

# **BENEFIT-COST ANALYSIS**

# RECONNECTING KNOXVILLE RECONNECTING COMMUNITIES AND NEIGHBORHOODS (RCN) BENEFITS COST ANALYSIS NARRATIVE

## EXECUTIVE SUMMARY

The Benefit-Cost Analysis (BCA) for the proposed 9.0-mile RECONNECTING COMMUNITIES AND NEIGHBORHOODS (RCN) Reconnecting Knoxville multimodal connections project adheres to the National Cooperative Highway Research Program Report 552: Guidelines for Analysis of Investments in Bicycle Facilities (NCHRP 552) and the U.S. Department of Transportation’s (USDOT’s) Benefit-Cost Analysis Guidance for Discretionary Grant Programs (January 2023).

This BCA generally assumed that typical future design and engineering costs will be expended in 2024 (3 years before projects being open), that right-of-way & utility costs will be expended in 2025 (2 years before projects being open), and that construction and inspection costs will be expended in 2026 & 2027. Some of these projects have different expenditure dates based on project specific information.

It is also assumed that annual operations and maintenance costs will be 0.5% of total project construction expenditures or \$5,125,229 for 20 years (YOES) in accordance with the National Cooperative Highway Research Program and 2023 US DOT BCA Guidance which translates to \$256,261 (YOES) per year of the trail’s operation for the entire project.

The proposed \$64.2 million (2021\$) Reconnecting Knoxville multimodal connections projects will conservatively provide up to \$151.7 million (2021\$) in economic benefits (Exhibit 1). This results in a benefit-cost ratio of 2.36 when a 7 percent discount rate is applied to the costs for their estimated year of expenditures. The project is also expected to accumulate hard to estimate benefits in tourism and increased property values that are not included in this analysis.

|   | 7% Discount Rate |
|---|------------------|
| <b>Costs (2021 M\$)</b>                   |                  |
| Capital Cost                              | \$64.2           |
| <i>Total Costs</i>                        | \$64.2           |
| <b>Benefits (2021 M\$)</b>                |                  |
| <b>Equity Benefits</b>                    |                  |
| Access to Pedestrian & Bike Recreation    | \$21.1           |
| Access to Bike Commuting                  | \$13.8           |
| Sub-Total                                 | \$35.0           |
| <b>Mobility Benefits</b>                  |                  |
| Bike Commuter General                     | \$16.5           |
| Bike Commuter Stadium                     | \$0.9            |
| Ped & Bike Recreation                     | \$12.6           |
| Ped & Bike Recreation - Urban Wilderness  | \$16.1           |
| Ped & Bike Recreation - Stadium           | \$28.5           |
| Sub-Total                                 | \$74.6           |
| <b>Health Benefits</b>                    |                  |
| Ped & Bike Activity - Mortality Reduction | \$33.4           |
| Sub-Total                                 | \$33.4           |
| <b>Safety Benefits</b>                    |                  |
| Reduced Crashes                           | \$1.4            |
| Sub-Total                                 | \$1.4            |
| <b>Operational Benefits</b>               |                  |
| Residual Savings                          | \$7.4            |
| Sub-Total                                 | \$7.4            |
| <i>Total Benefits</i>                     | \$151.7          |
| <b>Outcome</b>                            |                  |
| <b>Net Present Value (2021 M\$)</b>       | <b>\$87.6</b>    |
| <b>Benefit-Cost Ratio</b>                 | <b>2.36</b>      |

BCA Workbook – “BCA” Worksheet

## BCA SUPPORT DOCUMENTS:

The development of this BCA Narrative included the preparation of workbooks in Microsoft Excel format that are referenced within this document. These workbooks are unlocked and will allow full evaluation of formulas and input used in this BCA. Below is a brief description of these workbooks that are available on the webpage for use of US DOT in the evaluation of the Reconnecting Knoxville grant application.

1. KCDC\_RCN\_BCA\_2023.xlsx
  - a. BCA WITH DISCOUNT
    - i. BCA Calculations with Capital Cost Total, BCR and NPV Total
    - ii. 7% Discount applied to benefits.
    - iii. Project BCR is based on this worksheet.
  - b. BCA NO DISCOUNT
    - i. BCA Calculations with Capital Cost Total, BCR and NPV Total
    - ii. No discount applied to benefits.
  - c. BCA\_CapitalCosts
    - i. Summary of Capital Cost valuations
  - d. PROJECT SUMMARY
    - i. Tables for Project Budget, Funding Sources, Schedule, Project Status
  - e. PROJECT SPENDING
    - i. Tables for Year-to-Year Project Spending and Spending Categories
  - f. CAPITAL INFLATION
    - i. Inflation Factors Used in the BCA NPV
  - g. TRIP GENERATION
    - i. Population Density and Bike and Pedestrian Daily Trip Calculations
    - ii. Includes summaries & calculation references and detail.
  - h. CRASH SUMMARY
    - i. Crash Rate Calculations using Crash Data from ETRIMS and Screening
  - i. EQUITY Ped & Bike
    - i. EQUITY Benefit Calculation for Induced Ped & Bike Recreation
    - ii. Induced Ped & Bike – Households wo Vehicle
  - j. EQUITY Bike Commuter
    - i. EQUITY Benefit Calculation for Induced Bike Commuting
    - ii. Induced Bike Commuting – Households wo Vehicle
  - k. MOBILITY Bike Commuter
    - i. MOBILITY Benefit Calculation for Induced Bike Commuting
    - ii. Induced Bike Commuting within 1.0 Mile of Project
  - l. MOBILITY Bike Commuter – STADIUM
    - i. MOBILITY Benefit Calculation for Induced Bike Commuting – Stadium
    - ii. Induced Bike Commuting – Stadium Residential Development
  - m. MOBILITY Ped & Bike
    - i. MOBILITY Benefit Calculation for Induced Ped & Bike Recreation
    - ii. Induced Ped & Bike Trips from living near Reconnecting Knoxville Project
  - n. MOBILITY Ped & Bike UW
    - i. MOBILITY Benefit Calculation for Induced Ped & Bike Recreation
    - ii. Induced Ped & Bike Trips from those visiting the Urban Wilderness
  - o. MOBILITY Ped & Bike – STADIUM
    - i. MOBILITY Benefit Calculation for Induced Ped & Bike Recreation
    - ii. Induced Ped & Bike Trips from those visiting the Stadium.
      1. Access Parking, Community Events, and Festivals

- p. SAFETY NOBUILD Crash
    - i. Existing Crash Rates within the 400 m buffer area
    - ii. NO BUILD Crash Cost Calculations on a year-by-year bases for 20 Years
  - q. SAFETY BUILD Crash Reduction
    - i. SAFETY Benefit Calculation based on Build vs No Build Comparison
    - ii. Predicted Crash Rates with the 400 m buffer area.
    - iii. BUILD Crash Cost Calculations on a year-by-year bases for 20 Years
  - r. HEALTH Mortality Reduction
    - i. HEALTH Benefit Calculation for Reduced Mortality for Induced Active Transportation Values
  - s. OPERATIONAL Residual
    - i. OPERATION Benefit Calculation for Reconnecting Knoxville Project Value after 20 Year Operations
    - ii. Asset Life Assumptions based on BEA Rate of Depreciation & Linear decline in value based on service life.
2. RCP PROJECT CRASH ANALYSIS.XLSX
- a. Crash Type and Severity
    - i. TABLE used for Crash Safety Benefit of the BCA
  - b. CRASH DATA – BASE
    - i. Screened Data from TDOT ETRIMS Crash Database
  - c. KNOXVILLE CRASH DATA
    - i. Spreadsheet from Knoxville Regional Transportation Planning Organization
    - ii. Bike Crash Rates based on population for the City of Knoxville
3. CENSUS DATA BASE ANALYSIS.XLSX
- a. CENSUS DATA
    - i. Data from US Census and American Community Survey
    - ii. Tables with General Census Data from Census Tracts around Reconnecting Knoxville
    - iii. Data from Census Tracts 1, 8, 19, 20, 21, 22, 23, 67, 68
  - b. NS INCOME
    - i. Data from US Census and American Community Survey SO802 Dataset
    - ii. Data from Census Tracts 1, 8, 19, 20, 21, 22, 23, 67, 68
    - iii. Table – Data used in Grant Narratives
  - c. NS AGE
    - i. Data from US Census and American Community Survey SO101 Dataset
    - ii. Data from Census Tracts 1, 8, 19, 20, 21, 22, 23, 67, 68
    - iii. Table – Data used in Grant Narratives
  - d. NS RACE
    - i. Data from US Census and American Community Survey PO1 Dataset
    - ii. Data from Census Tracts 1, 8, 19, 20, 21, 22, 23, 67, 68
    - iii. Table – Data used in Grant Narratives
  - e. PD01DATA
    - i. Base Data from US Census and American Community Survey PO1 Dataset
  - f. SO101 AGE DATA
    - i. Base Data from US Census and American Community Survey SO101 Dataset
  - g. DPO3DATA
    - i. Base Data from US Census and American Community Survey DPO3 Dataset
  - h. SO802DATA
    - i. Base Data from US Census and American Community Survey SO802 Dataset
  - i. BASE
    - i. DATA TABLE Used in BCA to Sort Commuter Data from SO802 Dataset.

**PROJECT BUDGET**

Total project costs were compiled from engineering budgets of projects in design phase, actual cost data of similar bike, pedestrian, and multimodal roadway facility projects in the area currently under construction or completed within the last three years. The breakdown of the project budgeted cost is included in the Reconnecting Knoxville RCN application narrative and summary tables of project costs and funding on the next few pages.

The Reconnecting Knoxville project includes 7 project elements and are described in the Grant Narrative in detail. The summary table below summarizes and includes the budgeted costs, funding amounts and categories, and schedule (YOES).

|                                    |                      | EAST KNOXVILLE GREENWAY               | FIRST CREEK AT AUSTIN HOMES BRIDGE & CONNECTOR | STADIUM/ OLD CITY CONNECTORS   | CULTURAL CORRIDOR & CONNECTORS (Summit Hill, Morningside, Hill, Dandridge) | SOUTH KNOXVILLE BRIDGE CONNECTOR | COTTRELL CONNECTOR | URBAN WILDERNESS GATEWAY PARK |
|------------------------------------|----------------------|---------------------------------------|--|--------------------------------|--|----------------------------------|--------------------|-------------------------------|
| <b>PROJECT LENGTH</b>              | <b>7 TRACT AREAS</b> | 20, 21, 67, 68                        | 67, 68   | 67, 68                         | 20, 68   | 8, 68                            | 8                  | 22, 23                        |
| LENGTH (miles)                     | 9.85                 | 2.4                                   | 1.3  | 0.5                            | 2.7  | 0.9                              | 0.9                | 1.2                           |
| LENGTH (feet)                      | 52,276               | 12,672                                | 6,864  | 2,640                          | 14,256   | 4,752                            | 5,041              | 6,051                         |
| <b>TOTAL</b>                       |                      | <b>PROJECT COSTS &amp; FUNDING</b>    |  |                                |  |                                  |                    |                               |
| <b>PROJECT COST</b>                | <b>85,652,090</b>    | <b>4,940,270</b>                      | <b>11,279,820</b>                              | <b>31,000,000</b>              | <b>10,550,000</b>  | <b>2,738,000</b>                 | <b>144,000</b>     | <b>25,000,000</b>             |
| NEPA & DESIGN                      | 6,118,440            | 490,270                               | 842,470  | 2,700,000                      | 1,075,000  | 410,700                          |                    | 600,000                       |
| ROW & UTILITY                      | 500,000              | 450,000                               |  | 50,000                         |  |                                  |                    |                               |
| CONSTRUCTION & CEI                 | 79,033,650           | 4,000,000                             | 10,437,350                                     | 28,250,000                     | 9,475,000  | 2,327,300                        | 144,000            | 24,400,000                    |
| <b>TOTAL FUNDING</b>               | <b>43,051,770</b>    | <b>4,940,270</b>                      | <b>4,370,000</b>                               | <b>21,000,000</b>              | <b>4,600,000</b>   | <b>1,997,500</b>                 | <b>144,000</b>     | <b>6,000,000</b>              |
| FEDERAL FUNDING                    | 4,750,216            | 3,952,216                             |  |                                |  | 798,000                          |                    |                               |
| STATE FUNDING                      | 950,000              |                                       |  |                                |  | 950,000                          |                    |                               |
| NON GOVERNMENT LOCAL FUNDING       | 5,614,000            |                                       | 870,000  |                                | 4,600,000  |                                  | 144,000            |                               |
| LOCAL FUNDING                      | 31,737,554           | 988,054                               | 3,500,000                                      | 21,000,000                     |  | 249,500                          |                    | 6,000,000                     |
| <b>PREVIOUSLY INCURRED AMOUNT</b>  | <b>460,810</b>       | <b>190,810</b>                        | <b>270,000</b>                                 | <b>0</b>                       | <b>0</b>   | <b>0</b>                         | <b>0</b>           | <b>0</b>                      |
| <b>UNFUNDED AMOUNT</b>             | <b>42,600,320</b>    | <b>0</b>                              | <b>6,909,820</b>                               | <b>10,000,000</b>              | <b>5,950,000</b>   | <b>740,500</b>                   | <b>0</b>           | <b>19,000,000</b>             |
| <b>FUNDING STATUS</b>              |                      | <b>PROJECT PHASE - FUNDING STATUS</b> |  |                                |  |                                  |                    |                               |
| CURRENT PHASE TIP / FUNDING STATUS |                      | NEPA FUNDED                           | DESIGN PARTIALLY FUNDED                        | NEPA - DESIGN PARTIALLY FUNDED | PROGRAMMING PARTIALLY FUNDED   | NEPA PARTIALLY FUNDED            | DESIGN FUNDED      | DESIGN PARTIALLY FUNDED       |
| <b>PROJECT SCHEDULE</b>            |                      | <b>PROJECT SCHEDULE</b>               |  |                                |  |                                  |                    |                               |
| YR PROJECT FUNDED                  |                      | 2019 GRANT                            | Partial + 2023 RCN Request                     | Partial + 2023 RCN Request     | Partial + 2023 RCN Request   | Partial + 2023 RCN Request       | 2023               | Partial + 2023 RCN Request    |
| NEPA                               | 2022                 |                                       | 2023   | 2024                           | 2024   | 2024                             | N/A                | 2021                          |
| DESIGN                             | 2024                 |                                       | 2024   | 2024                           | 2025   | 2024                             | 2023               | 2024                          |
| ROW                                | 2024                 |                                       | 2023   | 2024                           | 2025   | 2024                             | 2023               | 2025                          |
| CONSTRUCTION BID                   | 2025                 |                                       | 2025   | 2025                           | 2026   | 2025                             | 2024               | 2026                          |
| CONSTRUCTION COMPLETE              | 2026                 |                                       | 2026   | 2026                           | 2027   | 2026                             | 2024               | 2027                          |

BCA Workbook – "PROJECT SUMMARY" Worksheet



**RECONNECTING KNOXVILLE PROJECT ELEMENTS & SPENDING BY YEAR (YOE\$)**

| PROJECT DESCRIPTION  | COST              | NEPA & DESIGN    | ROW & UTILITY  | CONSTRUCTION      | CONSTRUCTION DETAIL SUMMARY |                          |                          | SPENDING SUMMARY BY YEAR |                |                  |                   |                   |                   |
|--|-------------------|------------------|----------------|-------------------|-----------------------------|--------------------------|--------------------------|--------------------------|----------------|------------------|-------------------|-------------------|-------------------|
|  |                   |                  |                |                   | CONSTRUCTION ONLY           | CONSTRUCTION CONTINGENCY | CONSTRUCTION ENGINEERING | 2022                     | 2023           | 2024             | 2025              | 2026              | 2027              |
| EAST KNOXVILLE GREENWAY  | 4,940,270         | 490,270          | 450,000        | 4,000,000         | 3,200,000                   | 400,000                  | 400,000                  | 190,810                  |                | 749,460          | 2,000,000         | 2,000,000         | 0                 |
| FIRST CREEK AT AUSTIN HOMES BRIDGE & CONNECTOR                             | 11,279,820        | 842,470          | 0              | 10,437,350        | 8,349,880                   | 1,043,735                | 1,043,735                | 120,000                  | 150,000        | 722,470          | 5,143,675         | 5,143,675         | 0                 |
| STADIUM / OLD CITY CONNECTORS  | 31,000,000        | 2,700,000        | 50,000         | 28,250,000        | 22,600,000                  | 2,825,000                | 2,825,000                |                          |                | 2,750,000        | 14,125,000        | 14,125,000        |                   |
| CULTURAL CORRIDOR & CONNECTORS (Summit Hill, Morningside, Hill, Dandridge) | 10,550,000        | 1,075,000        | 0              | 9,475,000         | 7,580,000                   | 947,500                  | 947,500                  |                          |                | 161,250          | 4,072,083         | 3,158,333         | 3,158,333         |
| SOUTH KNOXVILLE BRIDGE CONNECTOR   | 2,738,000         | 410,700          | 0              | 2,327,300         | 1,861,840                   | 232,730                  | 232,730                  |                          |                | 410,700          | 1,163,650         | 1,163,650         |                   |
| COTTRELL GREENWAY  | 144,000           | 0                | 0              | 144,000           | 115,200                     | 14,400                   | 14,400                   |                          |                | 144,000          |                   |                   |                   |
| URBAN WILDERNESS GATEWAY PARK  | 25,000,000        | 600,000          | 0              | 24,400,000        | 19,520,000                  | 2,440,000                | 2,440,000                |                          |                | 600,000          |                   | 12,200,000        | 12,200,000        |
| <b>TOTAL</b>   | <b>85,652,090</b> | <b>6,118,440</b> | <b>500,000</b> | <b>79,033,650</b> | <b>63,226,920</b>           | <b>7,903,365</b>         | <b>7,903,365</b>         | <b>310,810</b>           | <b>150,000</b> | <b>5,537,880</b> | <b>26,504,408</b> | <b>37,790,658</b> | <b>15,358,333</b> |

BCA Workbook – "PROJECT SPENDING" Worksheet

**PROJECT SPENDING SUMMARY BY YEAR & COST TYPE 2021\$ & YOE\$**

| YEAR                                    | COSTS (2021\$) |             |           |         |              |             |  | COSTS (YOE\$) |             |           |         |              |             |             |  |
|---|----------------|-------------|-----------|---------|--------------|-------------|--|---------------|-------------|-----------|---------|--------------|-------------|-------------|--|
|   | NEPA           | DESIGN      | ROW       | UTILITY | CONST        | CEI         | CONTINGENCY                            | NEPA          | DESIGN      | ROW       | UTILITY | CONST        | CEI         | CONTINGENCY |  |
| 2022                                    | \$45,738       | \$259,179   |           |         |              |             |  | \$46,622      | \$264,189   |           |         |              |             |             | PREVIOUS DESIGN<br>PREVIOUS CONSTRUCTION           |
| 2023                                    |                |             |           |         | \$115,493    | \$14,437    | \$14,437                               |               |             |           |         | \$120,000    | \$15,000    | \$15,000    |  |
| 2024                                    | \$199,743      | \$3,795,121 |           |         |              |             |  | \$244,694     | \$4,649,186 |           |         |              |             |             | FUTURE DESIGN<br>FUTURE ROW<br>FUTURE CONSTRUCTION |
| 2024                                    |                |             | \$408,149 |         |              |             |  |               |             | \$500,000 |         |              |             |             |  |
| 2024                                    |                |             |           |         | \$94,038     | \$11,755    | \$11,755                               |               |             |           |         | \$115,200    | \$14,400    | \$14,400    | FUTURE DESIGN<br>FUTURE CONSTRUCTION               |
| 2025                                    | \$34,855       | \$662,241   |           |         |              |             |  | \$45,688      | \$868,063   |           |         |              |             |             |  |
| 2025                                    |                |             |           |         | \$15,618,393 | \$1,952,299 | \$1,952,299                            |               |             |           |         | \$20,472,527 | \$2,559,066 | \$2,559,066 | FUTURE CONSTRUCTION<br>FUTURE CONSTRUCTION         |
| 2026                                    |                |             | \$0       |         |              |             |  |               |             |           |         |              |             |             |  |
| 2026                                    |                |             |           |         | \$21,555,374 | \$2,694,422 | \$2,694,422                            |               |             |           |         | \$30,232,527 | \$3,779,066 | \$3,779,066 | FUTURE CONSTRUCTION<br>FUTURE CONSTRUCTION         |
| 2027                                    |                |             |           |         | \$8,187,125  | \$1,023,391 | \$1,023,391                            |               |             |           |         | \$12,286,667 | \$1,535,833 | \$1,535,833 |  |
| <b>PREVIOUS INCURRED COSTS (2021\$)</b> |                |             |           |         |              |             | <b>PREVIOUS INCURRED COSTS (YOE\$)</b> |               |             |           |         |              |             |             |  |
|   | NEPA           | DESIGN      | ROW       | UTILITY | CONST        | CEI         | CONTINGENCY                            | NEPA          | DESIGN      | ROW       | UTILITY | CONST        | CEI         | CONTINGENCY |  |
|   | \$45,738       | \$259,179   | \$0       | \$0     | \$115,493    | \$14,437    | \$14,437                               | \$46,622      | \$264,189   | \$0       | \$0     | \$120,000    | \$15,000    | \$15,000    |  |
| <b>FUTURE PROJECT (2021\$)</b>          |                |             |           |         |              |             | <b>FUTURE PROJECT (YOE\$)</b>          |               |             |           |         |              |             |             |  |
|   | \$234,598      | \$4,457,361 | \$408,149 | \$0     | \$45,454,929 | \$5,681,866 | \$5,681,866                            | \$290,382     | \$5,517,249 | \$500,000 | \$0     | \$63,106,920 | \$7,888,365 | \$7,888,365 |  |

BCA Workbook – "BCA\_CapitalCosts" Worksheet

**PROJECT SPENDING SUMMARY**

| <b>SPENDING SUMMARY</b>             |                     |                     |
|-------------------------------------|---------------------|---------------------|
| <b>PREVIOUSLY INCURRED SPENDING</b> | <b>YOES</b>         | <b>2021\$</b>       |
| CONSTRUCTION                        | \$150,000           | \$144,366           |
| ROW                                 | \$0                 | \$0                 |
| UTILITIES                           | \$0                 | \$0                 |
| DESIGN                              | \$264,189           | \$259,179           |
| NEPA                                | \$46,622            | \$45,738            |
| <b>TOTAL INCURRED</b>               | <b>\$460,810</b>    | <b>\$449,283</b>    |
| <b>FUTURE PROJECT SPENDING</b>      | <b>YOES</b>         | <b>2021\$</b>       |
| CONSTRUCTION                        | \$63,106,920        | \$45,454,929        |
| ROW                                 | \$500,000           | \$408,149           |
| UTILITIES                           | \$0                 | \$0                 |
| NEPA & DESIGN                       | \$5,807,630         | \$4,691,959         |
| CONST ENGINEERING (10%)             | \$7,888,365         | \$5,681,866         |
| CONST CONTINGENCIES (10%)           | \$7,888,365         | \$5,681,866         |
| 20 YR MAINTENANCE                   | \$5,125,229         | \$1,809,011         |
| <b>TOTAL FUTURE</b>                 | <b>\$90,316,509</b> | <b>\$63,727,780</b> |

BCA Workbook – “BCA\_CapitalCosts” Worksheet

**PROJECT BUDGET (YOES):**

- Project Costs: \$85,652,090
- Local Funding (includes State Only Funding) \$38,301,554
- Total Funding: \$43,051,770
- Unfunded Project: \$42,600,320

**PROJECT SPENDING:**

It is assumed that typical future design and engineering costs will be expended in 2024 (3 years before projects being open), that right-of-way & utility costs will be expended in 2025 (2 years before projects being open), and that construction and inspection costs will be expended in 2026 & 2027. Some of these projects have different expenditure dates based on project specific information.

It is also assumed that annual operations and maintenance costs will be 0.5% of total project construction expenditures or \$5,125,229 for 20 years (YOES) in accordance with the National Cooperative Highway Research Program and 2023 US DOT BCA Guidance which translates to \$256,261 (YOES) per year of the trail’s operation for the entire 9.0-mile project.

Project Element Year by Year (YOES) expenditures are detailed in the table titled “PROJECT SPENDING SUMMARY BY YEAR (YOES)” on the previous page and in the BCA Workbook on the “BCA CapitalCosts” and “PROJECT SPENDING” worksheets. Previous vs Future Spending Summary is included in the table above titled “SPENDING SUMMARY” and is included in the BCA Workbook on the “BCA\_CapitalCosts” worksheet.



## PROJECT BENEFITS

This BCA uses trip generation methods found in the National Cooperative Highway Research Program Report 552 (NCHRP 552) - Measuring and Forecasting Demand - "Guidelines for Analysis of Investments in Bicycle Facilities." This methodology assumes that the project will induce trips based on the distance Reconnecting Knoxville project is from potential users or households. This BCA used population density using census tracts where the project is located and established areas around the project at 200 M, 400 M, 600 M, 800 M, and 1,600 M (M = meters) as provided by the NCHRP 552. These buffer areas established influence zones where differential factors can be applied in establishing the number of induced Walk and Bike Trips. This methodology uses the "Base Commute Rate" C as a base rate for calculating the proximal effect of the project on trip generation. Below are input tables found in the BCA workbook on worksheet "TRIP GENERATION."

### CENSUS TRACT POPULATION SUMMARY AND OVERALL PROJECT POPULATION DENSITY

| CENSUS TRACTS AFFECTED BY PROJECT |                               |                       |                    |                                    |  |
|-----------------------------------|-------------------------------|-----------------------|--------------------|------------------------------------|--|
| CENSUS TRACT #                    | TOTAL CENSUS TRACT POPULATION | TRACT AREA (SQ MILES) | TRACT AREA (SQ KM) | POPULATION DENSITY (POP / SQ MILE) | POPULATION DENSITY (POP / SQ KM)       |
| 1                                 | 2,907                         | 0.59                  | 1.53               | 4,927                              | 1,902                                  |
| 8                                 | 3,502                         | 1.13                  | 2.93               | 3,099                              | 1,197                                  |
| 19                                | 1,555                         | 0.85                  | 2.20               | 1,829                              | 706                                    |
| 20                                | 3,114                         | 0.93                  | 2.41               | 3,348                              | 1,293                                  |
| 21                                | 2,857                         | 3.51                  | 9.09               | 814                                | 314                                    |
| 22                                | 3,658                         | 2.76                  | 7.15               | 1,325                              | 512                                    |
| 23                                | 3,261                         | 1.93                  | 5.00               | 1,690                              | 652                                    |
| 67                                | 2,922                         | 1.10                  | 2.85               | 2,656                              | 1,026                                  |
| 68                                | 4,483                         | 1.40                  | 3.63               | 3,202                              | 1,236                                  |
|                                   | <b>28,259</b>                 |                       | <b>36.78</b>       |                                    | <b>768.37</b>                          |
|                                   |                               |                       |                    |                                    | <b>PROJECT AREA POPULATION DENSITY</b> |

BCA Workbook – "TRIP GENERATION" Worksheet

### BUFFER AREA SUMMARY WITH CALCULATED DAILY PEDESTRIAN AND BIKE TRIPS

| PROJECT BUFFER AREAS |  |       |       |       |        |         |
|----------------------|--|-------|-------|-------|--------|---------|
| TOTAL BUFFER AREA    | BUFFER WIDTH (M)                         | 200 M | 400 M | 600 M | 800 M  | 1,600 M |
| 22.51                | AREA OF EACH BUFFER (KM <sup>2</sup> )   | 4.570 | 3.700 | 4.100 | 4.715  | 5.422   |
|                      | Number of Pedestrians                    | 779   | 336   | 327   | 259    | 298     |
|                      | Number of Bicyclists                     | 209   | 122   | 135   | 102    | 85      |
|                      | Population within Buffer Area            | 3,511 | 2,843 | 3,150 | 3,623  | 4,166   |
|                      | Cumulative Population within Buffer Zone | 3,511 | 6,354 | 9,505 | 13,128 | 17,294  |

BCA Workbook – "TRIP GENERATION" Worksheet

### BUFFER AREA INDUCED USAGE FACTOR TABLE

| DISTANCE FROM FACILITY |            | TOTAL TRIP GENERATION TABLE INPUTS |        |                 |                         |
|------------------------|------------|------------------------------------|--------|-----------------|-------------------------|
| ONE SIDE               | BOTH SIDES | WALK %                             | BIKE % | Adult %         |                         |
| 200 M                  | 400 M      | 22.18%                             | 5.95%  | 82%             | Based on 2020 Census    |
| 400 M                  | 800 M      | 11.84%                             | 4.28%  | Bike Commuter % | Base Commute Rate ( C ) |
| 600 M                  | 1,200 M    | 10.37%                             | 4.28%  | 2.03%           |                         |
| 800 M                  | 1,600 M    | 7.16%                              | 2.82%  | Walk Commuter % | Base Commute Rate ( C ) |
| 1,600 M                | 3,200 M    | 7.16%                              | 2.03%  | 7.16%           |                         |
| BASE DAILY TRIPS       |            | 1,999                              | 652    |                 |                         |

NCHRP 552 - Measuring and Forecasting Demand - "Guidelines for Analysis of Investments in Bicycle Facilities" 2006

BCA Workbook – "TRIP GENERATION" Worksheet

Total pedestrian (walk) trips 1,999 and bike trips are 652 are calculated using the base bike commuter rate of 2.03% ( C ) as detailed in the NCHRP 552 multiplied by a distance factor. The factors are summarized in the "Buffer Area Induced Usage Factor Table." The total trips for pedestrians and bikes for each buffer zone are calculated and listed in the "Buffer Area Summary with Calculated Daily Pedestrian and Bike Trips" table above.

Many of the benefit valuations are based on these base trip measurements. The benefit sections that follow detail the number of trips used and the benefit valuation in 2021\$ for each benefit used in this BCA.



## EQUITY BENEFITS

### Access to Recreation Opportunities - Pedestrian & Bike Facility Benefit

Knoxville has 92,471 working households. The 2021 American Community Survey S0802 that focuses on “Transportation to Work by Selected Characteristics.” This data indicates that 3.3% or 3,051 households within the City of Knoxville do not have access to a vehicle for transportation. These households significantly benefit from active transportation investments to improve access to employment as well as recreation.

Inside an area within 1.0 mile (1,600 meters) of the Reconnecting Knoxville multimodal connection projects, 20.0% of households do not have access to a vehicle (see summary table below). This project is generally located in an area that has nearly 7 times the City of Knoxville rate for working households without a vehicle. The mobility aspect being a Bike Commuter is reflected in a separate benefit analysis for this population. However, the utilization of a Bike for commuting purposes will provide a means to enjoy the Reconnecting Knoxville project for recreation. This means that based on the population density found within 1.0 mile (1,600 meters) of the Reconnecting Knoxville project that 3,461 working households without a vehicle will gain readily available access to the recreation opportunities created by walking, and biking. It is assumed that 100% of these households will use the project on average 2 walking trips a day (6,923 trips) (see table below). It is also assumed that the Bike Commuter rate of 2.03% of these households will ride a bike 2 trips a day for recreation. Reconnecting Knoxville will be providing safe connectivity to critical destinations such as downtown, shopping, restaurants, Stadium, the Urban Wilderness, Community Events, and Festivals.

| WITHIN A 1.0 MILE OF THE PROJECT    | POPULATION OF AREA | % WITHOUT VEHICLE | # HOUSEHOLDS | # of Trips (2 Trips / Household) |
|-------------------------------------|--------------------|-------------------|--------------|----------------------------------|
| HOUSEHOLDS WITHOUT A VEHICLE (HWOV) | 17,294             | 20.02%            | 3,461        | 6,923                            |

BASED ON USDOT ETC EXPLORER TRACT SUMMARY

| WITHIN A 1.0 MILE OF THE PROJECT | HOUSEHOLDS | % Bike to Commute | NEW BIKE COMMUTERS | # of Trips (2 Trips / Household) |
|----------------------------------|------------|-------------------|--------------------|----------------------------------|
| HWOV - NEW BIKE COMMUTERS        | 3,461      | 2.03%             | 70.3               | 141                              |

The USDOT Equitable Transportation Community Explorer was used to determine that 20% of households in the project area do not have a vehicle (see summary below).

| SUMMARY OF USDOT EQUITY EXPLORER TRACTS WITHIN PROJECT AREA |                  |                     |                              |
|---|------------------|---------------------|------------------------------|
| USDOT EQUITY EXPLORER TRACTS                                | TRACT POPULATION | % WITHOUT A VEHICLE | POPULATION WITHOUT A VEHICLE |
| 47093006800   | 4,500            | 49.20%              | 2,214                        |
| 47093002200   | 4,000            | 5.10%               | 204                          |
| 47093000800   | 4,000            | 9.30%               | 372                          |
| 47093002100   | 3,100            | 10.30%              | 319                          |
| 47093002000   | 2,700            | 20.50%              | 554                          |
| PROJECT AREA POP W/O A VEHICLE                              | 18,300           | 20%                 | 3,663                        |

The trips calculated for this recreation benefit is in addition to the trips calculated in the Mobility Benefit for other population segments included in this BCA. This Equity benefit was calculated using the National Cooperative Highway Research Program methodology. This benefit totals a Net Present Value of \$21,116,600 (2021\$) over 20-years using a 7 percent discount rate.

See the “EQUITY Ped & Bike” worksheet of the BCA spreadsheet.

## Access to Bike Commuting - Bike Commuter Mobility Benefit

Households without a vehicle uniquely benefit from having safe connections to work because they currently utilize existing infrastructure without the benefit of separated, safe, and well-connected multimodal paths. Reconnecting Knoxville project will provide working households within 1.0 mile (1,600 meters) a unique and new connection to abundant work, recreation, shopping, and leisure activities.

Based on data from Knoxville Regional Planning Organization, 2.03% bike commuter rate in Knoxville. Since the area within 1.0 mile of the project is disadvantaged with high levels of poverty it is assumed that twice as many commuter / utilitarian trips will be made by these households.

Bicyclists are willing to travel additional distances to avoid biking in traffic. The National Cooperative Highway Research Program finds that bicyclists are willing to travel up to 20.38 additional minutes (valued at \$12) to use an off-street bike path if one is available instead of the shortest path in mixed traffic.

The USDOT Equitable Transportation Community Explorer was used to determine that 20% of households in the project area do not have a vehicle (see summary below).

| SUMMARY OF USDOT EQUITY EXPLORER TRACTS WITHIN PROJECT AREA |                  |                     |                              |
|---|------------------|---------------------|------------------------------|
| USDOT EQUITY EXPLORER TRACTS                                | TRACT POPULATION | % WITHOUT A VEHICLE | POPULATION WITHOUT A VEHICLE |
| 47093006800   | 4,500            | 49.20%              | 2,214                        |
| 47093002200   | 4,000            | 5.10%               | 204                          |
| 47093000800   | 4,000            | 9.30%               | 372                          |
| 47093002100   | 3,100            | 10.30%              | 319                          |
| 47093002000   | 2,700            | 20.50%              | 554                          |
| PROJECT AREA POP W/O A VEHICLE                              | 18,300           | 20%                 | 3,663                        |

The BCA assumes that 2.03% (Commuting Bike Rate in Knoxville) of working households without a vehicle within 1.0 mile of the project was used to determine will be induced to ride to work. This corresponds to 70 new bike commuters in the 1.0-mile (1,600 meter) area around project.

| WITHIN A 1.0 MILE OF THE PROJECT    | POPULATION OF AREA | % WITHOUT VEHICLE | # HOUSEHOLDS | # of Trips (2 Trips / Household) |
|-------------------------------------|--------------------|-------------------|--------------|----------------------------------|
| HOUSEHOLDS WITHOUT A VEHICLE (HWOV) | 17,294             | 20.02%            | 3,461        | 6,923                            |

| WITHIN A 1.0 MILE OF THE PROJECT | HOUSEHOLDS |       | NEW BIKE COMMUTERS | # of Trips (2 Trips / Household) |
|----------------------------------|------------|-------|--------------------|----------------------------------|
| HWOV - NEW BIKE COMMUTERS        | 3,461      | 2.03% | 70.3               | 141                              |

The trips calculated for this bike commuting benefit is in addition to the trips calculated in the Mobility Benefit for other population segments included in this BCA.

This Equity benefit using the National Cooperative Highway Research Program methodology. This benefit totals a Net Present Value of \$13,844,135 (2021\$) over 20-years using a 7 percent discount rate.

See the "EQUITY Bike Commuter" worksheet of the BCA spreadsheet.

## MOBILITY BENEFITS

### Bike Commuter Mobility Benefit – Induced Use – Reconnecting Knoxville Project

Bicyclists are willing to travel additional distances to avoid biking in traffic. The National Cooperative Highway Research Program finds that bicyclists are willing to travel up to 20.38 additional minutes (valued at \$12) to use an off-street bike path if one is available instead of the shortest path in mixed traffic. Currently, 2.03% percent of commuters in the 1.0 mile radii of the Reconnecting Knoxville projects bike to work. This corresponds to about 334 existing bike commuters in the 1.0-mile radii of projects are expected to be added because of these projects being built.

This Mobility benefit for bike commuters totals a Net Present Value of \$ \$16,455,460 (2021\$) over 20-years using a 7 percent discount rate.

See the “MOBILITY Bike Commuter” worksheet of the BCA spreadsheet.

### Bike Commuter Mobility Benefit – Stadium Residential Development

The Stadium project includes the private construction of 466 residential units. These residential units are likely to attract people that want to live and work in the Downtown area and will have a higher likelihood of using active transportation.

| STADIUM - BIKE COMMUTER TRIPS                    |                 |        |                        |
|--|-----------------|--------|------------------------|
| TRIP DESCRIPTION                                 | # of Households | USER % | TRIPS (2 Trips / User) |
| RESIDENTIAL BIKE COMMUTERS - STADIUM DEVELOPMENT | 466             | 2.03%  | 18.9                   |

Commuter % Based on 2020 Census

BCA Workbook – “TRIP GENERATION” Worksheet

Using the Bike Commuter rate of 2.03% these residential units will generate 18.9 Bike Commuter Trips.

The National Cooperative Highway Research Program methods provide that a benefit for every commuter trip of \$12 can be applied.

This Mobility benefit for bike commuters totals a Net Present Value of \$931,909 (2021\$) over 20-years using a 7 percent discount rate.

See the “MOBILITY Bike Commuter STADIUM” worksheet of the BCA spreadsheet.

### Pedestrian & Bike Facility Benefit – Induced Use – Reconnecting Knoxville Project

This BCA assumes that the Reconnecting Knoxville projects provide new and improved connectivity to the existing transportation network. These improvements improve the quality or comfort of the journeys made by active transportation users (pedestrians, public transport, and cyclists). The 2023 US DOT BCA Guidance for Discretionary Grant Programs provides methodology for assessing the monetary value of each trip for pedestrian and bike facility “amenity” benefits.

US DOT Methods for evaluation of a new or improved pedestrian and bike facility includes projects that increase safety, level of service, and comfort primary through widening an existing sidewalk or creation of a new active transportation corridor. The US DOT BCA Guidance provides Table A-8 and A-9 that this BCA used in calculating the value of pedestrian and bicycle preference values. This BCA used the total induced trips for both pedestrians and bikes as this facility provides connectivity and levels of service not provided for by any nearby facilities. The value of \$0.11 / person mile / per ft of sidewalk width (Typical 10 ft wide) walked (up to 0.86 miles) and \$1.42 / cycling mile (up to 2.38 miles) are used in the valuation calculations as required the US DOT BCA Guidance in tables A-8 and A-9.

The Mobility benefit for the bike and pedestrian users who live nearby the Reconnecting Knoxville projects \$12,599,401 (2021\$) for the 20-year life of the project.

See the “MOBILITY Ped & Bike” worksheet of the BCA spreadsheet.

## Pedestrian & Bike Facility Benefit – Urban Wilderness Connection

South Knoxville’s 1,000 Acre Urban Wilderness is home to 42 miles of trail and is located just 2.2 miles from Downtown Knoxville. The Howard Baker Jr. Center for Public Policy prepared a whitepaper on the “Economic Potential of South Knoxville’s Urban Wilderness” in June 2015. This report noted that “Few cities outside the Rocky Mountain region have trail systems or bike parks within 10 miles of downtown with as many trail miles as the Urban Wilderness.” The Reconnecting Knoxville project will provide a vital link from the Urban Wilderness to downtown Knoxville, shopping, restaurants, and the Smokies Stadium venue. It also will allow those that live near the Reconnecting Knoxville project access to the benefits of the Urban Wilderness.

The Howard Baker Economic Report estimates that the Urban Wilderness will generate 260,070 bike user days annually or 713 bike trips per day as a local amenity trail system. The report estimates that the average user will spend \$32.03 per day. “The proximity of the Urban Wilderness to the downtown commercial district suggests trail use expenditures will be larger than other areas...” The report also indicates that “moving the Urban Wilderness from a local amenity to a regional and perhaps national destination will also require the city, county, and state level government investments to improve facilities, expand trail opportunities, and promote the area.”

| URBAN WILDERNESS - MODE SPLIT |      |                                  |
|-------------------------------|------|----------------------------------|
| 15.2%                         | 6.57 | Pedestrian - Walk, Hike, Running |
| 84.8%                         | 713  | Bikes                            |
| 100.0%                        | 720  | Total                            |

American Trails - Webinar - UT Professor Gene Fitzhugh- Presentation about the Urban Wilderness Trail 2020 Trail Count - Survey

BCA Workbook – “Trip Generation” Worksheet

Using data collected by UT Professor Gene Fitzhugh this BCA applied a 15.2%/84.8% modal split for pedestrians and bikes to the 713 bike and 6.57 pedestrian daily trips generated by the Urban Wilderness in accordance with the Howard Baker report.

The BCA assumes the visitors who use the Urban Wilderness trail using a bike will also use the Reconnect Knoxville project to access recreation and shopping opportunities referenced in the report that will equate to 713 bike trips per day. This conservative assumption doesn’t include how many induced bike trips from the Downtown areas will use the project to access the Urban Wilderness and will likely be much more than 713 trips a day. The round-trip mileage of 5 miles was used as the average trip distance because the distance from the Baker Creek trailhead to either Downtown Knoxville or Knoxville Stadium or heart of the project area is 2.5 miles.

The BCA assumes that 15.2 % of the visitors using the Urban Wilderness (pedestrian) based on the 2020 UT Urban Wilderness visitor counts at Baker Creek connect to the proposed Reconnecting Knoxville project. This equates to 6.57 daily pedestrian trips using both the Urban Wilderness trail and the Reconnect Knoxville project to access recreation and shopping opportunities referenced in the Howard Baker Report. This conservative assumption doesn’t include how many induced pedestrian trips from the Downtown areas will use the project to access the Urban Wilderness and will likely be much more than 6.57 trips a day.

The Mobility benefit for the bike and pedestrian users of the Urban Wilderness connection is \$16,133,032 (2021\$) for the 20-year life of the project.

See the “MOBILITY Ped & Bike UW” worksheet of the BCA spreadsheet.



## Pedestrian & Bike Facility Benefit – Smokies Stadium Connection

The Stadium project will include the building of parking to support the residents and tenants who live and work in the privately financed apartments, townhouses and offices that would be built near the stadium. There are nearly 7,700 public parking spaces within a 10-minute walk to the Stadium with 15,000 parking spaces in garages and surface lots within a 20-minute walk. Reconnecting Knoxville project will provide walkable, greenway-connected, and transit-friendly infrastructure that will support the economic success of the Stadium.

The Stadium project includes the private construction of 466 residential units. These residential units are likely to attract people that want to live and work in the Downtown area and will have a higher likelihood of using active transportation.

| STADIUM - BIKE AND RECREATION TRIPS |                 |        |                        |
|-------------------------------------|-----------------|--------|------------------------|
| TRIP DESCRIPTION                    | # of Households | USER % | TRIPS (2 Trips / User) |
| RESIDENTIAL WALKING COMMUTER        | 466             | 7.16%  | 66.7                   |
| RESIDENTIAL WALKING                 | 466             | 22.18% | 103.4                  |

Commuter % Based on 2020 Census Ridership  
Induced Walking % from NCHRP 552 200M Buffer

| TRIP DESCRIPTION | DAILY PARKING | %      | TRIPS (2 Trips / User) |
|------------------|---------------|--------|------------------------|
| VENUE - WALKING  | 958           | 50.00% | 958.0                  |

PARKING GARAGE AT 50% OCCUPANCY-  
KNOX COUNTY MULTI USE STADIUM TAX REVENUE AND ECONOMIC IMPACT  
ANALYSIS - TO USE PROJECT CONNECTION

| TRIP DESCRIPTION                                 | # of Households | USER % | TRIPS (2 Trips / User) |
|--|-----------------|--------|------------------------|
| RESIDENTIAL BIKE                                 | 466             | 5.95%  | 55.5                   |
| RESIDENTIAL BIKE COMMUTERS - STADIUM DEVELOPMENT | 466             | 2.03%  | 18.9                   |

Induced Biking % from NCHRP 552 200M Buffer  
Commuter % Based on 2020 Census Ridership

BCA Workbook – “TRIP GENERATION” Worksheet

This BCA uses the average bike and walk commuter rates from the 2020 US Census American Community Survey Data for the Reconnecting Knoxville project of 7.16% and 2.03% respectively. This residential housing development will generate 18.9 bike trips and 66.7 walk trips per day. Commuter bike trip benefits are not included in this section. See the BCA worksheet “TRIP GENERATION” for these calculations.

The NCHRP 552 provides a methodology for predicting bike and walk trip generation that provides higher rates of use for active transportation the closer a household is to a multimodal facility. The Stadium residences are closer than 200 meters from the Reconnecting Knoxville project and will generate 103.4 daily pedestrian trips (22.18% of households) and 55.5 bike trips (5.95% of households).

There are 958 average daily walking trips will use the project to access the Stadium event venue utilizing the City’s parking garages at 50% occupancy as per the Stadium’s economic impact and tax revenue analysis.

The Mobility benefit for the bike and pedestrian users who live in the Stadium housing that is nearby the Reconnecting Knoxville projects is \$28,476,767 (2021\$) for the 20-year life of the project.

See the “MOBILITY Ped & Bike STADIUM” worksheet of the BCA spreadsheet for benefit calculations.

## HEALTH

A study referenced in NCHRP 552 demonstrates a more physically active population will enjoy lower health care costs or “reduced mortality.” NCHRP 552 and US DOT provide methods for monetizing the annual per-capita cost savings from increased physical activity specifically created by the increased bicyclists and walkers expected to use the Reconnecting Knoxville projects.

This BCA uses a method detailed in the 2023 US Department of Transportation’s BCA Guidance for Discretionary Grant Programs for valuation of the health benefit of active transportation modes for this project. The method allows for all induced active transportation modes be included. We used NCHRP 552 methods to determine the induced trip demands using buffer areas at 200, 400, 600, 800, and 1,600 meters from our projects for bicyclists and walkers.

| DISTANCE FROM FACILITY  |            | TOTAL                        |            |                        |
|-------------------------|------------|------------------------------|------------|------------------------|
| ONE SIDE                | BOTH SIDES | TRIP GENERATION TABLE INPUTS |            |                        |
|                         |            | WALK %                       | BIKE %     | Adult %                |
| 200 M                   | 400 M      | 22.18%                       | 5.95%      | 82%                    |
| 400 M                   | 800 M      | 11.84%                       | 4.28%      | <b>Bike Commuter %</b> |
| 600 M                   | 1,200 M    | 10.37%                       | 4.28%      | 2.03%                  |
| 800 M                   | 1,600 M    | 7.16%                        | 2.82%      | <b>Walk Commuter %</b> |
| 1,600 M                 | 3,200 M    | 7.16%                        | 2.03%      | 7.16%                  |
| <b>BASE DAILY TRIPS</b> |            | <b>1,999</b>                 | <b>652</b> |                        |

NCHRP 552 - Measuring and Forecasting Demand - "Guidelines for Analysis of Investments in Bicycle Facilities" 2006

BCA Workbook – “TRIP GENERATION” Worksheet

The age range for this benefit calculation varies due to a statistical decline in bike use for users between 64 and 74. This benefit methodology allows for benefits due from walking for the age range of 20 to 64 and biking age range from 20 to 74.

| AGE DISTRIBUTION SUMMARY                |            |       |                |
|---|------------|-------|----------------|
| CENSUS TRACTS 1, 8,19,20,21,22,23,67,68 |            |       |                |
| AGE                                     | POPULATION | %     |                |
| Under 5 years                           | 1,275      | 5.0%  |                |
| 5 to 9 years                            | 1,519      | 6.0%  |                |
| 10 to 14 years                          | 1,358      | 5.4%  |                |
| 15 to 19 years                          | 1,183      | 4.7%  |                |
| 20 to 24 years                          | 4,056      | 16.1% |                |
| 25 to 29 years                          | 2,618      | 10.4% |                |
| 30 to 34 years                          | 1,714      | 6.8%  |                |
| 35 to 39 years                          | 1,311      | 5.2%  |                |
| 40 to 44 years                          | 1,450      | 5.7%  |                |
| 45 to 49 years                          | 1,090      | 4.3%  |                |
| 50 to 54 years                          | 1,771      | 7.0%  |                |
| 55 to 59 years                          | 1,595      | 6.3%  |                |
| 60 to 64 years                          | 1,294      | 5.1%  | 66.9% 20 TO 64 |
| 65 to 69 years                          | 1,090      | 4.3%  |                |
| 70 to 74 years                          | 737        | 2.9%  | 74.1% 20 TO 74 |
| 75 to 79 years                          | 428        | 1.7%  |                |
| 80 to 84 years                          | 496        | 2.0%  |                |
| 85 years and over                       | 273        | 1.1%  |                |

American Community Survey ACS 2020 SO101 - 5 YEAR

The trips used to calculate this benefit are found by using the base number of induced trips (all age ranges) for the Reconnecting Knoxville projects and applying various factors to account for trips induced within a certain age distribution. This BCA used guidance found in 2023 USDOT BCA Guidance Table A-13 to perform these calculations.

The health benefit for the pedestrian and bike users in reducing mortality corresponds to a Net Present Value of \$33,395,938 (2021\$) the 20-year evaluation of the projects.

See the “HEALTH Mortality Reduction” worksheet of the BCA spreadsheet for benefit calculations.

## SAFETY

Injury and fatality numbers involving bicyclists and pedestrians used for this benefit calculation were pulled from the Enhanced Tennessee Roadway Information Management System (ETRIMS) hosted by the Tennessee Department of Transportation and the Knoxville Regional Transportation Planning Organization (Knoxville TPO). FHWA Highway Safety Crash Screening Methods were used to determine the average annual bike and pedestrian-involved crash rates in Knoxville and crashes within 1.0 mile of the Reconnecting Knoxville projects.

| BUFFER WIDTH (M)                         | 200 M | 400 M |
|--|-------|-------|
| AREA OF EACH BUFFER (KM <sup>2</sup> )   | 4.570 | 3.700 |
| Number of Pedestrians                    | 779   | 336   |
| Number of Bicyclists                     | 209   | 122   |
| Population within Buffer Area            | 3,511 | 2,843 |
| Cumulative Population within Buffer Zone | 3,511 | 6,354 |

BCA Workbook – “TRIP GENERATION” Worksheet

| CRASH REDUCTION SUMMARY                    |       |       |                     |
|--|-------|-------|---------------------|
| NO BUILD CRASH STATISTICS (2017 TO 2021)   |       |       |                     |
| BUFFER AREA AROUND PROJECT                 | 200 M | 400 M | 200 M + 400 M AREAS |
| TOTAL POPULATION WITHIN EACH AREA          | 3,511 | 2,843 | 6354                |
| NO BUILD CRASH DATA                        |       |       |                     |
| TOTAL BIKE CRASHES 5YR - 400 M BUFFER AREA | 2     | 2     | 4                   |
| TOTAL PED CRASHES 5 YR - 400M BUFFER AREA  | 10    | 15    | 25                  |
| TOTAL BIKE & PED CRASHES - 5 YEAR PERIOD   | 12    | 17    | 29                  |
| BUFFER / CRASHES / YEAR                    | 2.40  | 3.40  | 5.80                |
| NO BUILD CRASH RATES                       |       |       |                     |
| BUFFER CRASH RATE PER 1000 POP             | 0.68  | 1.20  | 0.91                |
| KNOXVILLE CRASH RATE (CRASHES / 1000 POP)  | 0.63  | 0.63  | 0.63                |
| BUFFER CRASH RATE / KNOXVILLE CRASH RATE   | 1.08  | 1.90  | 1.45                |
| BUILD CRASH RATES                          |       |       |                     |
| BUFFER CRASH RATE - after 0.92 CMF APPLIED | 0.629 | 1.100 | 0.840               |
| PREDICTED CRASHES AFTER PROJECT            | 2.208 | 3.128 | 5.336               |
| PREDICTED BIKE & PED CRASHES AFTER PROJECT | 2.21  | 3.13  | 5.34                |
| CRASH REDUCTION NO BUILD VS BUILD          |       |       |                     |
| ANNUAL BIKE AND PED CRASH REDUCTION        | 0.192 | 0.272 | 0.464               |

BCA Workbook – “CRASH SUMMARY” Worksheet

This BCA used methods detailed in the 2023 US DOT BCA Guidance and NCHRP 552 to determine crash reduction and crash valuation. A 5-year time period from 2017 to 2021 was used to query georeferenced crash data from ETRIMS. This data established the existing crash rates per 1000 population within the 200 meter and 400 meter buffer areas for the existing conditions or No Build. The BCA applied a crash modification factor (CMF) to the existing crash rate calculated to determine the crash rate of the built project. The difference in the No Build vs Build crash rates were used to calculate the number of crashes reduced for bicyclists and pedestrians. This reduction was then applied to valuation methods detailed in the 2023 USDOT BCA Guidance. This BCA used KABCO Scale to MAIS conversion table to distribution crash severity and valuations as provided in the 2023 US DOT BCA Guidance in Table A-1.

The findings for the BCA evaluation were that existing bike and pedestrian crash rates would be reduced 0.464 crashes per year for a physically separated bike and pedestrian facility.

The Safety benefit for pedestrian and bike users corresponds crash rate reduction of the Build vs the No Build crashes. The Total Safety benefit was calculated as the Net Present Value of \$1,413,491 (2021\$) over the 20-year project life using a 7 percent discount rate.

See the “SAFETY BUILD Crash” & “SAFETY NO BUILD Crash” worksheets of the BCA spreadsheet.

**OPERATIONAL BENEFITS**

| TYPE OF ASSET                        | SERVICE LIFE (YEARS) |
|--------------------------------------|----------------------|
| Industrial buildings                 | 31                   |
| Mobile offices                       | 16                   |
| Office buildings                     | 36                   |
| Commercial warehouses                | 40                   |
| Other commercial buildings           | 34                   |
| Religious buildings                  | 48                   |
| Educational buildings                | 48                   |
| Hospital and institutional buildings | 48                   |
| Hotels and motels                    | 32                   |
| Amusement and recreational buildings | 30                   |
| All other nonfarm buildings          | 38                   |
| Railroad replacement track           | 38                   |
| Other railroad structures            | 54                   |
| Telecommunications                   | 40                   |
| Railroad equipment*                  | 50                   |
| Highways and streets                 | 60                   |
| Conservation and development         | 60                   |
| Sewer systems                        | 60                   |
| Water systems                        | 60                   |
| Military facilities                  | 50                   |
| Other                                | 60                   |

Source: BEA Rate of Depreciation, Service Lives, Declining-Balance Rates, and Hulten-Wyckoff Categories

[http://www.bea.gov/scb/account\\_articles/national/wlth2594/tableC.htm](http://www.bea.gov/scb/account_articles/national/wlth2594/tableC.htm)

FTA Circulator 5010.1D Grant Management Requirements 2008,

<https://cms.fta.dot.gov/funding/grant-programs/capital-investments/fta-circular-50101d-november-2008>

| RESIDUAL BENEFITS SUMMARY               |               |
|---|---------------|
| DISCOUNT YEAR                           | 2021          |
| UNITS FOR RESIDUAL BENEFITS             | 2021 \$       |
| VALUE OF ROW (DOES NOT DEPRECIATE)      | \$ -          |
| END OF LIFE YEAR FOR REMAINING VALUE    | 2047          |
| Asset after 20 years of service         | \$ 42,784,708 |
| Total Value Remaining in 2047           | \$ 42,784,708 |
| Linear decline in value of service life | \$ 21,392,354 |
| RESIDUAL BENEFIT w/ 7% (2021\$)         | \$ 7,367,334  |

BCA Workbook – “OPERATIONAL Residual” Worksheet

The residual capital benefit for this project after the calculated 20 years operation (remaining 40 years) is \$7,367,334 (2021\$).

See the “OPERATIONAL Residual” worksheet of the BCA spreadsheet.



## TOTAL BENEFITS

The total benefits for the Reconnecting Knoxville projects is \$151.7 (2021\$) including equity, mobility, health, safety, and operational benefits.

|   | 7% Discount Rate |
|---|------------------|
| <b>Costs (2021 M\$)</b>                   |                  |
| <b>Capital Cost</b>                       | \$64.2           |
| <i>Total Costs</i>                        | \$64.2           |
| <b>Benefits (2021 M\$)</b>                |                  |
| <b>Equity Benefits</b>                    |                  |
| Access to Pedestrian & Bike Recreation    | \$21.1           |
| Access to Bike Commuting                  | \$13.8           |
| Sub-Total                                 | \$35.0           |
| <b>Mobility Benefits</b>                  |                  |
| Bike Commuter General                     | \$16.5           |
| Bike Commuter Stadium                     | \$0.9            |
| Ped & Bike Recreation                     | \$12.6           |
| Ped & Bike Recreation - Urban Wilderness  | \$16.1           |
| Ped & Bike Recreation - Stadium           | \$28.5           |
| Sub-Total                                 | \$74.6           |
| <b>Health Benefits</b>                    |                  |
| Ped & Bike Activity - Mortality Reduction | \$33.4           |
| Sub-Total                                 | \$33.4           |
| <b>Safety Benefits</b>                    |                  |
| Reduced Crashes                           | \$1.4            |
| Sub-Total                                 | \$1.4            |
| <b>Operational Benefits</b>               |                  |
| Residual Savings                          | \$7.4            |
| Sub-Total                                 | \$7.4            |
| <i>Total Benefits</i>                     | \$151.7          |
| <b>Outcome</b>                            |                  |
| <b>Net Present Value (2021 M\$)</b>       | <b>\$87.6</b>    |
| <b>Benefit-Cost Ratio</b>                 | <b>2.36</b>      |

Furthermore, there are expected to be additional benefits to tourism, the environment, and property value increases, but these are difficult to quantify and excluded in this case since the other benefits are already estimated to significantly outweigh the costs.

After quantifying the expected net benefits expected under the Build case and taking into account the residual cost benefits of the project for years beyond the analysis period, the BCR for the project was calculated to be 2.36, suggesting that the project benefits over the analysis period would exceed the expected costs associated with project implementation.

See the "BCA WITH DISCOUNT" worksheet of the BCA spreadsheet.