



US Department of Transportation



# RAISE Grants

Rebuilding American Infrastructure with Sustainability and Equity

Preparing a Benefit-Cost Analysis for the RAISE Discretionary Grant Program

January 26, 2023



# Webinar Information

## Audio

- To listen via computer:
  - Select "Computer Audio"
- To listen via phone:
  - Call: 669-254-5252
  - Webinar ID: 161 435 5205
  - Passcode: 538775
- All participants automatically join on mute, with cameras off

## Technical Support

- Email
  - [corey.martin.ctr@dot.gov](mailto:corey.martin.ctr@dot.gov)
  - [webconference@dot.gov](mailto:webconference@dot.gov)

## Questions for Presenters

- Please type your questions in the Q&A box

## More Information

- This webinar is being recorded and will be posted on the RAISE Grants website at <https://www.transportation.gov/RAISEgrants>



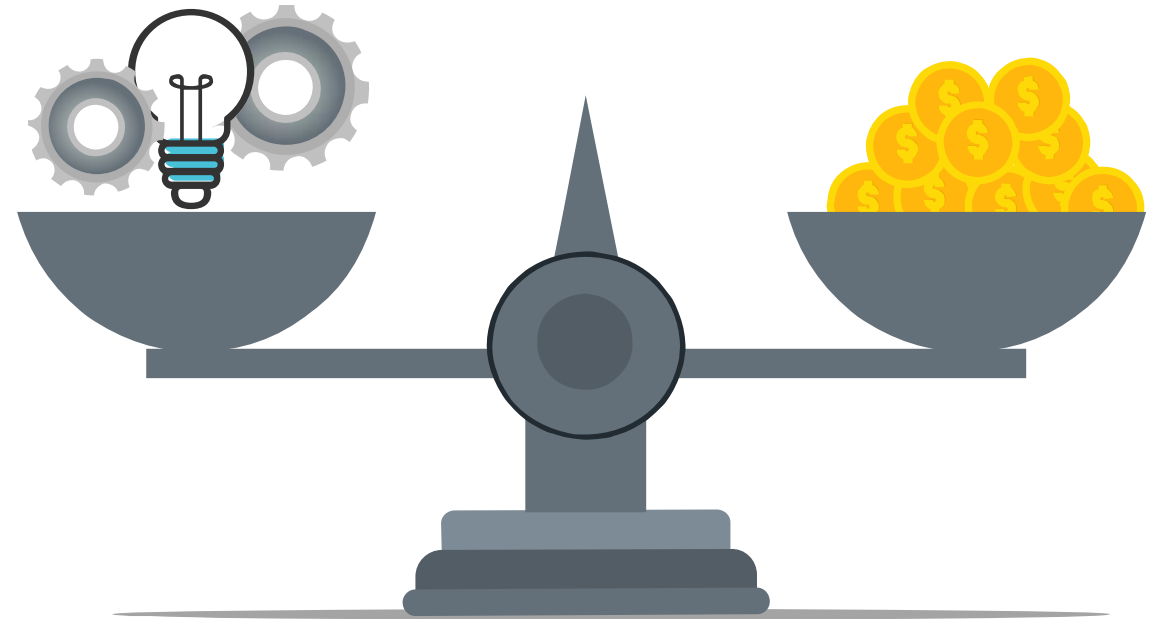
## Today's Presenters

- **Darren Timothy, Chief Economist, USDOT**
- **Jordan Riesenbergh, Economist, USDOT**



# What is BCA?

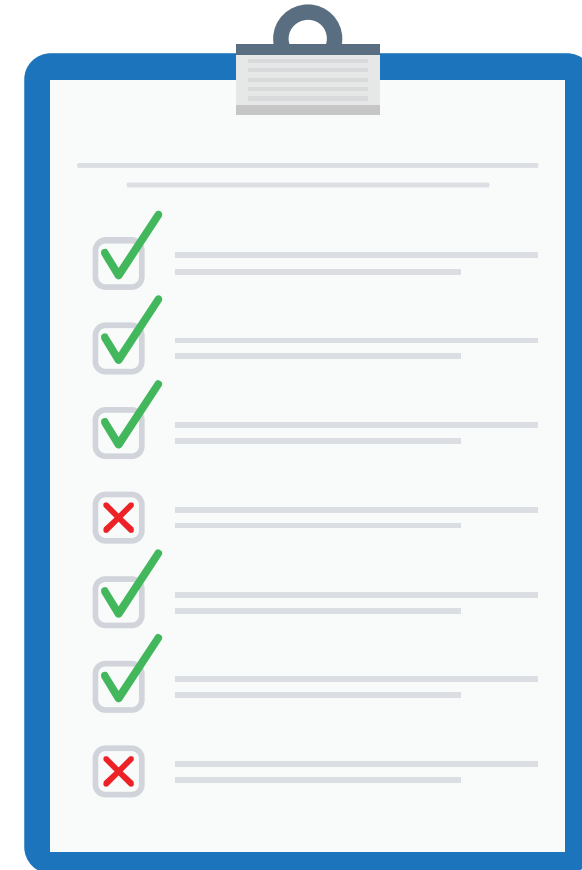
- Benefit-cost analysis (BCA) is a systematic process for identifying, quantifying, and comparing expected economic benefits and costs of a proposed infrastructure project.





## Why do we do BCA?

- Provides a useful benchmark from which to evaluate and compare potential transportation investments
- Adds a degree of rigor to the project evaluation process





## BCA and RAISE

- All sponsors of capital projects should submit a benefit-cost analysis (BCA) as part of their RAISE grant application
- Use of the BCA in RAISE
  - Consider the extent to which the project is cost effective
- Sponsors of planning grant applications **do not need** to submit a benefit-cost analysis



## Use of the BCA in Project Evaluation

- USDOT will consider the relative magnitude of estimated project benefits and costs in its evaluation
- Assign projects one of two ratings
  - Positive net benefits (benefits exceed costs)
  - Negative net benefits (costs exceed benefits)
- Projects with a negative BCA rating will not be selected for an award, unless the project has unquantified benefits that demonstrate clear outcomes for underserved communities.



## USDOT BCA Review

- USDOT economists will review the applicant's BCA
  - Examine key assumptions
  - Correct for any technical errors
  - Perform sensitivity analysis on key inputs
  - Consider any unquantified benefits







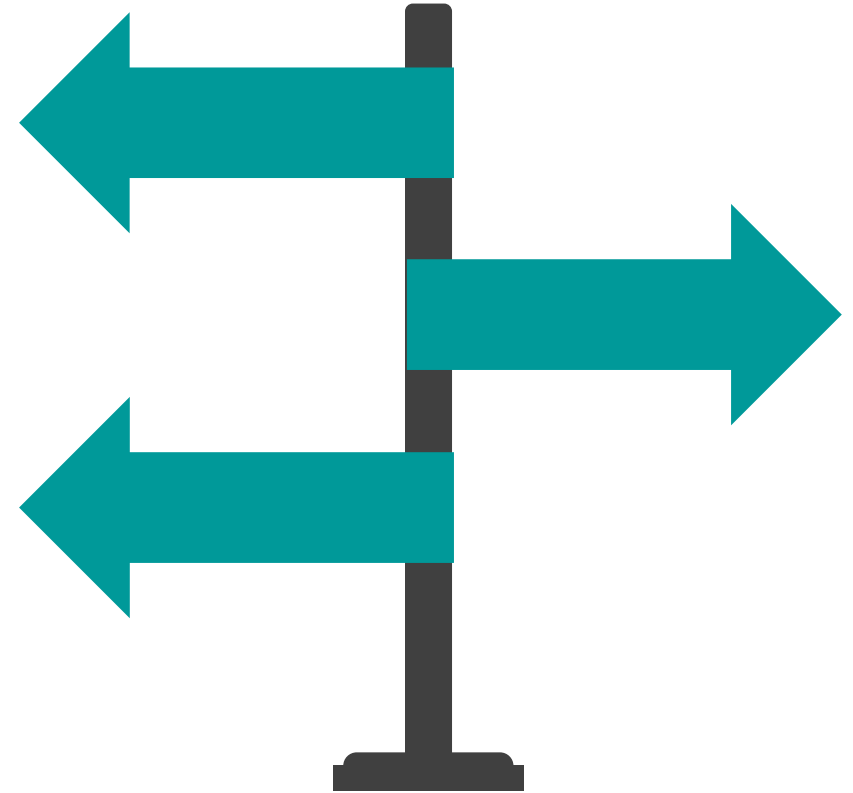
## What do I need to do BCA?

- Clear understanding of the problem the project is intended to solve (baseline conditions) and how the project addresses the problem (measures of effectiveness)
- Well-defined project scope and cost estimate
- Monetization factors for key project benefits



## What do I need to do BCA?

- Sources of information may include:
  - Project planning and engineering documents
  - Industry technical references and analytical tools
  - DOT BCA Guidance
  - Partners





## What should my BCA submission include?

- Technical memo/discussion describing the analysis, including any unquantified benefits, and documenting sources of information used (assumptions and inputs)
  - If provided as an appendix, does not count against page limit for the application narrative
- An unlocked spreadsheet (e.g., an Excel workbook) showing the calculations used to produce the estimates of benefits and costs



# USDOT BCA Guidance

- Covers all USDOT discretionary grant programs
- Available at <https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance>



U.S. Department  
of Transportation

## Benefit-Cost Analysis Guidance for Discretionary Grant Programs

---

Office of the Secretary  
U.S. Department of Transportation  
January 2023



## What's new for 2023?

- **The 2023 update to the BCA Guidance includes:**
  - Additional background information on BCA
  - New and updated monetization values
  - Additional guidance and new examples on
    - Valuing pedestrian and transit infrastructure improvements
    - Valuing the benefits of transit transfer reduction
  - Additional guidance on valuation of right-of-way being made available for other purposes



# Baselines

- **Should measure costs and benefits of a proposed project against a baseline alternative (“base” or “no build”)**
- **“Do’s”**
  - Factor in any projected changes that would occur even in the absence of the requested project
  - Factor in ongoing routine maintenance
  - Consider the full long-term impacts of the no build
  - Explain and provide support for the chosen baseline
- **“Don’t’s”**
  - Assume that the same (or similar) improvement will be implemented later
  - Use unrealistic assumptions about alternative traffic flows or travel



## Demand Forecasts

- **Most benefit estimates depend on ridership or usage, including for walking and cycling projects**
- **Provide supporting info on forecasts**
  - Geographic scope, assumptions, data sources, methodology
- **Provide forecasts for intermediate years**
  - Or at least interpolate –don't apply forecast year impacts to interim years
- **Exercise caution about long-term growth assumptions**
  - Consider underlying capacity limits of the improved and/or replacement facility



## Analysis Period

- **Should cover both initial development/construction and a subsequent operational period**
- **Generally tied to the expected service life of the improvement or asset**
  - I.e., the number of years until you would anticipate having to take the same action again
  - Lesser improvements should have shorter service lives
  - Recommend 20 years maximum for capacity expansion or other operational improvements
- **Avoid excessively long analysis periods (over 30 years of operations)**
  - Use residual value to cover out-years of remaining service life for long-lived improvements





# Inflation and Discounting

- **Inflation Adjustments**

- Recommend using a 2021 base year for all cost and benefit data
- Index values for the GDP Deflator included in the BCA guidance

- **Discounting**

- Use a 7% discount rate for all benefits and costs (except CO<sub>2</sub>)
- Recommend using a 2021 base year for discounting



## Scope of the Analysis

- **Project scope included in estimated costs and benefits must match**
  - Don't claim benefits from an entire project, but only count costs from the grant-funded portion
- **Scope should cover a project that has independent utility**
  - May need to incorporate costs for related investments necessary to achieve the projected benefits
- **Project elements with independent utility should be individually evaluated in the BCA**
  - BCA evaluation will cover both independent elements and the submitted project as a whole



## Benefits

- **Should be presented on an annual basis**
  - Don't assume constant annual benefits without a good reason to do so
- **Negative outcomes should be counted as “disbenefits”**
  - E.g., work zone impacts
- **Avoid double-counting benefits**



## Safety Benefits

- **Typically associated with reducing fatalities, injuries, and property damage**
- **Projected improvements in safety outcomes should be explained and documented**
  - Justify assumptions about expected reductions in crashes, injuries, and/or fatalities
  - Document any crash modification factors (CMFs) used
  - Show clear linkage between project and improved outcomes
  - Use facility-specific data history for baseline where possible
- **Crash-related injury and fatality data may be available in different forms**
  - KABCO injury scales
  - Fatal/Injury crashes vs. fatalities/injuries
  - BCA Guidance provides values covering all of these



# Travel Time Savings

- **Recommended monetization values found in BCA Guidance**
  - See footnotes for discussion of value of time for walking, cycling, waiting, standing, transfers, long-distance travel, business travel
- **Can be a function of both changes in travel speed and/or travel distance (e.g., new connections across a highway allowing for shorter walking or cycling trips)**
- **Consider vehicle occupancy where appropriate**
  - Local/facility-specific values preferred
  - National-level values provided in BCA Guidance
- **If valuing travel time reliability:**
  - Carefully document methodology and tools used
  - Show how valuation parameters are distinct from general travel time savings



## Operating Cost Savings

- **Avoid double counting operating savings and other impacts**
  - E.g., truck or rail travel time savings, fuel consumption reductions
- **Localized, specific data preferred**
- **Standard per-mile values for light duty vehicles and commercial trucks provided in BCA Guidance**



## Emissions Reduction Benefits

- **For infrastructure improvements, emission reductions will typically be a function of reduced fuel consumption**
- **Recommended year by year unit values for CO<sub>2</sub>, SO<sub>x</sub>, NO<sub>x</sub>, and PM<sub>2.5</sub> found in BCA Guidance**
  - Be careful about the measurement units being applied
  - Check for PM<sub>2.5</sub> versus PM<sub>10</sub>
- **Reductions in CO<sub>2</sub> emissions should be discounted at 3 percent, while all others should be discounted at 7 percent**



## Amenity Benefits

- **Pedestrian, cycling, and transit facility/vehicle improvements can improve the quality or comfort of journeys**
- **Recommended values for different types of improvements found in BCA Guidance**
  - Pay attention to whether value is on a “per-trip” or “per-person-mile” basis
- **Carefully document baseline amenities, as well as specifically how the proposed project will add any amenity benefit categories being claimed**





## Health Benefits

- **Trips diverted to active transportation (walking and cycling) from other modes may yield health benefits to users**
- **Recommended monetization values, on a per trip basis, are found in DOT BCA Guidance**
- **Absent local data on existing mode share and estimated age profiles of users, applicants may apply national averages included in the BCA Guidance**



## Benefits to Existing and Additional Users

- **Primary benefits typically experienced directly by users**
- **Includes both “existing” users (under baseline) and “additional” users attracted as a result of the improvement**
  - Standard practice in BCA would value benefits to additional users less than those for existing users (see BCA Guidance)



# Modal Diversion

- **Projected magnitude**
  - Should be based on careful analysis of local conditions and potential for shift from other modes that might be attributable to the project
- **Benefit estimates should not be based on comparing user costs of “old” and “new” mode**
  - Would be reflected in benefits to additional users
- **Reductions in external costs would be relevant**
  - E.g., emissions costs, congestion reduction, noise reduction
  - Values for congestion, noise and safety costs included in BCA Guidance



## Other Benefits Topics

- **Agglomeration Economies**
- **Noise, Stormwater Runoff, and Wildlife Impact Reduction**
- **Emergency Response**
- **State of Good Repair**
- **Resilience**
  - Consider expected frequency of events and their consequences
- **Property Value Increases**
  - Is a measure rather than a benefit –avoid double-counting



## Unquantified Benefits

- **Many potential benefits of RAISE projects may be difficult to quantify and monetize**
- **Any claimed unquantified benefits should be explained as well as possible**
  - Should clearly link specific project outcomes to any claimed unquantified benefits
  - Should quantify magnitudes/timing of the impacts wherever possible
  - Should only include impacts that would be counted as benefits, if quantified



# Capital Costs

- **Include all costs of implementing the project**
  - E.g., design, ROW acquisition, construction
  - Regardless of funding source
  - Include previously incurred costs
- **Three forms of capital costs**
  - Nominal dollars (project budget)
  - Real dollars (base year)
  - Discounted Real dollars (use in BCA)



## Maintenance Costs

- **Net maintenance costs may be positive or negative**
  - New facilities would incur ongoing maintenance costs over the life of the project
  - Rehabilitated/reconstructed facilities may result in net savings in maintenance costs between the build/no-build



## Residual Value

- **For assets with remaining service life at the end of the analysis period, may calculate a “residual value” for the project**
  - Recall that service life does not necessarily match the physical life of the asset
- **Simply approach: assume linear depreciation**
- **Be sure to properly apply discounting**





## Comparing Benefits to Costs

- **Net Present Value (Benefits – Costs)**
- **Benefit-Cost Ratio (Benefits / Costs)**
  - Denominator should only include capital costs (i.e., net maintenance costs and residual value should be in the numerator)
  - Dis-benefits should be subtracted from the numerator



## Other Types of Economic Analysis

- **Examples**

- Economic Impact Analysis (e.g., job creation)
- Financial Impacts (e.g., revenue impacts)
- Distributional Effects (e.g., equity)

- **Issues**

- Use different approaches and answer different questions than does BCA
- Do not represent additional benefits to include in BCA



Q&A

The background of the slide is a dark blue image showing the silhouettes of several people sitting around a long table in a meeting room. Large windows in the background show a cityscape at dusk or dawn. The word 'QUESTIONS?' is overlaid in large white letters.

# QUESTIONS?

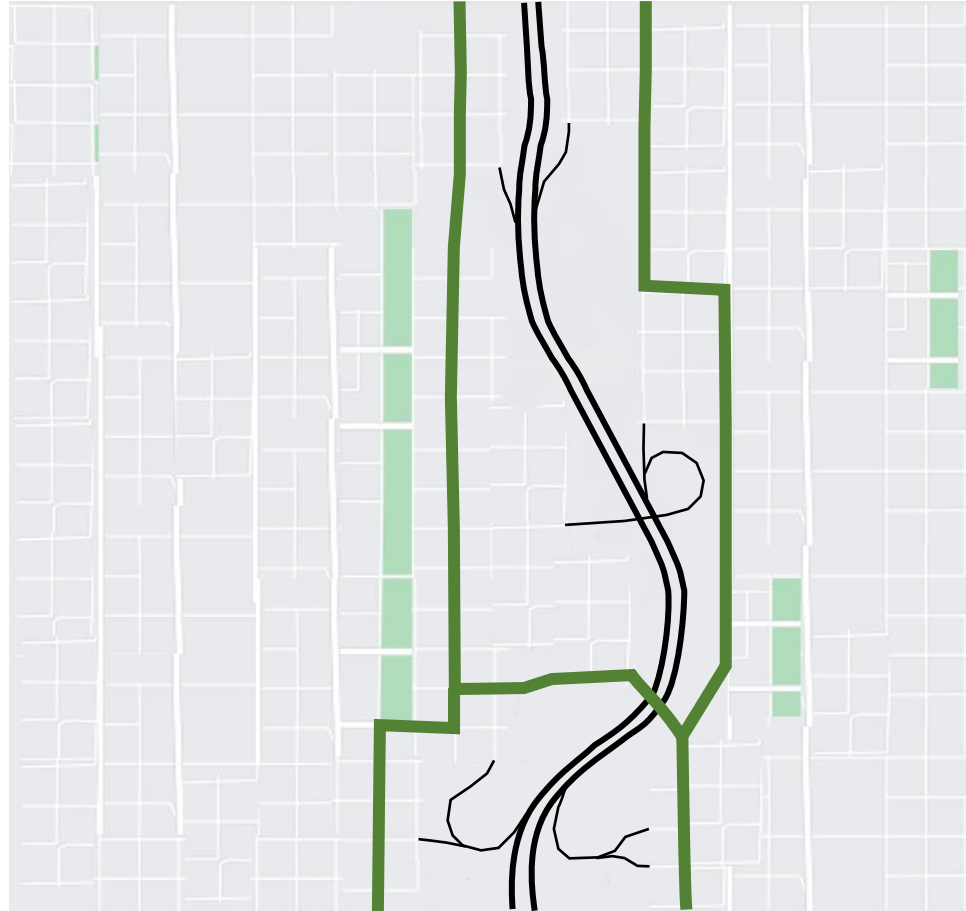


# Hypothetical BCA Example #1





# Hypothetical BCA Example #1

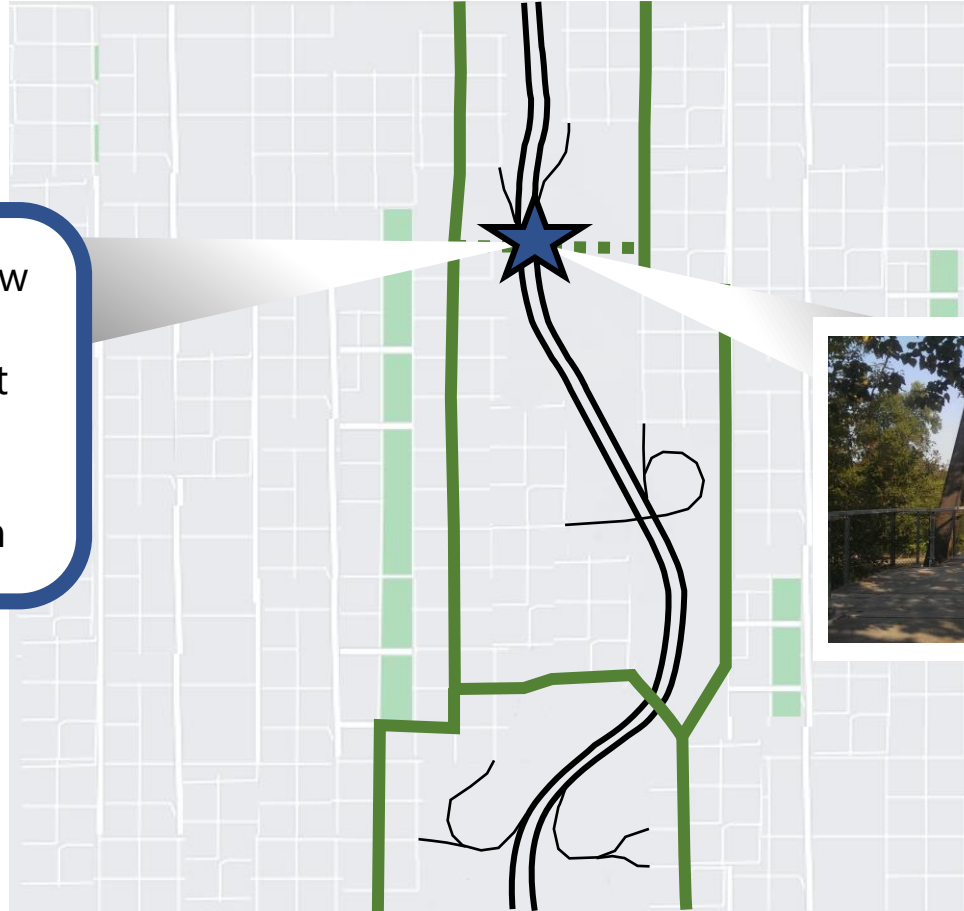




# Hypothetical BCA Example #1

Proposed Project: Add new bike/pedestrian bridge over freeway to reconnect local neighborhoods.

Project Cost: \$10.0 million

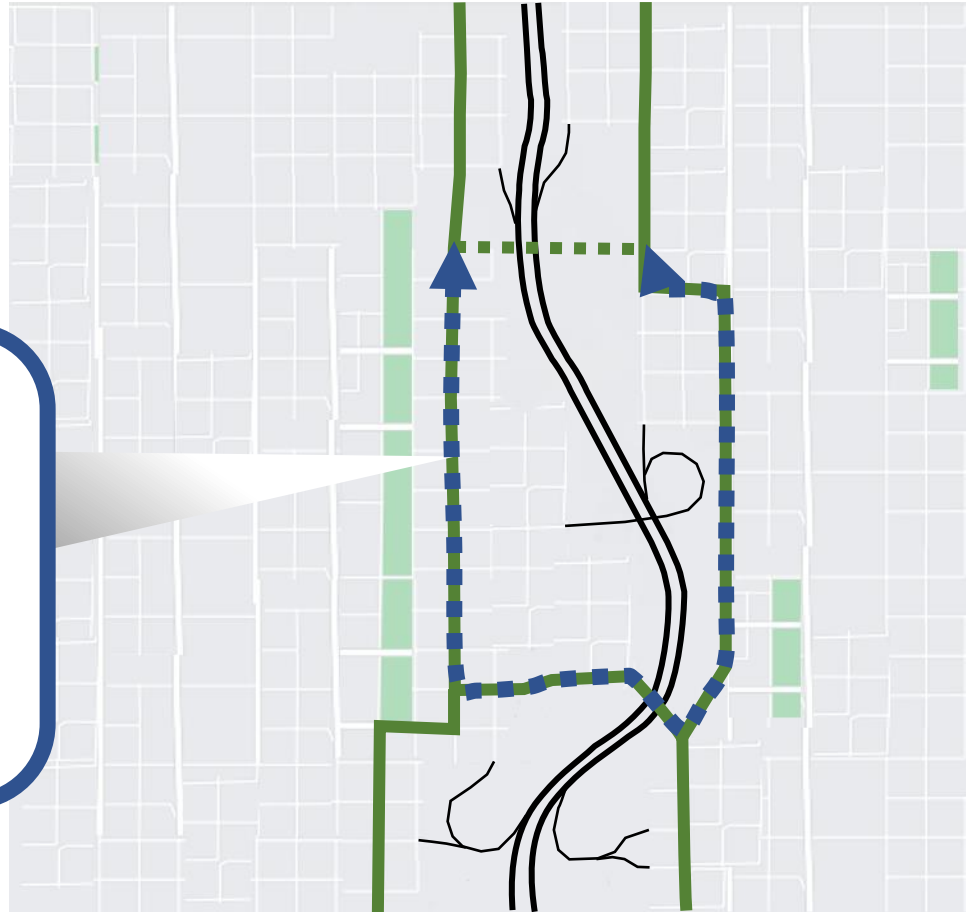




# Hypothetical BCA Example #1

No-Build Scenario: Cyclists and pedestrians continue to use crossing to the south.  
(2.6-mile route)

Daily users doing this route:  
1,000 cyclists (Trail Counters)

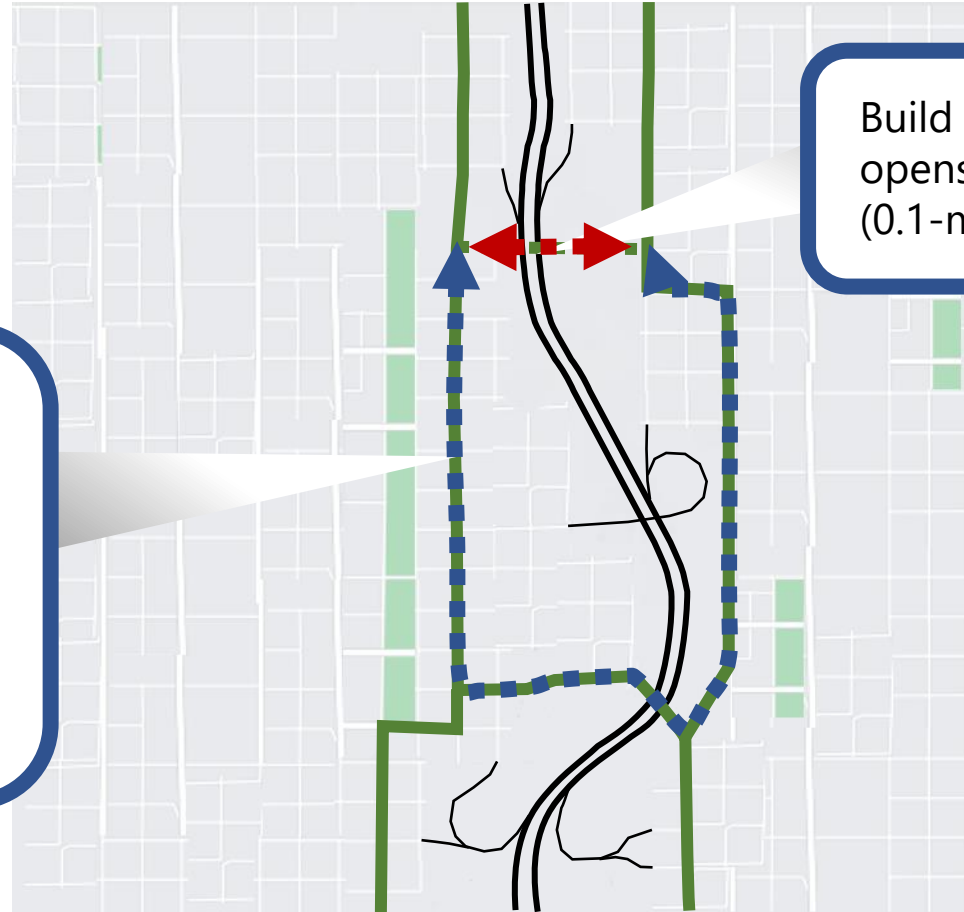




# Hypothetical BCA Example #1

No-Build Scenario: Cyclists and pedestrians continue to use crossing to the south.  
(2.6-mile route)

Daily users doing this route:  
1,000 cyclists (Trail Counters)

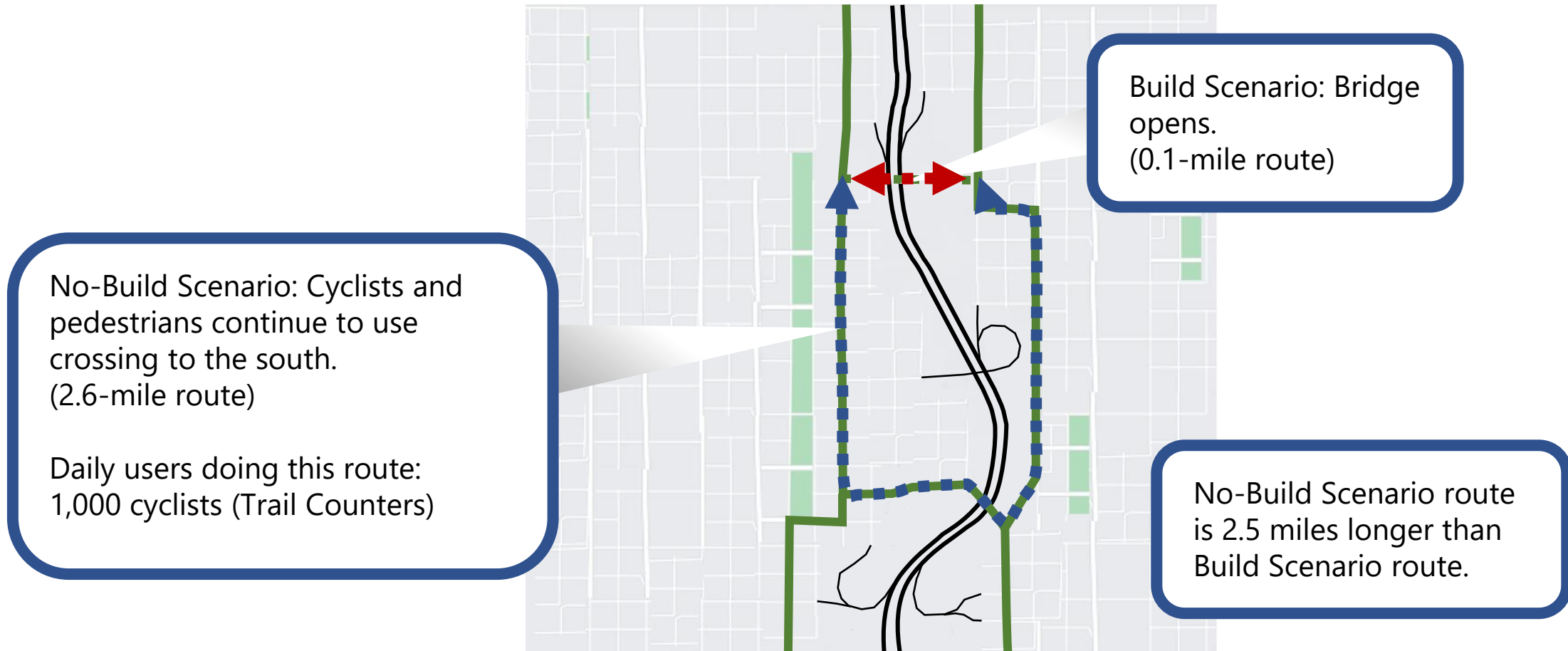


Build Scenario: Bridge opens.  
(0.1-mile route)





# Hypothetical BCA Example #1





# Approach

- **We want to compare the state of the world with and without the proposed project improvement**
  - No-Build Scenario: Cyclists use 2.6-mile route.
  - Build Scenario: Bridge opens, new route is 0.1 miles.
- **The expected major benefit category in this case would be the travel time savings for mitigating 2.5-miles of additional travel, starting when the project opens**



# Travel Time Savings Example

- For simplicity, let's assume no pedestrians, an average cycling speed of 9.8 mph, and no cycling growth over time

$$\text{Annual Travel Time Savings*} = \text{Marginal Detour Time} \times \text{Daily Users} \times \text{Hourly Value of Time} \times \text{Annualization Factor}$$

\*Undiscounted.



## Travel Time Savings Example

- For simplicity, let's assume no pedestrians, an average cycling speed of 9.8 mph, and no cycling growth over time

$$\text{Annual Travel Time Savings}^* = \text{Marginal Detour Time} \times \text{Daily Users} \times \text{Hourly Value of Time} \times \text{Annualization Factor}$$

$$\text{Annual Travel Time Savings}^* = \frac{2.5 \text{ Miles}}{9.8 \text{ mph}} \times$$

No-Build Scenario route: 2.6 miles  
Build Scenario route: 0.1 miles

Speed: Observed average speed on both routes

\*Undiscounted.



# Travel Time Savings Example

- For simplicity, let's assume no pedestrians, an average cycling speed of 9.8 mph, and no cycling growth over time

$$\text{Annual Travel Time Savings}^* = \text{Marginal Detour Time} \times \text{Daily Users} \times \text{Hourly Value of Time} \times \text{Annualization Factor}$$

$$\text{Annual Travel Time Savings}^* = \frac{2.5 \text{ Miles}}{9.8 \text{ mph}} \times 1,000 \times$$

Recent trail count

\*Undiscounted.

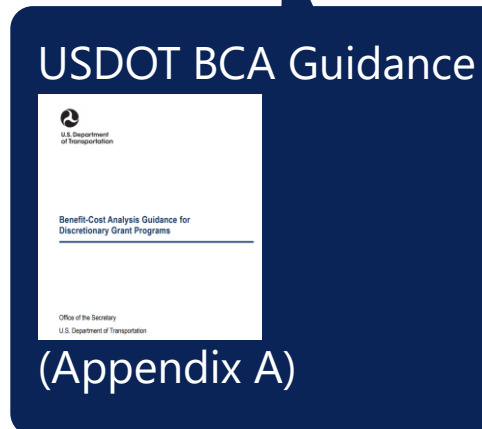


# Travel Time Savings Example

- For simplicity, let's assume no pedestrians, an average cycling speed of 9.8 mph, and no cycling growth over time

$$\text{Annual Travel Time Savings}^* = \text{Marginal Detour Time} \times \text{Daily Users} \times \text{Hourly Value of Time} \times \text{Annualization Factor}$$

$$\text{Annual Travel Time Savings}^* = \frac{2.5 \text{ Miles}}{9.8 \text{ mph}} \times 1,000 \times \$34.00 \times$$



\*Undiscounted.



# Travel Time Savings Example

- For simplicity, let's assume no pedestrians, an average cycling speed of 9.8 mph, and no cycling growth over time

$$\text{Annual Travel Time Savings}^* = \text{Marginal Detour Time} \times \text{Daily Users} \times \text{Hourly Value of Time} \times \text{Annualization Factor}$$

$$\text{Annual Travel Time Savings}^* = \frac{2.5 \text{ Miles}}{9.8 \text{ mph}} \times 1,000 \times \$34.00 \times 365$$

We expect this project to have an impact each day (not just weekdays, for example).



## Travel Time Savings Example

- For simplicity, let's assume no pedestrians, an average cycling speed of 9.8 mph, and no cycling growth over time

$$\text{Annual Travel Time Savings}^* = \text{Marginal Detour Time} \times \text{Daily Users} \times \text{Hourly Value of Time} \times \text{Annualization Factor}$$

$$\text{Annual Travel Time Savings}^* = \frac{2.5 \text{ Miles}}{9.8 \text{ mph}} \times 1,000 \times \$34.00 \times 365$$

$$= \$3,165,816 \text{ Per Year}$$

\*Undiscounted.





# Hypothetical BCA Example #1

- Assume construction in 2024, ten years of project operations, and \$10,000 in annual maintenance costs for the project

| Year | Capital Cost | Discounted Costs | Travel Time Savings | O&M Costs | Discounted Benefits |
|------|--------------|------------------|---------------------|-----------|---------------------|
| 2024 | \$10,000,000 |                  | \$0                 | \$0       |                     |
| 2025 | \$0          |                  | \$3,165,816         | \$10,000  |                     |
| 2026 | \$0          |                  | \$3,165,816         | \$10,000  |                     |
| 2027 | \$0          |                  | \$3,165,816         | \$10,000  |                     |
| 2028 | \$0          |                  | \$3,165,816         | \$10,000  |                     |
| 2029 | \$0          |                  | \$3,165,816         | \$10,000  |                     |
| 2030 | \$0          |                  | \$3,165,816         | \$10,000  |                     |
| 2031 | \$0          |                  | \$3,165,816         | \$10,000  |                     |
| 2032 | \$0          |                  | \$3,165,816         | \$10,000  |                     |
| 2033 | \$0          |                  | \$3,165,816         | \$10,000  |                     |
| 2034 | \$0          |                  | \$3,165,816         | \$10,000  |                     |



# Hypothetical BCA Example #1

- Next, we discount costs and benefits using a 7% discount rate

**Discounted Value = Future Year Value / (1+Discount Rate)^(Future Year - Base Discounting Year)**

| Year | Capital Cost | Discounted Costs | Travel Time Savings | O&M Costs | Discounted Benefits |
|------|--------------|------------------|---------------------|-----------|---------------------|
| 2024 | \$10,000,000 | \$8,162,979      | \$0                 | \$0       | \$0                 |
| 2025 | \$0          | \$0              | \$3,165,816         | \$10,000  | \$2,407,557         |
| 2026 | \$0          | \$0              | \$3,165,816         | \$10,000  | \$2,250,053         |
| 2027 | \$0          | \$0              | \$3,165,816         | \$10,000  | \$2,102,854         |
| 2028 | \$0          | \$0              | \$3,165,816         | \$10,000  | \$1,965,284         |
| 2029 | \$0          | \$0              | \$3,165,816         | \$10,000  | \$1,836,714         |
| 2030 | \$0          | \$0              | \$3,165,816         | \$10,000  | \$1,716,555         |
| 2031 | \$0          | \$0              | \$3,165,816         | \$10,000  | \$1,604,257         |
| 2032 | \$0          | \$0              | \$3,165,816         | \$10,000  | \$1,499,306         |
| 2033 | \$0          | \$0              | \$3,165,816         | \$10,000  | \$1,401,220         |
| 2034 | \$0          | \$0              | \$3,165,816         | \$10,000  | \$1,309,552         |

$\$10,000,000 / (1+0.07)^{(2024-2021)}$

$(\$3,165,816 - \$10,000) / (1+0.07)^{(2025-2021)}$

$(\$3,165,816 - \$10,000) / (1+0.07)^{(2034-2021)}$

Note: Totals may differ slightly due to rounding



# Hypothetical BCA Example #1

- Next, we sum the discounted benefits and costs to get total discounted benefits and total discounted costs

| Year         | Capital Cost | Discounted Costs   | Travel Time Savings | O&M Costs | Discounted Benefits |
|--------------|--------------|--------------------|---------------------|-----------|---------------------|
| 2024         | \$10,000,000 | \$8,162,979        | \$0                 | \$0       | \$0                 |
| 2025         | \$0          | \$0                | \$3,165,816         | \$10,000  | \$2,407,557         |
| 2026         | \$0          | \$0                | \$3,165,816         | \$10,000  | \$2,250,053         |
| 2027         | \$0          | \$0                | \$3,165,816         | \$10,000  | \$2,102,854         |
| 2028         | \$0          | \$0                | \$3,165,816         | \$10,000  | \$1,965,284         |
| 2029         | \$0          | \$0                | \$3,165,816         | \$10,000  | \$1,836,714         |
| 2030         | \$0          | \$0                | \$3,165,816         | \$10,000  | \$1,716,555         |
| 2031         | \$0          | \$0                | \$3,165,816         | \$10,000  | \$1,604,257         |
| 2032         | \$0          | \$0                | \$3,165,816         | \$10,000  | \$1,499,306         |
| 2033         | \$0          | \$0                | \$3,165,816         | \$10,000  | \$1,401,220         |
| 2034         | \$0          | \$0                | \$3,165,816         | \$10,000  | \$1,309,552         |
| <b>TOTAL</b> |              | <b>\$8,162,979</b> |                     |           | <b>\$18,093,351</b> |

Note: Totals may differ slightly due to rounding



## Results – The NPV and BCR

- Lastly, we calculate the project's net present value (NPV) and benefit-cost ratio (BCR)

$$\begin{aligned}\text{Net Present Value (NPV)} &= \text{Total Discounted Benefits} - \text{Total Discounted Costs} \\ &= \$18,093,351 - \$8,162,979 \\ &= \mathbf{\$9,930,372}\end{aligned}$$

$$\begin{aligned}\text{Benefit-Cost Ratio (BCR)} &= \frac{\text{Total Discounted Benefits}}{\text{Total Discounted Costs}} \\ &= \frac{\$18,093,351}{\$8,162,979} \\ &= \mathbf{2.2}\end{aligned}$$

Note: Totals may differ slightly due to rounding

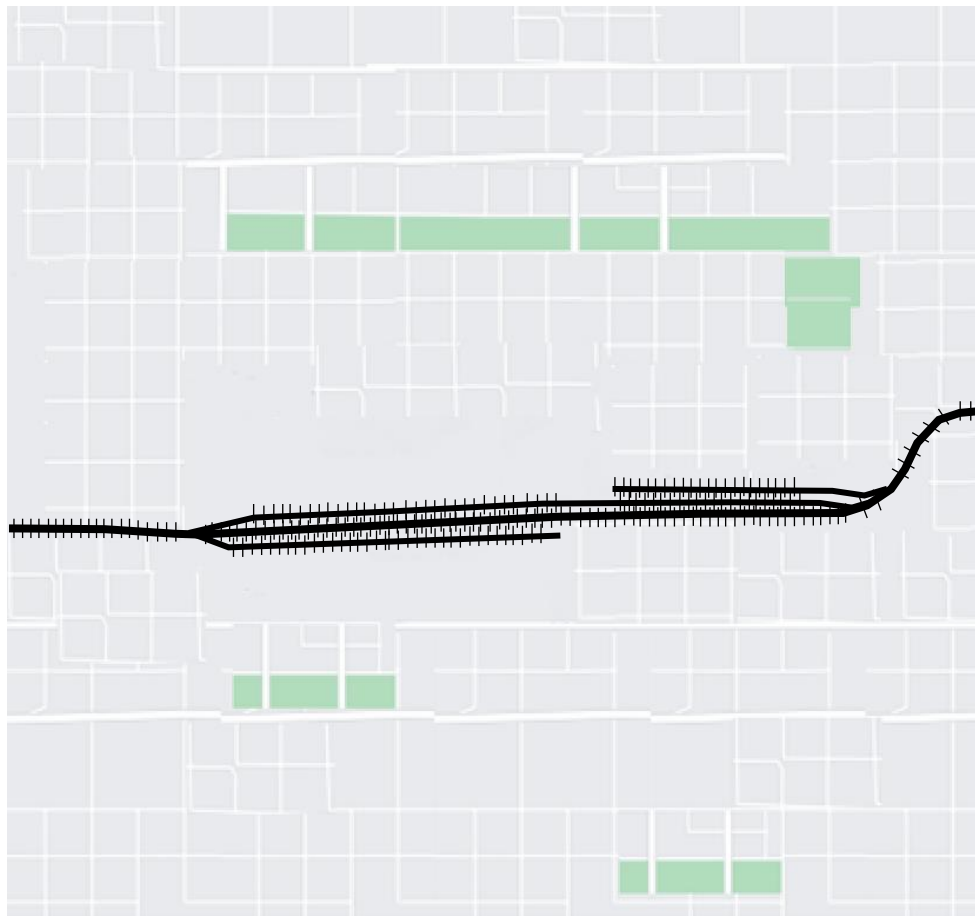


# Hypothetical BCA Example #1

- **Other potential benefits such a project might have:**
  - Travel time savings for pedestrians
    - Different speed assumptions and number of users as the example just given, but otherwise the method would be the same
  - Mortality reduction from induced walking and cycling trips
  - Reduced emissions from modal shift to active transportation
  - Amenity benefits
    - If the no-build route did not already have a dedicated cycling or pedestrian facility
  - Safety benefits
    - Shorter walking and cycling distances for existing users
  - Residual value
- **This is not meant to be an exhaustive list**



## Hypothetical Example #2





## Hypothetical Example #2

Proposed Project: Convert 2.0 miles of an abandoned rail line to a cycling path and sell 40 acres of excess right-of-way for future mixed-use development.

Project Cost: \$20.0 million

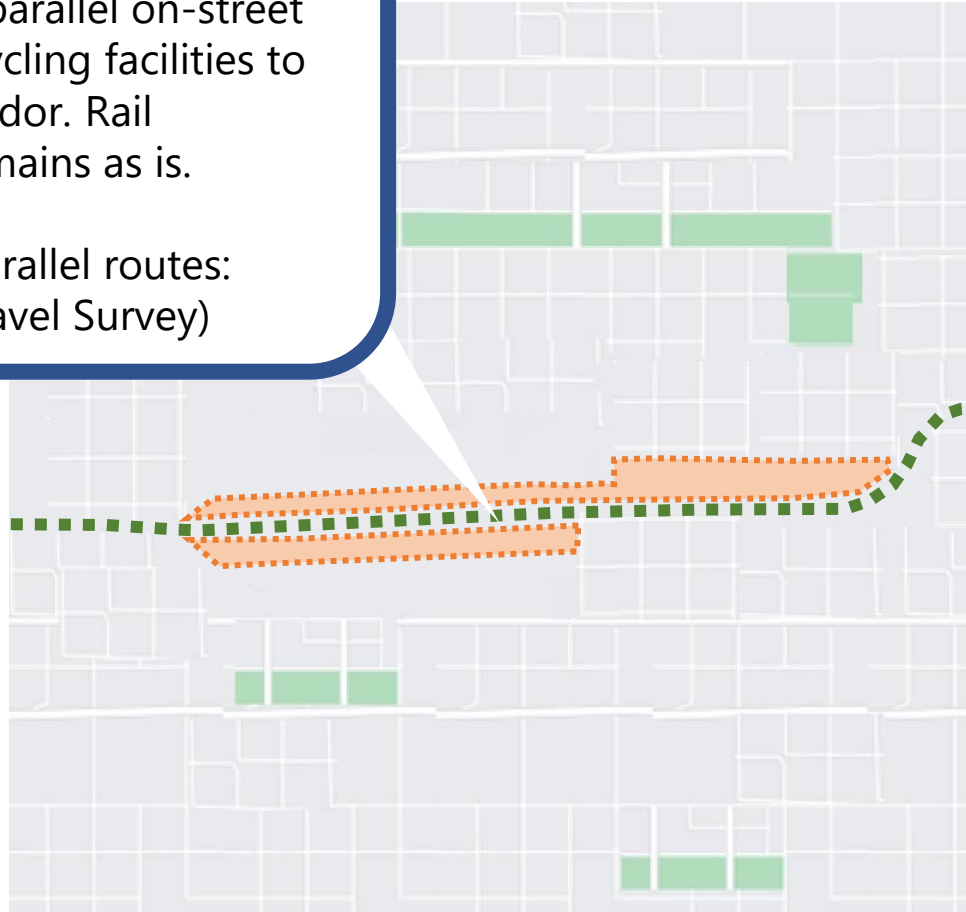




## Hypothetical Example #2

No-Build Scenario: Cyclists continue to use parallel on-street routes with no cycling facilities to traverse the corridor. Rail infrastructure remains as is.

Daily users on parallel routes:  
3,000 cyclists (Travel Survey)



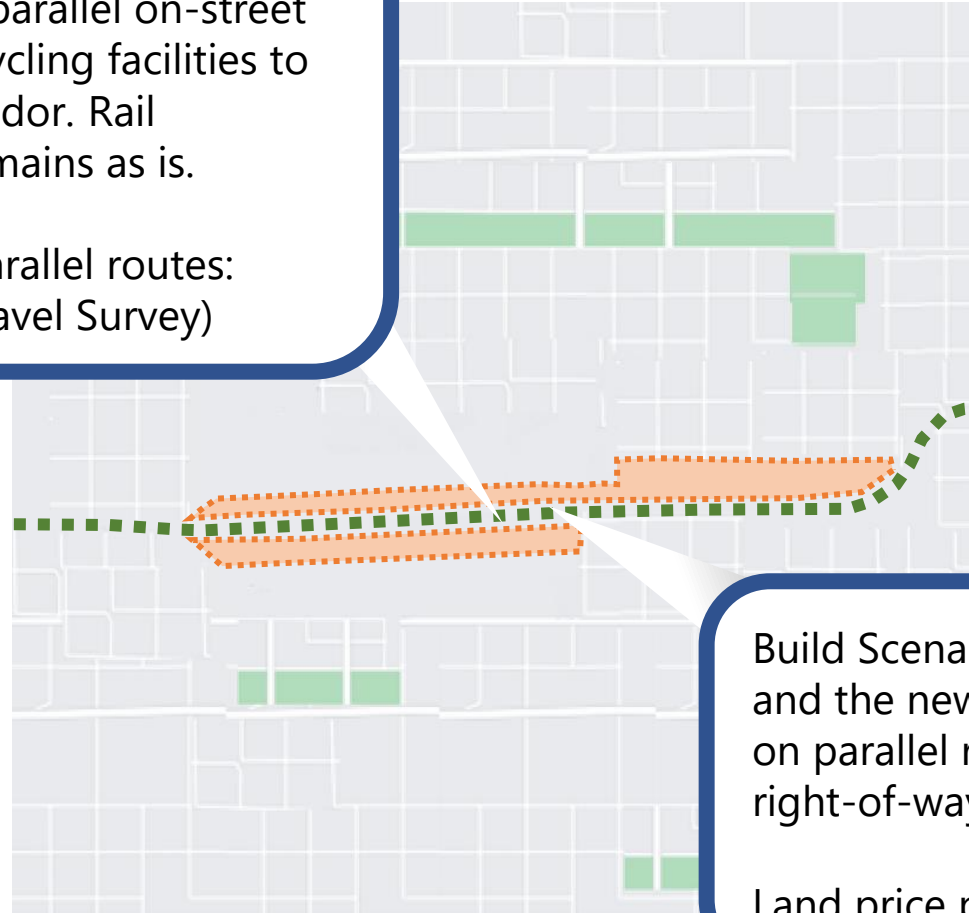




## Hypothetical Example #2

No-Build Scenario: Cyclists continue to use parallel on-street routes with no cycling facilities to traverse the corridor. Rail infrastructure remains as is.

Daily users on parallel routes:  
3,000 cyclists (Travel Survey)



Build Scenario: The rail infrastructure is removed and the new cycling path is completed. Cyclists on parallel routes shift to new facility. Excess right-of-way of 40 acres is sold.

Land price per acre: \$90,000 (Local Sale Comps)



# Approach

- **We want to compare the state of the world with and without the proposed project improvement**
  - No-Build Scenario: Abandoned rail infrastructure remains as is and cyclists use on-street parallel routes
  - Build Scenario: 2.0 miles of the abandoned rail line are converted to a cycling path for use by 3,000 daily cyclists and 40 acres of excess right-of-way are sold for future mixed-use development
- **The expected major benefit categories in this case would be:**
  - Amenity benefits to users given the addition of 2.0-miles of off-street cycling path, starting when the project opens
  - The sale of unused right-of-way for other purposes



## Amenity Benefits Example

- For simplicity, let's assume that all cyclists use the entire length of the facility, and no cycling growth over time

$$\text{Annual Amenity Benefits*} = \text{Improved Facility Length} \times \text{Daily Users} \times \text{Amenity Value Per Mile Cycled} \times \text{Annualization Factor}$$

\*Undiscounted.



## Amenity Benefits Example

- For simplicity, let's assume that all cyclists use the entire length of the facility, and no cycling growth over time

$$\text{Annual Amenity Benefits}^* = \text{Improved Facility Length} \times \text{Daily Users} \times \text{Amenity Value Per Mile Cycled} \times \text{Annualization Factor}$$

$$\text{Annual Amenity Benefits}^* = 2.0 \text{ Miles} \times$$

Distance traveled over new cycling path per user



## Amenity Benefits Example

- For simplicity, let's assume that all cyclists use the entire length of the facility, and no cycling growth over time

$$\text{Annual Amenity Benefits}^* = \text{Improved Facility Length} \times \text{Daily Users} \times \text{Amenity Value Per Mile Cycled} \times \text{Annualization Factor}$$

$$\text{Annual Amenity Benefits}^* = 2.0 \text{ Miles} \times 3,000 \times$$

Estimate based  
on travel survey

\*Undiscounted.



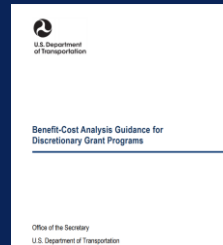
# Amenity Benefits Example

- For simplicity, let's assume that all cyclists use the entire length of the facility, and no cycling growth over time

$$\text{Annual Amenity Benefits}^* = \text{Improved Facility Length} \times \text{Daily Users} \times \text{Amenity Value Per Mile Cycled} \times \text{Annualization Factor}$$

$$\text{Annual Amenity Benefits}^* = 2.0 \text{ Miles} \times 3,000 \times \$1.49 \times$$

USDOT BCA Guidance



(Appendix A)

\*Undiscounted.



# Amenity Benefits Example

- For simplicity, let's assume that all cyclists use the entire length of the facility, and no cycling growth over time

$$\text{Annual Amenity Benefits}^* = \text{Improved Facility Length} \times \text{Daily Users} \times \text{Amenity Value Per Mile Cycled} \times \text{Annualization Factor}$$

$$\text{Annual Amenity Benefits}^* = 2.0 \text{ Miles} \times 3,000 \times \$1.49 \times 365$$

We expect this project to have an impact each day (not just weekdays, for example).



## Amenity Benefits Example

- For simplicity, let's assume that all cyclists use the entire length of the facility, and no cycling growth over time

$$\text{Annual Amenity Benefits}^* = \text{Improved Facility Length} \times \text{Daily Users} \times \text{Amenity Value Per Mile Cycled} \times \text{Annualization Factor}$$

$$\text{Annual Amenity Benefits}^* = 2.0 \text{ Miles} \times 3,000 \times \$1.49 \times 365$$

$$= \$3,263,100 \text{ Per Year}$$

\*Undiscounted.





## Excess Right-of-Way Sale Example

- **For simplicity, let's assume all excess land is sold at a single price per acre after project completion**

$$\begin{array}{ccccc} \text{Excess ROW} & & \text{Amount of Land} & & \\ \text{Benefits*} & = & \text{Made Available} & \times & \text{Land Price} \\ & & \text{for Sale} & & \end{array}$$

\*Undiscounted.



## Excess Right-of-Way Sale Example

- For simplicity, let's assume all excess land is sold at a single price per acre after project completion

$$\text{Excess ROW Benefits}^* = \text{Amount of Land Made Available for Sale} \times \text{Land Price}$$

$$\text{Excess ROW Benefits}^* = 40 \text{ Acres} \times$$

Excess right-of-way  
remaining after project

\*Undiscounted.



## Excess Right-of-Way Sale Example

- For simplicity, let's assume all excess land is sold at a single price per acre after project completion

$$\begin{array}{lcl} \text{Excess ROW} & & \text{Amount of Land} \\ \text{Benefits*} & = & \text{Made Available} \\ & & \text{for Sale} \end{array} \quad \times \quad \text{Land Price}$$

$$\begin{array}{lcl} \text{Excess ROW} & = & 40 \text{ Acres} \\ \text{Benefits*} & & \end{array} \quad \times \quad \$90,000 \text{ per Acre}$$

Based on recent  
land sale comps  
in the area

\*Undiscounted.



## Excess Right-of-Way Sale Example

- **For simplicity, let's assume all excess land is sold at a single price per acre after project completion**

$$\begin{aligned}\text{Excess ROW Benefits*} &= \text{Amount of Land Made Available for Sale} \times \text{Land Price} \\ \text{Excess ROW Benefits*} &= 40 \text{ Acres} \times \$90,000 \text{ per Acre} \\ &= \$3,600,000 \text{ after Project Completion}\end{aligned}$$

\*Undiscounted.



## Hypothetical BCA Example #2

- Assume construction in 2024, ten years of project operations, and no change in maintenance costs

| Year | Capital Cost | Discounted Costs | Amenity Benefits | Excess Land Sale | Discounted Benefits |
|------|--------------|------------------|------------------|------------------|---------------------|
| 2024 | \$20,000,000 |                  | \$0              | \$0              |                     |
| 2025 | \$0          |                  | \$3,263,100      | \$3,600,000      |                     |
| 2026 | \$0          |                  | \$3,263,100      | \$0              |                     |
| 2027 | \$0          |                  | \$3,263,100      | \$0              |                     |
| 2028 | \$0          |                  | \$3,263,100      | \$0              |                     |
| 2029 | \$0          |                  | \$3,263,100      | \$0              |                     |
| 2030 | \$0          |                  | \$3,263,100      | \$0              |                     |
| 2031 | \$0          |                  | \$3,263,100      | \$0              |                     |
| 2032 | \$0          |                  | \$3,263,100      | \$0              |                     |
| 2033 | \$0          |                  | \$3,263,100      | \$0              |                     |
| 2034 | \$0          |                  | \$3,263,100      | \$0              |                     |



# Hypothetical BCA Example #2

- Next, we discount costs and benefits using a 7% discount rate

**Discounted Value = Future Year Value / (1+Discount Rate)^(Future Year - Base Discounting Year)**

| Year | Capital Cost | Discounted Costs | Amenity Benefits | Excess Land Sale | Discounted Benefits |
|------|--------------|------------------|------------------|------------------|---------------------|
| 2024 | \$20,000,000 | \$16,325,958     | \$0              | \$0              | \$0                 |
| 2025 | \$0          | \$0              | \$3,263,100      | \$3,600,000      | \$5,235,826         |
| 2026 | \$0          | \$0              | \$3,263,100      | \$3,600,000      | \$4,893,345         |
| 2027 | \$0          | \$0              | \$3,263,100      | \$0              | \$2,174,341         |
| 2028 | \$0          | \$0              | \$3,263,100      | \$0              | \$2,032,095         |
| 2029 | \$0          | \$0              | \$3,263,100      | \$0              | \$1,899,154         |
| 2030 | \$0          | \$0              | \$3,263,100      | \$0              | \$1,774,910         |
| 2031 | \$0          | \$0              | \$3,263,100      | \$0              | \$1,658,795         |
| 2032 | \$0          | \$0              | \$3,263,100      | \$0              | \$1,550,275         |
| 2033 | \$0          | \$0              | \$3,263,100      | \$0              | \$1,448,855         |
| 2034 | \$0          | \$0              | \$3,263,100      | \$0              | \$1,354,070         |

$\$20,000,000 / (1+0.07)^{(2024-2021)}$

$(\$3,263,100 + \$3,600,000) / (1+0.07)^{(2025-2021)}$

$\$3,263,100 / (1+0.07)^{(2034-2021)}$

Note: Totals may differ slightly due to rounding



## Hypothetical BCA Example #2

- Next, we sum the discounted benefits and costs to get total discounted benefits and total discounted costs

| Year         | Capital Cost | Discounted Costs    | Amenity Benefits | Excess Land Sale | Discounted Benefits |
|--------------|--------------|---------------------|------------------|------------------|---------------------|
| 2024         | \$20,000,000 | \$16,325,958        | \$0              | \$0              | \$0                 |
| 2025         | \$0          | \$0                 | \$3,263,100      | \$3,600,000      | \$5,235,826         |
| 2026         | \$0          | \$0                 | \$3,263,100      | \$0              | \$2,326,545         |
| 2027         | \$0          | \$0                 | \$3,263,100      | \$0              | \$2,174,341         |
| 2028         | \$0          | \$0                 | \$3,263,100      | \$0              | \$2,032,095         |
| 2029         | \$0          | \$0                 | \$3,263,100      | \$0              | \$1,899,154         |
| 2030         | \$0          | \$0                 | \$3,263,100      | \$0              | \$1,774,910         |
| 2031         | \$0          | \$0                 | \$3,263,100      | \$0              | \$1,658,795         |
| 2032         | \$0          | \$0                 | \$3,263,100      | \$0              | \$1,550,275         |
| 2033         | \$0          | \$0                 | \$3,263,100      | \$0              | \$1,448,855         |
| 2034         | \$0          | \$0                 | \$3,263,100      | \$0              | \$1,354,070         |
| <b>TOTAL</b> |              | <b>\$16,325,958</b> |                  |                  | <b>\$21,454,867</b> |

Note: Totals may differ slightly due to rounding



## Results – The NPV and BCR

- Lastly, we calculate the project's net present value (NPV) and benefit-cost ratio (BCR)

$$\begin{aligned}\text{Net Present Value (NPV)} &= \text{Total Discounted Benefits} - \text{Total Discounted Costs} \\ &= \$21,454,867 - \$16,325,958 \\ &= \mathbf{\$5,128,910}\end{aligned}$$

$$\begin{aligned}\text{Benefit-Cost Ratio (BCR)} &= \frac{\text{Total Discounted Benefits}}{\text{Total Discounted Costs}} \\ &= \frac{\$21,454,867}{\$16,325,958} \\ &= \mathbf{1.3}\end{aligned}$$

Note: Totals may differ slightly due to rounding





## Hypothetical BCA Example #2

- **Other potential benefits such a project might have:**
  - Travel time savings for cyclists and pedestrians
    - If the new cycling path provides new shorter-distance connections
  - Mortality reduction from induced walking and cycling trips
  - Reduced emissions from modal shift to active transportation
  - Benefits to any induced cyclists
    - Remember to apply the “rule of half,” see Appendix B of BCA Guidance
- **This is not meant to be an exhaustive list**



## Remember Key Resources

- **The BCA Guidance**

- <https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance>
- The main body of the Guidance discusses methodology
- Appendix A has many useful input values
- Appendix B shows sample calculations

- **BCA webinars for previous USDOT discretionary grant programs**

- <https://railroads.dot.gov/rail-network-development/training-guidance/webinars-0>
- <https://www.transportation.gov/office-policy/rural/routes-webinar-bca>
- <https://www.transportation.gov/grants/reconnecting-communities/reconnecting-communities-additional-guidance>
- Note that parameter values updated each year

- **Project engineering and planning documents**



## Remember Key Resources

- **Local traffic counts and travel survey data**
- **U.S. Census Bureau**
- **Project partners (higher levels of government, MPOs, universities, etc.)**
- **Many BCAs submitted for other programs are publicly available via web search**
- **FRA's Crossing Inventory and Accident Reports**
  - <https://safetydata.fra.dot.gov/OfficeofSafety/PublicSite/Crossing/Crossing.aspx>
- **NHTSA's Fatality Analysis Reporting System**
  - <https://www.nhtsa.gov/research-data/fatality-analysis-reporting-system-fars>
- **The Crash Modification Factors Clearinghouse**
  - <https://www.cmfclearinghouse.org/>
- **Technical questions can be submitted to [RAISEgrants@dot.gov](mailto:RAISEgrants@dot.gov)**



# Avoiding Common Mistakes

- Make sure inputs and assumptions in the BCA are sourced and documented
- Make sure the submitted BCA and claimed benefits match the project being proposed for grant funding
- Show individual utility of different separable project components
- Provide an unlocked BCA spreadsheet (rather than a PDF of a spreadsheet)

|                        | C | D           | E                | F | G | H | I    | J            | K                       | L                       | M                | N                   |
|------------------------|---|-------------|------------------|---|---|---|------|--------------|-------------------------|-------------------------|------------------|---------------------|
| Improvement Length     |   | 2.0         | Miles            |   |   |   |      |              |                         |                         |                  |                     |
| Daily Users            |   | 3,000       |                  |   |   |   |      |              |                         |                         |                  |                     |
| Amenity Value          |   | \$1.42      | Per Cycling Mile |   |   |   |      |              |                         |                         |                  |                     |
| Annualization          |   | 365         |                  |   |   |   |      |              |                         |                         |                  |                     |
| Annual Amenity Benefit |   | \$3,109,800 |                  |   |   |   |      | Capital Cost | Discounted Capital Cost | Cycling Amenity Benefit | Excess Land Sale | Discounted Benefits |
|                        |   |             |                  |   |   |   | 2020 | \$0          | \$0                     | \$0                     | \$0              | \$0                 |
|                        |   |             |                  |   |   |   | 2021 | \$0          | \$0                     | \$0                     | \$0              | \$0                 |
|                        |   |             |                  |   |   |   | 2022 | \$0          | \$0                     | \$0                     | \$0              | \$0                 |
|                        |   |             |                  |   |   |   | 2023 | \$20,000,000 | \$16,325,958            | \$0                     | \$0              | \$0                 |
| Land Price             |   | \$90,000    | Per Acre         |   |   |   | 2024 | \$0          | \$0                     | \$3,109,800             | \$3,600,000      | \$5,118,874         |
| Amount of Land         |   | 40          | Acres            |   |   |   | 2025 | \$0          | \$0                     | \$3,109,800             | \$0              | \$2,217,244         |
| Sale Price             |   | \$3,600,000 |                  |   |   |   | 2026 | \$0          | \$0                     | \$3,109,800             | \$0              | \$2,072,191         |
|                        |   |             |                  |   |   |   | 2027 | \$0          | \$0                     | \$3,109,800             | \$0              | \$1,936,627         |
|                        |   |             |                  |   |   |   | 2028 | \$0          | \$0                     | \$3,109,800             | \$0              | \$1,809,932         |
|                        |   |             |                  |   |   |   | 2029 | \$0          | \$0                     | \$3,109,800             | \$0              | \$1,691,525         |
|                        |   |             |                  |   |   |   | 2030 | \$0          | \$0                     | \$3,109,800             | \$0              | \$1,580,865         |
|                        |   |             |                  |   |   |   | 2031 | \$0          | \$0                     | \$3,109,800             | \$0              | \$1,477,444         |
|                        |   |             |                  |   |   |   | 2032 | \$0          | \$0                     | \$3,109,800             | \$0              | \$1,380,788         |
|                        |   |             |                  |   |   |   | 2033 | \$0          | \$0                     | \$3,109,800             | \$0              | \$1,290,456         |
|                        |   |             |                  |   |   |   |      |              | \$16,325,958            |                         |                  | \$20,575,947        |
|                        |   |             |                  |   |   |   |      |              |                         |                         |                  |                     |
|                        |   |             |                  |   |   |   |      |              |                         |                         | NPV              | \$4,249,989         |
|                        |   |             |                  |   |   |   |      |              |                         |                         | BCR              | 1.3                 |



Q&A

# RAISE Grants

Rebuilding American Infrastructure with Sustainability and Equity



# QUESTIONS?