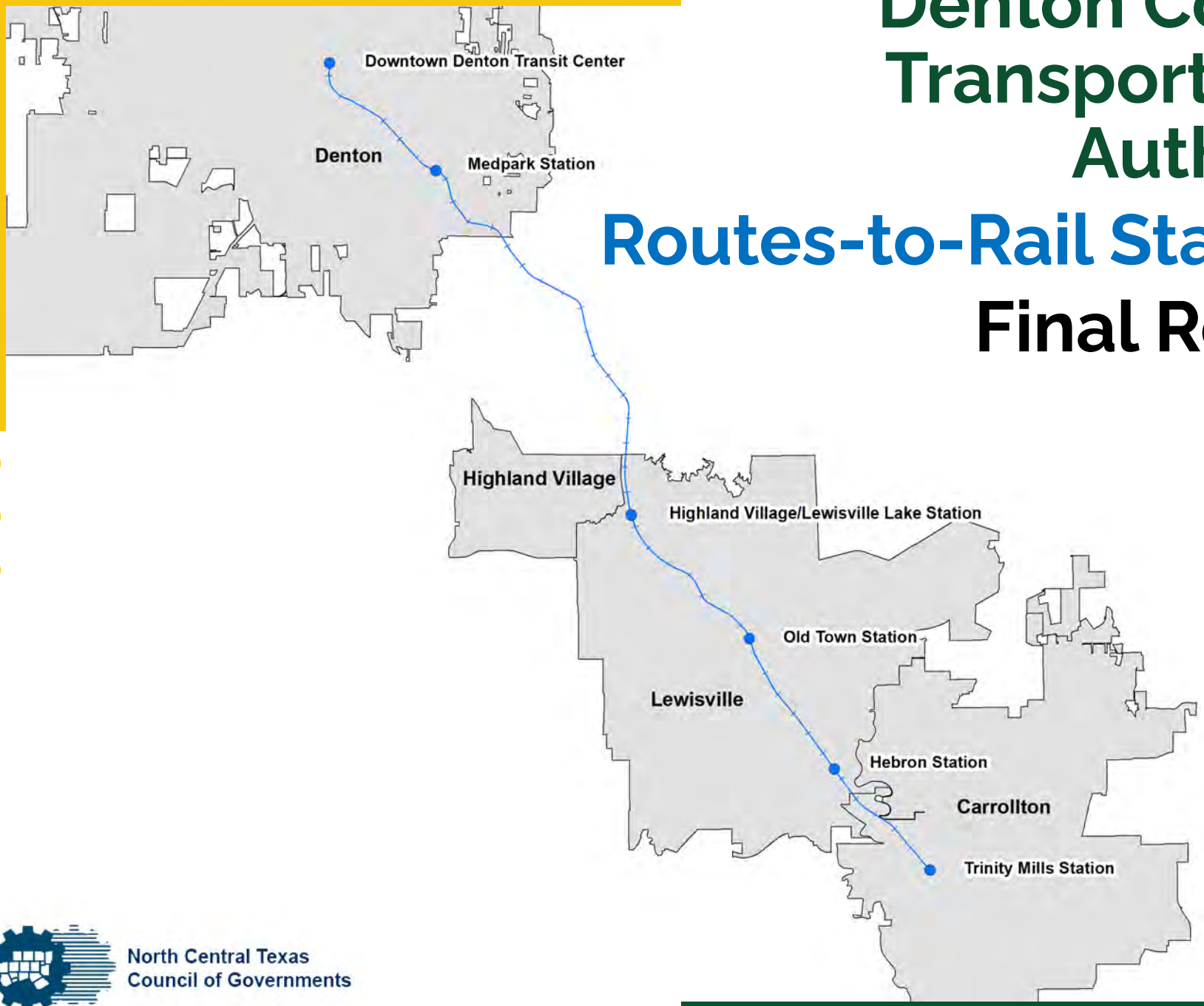
Denton County Transportation Authority

Routes-to-Rail Stations

Final Report

March 2023



North Central Texas Council of Governments

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Objective

The purpose of the Denton County Transportation Authority (DCTA) Routes-to-Rail Stations Study is to identify recommended infrastructure improvements that will enhance pedestrian accessibility for residents, workers, and shoppers on a continuously connected sidewalk network to and from rail stations, thus increasing the number of potential transit riders with improved access to DCTA Rail Stations for transportation. The key goal of the Study is to provide the opportunity to increase transit ridership.

Introduction

This study consisted of analysis performed by the North Central Texas Council of Governments (NCTCOG) and provides a high-level inventory and evaluation of pedestrian infrastructure needs within a half-mile radius of all six DCTA rail stations.

Recognizing full build-out of all improvements may not occur at once due to funding availability or other local conditions; this Study identifies a phased implementation approach, wherein recommended improvements are identified and ranked as high, medium, and low, based on the potential benefit to improve access for a greatest number of active users.

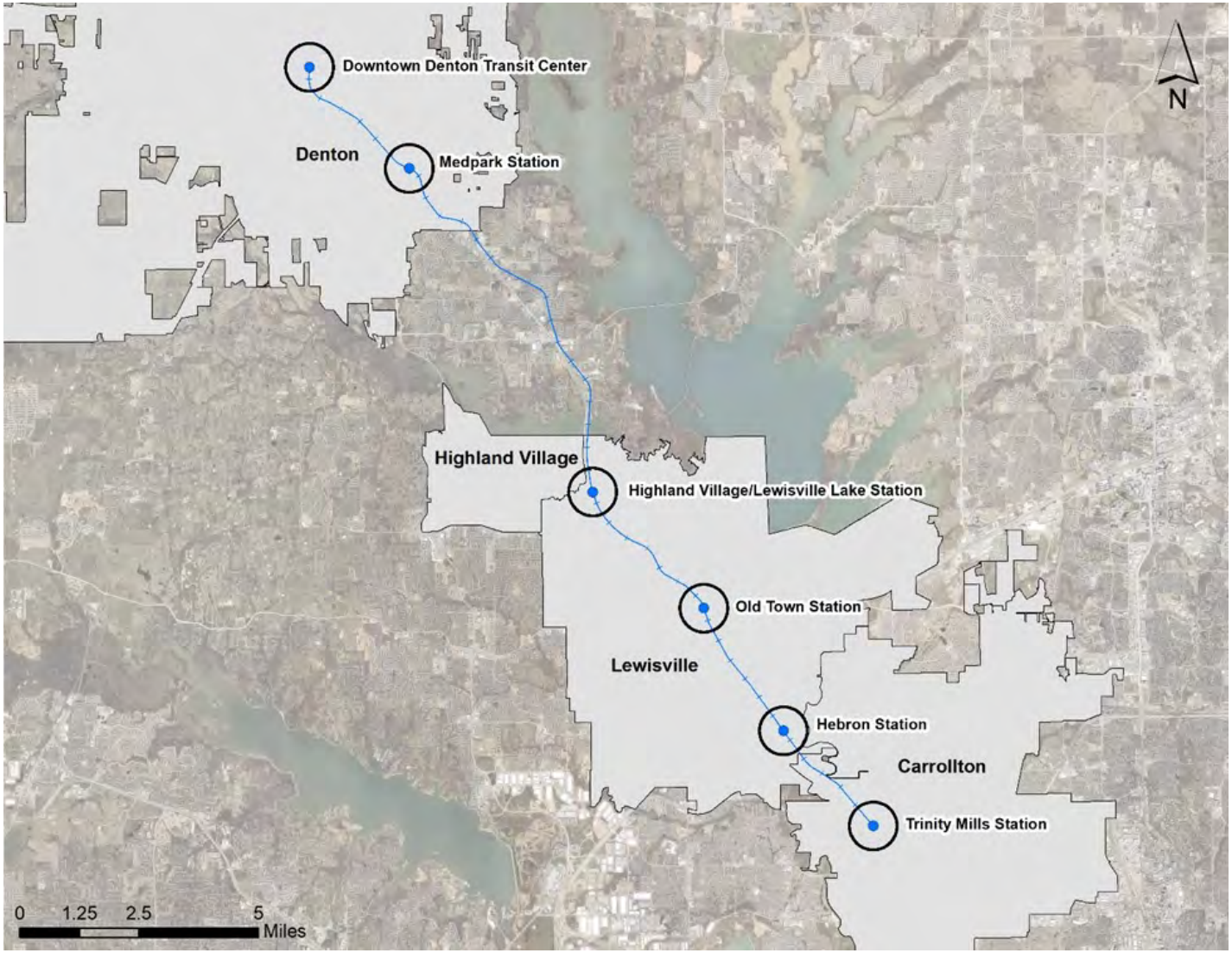
Opinions of Probable Construction Cost (OPCC) for new sidewalks with associated phasing priorities for implementation are developed for each station area.

This Study is focused on existing developed areas only; it is assumed any future development on undeveloped parcels will construct sidewalks with the adjacent public street rights-of-way.

This Study is intended to be a resource for the Cities of Carrollton, Denton, Lewisville, and the DCTA to plan for needed active transportation infrastructure to increase access for each rail station along the DCTA A-train rail corridor. This study focuses on the active walk distance (walkshed) using existing pedestrian facilities within public rights-of-way, which is impacted by gaps in the pedestrian network and other barriers of walking to and from a rail station. The corresponding analysis recommends sidewalk improvements and identifies priorities by analyzing parcel land uses, distance to rail stations, access to major destinations, and pedestrian safety. As a result, stakeholders and decisionmakers will have a better understanding of areas needing infrastructure investment and the associated opinions of probable construction costs to enhance the pedestrian network connectivity.

Study Area

Figure 1: DCTA Study Area



The study area includes the entire DCTA A-train corridor from Downtown Denton Transit Center on the north to Trinity Mills Station on the south. This DCTA rail line has six rail stations located in three cities (Denton, Lewisville, and Carrollton.)

Methodology

The study methodology is based on NCTCOG's Federal Transit Administration Transit -Oriented Development 2020 study*. The 2020 Study provided a base framework to collect data and to establish prioritization efforts for infrastructure improvements.

Sidewalk Inventory Base Data Collection

NCTCOG aerial imagery and Google Street View were used to review roadways within a half-mile radius of each DCTA station to identify existing sidewalks, trail facilities, and gaps between those existing facilities. Sidewalks, driveways, crosswalks, unmarked crossings, sidewalk gaps, crosswalk gaps, and trails were digitized in GIS to create an ultimate build-out scenario for active transportation needs.

Sidewalks were digitized only along public roadways owned by either the local municipal authority or the Texas Department of Transportation (TxDOT). Sidewalks within private development and along private roadways were not reviewed in this study. Additionally, all existing sidewalks determined to be in poor or unusable condition in the digitization phase were designated as a sidewalk gap since such sidewalks cannot properly accommodate ADA accessibility.

Appendix B provide more details on the methodology and analyses performed in this study.

Population and Employment Base Data Collection

For this study, NCTCOG staff developed a Transit-Oriented Development (TOD) land use/parcel population density database, with parcel level estimates of the average number of people who may be at a property site over the period of a typical day. This database is based on the reported size and land use of each building and supplemented with knowledge from city staff on special institutional uses, such as hospitals and universities.

The database of population and employment data was collected for parcels within the half-mile radius around DCTA rail stations and includes estimates for population, employment, and daily visitors. These estimates were used to help prioritize the sidewalk gaps and to calculate the total number of potential transit riders at the street block level.

The TOD land use/parcel population estimates were derived from the 2020 Denton and Dallas County appraisal districts, with additional information pulled from the NCTCOG 2015 Land Use data developed by the Research & Information Services team.

*This methodology is based on NCTCOG's Federal Transit Administration Transit Oriented Development 2020 study.

Methodology

Prioritized Improvements for Implementation

A prioritized network of sidewalk improvements for implementation was developed by analyzing the following criteria: tributary population and employment, distance to rail station, access to major developments, and pedestrian safety.

Tributary population and employment is considered as the total number of people that would benefit if a sidewalk gap was constructed; this was calculated by determining the routes people would need to take to reach the rail station from their respective parcel and assigning the parcel population numbers to the sidewalk gaps used to complete this trip. Appendix B provides more information about the tributary population and employment.

Improvements that provide enhanced access for the greatest number of people within the closest proximity to the rail station were identified as the highest priority for implementation. Other factors considered included the number of key destinations that would be connected (e.g. hospitals/clinics/urgent care, schools, government buildings, grocery stores, malls, supercenters, entertainment, fine arts, parks, libraries, museums), safety considerations including the number of reported crashes involving pedestrians and motor vehicles, and the posted speed limit.

Existing sidewalk gaps within the half-mile station area were grouped on a block-by-block basis. For this analysis, a block is defined by its limits between street intersections and includes sidewalk gap segments on both sides of the roadway.

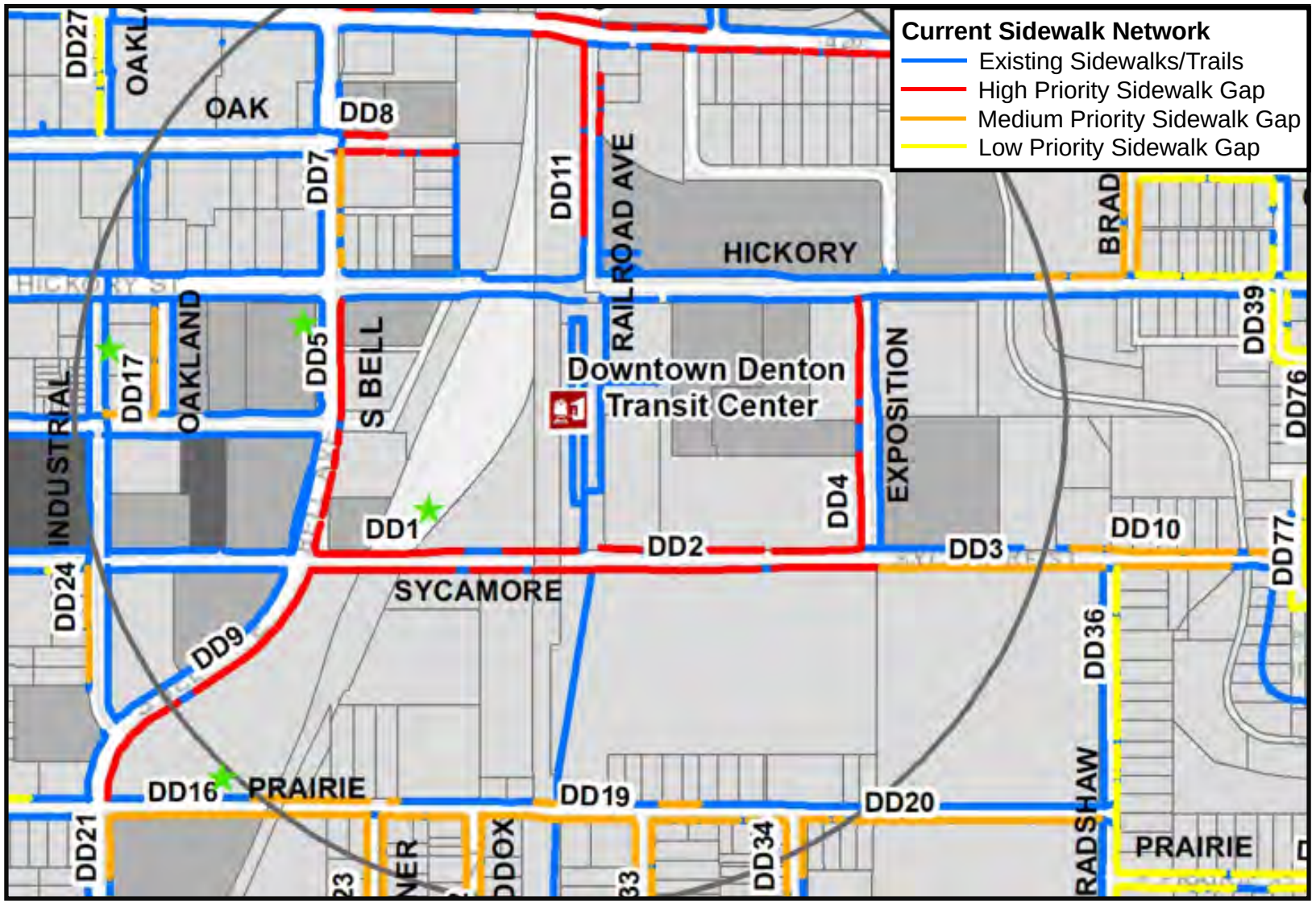
Each sidewalk block was given an identification number (ID), and the block groups were given the station letter abbreviations based on their respective station area: Downtown Denton (DD), Hebron (H), Lewisville Lakes (LS), MedPark (M), Old Town (OT), and Trinity Mills (TM). Additionally, each block ID includes a corresponding number with the station letter abbreviation to reference the map and table. For example, in Figure 2, block ID “DD1” begins at S. Bell Ave. and ends at Railroad Ave. (street accessing Downtown Denton Transit Center platform). Similarly, block ID “DD2” starts at Railroad Ave. and ends at Exposition Rd.

After grouping the individual sidewalk gap segments into block groups, an evaluation process of scoring the sidewalk gaps was created, as shown in Table 1, which established a prioritization process for the scored sidewalk gap block groups.

This evaluation process to score sidewalk gaps was based on the “DART Red & Blue Line Corridors Last Mile Connections Project” completed in 2020 by NCTCOG. However, this Study was modified to no longer include access to bus stops in the scoring process since DCTA is in the process of discontinuing several bus routes and moving to a new on-demand transportation system called GoZone.

Methodology

Figure 2: Gap Blocks



Methodology

Table 1: Scoring Matrix

Scoring Matrix													
Category	**Tributary Population & Employment**			**Distance**			**Access**		**Safety**				
Weight	50%			25%			15%		10%				
Detailed Data Input	Estimated parcel population, employment, and daily visitors			Distance from Station			Major Developments		Number of nearby pedestrian crashes (2016-2020)		Posted speed limit		
Description	Potential riders (Population + Employment + Daily Visitors) upstream of sidewalk and/ or crosswalk improvements along a connected route.			Distance from individual improvements, to station, measured at a straight-line distance (as the crow flies).			Number of key destinations (hospitals/clinics/urgent care, schools, government buildings, grocery stores, malls, supercenters, entertainment, fine arts, parks, libraries, museums).		Number of crashes within buffer zone (from network analyst output) created by addition of sidewalk project.		Posted speed limit of parallel street or street being crossed.		
	Range (Low-High) Number of People being Connected		**Points**	**Range (Low-High) Linear Feet from Rail Station**		**Points**	**Number of Destinations**	**Points**	**Number Of Crashes**	**Points**	**Range (Low-High) mph**		**Points**
Scoring Range 5	500+		**50**	0	660	**25**	1+	**15**	3	**5**	50	75	**5**
Scoring Range 4	400	499	**40**	661	1320	**20**			2	**4**	45		**4**
Scoring Range 3	300	399	**30**	1321	1980	**10**	n/a	**0**	1	**2**	40		**3**
	200	299	**25**										
Scoring Range 2	150	199	**20**	1981	2640	**5**					35		**2**
	100	149	**15**										
Scoring Range 1	50	99	**10**	2641	5280	**0**			0	**0**	10	30	**1**
	0	49	**5**										

Methodology

Opinions of Probable Construction Cost

A cost per linear foot was developed to calculate opinions of probable construction cost (OPCC) for each high, medium, and low priority block in each station area. After coordinating with local cities, a base construction cost of $200 per linear foot was estimated for sidewalk construction.*

This base cost provides a high-level engineering cost estimate for identified blocks needing improvement within the study area. This base cost includes standard items that would be included in constructing a sidewalk in addition to multipliers for other associated project costs.

The OPCC does not include specialty construction items that could be included in a project based on the context of the project area, such as: utility relocation (lines, poles, boxes), railroad crossings, traffic signals (Rectangular Rapid Flashing Beacon (RRFB), Pedestrian Hybrid Beacon, APS/ Countdown pedestrian signal, pedestrian signal), illumination, retaining walls, driveway reconstruction, drainage culverts, and reinforced concrete pipe (RCP). Thus, a more detailed engineering cost estimate should be developed for each improvement area before finalizing funding needed for project implementation.

Table 17: Opinions of Probable Construction Cost Assumptions provides a detailed explanation of the OPCC assumptions.

*The estimate of $200/LF is based on 2022 values and does not account for inflation; it is recommended that similar projects in the future reassess this value and update as needed.

Station Area Recommendations

Station and Gap Block Organization

The following station area recommendations are provided in order from the northernmost station (Downtown Denton Transit Center) to the southernmost station (Trinity Mills). Each station map includes the high, medium, and low priority recommendations and an associated table with base level opinions of probable costs in 2022 dollars.*

See Appendix A for a summary of detailed opinions of probable construction cost associated with each block segment.

*The OPCC does not include specialty construction items that could be included in a project based on the context of the project area, such as: utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/Countdown pedestrian signal, pedestrian signal), illumination, retaining walls, driveway reconstruction, drainage culverts, and reinforced concrete pipe.

Station Area Recommendations:

Downtown Denton Transit Center

Within the half-mile radius of Downtown Denton Transit Center, 108 blocks were identified with various amounts of existing sidewalk gaps (Figure 3). The highest priority improvements include blocks that directly connect to the station such as Sycamore Rd from S. Bell St. to Railroad Ave. at the Downtown Denton Transit Center (DD1) and from Railroad Ave. to Exposition St. (DD2). These improvements provide connections to existing sidewalk facilities towards the east and west, which would significantly improve the number of people connected to the rail station. These blocks would also provide a direct connection to the DCTA A-train Rail Trail (also called the Denton Katy Trail), which is a regionally significant trail that provides connection to the DCTA rail corridor.

High priority connections to the north along Railroad Ave. (DD11) and McKinney St. (DD15) would connect the rail station and existing facilities to Denton City Hall and Denton Civic Center. More than $10 million in base construction costs (2022 dollars) would be needed to implement all phases of improvements within the half-mile radius of the Downtown Denton Transit Center, not including specialty construction items that may be necessary in the project area (Table 2).

Table 2: Downtown Denton Station Summary Opinions of Probable Construction Cost

Priority Rank	Linear Feet	Opinions of Probable Construction Cost (2022 $)*
High	4,637	$ 927,348
Medium	19,225	$ 3,844,940
Low	29,205	$ 5,828,599
Total:	**53,066**	**$ 10,600,8867**

**The $200 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).*

Figure 3:

Downtown Denton Transit Center
Recommended Sidewalk Construction

DCTA Stations
Last Mile Connections: Recommended Sidewalk Construction
November 2022

Legend

- Commuter Rail Station
- Existing Sidewalks/Trails
- 1/4 Mile Radius from Station
- 1/2 Mile Radius from Station

Proposed Sidewalk Gaps by Priority

- High
- Medium
- Low

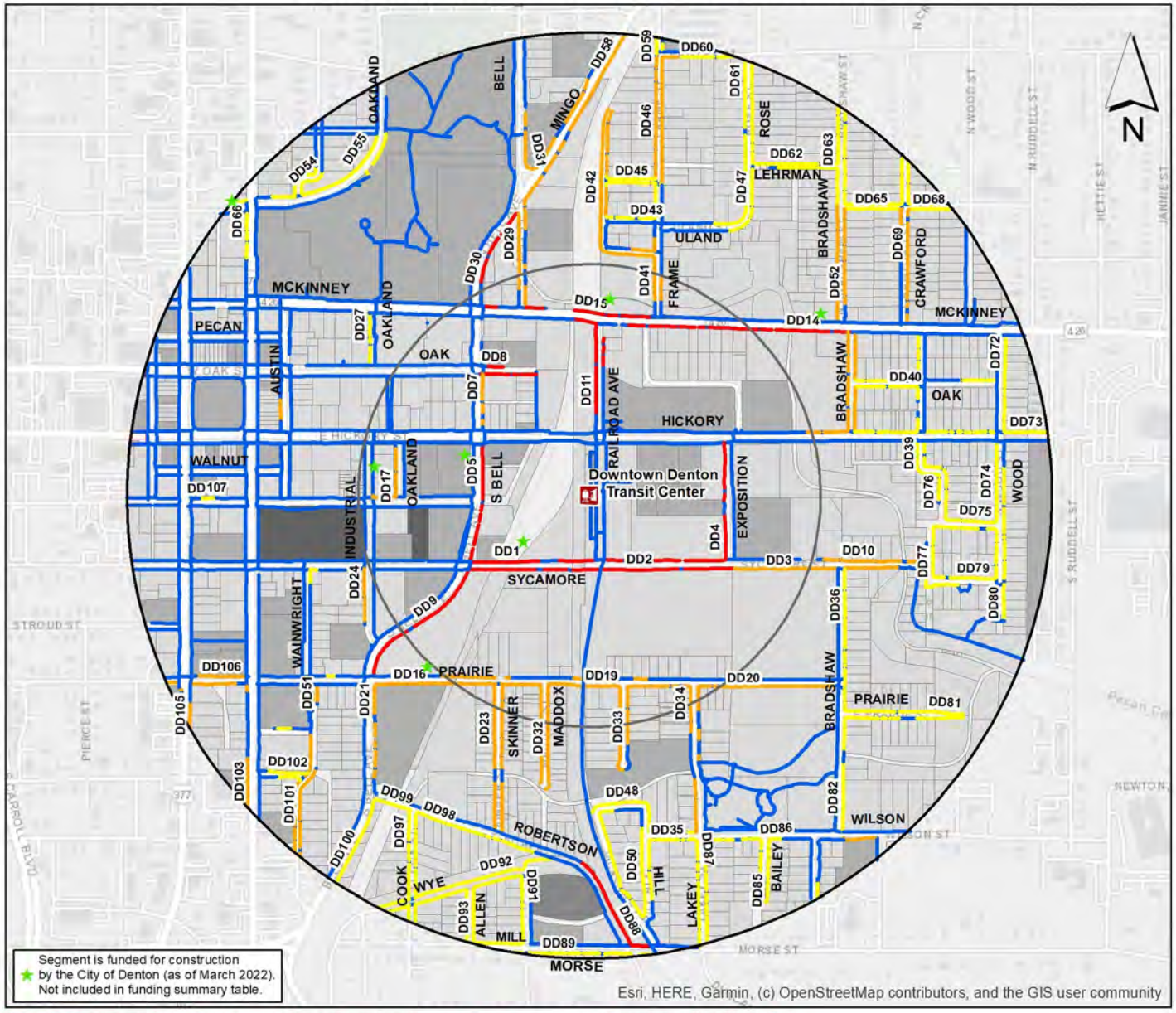
Opinion of Probable Base Construction Cost (2022 $)

High	$927,348
Medium	$3,844,940
Low	$5,828,599
Total	**$10,600,887**

See footnote below

Existing Residential and Employment Population (Number of People)

- 0 - 50
- 51 - 300
- 301 - 500
- 501 - 1,000
- 1,001+



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*The $200 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).

0 500 1,000 Feet

Station Area Recommendations:

MedPark Station

MedPark Station consists of seven blocks with various sidewalk gaps (Figure 4). South Mayhill Rd. from Edwards Rd. to Quailcreek Rd. (MS8) is designated as a high priority block and has local funding programmed for construction by the City of Denton. This roadway will provide a needed connection to a densely populated residential area and would also connect residents to the DCTA A-train Rail Trail (Denton Katy Trail).

Medium priority blocks along Colorado Blvd. (MS6) and Mayhill Rd. (MS7) will provide connections from MedPark Station to Medical City Denton, a major employer and health center in the city. More than $1.1 million in base construction costs (2022 dollars) are needed to implement all phases of improvements within the half-mile radius of the MedPark Station, not including specialty construction items that may be necessary in the project area. (Table 3).

Table 3: MedPark Station Summary
Opinions of Probable Construction Cost

Priority Rank	Linear Feet	Opinions of Probable Construction Cost (2022 $)*
High	-	-
Medium	2,699	$ 539,817
Low	3,124	$ 624,788
Total:	**5,823**	**$ 1,164,605**

**The $200 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).*

Figure 4:

MedPark Station
Recommended Sidewalk Construction

DCTA Stations
Last Mile Connections:
Recommended Sidewalk Construction
November 2022

Legend

- Commuter Rail Station
- Existing Sidewalks/Trails
- 1/4 Mile Radius from Station
- 1/2 Mile Radius from Station

Proposed Sidewalk Gaps by Priority

- High
- Medium
- Low

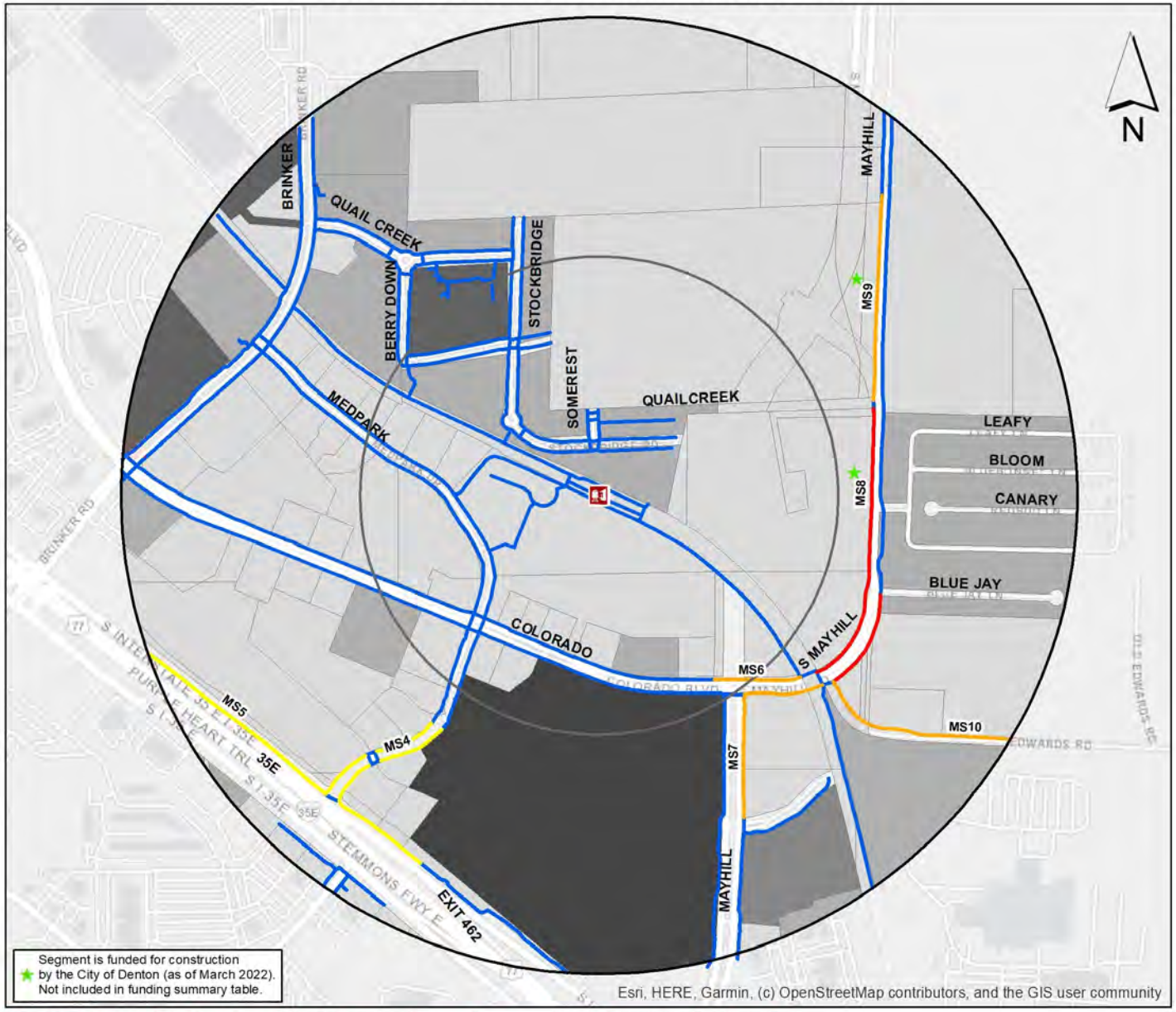
Opinion of Probable Base Construction Cost (2022 $)

High	N/A
Medium	$539,817
Low	$624,788
Total	**$1,164,605**

See footnote below

Existing Residential and Employment Population (Number of People)

- 0 - 50
- 51 - 300
- 301 - 500
- 501 - 1,000
- 1,001+



*The $200 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).

0 500 1,000 Feet

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Station Area Recommendations:

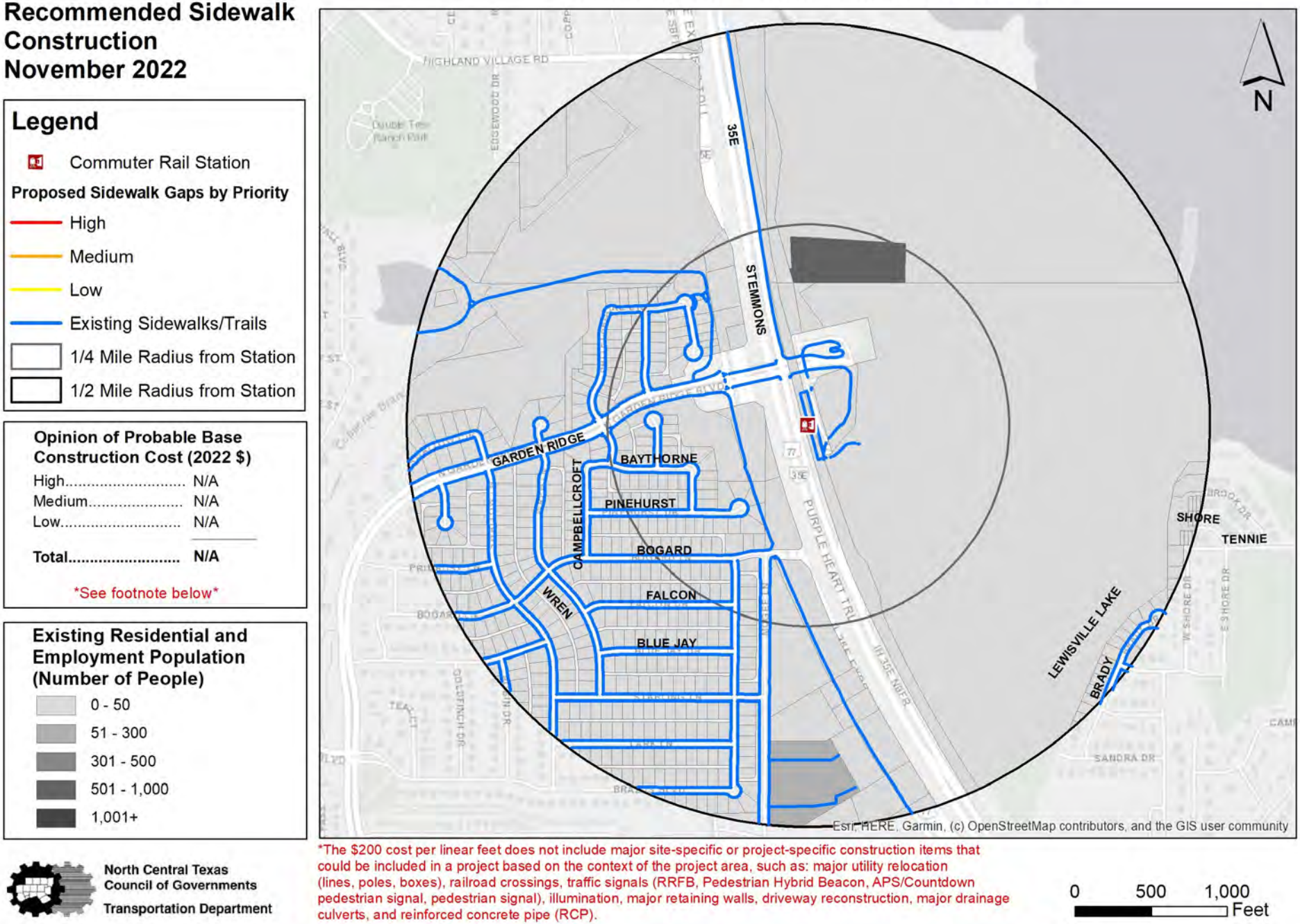
Highland Village/Lewisville Lake Station

The existing developed area around the Highland Village/ Lewisville Lake Station has a complete and well-connected sidewalk and trail network leading to and from the rail station (Figure 5). No improvements are currently necessary and it is anticipated that sidewalks will be constructed with future development projects in this area.

Figure 5:

Highland Village/Lewisville Lake Station
Recommended Sidewalk Construction

DCTA Stations
Last Mile Connections:
Recommended Sidewalk Construction
November 2022



*The $200 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).

Station Area Recommendations:

Old Town Station

A total of 46 blocks around Old Town Station are identified with various sidewalk gaps for construction (Figure 6), with the highest priority block for implementation located along Railroad St. (OT1). This block will connect to commercial areas south of Old Town Station.

While numerous sidewalk gaps were identified in the station area, many of these missing gaps in infrastructure ranked as either low or medium priority in the prioritization process due to their increased distance to the rail station and/or low estimates for increasing access for population, employment, and daily visitors.

More than $5.2 million in base construction costs (2022 dollars) would be needed to implement all phases of improvements within the half-mile radius of the Old Town Station, not including specialty construction items that may be necessary in the project area (Table 4).

Table 4: Old Town Station Summary Opinions of Probable Construction Cost

Priority Rank	Linear Feet	Opinions of Probable Construction Cost (2022 $)*
High	1,124	$ 224,816
Medium	11,394	$ 2,278,832
Low	13,830	$ 2,765,927
Total:	**26,348**	**$ 5,269,575**

**The $200 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).*

Figure 6:

Old Town Station
Recommended Sidewalk Construction

DCTA Stations
Last Mile Connections:
Recommended Sidewalk Construction
November 2022

Legend

- Commuter Rail Station
- Existing Sidewalks/Trails
- 1/4 Mile Radius from Station
- 1/2 Mile Radius from Station

Proposed Sidewalk Gaps by Priority

- High
- Medium
- Low

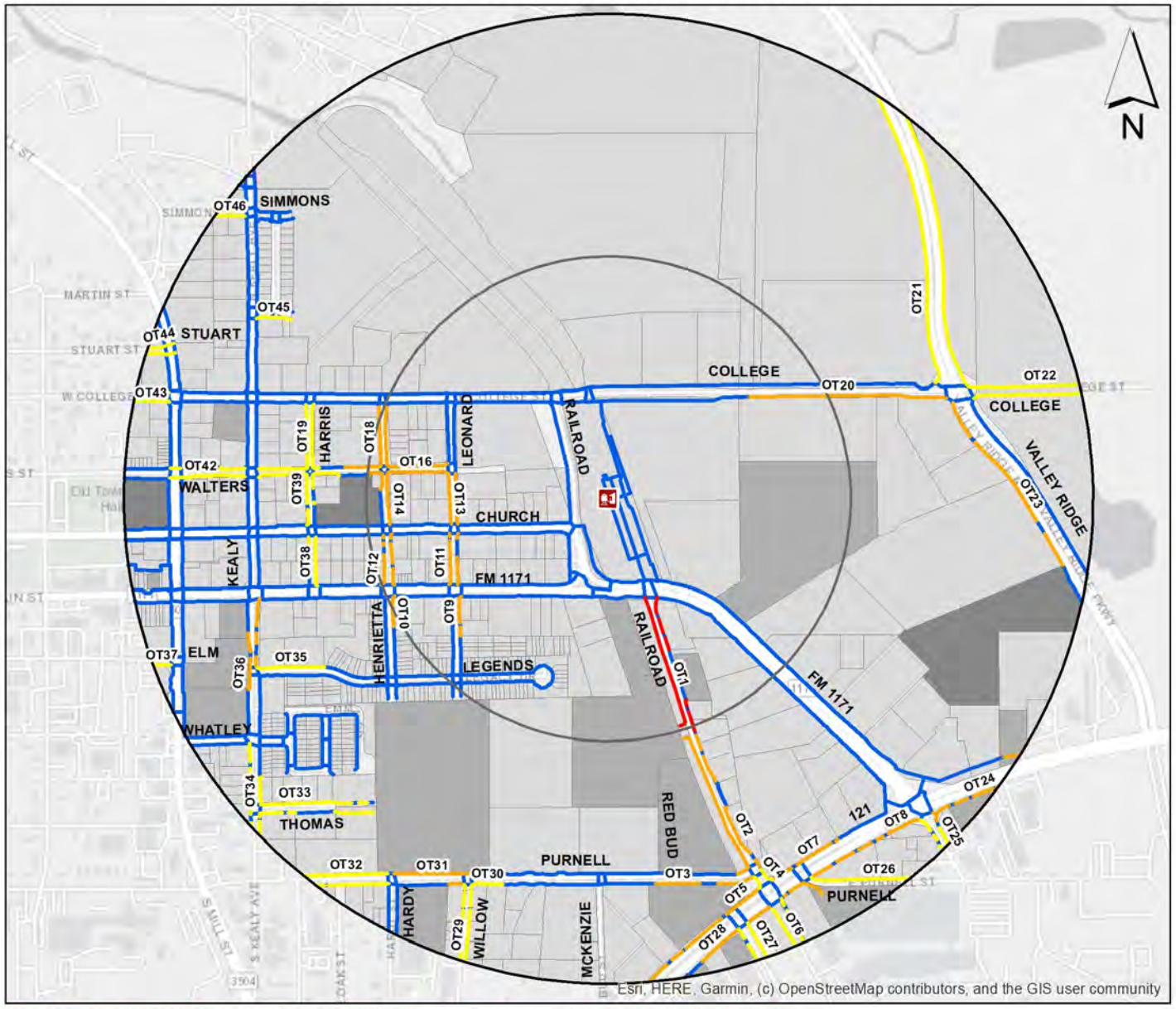
Opinion of Probable Base Construction Cost (2022 $)

High	$224,816
Medium	$2,278,832
Low	$2,765,927
Total	**$5,269,575**

See footnote below

Existing Residential and Employment Population (Number of People)

- 0 - 50
- 51 - 300
- 301 - 500
- 501 - 1,000
- 1,001+



*The $200 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).

0 500 1,000 Feet

North Central Texas Council of Governments
Transportation Department

Station Area Recommendations:

Hebron Station

There are total of 10 blocks within the Hebron Station area with various sidewalk gaps identified for construction. Each of the four high priority designated blocks for implementation have been excluded from the OPCC tables (Figure 7). High priority segments H1 and H2 are located within a private residential development and will be implemented with future development. The type of facility for high priority segments H9 and H10 is currently unknown (e.g. sidewalk or trail) and will need to be determined by the City of Lewisville. Blocks H5 and H6 have programmed funding for implementation and are also not included in the OPCC tables.

The remaining three sidewalk gap blocks (H3, H8, and H11) in Table 5 did not rank as high priority due to their proximity to the rail station. More than $600,000 in base construction costs (2022 dollars) would be needed to implement all phases of improvements within the half-mile radius of the Hebron Station, not including specialty construction items that may be necessary in the project area.

Table 5: Hebron Station Summary
Opinions of Probable Construction Cost

Priority Rank	Linear Feet	Opinions of Probable Construction Costs (2022 $)*
High	-	-
Medium	279	$ 55,780
Low	3,054	$ 610,787
Total:	**3,333**	**$ 666,567**

**The $200 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).*

Figure 7:

Hebron Station
Recommended Sidewalk Construction

DCTA Stations
Last Mile Connections:
Recommended Sidewalk Construction
November 2022

Legend

- Commuter Rail Station
- Existing Sidewalks/Trails
- 1/4 Mile Radius from Station
- 1/2 Mile Radius from Station

Proposed Sidewalk Gaps by Priority

- High
- Medium
- Low

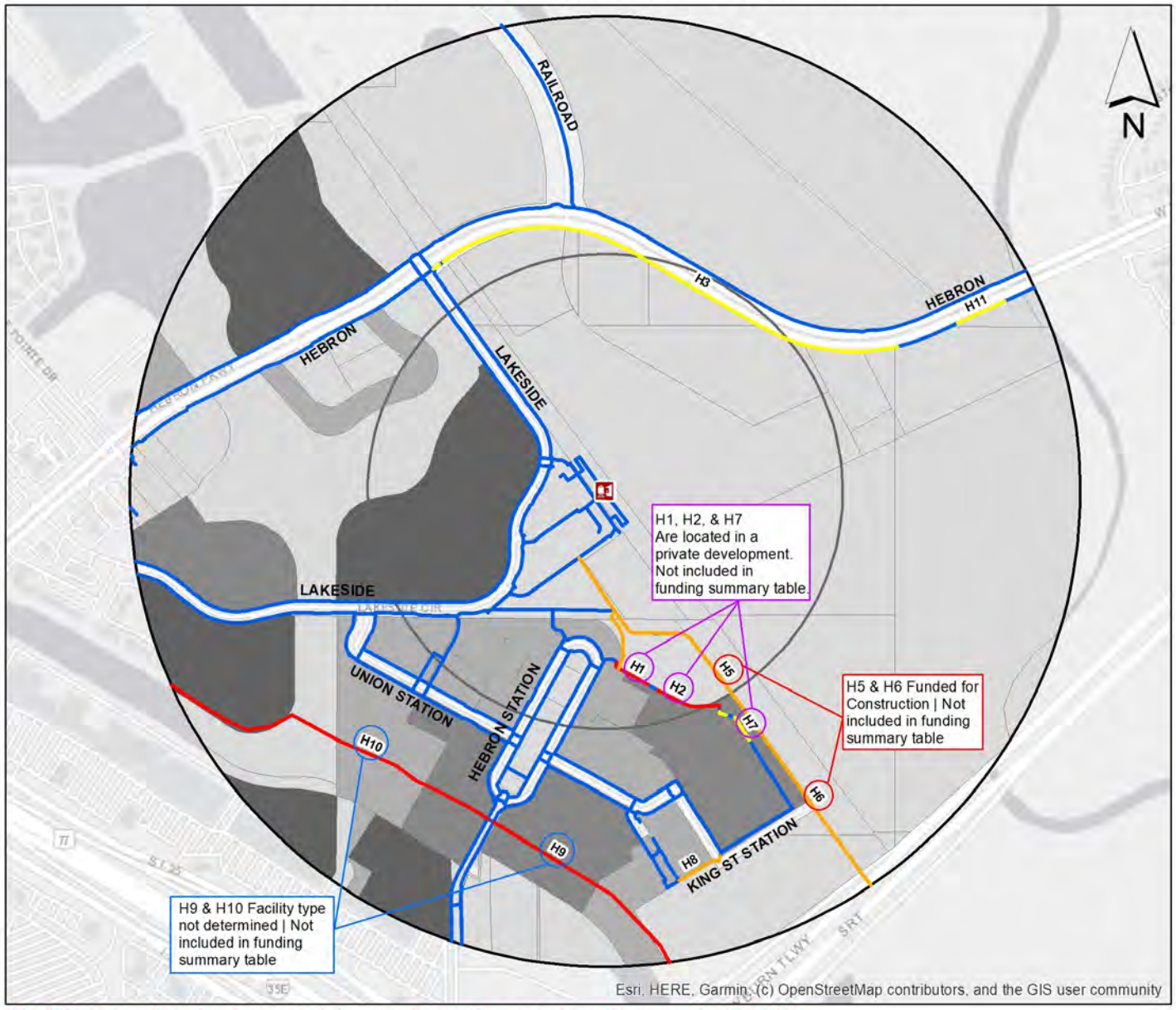
Opinion of Probable Base Construction Cost (2022 $)

High	TBD
Medium	$55,780
Low	$610,787
Total	**$666,567**

See footnote below

Existing Residential and Employment Population (Number of People)

- 0 - 50
- 51 - 300
- 301 - 500
- 501 - 1,000
- 1,001+



*The $200 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).

0 500 1,000 Feet

North Central Texas Council of Governments
Transportation Department

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Station Area Recommendations:

Trinity Mills Station

A total of 35 blocks around Trinity Mills Station are identified with various sidewalk gaps, with four blocks identified as highest priority for construction (Figure 8). Several of the high and medium priority blocks are planned to be trails as part of the Regional Veloweb network and have received preliminary engineering and opinions of probable construction costs.[1] As such, these segments (identified with purple in Figure 8) have been excluded from the OPCC tables. More than $4.1 million in base construction costs (2022 dollars) would be needed to implement all phases of improvements within the half-mile radius of the Trinity Mills Station, not including specialty construction items that may be necessary in the project area (Table 6).

Table 6: Trinity Mills Station Summary Opinions of Probable Construction Cost

Priority Rank	Linear Feet	Opinions of Probable Construction Cost (2022 $) *
High	2,537	$ 48,117
Medium	12,650	$ 623,285
Low	5,445	$ 310,367
Total:	**20,632**	**$ 981,770**

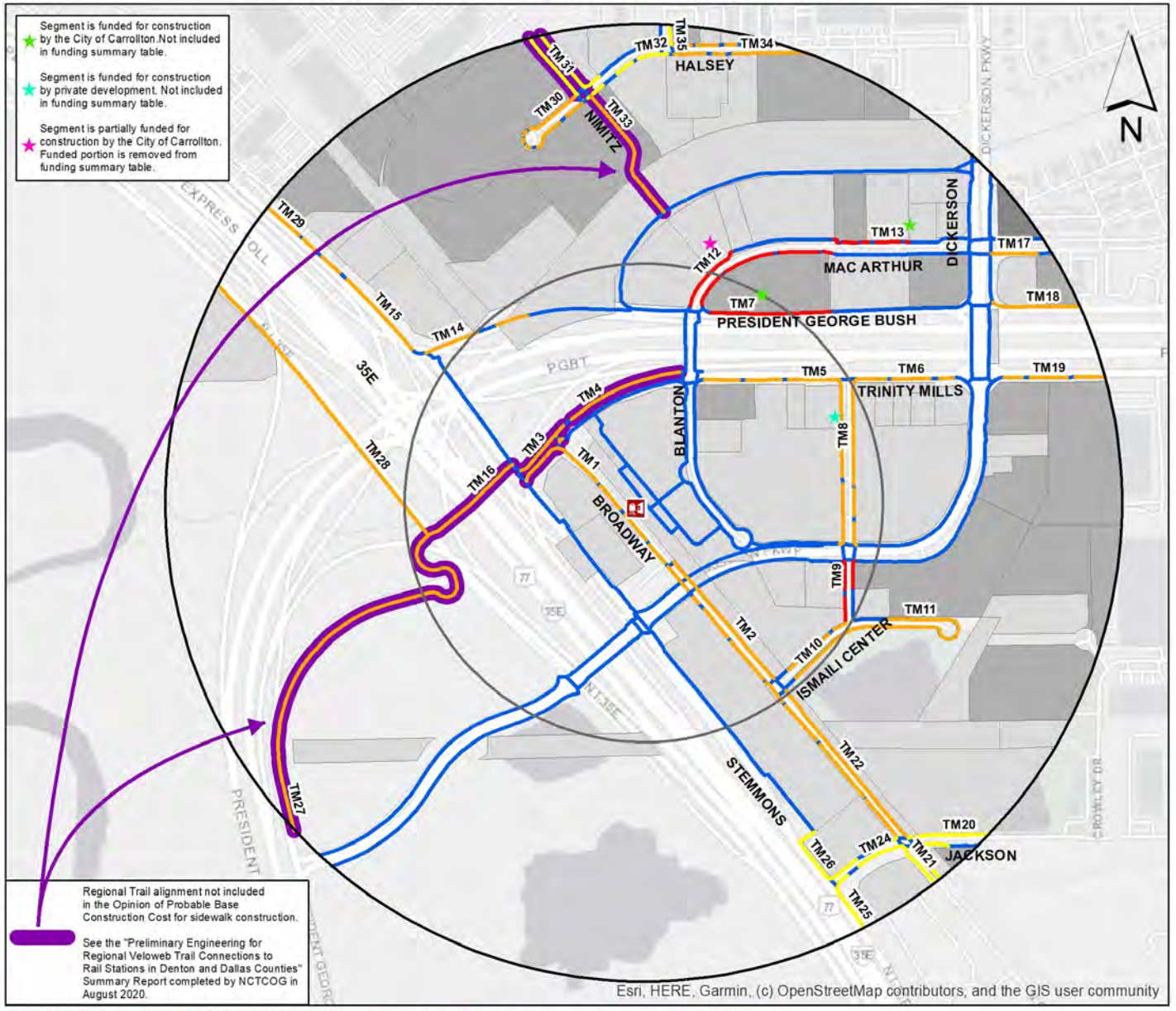
**The $57 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).*

1 = Trail segments have received preliminary engineering design costs from NCTCOG's 2020 report "Preliminary Engineering for Regional Veloweb Trail Connections to Rail Stations in Denton and Dallas Counties"

Figure 8:

DCTA Stations
Last Mile Connections: Recommended Sidewalk Construction
November 2022

Trinity Mills Station
Recommended Sidewalk Construction



Legend

- Commuter Rail Station
- Existing Sidewalks/Trails
- 1/4 Mile Radius from Station
- 1/2 Mile Radius from Station

Proposed Sidewalk Gaps by Priority

- High
- Medium
- Low

Opinion of Probable Base Construction Cost (2022 $)

High	$48,117
Medium	$623,285
Low	$310,367
Total	**$981,770**

See footnote below

Existing Residential and Employment Population (Number of People)

- 0 - 50
- 51 - 300
- 301 - 500
- 501 - 1,000
- 1,001+

North Central Texas Council of Governments
Transportation Department

*The $57 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).

0 500 1,000 Feet

Opinions of Probable Construction Cost Summary

Table 7 provides a summary of opinions of probable construction costs of the six stations in this report, the total costs, and a ranking by priority level.

Table 7: Opinions of Probable Construction Cost Summary (All Stations)

Station	Opinions of Probable Construction Cost Summary				
	High Priority	Medium Priority	Low Priority	Total (2022 $)*	Total (2027 $)**
Downtown Denton	$927,348	$3,844,940	$5,828,599	$10,600,887	$12,897,600
MedPark	N/A	$539,817	$624,788	$1,164,605	$1,417,000
Highland Village/Lewisville Lakes	N/A	N/A	N/A	N/A	N/A
Old Town	$224,816	$2,278,832	$2,765,927	$5,269,575	$6,411,300
Hebron	TBD	$55,780	$610,787	$666,567	$811,000
Trinity Mills †	$48,117	$623,285	$310,367	$981,770	$1,194,500
Total	$1,200,281	$7,342,654	$10,140,468	$18,683,404	$22,731,400

* *The $200 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/ Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).*

** *Assumes an annual inflation rate of four percent.*

† *The City of Carrollton uses a cost estimate of $57 per linear feet which does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).*

Next Steps for Implementation

The Denton County Transportation Authority Routes-to-Rail Stations Study estimates a base construction cost more than $21 million (in 2022 dollars) in sidewalk gap improvements primarily in existing developed areas surrounding the six DCTA rail stations. Opinions of probable construction costs generated for the improvements represent high-level cost estimates. Further detailed engineering estimates will be required to identify if additional infrastructure improvements are necessary, such as specialty construction items that may be necessary in the project area.* Constructing these pedestrian improvements will require local agency coordination and local funding in order to improve access to the greatest number of potential transit riders. It is anticipated future development will construct sidewalks in areas that are currently undeveloped.

Additional funding opportunities may also be options for the Cities of Carrollton, Denton, Lewisville, and DCTA. Sidewalk improvements are eligible for funding under various sources. At the local level, DCTA's Transportation Reinvestment Program (TRiP) may be a source used to leverage local funding of improvements. In addition sidewalk improvements providing improved access for significant numbers of potential transit riders may also be eligible for federal transportation funding allocated to the region.

*The OPCC does not include specialty construction items that could be included in a project based on the context of the project area, such as: utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/Countdown pedestrian signal, pedestrian signal), illumination, retaining walls, driveway reconstruction, drainage culverts, and reinforced concrete pipe.

Appendix A:

Half-Mile Area Improvement Opinions of Probable Construction Cost Matrices

North Central Texas Council of Governments

Table 8: Downtown Denton Transit Center Detailed OPCC

Gap Block/Location ID	Priority	Linear Feet	Opinions of Probable Construction Cost	Ownership
DD002	HIGH	1331.79	$ 266,358.80	City
DD003	MEDIUM	667.74	$ 133,548.36	City
DD004	HIGH	521.12	$ 104,223.24	City
DD007	MEDIUM	226.36	$ 45,271.54	City
DD008	HIGH	347.85	$ 69,570.13	TxDOT
DD009	HIGH	789.93	$ 157,986.87	TxDOT
DD010	MEDIUM	708.33	$ 141,666.73	City
DD011	HIGH	576.22	$ 115,243.88	City
DD012	MEDIUM	192.22	$ 38,444.47	City
DD013	MEDIUM	1009.06	$ 201,811.99	City
DD018	MEDIUM	137.17	$ 27,433.52	City
DD019	MEDIUM	582.47	$ 116,494.01	City
DD020	MEDIUM	723.26	$ 144,652.30	City
DD021	MEDIUM	385.62	$ 77,124.78	City
DD022	LOW	71.73	$ 14,345.20	City
DD023	MEDIUM	1437.56	$ 287,512.19	City
DD024	MEDIUM	265.98	$ 53,195.20	City
DD025	LOW	215.72	$ 43,144.96	City
DD026	MEDIUM	125.94	$ 25,188.23	City
DD027	LOW	320.79	$ 64,157.11	City
DD028	MEDIUM	76.55	$ 15,310.68	City
DD029	MEDIUM	649.52	$ 129,903.10	City
DD030	HIGH	392.12	$ 78,423.20	City
DD031	MEDIUM	797.71	$ 159,541.64	City
DD032	MEDIUM	1085.57	$ 217,114.40	City
DD033	MEDIUM	738.24	$ 147,648.86	City

Table 8 (Cont.): Downtown Denton Transit Center Detailed OPCC

Gap Block/Location ID	Priority	Linear Feet	Opinions of Probable Construction Cost ($200/Linear Foot)*	Ownership
DD034	MEDIUM	775.26	$ 155,051.39	City
DD035	LOW	481.53	$ 96,305.69	City
DD036	LOW	560.24	$ 112,048.16	City
DD037	LOW	365.71	$ 73,142.79	City
DD038	LOW	289.41	$ 57,882.50	City
DD039	LOW	770.88	$ 154,176.59	City
DD040	LOW	543.82	$ 108,763.99	City
DD041	MEDIUM	473.97	$ 94,794.77	City
DD042	MEDIUM	1741.39	$ 348,278.22	City
DD043	LOW	208.21	$ 41,642.76	City
DD044	LOW	190.03	$ 38,005.27	City
DD045	LOW	558.52	$ 111,703.21	City
DD046	MEDIUM	1266.53	$ 253,306.45	City
DD047	LOW	787.54	$ 157,508.69	City
DD048	LOW	626.83	$ 125,365.90	City
DD049	LOW	547.97	$ 109,594.84	City
DD050	LOW	757.44	$ 151,487.79	City
DD051	MEDIUM	134.40	$ 26,880.05	City
DD052	MEDIUM	1026.14	$ 205,228.29	City
DD053	LOW	191.81	$ 38,362.80	City
DD054	LOW	436.64	$ 87,327.29	City
DD055	LOW	805.43	$ 161,085.75	City
DD057	MEDIUM	86.12	$ 17,224.88	City
DD058	MEDIUM	895.63	$ 179,126.97	City
DD059	LOW	548.21	$ 109,642.89	City
DD060	LOW	365.91	$ 73,182.16	City

Table 8 (Cont.): Downtown Denton Transit Center Detailed OPCC

Gap Block/Location ID	Priority	Linear Feet	Opinions of Probable Construction Cost	Ownership
DD061	LOW	984.24	$ 196,847.27	City
DD062	LOW	752.86	$ 150,571.55	City
DD063	LOW	502.80	$ 100,559.70	City
DD064	LOW	383.58	$ 76,716.86	City
DD065	LOW	1450.28	$ 290,056.11	City
DD067	LOW	437.75	$ 87,549.55	City
DD068	LOW	377.38	$ 75,475.68	City
DD069	MEDIUM	610.07	$ 122,014.29	City
DD070	LOW	299.64	$ 59,928.78	City
DD071	LOW	184.37	$ 36,874.34	City
DD072	LOW	469.68	$ 93,935.79	City
DD073	LOW	246.28	$ 49,255.57	City
DD074	LOW	775.81	$ 155,161.26	City
DD075	LOW	540.21	$ 108,041.96	City
DD076	LOW	334.73	$ 66,946.55	City
DD077	LOW	380.88	$ 76,176.58	City
DD078	LOW	450.43	$ 90,085.25	City
DD079	LOW	507.50	$ 101,499.96	City
DD080	LOW	209.15	$ 41,829.03	City
DD081	LOW	1100.45	$ 220,090.53	City
DD082	LOW	685.90	$ 137,179.59	City
DD083	MEDIUM	194.08	$ 38,816.57	City
DD084	LOW	74.08	$ 14,815.78	City
DD085	LOW	615.59	$ 123,118.02	City
DD086	LOW	317.31	$ 63,462.59	City
DD087	LOW	957.36	$ 191,472.00	City

Table 8 (Cont.): Downtown Denton Transit Center Detailed OPCC

Gap Block/Location ID	Priority	Linear Feet	Opinions of Probable Construction Cost	Ownership
DD088	HIGH	677.71	$ 135,541.66	City
DD089	LOW	575.26	$ 115,052.22	City
DD090	LOW	331.42	$ 66,284.33	City
DD091	LOW	307.99	$ 61,598.72	City
DD092	LOW	785.63	$ 157,125.37	City
DD093	LOW	509.66	$ 101,931.25	City
DD094	LOW	654.42	$ 130,884.89	City
DD095	LOW	176.42	$ 35,284.41	City
DD096	LOW	302.56	$ 60,511.60	City
DD097	LOW	859.18	$ 171,836.76	City
DD098	LOW	593.72	$ 118,744.20	City
DD099	LOW	209.00	$ 41,800.28	TxDOT
DD100	LOW	535.93	$ 107,186.20	TxDOT
DD101	MEDIUM	1079.59	$ 215,917.27	City
DD102	LOW	385.67	$ 77,133.94	City
DD103	MEDIUM	266.93	$ 53,386.50	City
DD104	LOW	72.27	$ 14,454.14	City
DD105	MEDIUM	224.94	$ 44,988.46	City
DD106	MEDIUM	640.32	$ 128,063.65	City
DD107	LOW	97.50	$ 19,499.93	City
DD108	LOW	63.72	$ 12,744.07	City

**The $200 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/ Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).*

Table 9: MedPark Station Detailed OPCC

Gap Block/Location ID	Priority	Linear Feet	Opinions of Probable Construction Cost	Ownership
MS04	LOW	1298.48	$ 259,695.88	City
MS05	LOW	1825.46	$ 365,092.06	City
MS06	MEDIUM	915.32	$ 183,063.11	City
MS07	MEDIUM	679.03	$ 135,806.46	City
MS10	MEDIUM	1104.74	$ 220,947.30	City

**The $200 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/ Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).*

Table 10: Highland Village/Lewisville Lake Station Detailed OPCC

Gap Block/Location ID	Priority	Linear Feet	Opinions of Probable Construction Cost	Ownership
N/A	N/A	N/A	N/A	N/A

***** *The $200 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/ Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).*

Table 11: Old Town Station Detailed OPCC

Gap Block/Location ID	Priority	Linear Feet	Opinion of Probable Construction Cost	Ownership
OT01	HIGH	1,124.08	$ 224,815.99	City
OT02	MEDIUM	1,384.83	$ 276,965.35	City
OT03	MEDIUM	579.93	$ 115,985.64	City
OT04	LOW	158.42	$ 31,684.75	City
OT05	MEDIUM	354.27	$ 70,853.12	TxDOT
OT06	LOW	479.67	$ 95,934.38	City
OT07	MEDIUM	805.98	$ 161,195.12	TxDOT
OT08	MEDIUM	309.17	$ 61,833.67	TxDOT
OT09	MEDIUM	201.82	$ 40,363.75	City
OT10	MEDIUM	170.40	$ 34,079.21	City
OT11	MEDIUM	436.00	$ 87,200.50	City
OT12	MEDIUM	426.01	$ 85,202.69	City
OT13	MEDIUM	549.92	$ 109,983.38	City
OT14	MEDIUM	378.07	$ 75,614.66	City
OT16	MEDIUM	666.10	$ 133,219.70	City
OT17	MEDIUM	273.49	$ 54,697.79	City
OT18	MEDIUM	647.73	$ 129,545.99	City
OT19	LOW	697.74	$ 139,548.50	City
OT20	MEDIUM	1,072.10	$ 214,419.72	City
OT21	LOW	3,158.45	$ 631,689.42	City
OT22	LOW	1,191.75	$ 238,350.87	City
OT23	MEDIUM	955.40	$ 191,079.47	City
OT24	MEDIUM	428.08	$ 85,616.51	City
OT25	LOW	243.70	$ 48,739.44	City
OT26	LOW	541.95	$ 108,389.81	City
OT27	LOW	374.65	$ 74,930.90	City
OT28	MEDIUM	708.84	$ 141,768.15	TxDOT
OT29	LOW	760.42	$ 152,084.42	City
OT30	LOW	312.18	$ 62,435.98	City
OT31	MEDIUM	503.53	$ 100,706.58	City
OT32	LOW	828.46	$ 165,691.13	City
OT33	LOW	923.00	$ 184,600.96	City

Table 11 (Cont.): Old Town Station Detailed OPCC

Gap Block/Location ID	Priority	Linear Feet	Opinions of Probable Construction Cost	Ownership
OT34	LOW	478.73	$ 95,745.44	City
OT35	LOW	364.81	$ 72,962.36	City
OT36	MEDIUM	542.50	$ 108,500.91	City
OT37	LOW	95.64	$ 19,128.98	City
OT38	LOW	411.51	$ 82,302.01	City
OT39	LOW	334.41	$ 66,882.06	City
OT40	LOW	181.60	$ 36,320.61	City
OT41	LOW	531.39	$ 106,277.96	City
OT42	LOW	608.02	$ 121,604.20	City
OT43	LOW	379.14	$ 75,828.96	City
OT44	LOW	306.54	$ 61,308.41	City
OT45	LOW	187.46	$ 37,491.71	City
OT46	LOW	279.97	$ 55,993.75	City

**The $200 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/ Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).*

Table 12: Hebron Station Detailed OPCC

Gap Block/Location ID	Priority	Linear Feet	Opinions of Probable Construction Cost	Ownership
H03	LOW	2766.27	$ 553,253.59	City
H08	MEDIUM	278.90	$ 55,779.86	City
H11	LOW	287.67	$ 57,533.13	City

**The $200 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/ Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).*

Table 13: Trinity Mills Station Detailed OPCC

Gap Block/Location ID	Priority	Linear Feet	Opinions of Probable Construction Cost ($57/Linear Foot)*	Ownership
TM01	MEDIUM	769.19	$ 43,843.92	City
TM02	MEDIUM	1536.16	$ 87,561.11	City
TM05	MEDIUM	658.75	$ 37,548.88	TxDOT
TM06	LOW	438.43	$ 24,990.52	TxDOT
TM09	HIGH	458.65	$ 26,142.80	City
TM10	MEDIUM	715.39	$ 40,777.47	City
TM11	MEDIUM	1098.53	$ 62,616.00	City
TM12	HIGH	385.52	$ 21,974.53	City
TM14	MEDIUM	481.02	$ 27,418.01	TxDOT
TM15	LOW	525.88	$ 29,975.00	TxDOT
TM17	MEDIUM	255.48	$ 14,562.46	City
TM18	MEDIUM	486.43	$ 27,726.35	TxDOT
TM19	MEDIUM	470.84	$ 26,837.75	TxDOT
TM20	MEDIUM	600.91	$ 34,252.02	City
TM21	LOW	504.57	$ 28,760.32	City
TM22	LOW	2098.08	$ 119,590.35	City
TM24	LOW	652.09	$ 37,169.11	City
TM25	LOW	275.66	$ 15,712.81	TxDOT
TM26	LOW	363.52	$ 20,720.78	TxDOT
TM28	MEDIUM	1800.33	$ 102,618.84	TxDOT
TM29	MEDIUM	446.28	$ 25,438.08	TxDOT
TM30	MEDIUM	688.57	$ 39,248.26	City
TM32	LOW	477.62	$ 27,224.16	City
TM34	MEDIUM	926.95	$ 52,836.35	City
TM35	LOW	109.20	$ 6,224.28	City

**The $57 cost per linear feet does not include major site-specific or project-specific construction items that could be included in a project based on the context of the project area, such as: major utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/ Countdown pedestrian signal, pedestrian signal), illumination, major retaining walls, driveway reconstruction, major drainage culverts, and reinforced concrete pipe (RCP).*

Appendix B:

Half-Mile Area Improvement Prioritization Methodology Details

North Central Texas Council of Governments

Half-Mile Area Improvement Prioritization Methodology Details

Purpose of this Appendix

This appendix outlines the technical steps for performing data collection, identifying existing walksheds, determining a phased implementation of potential improvements, and calculating the benefits of the improvements to expand the walksheds and provide walking connections to a greater number of potential transit riders.

The study first identified the existing continuous pedestrian infrastructure (sidewalks and crosswalks) and the gaps within a half-mile radius of a transit station (walkshed). This was done using both NCTCOG and Google imagery to digitize both existing sidewalks and sidewalk gaps. Next, using Network Analyst in ArcGIS, an "actual" half-mile walkshed[2] using existing sidewalk infrastructure as identified from the rail station platform to represent existing base line conditions.

Next, the population/employment (data counting people actively occupying a site) base data was calculated for all parcels within the entire half-mile radius of each rail station based on parcel population data. Through analysis of the resulting population/employment estimates calculated for the parcels, the number of people that can potentially access a transit station on the current existing sidewalk network (what is currently connected) is calculated by extracting the parcels that touch the existing half-mile walkshed. The resulting population/employment totals provide a baseline number of people that can access a transit station on the existing sidewalk walkshed network.

Each sidewalk gap segment is then assigned a score using weighted criteria that includes: tributary employment and population, distance, access, safety, and equity (adapted from the DART Red and Blue Line Corridors Last Mile Connections Project Final Report, pages 5-8). All sidewalk gap segments are then ranked and assigned a designation of either high, medium, or low priority. The half-mile actual walkshed is then assessed again, based on implementation of sidewalk gap segments in each of the high, medium, or low priorities, which typically results in an expanded size of the actual half-mile walkshed and therefore an increase in the potential number of riders.

The final tasks calculate the opinions of probable construction costs (OPCCs) for each phase of implementation (high, medium, and low improvements) and compares these OPCCs to the potential number of new transit riders that can access the rail station within a half-mile actual walkshed distance resulting from each corresponding phase of implementation. Tables are prepared to summarize the OPCCs and the number of additional connected potential transit riders resulting with each implementation phase. Implementation of all three phases (high, medium, and low) is considered the full build out scenario.

2 = An actual half mile walk distance differs from the half mile radius from the rail stations in that actual walking routes typically must take multiple turns on several streets and are not direct as the crow flies (ex: Pythagorean Theorem).

Data Collection: Sidewalk Inventory

Data Sources for Sidewalk Digitization

All data analysis by North Central Texas Council of Governments (NCTCOG) staff was completed in ArcGIS Desktop. The digitization of the sidewalk network was completed for two purposes: quality control existing layers by adding new sidewalk segments built since ~2016, and second to create a layer that is suitable for GIS network analysis.

The following data layers were used:

- Sidewalk layers received from cities prior to 2016 and edited by NCTCOG for prior Transit-Oriented Development (TOD) routes to rail maps
- 2021 NCTCOG Aerial Imagery
- Google satellite imagery (various years)
- TxDOT Roadway Layer (used to help identify roadway ownership (https://gis-txdot.opendata.arcgis.com/datasets/TXDOT::txdot-roadway-inventory/about)
- NCTCOG Roads Layer (general, to identify the name of the roadway https://data-nctcoggis.opendata.arcgis.com/datasets/NCTCOGGIS::roads-2019/about

Step 1 : Sidewalk Network Digitization Updates and standards

This section includes definitions and specific examples on how to code Crosswalks, Crosswalk Gaps, Driveways, Sidewalks, Sidewalk Gaps, Station Areas, and Unmarked Crossings in this Routes to Rail analysis.

Important to digitizing the layer is ensuring editing practices like "snapping" in ArcGIS are used so the GIS layer is useable for network analysis, a key step in this methodology.

Attribute fields for each line segment were filled out as the lines were created to ensure consistency and save time by not having to go back and populate these attributes. The GIS layer attributes for each line segment are:

- SegmentCat (Segment Category): This field indicates whether a line is a Crosswalk, Crosswalk Gap, Driveway, Sidewalk, Sidewalk Gap, Station Area, Trail, or Unmarked Crossing.
- Miles: This field was calculated via the "Calculate Geometry" field tool. "Units" = "Miles US". The coordinate system used: NAD_1983_StatePlane_Texas_North_Central_FIPS_4202_Feet
- Feet: This field should update automatically, but it is good practice to do it manually after digitization is complete, Use the same process done to calculate miles, but for units, select feet.
- Side_Cond (Sidewalk Condition): This field indicates the condition of the existing sidewalk and should only be filled out if the line segment is a sidewalk.
    - Every Existing Sidewalk segment is automatically an Acceptable condition.
    - All Sidewalk Gaps are Unacceptable.
- Owner: This field is determined using the "TxDOT_Roadway_Linework_wAssets" layer.

1. Crosswalks

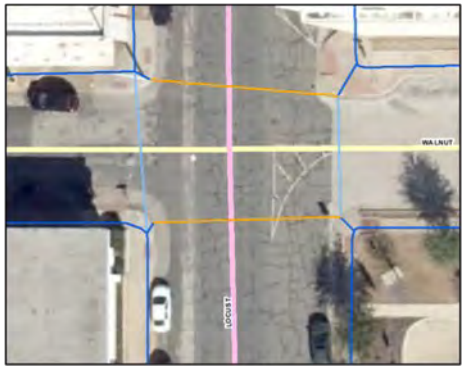
- Crosswalks must have definitive roadway markings indicating where a pedestrian should cross. An example can be seen below:

2. Crosswalk Gaps

- Crosswalk gaps are defined as signalized intersections at major arterials without a marked crosswalk. All four legs of that intersection need a crosswalk.
- Notice that, in the below photo, Locust St. in Downtown Denton is a major arterial (pink) and Pecan St. is a minor arterial (yellow). The orange lines represent a crosswalk gap across the major arterial and the blue lines represent an unmarked crossing across the minor arterial. These must all be drawn to connect the entire intersection.

3. Unmarked Crossings

- Unmarked crossings, are crossings that do not have a marked crosswalk but are acceptable to cross a minor arterial or neighborhood street.



- In the example above, Walnut St. is a minor arterial (yellow), and the crossings are coded as unmarked crossings (log as "Unmarked Cross" in attribute table). Locust St, however, is a major arterial, so it is coded as a crosswalk gap (see #2, Crosswalk Gaps).

4. Driveways

- Driveways (purple) are only marked for commercial and public facilities – not neighborhood driveways. Those will either be marked as a sidewalk or sidewalk gap.

Use best judgment on what is to be symbolized/coded as a driveway.

5. Sidewalks

- Use aerial imagery and Google Street View to draw line segments for additional existing sidewalks not in prior data.
- In addition, sidewalks should only be digitized for public roads. Roads that are inside of private developments should not be analyzed and instead, sidewalks or gaps should be drawn along the perimeter of the development. Use the layer mentioned previously to determine the ownership of a road and best judgment.
- All existing sidewalks in good/fair condition should be coded as an "Acceptable" attribute in the Sidewalk Condition field

6. Sidewalk Gaps

- Sidewalk gaps are drawn where there is no existing sidewalk or there is an unacceptable sidewalk condition.

- All sidewalk gaps that are made from existing concrete but in poor quality should be coded as “Unacceptable” attribute in the Sidewalk Condition field.
    - An existing sidewalk that is severely broken to where it can no longer serve its purpose or meet ADA requirements should always be coded as sidewalk gaps.
- Sidewalk gaps should not be digitized inside of private developments and instead should be drawn on the perimeter of the parcel along the public right-of-way.

7. Station Area

- This drawn line represents the station platform. Draw a line that stretches across the entirety of the station area and make sure it is snapped to the connecting sidewalk. It is critical that the line snaps to the connecting sidewalk so that network analyst can run properly .

8. Trails

- Trails, while not detailed in the referenced methodologies, are critical connectors for pedestrians/bicyclists. The easiest way to identify trails within the half-mile station area radius is to overlay the trails and bikeways layer from the NCTCOG geodatabase. (publicly visible on www.NCTCOG.org/veloweb, request data from NCTCOG if interested in using)
- Trails will need to be distinguished whether on-street bikeways and trails are actually trails (see AASHTO guidelines). Any “trail” that is less than 10-feet in width can be labeled as a sidewalk..

Step 2: Quality Control, Topology, and Network Analysis

Network analyst was used to create an existing walkshed and a walkshed representing a complete sidewalk network that includes improved gaps.

- For the sidewalk layer, use the ArcGIS "Feature Vertices to Points", and its point type" parameter "DANGLE" to identify isolated lines that should be connected at street/sidewalk intersections
- Some dangles are legitimate (e.g. dead end or end of street) and were not fixed.
- The process of creating walksheds and network datasets may need to be repeated to identify errors in digitized connectivity.

Create Walksheds

Step 3: Use Network Analyst to create existing walkshed with the base data

- Manually digitized sidewalk layers, quality controlled for connectivity were used by NCTCOG to create network datasets and run the network analysis service area solver for walksheds
- First a walkshed was created using only existing sidewalks
    - ◊ The mile distance of each sidewalk segment is calculated in ArcGIS, this will be important to walkshed creation.
    - ◊ Key network dataset parameters used:
      For each feature class, the Connectivity Policy for all of the feature classes is set to Any Vertex.
    - ◊ Elevation is set to "none', not used in this analysis.
    - ◊ Cost attribute is equal to the miles of each sidewalk segment.
- Calculate the Service Areas (walksheds) in network analyst using the rail station points as the facility locations.
- Key service area settings.
    - Make sure that Impedance is set to use Miles (Miles).
    - '0.5' for Default Breaks (half mile walk).
    - Under Direction, use 'Away From Facility'.
    - Allow U-Turns at Junctions.
    - Ignore Invalid Locations.
- Polygons representing the general area of access were created as well as lines representing the 0.5-mile connected sidewalk network
- Repeat this process for as needed for scenarios where proposed improvements to sidewalk gaps are evaluated.

Population and Employment Base Data Collection

The NCTCOG TOD trip/population density database is a parcel level estimate of the maximum potential number of people who may be at a property at any given time. It is based on the reported size and use of each building and local knowledge of special institutional uses like hospitals and universities. This dataset was created by NCTCOG and is only available for rail station areas in the specified project.

Geographic scope: Parcels intersecting the half-mile radius of six DCTA rail stations in the grant study.

Goal: Create a database reflecting existing development within the half-mile around DCTA rail stations that will provide approximate estimates of population/employment into potential transit riders.

Base Data: The TOD Land Use/Parcel Population demographics are derived from the 2020 Denton and Dallas County appraisal districts, with assistance from the NCTCOG 2015 Land Use layer (https://data-nctcoggis.opendata.arcgis.com/datasets/NCTCOGGIS::2015-land-use/about)

Step 4: Initial Parcel Data Preparation

NCTCOG staff used 2020 Denton County and Dallas County appraisal data access via NCTCOG's Regional Information Services.

Substantial quality control and edits are performed by NCTCOG to use in this analysis.

The following field and data from the appraisal parcel data are priority in this project (each county may have different but similar field names):

ACCT/ ID	Account or ID from Appraiser
SLUC	State Land Use Code
SLUC_DEF	State Land Use Code category name
SQFT	Total Square feet of structure
ACRES	Parcel size in acres
TOT_VALUE	Improvement plus land value
UNITS	Number of dwelling units
COG_LU	NCTCOG Land Use Code
SITUS	Site address

SQFT_COM	Total square feet of commercial space
SQFT_RES	Total square feet of residential space
Rail Station	The nearest rail station to the parcel
City	City that the parcel is located in
People	Estimated number of people at the destination

Step 5: Land Use Quality Control

Parcel data from the county appraisal districts needs to be vetted for quality control assurance, so that the resulting population forecasts are accurate. County appraisal data may be subject to gaps in data due to contested appraisals or special tax situations and generally is not prepared with the intent for mapping density. However, most of the data is useful with some manual review.

1. Sources used for Quality Control vetting:

- NCTCOG Development Monitoring features (https://data-nctcoggis.opendata.arcgis.com/datasets/NCTCOGGIS::features/about
- NCTCOG 2015 Land Use layer https://data-nctcoggis.opendata.arcgis.com/datasets/NCTCOGGIS::2015-land-use/about

  (significant edits to the base data specific to the station areas were made in this project such as capturing recent land use changes and verification of vertically mixed use developments)

- Google Earth Imagery and Street View
- Online Network Databases (ex: Apartments.com & Caring.com)
- Web search for development information

2. In QC process, the NCTCOG land use code (COG LU) for each parcel is modified based on manual and automated evaluation of the above data sources.

The fields for number of residential units and square foot commercial also need to be updated if missing from original county appraiser download. These are used to calculate parcel population.

3. Example of QC process:

- When examining a parcel in Old Town Station in Lewisville, it was found that the County coded the particular parcel as a commercial property that is 500 Sqft in area. However, this measurement appears incorrect based on closer inspection via the aerial imagery. Additionally, when using the Land Use 2015 data made by RIS, the parcel was coded as vacant land. By using aerial imagery in either Google Earth or GIS, it was confirmed that the property was a recent commercial development. Furthermore, by using the measurement tool in either program, it was confirmed that the site was actually closer to 2,542 Sqft in area. Because of this, the numbers were adjusted in the attribute table to match.

SLUC	SLUC_DEF	COG_LU	SQFT	UNITS
F1	COMMERCIAL	120	2,542	1

4. *Note: for certain counties, such as Denton County, the "Units" field from the parcel datasets will not be established beforehand and will therefore need to be calculated by hand.*

- To find the number of dwelling units for smaller apartment/ multi-family complexes, this can be done by using Google Earth photos to count electric meters, A/C units, doors, and parking spaces (1.25 spaces/unit).
- For larger apartment/multi-family complexes, this can be done by using a web search and/or using Apartments.com to track the number of units.
- Additionally, websites like Caring.com can be used to find the maximum living occupancy for Group Quarter residences like senior living facilities/nursing homes.

Step 6: Calculate Parcel Population Estimates

1. After performing the QC process for all stations, the next step in the process is to generate the population data for each parcel. Before proceeding, verify that all parcels have a correct Land Use code assigned to it, so that the estimates remain accurate.

This is calculated in ArcGIS field calculations:

- Example formula for commercial development:

  People = ([SQFT] / 1000) * 3.5

- Example formula for residential development

  People = [UNITS] * 2.8

2. Complete the population estimates for all land use codes.

Land Use Size to Parcel Population Estimate Method and Sources

The parcel population estimates are derived from calculations based on the building square footage in correlation to the land use category.

- These population estimate numbers were originally found for the 2016 Federal Transit Administration TOD Planning Pilot Grant. After reviewing the metrics during the study, it was decided to follow the same formulas as they provided reasonable results for the DCTA study. Please note, that future studies may need to use slightly modified numbers as more recent studies and Census data are made available.

Original 2016 data sources to estimate population per land use:

  - International Building Code 2015 - Section 1004 – Occupant Load, Table 1004.1.2 Maximum floor area allowances per occupant https://up.codes/viewer/general/int_building_code_2015/chapter/10#1004
  - U.S. Census 2000 Brief – Structural and Occupancy Characteristics of Housing: 2000, https://www.census.gov/prod/2003pubs/c2kbr-32.pdf
  - Methods used in NCTCOG 2040 Demographic forecast developed December 2006

- A large amount of the initial data calculations (referenced above) to find parcel density relied on 2000 Decennial Census Data and the following US report that came from it. At the time of this DCTA study, the 2020 Decennial Census Data & Report were not made available; for future studies, please verify that more recent data is available and check if any density numbers need to be adjusted for the future review.

Determine High/Medium/Low Implementation

Once Network Analysis is run for all stations in the previous steps, the sidewalk gaps go through a scoring process to be assigned a High, Medium, or Low priority. The scoring process for sidewalk gaps as part of the Routes-to-Rails project is adapted from a 2016 Lee Engineering Routes-to-Rails DART analysis and, due to differences between DART and DCTA facilities, was molded to better fit the DCTA station analysis. The scoring criteria may vary from project to project, with the addition and subtraction of certain categories to score each sidewalk gap. The scoring spreadsheet can be evaluated in Table 1: Scoring Matrix

Step 7: Determine High/Medium/Low Priorities

Scoring variables and their corresponding attribute table names in GIS layer:

- "DIST" – Distance from station
- "POPEMP" – Population and employment count from resulting/connecting parcels
- "DEST" – Destinations
- "CRASH" – Number of bicycle/pedestrian crashes (use most recent data)
- "SPEED" – Road speed
- "POINTS" – Number of points as a result of the analysis. This will be calculated later and coded later when points are finalized.
- "GAP_ID" – This will be the unique gap ID number that will be associated with each gap block.

1. Scoring sidewalk gaps within the fully built-out walkshed

  - All sidewalk gaps outside of the half-mile walkshed will be classified as "low" priority and will be reevaluated if needed, e.g., All gaps (red) outside of the green boundary (fully built-out walkshed) would be considered a low priority based upon their location.

2. All sidewalk gaps within the fully built-out half-mile walkshed (green) were assigned a gap ID. Individual sidewalk gap segments on the

same block will be assigned the same gap ID, instead of each individual sidewalk gap segment having its own unique gap ID. For this analysis, a block is considered to be intersection to intersection and includes sidewalk gap segments on both sides of the roadway. In the absence of a clear-cut block as defined here, a gap ID can be assigned to sidewalk gap segments that are close together and, based on professional judgement, would make sense to build together as a single project. (e.g., DD1 and DD2 below)

- Gap IDs are coded logically with an alphanumeric naming convention that identifies the station and numerical range. For instance, "DD1" stands for "Downtown Denton 1".
- This gap grouping was used to score improvements as logical project alignments

DEST	BUS	CRASH	SPEED	POINTS	GAP_ID
1	5	0	30	0	DD1

3. Tributary Employment and Population

- This counts the potential riders "upstream" of specific sidewalk improvements on a connected route within the fully built-out walkshed and not the half-mile radius boundary.
- A value for the number of population and employment dependent on the improved connection for most direct access to the station is calculated by GIS analysis.
- Population and employment points are attributed as follows (see Table 1: Scoring Matrix):

4,000		50
2000	3999	40
1000	1999	30
750	999	25
500	749	20
250	499	15
125	249	10
0	124	5

4. Distance from Station

- Distance is calculated by measuring the straight-line distance (linear distance) from the sidewalk gap block (closest end of the gap block) to the station area (closest end of the station area) using the measure tool in ArcMap. Points are attributed as follows (see Table 1: Scoring Matrix):

0	660	25
661	1320	20
1321	1980	10
1981	2640	5
2641	5280	0

5. Major Developments

- Major developments include key destinations such as hospitals/clinics/urgent care, schools, government buildings, grocery stores, malls, supercenters,

entertainment, fine arts, parks, libraries, museums. Import the "Important Developments" layer from this ArcMap document and manually count all destinations that are located on the sidewalk gap block. Only one destination is needed for full points. If there no destinations, then zero points should be attributed.

- *Note: the Important Developments layer is originally from the NCTCOG Features dataset, but has been altered to meet criteria for this project*

6. Number of Bicycle and Pedestrian Crashes

- Using the most updated bicycle and pedestrian crash data, count the number of crashes that are located on the gap block being evaluated.
- The points are attributed as follows (see Table 1: Scoring Matrix):

# Of Crashes	Points
3	5
2	4
n/a	n/a
1	2
0	0

7. Posted Speed Limit

- Log the posted speed limit of the roadway that the sidewalk gap block is on into the attribute table. NCTCOG used internal roadway data layer for some posted speeds; for roadways that are missing speed limits, google street view can be used to find the speed. If a speed limit is unposted or cannot be found for a street, use the speed limit of the cross street.
- The points attributed for posted speed limit are as follows (see Table 1: Scoring Matrix)

Range (Low-High) mph		Points
50	75	5
45		4
40		3
35		2
10	30	1

8. Once all attribute information is coded is the scoring can be run in an NCTCOG excel sheet that automatically scores the sidewalk gap blocks based on the scoring matrix and imported data.

Opinions of Probable Construction Costs

A cost per linear feet of sidewalk was developed to assess the cost of each sidewalk block To provide opinions of probable construction costs for each DCTA station. After coordinating with local cities a base construction cost of $200 per linear foot was estimated for sidewalk construction.* This base cost provides a high-level engineering cost estimate for all identified block gaps within the study area. It is recommended that a more detailed engineering cost estimates should be created for each block.

This base cost includes standard items that would be included in constructing a sidewalk gap in addition to multipliers for other associated project costs (Table 17).

Specialty items such as utility relocations, retaining walls, crossing signals, drainage culverts, and driveway reconstruction were not considered in the standard construction cost estimate.

Table 14: Opinions of Probable Construction Cost Assumptions

Construction Items Included in Base Cost*	
Sidewalk (5')	
Pedestrian Ramps	
Curb and Gutter Repair	
Drainage inlets (modify)	
Pavement Markings (crosswalks)	
Utility Adjustments (fire hydrant, manholes)	
Signage Adjustments	
ENGINEERING DESIGN (10%)	
GENERAL LANDSCAPING (4%)	
SWPPP (2%)	
TRAFFIC CONTROL (3%)	
MOBILIZATION (4%)	
FEDERAL CONTINGENCY (2%)	
BASE COST PER LINEAR FEET**	$200

* The $200 cost per linear feet does not include specialty construction items that could be included in a project based on the context of the project area, such as: utility relocation (lines, poles, boxes), railroad crossings, traffic signals (RRFB, Pedestrian Hybrid Beacon, APS/ Countdown pedestrian signal, pedestrian signal), illumination, retaining walls, driveway reconstruction, drainage culverts, and reinforced concrete pipe (RCP).

** The estimate of $200/LF is based on 2022 values and does not account for inflation; it is recommended that similar projects in the future reassess this value and update as needed.

Denton County Transportation Authority

Routes-to-Rail Stations

Final Report

2023

North Central Texas Council of Governments