APPENDIX E: Half-Mile Area Improvement Prioritization – Initial Trial Methodology Details

To provide opportunities for the greatest number of additional people to walk or bike to DART stations by building sidewalk, shared use path, and crosswalk connections, the prioritization of identified improvements was structured to provide balance between estimating this objective accurately and applying the methodology to a large study area.

Initially, a prioritization scheme that attempted to track as closely as possible to potential ridership increases was tested for the Parker Road Station in Plano, with adjustments for safety, key destination access, and equity. Though some of the elements of this initial prioritization methodology were ultimately discarded for this study, they are documented here as being potentially useful for later studies on a smaller scale. Also, many of the assumptions and methodologies explained below were retained in the ultimate methodology.

For the ridership component of the initial methodology, the likelihood of land parcels around each station to contribute potential transit customers walking or biking to the station was assumed to be related to three primary factors:

1. The distance of the parcel from the station,
2. The number of people living or employed at the parcel, and
3. People's tolerance for different levels of stress experienced along the route between the parcel and the station.

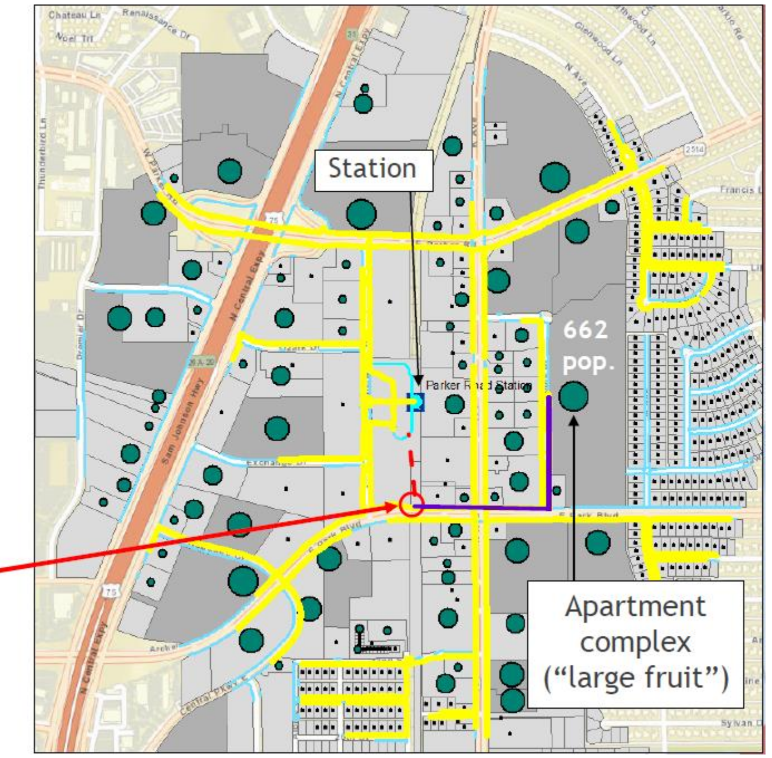
For the first input to ridership, distance, NCTCOG had previously collected appraisal district parcel data from Collin and Dallas Counties and provided a GIS shapefile containing the data. Consultants used ArcGIS Network Analyst tools to calculate the distance of each parcel to the station along the nearest available walking route, which was created by editing sidewalk shapefiles provided by NCTCOG to ensure end-to-end connectivity. The NCTCOG sidewalk files were found to require significant numbers of edits in this regard.

For the second component of ridership, population density, NCTCOG had included in the parcel-level data assumed population and employment values for individual parcels in the study area that had been calculated as part of a previous project. These values had been calculated by land use based on building square footage and assumed densities (for example 300 square feet/person for office land use).

Consultants used GIS tools to tabulate the total number of people who might use each sidewalk and crosswalk segment for first and last mile trips based on the parcel population totals and the shortest distance routes along available sidewalks and crosswalks between each parcel and the station. This collection of routes was designated as the "pedestrian tree" for the station. **Figure E1** shows an example pedestrian tree for Parker Road Station, with one "branch" of the tree to a 662-resident apartment complex highlighted in purple that could be shortened by constructing new sidewalk along a path worn in the grass by pedestrians who already take the shortcut.

This technique allowed modeling of how individual travelers would collectively contribute greater ridership increases along pedestrian routes with the highest density of population and employment.

Figure E1: Concept of Pedestrian Trees Illustrated



For the third assumed input to ridership, pedestrian stress could be due to uncomfortable circumstances such as high traffic speeds along the route, narrow sidewalks in close proximity to traffic, or multi-lane crossings of busy streets. This concept of "Pedestrian Level of Traffic Stress" (PLTS), was adapted for pedestrians by the Oregon Department of Transportation[1] from a similar method developed for bicyclists in 2012 by researchers from San Jose State University and the Northeastern University College of Engineering[2].

The PLTS method assigns scores to sidewalk and crosswalk segments for their levels of pedestrian stress, with scores ranging from 1 for low stress to 4 for high stress conditions. Details on the PLTS model methodology are available at the sources indicated in the footnotes.

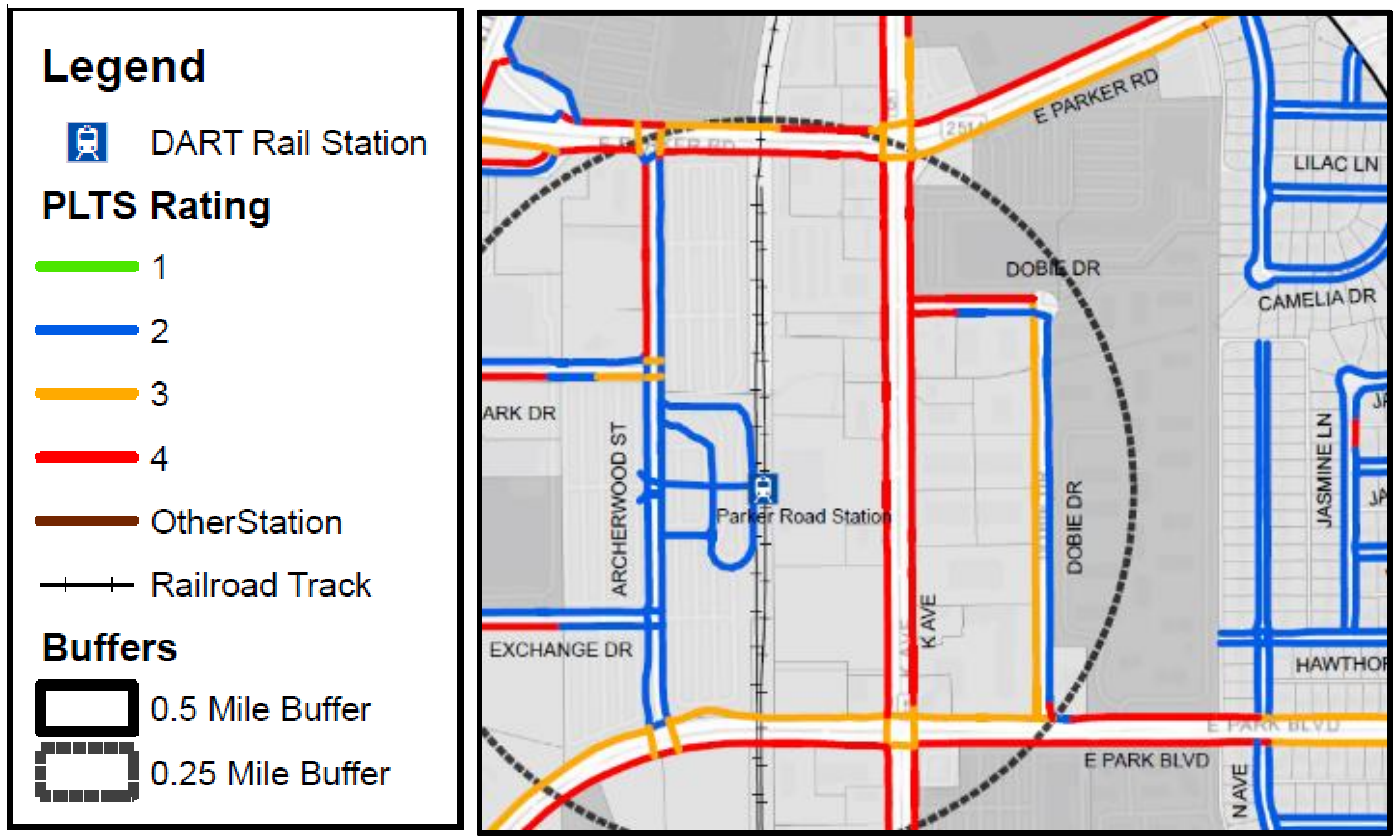
Consultants used inputs from the field data collection in the half-mile area around Parker Road Station to create a spreadsheet program for calculating PLTS scores based on a series of look-up tables defined in ODOT's methodology, with some adaptations for local Dallas-area conditions. They then joined these scores to sidewalk shapefiles in an ArcGIS model. An example map produced from this model is shown in **Figure E2**, highlighting in red the higher stress PLTS 4 conditions present along higher speed arterials near Parker Road Station. Potential riders unwilling to walk along higher stress PLTS 3 or PLTS 4 sidewalks in orange and red would only have access between the Parker Road Station, its adjacent parking lots, and some commercial properties to the west, but not to any residential areas in the vicinity.

The PLTS results were then used to refine the earlier estimates of how many residents and employees might use each sidewalk and crosswalk segment for their first and last mile trips. Generalized assumptions were developed for the percentage of transit riders with trip ends within a half-mile of

[1] See Oregon Department of Transportation, "Analysis Procedures Manual, Version 2," November 2018, pages 14-28 to 14-51. Accessed at: https://www.oregon.gov/ODOT/Planning/Documents/APMv2_Ch14.pdf

[2] See Mekuria, Furth & Nixon, "Low-Stress Bicycling and Network Connectivity," May 2012. Accessed at: https://transweb.sjsu.edu/research/low-stress-bicycling-and-network-connectivity

Figure E2: Existing PLTS Ratings for Portion of Parker Rd Station Area



the station who would be willing or able to travel via sidewalks and crosswalks of varying PLTS stress levels. Absent more specific data, these percentages were aligned loosely (and admittedly speculatively) with survey data about the four types of cyclists as found in a recent NCTCOG survey illustrated in **Figure E3**. The assumed split for different groups of transit riders follows:

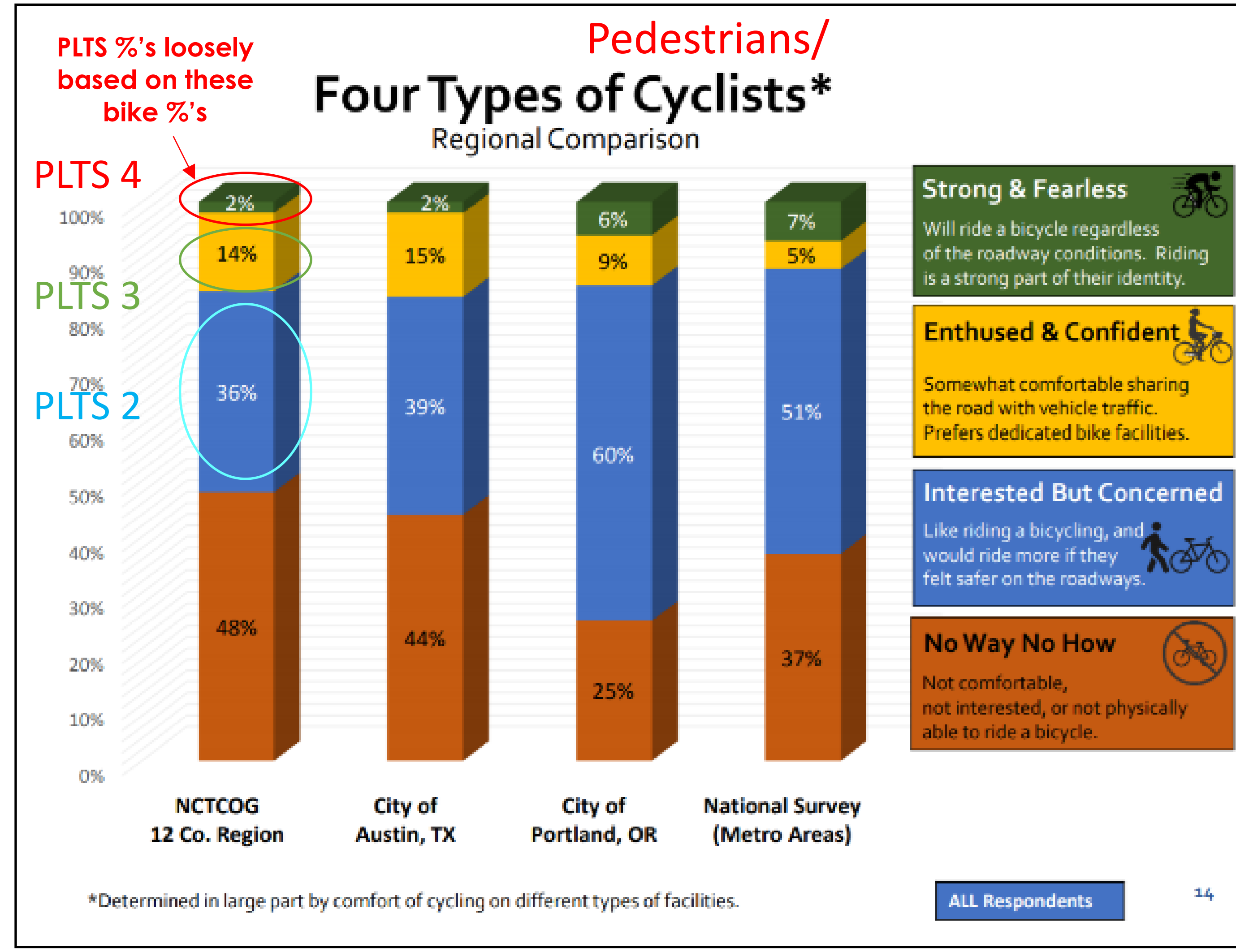
- 45% of transit riders were assumed to not walk or bike to transit regardless of the stress level, either based on ability or preference for car travel (similar to 48% No Way No How for bikes).
- Up to 35% of transit riders were assumed to walk or bike to transit if they could travel exclusively on PLTS 1 or PLTS 2 sidewalk and crosswalk facilities (similar to 36% Interested But Concerned for bikes).
- Up to 15% of transit riders were assumed willing to travel on PLTS 3 facilities (similar to 14% Enthused & Confident for bikes).
- Up to 5% of transit riders were assumed willing to travel on PLTS 4 facilities (similar to 2% Stong & Fearless for bikes).

More research would be ideal to investigate actual values for these assumptions.

Note that some of the in the PLTS 3 or 4 categories might be termed transit-dependent riders who don't have access to a car and for whom bus transfers to the station are not sufficiently convenient.

Each of the above assumed percentages was reduced based on a sliding scale for the distance of the parcel in question from the station. The sliding scale was based on data from a 2015 University

Figure E3: Data for Four Types of Cyclists Assumed Speculatively as Similar for Pedestrians

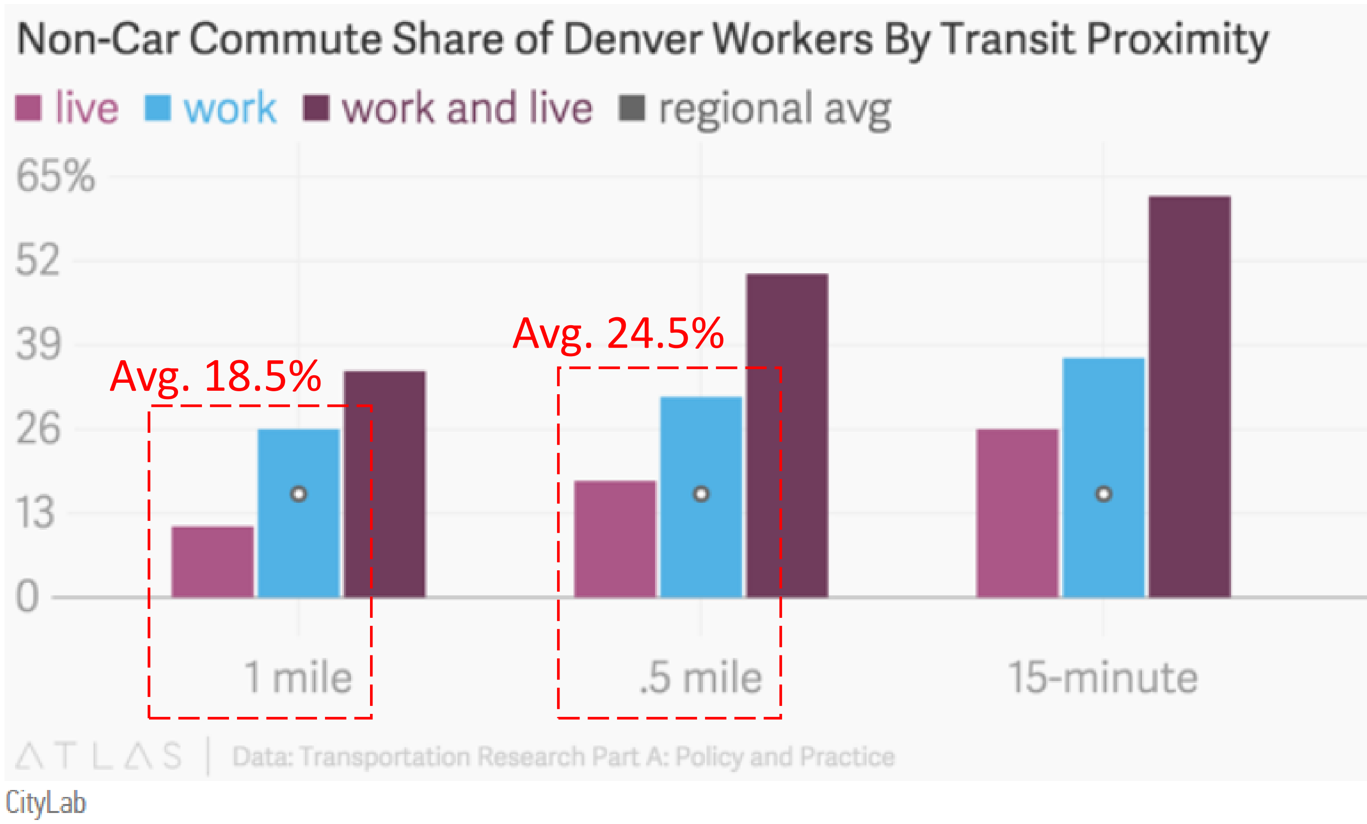


of Denver study illustrated in **Figure E4** that explored the proximity relationship of the non-car commute share of Denver workers based on transit proximity. The study found that the average percentage of people living or working within 1 mile of the station who used a non-car commute mode was about 18.5%. Within a half-mile of the station, the percentage increased to about 24.5%.

As shown in **Figure E5**, plotting these two points from Figure E4 in a linear relationship allows for an extrapolated assumption that no more than 30% of people living or working immediately adjacent to a transit station (at a theoretical 0 mile walking distance) would use a non-car commute mode.

It was surmised that the Denver data (as with all real-world cases) would represent non-ideal conditions constrained by imperfect sidewalks and pedestrian stress levels similar to those present in the Dallas metroplex and other cities. Therefore, since the object of the above-described analysis was to account for pedestrian stress more directly, it was surmised that a nominal value of 20% be added to the equation shown in Figure E5 to normalize the relationship for ideal conditions and adjustment using the PLTS methods instead. This adjusted relationship for a proximity factor to

Figure E4: Findings of 2015 University of Denver Study



Source: https://www.citylab.com/transportation/2015/09/whats-more-important-to-non-car-commuters-living-or-working-near-transit/405592/

provide the percentage of transit riders using non-car modes to reach the station under ideal sidewalk and crosswalk conditions based on distance from the station is shown in **Figure E6**.

Separate ArcGIS models were created around the Parker Road Station for two different partial pedestrian networks in addition to the full existing pedestrian network described earlier. These represented pedestrian networks that would be accepted by the segments of the transit riding population "Interested but Concerned" and "Enthused and Confident" about walking or riding to the station.

One network included only PLTS 1 and PLTS 2 links as route options (the blue lines in Figure 9) and therefore served the most limited number of parcels. Another network allowed for travel on PLTS 3 segments (the orange lines in Figure 9) in addition to PLTS 1 and PLTS 2. This network would serve a larger number of parcels. An overall estimate of existing ridership for Parker Road Station was calculated using the above-described inputs. For each parcel, a separate calculation for each PLTS group of transit riders was made as follows:

PLTS 1+2: Parcel population x Proximity Factor x 35% of transit riders in PLTS Group

PLTS 3: Parcel population x Proximity Factor x 15% of transit riders in PLTS Group

PLTS 4: Parcel population x Proximity Factor x 5% of transit riders in PLTS Group

Figure E5: Extrapolated Relationship from 2015 University of Denver Study

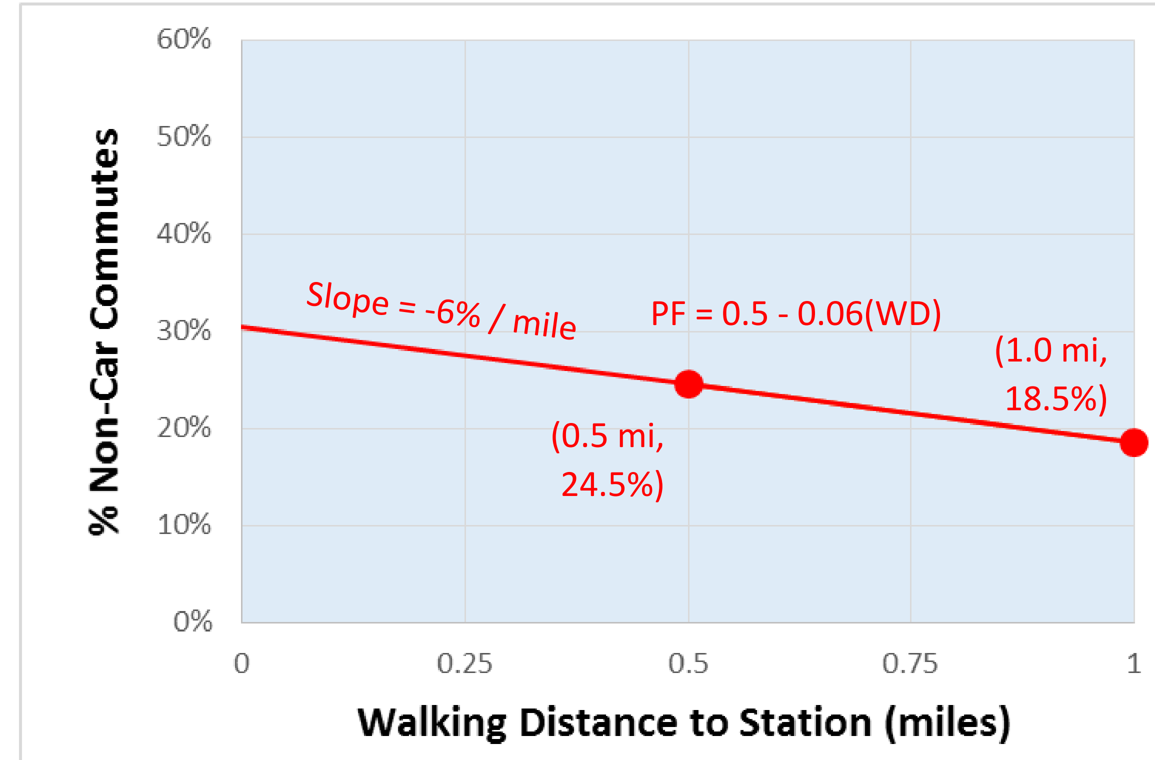


Figure E6: Adjusted Relationship Assumed for Proximity Factor

Criteria	Weight
Employment and Population Density (Number of potential riders connected by the improvement's catchment area)	50
Distance / Proximity of Improvements to the Station	25
Walkshed Trip Length Reduction (Catchment area benefitting from a reduced walk distance to the station)	5
Land Use Types and Key Destinations (e.g. schools, government buildings, social services, hospitals, large shopping centers, parks)	5
Crash History (Number of crashes in the general area of the project improvement)	5
Safety Benefit (Speed limit as a surrogate for systemic safety of the project improvement)	5
Equity / Transit Dependent Populations (Minority households, % below poverty line)	5

Note that the proximity factor was potentially different for each PLTS group, indicating that more selective travelers could only reach the station by following a longer path consistent with their intolerance for more stressful conditions. For parcels not connected to the station at all at a given PLTS (including PLTS 4) no ridership was assumed for that parcel as a simplifying assumption (despite the fact that many travelers, including those dependent on transit, can and do walk to the station without the benefit of sidewalk or crosswalk facilities).

The resulting estimate of existing non-car commuting trips to and from Parker Road Station was 631 people for existing conditions. This compared very favorably with 2015 survey data that had been provided by DART, indicating that 619 of the daily average riders either walked or biked to Parker Road Station.

Proposed sidewalk and crosswalk improvements were then added to the ArcGIS models for Parker Road Station so that an increase in ridership could be forecast. These are illustrated in **Figure E7**, which is an annotated screen capture from the GIS model where sidewalks and crosswalks are shown in purple or blue and parcel centroids are shown as brown circles.

With the originally proposed improvements, including a shared use path and pedestrian hybrid beacon (PHB) extending east of the station across K Ave, forecast ridership by non-car commute to the station was forecast to increase from 631 people to 1,018 people, a 61% increase.

Figure E7: Excerpt of Sidewalk Network, Including Originally Proposed Improvements near Parker Road