Rice University Fall 2024

Restoring Westpark Tollway Community Connections

Project Report

Partners:

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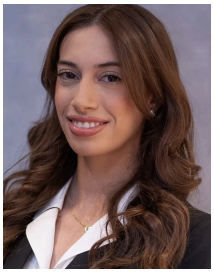

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Executive Summary

A team of Rice University students undertook a comprehensive project with the West Houston Association (WHA) to be delivered to the Harris County Precinct 4. This initiative analyzed the socioeconomic benefits of establishing and restoring community connections at different locations adjacent to the Westpark Tollway, located in Houston, Texas.

The Rice team began with a mile-by-mile comprehensive exploration of the Westpark Tollway and its surrounding areas. This initial phase involved a detailed assessment of pre-existing connections, potential connections, and overall infrastructure feasibility. The team analyzed existing amenities and community features of value to highlight any discrepancies that would help with site selection. 7+ potential connection sites were identified and considered. However, these other sites were eliminated as potential connection points due to factors including but not limited to infrastructure viability, limited benefit potential, and proximity to existing connections. This project phase was instrumental in selecting two connections for analysis: a pedestrian bridge in the Brays Bayou Park and extending the pathway between Clayton and Altamira. The two locations identified were most compelling to the team because building these connections could yield impactful benefits at scale, were moderately infrastructure-intensive, and were not adjacent to pre-existing connections across the Tollway.

After the locations were identified, the team began to perform more intensive data collection to determine the specific benefits of these connections, the impact on the nearby community and the estimated cost of each proposed project. Potential risks and mitigants for each connection were also considered. Once this data was collected, it was translated into Harvey ball diagrams which were then comparatively analyzed by the team. It was determined that these diagrams

would address public health benefits, improved walkability, educational experiences, inter-community connectivity, environmental awareness, enhanced aesthetic appeal, and residual economic benefits. Comparing the Harvey balls revealed that the Brays Bayou Park connection would lead to greater benefits to a larger population, but analysis of the estimated cost also demonstrated that the cost of this project would be significantly higher than that of the Clayton and Altamira pathway enhancement. This is largely due to the larger population near Brays, with approximately 4,098 residents compared to around 1,000 near Clayton and Altamira, allowing more people to utilize the pedestrian and bike-friendly infrastructure. Additionally, the Brays connection provides access to Brays Bayou Park, which features a large water area and a 5.5-mile walking/running trail linking to Bishop Fiorenza Park. This access promotes greater community impact in public health, walkability, educational experiences, and environmental awareness. The team also developed a list of additional recommendations to ameliorate the potential limitations of each project, such as increasing lighting in the area and offering community engagement opportunities near the connection points.

Introduction

Background:

The West Houston Association (WHA) is dedicated to introducing innovative ideas to Greater West Houston and continuously enhancing the quality of life in the region. To achieve this mission, WHA actively promotes high-quality development, sustainable infrastructure, long-term planning, and proactive public policy.

The Westpark Tollway spans approximately 22 miles east to west from the Uptown District of Houston to just outside of Fulshear. The tollway serves the western areas of Harris County and northeastern Fort Bend County. However, it currently disrupts communities and reduces accessibility for residents on either side. In response to this challenge, the West Houston Association has partnered with Harris County Pct 4 to explore options for connecting these communities and developing valuable infrastructure to support this objective.

The precinct is also collaborating with another team to engage with residents near the highway to assess their needs related to engineering solutions. In addition, the West Houston Association connected with a group of students from Rice University to evaluate the potential socioeconomic values and advantages of constructing north-south connections to unite the separated communities at various points along the Tollway.

Project Goal and Approach:

This project aimed to evaluate the value of adding north-south connections along the Westpark Tollway. The team determined two locations that can provide a convenient, affordable connection with a wide range of benefits for the surrounding community. These locations were

defined as areas along the tollway where vehicle or pedestrian connections could be constructed, narrowing the options for conducting an in-depth benefit analysis. The project focused on analyzing where and why restoring north-south community connections would be beneficial rather than emphasizing the engineering aspect of addressing the "how" and evaluating key socioeconomic benefits for potential connections. Previous research on similar connections was used to determine key metrics relevant to the proposed locations. A Harvey ball analysis was utilized to compare the potential benefits of each site. The team then studied limitations, mitigation strategies, and the estimated costs of each proposed connection to ensure complete due diligence.

Project Phases

Methodology:

Step 1: Initial Mapping

As the project's first step, the team used Google Maps to conduct a comprehensive mile-by-mile scan of the Westpark Tollway. This analysis assessed existing infrastructure such as roads, bridges, and underpasses between the north and south sides of the tollway.

Step 2: Site Selection and Feasibility Analysis

Upon completing the initial mapping, the focus shifted to identifying connectivity gaps. This process revealed community features and high-value areas that made restoring connections worthwhile. Key factors included population density, proximity to community amenities, access to education, and outdoor physical activity opportunities. Prioritizing pedestrian accessibility over vehicular access, potential connections were evaluated against specific criteria. Locations meeting these thresholds were selected for further exploration:

Location A: Pedestrian bridge along Brays Bayou Park, connecting with Howell Sugarland Dr.

Location B: Walking trail expansion across the Clayton and Altamira areas.

Step 3: Data Collection and Key Benefits Analysis

At this stage, key benefits were selected to facilitate further research on the two chosen locations. These benefits were ranked based on their relevance and alignment with the objective of restoring connectivity in these two locations. The identified benefits include public health,

improved walkability, educational experiences, inter-community connectivity, environmental awareness, enhanced aesthetic appeal, and residual economic benefits.

Next, the team collected location-specific data to provide evidence supporting the potential benefits of the proposed connections. This research included a demographic analysis of the Brays Bayou and Clayton/Altamira areas and an evaluation of community engagement levels. Additionally, a detailed assessment of accessibility and safety metrics for both locations was conducted to validate their feasibility and necessity for further improvements.

Step 4: Benefit Estimation Analysis

To effectively present the findings, the team conducted a direct benefit comparison, outlining the estimated benefits of each location relative to the identified key variables. Harvey ball diagrams were utilized as a visual tool to enhance stakeholder understanding of the research and proposed location for restoring connectivity alongside the Westpark Tollway. This comparison was structured to quantify the impact of the connections, highlight their long-term value to the community, and suggest strategies for mitigating potential risks.

Location Selection:

Upon scanning the 22-mile toll road, the team analyzed the surrounding areas and identified all current connection infrastructure and specific disparities in accessibility. The exhibits below represent a visualization of the team's mile-by-mile scan and the thought process that went into selecting the two proposed locations.

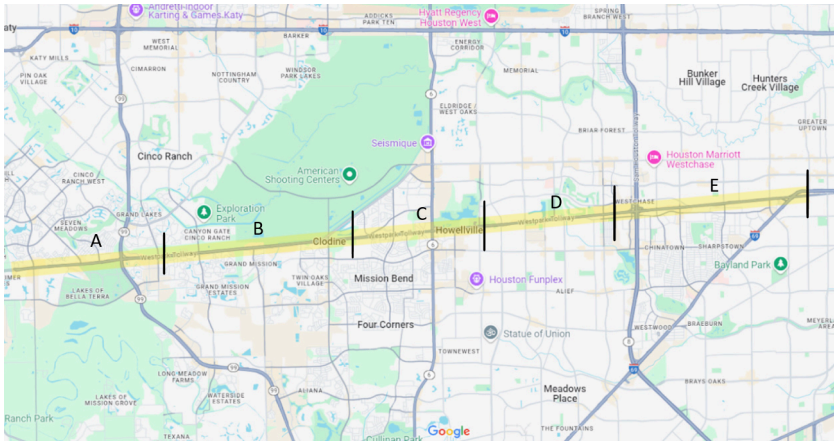

Figure 1: The 5 segments of the Westpark Tollway

The tollway was divided into 5 sections going west to east for a further comprehensive deep dive into the surrounding areas and communities: sections 1 through 5. As displayed in the following exhibits, the tollway runs on average 1.03 miles before hitting an underpass or some form of connection between the north and south sides of the tollway. Connection points are highlighted in blue with the exception of major intersection points and overlapping highways. Additionally, the duration between connection points is labeled in blue or otherwise in red if there was a zone with an abnormally long distance between connections.

Section 1:

Figure 2: Section 1 with existing connections labeled

The westernmost part of the tollway is predominantly lined with retaining walls on both the north and south sides, creating physical barriers that limit potential connections in this section. These retaining walls are particularly prevalent near residential areas located in close proximity to the tollway, leaving little available space for new infrastructure like roads or pathways. Their structural role in supporting the terrain, proximity to residential properties, and the high modification cost present significant challenges to creating new connections like underpasses. Additionally, the demographic in this area tends to be wealthier than the average Houston population, suggesting that residents are more likely to rely on personal vehicles for travel between communities north and south of the tollway. This reliance reduces the perceived need for alternative connectivity solutions, especially given that the few unblocked areas already have connecting roads spaced less than a mile apart.

Section 2:

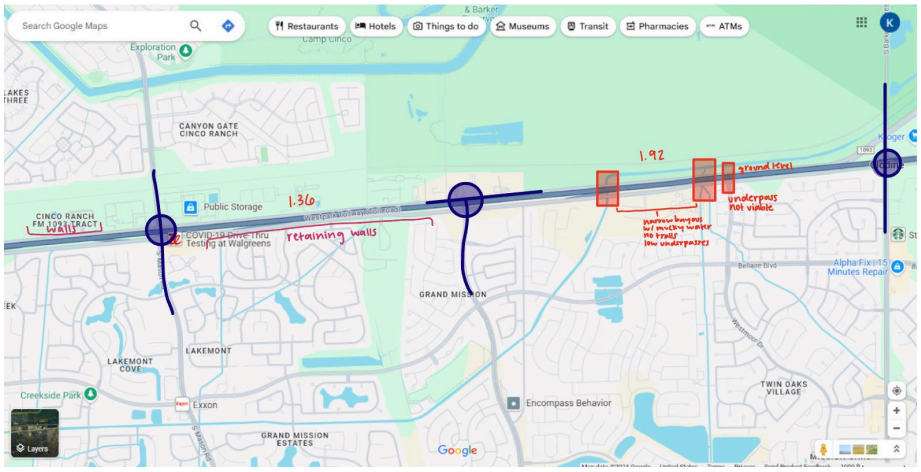

Figure 3: Section 2 with existing connections labeled

Section 2, extending to Grand Mission, is also largely dominated by retaining walls. Notably, there are two outliers of long distances between connection points in this area, spaced 1.36 miles

apart and 1.92 miles apart. While opportunities for new infrastructure are limited due to the retaining walls along much of the southern side between S Mason Rd and Grand Mission Blvd, a few areas of interest emerge between Grand Mission and Clodine. Two specific points highlighted in red are located where the bayou runs beneath the tollway. In other sections of the tollway, similar spaces have been converted into pedestrian pathways, prompting exploration of these sites as potential connection points.

However, several challenges surfaced. First, the waterway in this area is notably mucky, narrow, and appears partially dried up, with the western bayou segment leading directly to a drainage system on the north side. Second, there is no existing infrastructure nearby to build upon, meaning any development would require entirely new construction on an already unattractive and difficult site. Finally, the underpasses have a very low clearance beneath the roadway. Although specific measurements were unavailable, visual assessment indicates that the height is insufficient for a pedestrian-friendly pathway.

Additionally, Westmoor Drive was considered as a potential connection point, but the tollway remains at ground level there. Elevating the road and constructing an underpass would be excessively expensive, outweighing the potential benefits of such a connection.

Section 3:

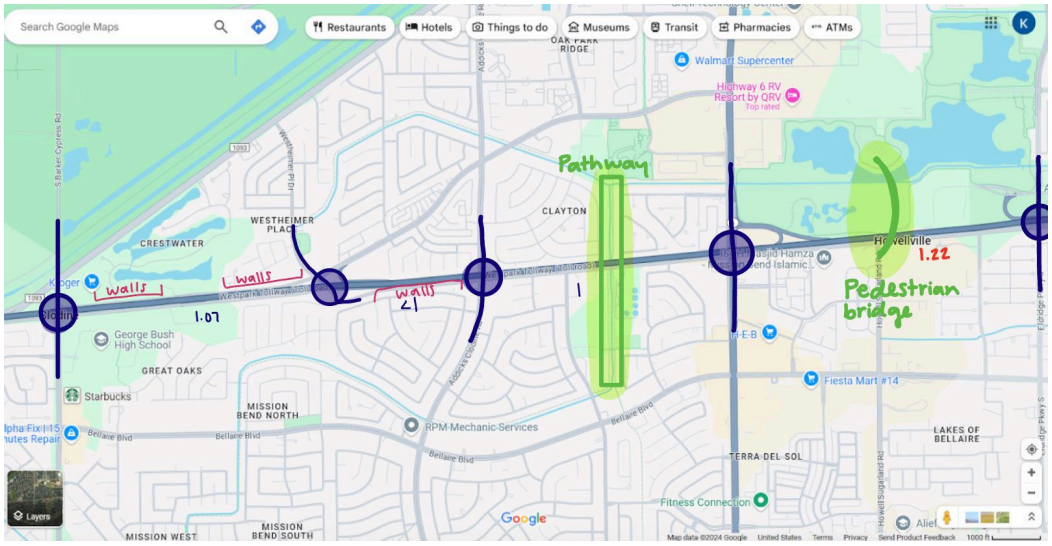

Figure 4: Section 3 with existing connections labeled, as well as the team's selections for proposed new connections

Section 3 is where the team came across the locations that would become the two connection proposals. The area is once again filled with retaining walls, preventing opportunity for new infrastructure across the tollway. In the Clayton & Altamira areas, the team identified that the socioeconomic impact of improving access to amenities in this area could be significant. A pathway adjacent to the bayou currently crosses underneath the tollway, allowing for nearby residential blocks to be connected to outdoor communal spaces and have better accessibility between the north and south sides of the Tollway. However, this pathway is currently too narrow for efficient, multidirectional foot traffic or cyclists and lacks aesthetic appeal. This area was therefore selected as a place where feasible construction could greatly improve a connection.

The team also identified a large gap in connectivity between South Texas 6 and Eldridge Parkway South, another outlier with a distance of 1.22 miles. This space features Brays Bayou Park directly north of the tollway, but the park is currently blocked for residents on the south

side, who must drive for 7 minutes to reach the park despite living within walking distance. This presents an opportunity to improve pedestrian connectivity.

Section 4:

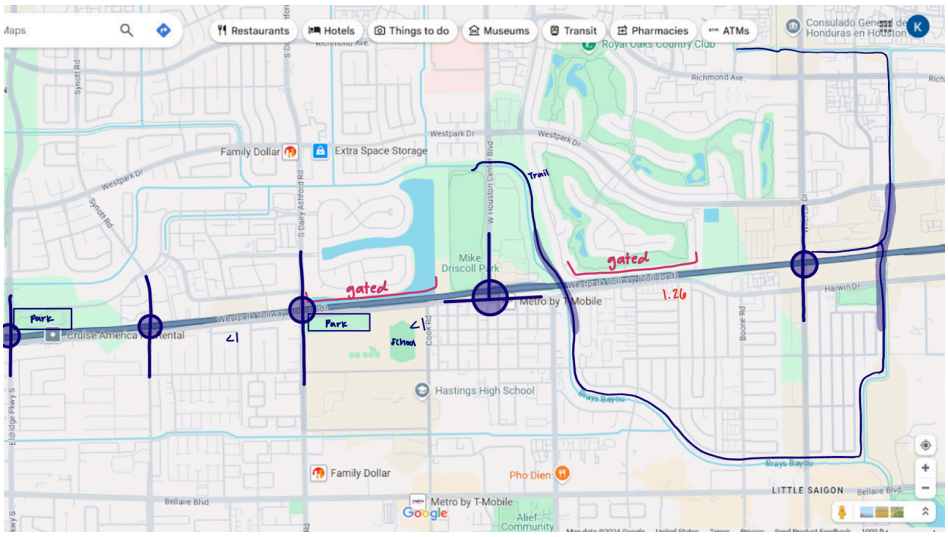

Figure 5: Section 4 with existing connections labeled

Section 4 already contains a number of connections for communities along the north and south side of the tollway. Connections are mostly spaced within less than a mile of one another, with the only exception being the area from West Houston Center Boulevard to Wilcrest Drive which is 1.26 miles apart. About half of this area is occupied by a gated community. Residents of gated communities often prioritize privacy, security, and exclusivity. These residents would likely be opposed to infrastructure projects that could increase outside traffic or reduce the perceived safety of their neighborhood. Additionally, these communities are designed to control and limit access, so even if a connection were built that was accessible from within the community, it would not be accessible to the general public. Additionally, the area features a scenic pedestrian trail that runs along the bayou, passing under the tollway twice within this section of map. The

trail stretches on for miles and even connects to the Mike Driscoll Park, offering a valuable alternative for pedestrian and recreational connectivity without the need for further development.

Section 5:

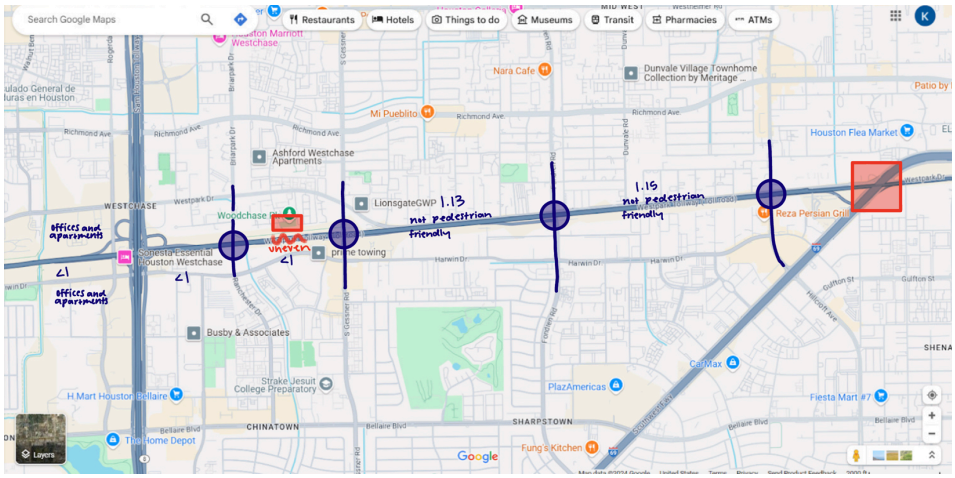

Figure 6: Section 5 with existing connections labeled

Along this section of the tollway, numerous major roads already provide connectivity along the tollway, leaving little additional opportunity or necessity to add more roads across the tollway for improved accessibility. While exploring potential amenities that could benefit the community, Westchase Park stood out as a relatively new park, having opened in October of 2021. However, it is currently only accessible by driving along either Briarpark Dr or S Gessner Rd, and through the back of a neighborhood. This inconvenience led the team to explore the possibility of connecting Velure St across the tollway to Woodchase Dr. However, there were two serious dilemmas with this idea. First, both Velure St and Woodchase Dr are single-lane roads, making them too small to justify the large construction needed for an underpass. Second, the tollway's existing infrastructure presents a physical barrier: the westbound lanes are at ground level, while the eastbound lanes are elevated, making it impractical to create any underpass or crossroad. While no further road infrastructure is viable along this area, it is also not very pedestrian

friendly. The area is characterized by high-speed traffic and wide streets, which create a hazardous environment for pedestrians. The lack of continuous sidewalks and pedestrian pathways further compounds the problem. Much of the area is designed with vehicle traffic in mind, with large parking lots, loading docks, and broad streets that are not conducive to foot traffic. Consequently, creating a safe, continuous pedestrian path would require entirely new infrastructure, which would be both costly and disruptive to existing properties. Finally, given the high volume of accidents at the intersection of the toll road and I-69, the team looked into the possibility of redesigning this area and creating a safer space for pedestrians. However, there were already numerous existing connections in the area, and the incidents were not primarily occurring on the Westpark Tollway itself. As a result, it was determined that no changes were necessary for this intersection.

Data Collection:

After analyzing potential connection points, the team selected the Brays Bayou Park area and Clayton and Altamira as the optimal locations. To determine the scale of the impact of these connections, the population[1] of each area was calculated for the residential areas within walking distance of the proposed connection. "Walking distance" was estimated as the immediate area within a few blocks of the connection. For location the Brays Bayou Park area, this trapezoidal area was outlined in red in Fig. 8 (below). The population for this location was estimated at approximately 4100 people, and location B was estimated at approximately 1000 people. Because the team chose to focus on pedestrian-accessible connections, the next step was to research existing walkability in Houston and the benefits[2] provided by improving walkability, which include increased home values and better access to exercise for residents. Since the

[1] Appendices A and B
[2] Kinder Institute – walkability

pedestrian bridge at Brays Bayou Park is intended to provide residents with more convenient access to a park, research was also conducted into the benefits provided by park access. These benefits[3] include reducing heat and flooding, encouraging exercise, and increasing property values and tax revenue.[4] Finally, the team conducted research into the approximate cost of constructing each proposed connection. For Brays Bayou Park, this was done using previous similar projects involving the construction of pedestrian bridges and applying this cost to the size of the proposed bridge.[5] For Clayton and Altmaria, the team used past sidewalk expansion projects in Houston as well as the online purchase price of proposed amenities such as streetlights and outdoor exercise equipment.[6] Using this data, the team created case studies for each location to evaluate the overall impact of each connection and performed a Harvey ball analysis based on the data for these benefits and costs.

[3] Kinder Institute – parks
[4] NIH park impacts
[5] Appendix C
[6] Appendix D

Findings and Analysis

Location Case Studies:

Brays Bayou Park: The first location the team decided to analyze was Brays Bayou Park, which lies on the north side of the Westpark Tollway. The tollway is a significant obstruction preventing the residential areas and academic institutions in the Howellville neighborhood, directly south of Brays Bayou Park, from accessing this green space. Building a connection across the tollway to this park would allow the residents near the Howellville neighborhood to have pedestrian access to the space. There is a significant push to improve ambulatory opportunities across Houston, as this city has a walkability score of 47 compared to cities like New York City, which boasts a walking score of 89.[7]

The team determined that approximately 4,098 individuals reside in this location through a thorough, bottom-up sizing analysis. This analysis used Google Maps to count the number of houses and identify the apartment complexes in the 0.65 square mile area (outlined in red below) within walking distance of the proposed connection. The team did more in-depth research to determine the number of units for each apartment complex. Using statistics regarding average household size and average number of people per apartment unit, the team was able to estimate the population of this area.

For this location, the team proposed building a pedestrian bridge across the Tollway, which is indicated in Fig. 8 by a black dotted line. This would be less infrastructurally intensive than building an entire road, which would have to be much broader and capable of supporting more weight. Additionally, this type of connection would make logical sense because it would give pedestrians access to a walking/running trail around Brays Bayou Park and connect to Bishop

[7] Walk Score

Fiorenza Park. This connection spans approximately 0.3 miles in length, from the southern side of the Westpark Tollway to the center of Brays Bayou Park.

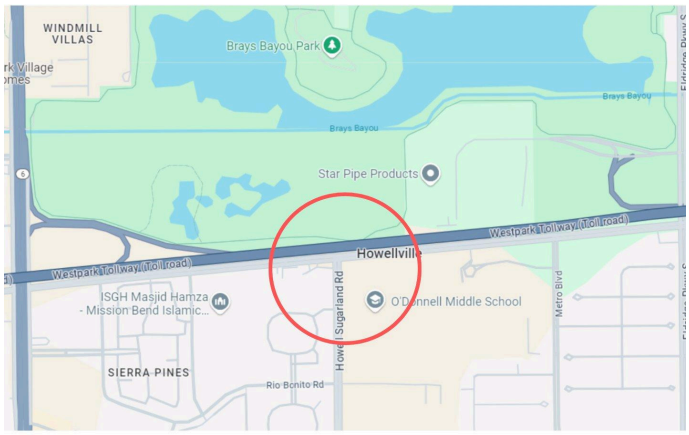

Figure 7: Location selection for Brays Bayou Park connection along the Westpark Tollway, as viewed on Google Maps.

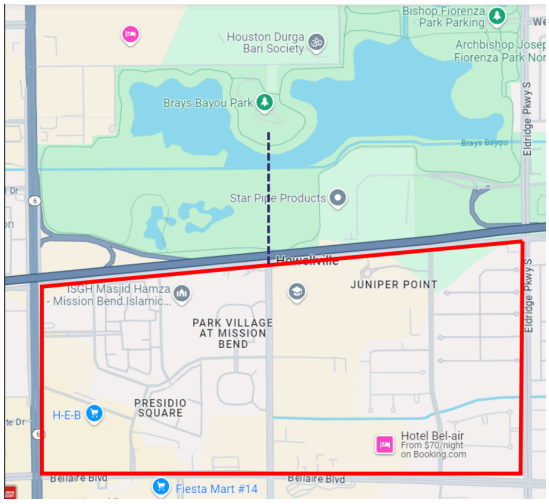

Figure 8: Proposed connection and bridge design for Brays Bayou Park. Area outlined in red indicates the immediate area/population that is within walking distance of the connection.

<u>Clayton and Altamira:</u> The second location analyzed is a pre-existing pedestrian pathway that crosses under the Westpark Tollway and through the neighborhoods of Clayton and Altamira. Improving and widening the path would make it more accessible and convenient for residents and students from the nearby schools. Additionally, since Houston has limited cyclist

accessibility, an expanded pathway would support safe bike lanes in accordance with the Houston Bike Plan,[8] which requires pathways and lanes to be at least 6 feet wide.

To assess the Clayton and Altamira locations, the team estimated that around 1,000 individuals live within the four residential blocks. Google Maps was utilized to count approximately 340 houses in a 2-3 mile radius of the area (outlined in red in Fig. 9). Additionally, the team referred to census data to determine the average number of people per household in the area, approximately 2.75. This information allowed the team to arrive at the final estimate.

For Clayton and Altamira, the team proposed expanding the existing pathway from 4.9 feet to 9 feet in width while maintaining its length of 0.8 miles. A few amenities will also be added to attract more pedestrians and cyclists. This improvement will create a safer and wider pathway, featuring new lights, communal outdoor exercise facilities, and enhanced ecological and aesthetic appeal. The project will also improve connections to nearby residential blocks. Overall, these enhancements aim to draw more people to Houston's outdoor communal spaces and facilitate better accessibility between the north and south sides of the tollway. This approach is also more efficient and affordable than constructing a new connection.

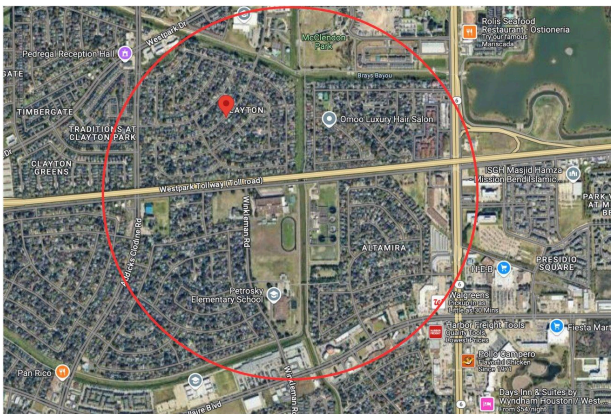

Figure 9: Location selection radius for the Clayton and Altamira pathway connection along the Westpark Tollway, as viewed on Google Maps.

[8] Houston Bike Plan – Bicycle Toolbox

Figure 10: Proposed connection and pathway expansion for Clayton and Altamira.

Benefits and Comparison:

Estimating benefits involved a two-pronged approach. First, the team had to identify and rank the benefits associated with building these connections in each location. Next, the team sought to advance this analysis by comparing the benefits for each location using Harvey ball diagrams. Many of these benefits are difficult, if not impossible, to quantify before the connections have been constructed, so this method was selected as the best way to incorporate objectivity in a largely qualitative analysis.

For the first task of identifying the benefits associated with building a connection in these locations, the team turned to urban research reports and articles from Rice University's Kinder Institute. The Kinder Institute has extensively analyzed the landscape of Houston and the implications of creating infrastructural improvements around the city. The two primary articles used in data collection discussed the benefits of increasing access to green spaces, the implications of enhanced walkability on the surrounding communities, and the physical health impacts that certain infrastructure improvements could foster. Through our research we identified that the primary benefits that both locations shared involved public health, walkability,

educational development, intercommunity connectivity, environmental awareness, and residual economic benefits.[9]

Beginning with public health, the first connection improves pedestrian access to Brays Bayou Park, which is considered "social infrastructure" that can boost physical activity and improve mental health by reducing stress through immersion in an outdoor green space. Furthermore, this connection would give pedestrians in the Howellville neighborhood quick access to the center of the Brays Bayou Park (approximately a 0.3 mile walk across the pedestrian bridge) compared to the current 1+ hour/3 mile walk currently needed to access the heart of the park. Consequently, more people will be able to access this amenity and engage in outdoor activities, such as walking or running on the 5.5 mile trail that the park offers. Moreover, Houstonians have long had limited access to parks with Houston ranking 68th out of 100 major U.S. cities for parks by the Trust for Public Land.[10] This connection thus directly addresses an evident need, which is why it was ranked as the most significant benefit that the connection has to offer.[11]

The connection in Clayton and Altamira will also yield significant public health benefits because the expansion of the trail will encourage more people to walk and bike from the surrounding residential areas. On the north side of the tollway, McClendon Park is near the connection site, granting improved access to a green space. Additionally, incorporating outdoor exercise equipment alongside the trail could further incentivise physical activity. Houston struggles with physical activity and health, with 34% of Houston children over the age of 12 considered clinically obese.[12] Because these connections provide a tangible, concrete opportunity to improve

[9] Kinder Institute: Evaluate the Benefits of Park Access
[10] Trust for Public Land
[11] Kinder Institute: Evaluate the Benefits of Park Access
[12] Legacy Community Health

the public health of the surrounding communities, the team deemed this benefit to be the strongest for the two locations.

In addition to public health, the team ranked enhanced walkability as a compelling benefit because of its financial implications. According to urban economist Joe Cortright, who serves as the director of City Observatory, a think tank that conducts research on the urban economic landscape, one additional walk score point results in a $3,500 boost in home values.[13] Furthermore, real estate analytics companies Redfin and Zillow have both determined a statistically significant correlation between walkability and home values.[14] As both connections aim to improve pedestrian access to external amenities and mobility across the Westpark Tollway, these proposed developments will contribute to improving Houston's walkability.

The third most significant benefit is the educational experiences that these connections could provide to the students in the immediate areas. These connections increase access to outdoor green spaces, and studies have demonstrated that children who engage with nature experience improved learning outcomes. With an elementary and middle school located near both connection points, students stand to gain directly from improved access to green spaces. Furthermore, a NIH literature review of prior studies discusses how exposure to nature fosters improved memory, attention, and academic performance.[15] The reason that this benefit was not ranked higher was because its implications are only relevant to the student populations in these locations rather than the total population. Consequently, while the depth of this benefit is significant, the breadth of people it affects is limited compared to the preceding benefits.

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[13] Kinder Institute: Walkability
[14] City Observatory
[15] NIH: Health Benefits of Nature-Based Physical Activity

The last four benefits of inter-community connectivity, environmental awareness, enhanced aesthetic appeal, and residual economic benefits are ranked below the other three because they are less concrete than the preceding three. To enhance aesthetic appeal, the team is considering how improving the landscaping and overall appearance of each area could attract more residents. Additionally, they recognize potential economic benefits for nearby communities, such as increased housing values, support for local businesses, and an overall boost in economic activity.. It was difficult to find direct statistics and evidence to support the true extent that these connections would provide these benefits so the extent of these impacts is purely theoretical. However, the team believed that of these four, inter-community connectivity was most significant because both locations would mobilize more people around these areas. Consequently, building these connections would offer opportunities for members of surrounding neighborhoods to interact with each other more. While the team considered this to be a benefit, it was difficult to gauge the extent to which these connections would deliver this cross-connectivity. Environmental awareness is another benefit that would come out of improving access to greenspaces. By facilitating more interactions with nature, people would likely be more acutely geared towards preserving the environment. However, this is a lower tier benefit because it is less concrete and more difficult to prove/justify compared to the other benefits.

The next step in this benefit evaluation and comparison analysis was to evaluate how the benefits for each location compared to one another. In order to exercise an objective approach for comparing benefits that were measured through primarily qualitative measures, the team, decided to perform a Harvey ball analysis to evaluate these benefits. The extent to which these balls were shaded indicated how strong the benefit was for its corresponding location/connection. Looking horizontally at figure 11, the rankings of benefits were largely in

line with the benefit rankings discussed above. However, the general trend indicates that the Brays Bayou Park connection yielded more significant benefits across the majority of the benefit categories compared to the Clayton connection.

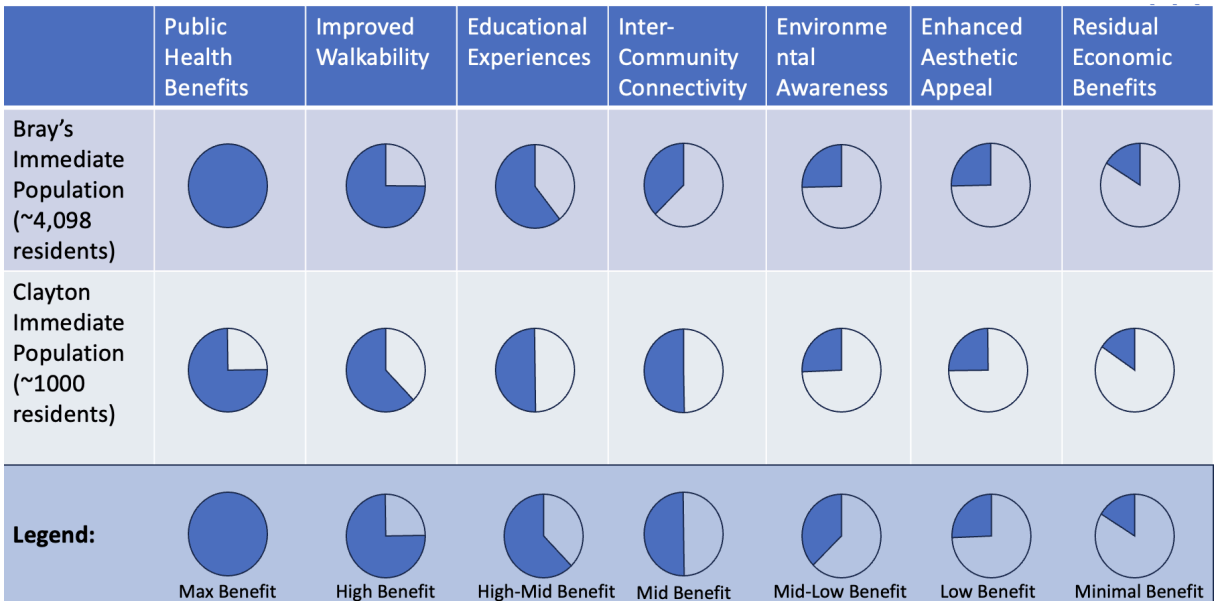

Figure 11: Harvey ball analysis comparing benefits for the two prospective connections

The justification for this comparison between Brays and Clayton is multifaceted. Firstly, the population of the immediate 0.65 sq. mile area surrounding the Brays connection was approximately 4,098 residents compared to the approximately 1,000 residents surrounding the Clayton area. These are the residents within walking distance of the connections who would be able to feasibly take advantage of this pedestrian or bike friendly infrastructure. Consequently, the more residents there were in these immediate areas, the greater the impact/benefit these connections would have, which helped inform the weighting of the Harvey ball analysis.

Additionally, the team considered that the Brays connection would tend to have a more significant impact compared to the Clayton connection because the Brays connection provides cross-tollway access to a larger amenity: the Brays Bayou Park. This park, which has a large

water feature and a 5.5 mile walking/running trail that connects to the Bishop Fiorenza park, can provide more community impact in regards to public health, walkability, educational experiences, and environmental awareness. While the Clayton connection does grant improved access to the McClendon Park green space, it is smaller and has fewer offerings than Brays Bayou Park. However, Clayton wins out in regards to intercommunity connectivity because the expansion of the sidewalk allows more pedestrians and cyclists to mobilize themselves across the tollway. Furthermore, the widening of the sidewalk and additions of new recreational infrastructure would enhance the aesthetic appeal of the Clayton location more than the development of a pedestrian bridge would for the Brays location. Finally, the residual economic benefits of increased economic exchange due to more mobility across the tollway are difficult to project and hence the least significant for each location.

Other Considerations:

Building on the detailed analysis of the estimated benefits outlined earlier, the team further examined potential limitations associated with each location and identified mitigants for these challenges, offering additional factors to consider in the connection selection process. The first concern is the community's potential low usage of the two projects. Houston is not known as a walkable city, so it is possible that even with improved accessibility, the most common means of transportation will be vehicles as opposed to walking or cycling. To mitigate this concern, it is recommended that community events be hosted in the connection area to attract the public's use of the new public amenities. Furthermore, improvements to both projects' environmental aesthetics and locations should enhance their overall appeal and attractiveness to users.

Another factor to consider is the safety of both locations. Today, Houston is considered the most dangerous city in Texas, so it is essential to implement safety measures, especially since both connections are near schools.[16] Suggested ways to improve safety include installing surveillance cameras and emergency call boxes, hiring Houston Police to patrol, and installing streetlights, which the team has included in the costs for the pathway project in location B. Houston and the bayou area are also in a flood zone, which is an extremely important consideration and potential risk to both projects' success. The Harris County Flood Control District has developed several strategies to reduce flood risk. One such strategy is the construction of deeper water channels, which can enhance the capacity of the bayou to carry stormwater.[17] These connections can significantly contribute to improving flood management efforts, which will also benefit the surrounding neighborhoods during inclement weather.

Lastly, there are also some potential accessibility issues to consider. For both projects, there is currently a lack of access to public parking that could influence the public's usage of both connections. The two projects are near schools, so one possible solution would be to seek permission from these institutions to utilize their parking spots for the public, particularly outside. Furthermore, construction for these two connections could create traffic disruptions along the Westpark Tollway, which is particularly busy and important to Houston's transportation. The team recommends ensuring there are measures applied that should be implemented in adjunct to the construction, including clear detour signage and perhaps the use of prefabricated bridge components to reduce on-site construction time.

Estimated Costs:

[16] Houston, TX Crime Rate and Statistics [2024 Updated].
[17] Project Brays Approach

Aside from the benefits and limitations, the team found it essential to consider the project costs for the pedestrian bridge and extended pathway to help WHA and Harris County Pct 4 assemble a well-informed decision about which connection would be most beneficial to the community. As the project goal does not encompass detailing engineering and construction, estimates were calculated based on similar existing projects or costs for construction.

The estimated cost of the Brays Bayou Park bridge project is very high. Comparing it directly to a similar project, the total was $16,300,000. This cost was attained by comparing it to an adjacent Brays Bayou walk and trail bridge project across the drainage channel east of Stella Link Road, which, according to Pape-Dawson Engineers, is valued at $2,500,000.[18] The cost difference originates from the bridge lengths and square footage; Pepe-Dawson's project covered 231 linear feet, while the proposed bridge by the team covers 1,500 linear feet. This is intended to connect pedestrians from the southern side of the tollway to the center of the park across the bayou, but it would also be possible to conserve spending by connecting the bridge to the trail instead. The longest proposed length was computed through a rendering measurement, as shown by the dotted line in Fig. 8. Dividing the total cost of the original project by the linear feet, the price per foot equaled approximately $10,587. This would be about $16,300,000 for the 1500 linear feet. Hence, the pedestrian bridge to Brays Bayou Park is defined as the more costly project. This final value does not include contingencies and other variables in the construction budget but estimates the total cost.

The costs for the Altamira and Clayton pathways are very different and are significantly lower than that for the pedestrian bridge, estimated at $274,000. Although there was no similar project for comparison in the area, the team compiled the numbers for each project component and sized it to the specific desired pathway extension. According to a Forbes article on the costs of

[18] Brays Bayou Pedestrian Bridge | Pape-Dawson Engineers

installing a concrete sidewalk, the average price per square foot of sidewalk expansion today is $9[19]. Since the pathway runs for 0.89 miles and has a 4.9-foot width, the expansion to a widened 9-foot sidewalk would be 19,267 feet for a total cost of $174,000.

The team has suggested that in addition to the sidewalk expansion, the connection at location B should include street lights and outdoor exercise facilities. Streetlights are recommended to be placed 400 feet apart, and accounting for the 0.89 miles, it would be ideal to install approximately 20 posts. The streetlights are, on average, around $2,500, and adding $1000 for each one would result in a $70,000 increase in the total project cost.[20] The team recommends adding four outdoor exercise equipment stations specifically designed for active adults, strategically placed at various points along the pathway to encourage greater usage. The proposed equipment includes an inground mount for $15,015, an assisted balance walk for $2,540, an assisted functional trainer for $3,600, and an assisted step-around for $3,040. Additionally, there will be an estimated $4,000 installation fee, bringing the total cost to $24,195. Without considering contingency costs, the team has defined the extended pathway in the Clayton and Altamira regions as the more budget-friendly option for a connection.

[19] How Much Does It Cost To Install A Concrete Sidewalk Or Walkway In 2024?
[20] How Much do The Street Lights Cost? | ZGSM

Recommendations

The team determined that the benefits of the pedestrian bridge connection at the Brays Bayou Park would be greater and impact a larger population. However, the construction of the pedestrian bridge is a much higher cost while the sidewalk expansion project at Clayton and Altmaria would be relatively low-cost. In both locations, public health and improved walkability are likely to be the most impactful benefits. Because the pedestrian bridge at Brays Bayou Park provides access to a larger amenity and is accessible for more people, these benefits would be greater in that location per the Harvey ball analysis. In both locations, the team also recommends the implementation of a few additional features to maximize the impact of the connection. Firstly, it is important to determine security and safety measures in and around the connection points. One facet of this is community engagement, increasing the presence of community members in their neighborhood to encourage them to look out for one another. This can be accomplished by hosting events in the outdoor spaces that they can access using the new connection, such as running clubs or live music performances. During the construction of the connections, another priority should be providing clear signage for detours and work zones to minimize the inconvenience to local residents. These residents should also have access to parking facilities so that both pedestrians and vehicles can easily visit the area near the connection and make use of the amenities therein.

Appendices

Appendix A: Sizing Bray's Bayou Immediate Area and Population

Sizing the Immediate Bray's Bayou Area
h=1.21 miles; a=.48 miles; b=0.60 miles
Area of immediate area: ((a+b)/2)*h = **0.65 sq. miles**
Sizing the Population:
Houses: 81+60+193 = 334
Apartment Units:424 (El Sol del Rio Apartments)+320 (Park Village at Mission Bend)+404 units (cozumel apartments)+400 units (La Paz Apartments) = 1548 units
Number of Houses in the neighborhood from Metro Blvd to Howell Sugarland Road (North of Bellaire Road): 334 households and 1548 apartment units
Average household size in Houston = 3 residents/household; Average number of people/apartment unit = 2 residents/unit
Determined Number of People in the immediate 0.65 square mile area around the pedestrian bridge = 334*3+1548*2 = **4098 people**

Appendix B: Sizing Altamira & Clayton's Immediate Area and Population

Houses (approximation)	
Clayton	80
Altamira	100
Northern Block (Near McClendon Park)	70
Southern Block (Near Elementary School)	90
Total	340
A verage Household Size in Houston (Census Data) **2.75 People**	
Population Estimate (approximation)	
Clayton	220
Altamira	275
Northern Block (Near McClendon Park)	192.5
Southern Block (Near Elementary School)	247.5
Total	935
	(Approx ~1000 people)

Appendix C: Sizing the Cost for Bray's Bayou Pedestrian Bridge

Costs are proportional to the original $2.5M project across Brays Bayou

For the original 230' project:

$$Cost\ per\ foot = \frac{2500000}{230}$$ **= $10,869.57 per foot**

For the 100' project:

$$10{,}869.57 \times 1500$$ **= $16,304,355**

~ $16,300,000

Appendix D: Sizing the Cost for Clayton and Altamira's Extended Pathway

Sidewalk Expansion https://www.forbes.com/home-improvement/outdoor-living/concrete-sidewalk-cost/#:~:text=Explore%20Options-,Concrete%20Sidewalk%20Installation%20Cost%20Per%20Square%20Foot,expect%20to%20pay%20around%20$1%2C800.	Avg price per sqft of sidewalk expansion: $9 New area = 19,267.72 ft 19,267.72 x 9 = **$173,403**
Streetlights https://www.zgsm-china.com/blog/how-much-do-the-street-lights-cost.html	20 streetlights needed keeping approx. distance of 400 ft apart $2,500 cost + $1,000 installation =$3,500 $3,500 x 20 = **$70,000**
Outdoor Recreational Equipment https://parkwarehouse.com/product-category/outdoor-fitness-equipment/?srsltid=AfmBOopYLOanYHyGqW7-4x5e1l_nZwK-iBlq7hfWthsGSvSmnUQKgFHC	Inground Mount = $15,015 Assisted Balance Walk = $2,540 Assisted Functional Trainer = $3,600 Assited Step Around = $3,040 $4,000 installation cost Total = **$24,195**