaling to \$216,000 for operation and maintenance costs over 20 years.

Finally, the Mariemont Connector is expected to increase the cost of bicycle operation and maintenance for new commuters. This cost is estimated to be \$0.05 per mile in 2022 dollars.<sup>19</sup>

## Benefit Cost Calculations

The benefit cost calculations for the Mariemont Connector are summarized below. The cumulative benefits and costs are compared for undiscounted calculations in Table 9. The cumulative undiscounted net benefits for Alternative B are \$1.245 million while the undiscounted net benefits for Alternative C total \$1.248 million.

**Table 9: Benefit Cost Summary (2022\$)**

Type	Alternative B	Alternative C
Local Share of Construction Costs	\$479,500	\$437,500
Net Benefits Year 1	\$72,369	\$72,328
Cumulative Undiscounted Net Benefits	\$1,244,984	\$1,248,242

Source: Economics Center calculations.

In both proposed trail options, the Mariemont Connector has a positive net present value (NPV) at both 3.0 percent and 7.0 percent discount rates, as shown below in Table 10. For Alternative B, the NPV at the 3.0 percent discount rate is \$920,483 and \$644,775 at the 7.0 percent discount rate. The NPV for Alternative C is \$922,139 at the 3.0 percent discount and \$645,184 at a discount rate of 7.0 percent.

**Table 10: Net Present Value Summary (2022\$)**

Rate	Alternative B	Alternative C
3.0% Discount Rate	\$920,483	\$922,139
7.0% Discount Rate <sup>20</sup>	\$644,775	\$645,184

Source: Economics Center calculations.

It is important to note that the NPV at the 3.0 percent discount rate, which is the standard for government expenditures, is \$920,483 for Alternative B and \$922,139 for Alternative C.

<sup>19</sup> Victoria Transport Policy Institute. "Transportation Cost Analysis-Vehicle Costs"  
<https://www.vtpi.org/tca/tca0501.pdf>

<sup>20</sup> Carbon dioxide emissions are discounted at 3.0 percent per the USDOT Guidance.

## Conclusion

The Economics Center found that the expected benefits of the Mariemont Connector outweigh its costs. The \$920,483 (Alternative B) and \$922,139 (Alternative C) NPV at the 3.0 percent discount rate indicates that the Mariemont Connector is expected to produce an estimated 1.91:1 and 2.17:1 benefit-to-cost ratio for investment in Alternative B and C, respectively. The primary benefits are reduction in vehicle miles traveled, recreation, mobility, and health. Residents of the Village of Mariemont will receive an annual benefit of approximately \$62,000 in recreation benefits, nearly \$5,500 in mobility benefits, and \$5,000 each year in health benefits.

While construction the Mariemont Connector will require a large upfront investment, its operation and maintenance costs are low. Therefore, the annual benefits will accumulate and surpass the initial investment. The Mariemont Connector will provide a valuable cycling option for recreational bicyclists.

## Appendix A: Summary of Benefits and Costs for Alternative B

Year	Net Benefits	7% NPV Net Benefits	3% NPV Net Benefits	Annual Costs (2022\$)	Local Construction Costs (2022\$)	Commuter Bicycle Operating Costs (2022\$)	Operation and Maintenance Costs (2022\$)	7% Discount Costs	3% Discount Costs	Sum of All Benefits (2022\$)	Other Emission Benefits	Reduce CO2 Benefits	Benefits of Reduced Vehicle Miles	Benefits of Crash Congestion Noise Reduction	Benefit of Cyclist Mobility	Benefits of Recreation	Health Benefits
2023	N/A	N/A	N/A	N/A	\$497,500	N/A	N/A	\$464,953	\$483,010	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2024	\$70,337	\$61,411	\$66,300	\$2,032	N/A	\$32	\$2,000	N/A	N/A	\$72,369	\$6	\$14	\$381	\$113	\$5,399	\$61,534	\$4,921
2025	\$60,337	\$49,229	\$55,217	\$12,032	N/A	\$32	\$12,000	N/A	N/A	\$72,369	\$6	\$14	\$381	\$113	\$5,399	\$61,534	\$4,921
2026	\$70,336	\$53,637	\$62,493	\$2,032	N/A	\$32	\$2,000	N/A	N/A	\$72,368	\$6	\$13	\$381	\$113	\$5,399	\$61,534	\$4,921
2027	\$70,336	\$50,128	\$60,673	\$2,032	N/A	\$32	\$2,000	N/A	N/A	\$72,368	\$5	\$13	\$381	\$113	\$5,399	\$61,534	\$4,921
2028	\$60,336	\$40,184	\$50,531	\$12,032	N/A	\$32	\$12,000	N/A	N/A	\$72,368	\$5	\$14	\$381	\$113	\$5,399	\$61,534	\$4,921
2029	\$70,336	\$43,782	\$57,190	\$2,032	N/A	\$32	\$2,000	N/A	N/A	\$72,368	\$5	\$14	\$381	\$113	\$5,399	\$61,534	\$4,921
2030	\$70,336	\$40,917	\$55,524	\$2,032	N/A	\$32	\$2,000	N/A	N/A	\$72,368	\$5	\$14	\$381	\$113	\$5,399	\$61,534	\$4,921
2031	\$70,335	\$38,240	\$53,906	\$2,032	N/A	\$32	\$2,000	N/A	N/A	\$72,367	\$5	\$14	\$381	\$113	\$5,399	\$61,534	\$4,921
2032	\$70,335	\$35,738	\$52,336	\$2,032	N/A	\$32	\$2,000	N/A	N/A	\$72,367	\$4	\$14	\$381	\$113	\$5,399	\$61,534	\$4,921
2033	\$60,335	\$28,649	\$43,587	\$12,032	N/A	\$32	\$12,000	N/A	N/A	\$72,367	\$4	\$14	\$381	\$113	\$5,399	\$61,534	\$4,921
2034	\$70,335	\$31,214	\$49,332	\$2,032	N/A	\$32	\$2,000	N/A	N/A	\$72,367	\$4	\$14	\$381	\$113	\$5,399	\$61,534	\$4,921
2035	\$70,524	\$29,250	\$48,024	\$2,032	N/A	\$32	\$2,000	N/A	N/A	\$72,556	\$4	\$14	\$381	\$113	\$5,399	\$61,534	\$5,111
2036	\$70,525	\$27,336	\$46,625	\$2,032	N/A	\$32	\$2,000	N/A	N/A	\$72,557	\$4	\$14	\$381	\$113	\$5,399	\$61,534	\$5,111
2037	\$72,891	\$26,405	\$46,786	\$2,032	N/A	\$32	\$2,000	N/A	N/A	\$74,923	\$4	\$14	\$381	\$113	\$5,399	\$63,901	\$5,111
2038	\$62,891	\$21,290	\$39,192	\$12,032	N/A	\$32	\$12,000	N/A	N/A	\$74,923	\$4	\$14	\$381	\$113	\$5,399	\$63,901	\$5,111
2039	\$72,891	\$23,062	\$44,100	\$2,032	N/A	\$32	\$2,000	N/A	N/A	\$74,923	\$4	\$14	\$381	\$113	\$5,399	\$63,901	\$5,111
2040	\$72,891	\$21,553	\$42,816	\$2,032	N/A	\$32	\$2,000	N/A	N/A	\$74,923	\$4	\$14	\$381	\$113	\$5,399	\$63,901	\$5,111
2041	\$72,891	\$20,143	\$41,569	\$2,032	N/A	\$32	\$2,000	N/A	N/A	\$74,923	\$4	\$14	\$381	\$113	\$5,399	\$63,901	\$5,111
2042	\$72,892	\$18,825	\$40,358	\$2,032	N/A	\$32	\$2,000	N/A	N/A	\$74,924	\$4	\$14	\$381	\$113	\$5,399	\$63,901	\$5,111
2043	(\$67,108)	(\$16,219)	(\$36,074)	\$142,032	N/A	\$32	\$142,000	N/A	N/A	\$74,924	\$4	\$15	\$381	\$113	\$5,399	\$63,901	\$5,111
<b>20 Year NPV</b>	<b>\$1,244,984</b>	<b>\$644,775</b>	<b>\$920,483</b>	<b>\$220,640</b>	<b>\$497,500</b>			<b>\$464,953</b>	<b>\$483,010</b>								
<b>BCR</b>	<b>2.50</b>	<b>1.39</b>	<b>1.91</b>														

Source: Economics Center calculations.

## Appendix B: Summary of Benefits and Costs for Alternative C

Year	Net Benefits	7% NPV Net Benefits	3% NPV Net Benefits	Annual Costs (2022\$)	Local Construction Costs (2022\$)	Commuter Bicycle Operating Costs (2022\$)	Operation and Maintenance Costs (2022\$)	7% Discount Costs	3% Discount Costs	Sum of All Benefits (2022\$)	Other Emission Benefits	Reduce CO2 Benefits	Benefits of Reduced Vehicle Miles	Benefits of Crash Congestion Noise Reduction	Benefit of Cyclist Mobility	Benefits of Recreation	Health Benefits
2023	N/A	N/A	N/A	N/A	\$437,500	N/A	N/A	\$408,879	\$424,757	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2024	\$69,799	\$60,942	\$65,792	\$2,529	N/A	\$29	\$2,500			\$72,328	\$6	\$13	\$351	\$104	\$5,399	\$61,534	\$4,921
2025	\$59,798	\$48,792	\$54,724	\$12,529	N/A	\$29	\$12,500			\$72,327	\$6	\$12	\$351	\$104	\$5,399	\$61,534	\$4,921
2026	\$69,798	\$53,228	\$62,015	\$2,529	N/A	\$29	\$2,500			\$72,327	\$5	\$12	\$351	\$104	\$5,399	\$61,534	\$4,921
2027	\$69,798	\$49,745	\$60,208	\$2,529	N/A	\$29	\$2,500			\$72,327	\$5	\$12	\$351	\$104	\$5,399	\$61,534	\$4,921
2028	\$59,798	\$39,827	\$50,080	\$12,529	N/A	\$29	\$12,500			\$72,327	\$5	\$13	\$351	\$104	\$5,399	\$61,534	\$4,921
2029	\$69,797	\$43,448	\$56,752	\$2,529	N/A	\$29	\$2,500			\$72,326	\$5	\$12	\$351	\$104	\$5,399	\$61,534	\$4,921
2030	\$69,797	\$40,606	\$55,099	\$2,529	N/A	\$29	\$2,500			\$72,326	\$4	\$12	\$351	\$104	\$5,399	\$61,534	\$4,921
2031	\$69,797	\$37,949	\$53,494	\$2,529	N/A	\$29	\$2,500			\$72,326	\$4	\$12	\$351	\$104	\$5,399	\$61,534	\$4,921
2032	\$69,797	\$35,466	\$51,935	\$2,529	N/A	\$29	\$2,500			\$72,326	\$4	\$12	\$351	\$104	\$5,399	\$61,534	\$4,921
2033	\$66,797	\$31,720	\$48,255	\$5,529	N/A	\$29	\$5,500			\$72,326	\$4	\$12	\$351	\$104	\$5,399	\$61,534	\$4,921
2034	\$69,797	\$30,976	\$48,954	\$2,529	N/A	\$29	\$2,500			\$72,326	\$4	\$12	\$351	\$104	\$5,399	\$61,534	\$4,921
2035	\$69,986	\$29,028	\$47,657	\$2,529	N/A	\$29	\$2,500			\$72,515	\$4	\$13	\$351	\$104	\$5,399	\$61,534	\$5,111
2036	\$69,986	\$27,128	\$46,269	\$2,529	N/A	\$29	\$2,500			\$72,515	\$4	\$13	\$351	\$104	\$5,399	\$61,534	\$5,111
2037	\$72,353	\$26,211	\$46,440	\$2,529	N/A	\$29	\$2,500			\$74,882	\$4	\$13	\$351	\$104	\$5,399	\$63,901	\$5,111
2038	\$69,353	\$23,480	\$43,218	\$5,529	N/A	\$29	\$5,500			\$74,882	\$4	\$13	\$351	\$104	\$5,399	\$63,901	\$5,111
2039	\$72,353	\$22,893	\$43,775	\$2,529	N/A	\$29	\$2,500			\$74,882	\$3	\$13	\$351	\$104	\$5,399	\$63,901	\$5,111
2040	\$72,353	\$21,395	\$42,500	\$2,529	N/A	\$29	\$2,500			\$74,882	\$3	\$13	\$351	\$104	\$5,399	\$63,901	\$5,111
2041	\$72,353	\$19,995	\$41,262	\$2,529	N/A	\$29	\$2,500			\$74,882	\$3	\$13	\$351	\$104	\$5,399	\$63,901	\$5,111
2042	\$72,353	\$18,687	\$40,060	\$2,529	N/A	\$29	\$2,500			\$74,882	\$3	\$13	\$351	\$104	\$5,399	\$63,901	\$5,111
2043	(\$67,618)	(\$16,331)	(\$36,348)	\$142,500	N/A	\$29	\$142,500			\$74,882	\$3	\$14	\$351	\$104	\$5,399	\$63,901	\$5,111
<b>20 Year NPV</b>	<b>\$1,248,242</b>	<b>\$645,184</b>	<b>\$922,139</b>	<b>\$216,551</b>	<b>\$437,500</b>			<b>\$408,879</b>	<b>\$424,757</b>								
<b>BCR</b>	<b>2.85</b>	<b>1.58</b>	<b>2.17</b>														

Source: Economics Center calculations.



## Appendix C: Recreational Benefit Calculations

Calendar Year	Number of Riders	Recreation Benefits
2024	26	\$61,534
2025	26	\$61,534
2026	26	\$61,534
2027	26	\$61,534
2028	26	\$61,534
2029	26	\$61,534
2030	26	\$61,534
2031	26	\$61,534
2032	26	\$61,534
2033	26	\$61,534
2034	26	\$61,534
2035	26	\$61,534
2036	26	\$61,534
2037	27	\$63,901
2038	27	\$63,901
2039	27	\$63,901
2040	27	\$63,901
2041	27	\$63,901
2042	27	\$63,901
2043	27	\$63,901
<b>Total</b>		<b>\$1,247,255</b>

Source: Economics Center calculations using NCHRP Guidance.

## Appendix D: Health Benefit Calculations

Calendar Year	Total Number of Riders	Health Benefits
2024	26	\$4,921
2025	26	\$4,921
2026	26	\$4,921
2027	26	\$4,921
2028	26	\$4,921
2029	26	\$4,921
2030	26	\$4,921
2031	26	\$4,921
2032	26	\$4,921
2033	26	\$4,921
2034	26	\$4,921
2035	27	\$5,111
2036	27	\$5,111
2037	27	\$5,111
2038	27	\$5,111
2039	27	\$5,111
2040	27	\$5,111
2041	27	\$5,111
2042	27	\$5,111
2043	27	\$5,111
<b>Total</b>		<b>\$100,131</b>

Source: Economics Center calculations using NCHRP Guidance.