Simple Tool for Estimating Benefits of Closing Gaps in Active Transportation Networks

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Who are we?

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TREC
TRANSPORTATION RESEARCH and EDUCATION CENTER

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Jennifer Dill, PSU
Alta Planning & Design (Mike Sellinger, PI)
Fehr & Peers | Safe Streets
Cambridge Systematics

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Transportation Resource Hub

PACTRANS PACIFIC NW TRANSPORTATION CONSORTIUM REGION 10

ibpi Initiative for Bicycle & Pedestrian Innovation

PORTAL BikePed Portal

Hub

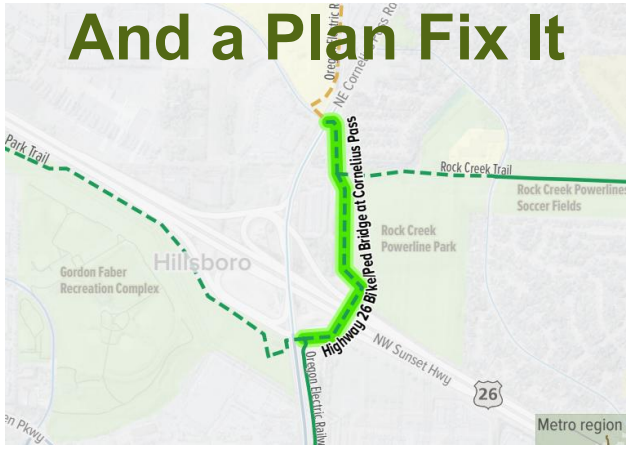
The Hub is funded through the Consolidated Appropriations Act of 2024 and administered through NIST.

NIST NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY U.S. DEPARTMENT OF COMMERCE

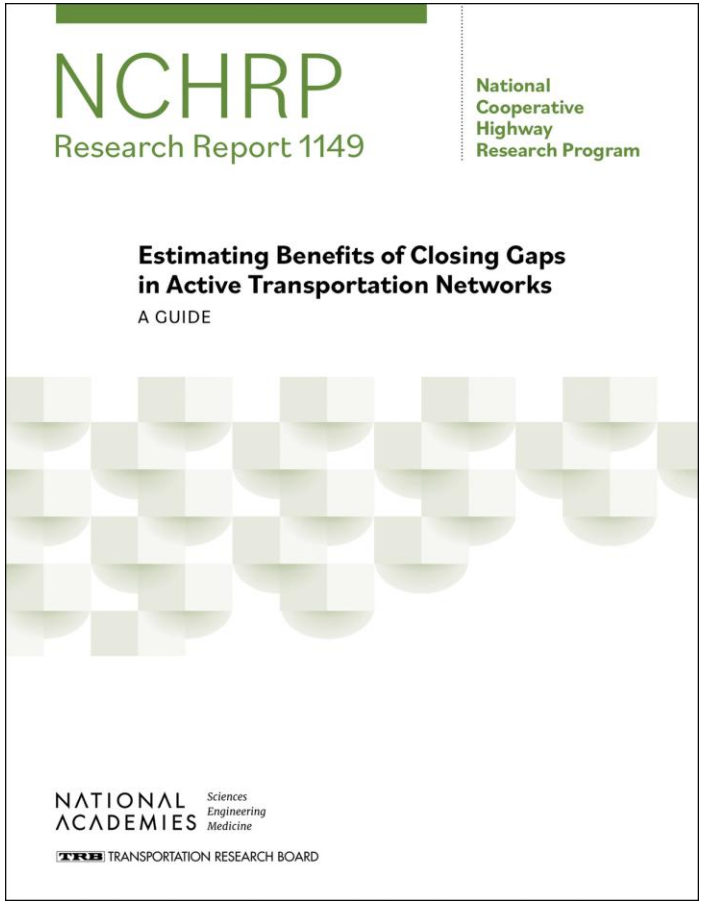
Resource center **supporting local, regional, and state agencies and tribal governments** across Oregon by **providing training, technical assistance, and technology transfer services** to help meet state and local decarbonization goals while enhancing livability, economic opportunity, and community outcomes.

https://trec.pdx.edu/resource-hub

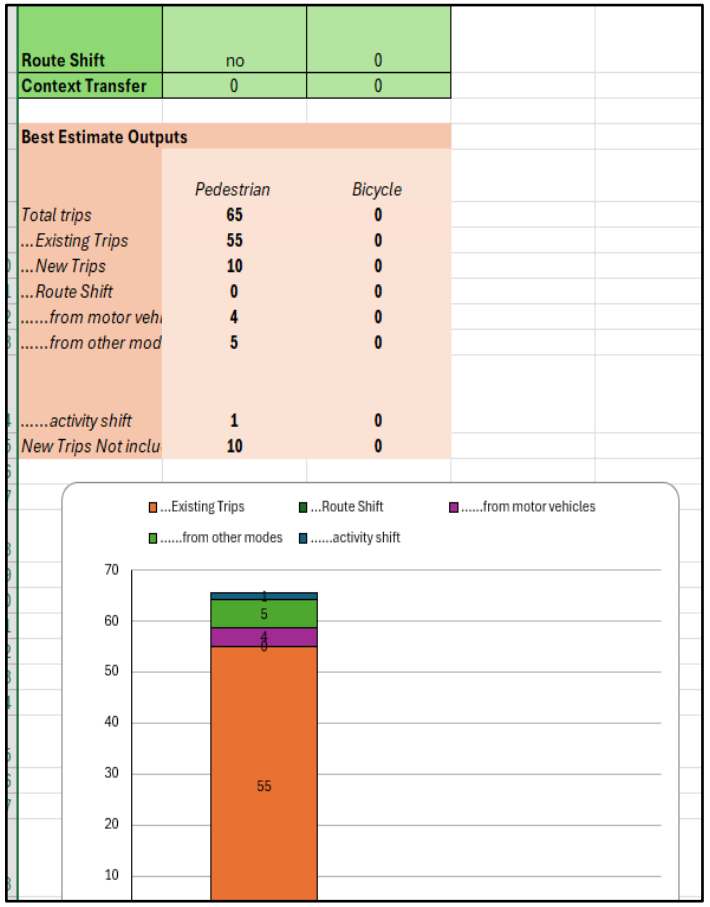
Overview



…Benefits?



A guide!



Route Shift	no	0
Context Transfer	0	0

Best Estimate Outputs

	Pedestrian	Bicycle
Total trips	65	0
...Existing Trips	55	0
...New Trips	10	0
...Route Shift	0	0
.....from motor vehi	4	0
.....from other mod	5	0
.....activity shift	1	0
New Trips Not inclu	10	0

A tool!

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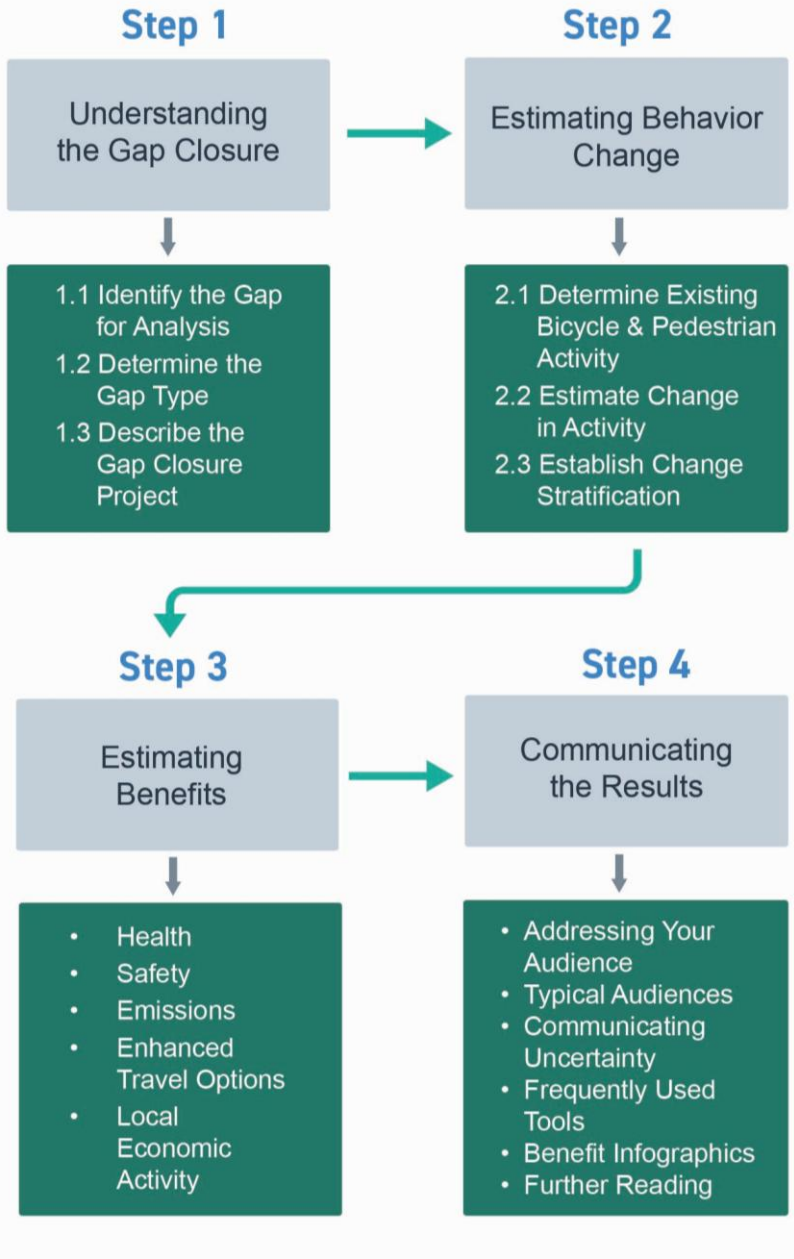
The Guide

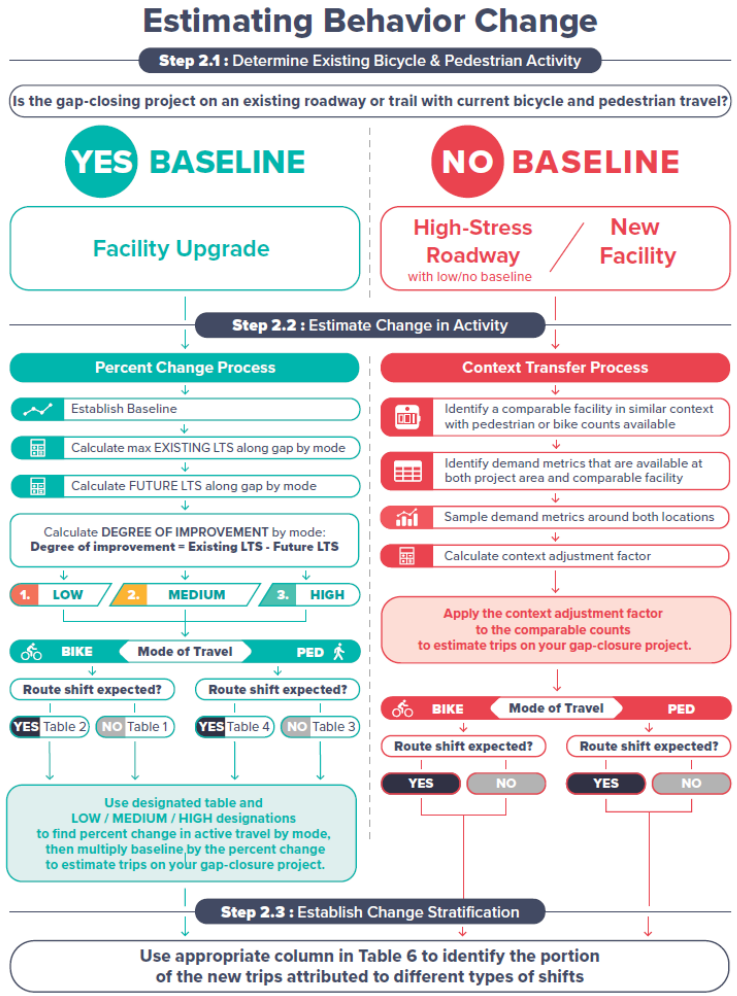
NCHRP 1149: Estimating Benefits of Closing Gaps in Active Transportation Networks: A Guide (2026)

- Gaps
  - missing infrastructure
  - substandard facilities
- Behavior change
  - walking and biking estimates after gap closure
  - stratification: new activity, shift from vehicles, route shift, shift from walk/transit
- Monetized Benefits (Basic, Enhanced, Advanced)
  - Health
  - Safety
  - Emissions
  - Travel Options
- And more!



The Tool

1



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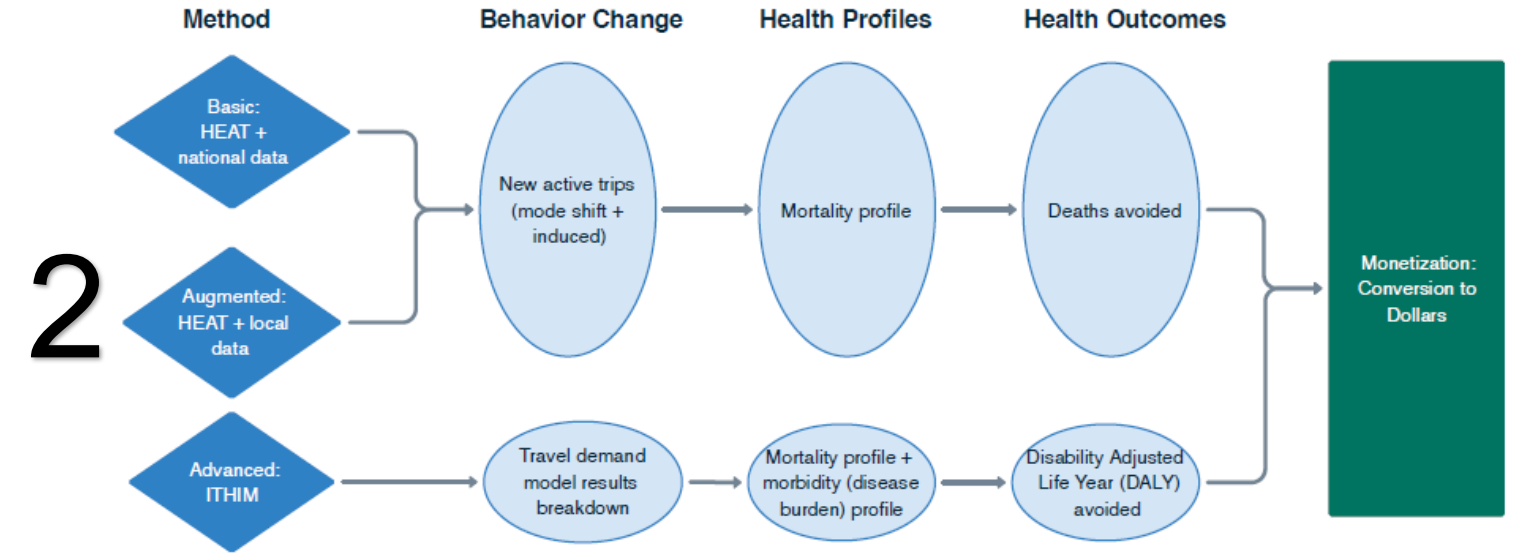


3

Estimated health benefits from walking = New walking trips per day for all ages × Percent of population within 20–74 age range × Health benefits per trip in that age group × 365 days

Estimated health benefits from bicycling = New bicycling trips per day for all ages × Percent of population within 20–64 age range × Health benefits per trip in that age group × 365 days

Table 9. National mu
BCA Guidance.

Mode	Per trip benefit	% of population in age range
Walking	$7.63	68% 20–74 years
Bicycling	$6.80	59% 20–64 years

Source: U.S. DOT (2023a).

Streamlined Basic Calculations

The Goal

1. Bring your gap, a project (proposed or actual), and bare minimum data to establish usage
2. Input basic information into a guided spreadsheet tool
3. Leave with outputs of behavior change and benefit estimates, along with a snapshot of calculations, assumptions, and references all in one place
4. Use the Guide to better understand and communicate your results (and explore more advanced methods—everything is modular!)

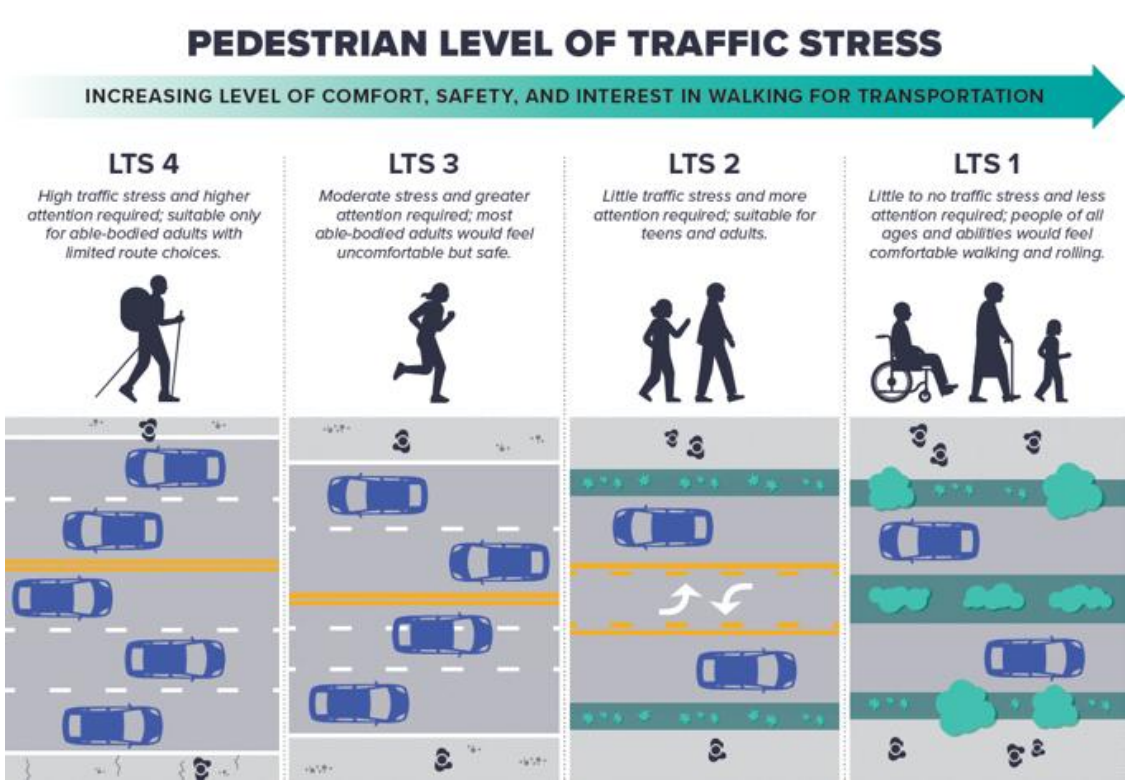
Example: Bike Lane Upgrade

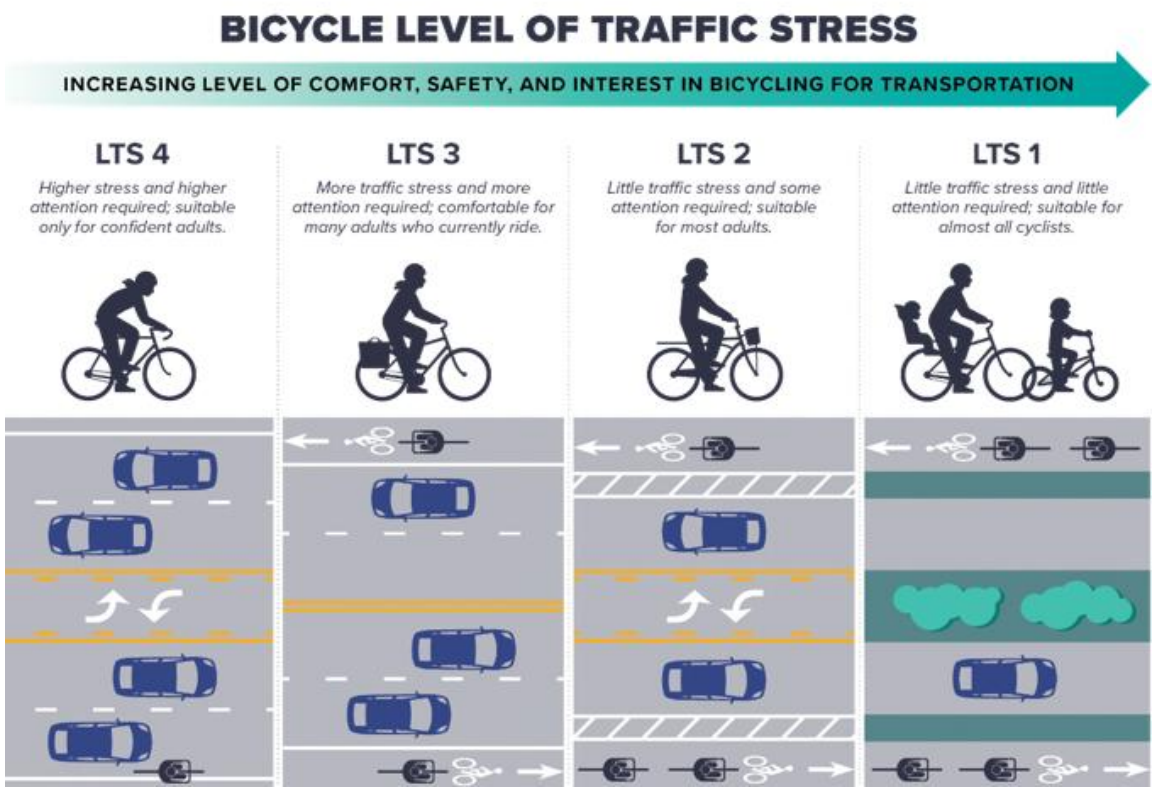
Example Case Study Bicycle

Name: Protected Bike Lane
User Type: Bicycle
Proposed Gap Type: Substandard infrastructure
Length of Facility in Miles: 1
Is there Significant route shift: Yes

Other Information Needed for Behavior Change
Baseline Ridership: For Bicycles
Annual Average Daily Baseline User Count: 100
Previous LTS: 3
Post-Project LTS: 2

Level of Traffic Stress





Example: Percent Change for Bike Lane Upgrade (LTS 3 -> 2)

Existing bike lane

100 daily bike trips

Project Element	Increase in Bicycle Travel *Where Significant Route Shift Expected*, %		
	Degree of Improvement (Number)		
	Low (1)	Medium (2)	High (3)
Trails/off-street paths	92%	254%	411%
Conventional bike lane	22%	131%	301%
Buffered/protected bike lane*	65%	174%	328%
Bicycle boulevard	68%	229%	387%
Road diet**	7%	12%	25%

100 x 0.65

=

65 new bike trips per day

On to shift shares...

Example: Shift Shares for Bike Lane Upgrade (LTS 3 -> 2)

From % Change

65

New Daily Bike Trips

Shift Type	Bicycle Shifts and New Travel (WITH Route Shift)	Bicycle Shifts and New Travel (NO Route Shift)
Vehicle shift	17%	43%
New travel / Trip generation	11%	28%
Route shift	60%	0%
Other mode shift	12%	29%

65 New Bike Trips at Location

11 from vehicle trips

7 new trips

39 from parallel routes

8 from non-vehicle trips (walk, transit)

100 Existing Bike Trips at Location

To Benefits...

Benefits Directly from Behavior Change: The Math (Basic Method)

Health

18 New Trips from Vehicle or Activity Shift

Mode	Per trip benefit	% of population in age range
Walking	$7.63	68% 20-74 years
Bicycling	$6.80	59% 20-64 years

18*$6.80*.59

=$73.02 (Daily) or

$26,651.72 annually

Travel Options

65 New Trips

100 Existing Trips

Recommended Monetized Value(s)	
Facility Type	**Recommend Value per Cycling Mile (2022 $)**
Cycling path with at-grade crossings	$1.57
Cycling path with no at-grade crossings[2]	$1.97
Dedicated cycling lane	$1.86
Cycling boulevard / "sharrow"[4]	$0.29
Separated cycle track	$1.86

(100+.5*65)*1*$1.86

=$246.45 (Daily) or

$89,954.25 annually

Emissions

11 from Vehicle Shift

Pollutant	2025	2030	2035	2040
Carbon Monoxide (CO)	3.648	2.641	1.989	1.664
Particulate Matter <2.5 µm ($PM_{2.5}$)	0.012	0.011	0.010	0.010
Particulate Matter <10 µm (PM_{10})	0.047	0.046	0.045	0.045
Nitrogen Oxide (NOx)	0.191	0.097	0.057	0.045
Volatile Organic Compounds (VOC)	0.156	0.107	0.086	0.078
Carbon Dioxide (CO_2)	371	336	NA	NA
Carbon Dioxide Equivalent (CO_2e)	374	339	NA	NA
Total Energy Consumption (MMBTU/day)	5.02	4.55	4.25	4.08

Year	CO_2 (value per metric ton)	NO_x (value per metric ton)	$PM_{2.5}$ (value per metric ton)
2025	$237	$20,300	$975,500

((11*2.38(avg. bike trip in miles)*.191*365)/1000)*$20,300 = $37.22

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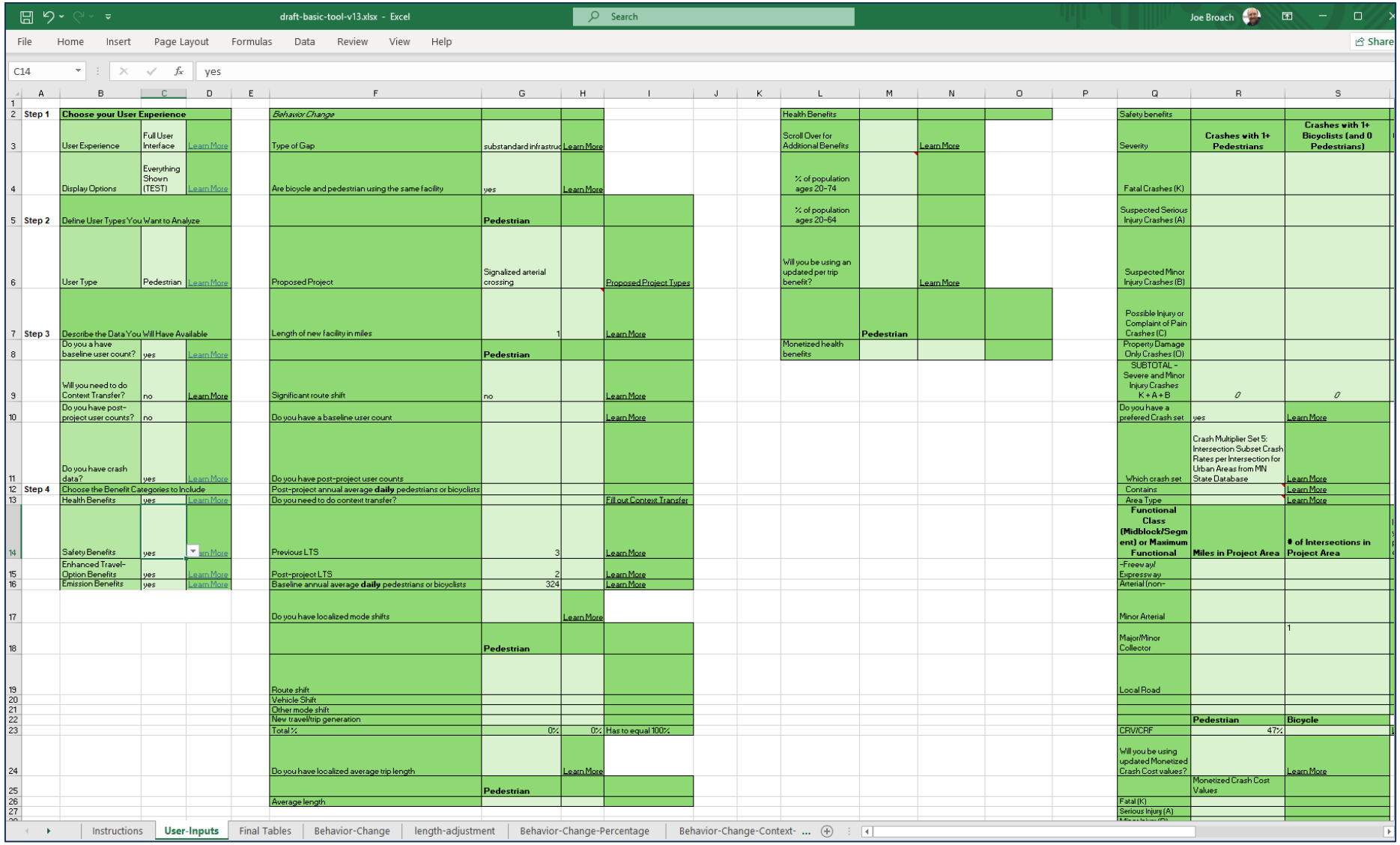
The Tool



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Adding an RRFB at an Existing Crossing

Example Case Study Pedestrian

Name: Adding an RRFB at an existing crossing
User Type: Pedestrian
Proposed Gap Type: Substandard infrastructure
Length of Facility in Miles:
Is there Significant route shift: No

Other Information Needed for Behavior Change
Baseline User Count: For Pedestrians
Annual Average Daily User Count: 324
Previous LTS: 3
Post-Project LTS: 2

Safety Benefits
Crash Data: No
Crash Set: Crash Multiplier Set #5
Road Type: Major/Minor Collector
# of Intersections: 1
CRV Pedestrian: 47% (Countermeasure ID: 9024)
CRV Bicycle: 0 – Were not using bicycle safety for this one

Source: Google

Quick Safety Guide

CRASH MODIFICATION FACTORS CLEARINGHOUSE

▼ Countermeasure: Install rectangular rapid flashing beacon (RRFB)

Compare	CMF	CRF(%)	Quality	Crash Type	Crash Severity	Area Type	Reference	Comments
☐	0.526	47.4	★★★★☆	Vehicle/pedestrian	All	Urban and suburban	ZEGEER ET AL., 2017	[READ MORE]

Things you need for safety
- CRF/CRV(%)
- How many crashes
  - Crash data
  - Crash multiplier sets

Crash Multiplier Set 5: Intersection Subset Crash Rates per Intersection for Urban Areas from MN State Database

Pedestrian

	Fatal (K) per Intersection	Suspected Serious Injury (A) per Intersection	Suspected Minor Injury (B) per Intersection	Possible Injury (C) per Intersection	Property Damage Only (O) per Intersection
Principal Arterial –Freeway/ Expressway	0.001331	0.003195	0.014377	0.011981	0.001597
ajor Arterial (non-Freeway)	0.004587	0.008028	0.015138	0.011468	0.001606
Minor Arterial	0.003204	0.01342	0.037149	0.030369	0.003436
Major/Minor Collector	0.000776	0.005797	0.012578	0.009576	0.00088
Local Road	0.000201	0.00109	0.002468	0.001707	0.000258

Bicycle

	Fatal (K) per Intersection	Suspected Serious Injury (A) per Intersection	Suspected Minor Injury (B) per Intersection	Possible Injury (C) per Intersection	Property Damage Only (O) per Intersection
Principal Arterial – Freeway/ Expressway	0.000799	0.001331	0.010916	0.013578	0.002129925
ajor Arterial (non-Freeway)	0.001147	0.00344	0.02156	0.013532	0.003440367
Minor Arterial	0.000557	0.005247	0.031391	0.022196	0.00492222
Major/Minor Collector	5.18E-05	0.00176	0.012112	0.007816	0.001759925
Local Road	2.87E-05	0.000416	0.00241	0.001248	0.000330005

Adding an RRFB at an Existing Crossing Inputs

Step 1	**Choose your User Experience**			*Behavior Change*			
	User Experience	Full User Interface	Learn More	Type of Gap	substandard infrastruc	Learn More	
	Display Options	All Categories at Once	Learn More				
Step 2	Define User Types You Want to Analyze				**Pedestrian**		
	User Type	Pedestrian	Learn More	Proposed Project	Signalized arterial crossing		Proposed Project Types
Step 3	Describe the Data You Will Have Available						
	Do you a have baseline user count?	yes	Learn More		**Pedestrian**		
				Significant route shift	no		Learn More
	Do you have crash data?	no	Learn More				
Step 4	Choose the Benefit Categories to Include						
	Health Benefits	yes	Learn More				
	Safety Benefits	yes	Learn More	Previous LTS	3		Learn More
	Enhanced Travel-Option Benefits	yes	Learn More	Post-project LTS	2		Learn More
	Emission Benefits	yes	Learn More	Baseline annual average **daily** pedestrians or bicyclists	324		Learn More

Do you have a prefered Crash set	yes	Learn More
Which crash set	Crash Multiplier Set 5: Intersection Subset Crash Rates per Intersection for Urban Areas from MN State Database	Learn More

Functional Class (Midblock/Segment) or Maximum Functional Class (Intersection)	**Miles in Project Area**	**# of Intersections in Project Area**	If using significant route shift you will need data from the parallel facility the route shift is expected to come from
Principal Arterial –Freeway/			
Arterial (non-			
Minor Arterial			
Major/Minor Collector		1	
Local Road			
	Pedestrian	**Bicycle**	
CRV/CRF	47%		Learn More

Travel Options			
	Pedestrian		
Proposed Project (Travel Options)	for Pedestrian Crossing on Roadway with Volumes		Learn More

Adding an RRFB at an Existing Crossing Results

Saftey Benefits — Number of Yearly Crahses Prevented from Gap Closure

	Pedestrians	Bicycles	Total
Fatal Crashes (K)	0.000072985172	0	0.000072985172
Suspected Serious Injury Crashes (A)	0.000544955788	0	0.000544955788
Suspected Minor Injury Crashes (B)	0.001182359354	0	0.001182359354
Possible Injury or Complaint of Pain Crashes (C)	0.00090015011	0	0.00090015011
Total Crashes Prevented	**0.002700450424**	**0**	**0.002700450424**

Annual Emissions Benefits — Avoided Emissions

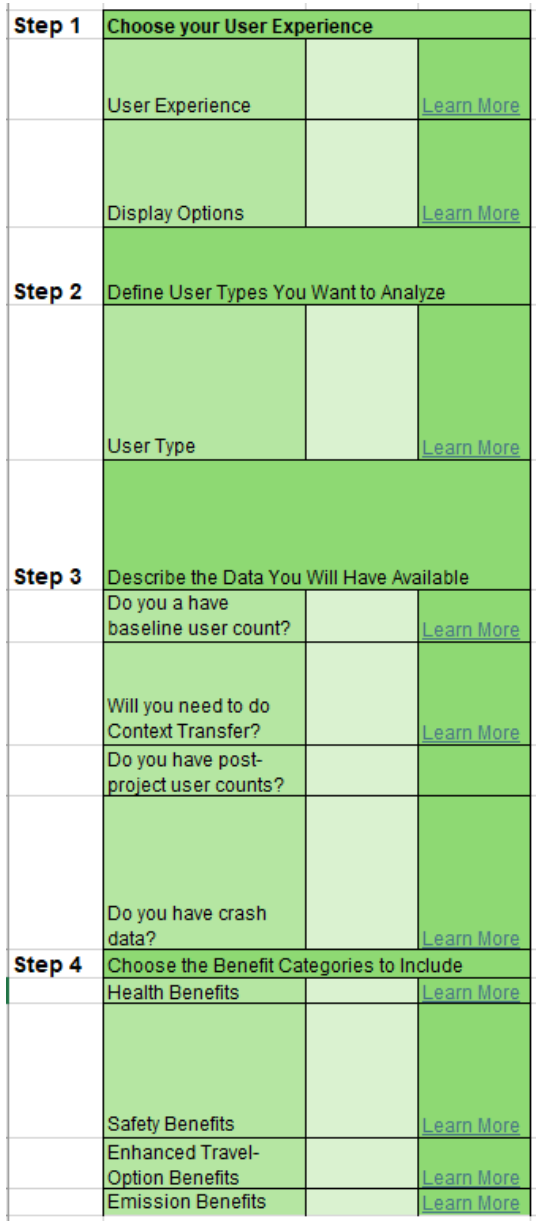
	Pedestrian	Bicycle	**Total**
Carbon Dioxide (CO_2) (Tons/Year)	1.0	0.0	**1.0**
Nitrogen Oxide (NOx) (Kilograms/year)	0.5	0.0	**0.5**
Particulate Matter <2.5 µm ($PM_{2.5}$) (Grams/Year)	30.8	0.0	**30.8**

Total Annual Monetary Benefits

	Pedestrian	Bicycle	Total
Total Trips	126,538	0	126,538
Health Benefits	$20,616	$0	$20,616
Safety Benefits	$1,937	$0	$1,937
Enhanced Travel-Option Benefits	$62,424	$0	$62,424
Emission Benefits	$265	$0	$265
Total Monetary Benefits	**$85,242**	**$0**	**$85,242**

Customization / Options

- User Experience
  - Basic
  - Full
  - Advanced/personalization
    - Localized data
    - Updated monetization values/other updates
    - Post-project counts/surveys
- Display Options
  - Benefit Category
  - All Categories at Once
- Benefit Categories Included



Step 1	**Choose your User Experience**		
	User Experience		Learn More
	Display Options		Learn More
Step 2	Define User Types You Want to Analyze		
	User Type		Learn More
Step 3	Describe the Data You Will Have Available		
	Do you a have baseline user count?		Learn More
	Will you need to do Context Transfer?		Learn More
	Do you have post-project user counts?		
	Do you have crash data?		Learn More
Step 4	Choose the Benefit Categories to Include		
	Health Benefits		Learn More
	Safety Benefits		Learn More
	Enhanced Travel-Option Benefits		Learn More
	Emission Benefits		Learn More

Communicating Results

Metro

TUALATIN HILLS PARK & RECREATION DISTRICT

Westside Trail Bicycle & Pedestrian Bridge

Tualatin Hills Park & Recreation District

Construction of the Westside Trail Bicycle and Pedestrian Bridge will complete a key trail segment in the Metro Regional Trail system and connect the 25-mile-long Westside Trail over U.S. 26, linking communities from King City to the City of Portland.

Described within Metro's 2014 Westside Trail Master Plan as "a crucial link, without which intersecting Westside Trail sections would not be functional," the bridge closes a critical gap in the region's active transportation network, improving access to housing, schools, jobs, local businesses, parks, recreation centers, public transit hubs, and downtown cultural and commercial districts. The bridge will create a safe off-street alternative to nearby high-crash and high-injury corridors for over 100,000 pedestrians, runners, and cyclists using the Westside Trail each year. Key destinations served by this project include Sunset High School, businesses including the Nike and Columbia Sportswear world headquarters, and the Cedar Mill 2040 Town Center.

State & Federal Agency Coordination

The Westside Trail and the bridge are in the right-of-way of power transmission lines and will also cross U.S. 26 right-of-way. Construction will require coordination with the Bonneville Power Administration and Portland General Electric, as well as the Oregon Dept. of Transportation (ODOT) and Washington County. Other permits and coordination will be required from Oregon Dept. of Environmental Quality, Oregon Dept. of State Lands, and the U.S. Army Corps of Engineers.

Project Partners

- ***Lead agency: Tualatin Hills Park & Recreation District***
- Oregon Department of Transportation
- Washington County
- City of Beaverton

Total Estimated Project Cost

- Up to $35.4 million
- *In 2024, THPRD will begin design and engineering of the bridge, further refining the cost estimate and developing construction drawings. Depending on regulatory, engineering, and construction constraints, the total cost to develop the bridge, inclusive of all project phases, could range from $28.1 to $35.4 million.*

Remaining Funding Gap

- $24.7-32 million

In Summer 2024 Metro staff collaborated with local agency partners to compile a list of "shovel-ready" projects key to building out the regional trail system, with fact sheets that can be used to advocate for and secure state, federal, and private funding for trail design and construction.

Graphics are for illustration purposes only and may not reflect final designs.

oregonmetro.gov

Image credit: Toole Design/THPRD

Project Vicinity

Multi-use Trail
Existing
Planned
Conceptual

On-Street Connection
Existing
Planned

Estimated Annual Project Outcomes and Impact When Project is Complete[1]

- Trail users: 399,000
- Tons of greenhouse gases reduced: 40
- VMT[2] reduction: 175,000
- Enhanced amenities benefits[3]: $299,000
- Emission benefits: $11,000
- Health benefits: $294,000
- Total emissions, amenities, and health benefits: $604,000

1 - These benefits were calculated using outputs from the Metro travel demand model and guidance from the forthcoming NCHRP 08-140 Report. Values are in 2022 dollars.
2 - Vehicle Miles Traveled
3 - Enhanced amenity benefits include reductions in travel costs and quality improvements experienced by the user.

Major Opportunities & Constraints

The project will serve areas of higher concentrations of people of color and lower average household incomes than the region overall. It will provide low- and no-cost transportation options within an ODOT-identified transportation-disadvantaged area, in addition to providing street, dedicated pedestrian alternative to existing near crossings identified as high high-injury corridors by Wa County's 2016 Transportati Plan and Metro's 2017 High & Intersections Report.

The bridge will serve as a ca development of unbuilt seg Westside Trail north and so 26, many of which are being concurrently with the bridg

Current work in progress in development of final const documents, which are expected within fiscal year 2027-28. This project is essentially "shovel-ready" and if remaining funding were secured the Westside Trail bridge could move to secure permits and proceed with construction.

Project Contact

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Metro

October 2024

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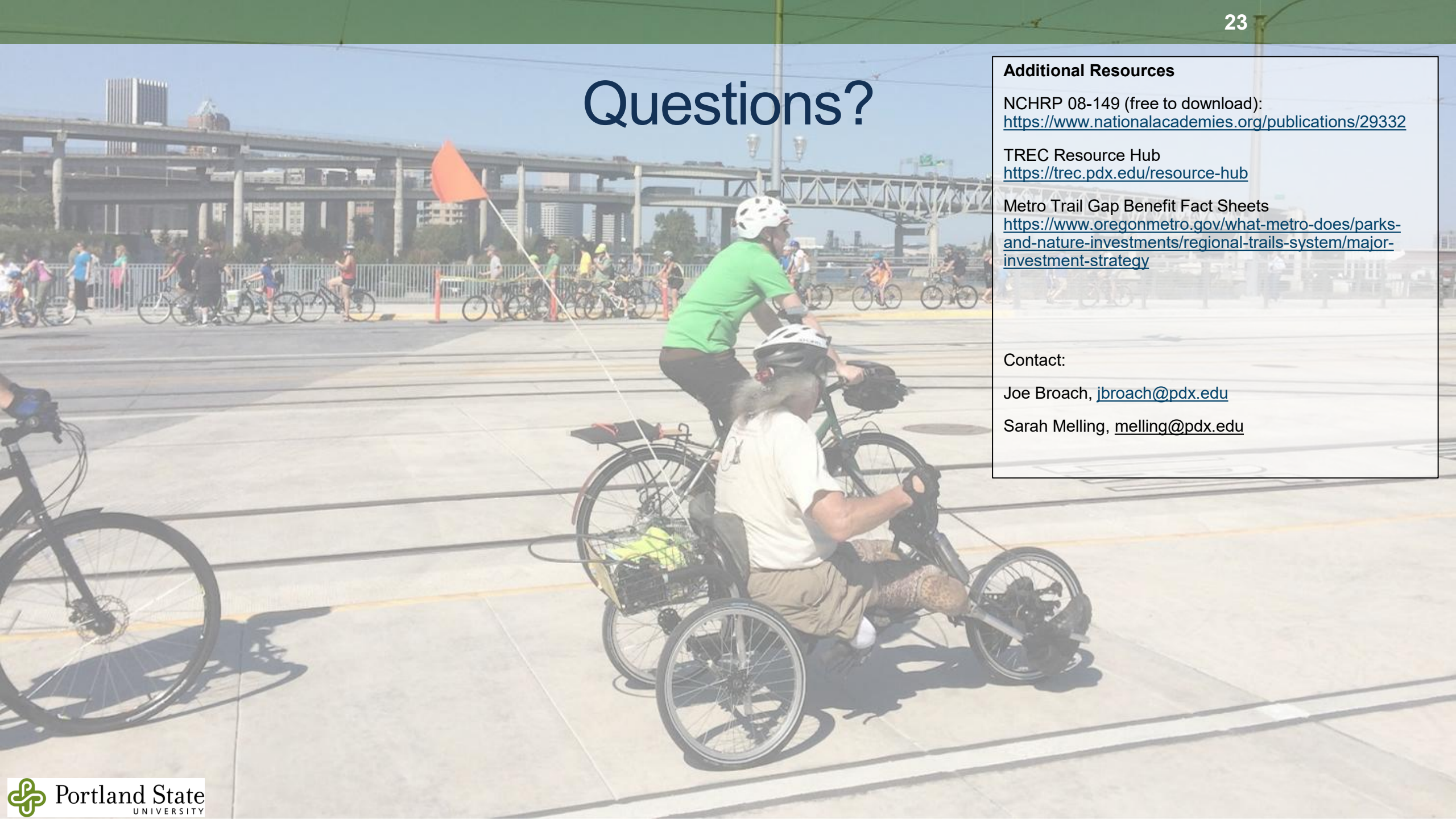
- Total emissions, amenities, and health benefits: $604,000

Thank you!

Please feel free to talk to or email me (melling@pdx.edu) at any time and I will happily answer any questions or show you in depth examples of the tool (Graduating in June if you have a need for an analyst or a policy person)!

Also we are looking for beta testers for the tool! If interested please reach out to Joe! jbroach@pdx.edu

Questions?



Additional Resources

NCHRP 08-149 (free to download):
https://www.nationalacademies.org/publications/29332

TREC Resource Hub
https://trec.pdx.edu/resource-hub

Metro Trail Gap Benefit Fact Sheets
https://www.oregonmetro.gov/what-metro-does/parks-and-nature-investments/regional-trails-system/major-investment-strategy

Contact:

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