Houston Parks and Recreation Department / Houston Parks Board 2018 H-GAC Call for Projects
10/30/2018

Alternative Benefit Cost Analysis Memo

Projects:

Little White Oak Bayou Regional Greenway
Port Connector Greenway
West Side / Westpark Connector Greenway

Operations and Maintenance Cost

Based on standard estimates provided by the Houston Parks and Recreation Department (the entity that will be maintaining the new shared use paths after they are completed), the operations and maintenance costs for Projects #1-#4 and #6 are calculated at $16,000 per mile for the first 10 years of the project, and then $33,000 per mile for years 11 and beyond. The maintenance costs include trash removal, pavement repair, traffic controls (pavement marking, signs, and traffic signal maintenance), and landscape maintenance.

Demand

To estimate demand for each of the projects, we used the University of Minnesota's formula available at http://www.pedbikeinfo.org/bikecost/step1.cfm. The methodology behind that formula relies heavily on National Cooperative Highway Research Program's Report 552, and the formula's methodology is discussed at this webpage: http://www.pedbikeinfo.org/bikecost/methodology.cfm.

Using this website, we calculated demand twice—once to reflect a medium demand and a second time (relying partly on the website) to reflect a low demand. For the medium demand calculation, we used the American Community Survey 2010 Means of Transportation to Work numbers for the City of Houston. Using that survey's estimate of 961,240 workers, 4,393 of whom commute to work by bicycle, we arrived at a 0.457% bicycle commute rate for the City of Houston. We used actual population densities calculated from census data using buffers in GIS. We then entered the length of the project in meters as reflected by the worksheet titled Medium Demand in the BCA Workbook (Attachment 6). To calculate our medium benefits for the TIGER IV projects, we used the number of existing commuters, new commuters, existing bicyclists and new bicyclists provided by the University of Minnesota's formula referenced above.

Because the range of recreational bicyclists varies dramatically, we chose to calculate low demand as well. However, rather than use low demand numbers that were provided by the above formula (which accounts for little more than the bicyclists represented in the commute share),[8] we tweaked the model to arrive at the following low demand estimate. Using the density numbers we used for the medium demand, we lowered the American Community Survey by the margin of error to arrive at a 0.329% bicycle commute share. As we did for the medium demand estimate, we then entered the length of the project in meters as reflected by the worksheet titled Low Demand in BCA Workbook. However, we only used the existing commuter and new commuter numbers from the formula. To arrive at the existing and new bicyclists numbers for the low demand estimate, we limited this number to 10% of the overall population within the 1.5 mile bike shed for each project. The total of existing and new bicyclists for each project in the medium demand estimate ranged from 22-23%, so the low demand represents the lowest possible Houston commute share and less than half the number of recreational bicyclists estimated for the medium demand. To calculate the existing and new bicyclists, we then divided the number totaling 10% of the residents in the bike shed between the existing bicyclists and the new bicyclists to reflect the division of those two numbers provided by the above formula in estimating the medium demand.

These medium demand and low demand numbers were then used to calculate the range of monetized benefits for each of the projects. We believe these estimates are conservative based on an alternate calculation that we have performed using the August 2008 National Survey of Bicyclists and Pedestrian Attitudes and Behavior conducted by the U.S. Department of Transportation's National Highway Traffic Safety Administration. Based on that survey, 43% of respondents bicycle at least once during the summer. Of respondents who bicycle at least once during the summer, the average number of days that they had bicycled in the preceding month was 5. Using these alternative numbers to calculate the number of bicycle rides per month, we estimate that the monthly bicycle rides for all residents in the bike shed of the TIGER IV projects will total 519,369. Our bicycle demand estimates following the University of Minnesota model puts the number of bicycle rides per month (3 each week for each existing bicyclists) between 220,395 (Low) and 542,038 (Medium). Thus, the recreation demand numbers used in this BCA are 42% (Low Demand) and 104% (Medium Demand) of the estimated monthly rides using the August 2008 Survey. See the worksheet titled Alternative Demand in the BCA Workbook (Attachment 6). Given that bicycle ridership is higher during the non-summer months in Houston and given that we do not calculate a separate recreational value for pedestrians as stated below, we believe these benefits estimated for recreation to be a conservative for both bicyclists and pedestrian recreational benefits.

Mobility Benefits

See worksheets titled Low Demand and Medium Demand in the BCA Workbook

According to the National Cooperative Highway Research Program's Report 552 "on average respondents are willing to travel about 22 additional minutes if an off-road bike path is available if the alternative is to bike in traffic."[11] For each of the shared use paths created by the TIGER IV projects, the alternative to the proposed shared use path is to "bike in traffic." Assuming an hourly value of time for all travel purposes of $12.50 (as provided by the TIGER Benefit Cost

Analysis Resource Guide), the per-trip benefit is $4.58. The University of Minnesota research then multiplies the per-trip benefit for the appropriate facility by the number of daily existing and induced commuters, and then doubles it to include trips both to and from work. This results in a daily mobility benefit. Multiplying the daily benefit by 50 weeks per year and 5 days per week results in an annual benefit.

However, we believe that this calculation likely reflects benefits from safety, recreation and possibly health that bicycle commuters attribute to the shared use paths. To the extent that this amount does reflect a safety benefit, it is likely that this benefit is at least partially redundant of the value calculated elsewhere.

To ensure that the benefits were not double counted, we calculated the recreation value and the safety value for the shared use path for both existing and new commuters. The recreation value was calculated at the same $12 value for the round trip commute that was used for recreational bicyclists. The safety benefit was calculated by dividing the total number of all bicycle commuters by the total number of bicyclists. This number was then multiplied by the total safety benefit. To arrive at the Alternative Mobility Benefit, we added the commuter safety benefit to the commuter recreation benefit. The mobility benefit for commuters as calculated by this BCA totaled $907,630 (Low); $1,310,686 (Medium). The mobility benefit for commuters as calculated our Alternative Mobility Benefit calculation totaled $1,300,124 (Low) and $1,784,492 (Medium). Thus, our numbers are more conservative than the alternative calculations by 70% and 73% respectively, without calculating health benefits or any other benefits ascribed to the longer route. See worksheet titled Alternative Mobility Benefit in the BCA Workbook (Attachment 6). These lower numbers for the mobility benefit provide a certain degree of certainty that the mobility value to the commuter of the new shared use path is not overvalued. The suggestion that the mobility calculation is a good indicator of value still leaves open the possibility that individual commuters may differ on how they define the mobility benefit and the proportion of the benefit that they ascribe to recreation, actual safety, a sense of safety, a reduction of the number of traffic signals and stop signs, or health including emotional health that comes from reducing interactions with automobiles on high speed roads.

Thus, for the mobility benefit used in our calculations, we used the University of Minnesota's calculation, but we reduced that amount by the amount of the safety benefit we calculated for all bicycle commuters.

One additional significant mobility benefit provided by the bayou shared use paths, that is not factored into our calculations, is the near absence of intersections along the paths. As mentioned elsewhere, the paths pass under existing bridges, and thus provide the bicyclists with miles of paths uninterrupted by traffic signals, stop signs, or other intersections. Since urban shared use paths in many other cities do not have this feature, we believe the likelihood of attracting existing and new bicyclists to the TIGER IV shared use paths is higher than indicated by the numbers we have used following the University of Minnesota's model. However, while recognizing this significant benefit, we have chosen not to monetize it as a separate benefit. Instead, we point to this benefit as a reason for believing that the mobility benefits above are conservative and that Houston's bicycle commute share will see an increase over the coming

decades similar to the increase seen by cities like Chicago, Denver and Washington D.C. after they invested in bicycle infrastructure.

For these reasons, we have used the following formula to calculate the mobility benefit:

Mobility Benefit = ($4.58 * (Existing Commuters + New Commuters) * 50 weeks * 5 days * 2 trips) – Safety Benefit for Commuters

Health Benefits

See worksheets titled Low Demand and Medium Demand in the BCA Workbook

The University of Minnesota's methodology relied on the National Cooperative Highway Research Program's Report 552 to value an annual per-capita cost savings from physical activity of $128. The University of Minnesota's methodology arrived at this valuation by taking the median value of ten studies referenced in Report 552. They then multiplied $128 by the total number of new bicyclists to arrive at an annual health benefit (Annual health benefit = total new cyclists * $128).

According to Report 552, "the daily recommended level of physical activity is defined as 30 minutes of moderate physical activity on 5 or more days per week. Thus, cycling 5 miles in 30 minutes or 4 miles in 15 minutes would meet these current public health guidelines for physical activity."[12]

Because we estimate that the new bicyclists will bicycle on average 3 times a week rather than the 7 times a week used by the University of Minnesota, we have reduced our health benefit to reflect only 60% of the value that would occur if the new bicyclists used the new shared use path at least five times a week. Thus, the calculation used for the annual health benefit for the TIGER IV projects = total new cyclists * $128 * 0.6. As discussed above in the section regarding Demand, this reduction to only 3 times a week is a conservative calculation based on Houston's mild winters and the numbers reported in the August 2008 National Survey of Bicyclists and Pedestrian Attitudes and Behavior conducted by the U.S. Department of Transportation's National Highway Traffic Safety Administration.

Arguably, there are health benefits that would accrue for existing bicyclists who will bicycle more frequently as a result of the TIGER IV projects. However, we have chosen not to attempt to monetize that value since we found no recommended way of calculating those potential benefits. Additionally, we believe that there are significant health benefits to transit riders, pedestrian commuters, and recreational walkers and runners that will use the shared use paths. However, identifying how much of this value is new value versus transferred value and estimating the actual demand from pedestrians for these paths proved difficult to monetize. Thus, we mention these benefits as an additional reason for believing that TIGER IV health benefits calculated for just bicyclists are very conservative numbers when considering the wide range of likely shared path users.

Health Benefit = Total New Cyclists * $128 * 0.6

Recreation Benefits

See worksheets titled Low Demand and Medium Demand in the BCA Workbook

According to the National Cooperative Highway Research Program's Report 552, a wide variety of studies of outdoor recreational activities (non-bicycling) generated typical values of about $40 per day in 2004 dollars. If a typical day of recreation is about 4 hours, this would be about $10/hour. This is an estimate of the net benefits, above and beyond the value of the time taken by the activity itself. This estimate is also in line with a recent study of urban trails in Indianapolis, which used the travel cost method to find typical implied values per trip of about $7–$20.

Report 552 notes that the "typical" day involves about an hour of total bicycling activity, so it values a day at $10 (D). From both NHTS and Twin Cities TBI, the average adult cycling day includes about 40 minutes of cycling. By including the average ride time plus some preparation and cleanup time, they arrive at an hour for the typical ride time. Given that the TIGER Benefit-Cost Analysis Resource Guide indicates that local travel time for personal purposes should be valued at $12 an hour, we have increased the value of an hour-long bicycle ride to $12 for the average recreational cyclists.

Report 552 concludes that the formula for the Annual recreation benefit is as follows: (New bicyclists – New commuters) * D * 365. We believe that any calculation that assumes recreational bicyclists will use the shared use path 365 days a year is a little optimistic. We have chosen to reduce the average number of times per week the shared use path will be used by recreational bicyclists to an average of 3 times a week. As discussed above in the section regarding Demand, this reduction to only 3 times a week is supported by numbers reported in the August 2008 National Survey of Bicyclists and Pedestrian Attitudes and Behavior conducted by the U.S. Department of Transportation's National Highway Traffic Safety Administration. Thus, we have used the following calculation for the Annual Recreation Benefit:

Recreation Benefit = (New bicyclists – New commuters) * $12 * 52 weeks * 3 days.

As noted above in the Health Benefits section, we have also reduced the health benefits accordingly since the new bicyclists that are recreating only 3 days a week will not receive the full value of the health benefit since they are falling short of the recommended 30 minutes of moderate exercise five times a week.

As noted elsewhere, we find it likely that existing bicyclists will also increase the number of times per week that they recreate due to the new shared use path. However, we have not calculated this increased recreational value for the existing bicyclists since no standard model existed to predict an increase in recreational benefits to existing bicyclists. Finally, we believe that there are significant recreational benefits to transit riders, pedestrian commuters, and recreational walkers and runners that will use the shared use paths. However, identifying how much of this value is new value versus transferred value and estimating the actual demand from pedestrians for these paths proved difficult to monetize. Thus, we mention these benefits as an additional reason for believing that recreational benefits calculated for just bicyclists are very conservative numbers when considering the wide range of likely shared path users.

Reduction in Pedestrian Injuries and Fatalities

See worksheets titled Low Demand and Medium Demand in the BCA Workbook

Injury and fatality numbers used for this calculation were drawn from the Houston- Galveston Area Council (H-GAC) June 2009 report titled "The State of Safety in the Region."[16] Because H-GAC's numbers are reported for the entire county (the City does not provide a similar report), we calculated the percentage of the Harris County population that lives inside the City of Houston, and used this percentage to calculate the estimated number of injuries and fatalities that occur inside of Houston. Based on the number of annual pedestrian fatalities reported by the Bicycling and Walking in the United States 2010 Benchmarking Report, the number of pedestrian fatalities are low for the City of Houston. Rather than calculating them to be higher, we kept the lower numbers as one more reason why these benefit estimates are conservatively drawn. We then took H-GAC's KABCO scaled accident numbers, and converted them using the formula provided in the TIGER Benefit-Cost Analysis Resource Guide. Using the values provided in that guide, we arrived at the Estimated Total Value of Bicyclists Fatalities & Injuries for Houston. See the worksheet titled Safety in the BCA Workbook (Attachment 6).

For each project we then calculated the number of residents living with 0.5 miles of the project using the University of Minnesota's formula available at http://www.bicyclinginfo.org/bikecost/.[17]

If each of the TIGER IV projects could reduce the chance of a pedestrian accident for all residents within 0.5 miles of the project, the value of those reduced pedestrian injuries and fatalities would average $6,103,863. This (ultimately overvalued) estimate rests on two assumption: (1) that a pedestrian's chance of an injury causing traffic accident drops to nearly zero if they are on the shared use path and (2) that 100% of the pedestrians in the pedestrian shed (0.5 miles) will walk all of their pedestrian miles on the new shared use path. For reasons stated below, we accept the first assumption but reject the second assumption and greatly reduce the calculated benefits accordingly.

We analyzed the first assumption using data provided the National Highway Traffic Safety Administration in its June 2008 National Pedestrian Crash Report.[18] Looking at nationwide pedestrian fatalities (crash deaths) for years 1997 to 2006, we calculated 7 pedestrian fatalities on a bike path out of 49,128 pedestrian crash fatalities for the same time period. Thus, an estimated 0.01% of all pedestrian crash fatalities occur on bike paths. See the worksheet titled Safety in the BCA Workbook (Attachment 6).

While we did not find similar data for pedestrian injuries, we expect a similar (though likely slightly higher) percentage of pedestrian crash injuries occur on bike paths. Regardless, a full 86% of the Estimated Total Value of Pedestrian Fatalities and Injuries for Houston is attributable to pedestrian fatalities, so even if incidents of pedestrian crash injuries on bike paths are slightly higher than incidents of pedestrian crash fatalities on bike paths, the estimated value of those injuries will likely be nominal. Thus, though not entirely accurate, we believe that the assumption that a pedestrian's chance of an injury causing traffic accident drops to nearly zero if

they are on a shared use path is mostly accurate for purposes of calculating benefits from pedestrian safety. However, Project #5 includes a significant portion of its projects that are not shared use paths. While these projects improve safety, they likely do not reduce the chance of a pedestrian crash injury or accident like a shared use path does. For Project #5, we have reduced the value of the benefits from reduced pedestrian injuries and fatalities by 50%.

The second assumption (that 100% of the pedestrians in the pedestrian shed (0.5 miles) will walk all of their pedestrian miles on the new shared use path) is more problematic. Assuming that pedestrian trips taken for exercise, health, leisure or recreation inside the pedestrian 0.5 mile shed will use the shared use path, we reduce the pedestrian safety value to reflect the percentage of all pedestrian trips taken for exercise, health, leisure or recreation. According to the August 2008 National Survey of Bicyclist and Pedestrian Attitudes and Behavior, 28% of all walking trips are for exercise or health and 21% of all walking trips are for recreation or leisure. Thus, we count only 49% of the pedestrian safety value. While we know that the shared use paths will be used to connect to public transit and for utilitarian trips, we do not calculate these benefits since it is difficult to know what percentage of the pedestrians trips will be used for non-recreational purposes, and any value here will be netted out by the likely small number of recreational pedestrians who do not use the shared use path.

Additionally, for projects #3 and #4, residents within 0.5 miles of this project already have shared use paths nearby, even though those shared use paths do not make important connections. To count the full value from these projects would likely result in calculating value that is simply transferred from existing shared use paths to the new shared use paths. Thus, for projects #3 and #4, we have reduced the value of the benefits from reduced pedestrian injuries and fatalities by 75% to account for the fact that an estimated 75% the benefit is already in place near these projects.

A more important factor is that unless trail users drive to the shared use path to begin their walk or run, they must walk or run some portion of their trip on sidewalks or along city streets to reach the shared use path. To account for this issue, we have reduced the value of the pedestrian safety benefit by multiplying it times 1.3 miles (the average walking trip reported by the August 2008 National Survey of Bicyclist and Pedestrian Attitudes and Behavior) minus .5 miles (the average round trip distance that a pedestrian in the walk shed will spend off of the shared use path), and then divided by 1.3 miles. Thus the pedestrian safety value for the shared use path is 62% of the total value for the average 1.3 mile trip taken within the walk shed.

Thus, we used:

Pedestrian Safety Benefit = ((Residents within 0.5 miles of Project/Total Houston Population) * Estimated Total Value of Pedestrian Fatalities & Injuries for Houston * 0.49 [percentage of pedestrian trips for exercise, health, recreation or leisure] * 0.62 [percentage of average pedestrian trip (1.3 miles) within the 0.5 mile bike shed that will occur on the shared use path]

Reduction in Bicyclist Injuries and Fatalities

See worksheets titled Low Demand and Medium Demand in the BCA Workbook

Injury and fatality numbers used for this calculation were also drawn from the Houston-Galveston Area Council (H-GAC) June 2009 report titled "The State of Safety in the Region."[19] We similarly reduced the Harris County numbers to calculate the estimated number of injuries and fatalities that occur inside of Houston. We then took H-GAC's KABCO scaled accident numbers, and converted them using the formula provided in the TIGER Benefit-Cost Analysis Resource Guide. Using the values provided in that guide, we arrived at the Estimated Total Value of Bicyclists Fatalities & Injuries for Houston. See the worksheet titled Safety in the BCA Workbook (Attachment 6).

For each project, we used the existing commute numbers as a proxy for all bicyclists—commuters, utilitarian short-trip cyclists and recreational cyclists—in the project's bike shed. We did not use the recreational and utilitarian estimates since these estimates are based on a region's commute share by both our model and most other models.[20] Using these recreational numbers would introduce a wide range of potential value that could inflate the potential safety benefit. We also did not include new commuters into the calculation since a reduction of injuries and fatalities for bicyclists induced to ride only by the project is not a direct benefit of the project.

We also assumed that hundred percent (100%) of bicyclists calculated to use the project will use the new shared use path for their entire trip (commute, recreation or utilitarian) except for side roads at the beginning and end of their trip. Given that the speed limits on these side roads are 30 miles per hour or less, we have assumed that using the shared use path reduces the likelihood of an injury or fatality for these bicyclists by ninety percent (90%).

Thus, we used the following formula:

Bicyclists Safety Benefit = ((Existing Commuters * 0.9)/City-wide ACS commute numbers) * Estimated Total Value of Bicyclists Fatalities & Injuries for Houston

Reduced Auto Use

See worksheets titled Low and Medium of the attached workbook.

The National Cooperative Highway Research Program's Report 552 calculates reduced auto use benefits to include reduced congestion, reduced air pollution, and user cost savings. Report 552 calculates reduced auto use benefits to apply only to commuter and other utilitarian travel, because it is assumed that recreational riding does not replace auto travel. In contrast to the writers of Report 552, we believe that providing an easily accessible shared use path will likely replace auto travel to and from a gym or other location to ride a bike for at least some recreational riding in a car-centric city like Houston. However, we follow Report 552's lead in calculating the benefit only for the new bicycle commuters.

In considering the validity of using bicycle commuters to calculate the reduced auto use benefit, Report 552 considers two offsetting adjustments that ultimately leave the total number unchanged. First, there are utilitarian riders, sometimes known as short trip bicyclists, in addition to commuters and some of these trips will replace auto trips. Second, not all new bike commuters and utilitarian riders would have made the trip by car. Report 552 points to evidence from NHTS that suggests that something less than half of bicycle commuters use driving as their secondary commuting mode. For simplicity, assume that these two factors offset each other, and thus the total amount of new bike commuter mileage is a reasonable number to use to represent the total amount of new bike riding substituting for driving. Like the preceding assumption, we are less than certain that these two offsetting adjustments will net each other out in a car-centric city like Houston where, according to the American Community Survey, 78% of all commuters drive to work in a single-occupancy car, truck or van.[21] However, for simplicity purposes, we leave Report 552 survey assumptions in place and only use the number of new commuters to calculate the reduced auto use benefit.

Report 552 calculates congestion savings to be 0 to 5 cents per mile and pollution savings to be 1 to 5 cents per mile depending on conditions. It then assumes the high end of this range in central city areas, the middle range in suburban areas, and the low end in small towns and rural areas. A final assumption is that all commuting and utilitarian trips are

during congested periods. User cost savings were determined to be 3 cents per mile during congested peak periods and 0 otherwise.

Overall, the savings per mile (S) is 13 cents in urban areas. Since all of Houston's TIGER IV projects occur within the City, and all but Project 1 occur within the urban core of Loop 610, we have used the estimated savings of 13 cents a mile to calculate the reduced auto use benefit.

In order to estimate the average commute, we have used an August 2009 Downtown Houston Commute Survey Report.[22] That survey was conducted by Central Houston, Inc. of downtown employees, and the survey was completed by a total of 11,804 employees. According to that survey, 0.3% of downtown employees ride a bicycle to work. This reflects approximately the same number we have used as the low end of the American Community Survey commute share for Houston.[23] The average round trip commute distance for these bicycle commuters was 8 miles.[24]

Reduced auto use benefit = New Commuters * 8 miles * 13 cents * 50 weeks * 5 days