Appendix F. Estimating Active Transportation Bridge Trips Methodology

Interstate BRIDGE Replacement Program

DRAFT Estimating Active Transportation Bridge Trips Methodology

February 2023

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Estimating Active Transportation Bridge Trips Methodology

CONTENTS

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

IBR	Interstate Bridge Replacement
VMT	vehicle miles traveled
SR	State Route
I-5	Interstate 5

1. INTRODUCTION

This memo describes the methodology to forecast 2045 bicycle and pedestrian trips across the Columbia River.

The 2045 bicycle and pedestrian trips were determined by evaluating three types of shifts in behavior that might accompany new or improved facilities planned as part of the Interstate Bridge Replacement (IBR) program, including:

- Mode shift: People may switch from driving to walking or biking (CARB 2019; Sevtsuk et al. 2021; Scheepers et al. 2014).
- Activity shift: As a result of reducing gaps in the active transportation network, people may take new trips as they shift activities to walk or bike more (CARB 2019).
- Route shift: Active transportation users may switch from a parallel route to the improved segment (CARB 2019; Sevtsuk et al. 2021). The new route may be safer, more comfortable and more direct.

The range of possible responses to active transportation improvements is tied to a combination of factors that include built context, infrastructure and traveler characteristics.

The two methods used to generate the range of active transportation estimates fall into two categories:

1. Method 1. Short Trips Conversion: Estimates are generated by examining short trip rates across the Interstate bridge that could be converted to active travel. For the purposes of this analysis, a threshold of trip distances less than 3 miles was used to identify convertible trips to yield a conservative estimate for analysis.
2. Method 2. Percent Ridership Inflation: Estimates are based on literature-derived percentage increases in active transportation from similar trail or bridge facility projects. Existing literature documents evidence from resources such as before and after intercept surveys that document percentage increases in total ridership. These same resources also provide data that support the stratification of this increase into feasible rates of mode, route and activity shift.

These two methods were employed to estimate mode shift to active transportation from vehicle trips under optimistic (high), moderate (medium) and conservative (low) scenarios.

2. EXISTING TRIP ESTIMATES AND COUNTS

Both active transportation forecasting methodologies depend on annual average bicycle and pedestrian activity across the Columbia River using the bridge's active transportation facilities. This analysis uses a 24-hour count conducted on October 19, 2022, when a combined total of 296 bicyclists and pedestrians were observed using the facility. This count was collected on a clear day when the ambient temperature was around 75 degrees Fahrenheit; however, the air quality was low due to an extreme wildfire smoke event. Therefore, the fall 2022 count was adjusted up to 410 based on literature review stating the travel impacts that smoke events have on active behavior of bicyclists and pedestrians.

In addition to these counts, the project team reviewed count data of comparable projects to develop supplemental reviews of other datasets and best practices that may aid in the understanding of active traveler activity across the bridge.

2.1 Existing I-5 User Counts

The counts used for this analysis are based on a 24-hour bicycle and pedestrian count on October 19, 2022 (Wednesday), when a combined total of 296 bicyclists and pedestrians was counted during this time period. This count was conducted during a day in October with relatively warm (75 degrees Fahrenheit), clear weather (no rain or similar) but during a significant smoke event. This count looked at southbound and northbound bicycle and pedestrian activity near the I-5 ramps on Hayden Island. Due to poor air quality conditions, adjustments to the counts were necessary.

2.1.1 Adjustments to Count

During this day, nearby wildfires pushed the air quality as measured by sensors at Portland's Roosevelt High School to unhealthy for approximately half the day (see Figure 2). This likely impacted activity across the bridge, but the degree of impact is unclear. To account for this, the project team looked for potential literature on the impact wildfire smoke might have on bicycle and pedestrian activity in the Pacific Northwest. This search yielded a paper looking at changes in activity in eight bicycle counters and two pedestrians counters in 2018 in Seattle during a wildfire smoke event (Doubleday et al. 2021). They reported reductions of up to 36% for bikes and 45.2% for pedestrians. To provide a conservative estimate of the impact smoke might have had on the counts, these values were adjusted up to account for the wildfire event. The project team considered the development of a seasonal estimate after this correction, given that this count was collected in October, but given the unusually temperate weather conditions during this time of the year, a more conservative estimate after the wildfire correction was considered sufficient as a basis for an annualized estimate of existing counts. This is documented in Table 1, which outlines the adjustment factors and the literature sources from which they are derived. Post-adjustment, with rounding to the nearest 10, the project team estimates a reasonable average daily count of 410 active travelers.

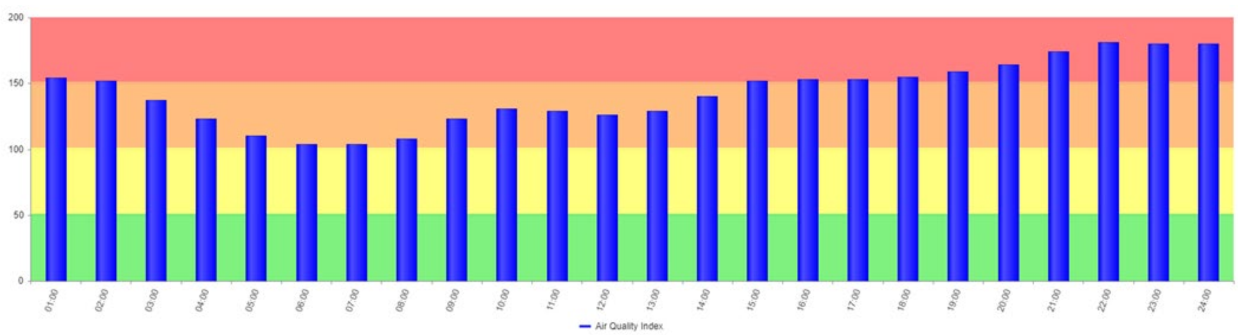
Table 1. Summary of Existing Count Adjustment Factors

	Pedestrians	Bicyclists	Total
Oct. 19 – 24-Hour Count	91	205	296
Air Quality Index Adjustment Factor	1.452[1]	1.3601	-
Air Quality Index Adjusted	132	279	411
Adjusted Count	-	-	410[2]

Notes:

1. Based on maximum reported reductions from Doubleday, Annie, Youngjun Choe, Tania Isaksen, and Nicole Errett (2021). Urban bike and pedestrian activity impacts from wildfire smoke events in Seattle, WA. Journal of Transport & Health. 21. 101033. 10.1016/j.jth.2021.101033.
2. Final totals were rounded to the nearest 10. Seasonal adjustment was not used, and count is assumed to be typical given the good weather and the existing adjustment made here.

Figure 1. Air Quality Index readings from Portland Roosevelt High School, near the Interstate Bridge on October 19, 2022.



2.2 Permanent Counts Review

In addition to collecting new counts, permanent counts were reviewed. Reviewing active transportation counts collected for both State Route 520 (SR 520) on the floating bridge and Interstate 5 (I-5) at the Interstate Bridge revealed several irregularities in the data. SR 520 data had missing values, but the trendline was more reliable than I-5 data. Within the permanent counts, the trendline data displayed troughs and peaks, with the peaks being unreliable.

2.2.1 Context Transfer StreetLight Data

In addition to this review of the permanent count data, the project team attempted to do a context transfer analysis with StreetLight Data's bike and pedestrian index. StreetLight Data zones were created that span the SR 520 trail near Seattle and the existing Interstate Bridge paths. I-5 had zones created between the north bank of the Columbia River and the Columbia Slough. To estimate the existing rates of active travelers on I-5, StreetLight Data zones between SR 520 and Columbia Slough were used for comparison. The I-5 south zone was selected because it captured shorter trips to Hayden Island from Portland and was likely more representative of the total bicycle and pedestrian activity on the bridge. This analysis yields results far outside a reasonable range for the bridge year-round. The project team moved away from this supplemental analysis upon its review. It yielded multipliers relative to travel on the SR 520 trail in the range of 3.8 and above, which was far too high to be considered a possible count.

3. ACTIVE TRANSPORTATION TRIP FORECAST ESTIMATES

The IBR team used two methods — Method 1: Short Trip Conversion, and Method 2: Percent Ridership Inflation Method — to estimate active transportation mode shift estimates. As mentioned above, two methods were employed to estimate mode shift to active transportation from vehicle trips under optimistic (high), moderate (medium) and conservative (low) scenarios.

3.1 Method 1. Short Trip Conversion

The role of a trip distance's connection to active transportation is well established in research surrounding the influence of the built environment on transportation behavior (Cervero and Kockelman 1997; Saelens et al. 2003; McCormack et al. 2004; Kuzmyak et al. 2014). The short trip estimation method is the most conservative of the two approaches, as it is using a small-distance bandwidth to identify convertible trips relative to the trip distances of cross-bridge trips.

While short trips are indicators of trips that can be met using active modes, it is unrealistic to expect that it would be possible to convert all short trips to active transportation. While many people are forecast to travel across the Interstate Bridge, very few are currently making short trips (less than 3 miles). This is a result of a few factors:

1. Automobile volumes: Volume of regional and interstate traffic.
2. Distance: Length of the Interstate Bridge and distance between local origins and destinations.
3. Land use: Low-density land use on the Portland side of the Interstate Bridge.
4. Barriers: Physical and perceived barriers associated with natural features, grade changes, and highway and interchange environments.
5. Heavy or bulky loads: In many cases, cargo bikes can support many types of grocery or shopping trips, but some heavy loads are often bulky or heavy enough to encourage the use of a vehicle.
   - Travel trip type: Some shared trips are chained in ways where using active transportation for the entire trip is difficult. For example, if one leg of a tour that is part of a chain of trips is too long to consider using an active mode, the entire tour may be better made using a vehicle.
   - Physical impairment: Some members of the community may have an impairment that prevents them from comfortably using active transportation.

- Personal preference: Some members of the community may elect to never bike or walk even if an all ages and abilities network is provided in a community.

These limitations on active trip potential and literature related to it inform the thresholds for what percentage of short trips can be converted to active modes (Mackett 2003).

The Short Trip Conversion method converts short-distance auto trips to active transportation trips based on improved facilities and travel time. For the purposes of this analysis, a threshold of trip distances less than 3 miles was used to identify convertible trips to yield a conservative estimate for analysis. Figure 3 visualizes existing short trip vehicle flows. As part of this analysis, Big Data from StreetLight pass-through zones were drawn on the north and south ends of the Interstate Bridge. This pass-through analysis was intended to provide estimates of short trips and bicycle and pedestrian activity for comparison. Based on a pass-through zone analysis, there seem to be both short trips and bicycle and pedestrian trips that would use active transportation modes to travel across the river if the facility was improved. Figure 4 visualizes existing bicycle and pedestrian trips.

Based on the StreetLight Data estimate, total vehicle trips across the I-5 are estimated to average 143,400, but only 1.6% of those trips are less than 3 miles. This translates roughly to 2,300 trips being within the range considered as potentially available for mode shift. However, the upper limits for this can be estimated by research looking at why people who make short trips might not be using active modes.

For example, researchers have asked short-trip drivers about their modal alternatives. While 22% considered no alternatives to driving, 31% considered transit, 31% considered walking, and another 7% considered cycling. These survey data are based on people's existing perceptions of travel options, but it could suggest an upper limit of active transportation mode shift of around 40% for active modes (Mackett 2003).

Other research evaluating trip potential of micromobility have suggested scenarios of micromobility usage (15%, 30%, and 44%) among short trips (less than 3 miles) (Harper et al. 2021). The range of conversion to active modes caps at less than half.

The ranges of possible conversion to active modes is based on the thresholds used by Harper et al. but informed by the other research on the topic as well. The short trip estimation method assumes mode shifted trips are converted, and then generated trips identified on top of those converted trips.

Figure 2. Visualization of existing short vehicle trip flows from supplemental zonal analysis. These show regional trips that are less than 3 miles and were provided for a conceptual view of regional short trip flows near the bridge.

Figure 3. Visualization of existing bicycle and pedestrian trips from supplemental zonal analysis.

The estimates of active transportation users and the number of mode-shifted trips from short trip conversion analysis are presented in Table 2.

Table 2. Estimated Active Transportation Trips Using the Short Trip Conversion Method

		Scenario 1: Conservative	Scenario 2: Moderate	Scenario 3: Optimistic
a	Existing Daily Pedestrian and Bicycle Trips [1]	410	410	410
b	Short Car and Motorcycle Daily Trips (<3 miles)	2,300	2,300	2,300
c	*Mode Shift Factor* [2]	*15%*	*30%*	*40%*
d	Mode Substitution Trips (b x c)	350	690	920
e	Existing and Mode Substituted Trips (a + d)	760	1,100	1,330
f	*Generated Trips Factor* [3]	*10%*	*15%*	*20%*
g	Generated Trips (e x f)	80	170	270
h	**TOTAL TRIPS (a + d + g)**	**840**	**1,270**	**1,600**

1 Based on the Green Lanes Study (Monsere et al. 2014) and California Air Resources Board Literature Review of Bike & Pedestrian infrastructure's impact on vehicle miles traveled (VMT) (CARB 2019). Other studies specifically looking at short-trip conversion rates for micromobility were consulted, but the range of percentages is ultimately a range of scenarios intended to inform a range of possible responses to bridge construction. There is no accounting for route shift or trip diversion from other pathways in this estimate because there are no feasible competing crossing options.

2 The counts used for this analysis are based on a 24-hour bicycle and pedestrian count on October 19, 2022 (Wednesday), when a combined total of 296 bicyclists and pedestrians were counted during this time period. This count was conducted during a day in October with relatively warm (75 degrees Fahrenheit), clear weather (no rain or similar) but during a significant smoke event. To account for this, the project team looked for potential literature on the impact wildfire smoke might have on bicycle and pedestrian activity in the Pacific Northwest. This search yielded a paper looking at changes in activity in eight bicycle counters and two pedestrians counters in 2018 in Seattle during a wildfire smoke event (Doubleday et al. 2021). They reported reductions up to 36% for bikes and 45.2% for pedestrians. To provide a conservative estimate to the impact smoke might have had on the counts, these values were used to adjust the counts during this wildfire event up to 410.

3 Based on California Air Resources Board Literature Review of Bike & Pedestrian infrastructure's impact on VMT Modal Substitutional Estimates table using the approximate average percentage of new trips. Ranges for new trips were 2% to 22%. Generated trips are assumed to be a contributor relative to generated existing and converted trips as a type of backward stratification exercise.

3.2 Method 2. Percent Ridership Inflation

The literature-based inflation method references evidence from similar projects (trails/protected bikeways) and attempts to estimate increases in activity from some established baseline (CARB 2019; Monsere et al. 2014). Existing literature documents evidence from resources such as before and after intercept surveys that document percentage increases in total ridership. These same resources also provide data that support the stratification of this increase into feasible rates of mode, route, and activity shift.

The literature used to inform these estimates includes Lessons from Green Lanes Study (Monsere et al. 2014) and a California Air Resources Board Literature Review on the VMT reductions attributable to bicycle projects (CARB 2019). Literature and findings from Chapter 16 (Pedestrian and Bicycle Facilities) Transit Cooperative Research Program (TCRP) Report 95 Traveler Response to Transportation Systems Changes were consulted to inform limitations of source datasets, such as intercept surveys, and as a secondary source of traveler response data (Pratt et al. 2012).

One of the observations made in TCRP Report 95 is that many of the studies recording active transportation before and after studies often can have trouble controlling for exogenous variables or resolving lags in behavior that stabilize maybe six to seven years into the future (Pratt et al. 2012). Additionally, a lack of standardization can be a concern in aggregated results in ridership response from multiple studies (Pratt et al. 2012). These challenges are not unique in transportation research but are considerations for literature-based inflation estimates for active travel.

Previous studies looking at increases in bicycling across 44 facilities (34 bike lanes, six cycle tracks, two paths and two bike boulevards) found a mean 110% ridership change across all facility types (CARB 2019). Within that study, higher-quality facilities that replaced existing bike facilities were shown to have reduced changes in ridership relative to new facilities (CARB 2019). The Lessons from Green Lanes Study found improvements associated with cycle tracks on bike facilities that were two way had increases that ranged from 46% to 126% (Monsere et al. 2014). Studies that did not distinguish between bicyclists and pedestrians looking at increases in traffic on trails (Class I facilities) saw percentage changes of between 38% and 189% (CARB 2019). The high-quality facilities under consideration for the IBR program would see estimates in this range for active transportation use. Based on the rates and the types of projects reported, rates of 20%, 30% and 70% were identified as potential mode shift conversion rates. Except for the optimistic scenario, these assumptions produce similar mode shift estimates to our short trips analysis as a point of comparison.

For the IBR program, the route diversion percentage is assumed to be 0% because there are no realistic routes competing with the bridge connection. Trips that are not mode shift from automobile or generated can either be attributed to mode shift from other modes or be apportioned to generated trips.

The resulting estimates of active travelers and the number of mode-shifted trips from the percent inflation method are summarized in Table 3.

Table 3. Estimated Active Transportation Trips Using Bridge Percent Inflation Mode Shift Method

		Scenario 1: Conservative	Scenario 2: Moderate	Scenario 3: Optimistic
a	Existing Daily Pedestrian and Bicycle Trips [1]	410	410	410
b	*Percent Inflation Factor* [2]	*80%*	*120%*	*160%*
c	New Pedestrian and Bicycle Trips (a x b)	330	490	660
d	*Mode Shift Substitution Percentage* [3]	*20%*	*30%*	*70%*
e	Mode Shifted Trips (c x d)	70	150	460
f	*Generated Trip Percentage* [4]	*15%*	*20%*	*25%*
g	Generated Trips (c x f)	50	100	170
h	*Route Diversion Percentage* [5]	*0%*	*0%*	*0%*
i	Route Diversion Trips (a x h)	0	0	0
j	Other New Trips (c – (e + g + i)) [6]	210	240	30
k	**TOTAL TRIPS (a + c)**	**740**	**900**	**1,070**

1 The counts used for this analysis are based on a 24-hour bicycle and pedestrian count on October 19, 2022 (Wednesday), when a combined total of 296 bicyclists and pedestrians were counted during this time period. This count was conducted during a day in October with relatively warm (75 degrees Fahrenheit), clear weather (no rain or similar) but during a significant smoke event. To account for this, the project team looked for potential literature on the impact wildfire smoke might have on bicycle and pedestrian activity in the Pacific Northwest. This search yielded a paper looking at changes in activity in eight bicycle counters and two pedestrians counters in 2018 in Seattle during a wildfire smoke event (Doubleday et al. 2021). They reported reductions up to 36% for bikes and 45.2% for pedestrians. To provide a conservative estimate to the impact smoke might have had on the counts, these values were used to adjust the counts during this wildfire event up to 410.

2 Based on the Green Lanes Study (Monsere et al. 2014) and California Air Resources Board Literature Review of Bike & Pedestrian infrastructure's impact on VMT (CARB 2019). Percent inflation factors are based on ranges from trails and protected bike lane projects ridership response as a conservative estimate for responses to a high-quality facility. The percentage change from protected bicycle facilities and trails ranged from 21% to 500%, but the average rates of increase for trails and protected bicycle facilities (> 1 mile in length) were 100% and 118%, respectively.

3 Based on CARB's literature review of intercept surveys looking to understand the rates of modal substitution, route shift and new trip taking. Ranges for mode shift substitution from automobile were from 11% to 72%. Numbers selected are based on the range of observed modal substitution rates in the literature and special focus on studies also in Portland, Oregon.

4 Based on CARB's literature review of intercept surveys looking to understand the rates of modal substitution, it is seen that routes have shifted and new trips are not taking longer. Ranges for new trips were 2% to 22%. Induced trips are assumed to be a contributor relative to induced existing and converted trips as a type of backward stratification exercise. Given the quality of facility being proposed, a higher induced trip rate was assumed.

5 Route diversion percentage is assumed to be 0% because there are no realistic routes competing with the bridge connection. Trips that are not mode shift from automobile or induced can be either reattributed to mode shift from other modes or apportioned to induced trips.

6 Other trips are a catchall for all new trips not stratified by this analysis. This could be modal substitution from other modes or other trips not explicitly stratified by literature derived rates. This can be quite high depending on the estimate and could appropriately be reapportioned into the other stratifications if a less conservative estimate was desired for modal substitution or induced trips.

A range of estimates is possible for active travel and mode shift from automobile usage after the construction of a high-quality bicycle and pedestrian facility across the Columbia River. Based on these two methods, future active transportation trips across the bridge in the moderate estimate scenario are estimated to be between 740 and 1,600 per day.

4. REFERENCES

CARB (California Air Resources Board). 2019. Quantifying Reductions in Vehicle Miles Traveled from New Bike Paths, Lanes, and Cycle Tracks. https://ww2.arb.ca.gov/sites/default/files/auction-proceeds/bicycle_facilities_technical_041519.pdf

Cervero, R., and K. Kockelman. 1997. Travel demand and the 3Ds: Density, diversity, and design. Transportation Research Part D: Transport and Environment, 2(3), 199-219. https://doi.org/10.1016/S1361-9209(97)00009-6

Doubleday, Annie, Youngjun Choe, Tania Isaksen, and Nicole Errett. 2021. Urban bike and pedestrian activity impacts from wildfire smoke events in Seattle, WA. Journal of Transport & Health. 21. 101033. 10.1016/j.jth.2021.101033.

Harper, C., and Z. Fan. 2021. Environmental impacts of short car trip replacement with micromobility modes. Mobility21. https://rosap.ntl.bts.gov/view/dot/60107

Kuzmyak, R., J. Walters, M. Bradley, and K. Kockelman. 2014. Estimating Bicycling and Walking for Planning and Project Development: A Guidebook. NCHRP Report 770. ISSN 0077-5614. https://nap.nationalacademies.org/catalog/22330/estimating-bicycling-and-walking-for-planning-and-project-development-a-guidebook

Mackett, R.L. 2003. Why do people use their cars for short trips? Transportation, 30(3), 329-349. https://doi.org/10.1023/A:1023987812020

McCormack, G., B. Giles-Corti, A. Lange, T. Smith, K. Martin, and T.J. Pikora. 2004. An update of recent evidence of the relationship between objective and self-report measures of the physical environment and physical activity behaviours. Journal of Science and Medicine in Sport, 7(1), 81-92. https://doi.org/10.1016/S1440-2440(04)80282-2

Monsere, C., J. Dill, K. Clifton, and N. McNeil. 2014. Lessons from the Green Lanes: Evaluating Protected Bike Lanes in the U.S. https://trec.pdx.edu/research/project/583/Lessons_from_the_Green_Lanes:_Evaluating_Protected_Bike_Lanes_in_the_U.S._

Pratt, R., J. Evans, IV, H. Levinson, S. Turner, Chawn Yaw Jeng, and D. Nabors. 2012. Chapter 16, Pedestrian and Bicycle Facilities. In H. Levinson (Ed.), TCRP Report 95 – Traveler Response to Transportation Systems Changes. Transit Cooperative Research Program.

Saelens, B.E., J.F. Sallis, and L.D. Frank. 2003. Environmental correlates of walking and cycling: findings from the transportation, urban design, and planning literatures. Annals of Behavioral Medicine, 25(2), 80-91. https://doi.org/10.1207/S15324796ABM2502_03.

Scheepers, C.E., G.C.W. Wendel-Vos, J.M. den Broeder, E.E.M.M. van Kempen, P.J.V. van Wesemael, and A.J. Schuit. 2014. Shifting from car to active transport: A systematic review of the effectiveness of interventions. https://doi.org/10.1016/j.tra.2014.10.015

Sevtsuk, A., R. Basu, X. Li, and R. Kalvo. 2021. A big data approach to understanding pedestrian route choice preferences: Evidence from San Francisco, Travel Behav. Soc., vol. 25, pp. 41–51, 2021, doi: https://doi.org/10.1016/j.tbs.2021.05.010.

WSDOT (Washington State Department of Transportation). 2019. Bicycle and Pedestrian Count Programs. https://wsdot.wa.gov/about/transportation-data/travel-data/bicyclist-and-pedestrian-count-programs.