A3

Gap Analysis

MEMORANDUM

To: City of Sacramento

From: Mauricio Hernandez, Alta Planning + Design

CC: Cole Peiffer, Elizabeth Yarnall, David Wasserman

Date: March 8, 2024

Re: Sacramento Active Transportation Plan – Gap Analysis

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1. Introduction

The *Streets for People: Sacramento Active Transportation Plan* (the *Streets for People* plan) focuses on improving conditions for people walking, biking, and rolling in the City of Sacramento. This citywide plan is geared towards addressing active transportation needs with a focused approach to three areas of high-need and historical disinvestment: Fruitridge/Broadway, North Sacramento, and South Sacramento.

To understand the roadway corridors representing the biggest barriers or gaps for people walking, biking, and rolling throughout the city, Alta Planning + Design (Alta) completed this data-driven analysis. The critical gap corridors and findings identified in this memo will inform the infrastructure recommendations for improving the entire network of facilities for people walking, biking, and rolling. These recommendations will be further refined and evaluated by City staff utilizing feedback from the public engagement process completed as part of Phase 1 of this project.

Memo Overview

This memorandum identifies active transportation gaps in Sacramento and has been organized into seven sections:

- Section 1 – Introduction: This section introduces the project, provides an overview of the contents of this memorandum and summarizes key findings.
- Section 2 – Existing Conditions for Gap Analysis: This section summarizes the findings from the equity, safety, and current active transportation network analyses included in the existing conditions memorandum.
- Section 3 – Estimating Demand: Active-Trip Potential. This section includes an analysis of the potential for active trips in the city.
- Section 4 – Understanding User Comfort: Level of Traffic Stress. This section focuses on understanding the potential stress experienced by people walking and biking along city roadways.
- Section 5 – Access to Parks, Schools, and High-Ridership Transit Locations. This analysis considers the existing active transportation network and potential traffic stressors on people walking and biking to estimate the proportion of city residents that can easily/most comfortably access parks and schools throughout the city. This section also highlights schools and parks that could benefit the most from roadway improvements to improve access to these destinations.
- Section 6 – Bringing It Together: Sacramento Gap Analysis. This section combines the analyses described in Sections 2 through 5 to determine potential gap areas across the city, creating a Gap Evaluation Grid. Key gaps are identified within the focus plan areas.
- Section 7 – Next Steps. This section provides a summary of next steps and how the City can use the results from the Gap Analysis to inform future phases of the *Streets for People* plan.

To provide supplemental information about these analyses, a set of appendices has been included as part of this document:

- **Appendix A** – Active-Trip Potential Methodology
- **Appendix B** – Level of Traffic Stress Methodology
- **Appendix C** – Level of Traffic Stress and OpenStreetMap Derivation Assumptions
- **Appendix D** – Bicycle Level of Traffic Stress Analysis Details
- **Appendix E** – Pedestrian Level of Traffic Stress Analysis Details
- **Appendix F** – Access Shed Methodology
- **Appendix G** – Gap Analysis Methodology

Summary of Findings

The Alta Team identified key gaps in Sacramento's active transportation network following the aggregation of analyses and data included in this memo. Five different inputs were combined into a Gap Evaluation Grid representing user comfort, potential demand, equity, safety, and connectivity to destinations (i.e., parks, schools and transit).

The results of the analysis indicated that residential areas of the city co-located with schools, parks, high-ridership transit, or smaller commercial areas have the potential to accommodate more active trips (i.e., walking, biking, and/or rolling). The data also showed that walking, biking, or rolling along higher-speed and wider roadways tends to be less comfortable based on the Level of Traffic Stress analyses. Furthermore, areas experiencing higher pollution burden, socioeconomic impacts, and health impacts (*CalEnviroScreen*) tend to experience more difficult roadway conditions.

At the citywide level, the results of the analysis demonstrated that 74% of Sacramento residents have access to a park within a 5-minute bike ride/ 15-minute walk. Similarly, 64% of Sacramento residents can reach a school site (i.e., elementary, middle, or high school) within a 5-minute bike ride or a 15-minute walk, when accounting for traffic stress.[1] However, only about 15% of Sacramento residents live within a 15-minute walk of a light rail station or high-ridership bus stop when accounting for traffic stress. Residents with limited access caused by traffic stress will be the highest potential beneficiaries of improvements for bicycling and walking near their homes.

The analysis also identified specific infrastructure gaps (i.e., sections of the existing roadway network that act as barriers to active transportation) using a Gap Evaluation Grid aggregation that considered the inputs above and existing facilities for people biking, walking, and rolling. The resulting critical gaps for biking, walking, and rolling can be found in **Figure 1**. Additional details on specific corridors can be found in **Table 24** of this memorandum. Key infrastructure gaps highlighted from the analysis include:

- North-South roadways including 16th Street, Franklin Boulevard, Del Paso Boulevard, Northgate Boulevard, Norwood Avenue, and Bruceville Road
- East-West corridors including Bell Avenue, San Juan Road, El Camino Avenue, Arden Way, J Street, Broadway, Fruitridge Road, and Florin Road

Within the focus plan areas, key critical gaps included:

- **Fruitridge/Broadway**: North-South connection of Stockton Boulevard from Broadway to 28th Street. East-West connections along Fruitridge Road (E-W) from Laurence Drive to Power Inn Road, and Broadway from Stockton Boulevard to 65th Street.
- **North Sacramento**: Norwood Avenue from Grand Avenue to Carroll Avenue (North-South connection) as well as Marysville Boulevard and Del Paso Road (on an east-west trajectory) are among the most notable.
- **South Sacramento:** Franklin Boulevard from Florin Road to Mack Road and Bruceville Road from Calvine Road to Wyndham Drive, providing North-South Connectivity, and Florin Road from Greenhaven Drive through 24th Street (E-W corridor), among others.

[1] Public charter schools and private schools were included in the analysis. The Sacramento City Unified School District also offers each student the chance to enroll in any school or program within the district when space is available. Public, Private, and Charter schools were all included in the analysis. However, only public schools are summarized in the tables since these schools are most likely to enroll students who live nearby and might walk or bicycle to school.

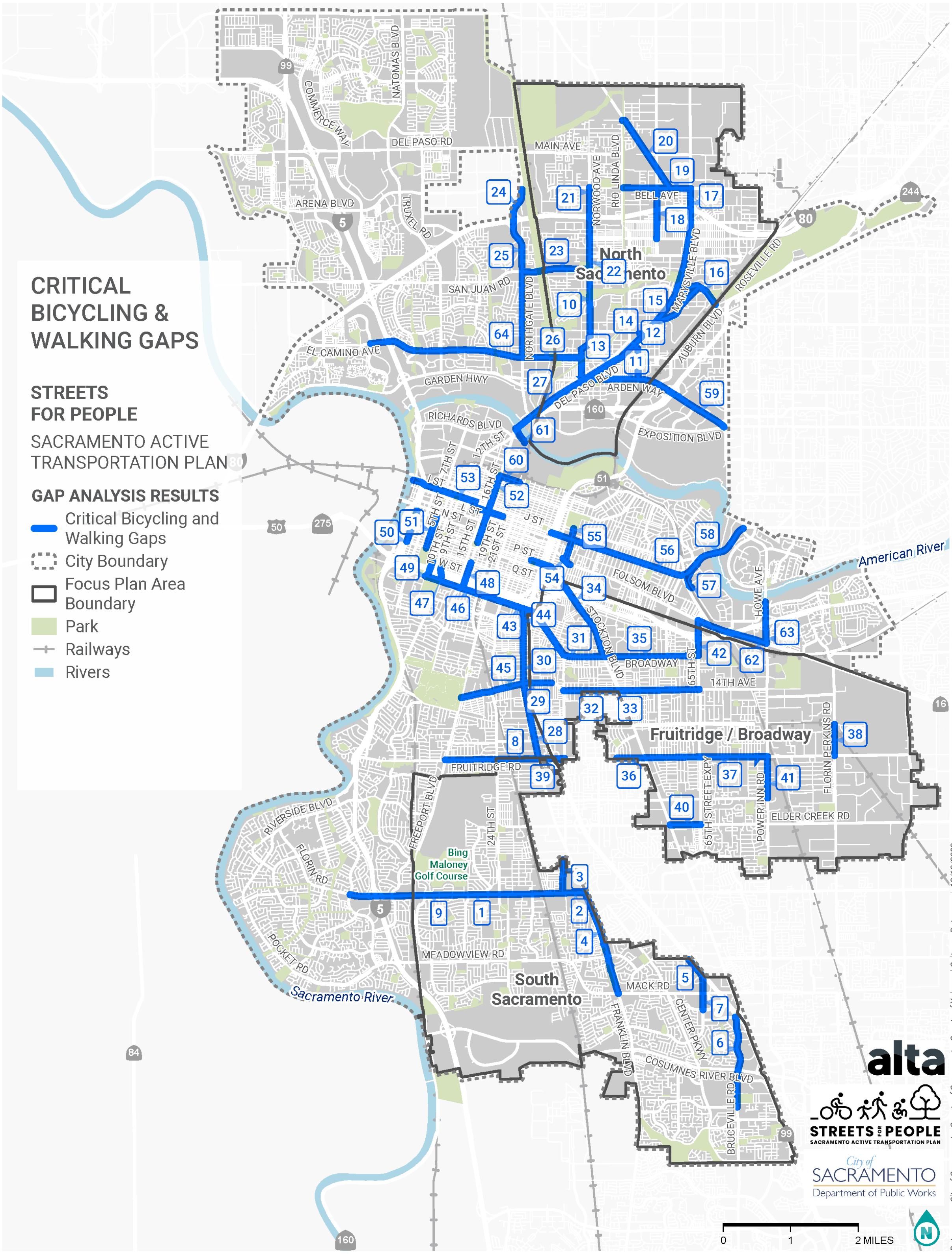

Figure 1. Critical Gaps

Additionally, Alta identified key parks and schools with limited walking and biking access co-located with critical gaps in focus plan areas. These included:

- **Fruitridge/Broadway**: Artivio Guerro Park and Earl Warren Elementary which represents one of the schools most limited by traffic stress.
- **North Sacramento:** Hagginwood Park, John Mackey Memorial Park at Kenwood Oaks, Mae Fong Park, and Robla Park; as well as Hagginwood Elementary and Norwood Junior High represent schools most limited by traffic stress in the focus plan area.
- **South Sacramento**: Consumnes River College Park and Shasta Community Park.

Alta anticipates using the results of this analysis coupled with feedback from public and stakeholder groups to define the infrastructure recommendations and the general active transportation network along City roadways. Facility recommendations developed for the plan may also consider roadways that are important for other reasons: for example, a connection to a neighboring jurisdiction's network for people biking even in an area where there may be a lower Gap Evaluation Grid score.

Please note that the list of projects and recommendations contained in the final *Streets for People* plan will require further evaluation on a case-by-case basis. This evaluation would identify the most appropriate context-sensitive improvements based on the unique characteristics of that corridor, such as land-use context, available right-of-way, user comfort, and traffic conditions among others.

2. Existing Conditions for Gap Analysis

The *Streets for People* plan evaluated key metrics during the existing conditions phase including equity, safety, and the location of existing active transportation infrastructure. This section provides a summary of those findings, which were used to inform the Gap Analysis identified in Section 6. Bringing It Together: Sacramento Gap Analysis of this memo.

Equity

Alta used *CalEnviroScreen 4.0* data to identify areas of the city showcasing the greatest need to address environmental justice issues.[2] Overall scores for each census tract within the city are shown in **Figure 2**. Higher scores depicted by red and yellow on the map signify higher levels of need. Areas of the city from the three community plan areas with the greatest need included: Fruitridge/Broadway, North Sacramento, and South Sacramento. Additional high-need areas identified included

- Main Avenue and areas south
- The Belvedere, Power Ridge, and New Brighton neighborhoods in the northeast
- A significant portion of the Avondale and Fruitridge Manor neighborhoods between Power Inn Road to the east, Fruitridge Road to the north, and Stockton Boulevard to the west
- The South Oak Park neighborhood
- Along the eastern city boundary, in the South City Farms neighborhood, and in the small portion of the Parkway neighborhood north of Florin Road

Safety

The City of Sacramento identified a high injury network (HIN) as part of its 2018 Vision Zero Action Plan. Corridors included in the HIN have the highest levels of fatal and serious injury collisions for people walking, biking, and driving in the city. This data also indicated that 79% of all collisions occur on the HIN, which accounts for just 14% of the City's roadways. In total, 94 (56%) of the City's elementary, middle, and high schools are located within 1,000 feet of an HIN roadway. Furthermore, 35% of the HIN falls within equity priority communities. The existing conditions also identified the top 10 intersections experiencing high numbers of collisions involving people walking and biking. **Figure 3** shows both the HIN and these key intersections.

Existing Network for Walking and Bicycling

Walking facilities in the city include sidewalks, shared-use paths (Class I), freeway overpasses, river crossings, and intersection or midblock crossing facilities. A map of the existing sidewalks is shown in **Figure 4**. Corridors highlighted in red lack sidewalks while streets shown in dark gray lack data on the presence of sidewalks. The City of Sacramento has over 427 miles of existing bicycle facilities primarily consisting of bicycle lanes (Class II), bicycle routes (Class III), shared-use paths (Class I), and separated bikeways (Class IV) as shown in **Figure 5**.[3] Many of the existing facilities for people walking, biking, and rolling are often disconnected from one another. Areas of the city with the least bicycle facilities coverage include Fruitridge/Broadway, North Sacramento, and South Sacramento.

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[2] CalEnviroScreen 4.0 aggregates 21 data points measuring many factors including pollution burden, socioeconomic impacts, and health impacts.

[3] At the time of the completion of the existing conditions report, the city was completing the implementation of additional separated bike lanes (Class IV) in Downtown Sacramento. This data is NOT reflected in these maps.

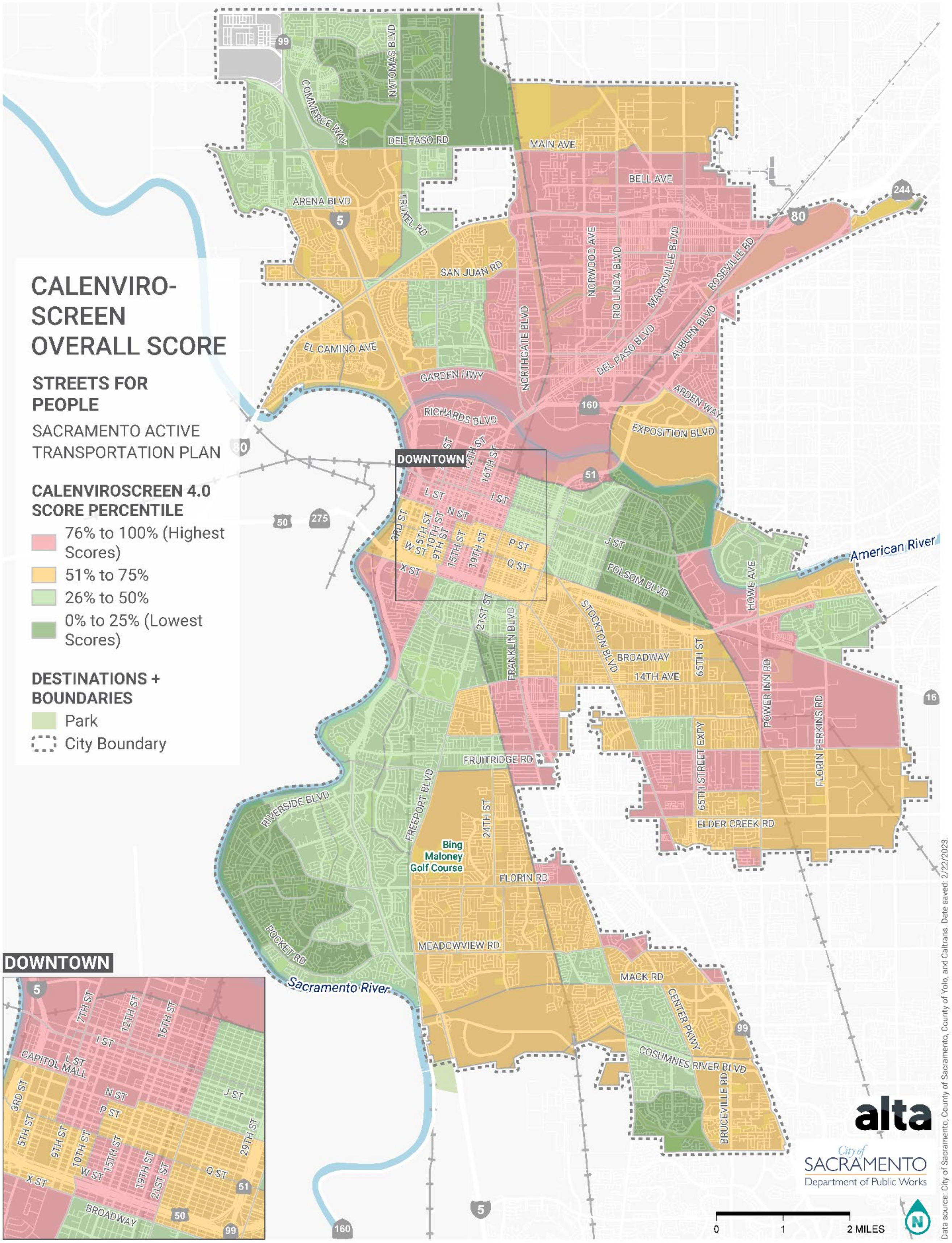

Figure 2. CalEnviroScreen Overall Score

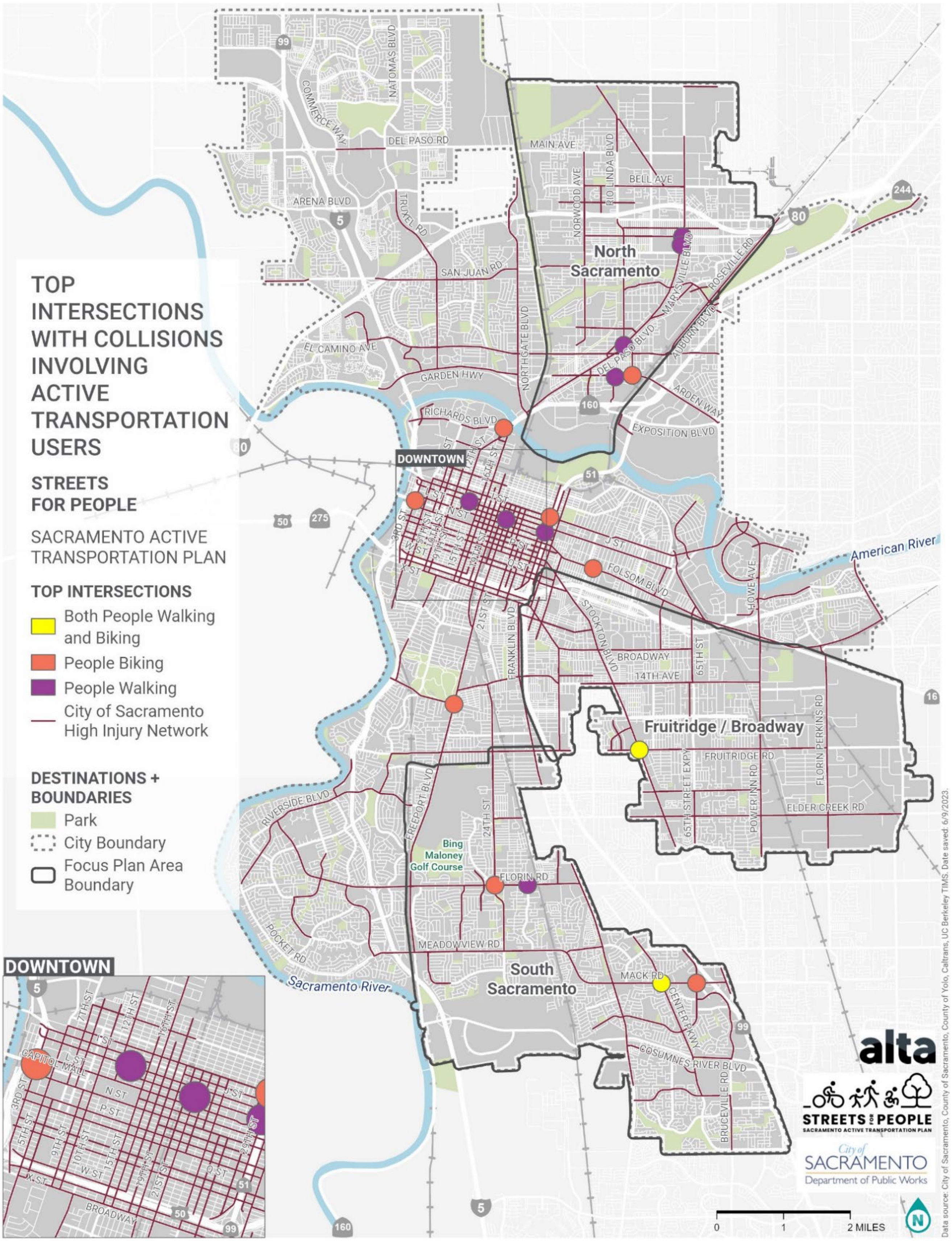

Figure 3. Top Intersections with Greatest Number of Crashes Involving Active Transportation Users (All Severities, 2016–2020)

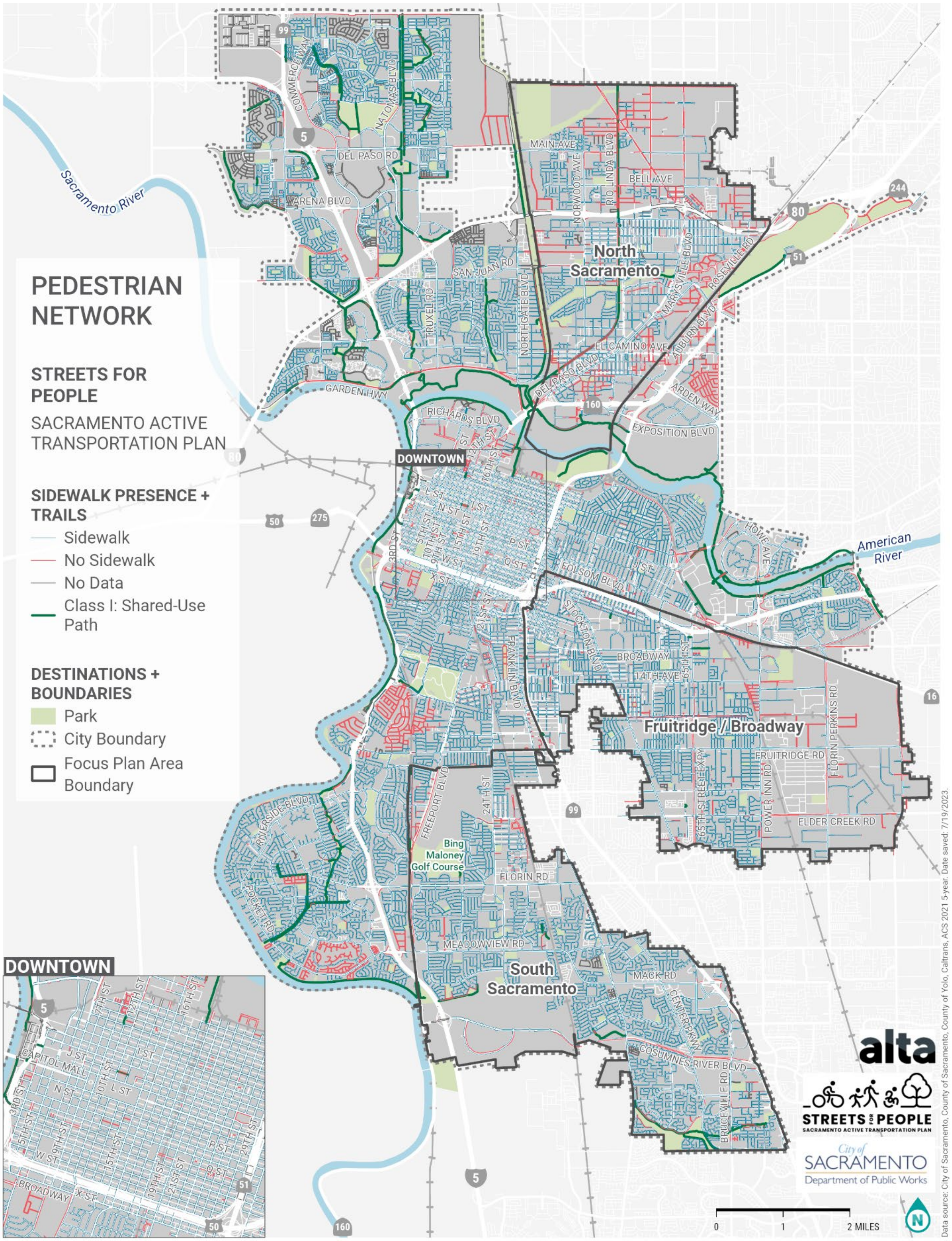

Figure 4. Existing Walking Facilities

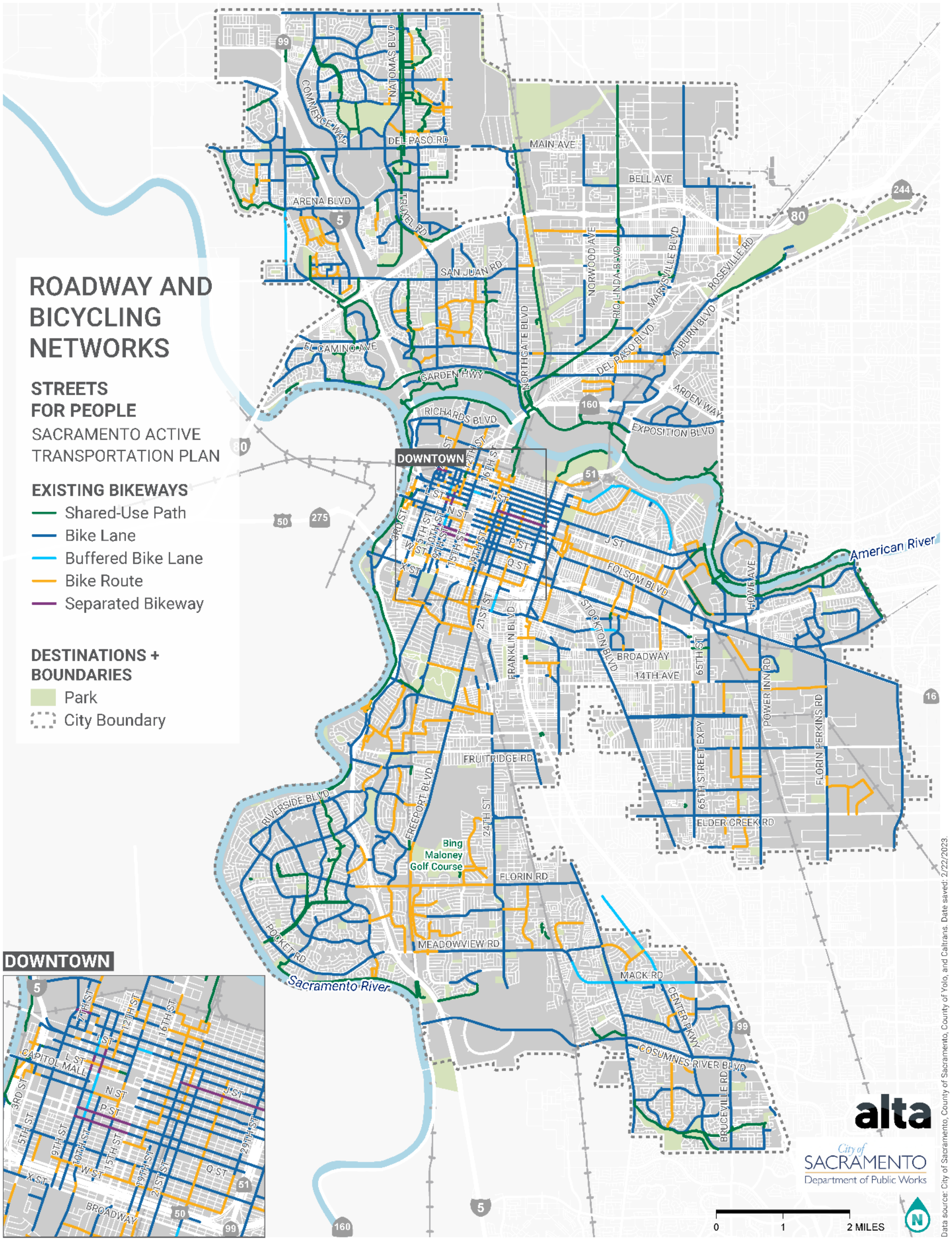

Figure 5. Existing Biking Facilities as of May 2023

3. Estimating Demand: Active-Trip Potential

Active-trip potential measures the proportion of all trips that may reasonably be made by active modes—like walking/rolling, biking, or e-micromobility—in a particular area. As trip distance is an important factor in mode choice, this analysis considered trips less than one mile, three miles, and six miles, as reasonable distances for walking/rolling, biking, and e-micromobility, respectively, based on trip distances from the 2017 National Household Travel Survey.[4] To this end, a neighborhood with high active-trip potential reflected a relatively larger percentage of people traveling to that area from short distances away, whereas a neighborhood with lower active-trip potential reflected a greater percentage of long-distance trips ending in that area. This ultimately meant that areas of the city with a higher proportion of short trips are areas of the city where more walking/rolling, biking, and e-micromobility may be promoted/increased.

Summary of Methods

Alta used data from Replica Places, an activity-based travel demand model, to understand the proportion of all trips in Sacramento that could reasonably be shifted to active trips (i.e., biking, walking, and rolling) based on distance. Replica uses a large collection of data sources, including mobile location data, consumer/resident data, land-use data, building location data, and even economic data from transactions, to create a simulated model population that then travels around a simulated city, creating simulated trips. Alta then studied this simulation to learn about mobility in Sacramento. Because there are no privacy issues with simulated trips, the analysis also examined granular information, such as where trips began and ended, modes utilized, and characteristics of the trip-takers.

The analysis aggregates trips to the census block group level and then identifies the percentage of trips that are less than one mile; three miles, and six miles as a percentage of the total trips ending in that census block group. The trip lengths of one mile, three miles, and six miles estimate walking, biking, and e-micromobility active-trip potential for the given block group. Detailed methodology is available in Appendix A.

Summary of Findings

Since this analysis primarily examined short trips that could be conducted or shifted to biking, walking, or rolling, some travel patterns that arose were surprising. Figure 6 displays the number of trips per square mile ending in each block group, and the areas where a greater number of short trips end are shown in darker colors.

In downtown Sacramento, for example, while there is a high density of short trips happening in the general area, these short trips are overshadowed by the greater proportion of long-distance trips that end there. Similarly, the area near Sacramento City College has a large number of short trips, but those trips are still a small proportion of all trips ending in that same area of the city. This patten is common in downtowns where some of the most observable multimodal activity is occurring alongside long-distance commute trips that make up significant proportions of total trip activity. Conversely, areas near Sacramento State have many short trips that make up a large proportion of the overall trips, as students at this college tend to be full-time and living on or near campus.

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[4] *2017 National Household Travel Survey Estimated Person Trips (ORNL, n.d.).*

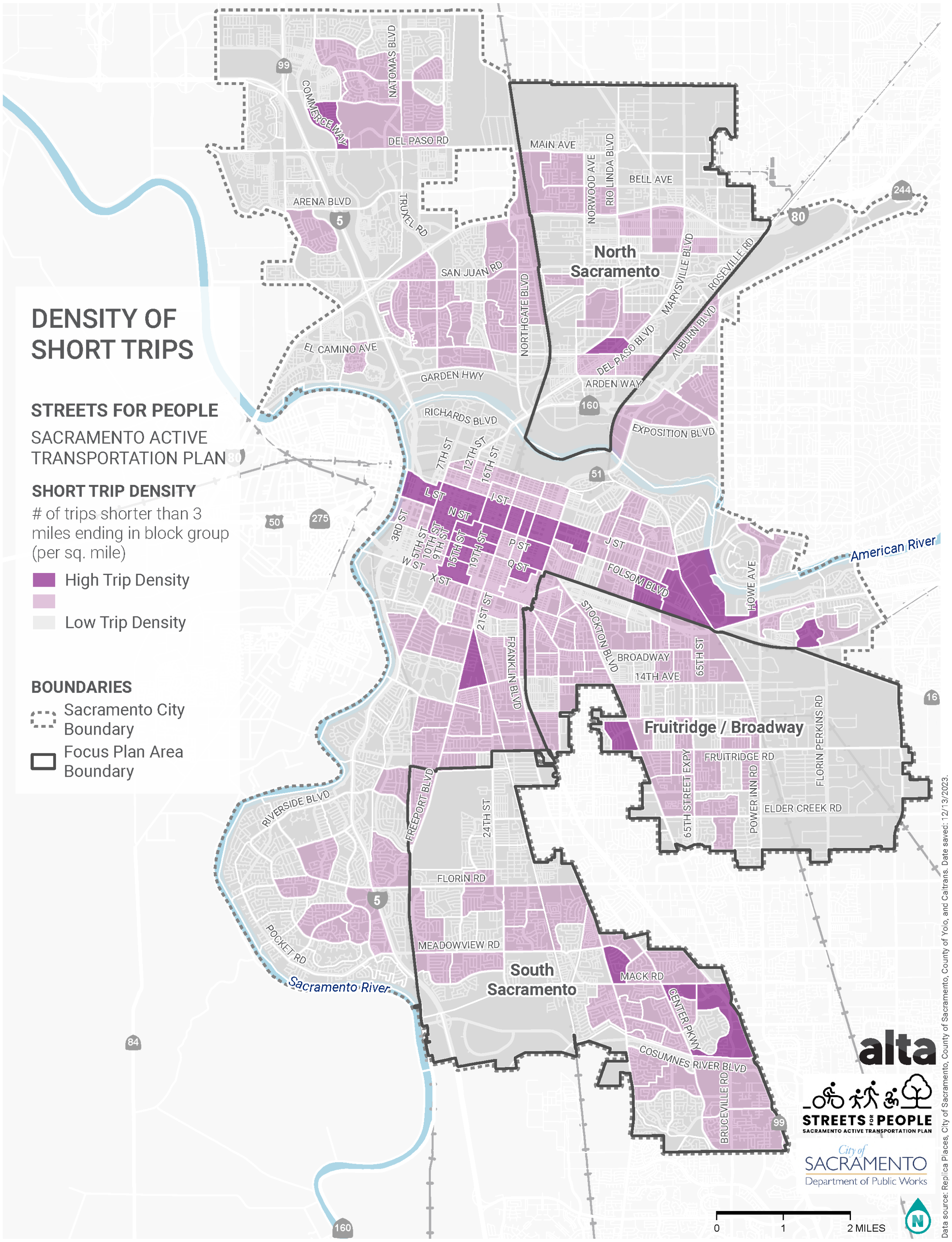

Figure 6. Density of Short Trips (less than three miles) in Sacramento

The following sections and accompanying figures break down the findings further into three specific trip types or distances: walking trips (less than one mile), biking trips (three miles), and e-micromobility trips (six miles). This analysis assumes a particular distance that can be reached by e-scooters or e-bikes at six miles, these could be shared or personally owned. Figure 7, Figure 8, and Figure 9 show each of these types of active-trip potential at the block group level. The maps show the percentage of all trips that are short trips (lengths of one mile, three miles, and six miles), which could therefore be conducted via walking, biking, or e-biking, respectively. Darker colors indicate a higher percentage of short trips ending in these locations. The darker-colored locations are where improved and more comfortable active transportation facilities may influence and help shift the percentage of trips completed from single occupancy vehicles to active transportation modes.

Walk-Trip Potential (less than one mile)

Citywide Findings

Walk-trip potential measures the proportion of all trips that are less than one mile. Across Sacramento, 16% of all trips are considered short enough (that is, less than one mile) to be shifted to walking trips.[5] Areas of high walk-trip potential tend to occur in residential areas co-located with schools, parks, or smaller commercial areas.

In Figure 7 key corridors in areas of high walk-trip potential include:

- J Street and Folsom Boulevard
- South of Downtown west of 21st Street and south of X Street
- San Juan Road in northwest Sacramento
- Fruitridge Road in the Fruitridge/Broadway area
- Del Paso Boulevard and Rio Linda Boulevard in North Sacramento
- The central portion of South Sacramento near Florin Road, Meadowview Road, and 24th Street
- Western portions of South Sacramento near Mack Road and Center Parkway

Walk-trip potential is lower in industrial or large commercial centers: near the junction of SR 160 and I-80, as well as surrounding Cosumnes River Boulevard in South Sacramento. Areas of walk-trip potential are segmented by freeways due to the limited crossing opportunities and longer distances between freeway exits.

Focus Plan Area Findings

Short trips (less than one mile) occur at about the same rate within focus plan areas as across the city as a whole: 16% of all trips in Fruitridge/Broadway, 18% of all trips in North Sacramento, and 16% of all trips in South Sacramento could be walking trips.

- **Fruitridge/Broadway**: Tallac Village and Fruitridge Manor neighborhoods along Stockton Boulevard have high walk-trip potential. Large portions of Fruitridge Road and 14th Avenue in the area surrounding Hiram Johnson High School have high walk-trip potential. Walk-trip potential is low in the industrial areas east of the railroad tracks.
- **North Sacramento**: There is high walk-trip potential near Richardson Village and Del Paso Heights neighborhoods near Las Palmas Elementary and MLK Jr. Technology Academy, as well as Grant Union High School.
- **South Sacramento**: There is high walk-trip potential near the Parkway and Valley Hi/North Laguna neighborhoods near the Blue Line stations, Burbank High School, Charles Mack School, and Valley High School.

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[5] Derived from all modeled trips within the Replica's Activity Based model that end in Sacramento. These figures are generally consistent with 2022 NHTS estimations of walk mode splits for all trips in urbanized areas (8%).

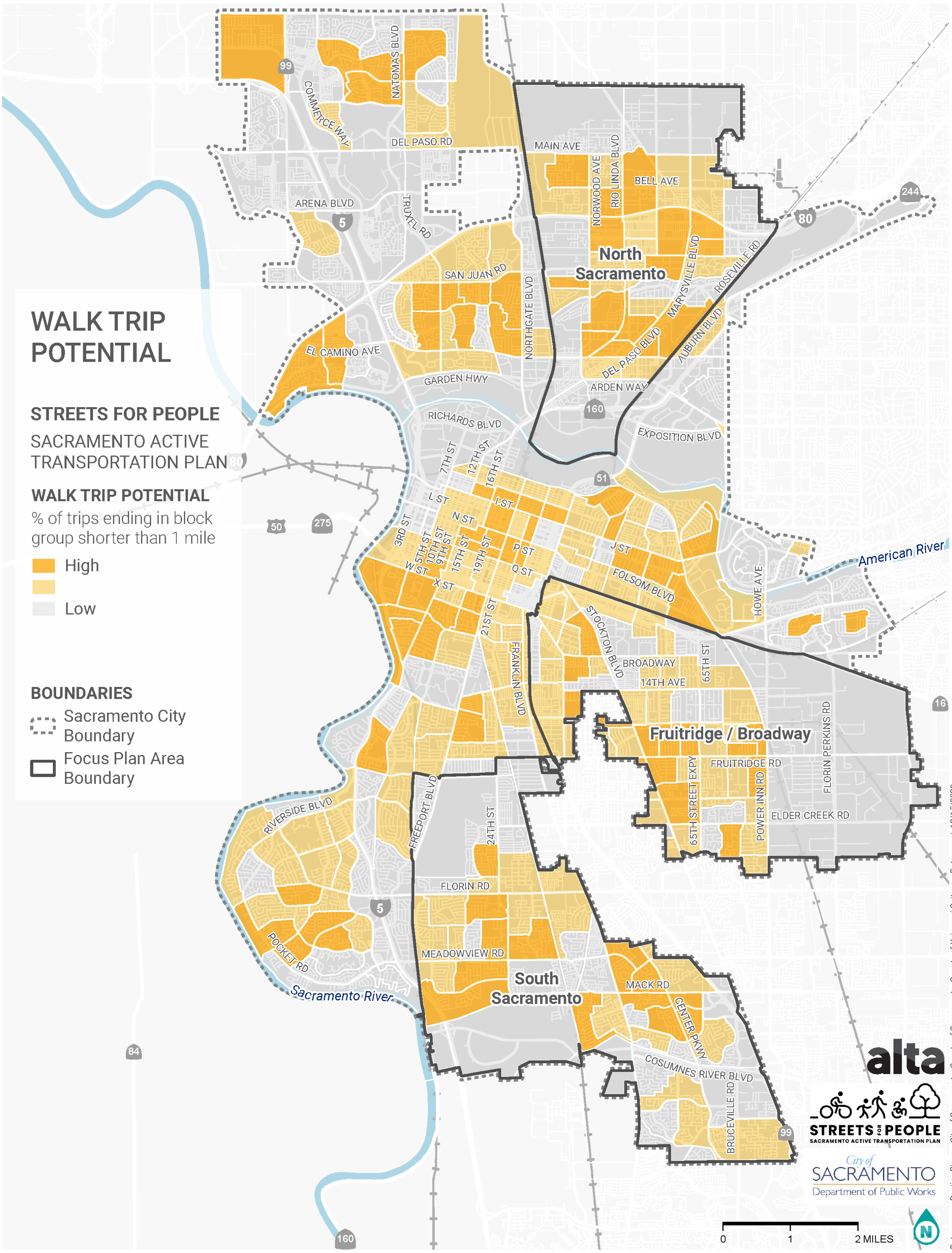


Figure 7. Walk-Trip Potential

Bike-Trip Potential (three miles)

Citywide Findings

Bike-trip potential measures the proportion of all trips that are less than three miles. As noted in Figure 8, areas with high bike-trip potential tend to align with those that experience high walk-trip potential, including:

- Rio Linda Boulevard in North Sacramento
- San Juan Road in northwest Sacramento
- West of 42nd Street between J Street and Folsom Boulevard
- 14th Avenue and Fruitridge Road in the Fruitridge/Broadway area
- South of downtown west of 21st Street and south of X Street
- Portions of South Sacramento near Florin Road, Mack Road, Center Parkway, and Cosumnes River Boulevard

Notable exceptions are downtown Sacramento, where bike-trip potential is relatively low. Furthermore, commercial areas are more often associated with bike-trip potential than with walk-trip potential. Citywide, 40% of all trips are short enough (no more than three miles) to be accommodated as biking trips, suggesting a large potential to increase bicycle mode share beyond the current 2% of trips Replica estimates are biking trips that end in Sacramento.[6]

Focus Plan Area Findings

Short trips (less than three miles) occur at about the same rate within focus plan areas as across the city: 41% of all trips in Fruitridge/Broadway; 40% of all trips in North Sacramento, and 42% of all trips in South Sacramento could be bicycling trips.

- **Fruitridge/Broadway**: Tallac Village and Fruitridge Manor neighborhoods along Stockton Boulevard showcase high bike-trip potential. Large portions of 14th Avenue, Fruitridge Road, and Elder Creek Road west of Power Inn Road have high bike-trip potential. Similar to walk-trip potential, bike-trip potential is low in the industrial area east of the railroad tracks.
- **North Sacramento**: There is high bike-trip potential between El Camino Ave and I-80, especially between Norwood Avenue and Rio Linda Boulevard. There is also a pocket of high bike-trip potential near Norwood Junior High School and Futures High School.
- **South Sacramento**: There is high bike-trip potential near the Parkway and Valley Hi/North Laguna neighborhoods near the Blue Line stations, Burbank High School, Charles Mack School, and Valley High School.

[6] Derived from all modeled trips within the Replica's Activity Based model that end in Sacramento. These figures are generally consistent with 2022 NHTS estimations of bike mode splits for all trips in urbanized areas (1%).

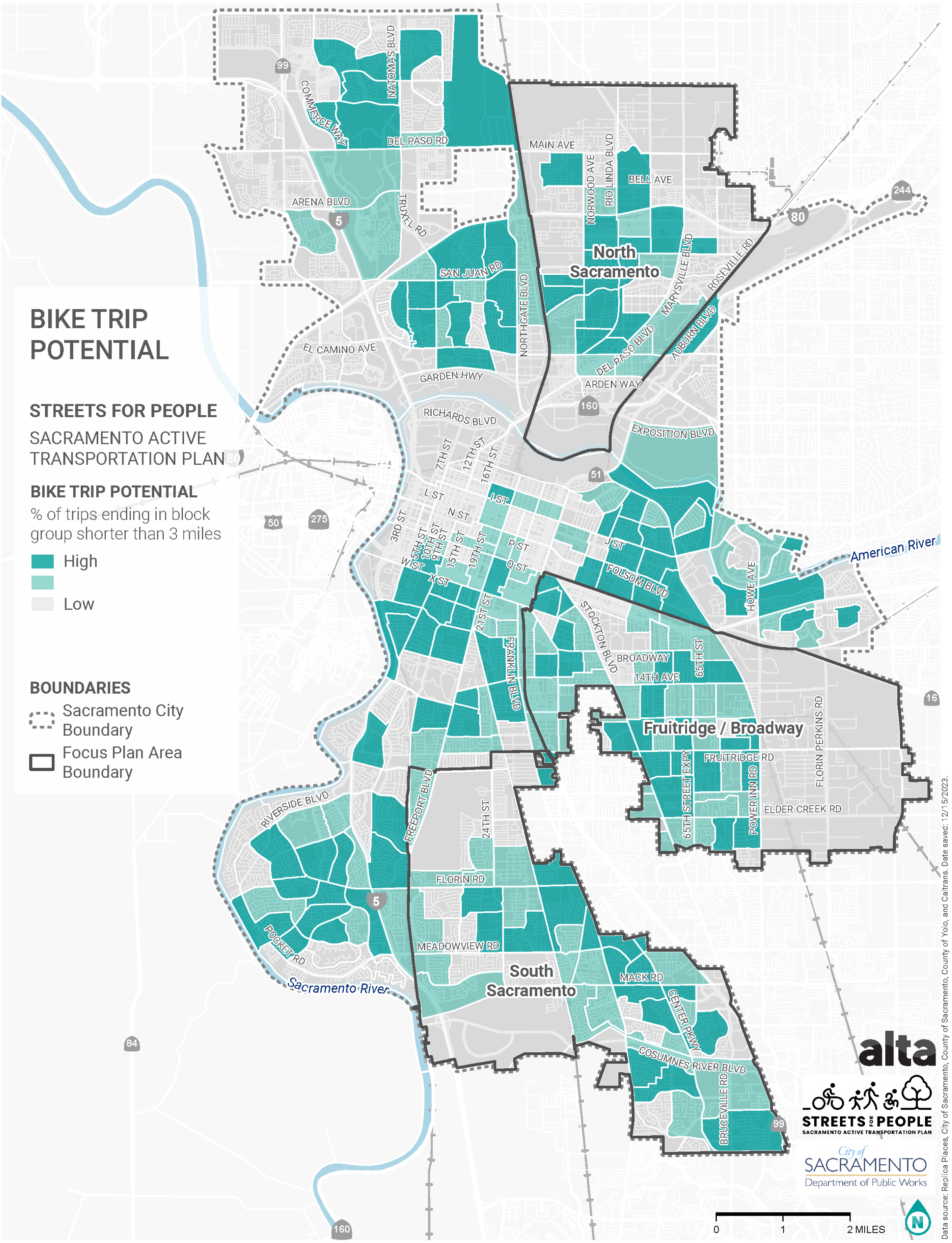


Figure 8. Bike-Trip Potential

E-Micromobility Trip Potential (less than six miles)

Citywide Findings

Increasing the trip distance to six miles, a length suitable for e-micromobility or e-bike trips (private or for rent), trip potential decreases in downtown Sacramento, but there is strong e-micromobility trip potential beyond the city center, with 60% of all trips being potential e-bike trips. This trip potential is applicable for either shared or personally owned e-micromobility vehicles, as it is based on an assumption of distance that can be traveled by this type of vehicle. Figure 9 provides a representation of the data.

Focus Plan Area Findings

Short trips (less than six miles) occur at about the same rate within focus plan areas as across the city as a whole: 61% of all trips in Fruitridge/Broadway, 61% of all trips in North Sacramento, and 66% of all trips in South Sacramento could be accommodated by e-bike trips. Additional findings include:

- Fruitridge/Broadway: Much of the focus plan area south of 14th Avenue and west of Power Inn Road experiences high e-bike-trip potential. Similar to bike-trip potential, e-bike-trip potential is low in the industrial area east of the railroad tracks.
- North Sacramento: There is high e-bike-trip potential between El Camino Avenue and San Juan Road, especially between Norwood Avenue and Rio Linda Boulevard. There are also areas of high e-bike-trip potential near Norwood Junior High School and Grant Union High School.
- South Sacramento: There is high e-bike-trip potential throughout much of the eastern and southeastern portions of the focus plan area. E-bike-trip potential includes the areas seen for high bike-trip potential along Florin Road east of 24th Street, Franklin Road south of Florin Road, Mack Road east of Franklin Road, and through the areas around Center Parkway, Cosumnes River Boulevard, and Bruceville Road.

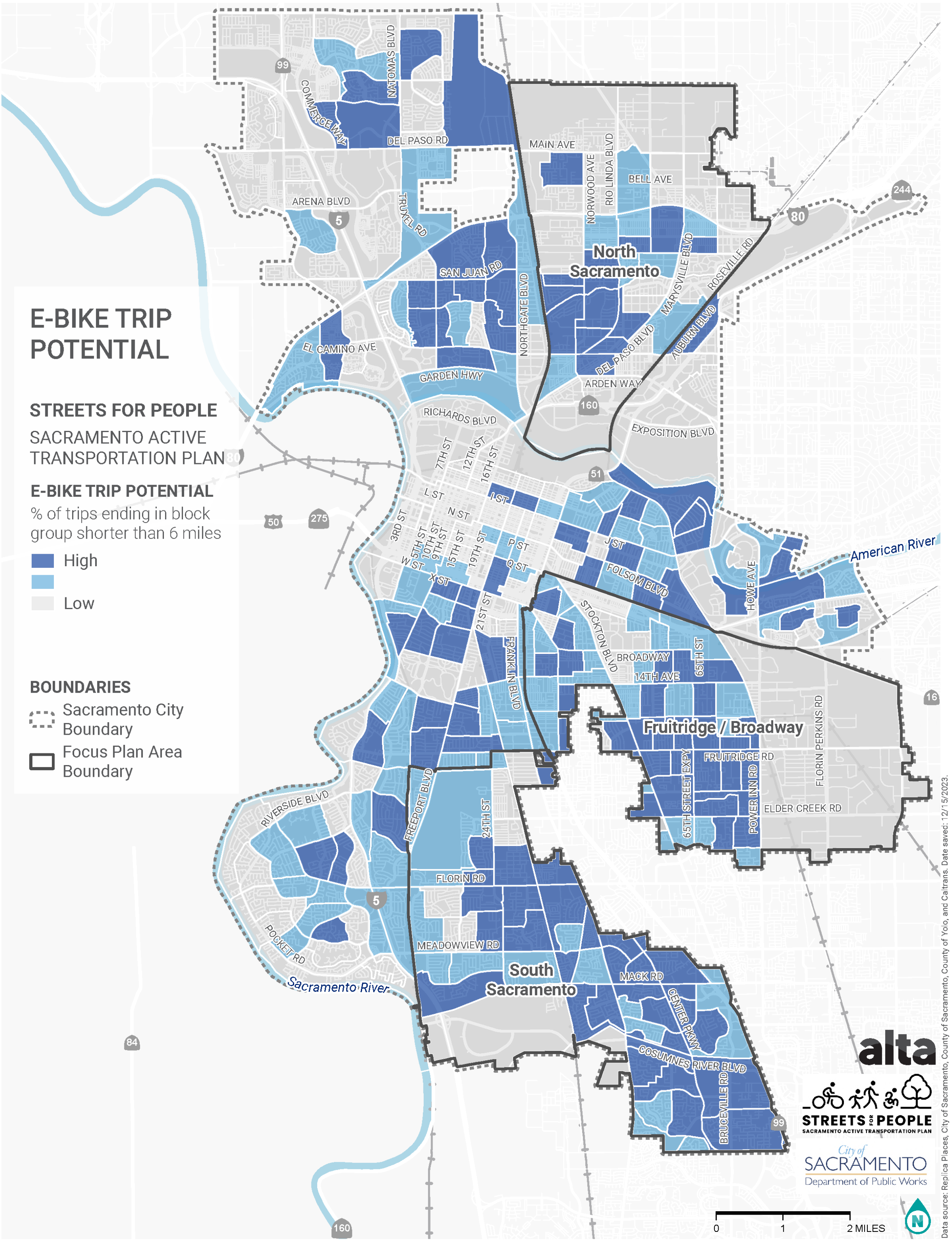


Figure 9. E-Bike-Trip Potential

4. Understanding User Comfort: Level of Traffic Stress

Level of Traffic Stress (LTS) analyses estimate the level of comfort for people walking or biking on a given roadway segment. Segments are defined as the stretch of road between intersections. These analyses identify segments that represent the highest barriers to walking or biking based on users' ability and comfort level. LTS scores are determined by characteristics of a given roadway segment that affect a user's perception of safety and comfort.

Bicycle Level of Traffic Stress (BLTS)

Bicycle Level of Traffic Stress (BLTS) Methods

The BLTS methodology used for this project is adapted from the 2012 Mineta Transportation Institute Report 11-19: Low-Stress Bicycling and Network Connectivity.[7] BLTS was determined by roadway factors including posted speed limit, number of travel lanes, and the presence and type of bicycle facility. Appendix B includes a more detailed description of the BLTS methodology, with additional details provided in Appendix C and Appendix D. The combination of these criteria classifies a road segment into one of four levels of traffic stress as shown in Figure 10.

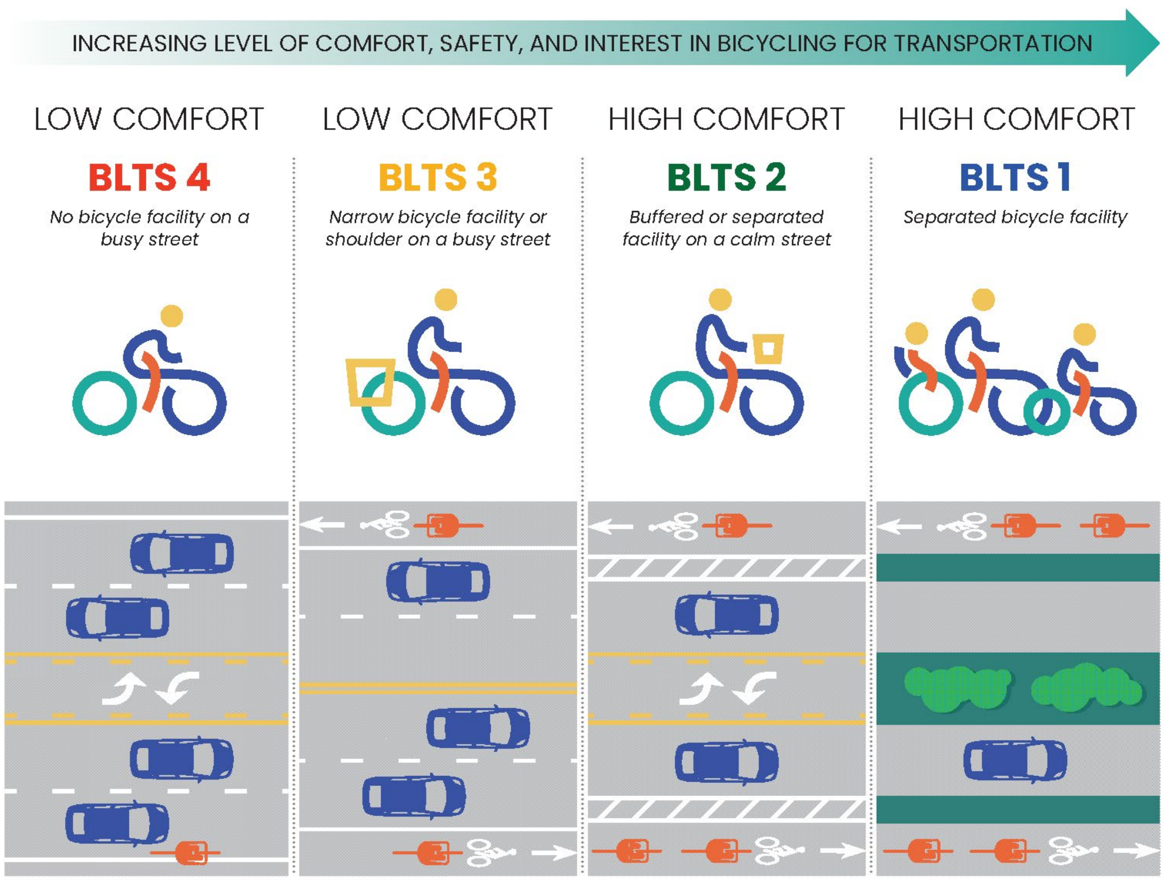


Figure 10. Bicycle Level of Traffic Stress Illustrated

[7] Mineta Institute. Mekuria M., Furth P., Nixon H. *Low-Stress Bicycling and Network Connectivity*. 2012. https://transweb.sjsu.edu/research/Low-Stress-Bicycling-and-Network-Connectivity

Bicycle Level of Traffic Stress (BLTS) Citywide Findings

The results showed that most major roadways in Sacramento represent high-stress (BLTS 3 and 4) environments for people biking, despite the presence of conventional or buffered bike lanes on many arterials and collectors. Some of these roadways include north-south connections like Stockton Boulevard and Truxel Boulevard, as well as east-west connections including San Juan Road, Del Paso Road, El Camino Avenue, Fruitridge Road, and 47th Avenue/Elder Creek Road. These results are linked to existing high-speed, multilane conditions with low to no buffer or vertical separation between people driving and people biking. Residential roads do provide more comfortable travel within neighborhoods (BLTS 1 and 2) while shared-use paths including the Sacramento Northern Bikeway, American River Trail, and Pocket Canal Parkway provide the most separation and low-stress connections between various areas of the city. Full results of the BLTS analysis are shown in Figure 11.

Bicycle Level of Traffic Stress (BLTS) Focus Plan Area Findings

Within each focus plan area, there are key roads that serve as challenging barriers to comfortable movement on a bicycle:

Fruitridge/Broadway

Despite bike lanes on major roads like Power Inn Road and portions of 65th Street Expressway, Stockton Boulevard, and Fruitridge Road, these are still high-stress facilities because of the lack of separation or protection from multilane roads with posted speed limits of 35 miles per hour (mph) or greater.

South Sacramento

Franklin Boulevard, Cosumnes River Boulevard, Center Parkway, 24th Street, and Meadowview Road all have bike lanes but require additional buffer space and protection from vehicles to reduce the traffic stress felt by people biking using these facilities. Buffered bike lanes on Mack Road provide an additional level of separation from vehicle travel lanes, but the lack of physical protection on a multilane road with a posted speed limit of 45 mph still produces a high-stress environment.

North Sacramento

The Sacramento Northern Bikeway provides an extensive, low-stress north-south connection, linking North Sacramento to downtown. Except for Grand Avenue and Eleanor Avenue, there are limited low-stress connecting roads, and most other major roads are high-stress experiences for people biking, particularly Arden Way, Norwood Avenue, and Marysville Boulevard.

Figure 12 through Figure 14 illustrate the results of the BLTS analysis for each of the focus plan areas.

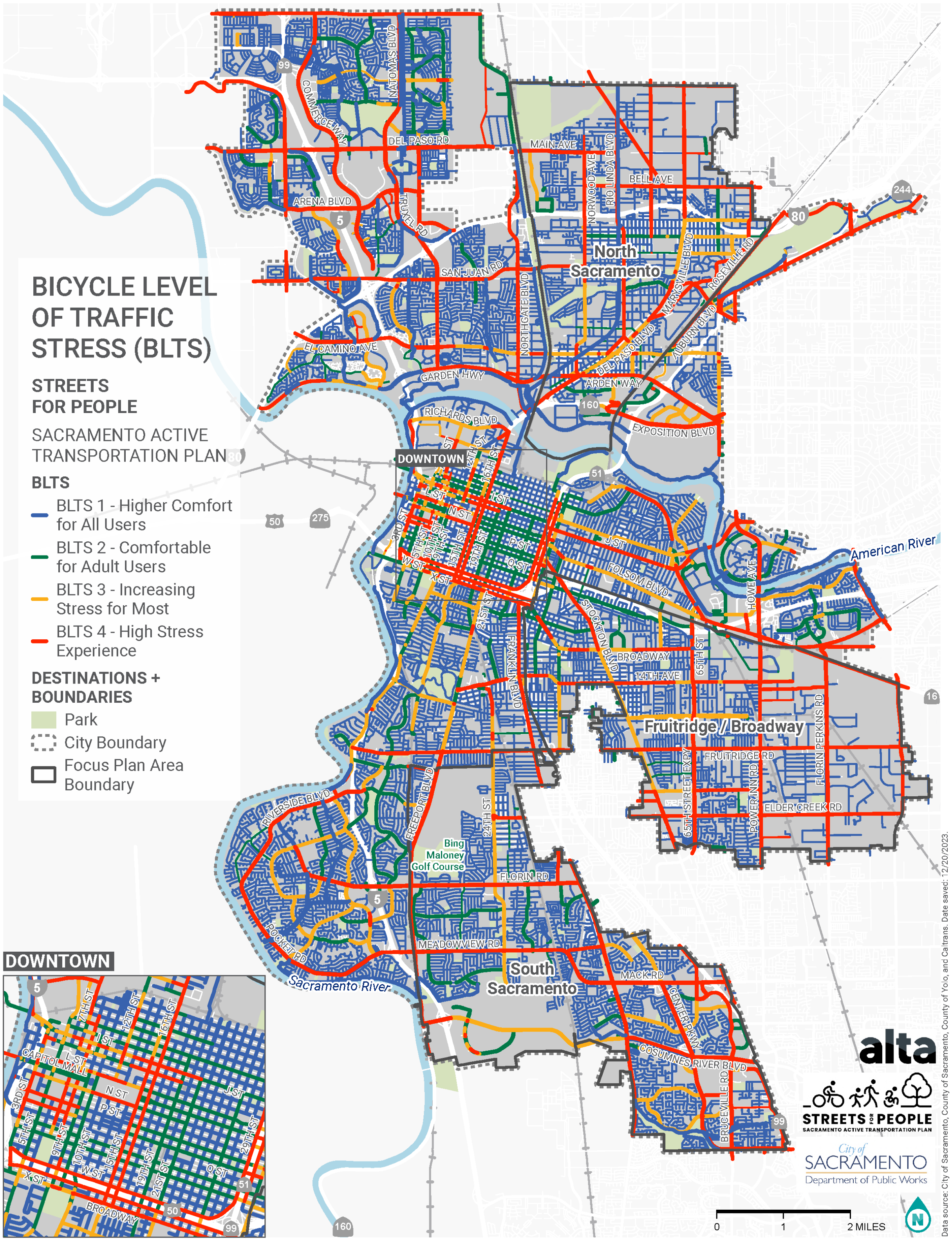
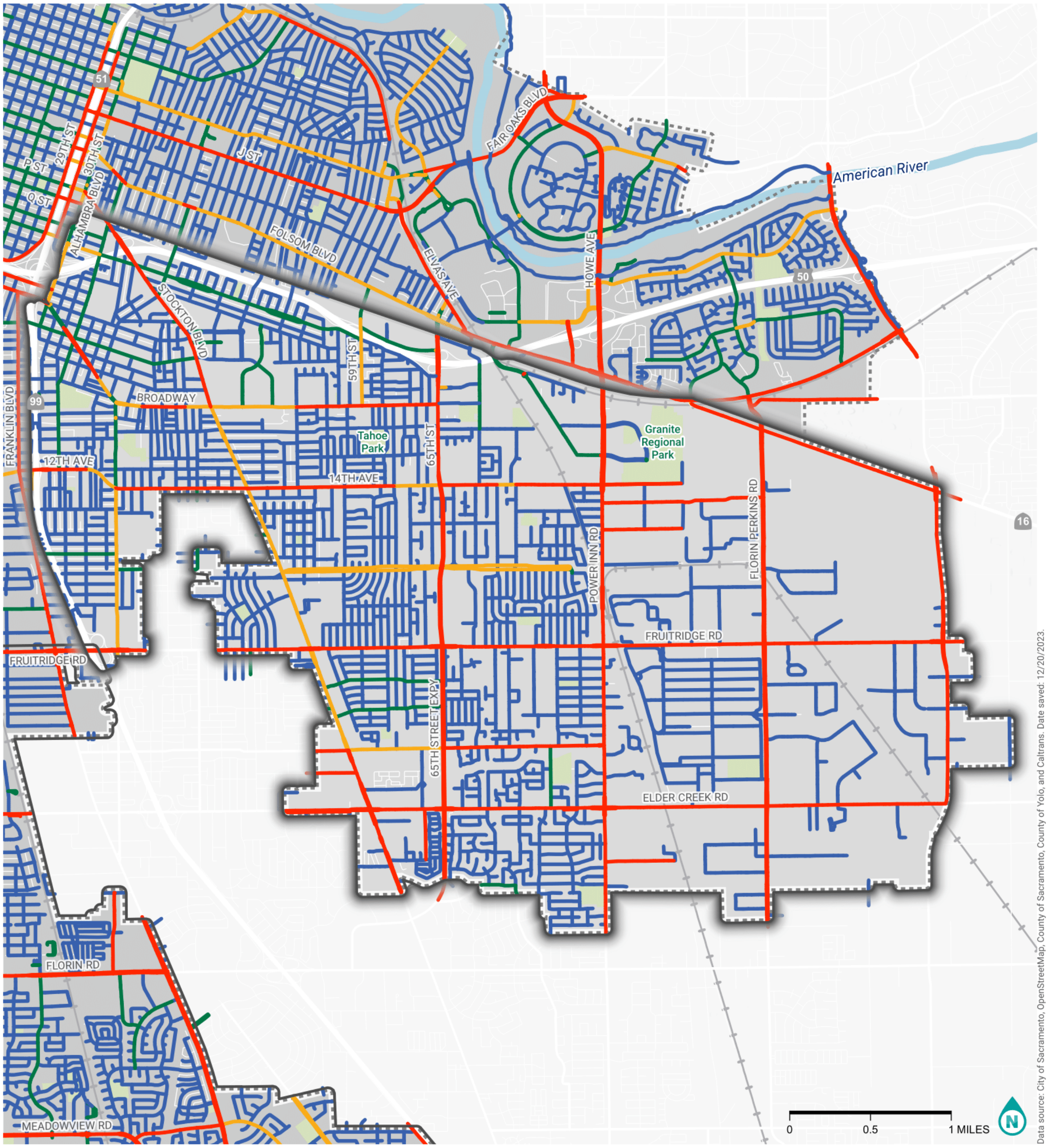


Figure 11. BLTS Analysis Results (Citywide)



BICYCLE LEVEL OF TRAFFIC STRESS (BLTS)

FRUITRIDGE/BROADWAY

STREETS FOR PEOPLE

SACRAMENTO ACTIVE TRANSPORTATION PLAN

BLTS

- BLTS 1 - Higher Comfort for All Users
- BLTS 2 - Comfortable for Adult Users
- BLTS 3 - Increasing Stress for Most
- BLTS 4 - High Stress Experience

DESTINATIONS + BOUNDARIES

- Park
- City Boundary
- Focus Plan Area Boundary

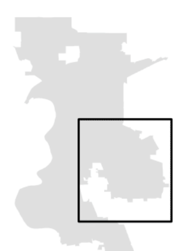


Figure 12. BLTS Analysis Results (Fruitridge/Broadway)

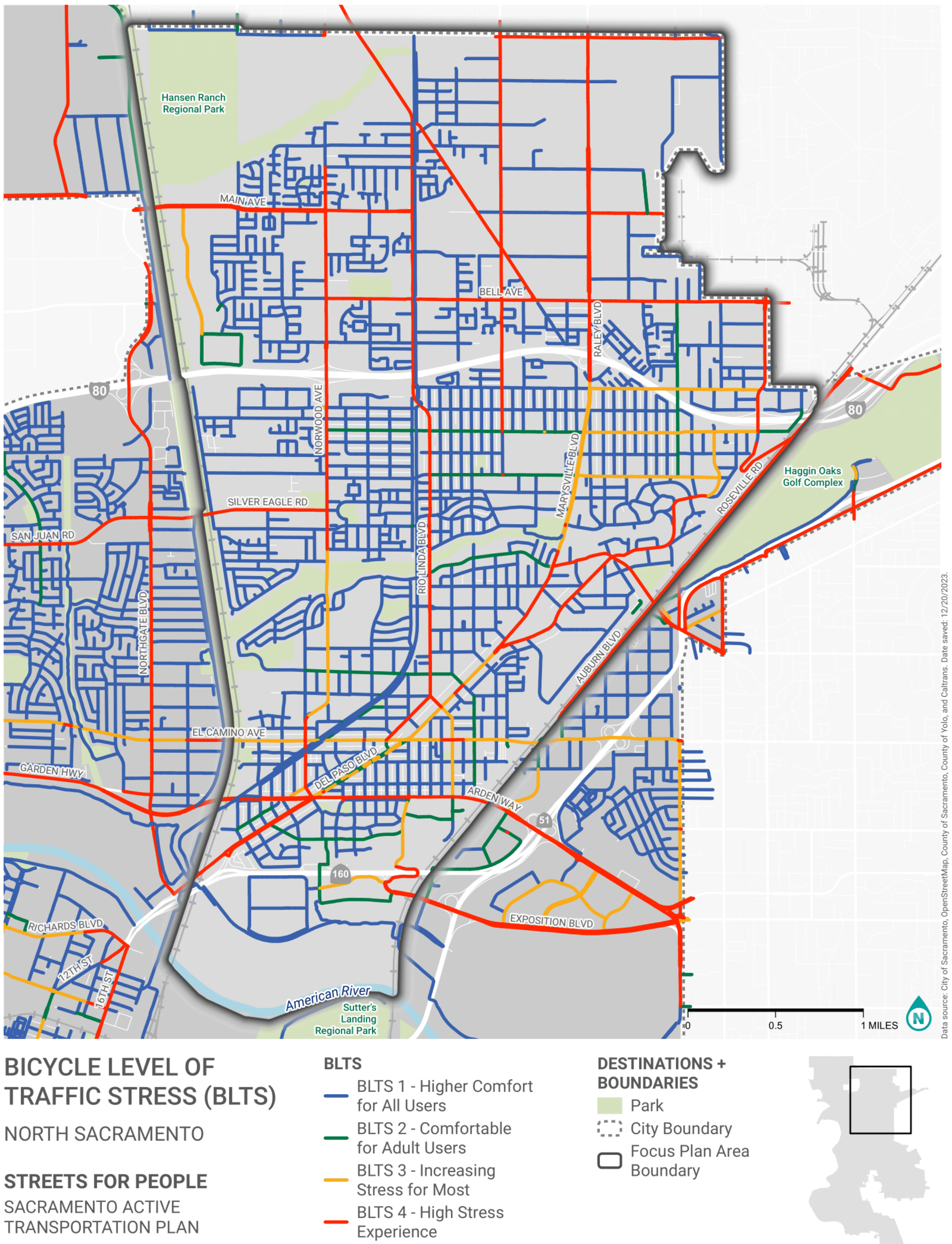


Figure 13. BLTS Analysis Results (North Sacramento Focus Plan Area)

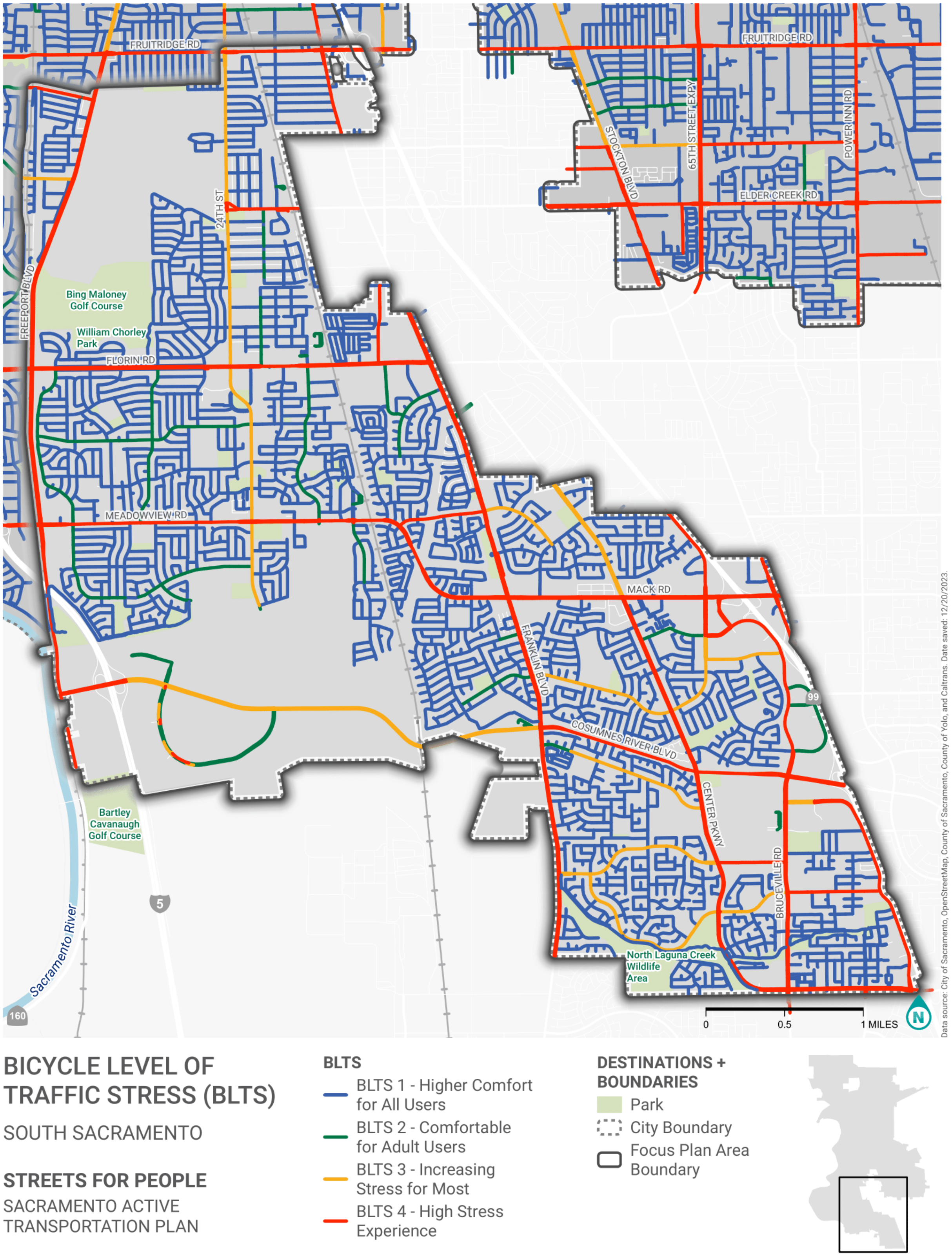


Figure 14. BLTS Analysis Results (South Sacramento Focus Plan Area)

Pedestrian Level of Traffic Stress (PLTS)

Pedestrian Level of Traffic Stress (PLTS) Methods

The PLTS methodology used for this analysis was adapted from the *Oregon Department of Transportation's Analysis Procedures Manual*[8] and is intended as a companion for the BLTS analysis mentioned above. PLTS is determined by characteristics of a given roadway segment that affect the perception of safety and comfort for a person walking including *sidewalk presence and width*, *sidewalk buffer width and type*, *posted speed limit*, and *number of travel lanes*. **Appendix B** includes a more detailed description of the PLTS methodology, with additional details provided in **Appendix C** and **Appendix E**. PLTS scores classify road segments into one of four levels of traffic stress and, while similar to bicycle LTS scores, PLTS considers the level of attention required in addition to the user experience as shown in **Figure 15.**

The results of the PLTS analysis helps identify existing roadway segments that are low stress for people walking and identifies the degree to which roadways may need improvement to provide a comfortable experience for people walking of all ages and abilities.

Figure 15. Pedestrian Level of Traffic Stress Illustrated

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[8] Oregon Department of Transportation. 2020. *Analysis Procedures Manual Version 2.* Transportation Development Division Planning Section: Transportation Planning Analysis Unit. https://www.oregon.gov/odot/Planning/Pages/APM.aspx

Pedestrian Level of Traffic Stress (PLTS) Citywide Findings

Similar to the results from the BLTS, this analysis concluded that a preponderance of major roads outside of downtown Sacramento represent high-stress environments for people walking, even as most of these corridors include continuous sidewalks on both sides of the street. Examples of high-stress roadways include Fruitridge Road, Freeport Boulevard, Northgate Boulevard, Meadowview Road, and Norwood Avenue. Lack of separation, high-speed, and presence of multiple lanes of traffic are contributing factors to stressful travel conditions for most people walking along these corridors. Other major roads including portions of 65th Street Expressway, Cosumnes River Boulevard, Commerce Way, Marysville Boulevard and Rio Linda Boulevard, have no sidewalk on one or more sides of the street, which is the contributing factor to the stressful environment shown in the analysis. It is important to note that throughout various parts of the city major roads are often the only connection to destinations, and stressful conditions on these roads may result in a barrier to walking, hindering connectivity within and across neighborhoods of the city.

Del Paso Boulevard in North Sacramento, Broadway in North Oak Park, and many downtown streets like Capitol Avenue, 21st Street, and N Street provide comfortable environments for people walking on major roads due to wider sidewalks, planted sidewalk buffers, slower vehicle speeds and/or a fewer number of travel lanes. Local or residential roads are typically low-speed, two-lane roads that do not require the same level of separation from motor vehicles to produce low-stress walking conditions. Full results of the PLTS analysis are shown in Figure 16.

Pedestrian Level of Traffic Stress (PLTS) Focus Plan Area Findings

Within the focus plan areas, several key roads showcased challenging environments for people walking based on the analysis:

Fruitridge/Broadway

65th Street Expressway is a major north-south connection that lacks sidewalks on both sides of the street in many places. Fruitridge Road, 14th Avenue, and parts of Broadway east of Martin Luther King Jr Boulevard have sidewalk facilities but are high stress for people walking because of the lack of separation from multilane roads with posted speed limits of 35 mph or greater. Broadway between Alhambra Boulevard and 36th Street provides a more comfortable experience for people walking due to sidewalk buffers with street trees.

North Sacramento

Sidewalk completeness is poor on major roads north of and including Bell Avenue. Arden Way, Norwood Avenue north of Gateway Park, and Marysville Boulevard have sidewalks but do not show additional separation (buffer) from the multilane roads with posted speed limits of 35 mph or greater to provide a comfortable setting for people walking. Del Paso Boulevard from Globe Avenue to El Camino Avenue is a good example of a low-stress road through a commercial area that provides buffered sidewalks on both sides of the street in addition to a lower posted speed of 25 mph.

South Sacramento

Cosumnes River Boulevard lacks sidewalk on one or both sides of the street in most locations. Florin Road, Meadowview Road, Franklin Boulevard, and Center Parkway are roads with posted speed limits of at least 35 mph with sidewalks abutting multilane roads that lack sufficient buffers to provide a low-stress environment for people walking. Portions of Mack Road near the Valley Shopping Center at Franklin Boulevard have landscaped buffers with trees, but not consistently on both sides of the street.

Figure 17 through Figure 19 illustrate the results of the PLTS analysis for each of the focus plan areas.

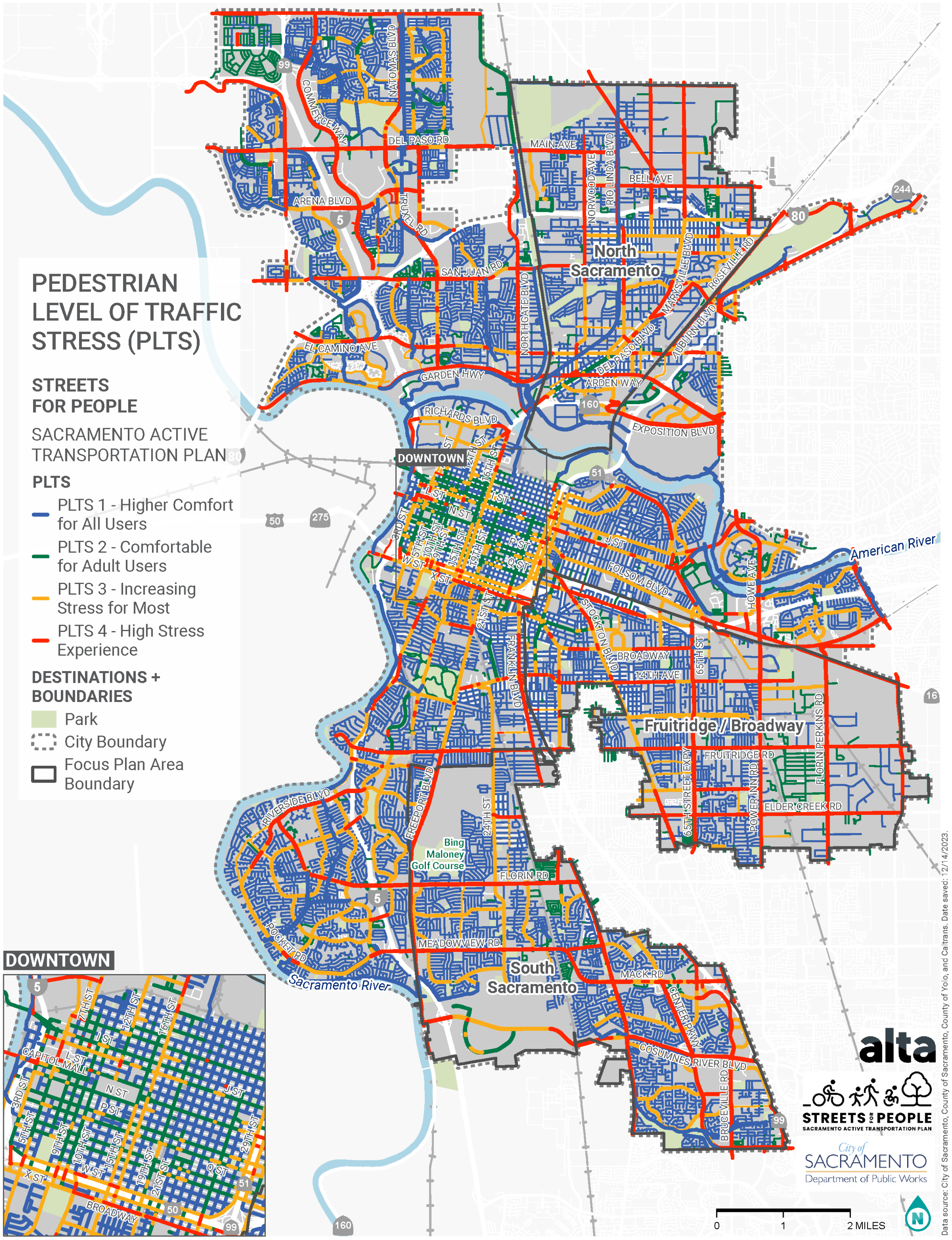


Figure 16. PLTS Analysis Results (Citywide)

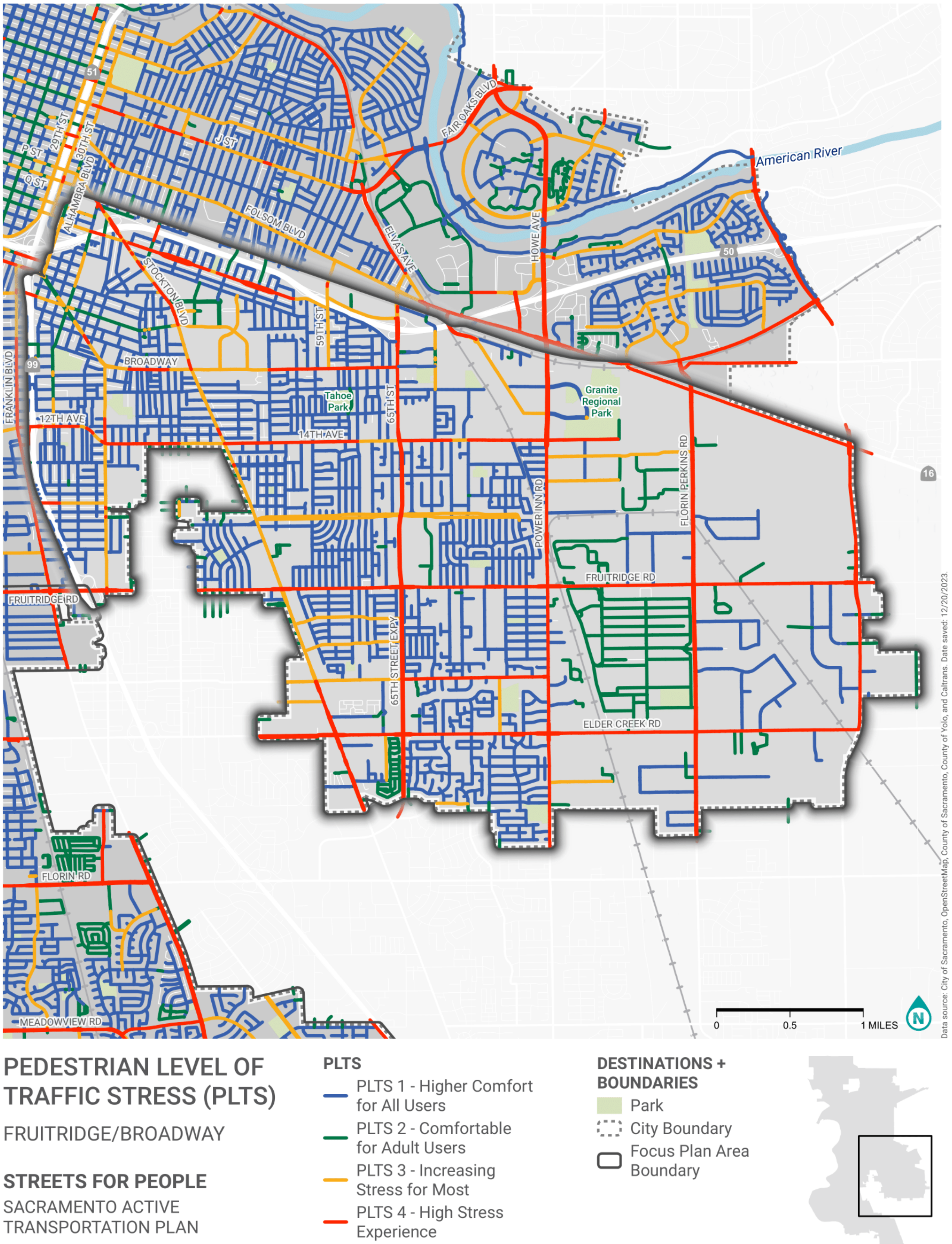


Figure 17. PLTS Analysis Results (Fruitridge/Broadway)

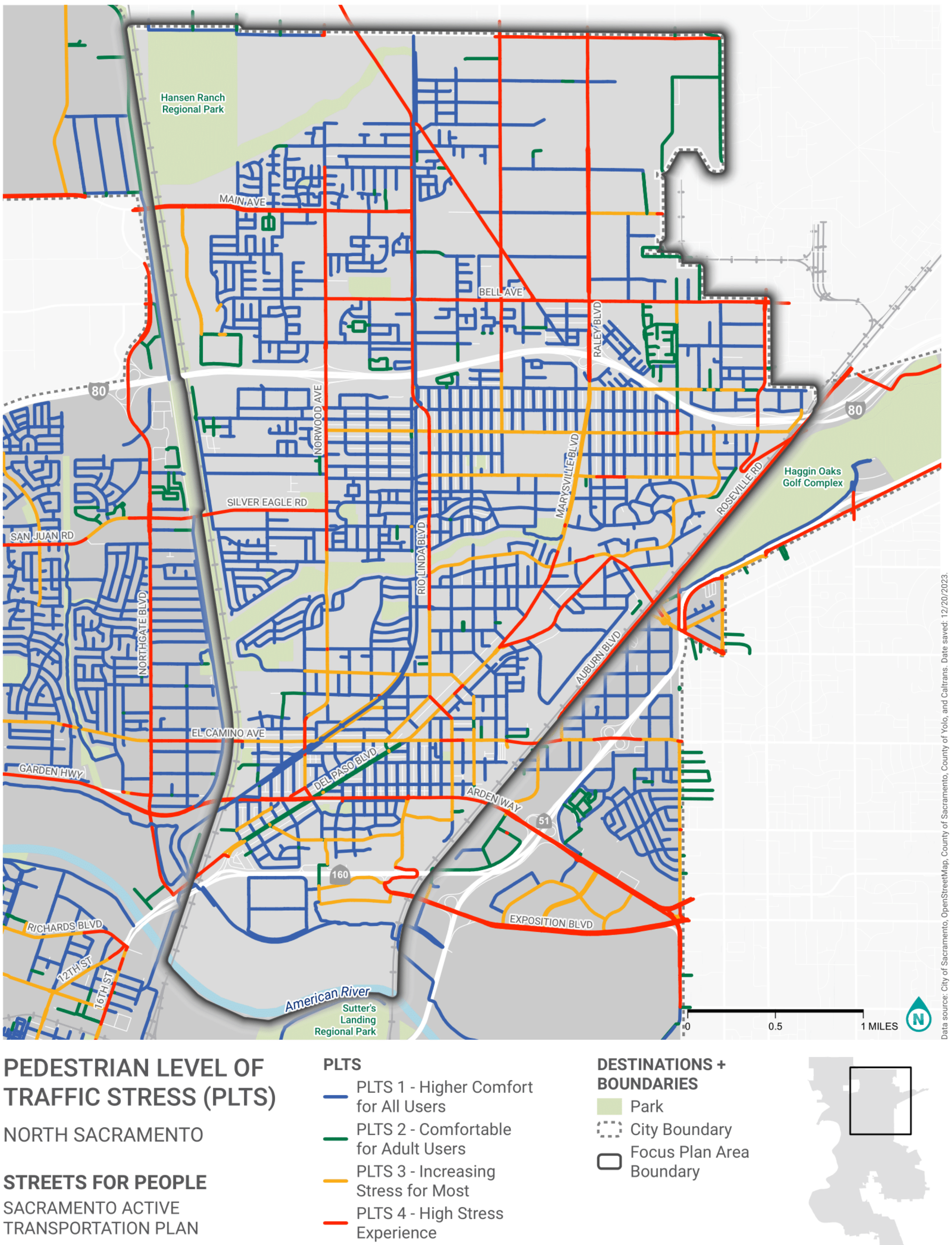


Figure 18. PLTS Analysis Results (North Sacramento)

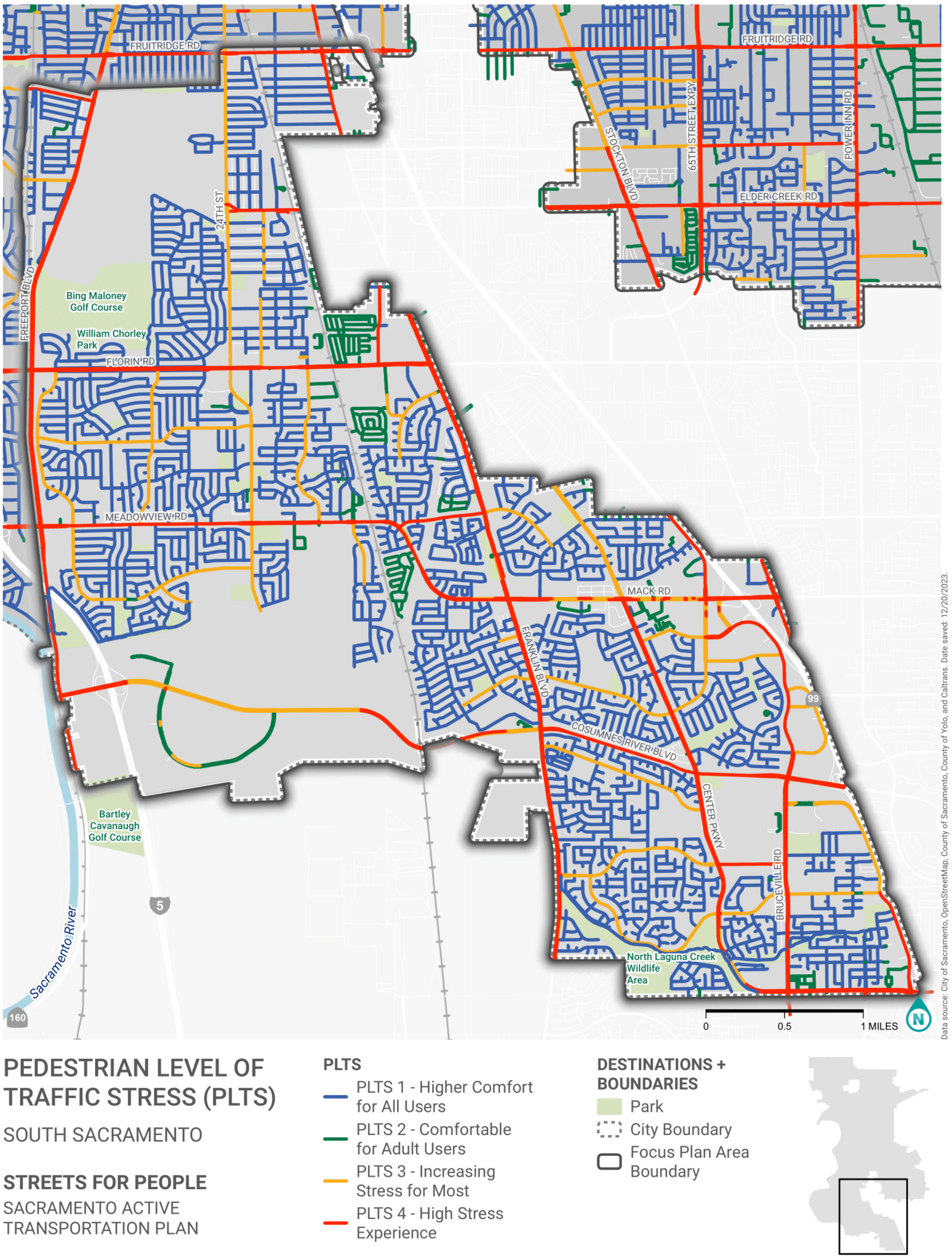


Figure 19. PLTS Analysis Results (South Sacramento)

5. Access to Parks, Schools, and High-Ridership Transit Locations

This analysis focuses on how the existing roadway network impacts an average adult's ability to reach key destinations (parks, schools, and high-ridership transit locations) while biking, walking, and rolling. For this analysis, a high-ridership transit location was defined as all light rail stations plus bus stops, which are used most frequently across Sacramento, as shown in **Table 1**.

Table 1. High-ridership bus stops included in the citywide analysis

Ranking	Bus Stop	Average Weekday Ridership[9]
1	University/65th St Light Rail Station*	2,389
2	Watt Ave/I-80 Light Rail Station*	2,202
3	CSU - Sacramento (State University Dr & J St)	2,092
4	Arden/Del Paso Light Rail Station*	1,385
5	Arden Fair Mall	1,055
6	Florin Towne Center	1,026
7	Marconi/Arcade Light Rail Station*	988
8	9th St and L St	876
9	The Promenade Center	406
10	8th St and J St	398

*Bus stops located at light rail stations are evaluated with coincident light rail station access shed and not evaluated separately.

The analysis also considered the levels of traffic stress on the road and the corresponding impacts on the speed of their travel. Roads with high vehicle speeds and no physical separation from motor vehicles tend to feel more stressful for people biking, walking, or rolling.

As a result, someone biking may choose to instead walk their bike along the sidewalk, and someone walking may travel more slowly in order to stay as far from traffic as possible. This analysis identifies the difference between a typical distance traveled in a short trip in low-stress conditions (Scenario 1) versus a network of stressful facilities (Scenario 2), which would allow people biking, walking, and rolling to travel at their own pace.

The results are presented as "travel sheds" that show how far a user would be able to travel along the roadway network from a park, school, or high-ridership transit location under each scenario. Areas that could be accessed with a short trip under **Scenario 1 (low-stress facilities)** but are out of reach in a short trip under **Scenario 2 (stressful conditions)** are the areas that would benefit most from specific improvements in the network; these are called Potential Access-Benefit Areas (PABAs).

PABAs were overlaid with key demographics such as age and income to better understand the communities within Sacramento that would benefit from investments in improved access;[10,11] equity priority populations were also summarized within each of the PABAs. For this analysis, equity priority populations were defined as individuals living in households with a combined income less than twice the federal poverty level. For example, a four-person family would be considered an equity priority household if the combined income was less than $53,000 per year.[12]

[9] SacRT. September-December 2019 ridership data.
[10] Demographics were allocated to the travel sheds in proportion to the area of overlap they had with census geography (i.e., block group). For example, if a travel shed covered 40% of a census block group, 40% of its population would be allocated to the calculated shed alongside its contribution to a larger total. The proportion of other demographic characteristics such as age or income were similarly allocated. The analysis used U.S. Census American Community Survey 2017–2021 five-year summary data.
[11] For this analysis, access is defined as how well the existing roads/sidewalks/paths connect key community destinations.
[12] The analysis used U.S. Census American Community Survey 2017–2021 five-year summary data and thresholds for demographic information. For more information on poverty thresholds and designations, see the U.S. Census Bureau reference page https://www.census.gov/topics/income-poverty/poverty/guidance/poverty-measures.html.

Summary of Methods

This analysis calculated walking and biking travel sheds showing how far an average person could walk or bike in 5 minutes, 10 minutes, and 15 minutes[13] under the following scenarios. For simplicity, the results below are presented for 15-minute walk sheds and 5-minute bike sheds. The full details of the methods for this analysis are included in **Appendix F**.

- **Scenario 1. Low-Stress Conditions**: In a low-stress scenario, all sidewalks and roads allow for comfortable travel conditions for all types of users. This scenario models a network with appropriate infrastructure in place so that people biking travel at average biking speeds, and people walking/rolling travel at average walking speeds, unaffected by vehicle traffic.
- **Scenario 2. Stressful Conditions**: As presented in Section 4, people biking, walking, and rolling currently experience varying levels of stress during their trip. In this scenario, those walking, biking, and rolling along stressful routes do not travel as far as in Scenario 2: Low-Stress Conditions.

In the illustrative example presented in **Figure 20**, Scenario 1: Low-stress conditions results in larger travel sheds (yellow and blue) than in Scenario 2: Stressful conditions (red). Stated another way: fewer areas of any city are comfortable for walking, biking, and rolling when accounting for traffic stress, as is the case in Scenario 2: Stressful conditions.

Figure 20. Illustration of how a comfortable travel shed is smaller under stressful conditions (in red) than the potential travel shed under low-stress conditions (in yellow and blue). Illustrations in this figure do not depict conditions in Sacramento.

Summary of Findings – Parks

The areas of Sacramento that are within a 15-minute walk of a park are shown in **Figure 21** and **Figure 22**. The maps provide a full account of 5-minute (bright orange), 10-minute (medium orange), and 15-minute (light orange) walksheds. **Table 2** shows the top 10 parks with the largest difference in the 15-minute (light orange) travel sheds between **Figure 21** and **Figure 22**.

Figure 23 and **Figure 24** provide a summary of bike access to parks. These figures are also presented in 5-minute (bright green), 10-minute (medium green), and 15-minute (light green) increments. The communities summarized

[13] For active travel often one-half mile (or a 10-minute walk) and three miles (or an 18-minute bicycle ride) are used as a typical travel shed distance or time.

in Table 3 are represented by the difference in the 5-minute (light green) travel sheds between Figure 23 and Figure 24.

Citywide Access to Parks

Based on the data analysis, 78% of Sacramento residents live within a 15-minute walk of a park (under Scenario 1: Low-stress conditions). This figure is lower (74%) under Scenario 2: Stressful conditions. Similarly, 80% of people in Sacramento live within a 5-minute bike ride of a park, based on the distance along the roads or paths in the network, rather than the “as the crow flies” distance. The percentage of residents in Sacramento living within a 5-minute bike ride of a park also drops from 80% to 74% when accounting for traffic stress in Scenario 2: Stressful conditions.

The tables below summarize the top 10 parks experiencing the most limited access for people walking (Table 2) and people biking (Table 3). These tables include demographics of neighboring communities including the concentration of youth and equity priority populations in proximity to these parks.

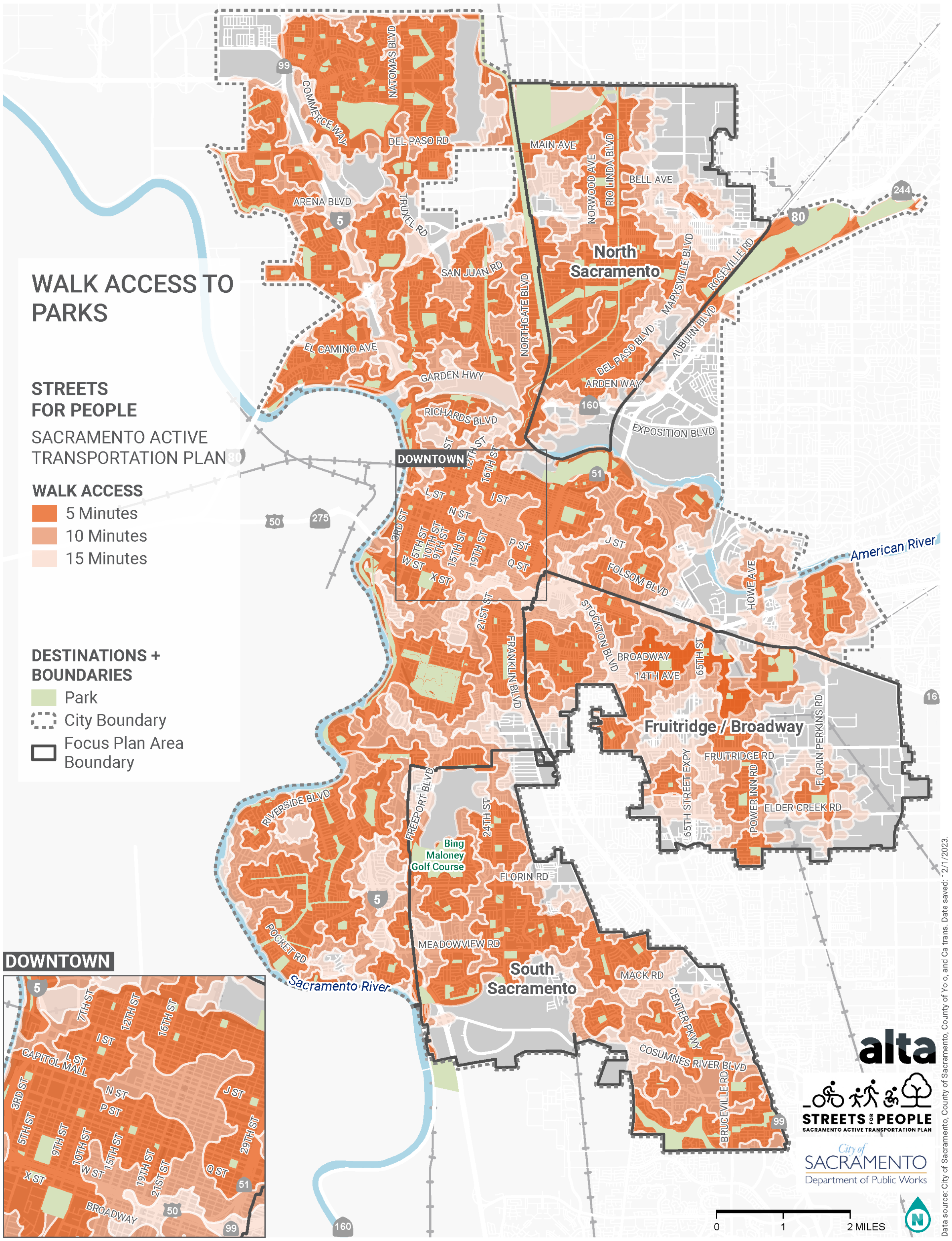


Figure 21. Walk Access to Parks (Scenario 1: Low-stress conditions)

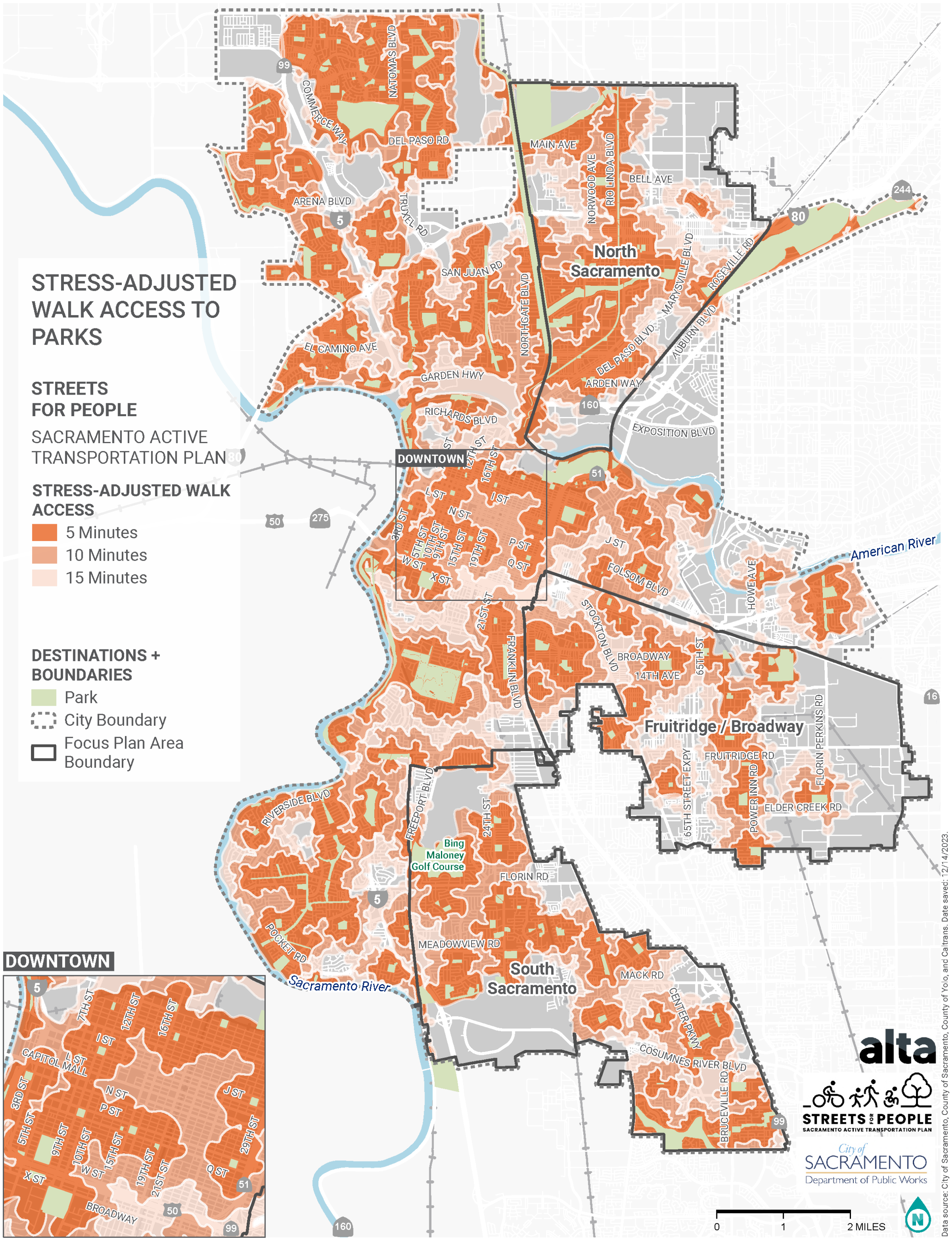


Figure 22. Walk Access to Parks (Scenario 2: Stressful conditions)

*Table 2. Sacramento Parks with the most limited access for people walking by park name (15-minute walk) **

Park Name	Focus Plan Area[ϕ]	Persons Who Can Access the Park within Low-Stress Travel Shed			Persons Who Can Access the Park within Scenario 2: Stressful Travel Shed			
		Population*	% Youth	% Equity **	Population	% of Low-stress Pop.	% Youth	% Equity **
Bannon Creek Park	O	4,947	25%	45%	2,487	50%	28%	46%
Cosumnes River College Park	S	8,827	28%	36%	4,022	46%	29%	45%
Emil Bahnfleth Park	O	3,007	23%	26%	1,492	50%	20%	22%
Granite Regional Park	F	1,617	13%	36%	547	34%	8%	43%
Matsui Waterfront Park	O	1,525	5%	33%	298	20%	18%	63%
Olympians Park	O	3,166	25%	52%	1,669	53%	29%	56%
Ray and Judy Tretheway Oak Preserve	O	3,480	18%	28%	1,621	47%	15%	26%
River View Park	O	235	26%	24%	111	47%	26%	22%
Sally Hudson Park	O	3,756	26%	17%	1,946	52%	27%	14%
Shasta Community Park	S	6,309	28%	38%	2,907	46%	30%	45%

**Minimum Scenario 1: Low-stress travel shed population of 200 people*

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

[φ] The focus plan area for each park is indicated by a letter: N for North Sacramento; F for Fruitridge/Broadway; S for South Sacramento; and O for outside of focus plan areas.

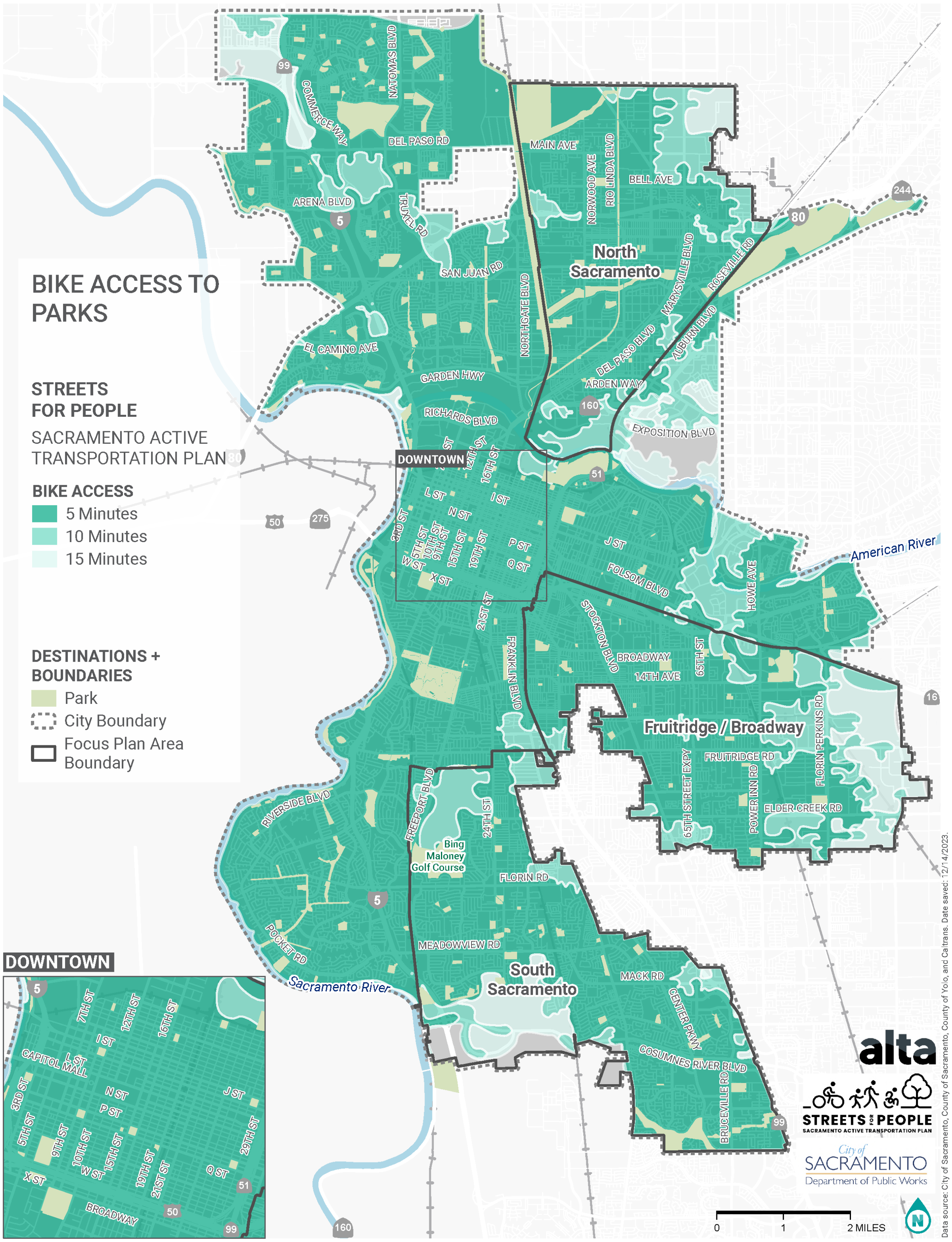


Figure 23. Bike Access to Parks (Scenario 1: Low-stress conditions)

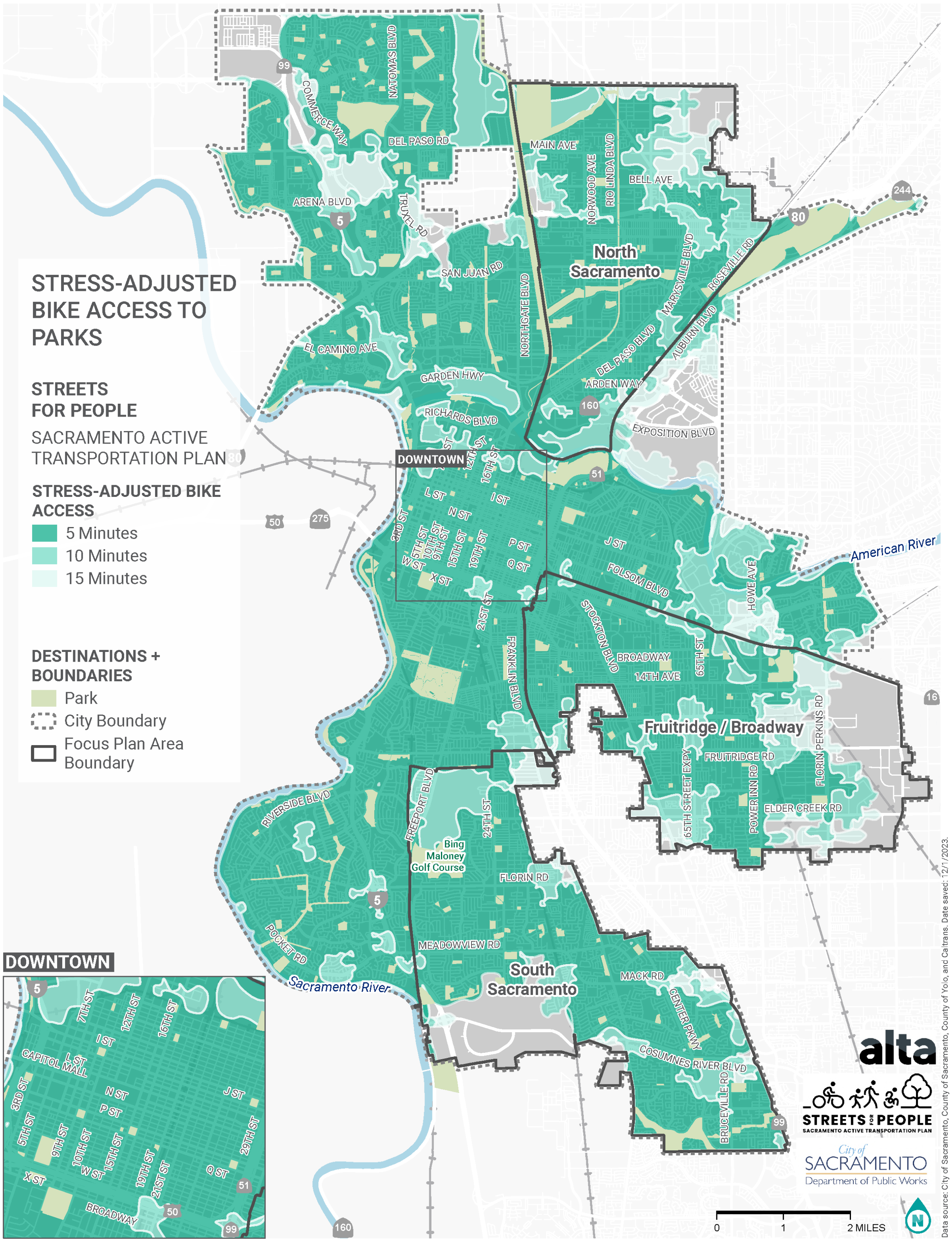


Figure 24. Bike Access to Parks (Scenario 2: Stressful conditions)

Table 3. Sacramento Parks with the most limited access for people biking by park name (5-minute bike ride)

Park Name	Focus Plan Area[φ]	Persons Who Can Access the Park within Low-Stress Travel Shed			Persons Who Can Access the Park within Scenario 2: Stressful Travel Shed			
		Population*	% Youth	Population*	% Youth	Population*	% Youth	Population*
Cosumnes River College Park	S	10,686	27%	35%	1,964	18%	31%	44%
Emil Bahnfleth Park	O	3,542	23%	25%	1,435	41%	20%	20%
Granite Regional Park	F	2,146	14%	35%	298	14%	3%	51%
Haggin Oaks Golf Complex	O	3,048	30%	50%	1,048	34%	27%	41%
Matsui Waterfront Park	O	1,960	5%	32%	456	23%	10%	43%
Pannell/Meadowview Community Center Park	S	10,899	28%	44%	4,227	39%	27%	41%
Ray and Judy Tretheway Oak Preserve	O	3,883	18%	27%	926	24%	15%	24%
River View Park	O	336	26%	24%	84	25%	27%	21%
Sacramento River Parkway (Land Park Area)	O	4,914	20%	18%	1,596	32%	20%	21%
Shasta Community Park	S	6,918	28%	38%	1,912	28%	32%	46%

**Minimum distance-only travel shed population of 200 persons*
***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*
[φ] The focus plan area for each park is indicated by a letter: N for North Sacramento; F for Fruitridge/Broadway; S for South Sacramento; and O for outside of focus plan areas.

Focus Plan Area Findings

Focus plan area residents experience less access to parks than residents in other parts of the city. As shown in **Table 4**, only around 80% of residents in these areas can access parks within a 15-minute walk, compared to an average of 95% citywide. Similarly, only about 26% of youth and 44% of equity populations, those living in households with incomes below 200% of the federal poverty level, can access parks within a 15-minute walk.

Table 4. Populations within a 15-minute walk to parks across Sacramento and in focus plan areas

Focus Plan Area	Persons Who Can Access the Park within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Park within Scenario 2: Stressful Travel Shed			
	Population*	% Youth	% Equity**	Population	% of Low-stress Population	% Youth	% Equity**
Citywide	468,742	22%	33%	446,166	95%	22%	33%
Fruitridge/Broadway	142,786	20%	43%	117,663	82%	21%	44%
North Sacramento	161,666	29%	48%	134,022	83%	29%	48%
South Sacramento	325,699	28%	41%	248,376	76%	28%	41%

**Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

Focus plan area residents experience less access biking to parks than in other parts of the city. As shown in **Table 5**, only an average of 75% of residents in focus plan areas can access parks within a 5-minute bike ride, compared to around 92% citywide when accounting for traffic stress. South Sacramento and North Sacramento experience the highest disparity in access for youth where only around 29% of youth in these areas can access parks within a 5-minute bike ride. In addition, a larger proportion of minority community residents (an average of 44%) have limited access to parks than the city as a whole (32%).

Table 5. Populations within a 5-minute bike ride to parks across Sacramento and in focus plan areas

Focus Plan Area	Persons Who Can Access the Park within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Park within Scenario 2: Stressful Travel Shed			
	Population*	% Youth	% Equity**	Population	% of Low-stress Population	% Youth	% Equity**
Citywide	478,125	22%	33%	442,204	92%	22%	32%
Fruitridge/Broadway	169,768	20%	43%	133,882	79%	20%	43%
North Sacramento	234,447	29%	48%	176,501	75%	29%	48%
South Sacramento	370,433	28%	41%	271,609	73%	28%	41%

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

Fruitridge/Broadway

Table 6 shows the parks in the Fruitridge/Broadway Focus Plan Area with the most limited access for people walking and biking by mode. **Figure 25** through **Figure 28** show walk and bike access to parks under low-stress and stressful conditions.

Table 6. Fruitridge/Broadway parks with the most limited access (walking and biking)

Park Name	Mode	Persons Who Can Access the Park within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Park within Scenario 2: Stressful Travel Shed			
		Population *	% Youth	% Equity**	Population	% of Low-stress Population	% Youth	% Equity**
Granite Regional Park	Walking	1,617	13%	36%	547	34%	8%	43%
	Biking	2,146	14%	35%	298	14%	3%	51%
Coloma Park	Walking	4,613	11%	29%	3,050	66%	9%	31%
Artivio Guerrero Park	Walking	8,080	26%	46%	5,375	67%	26%	42%
	Biking	9,350	26%	46%	5,839	62%	25%	39%
Army Depot Park	Walking	283	24%	47%	197	69%	24%	47%
	Biking	326	23%	47%	177	54%	24%	47%
Mae Fong Park	Walking	5,050	12%	40%	3,569	71%	12%	42%
Colonial Park	Biking	7,161	17%	27%	4,232	59%	17%	24%
Lawrence Park	Biking	3,767	17%	30%	2,246	60%	15%	34%

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

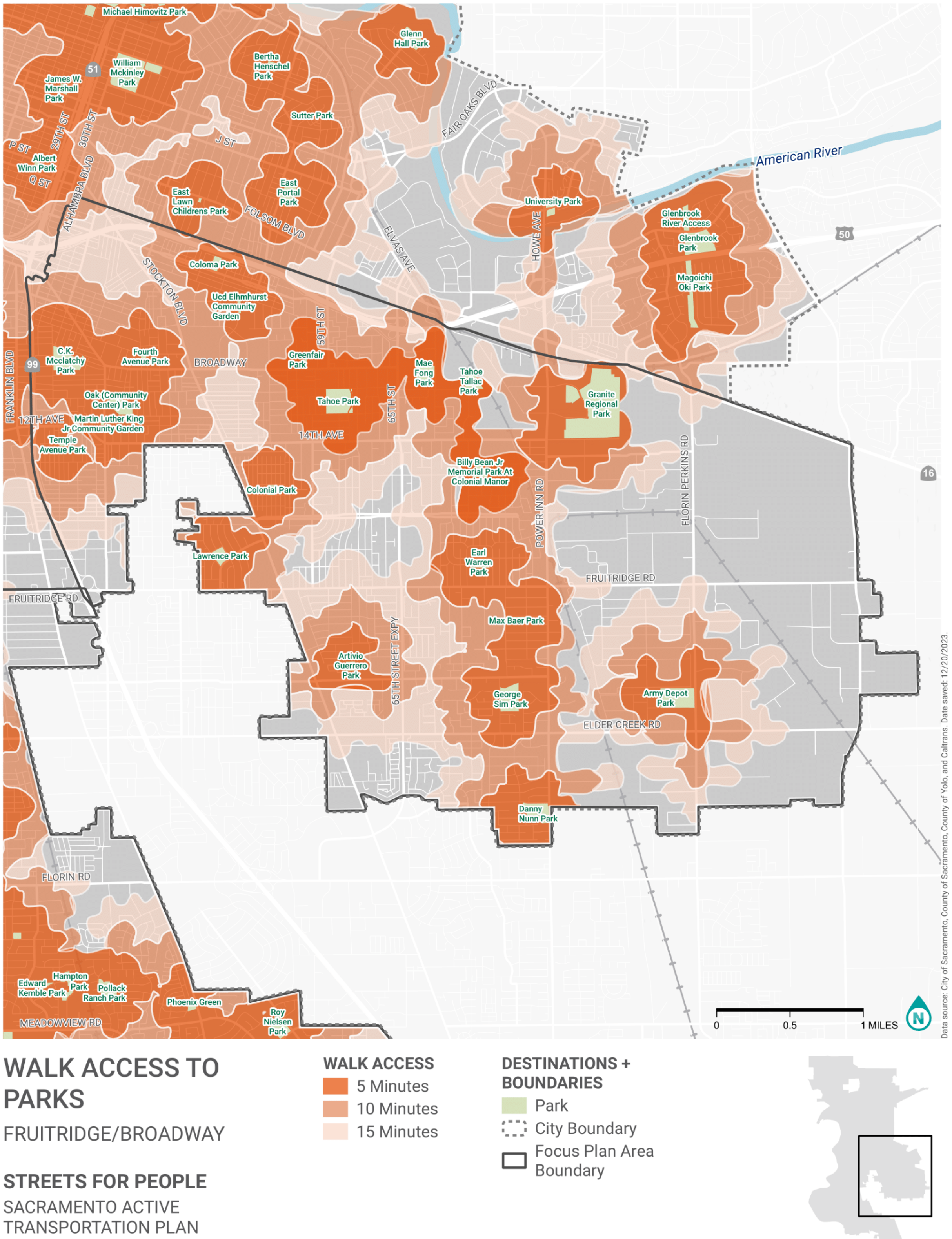


Figure 25. Fruitridge/Broadway Walk Access to Parks (Scenario 1: Low-stress conditions)

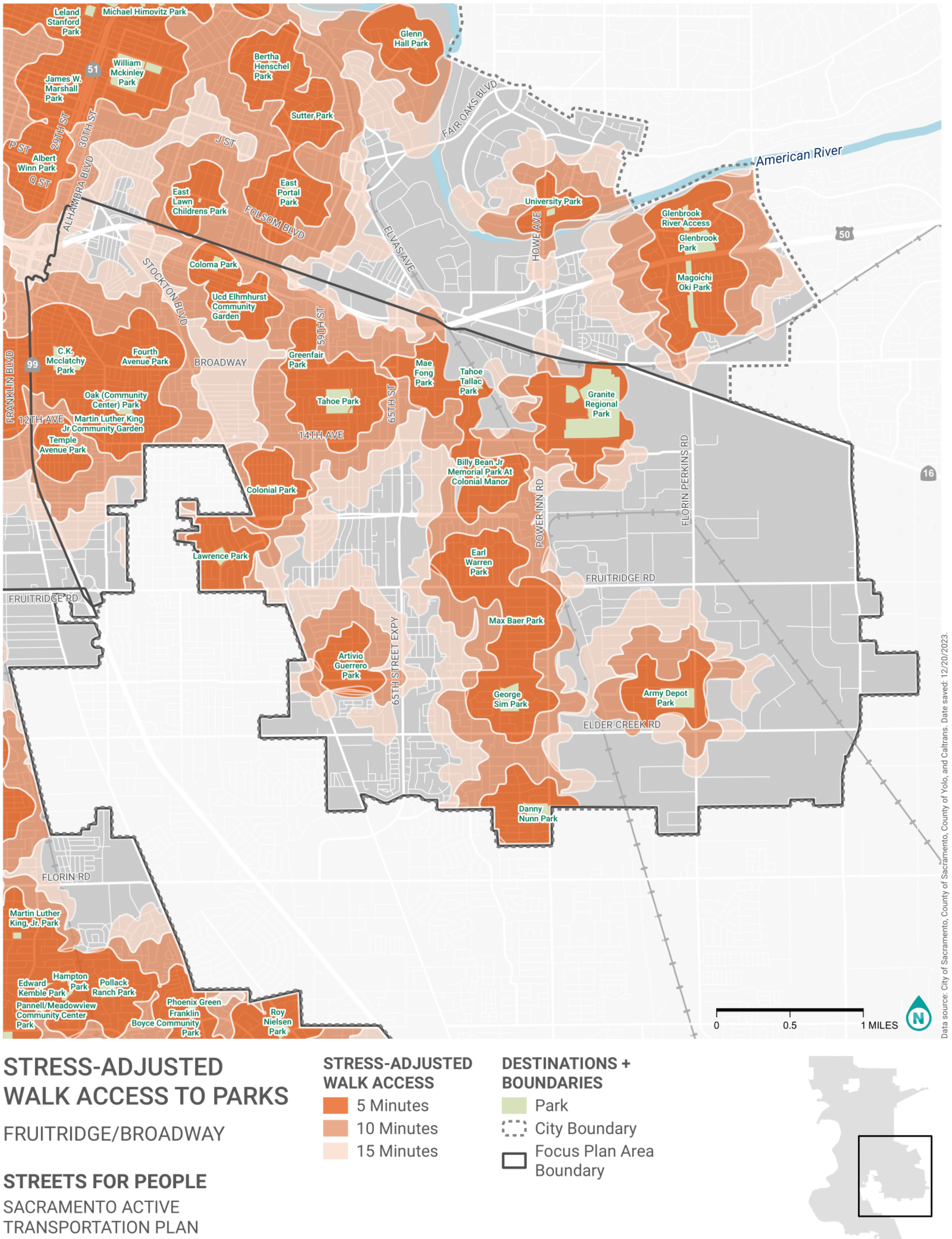


Figure 26. Fruitridge/Broadway Walk Access to Parks (Scenario 2: Stressful conditions)

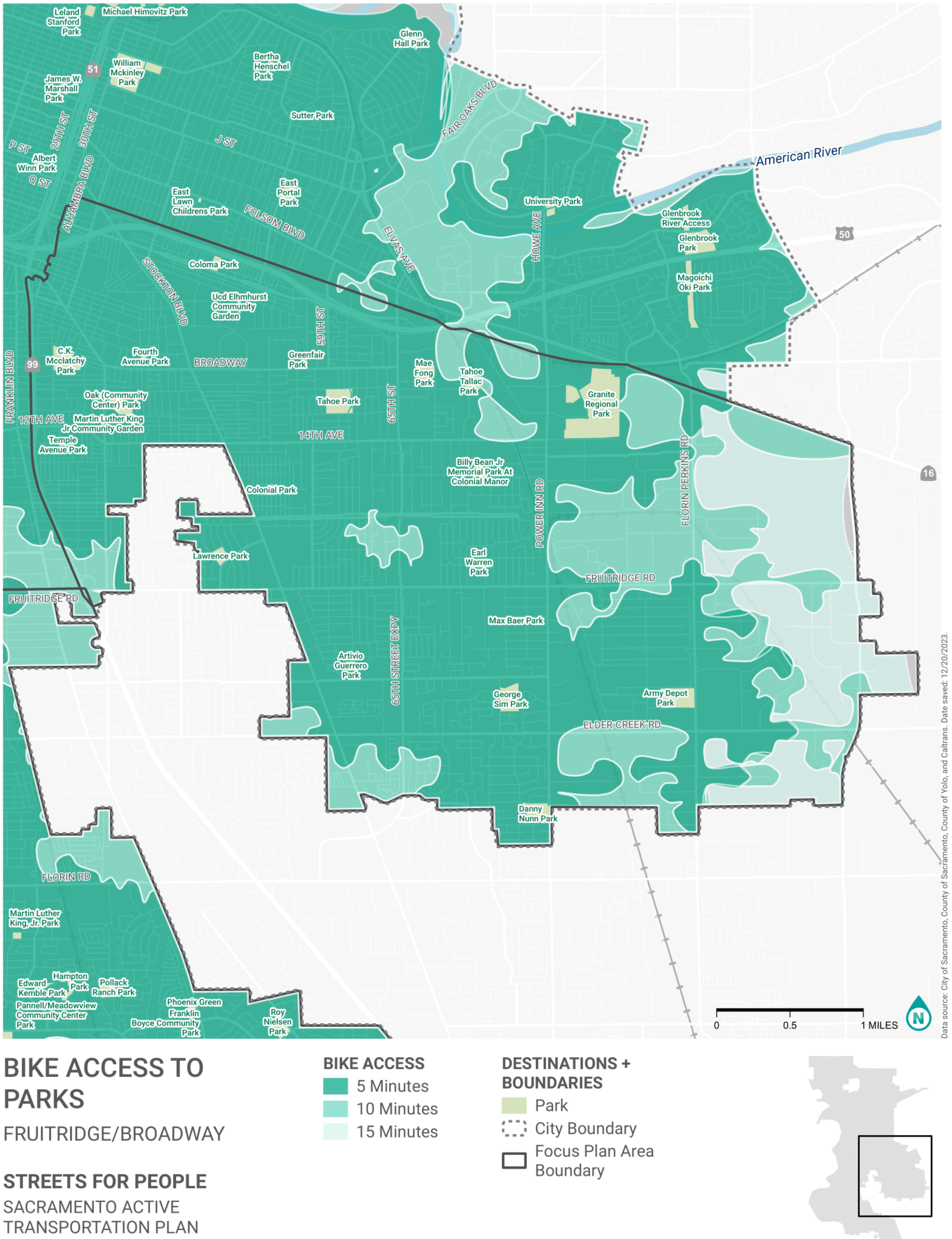


Figure 27. Fruitridge/Broadway Bike Access to Parks (Scenario 1: Low-stress conditions)

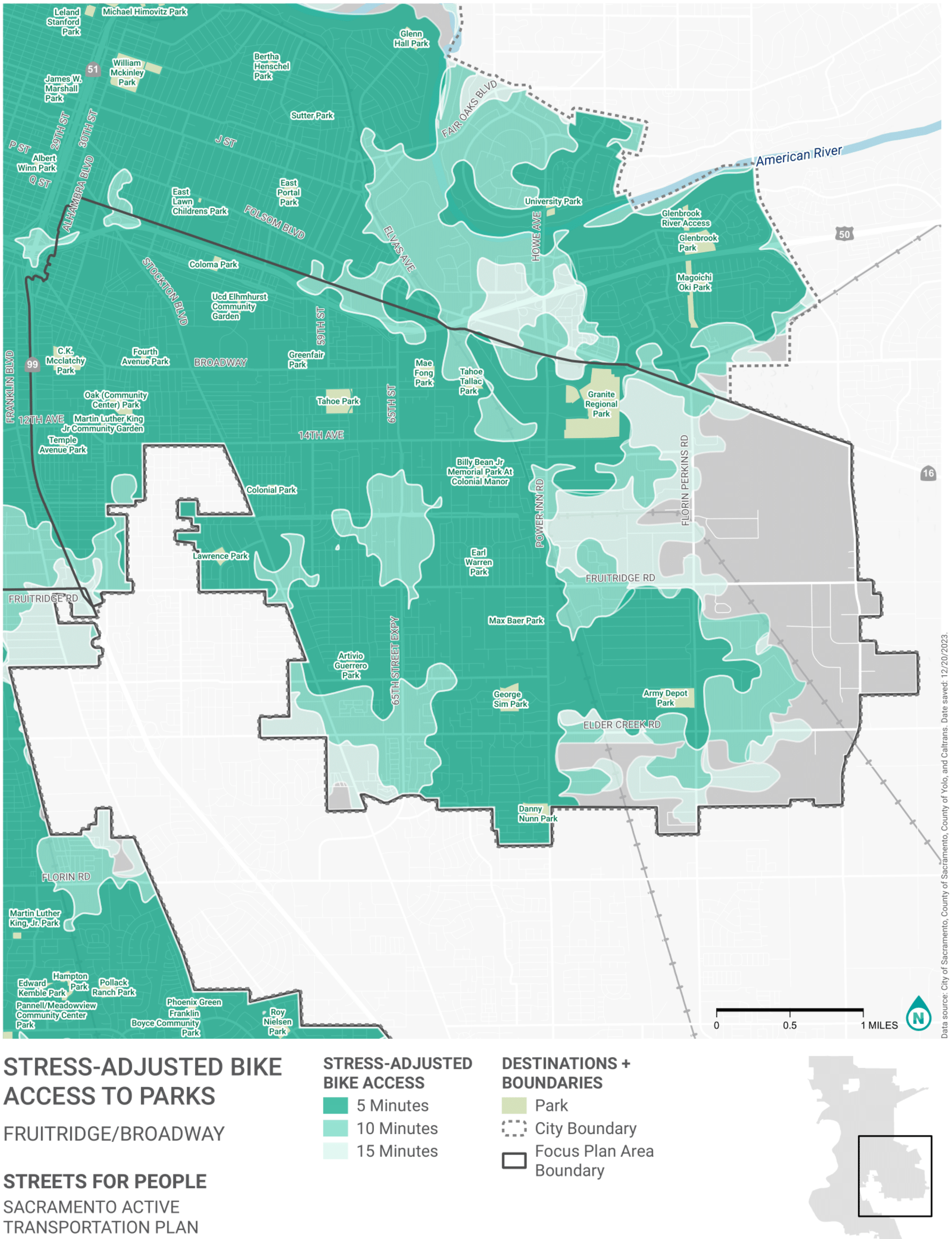


Figure 28. Fruitridge/Broadway Bike Access to Parks (Scenario 2: Stressful conditions)

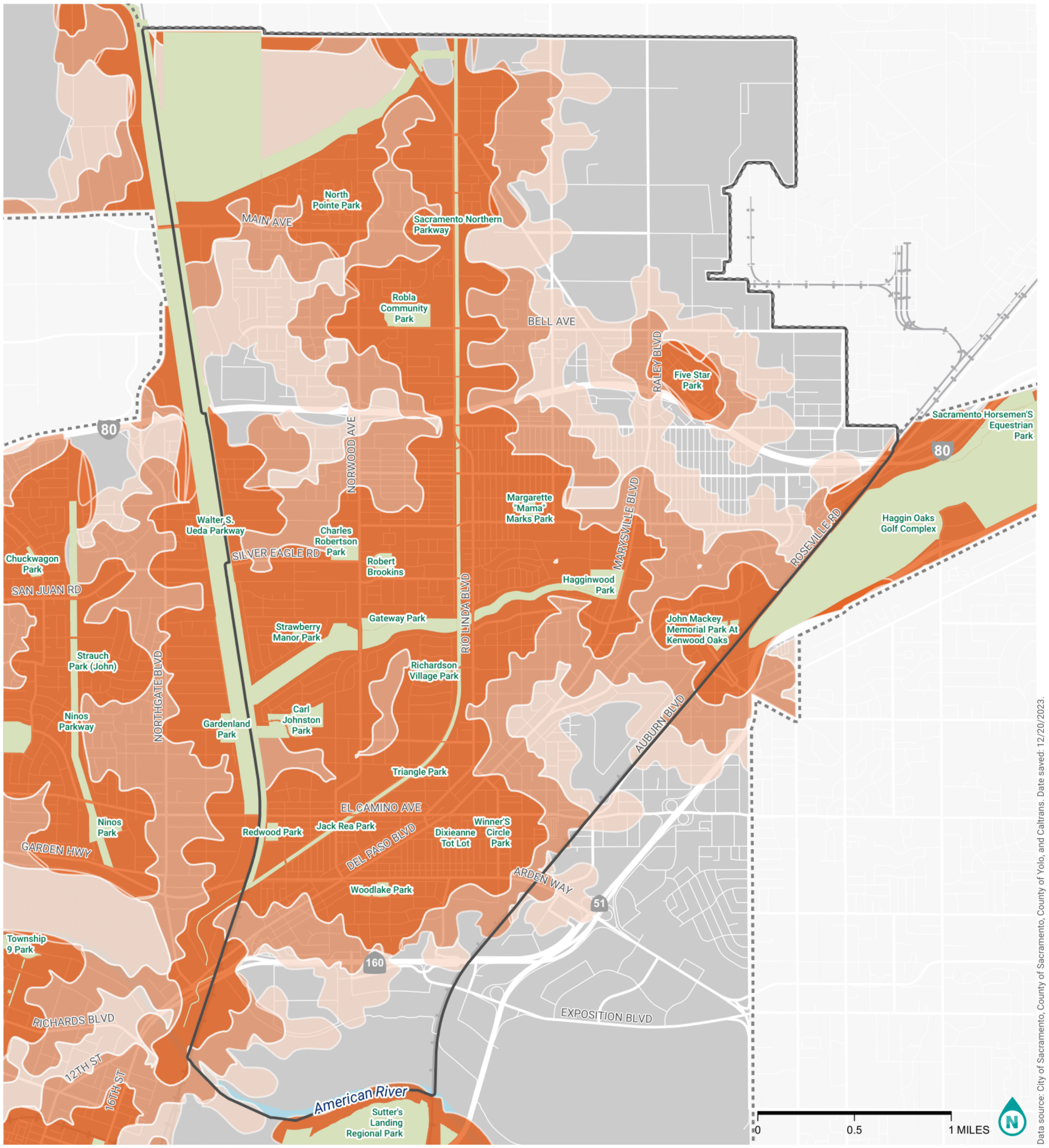
North Sacramento

Table 7 shows the parks in the North Sacramento Focus Plan Area with the most limited access for people walking and biking by mode. **Figure 29** through **Figure 32** show walk and bike access to parks under low-stress and stressful conditions.

Table 7. North Sacramento parks with the most limited access (walking and biking)

Park Name	Mode	Persons Who Can Access the Park within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Park within Scenario 2: Stressful Travel Shed			
		Population *	% Youth	% Equity **	Population	% of Low-stress Population	% Youth	% Equity **
John Mackey Memorial Park at Kenwood Oaks	Walking	6,551	30%	56%	4,527	69%	32%	58%
	Biking	7,901	30%	56%	3,995	51%	32%	58%
North Pointe Park	Walking	4,894	23%	38%	3,396	69%	22%	39%
	Biking	6,311	23%	38%	2,860	45%	22%	38%
Hagginwood Park	Walking	10,408	28%	52%	7,611	73%	28%	52%
Gateway Park	Walking	9,146	35%	45%	6,702	73%	35%	43%
	Biking	10,913	35%	45%	5,715	52%	35%	40%
Five Star Park	Walking	1,540	20%	40%	1,140	74%	19%	38%
Charles Robertson Park	Biking	10,090	34%	44%	5,178	51%	37%	37%
Robla Community Park	Biking	10,520	25%	43%	5,554	53%	23%	40%

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*



WALK ACCESS TO PARKS

NORTH SACRAMENTO

STREETS FOR PEOPLE

SACRAMENTO ACTIVE TRANSPORTATION PLAN

WALK ACCESS

- 5 Minutes
- 10 Minutes
- 15 Minutes

DESTINATIONS + BOUNDARIES

- Park
- City Boundary
- Focus Plan Area Boundary

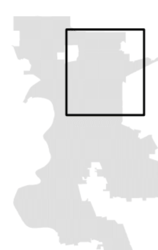
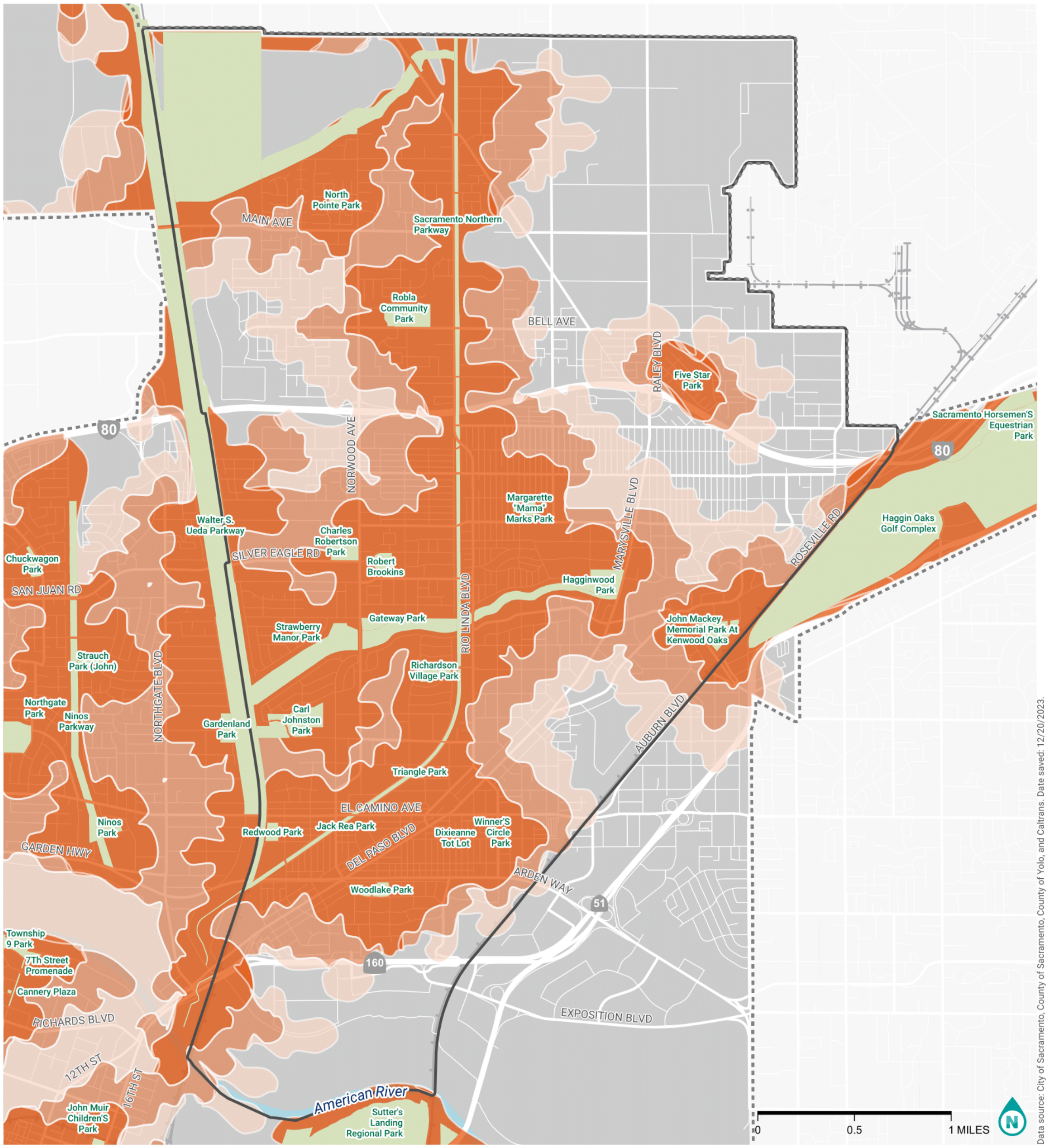


Figure 29. North Sacramento Walk Access to Parks (Scenario 1: Low-stress conditions)



STRESS-ADJUSTED WALK ACCESS TO PARKS

NORTH SACRAMENTO

STREETS FOR PEOPLE

SACRAMENTO ACTIVE TRANSPORTATION PLAN

STRESS-ADJUSTED WALK ACCESS

- 5 Minutes
- 10 Minutes
- 15 Minutes

DESTINATIONS + BOUNDARIES

- Park
- City Boundary
- Focus Plan Area Boundary

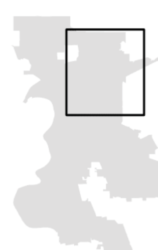


Figure 30. North Sacramento Walk Access to Parks (Scenario 2: Stressful conditions)

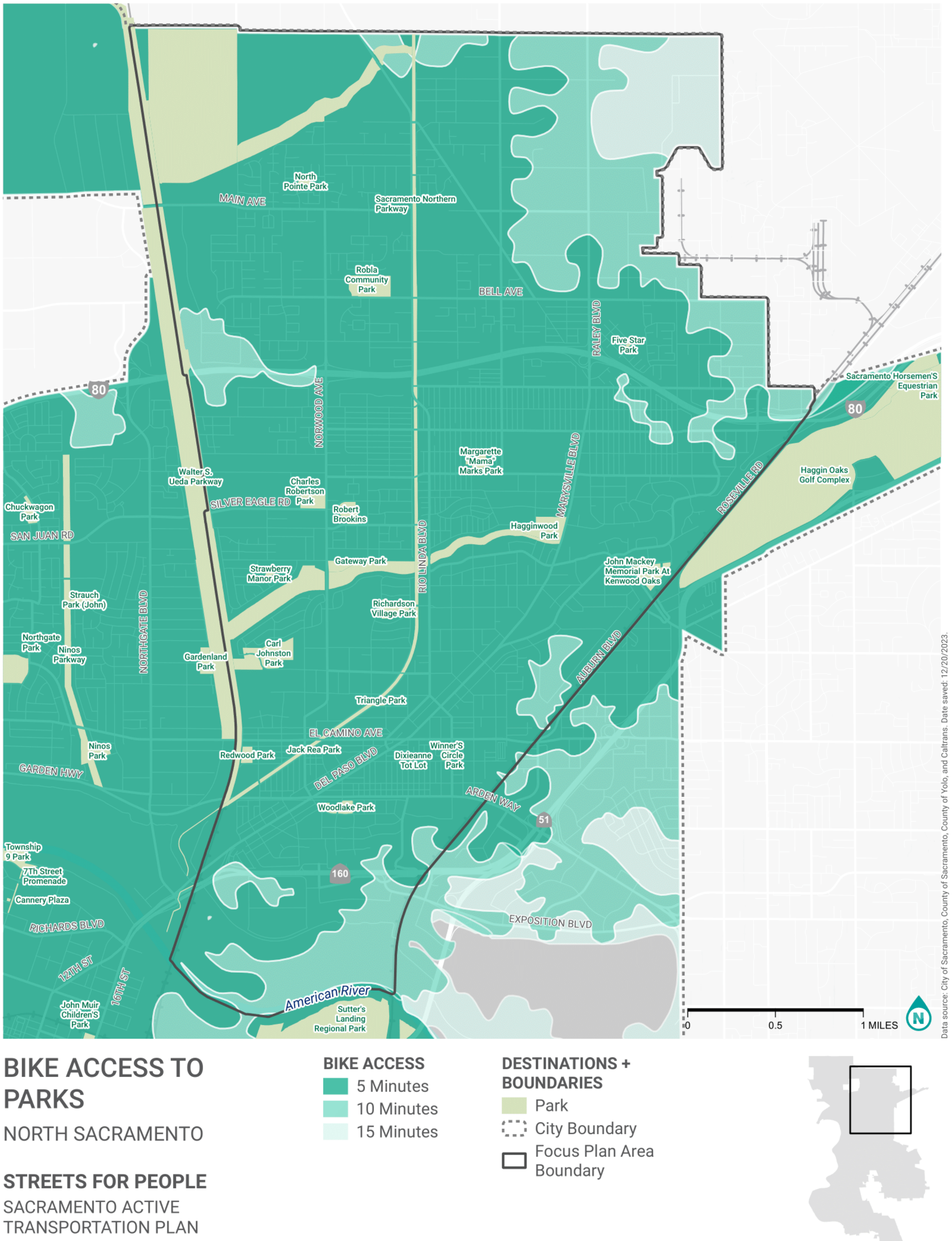


Figure 31. North Sacramento Bike Access to Parks (Scenario 1: Low-stress conditions)

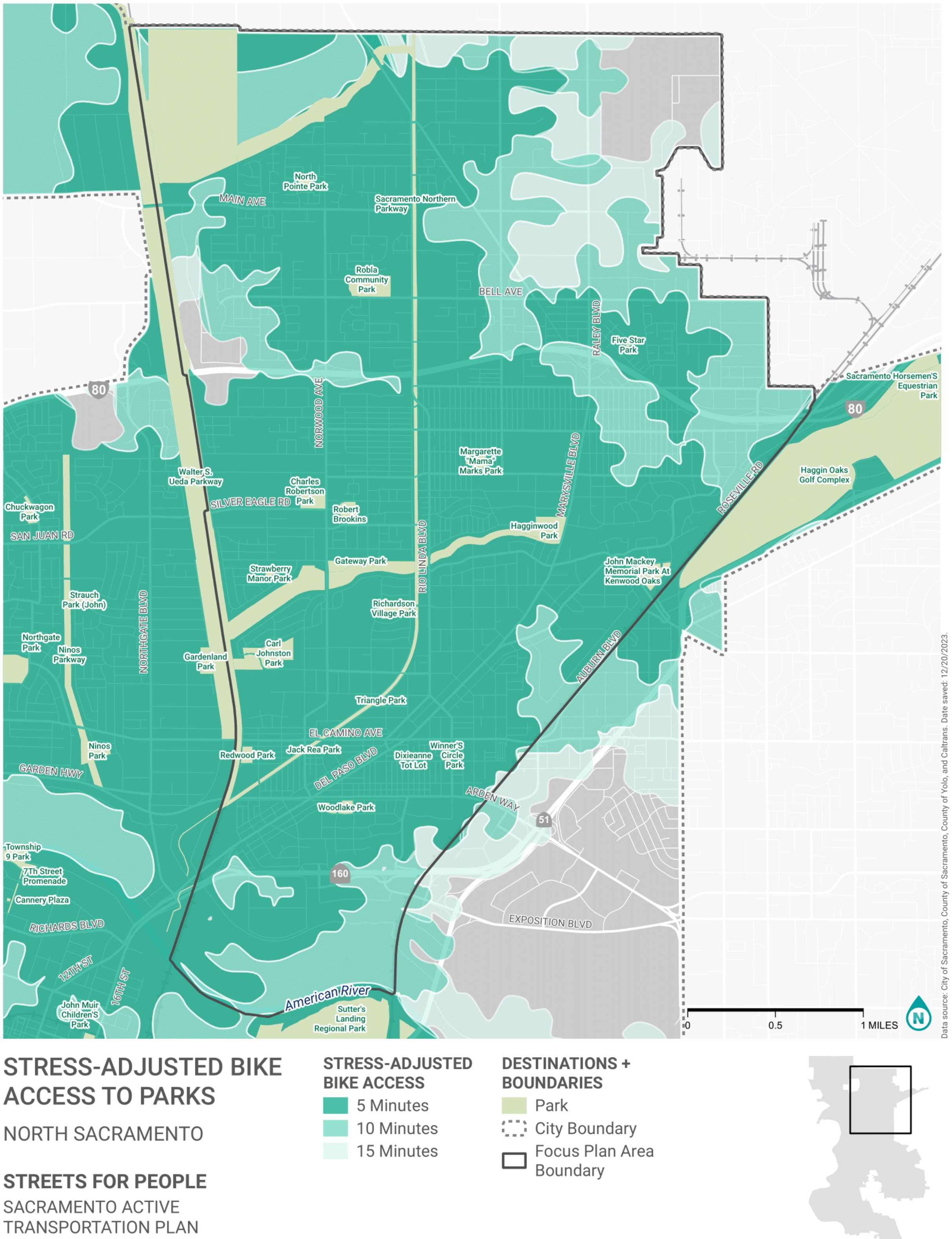


Figure 32. North Sacramento Bike Access to Parks (Scenario 2: Stressful conditions)

South Sacramento

Table 8 shows the parks in the South Sacramento Focus Plan Area with the most limited access for people walking and biking by mode. **Figure 33** through **Figure 36** show walk and bike access to parks under low-stress and stressful conditions.

Table 8. South Sacramento parks with the most limited access (walking and biking)

Park Name	Mode	Persons Who Can Access the Park within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Park within Scenario 2: Stressful Travel Shed			
		Population*	% Youth	% Equity**	Population	% of Low-stress Population	% Youth	% Equity**
Cosumnes River College Park	Walking	8,827	28%	36%	4,022	46%	29%	45%
	Biking	10,686	27%	35%	1,964	18%	31%	44%
Shasta Community Park	Walking	6,309	28%	38%	2,907	46%	30%	45%
	Biking	6,918	28%	38%	1,912	28%	32%	46%
Meadowview Park	Walking	6,579	27%	40%	3,582	54%	27%	39%
Pannell/Meadowview Community Center Park	Walking	10,437	28%	44%	5,955	57%	27%	41%
	Biking	10,899	28%	44%	4,227	39%	27%	41%
24th Street Bypass Park	Walking	12,743	28%	43%	8,392	66%	28%	45%
	Biking	13,819	28%	42%	7,863	57%	27%	47%
Phoenix Green	Biking	8,925	30%	56%	4,922	55%	34%	63%

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

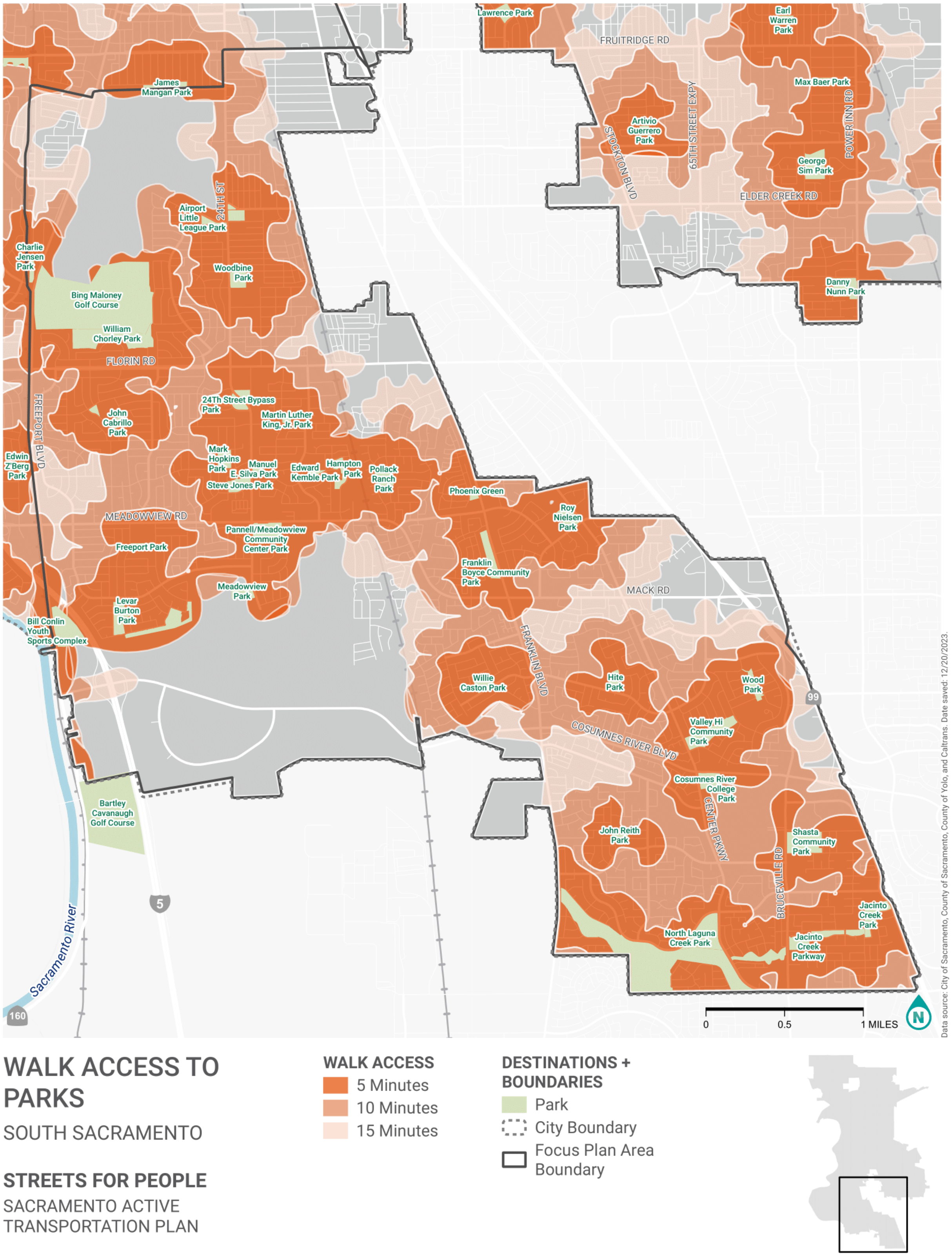


Figure 33. South Sacramento Walk Access to Parks (Scenario 1: Low-stress conditions)

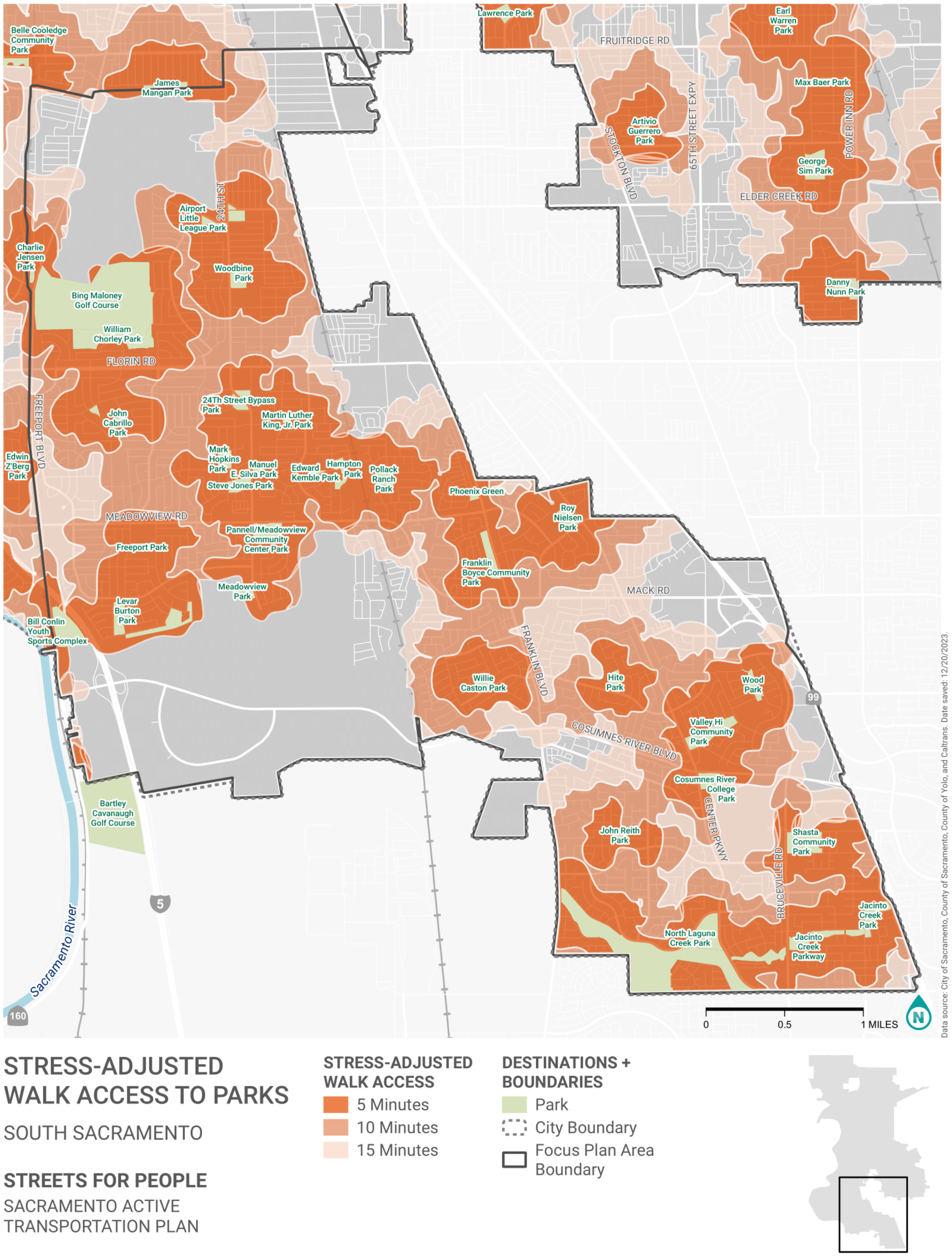
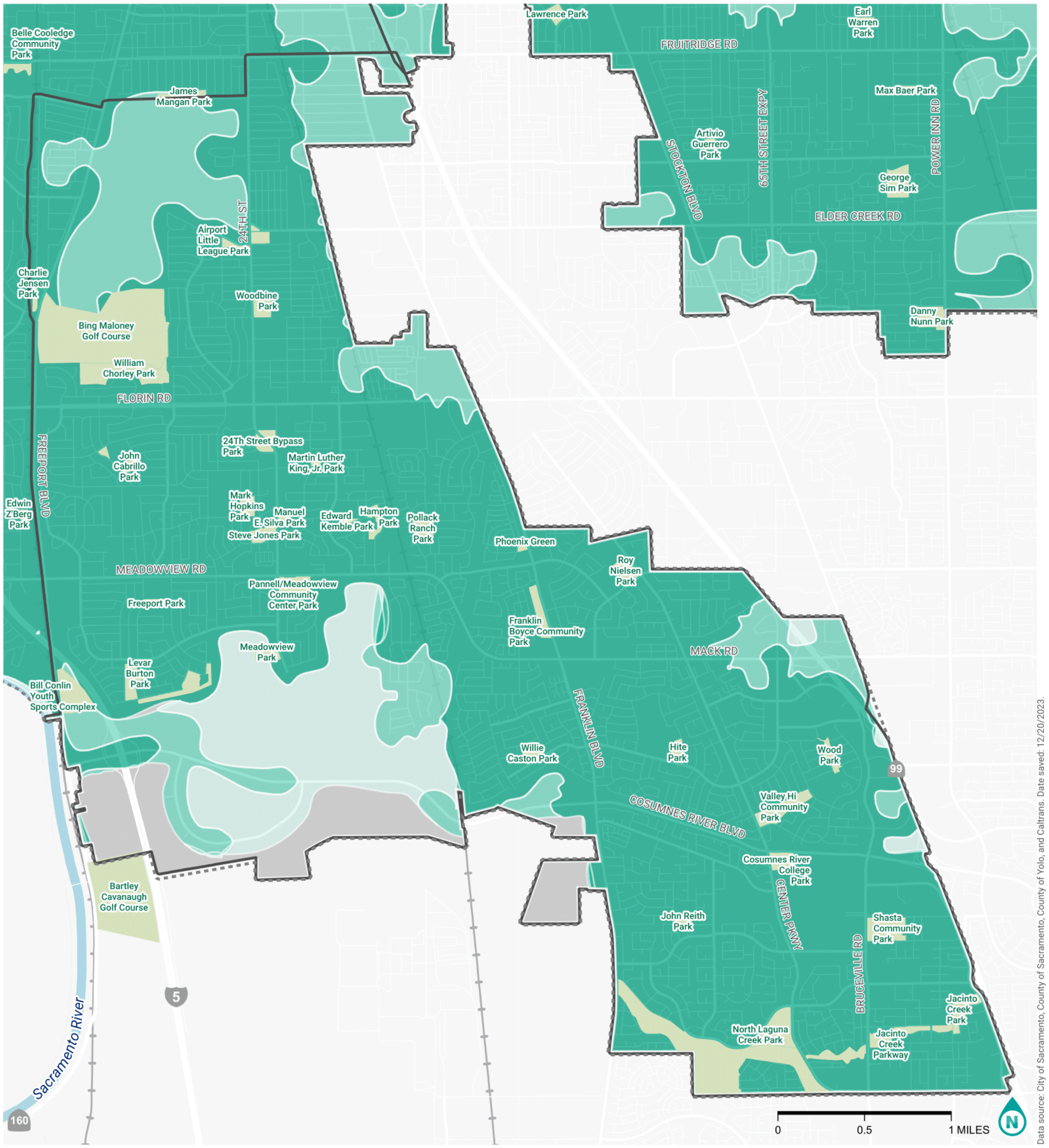


Figure 34. South Sacramento Walk Access to Parks (Scenario 2: Stressful conditions)



BIKE ACCESS TO PARKS

SOUTH SACRAMENTO

STREETS FOR PEOPLE

SACRAMENTO ACTIVE TRANSPORTATION PLAN

BIKE ACCESS
- 5 Minutes
- 10 Minutes
- 15 Minutes

DESTINATIONS + BOUNDARIES
- Park
- City Boundary
- Focus Plan Area Boundary

Figure 35. South Sacramento Bike Access to Parks (Scenario 1: Low-stress conditions)

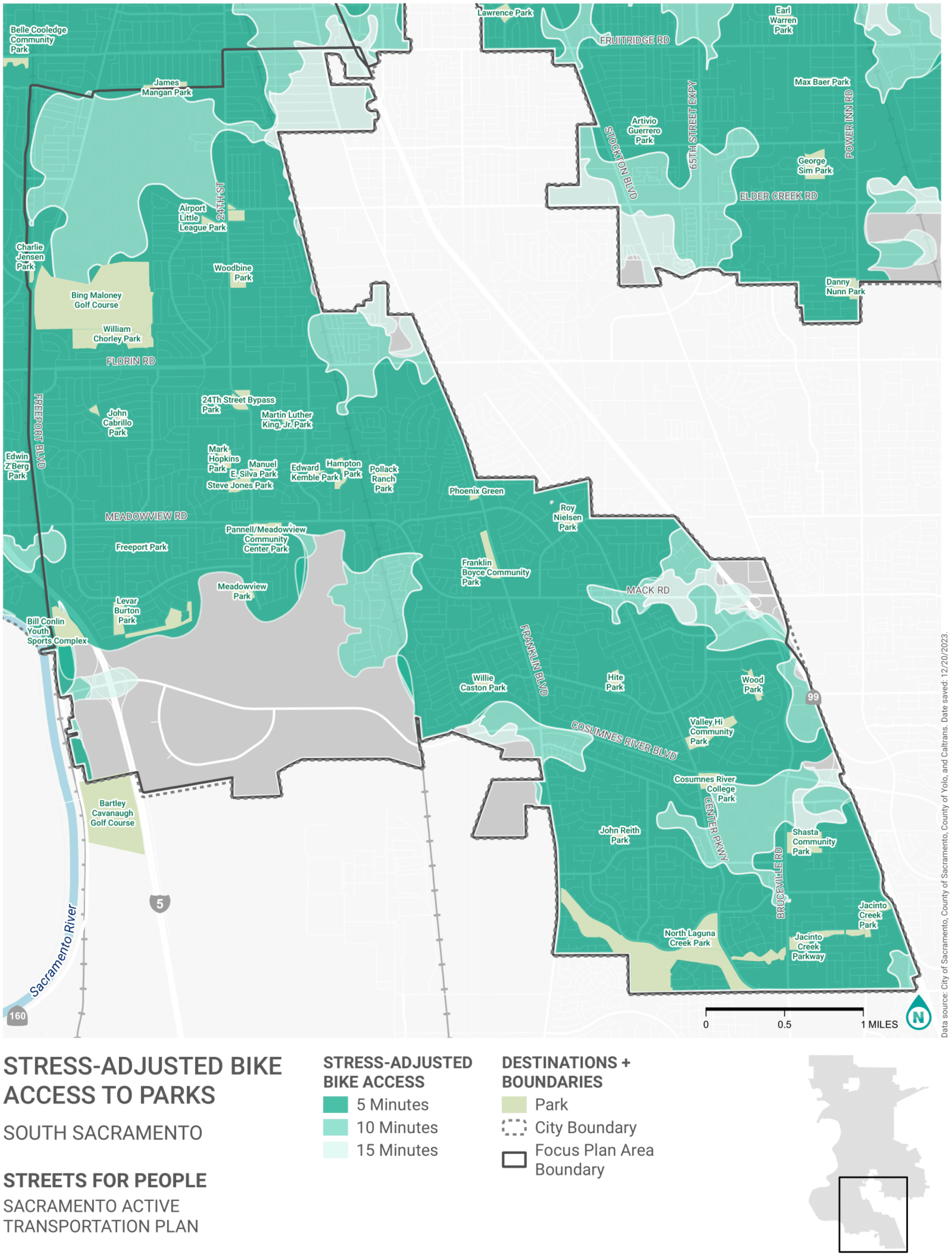


Figure 36. South Sacramento Bike Access to Parks (Scenario 2: Stressful conditions)

Summary of Findings – Schools

The areas of Sacramento which are within a 15-minute walk of a school are shown in Figure 37 and Figure 38. These maps provide a full account of 5-minute (bright orange), 10-minute (medium orange), and 15-minute (light orange) walksheds for a comprehensive look. The Sacramento City Unified School District also offers each student the chance to enroll in any school or program within the district when space is available. Public, Private, and Charter schools were all included in the analysis, however, only public schools are summarized in the tables since these schools are most likely to enroll students who live nearby. The communities summarized in Table 9 are the difference in the 15-minute (light orange) travel sheds between Figure 37 and Figure 38.

Similarly, Figure 39 and Figure 40 provide a summary of bike access to schools. These figures are also presented in 5-minute (bright green), 10-minute (medium green), and 15-minute (light green) increments. The communities summarized in Table 10 are represented by the difference in the 5-minute (light green) travel sheds between Figure 39 and Figure 40.

Citywide Access to Schools

Approximately 72% of people in Sacramento live within a 15-minute walk of a school (under low-stress conditions), but when adjusting for stressful conditions for people walking, that figure falls to 64% of Sacramento residents.

Similarly, when considering access for people biking, 74% of Sacramento residents live within a 5-minute bike ride of a school (or 64% when adjusting for travel stress). Major roads like I-5, US 50, SR 99, and I-80 and physical features like the American River serve as physical barriers that block access for people biking, walking, and rolling citywide.

Schools listed in the tables below exhibit the largest access disparity for people walking (Table 9) and biking (Table 10) under low-stress conditions, as well as actual access when accounting for travel stress. High schools are some of the most access-limited across the city. Only 31% of the residents within the low-stress travel shed can still access Valley High School in the stressful travel shed. Similarly, only one-third of the residents within the low-stress travel sheds can still access Natomas High, John F. Kennedy High, and Luther Burbank High.

*Table 9. Sacramento Public Schools with the most limited access for people walking by name of school (15-minute walk) **

School Name	Focus Plan Area$^{\Phi}$	Persons Who Can Access the Public School within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Public School within Scenario 2: Stressful Travel Shed			
		Population	% Youth	% Equity **	Population	% of Low-stress Travel Shed Pop	% Youth	% Equity**
Valley High	S	6,460	29%	37%	2,013	31%	30%	41%
Natomas High	O	7,085	22%	34%	2,454	35%	21%	31%
John F. Kennedy High	O	5,564	19%	15%	1,927	35%	17%	16%
Luther Burbank High	S	6,311	31%	41%	2,214	35%	29%	39%
Paso Verde	O	2,952	26%	17%	1,128	38%	26%	13%
Success Academy	F	3,180	28%	60%	1,339	42%	28%	60%
Norwood Junior High	N	6,640	23%	39%	2,892	44%	23%	37%
Two Rivers Elementary	O	3,808	27%	16%	1,690	44%	26%	12%
Main Avenue Elementary	N	1,676	22%	28%	762	45%	23%	28%
Woodlake Elementary	N	3,210	18%	55%	1,514	47%	14%	50%

**Minimum distance-only travel shed population of 200 persons, public schools only, not charter or private schools.*

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

$^{\varphi}$ The focus plan area for each park is indicated by a letter: N for North Sacramento; F for Fruitridge/Broadway; S for South Sacramento; and O for outside of focus plan areas.

*Table 10. Sacramento schools with the most limited access for people biking by name of school (5-minute bike ride)**

School Name	Focus Plan Area ϕ	Persons Who Can Access the Public School within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Public School within Scenario 2: Stressful Travel Shed			
		Population	% Youth	% Equity **	Population	% of Low-stress Travel Shed Pop.	% Youth	% Equity **
Natomas High	O	8,605	22%	34%	409	5%	21%	34%
Luther Burbank High	S	7,336	31%	42%	643	9%	29%	37%
Paso Verde	O	1,267	26%	11%	120	9%	26%	11%
Valley High	S	8,032	28%	36%	842	10%	31%	42%
John F. Kennedy High	O	6,695	19%	15%	707	11%	16%	18%
Norwood Junior High	N	7,987	23%	40%	1,049	13%	22%	31%
Success Academy	S	3,813	27%	60%	505	13%	29%	57%
Will C. Wood Middle	F	8,233	26%	52%	1,637	20%	27%	60%
Main Avenue Elementary	N	1,992	22%	28%	440	22%	24%	28%

**Minimum distance-only travel shed population of 200 persons*

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

φ The focus plan area for each park is indicated by a letter: N for North Sacramento; F for Fruitridge/Broadway; S for South Sacramento; and O for outside of focus plan areas.

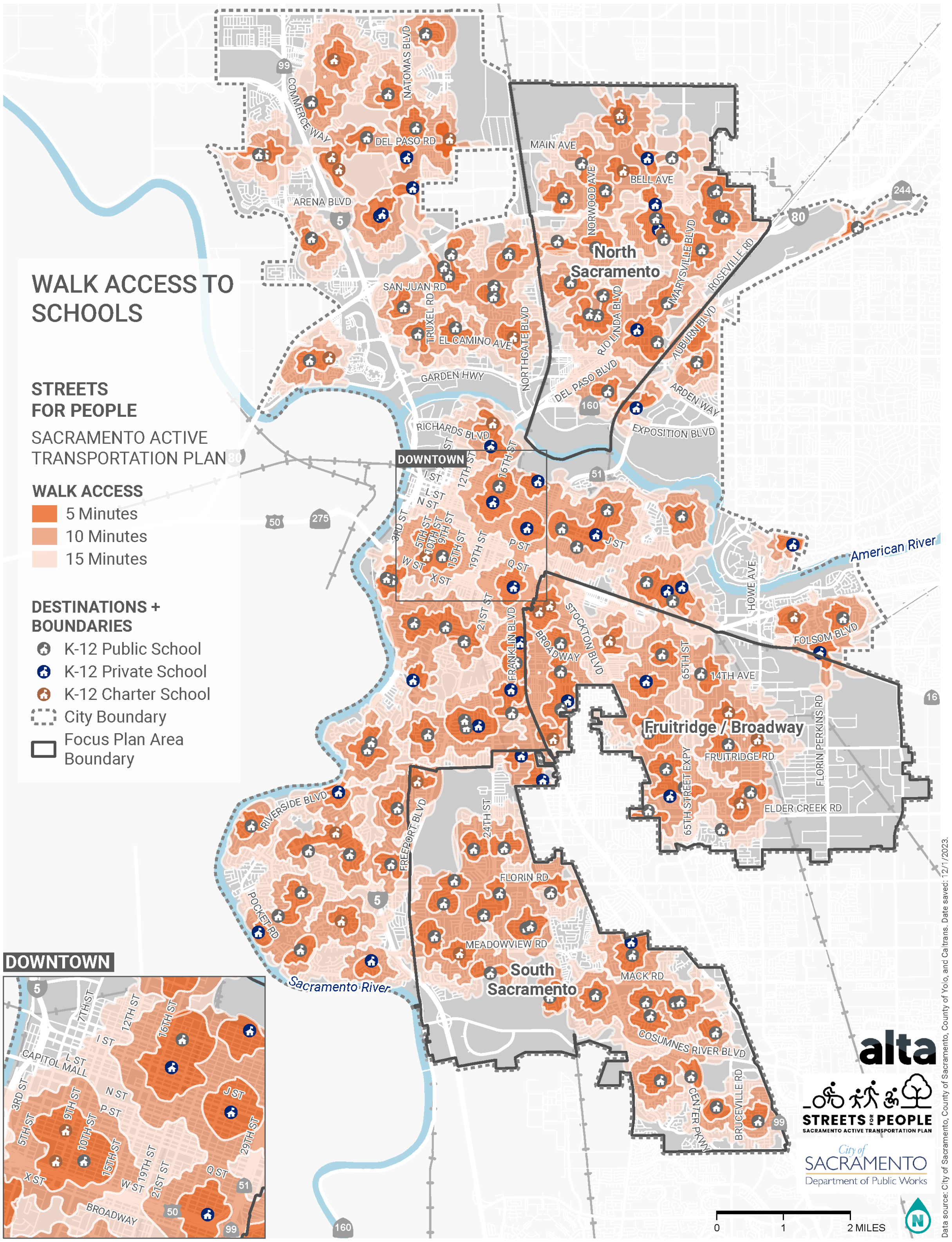


Figure 37. Walk Access to Schools (Scenario 1: Low-stress conditions)

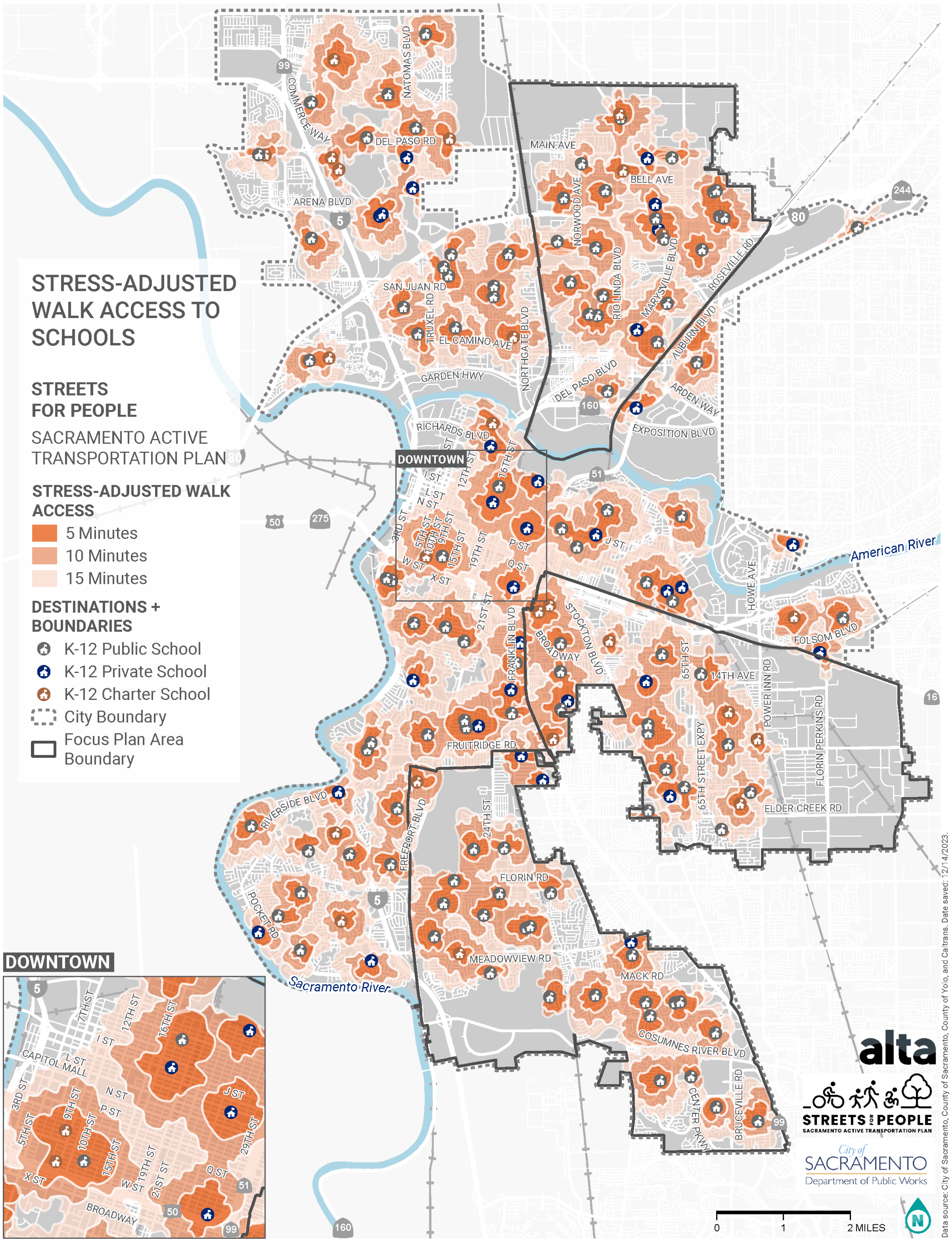


Figure 38. Walk Access to Schools (Scenario 2: Stressful conditions)

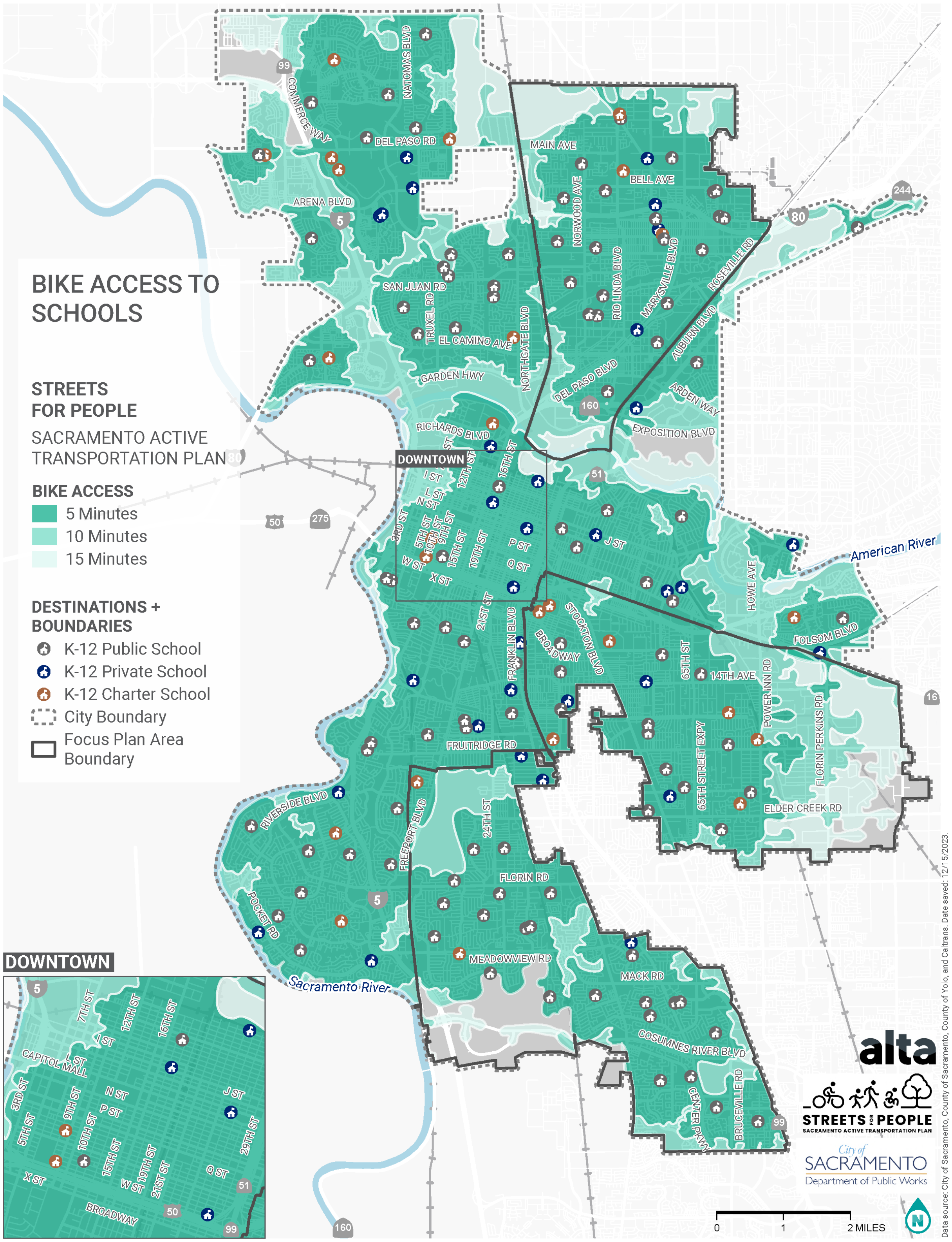


Figure 39. Bike Access to Schools (Scenario 1: Low-stress conditions)

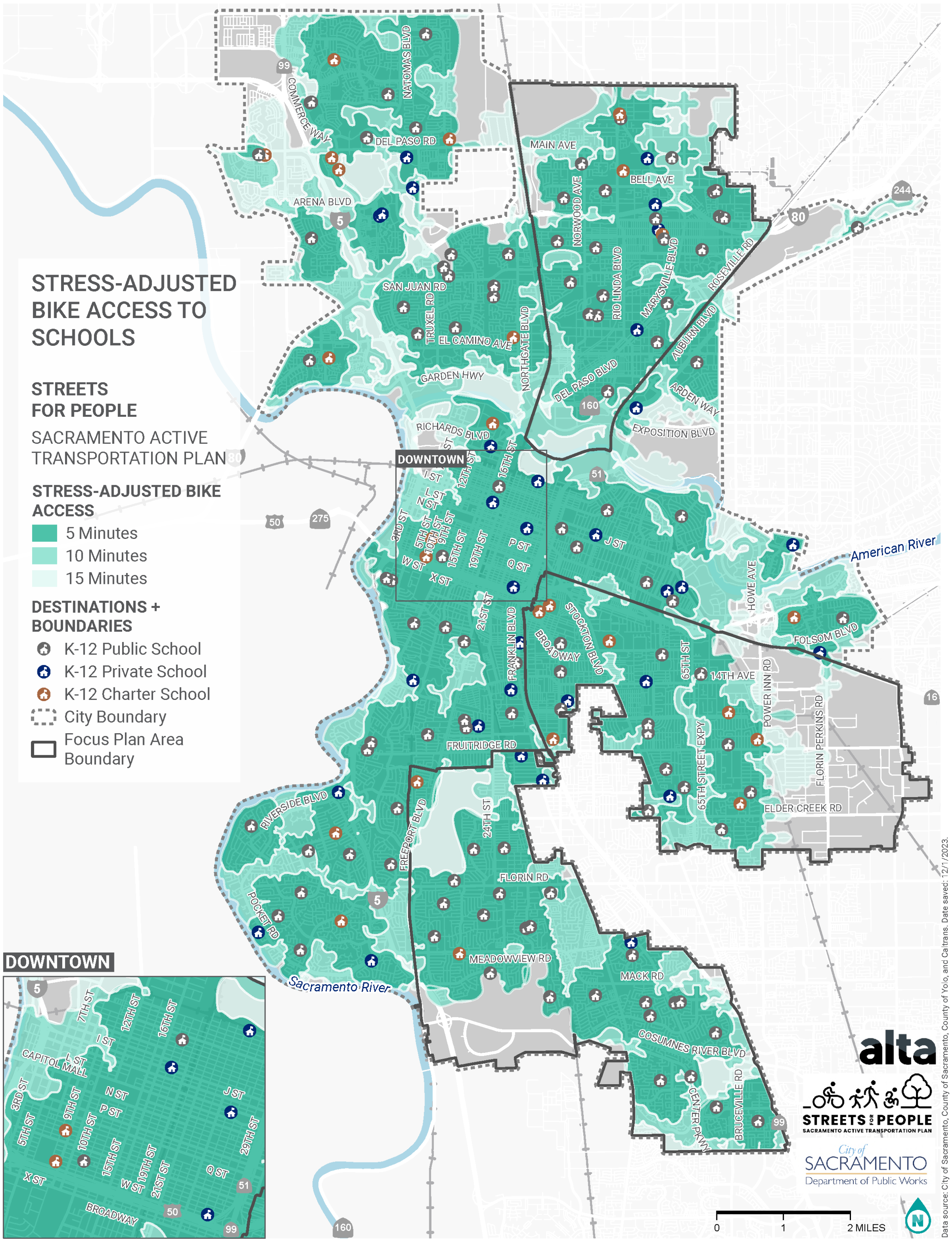


Figure 40. Bike Access to Schools (Scenario 2: Stressful conditions)

Focus Plan Area Access to Schools

Generally, people living in the focus plan areas have more limited access to schools than residents across the city as summarized in **Table 11** and **Table 12**. Citywide approximately 430,000 persons live within a 15-minute walk of a public school, according to the American Community Survey five-year estimates 2017–2021. That number is 385,000 (89%) when accounting for traffic stress. As shown in **Table 11**, only an average 74% of focus plan area residents can access schools within a 15-minute walk. For the North and South Sacramento focus plan areas a greater proportion of residents with limited access to schools are youth (26% average) or part of an equity priority community (42% average), compared to 23% of youth and 33% of equity priority communities citywide.

Table 11. Populations within a 15-minute walk to Public Schools across Sacramento*

Focus Plan Area	Persons Who Can Access the Public School within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Public School within Scenario 2: Stressful Travel Shed			
	Total Population	% Youth	% Equity **	Total Population	% of Low-stress Travel Shed Pop	% Youth	% Equity **
Citywide	430,039	23%	34%	384,778	89%	23%	33%
Fruitridge/Broadway	101,213	22%	41%	74,575	74%	22%	39%
North Sacramento	105,312	28%	49%	81,133	77%	29%	49%
South Sacramento	178,963	28%	41%	127,546	71%	27%	40%

Only includes public schools, not charter or private schools

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

Approximately 442,000 persons in Sacramento are within a 5-minute bike ride of a public school, according to the American Community Survey five-year estimates for 2017–2021. That number is 385,000 (87%) when accounting for traffic stress. As shown in **Table 12**, only an average of 66% of focus plan area residents can access schools within a 5-minute bike ride in the existing scenario. For North and South Sacramento focus plan areas, a greater proportion of youth have limited access to schools (29% and 26% respectively) than the city as a whole (22%). In addition, a larger proportion of equity priority community residents (64% average) have limited access to schools than the city as a whole (33%)

Table 12. Populations within a 5-minute bike ride to Public Schools across Sacramento and in Focus Plan Areas*

Focus Plan Area	Persons who can access the Public School within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Public School within Scenario 2: Stressful Travel Shed			
	Population	% Youth	% Equity **	Population	% of Low-stress Travel Shed Pop	% Youth	% Equity **
Citywide	441,771	23%	34%	384,721	87%	22%	33%
Fruitridge/Broadway	127,138	21%	40%	84,229	66%	21%	38%
North Sacramento	115,977	28%	48%	77,828	67%	29%	50%
South Sacramento	206,217	27%	40%	136,394	66%	26%	39%

Only includes public schools, not charter or private schools

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

Fruitridge/Broadway

Table 13 shows the public schools in the Fruitridge/Broadway focus plan area with the greatest difference in population that can access the schools between the Scenario 1: Low-stress and Scenario 2: Stressful travel sheds. **Figure 41** through **Figure 44** show walk and bike access to schools under low-stress and stressful conditions.

Table 13. Fruitridge/Broadway Public Schools with the most limited access (walking and biking)*

School Name	Mode	Persons Who Can Access the Public School within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Public School within Scenario 2: Stressful Travel Shed			
		Population	% Youth	% Equity **	Population	% of Low-stress Pop.	% Youth	% Equity **
Success Academy	Walking	3,180	28%	60%	1,339	42%	28%	60%
	Biking	3,813	27%	60%	505	13%	29%	57%
Elder Creek Elementary	Walking	6,462	28%	65%	3,383	52%	29%	66%
	Biking	7,735	28%	64%	2,795	36%	30%	67%
Earl Warren Elementary	Walking	7,857	25%	47%	5,381	68%	24%	46%
Will C. Wood Middle	Walking	6,853	26%	53%	3,483	51%	26%	58%
	Biking	8,233	26%	52%	1,637	20%	27%	60%
Father Keith B. Kenny	Walking	10,177	25%	49%	7,098	70%	25%	48%
Hiram W. Johnson High	Walking	4,872	14%	38%	3,636	75%	15%	42%
	Biking	6,085	14%	37%	3,657	60%	15%	44%
Phoebe A. Hearst Elementary	Biking	5,024	12%	22%	2,187	44%	16%	18%
Bret Harte Elementary	Biking	8,870	17%	30%	4,636	52%	15%	21%

Only includes public schools, not charter or private schools.

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

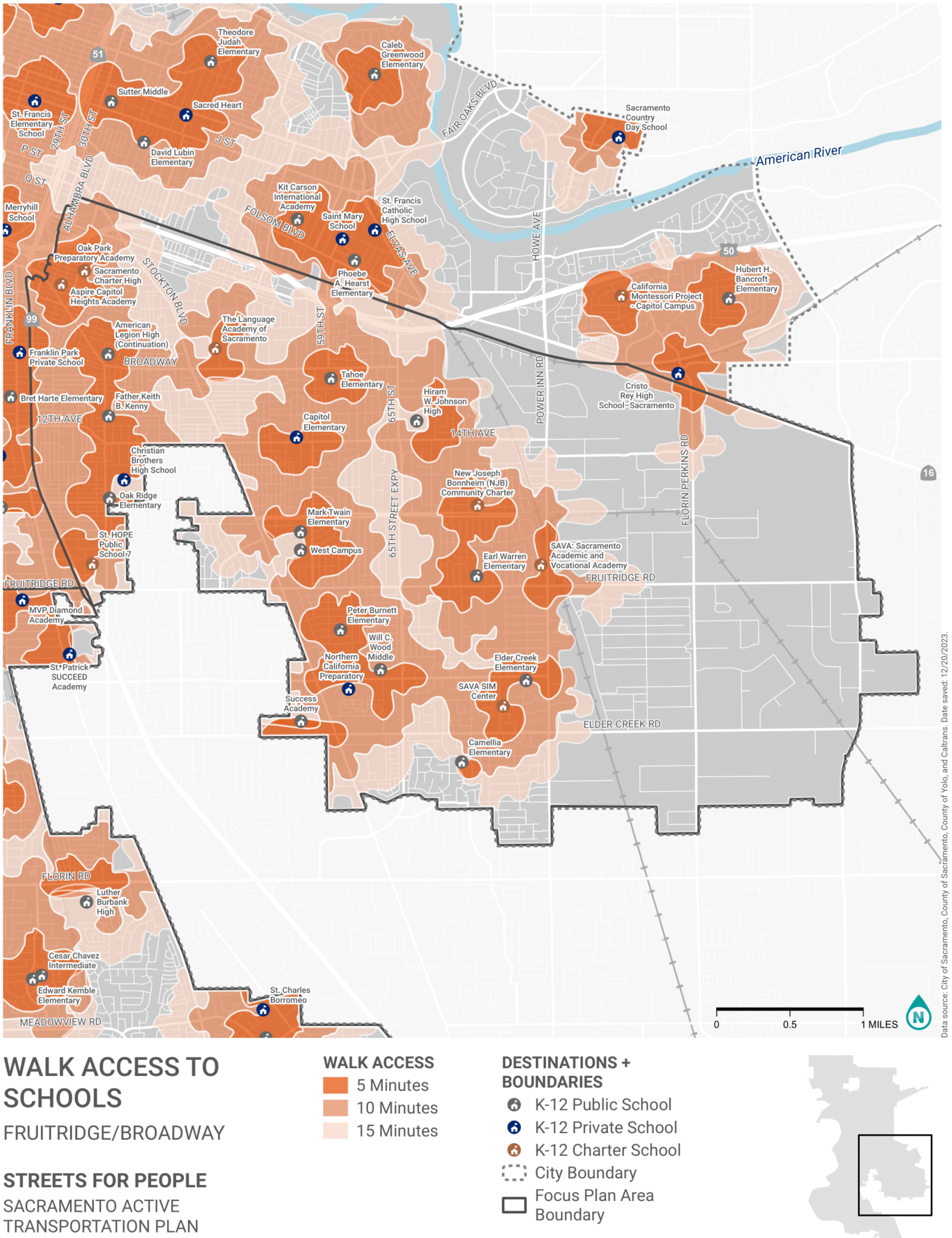


Figure 41. Fruitridge/Broadway Walk Access to Schools (Scenario 1: Low-stress conditions)

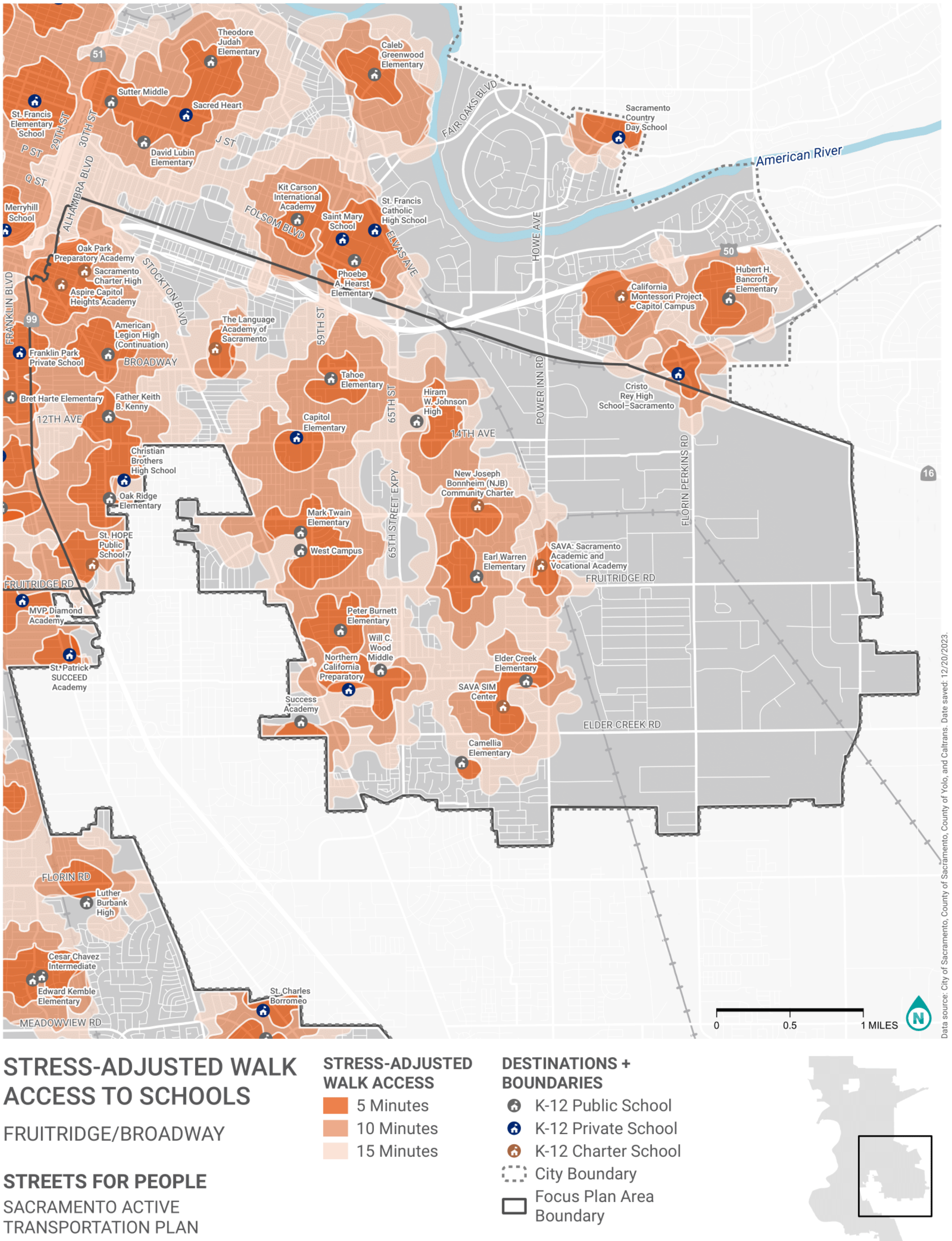


Figure 42. Fruitridge/Broadway Walk Access to Schools (Scenario 2: Stressful conditions)

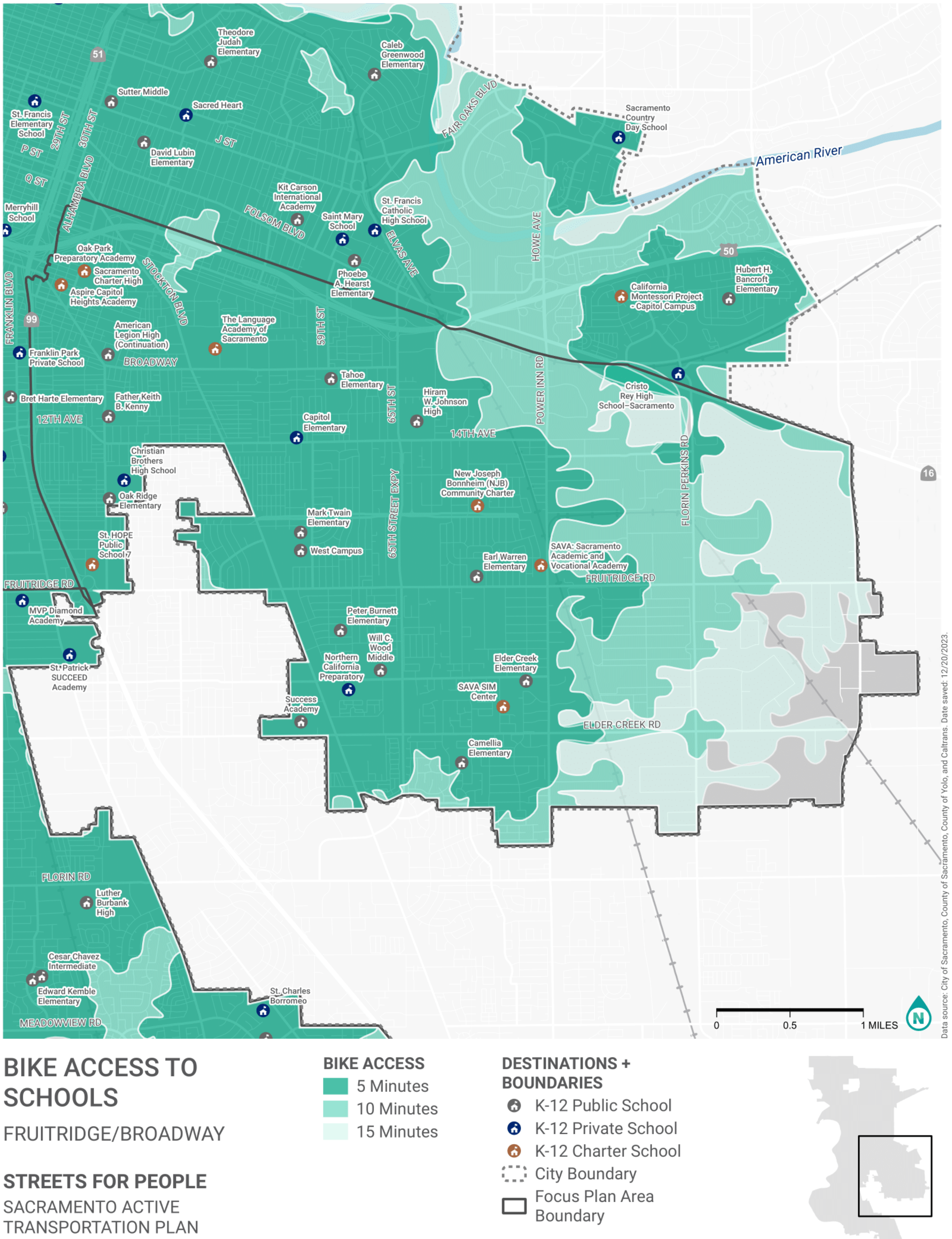


Figure 43. Fruitridge/Broadway Bike Access to Schools (Scenario 1: Low-stress conditions)

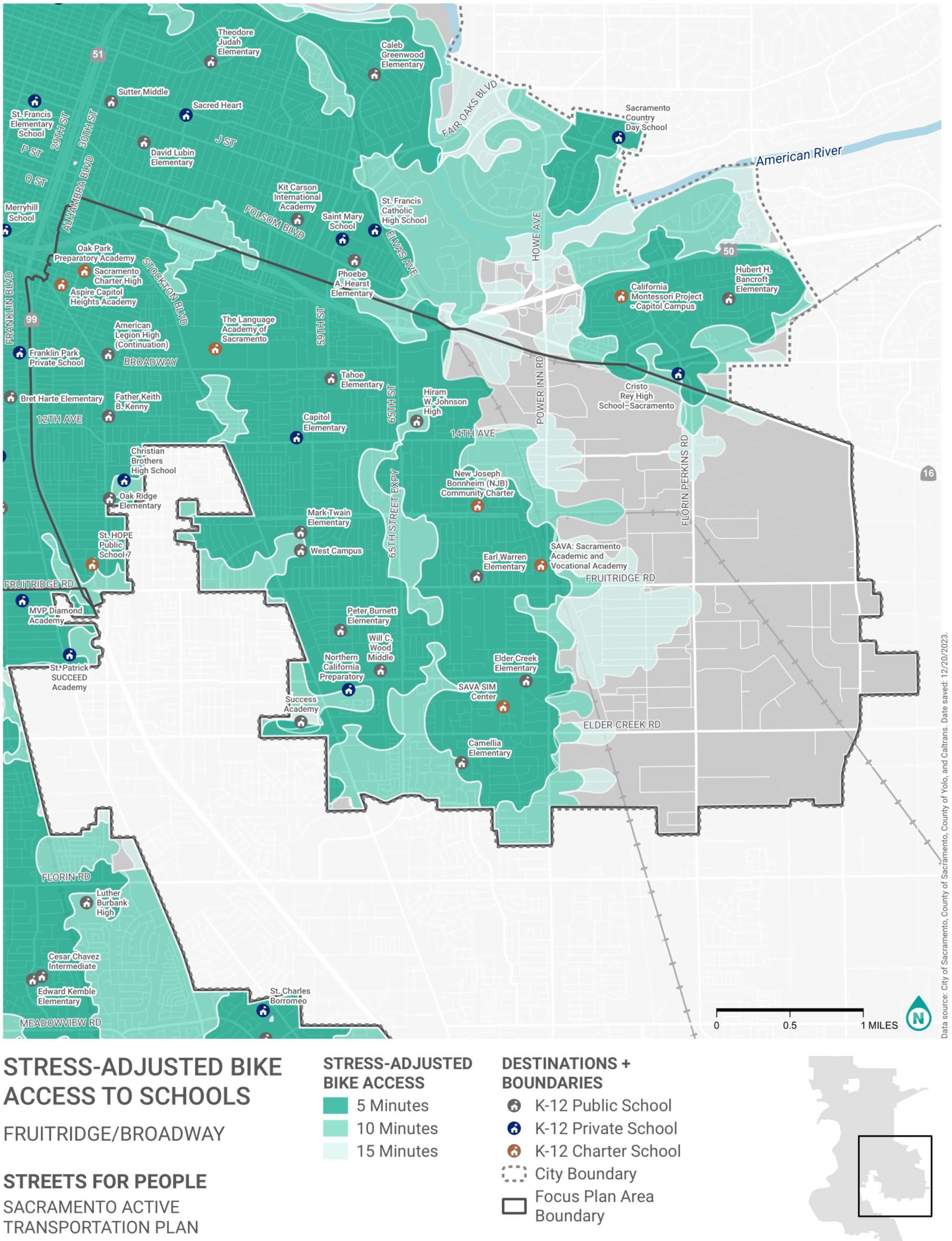


Figure 44. Fruitridge/Broadway Bike Access to Schools (Scenario 2: Stressful conditions)

North Sacramento

Table 14 shows the schools in North Sacramento with the most limited access based on the analysis completed. **Figure 45** through **Figure 48** show walk and bike access to schools under low-stress and stressful conditions.

Table 14. North Sacramento Public Schools with the most limited access (walking and biking)*

School Name	Mode	Persons Who Can Access the Public School within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Public School within Scenario 2: Stressful Travel Shed			
		Population	% Youth	% Equity **	Population	% of Low-stress Pop	% Youth	% Equity **
Main Avenue Elementary	Walking	1,676	22%	28%	762	45%	23%	28%
	Biking	1,992	22%	28%	440	22%	24%	28%
Woodlake Elementary	Walking	3,210	18%	55%	1,514	47%	14%	50%
Hagginwood Elementary	Walking	6,760	25%	50%	4,245	63%	24%	48%
	Biking	7,855	25%	50%	3,127	40%	23%	47%
Norwood Junior High	Walking	6,640	23%	39%	2,892	44%	23%	37%
	Biking	7,987	23%	40%	1,049	13%	22%	31%
Nova Opportunity	Biking	4,605	28%	47%	1,914	42%	25%	39%
Vista Nueva Career and Technology High	Biking	4,605	28%	47%	1,914	42%	25%	39%
Grant Union High	Walking	7,612	31%	61%	4,775	63%	32%	63%

**Only includes public schools, not charter or private schools.*

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

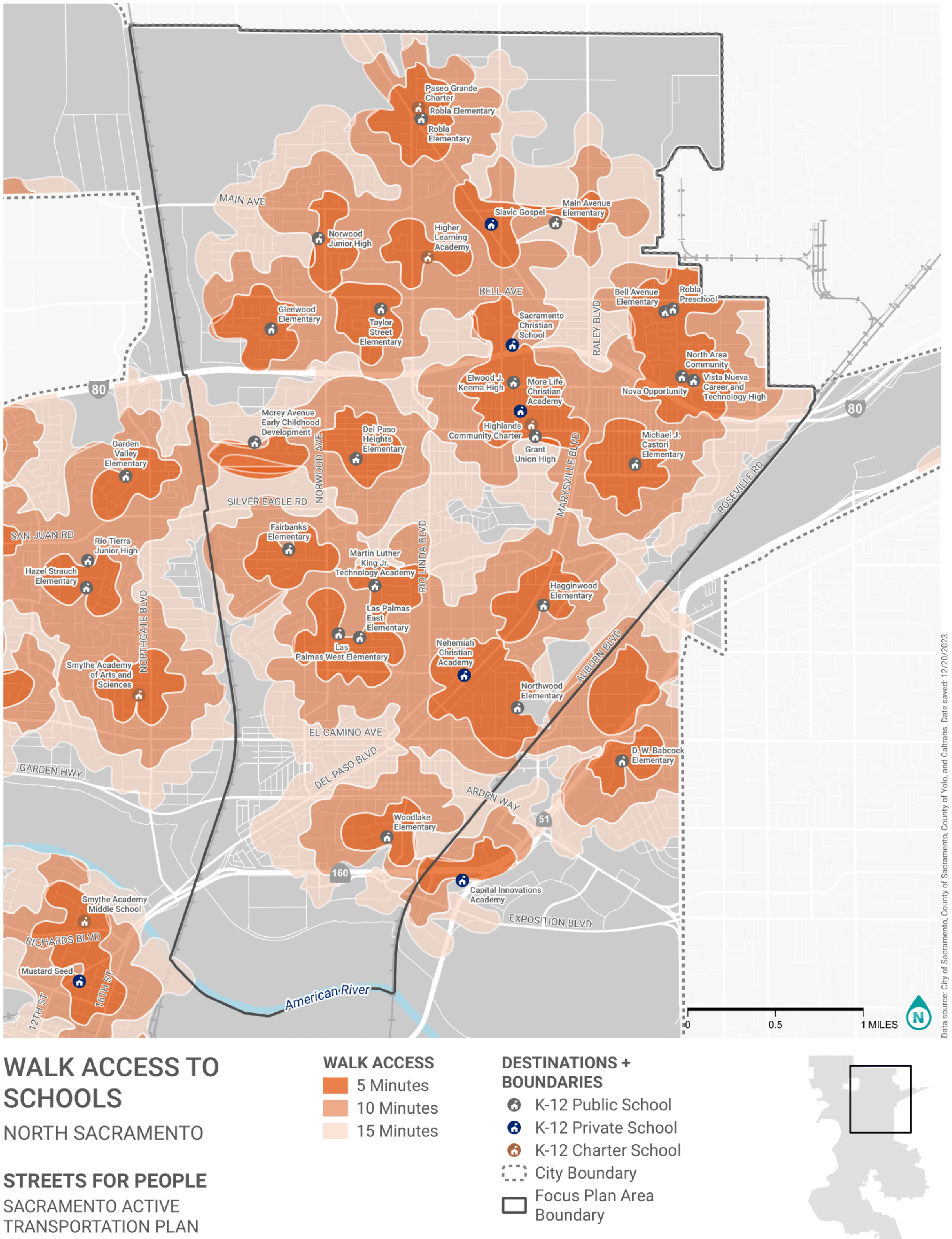


Figure 45. North Sacramento Walk Access to Schools (Scenario 1: Low-stress conditions)

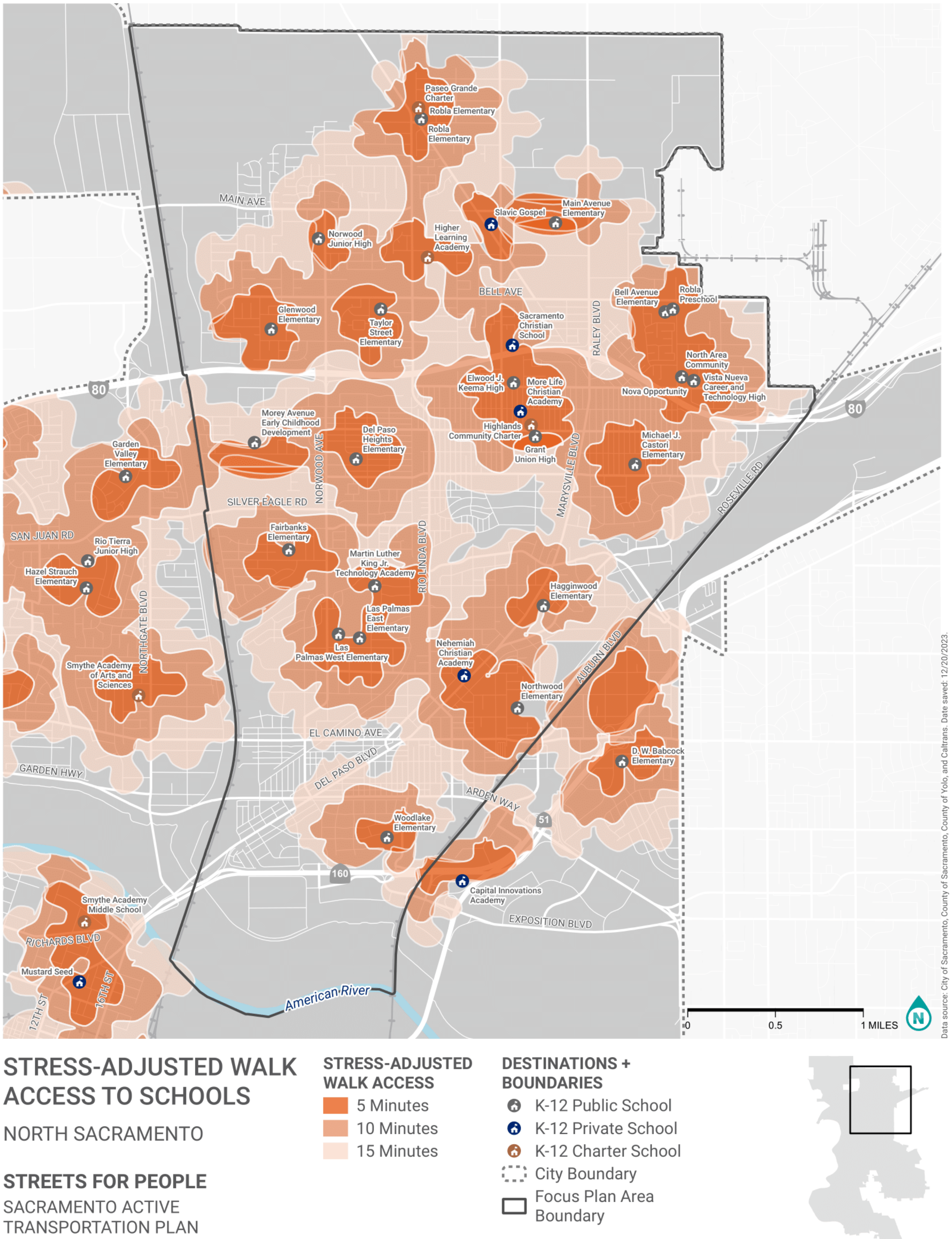


Figure 46. North Sacramento Walk Access to Schools (Scenario 2: Stressful conditions)

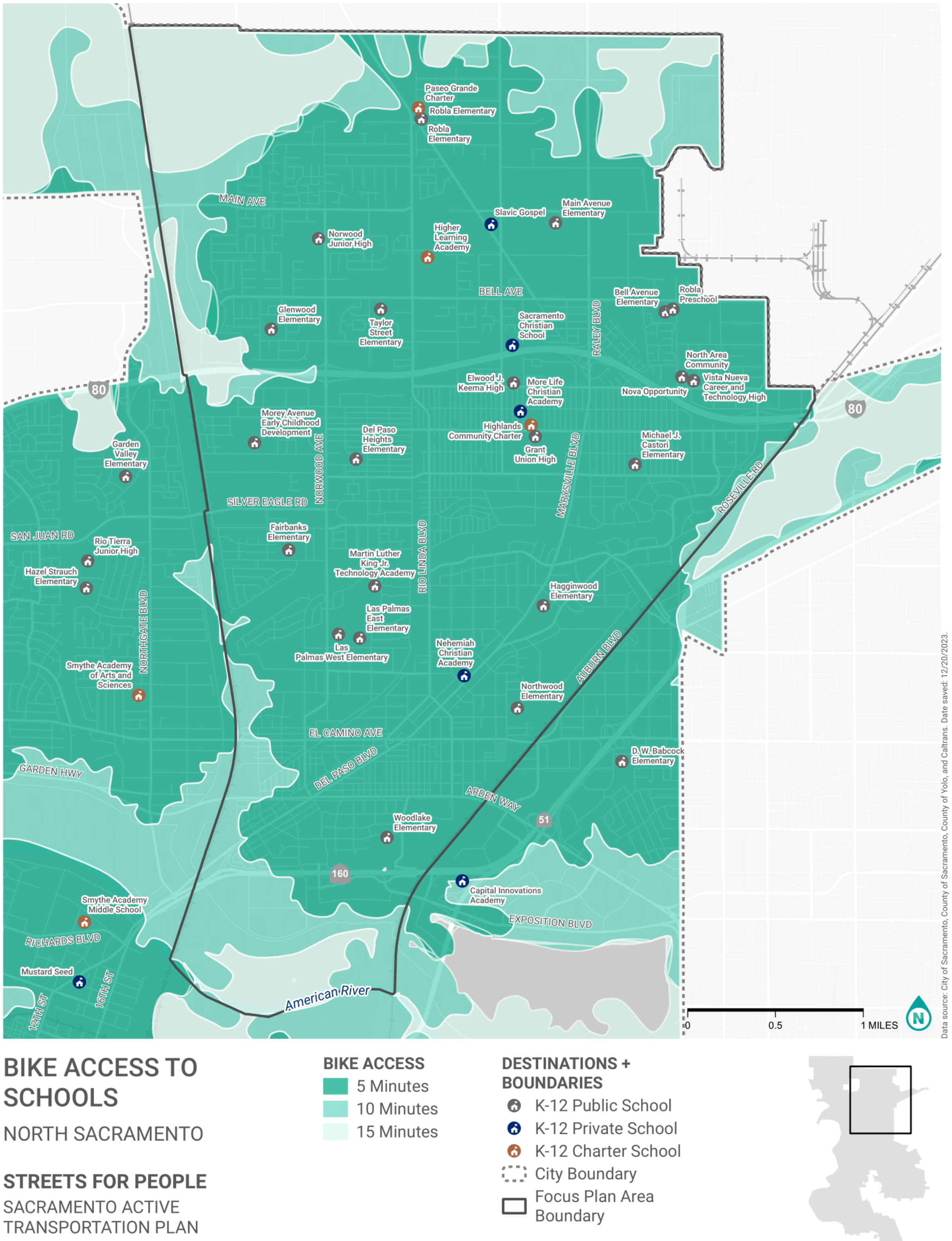


Figure 47. North Sacramento Bike Access to Schools (Scenario 1: Low-stress conditions)

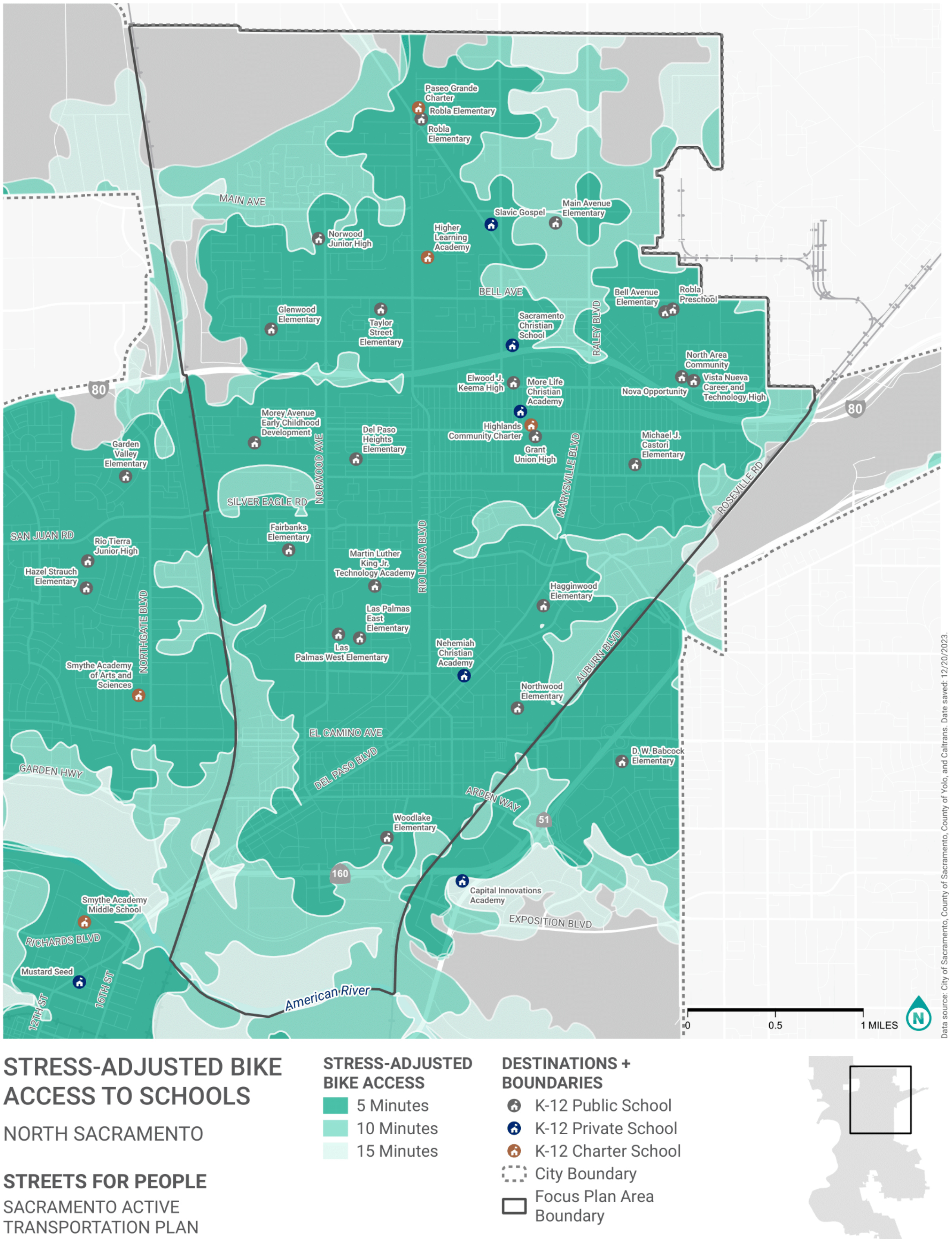


Figure 48. North Sacramento Bike Access to Schools (Scenario 2: Stressful conditions)

South Sacramento

Table 15 shows the schools in the South Sacramento focus plan area experiencing the most limited access. **Figure** 49 through **Figure 52** show walk and bike access to schools under low-stress and stressful conditions.

Table 15. South Sacramento Public Schools with the most limited access (walking and biking)*

School Name	Mode	Persons Who Can Access the Public School within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Public School within Scenario 2: Stressful Travel Shed			
		Population	% Youth	% Equity **	Populatio n	% of Low-stress Pop.	% Youth	% Equity **
John H. Still (K-8)	Walking	7,633	28%	42%	4,393	58%	28%	40%
Barbara Comstock Morse Elementary	Walking	4,932	29%	40%	2,912	59%	25%	38%
	Biking	6,177	30%	40%	2,248	36%	23%	37%
Las Flores High (Alternative)	Walking	9,020	29%	45%	5,890	65%	28%	40%
Valley High	Walking	6,460	29%	37%	2,013	31%	30%	41%
	Biking	8,032	28%	36%	842	10%	31%	42%
Luther Burbank High	Walking	6,311	31%	41%	2,214	35%	29%	39%
	Biking	7,336	31%	42%	643	9%	29%	37%
Prairie Elementary	Biking	13,718	27%	39%	6,028	44%	28%	39%
Charles E. Mack Elementary	Biking	10,958	32%	53%	4,995	46%	28%	42%
Samuel Jackman Middle	Biking	14,675	29%	46%	8,996	61%	29%	47%

**Only includes public schools, not charter or private schools.*

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

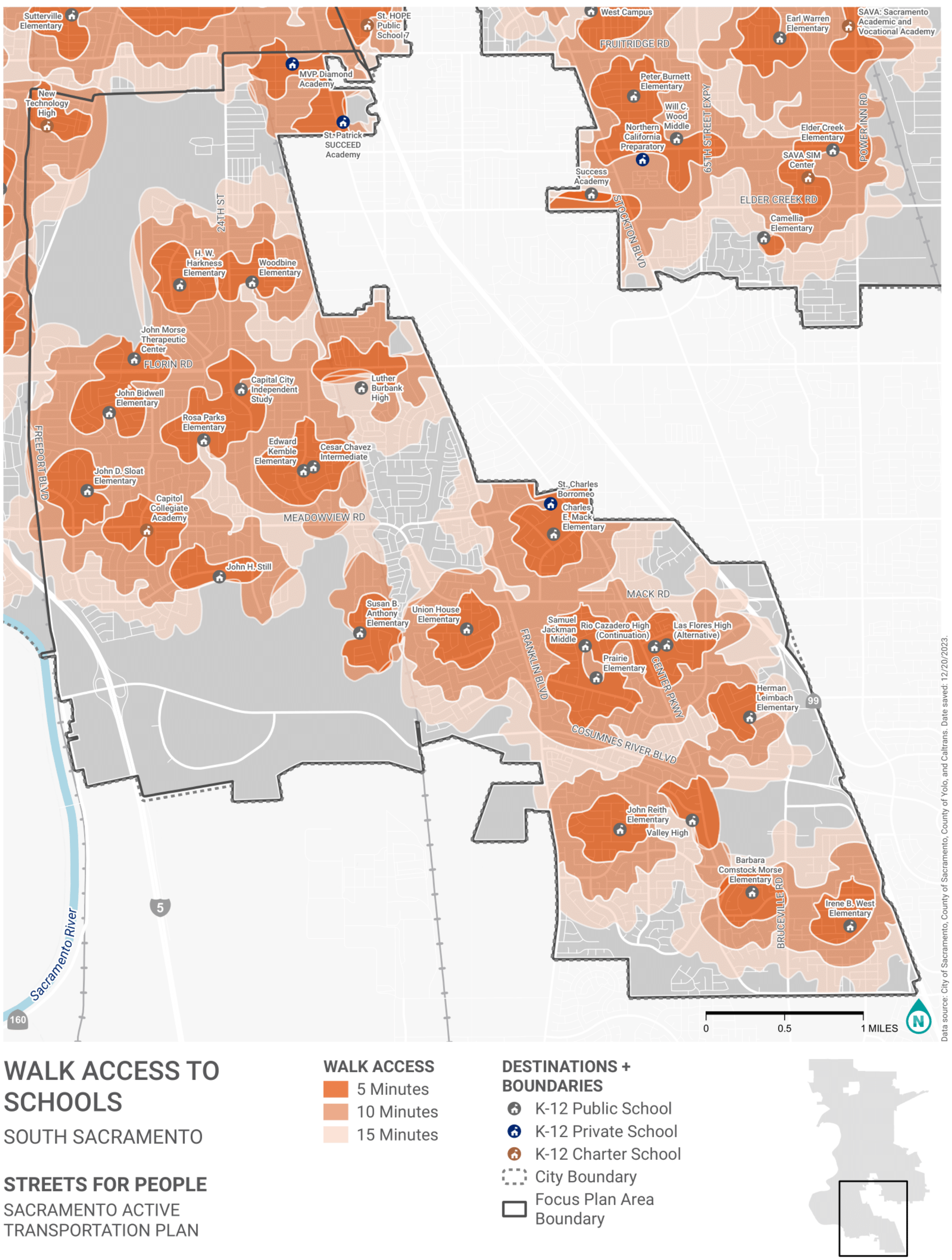
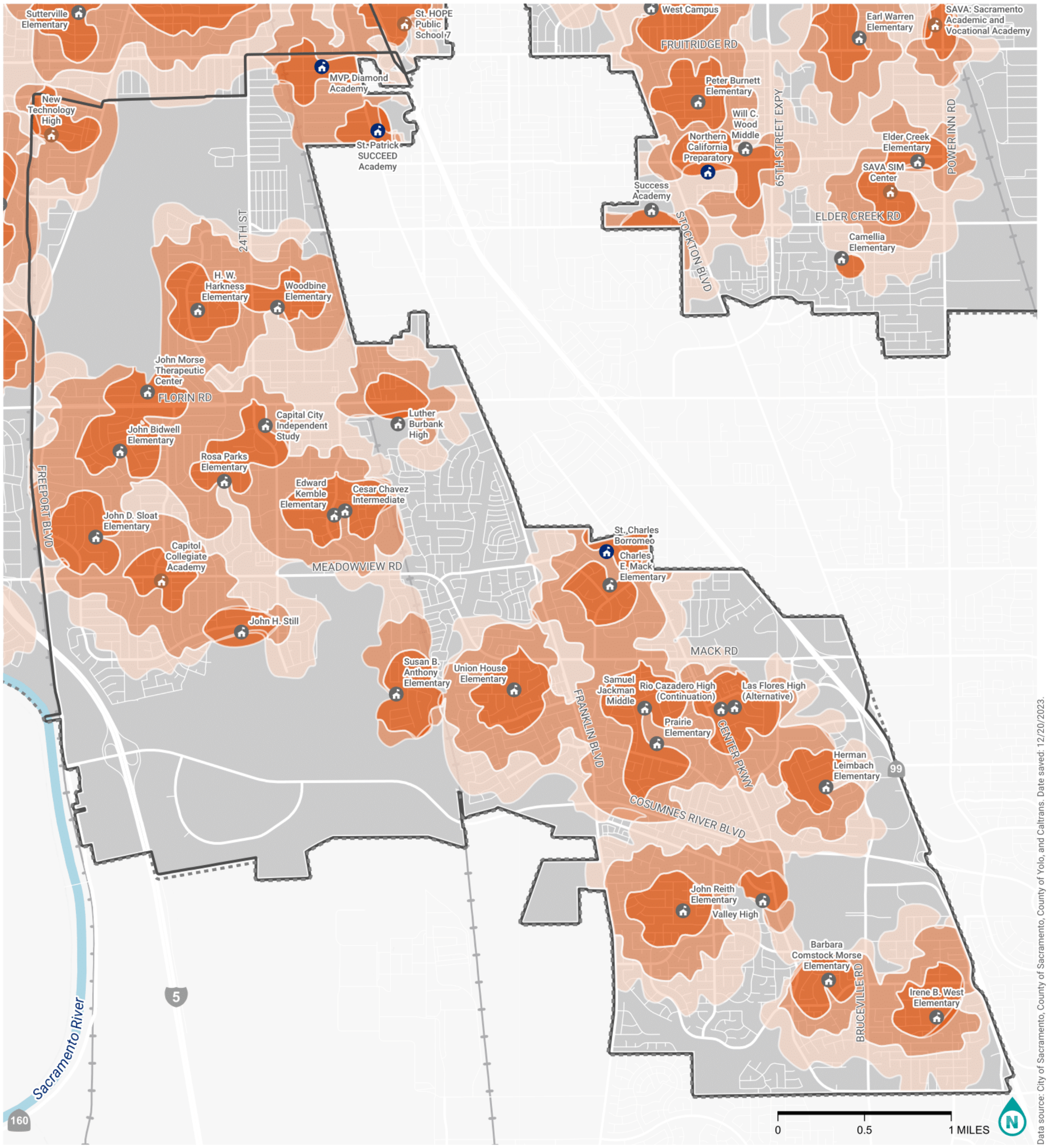


Figure 49. South Sacramento Walk Access to Schools (Scenario 1: Low-stress conditions)



STRESS-ADJUSTED WALK ACCESS TO SCHOOLS

SOUTH SACRAMENTO

STREETS FOR PEOPLE

SACRAMENTO ACTIVE TRANSPORTATION PLAN

STRESS-ADJUSTED WALK ACCESS

- 5 Minutes
- 10 Minutes
- 15 Minutes

DESTINATIONS + BOUNDARIES

- K-12 Public School
- K-12 Private School
- K-12 Charter School
- City Boundary
- Focus Plan Area Boundary

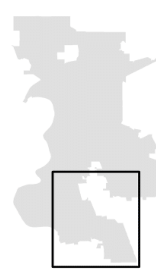


Figure 50. South Sacramento Walk Access to Schools (Scenario 2: Stressful conditions)

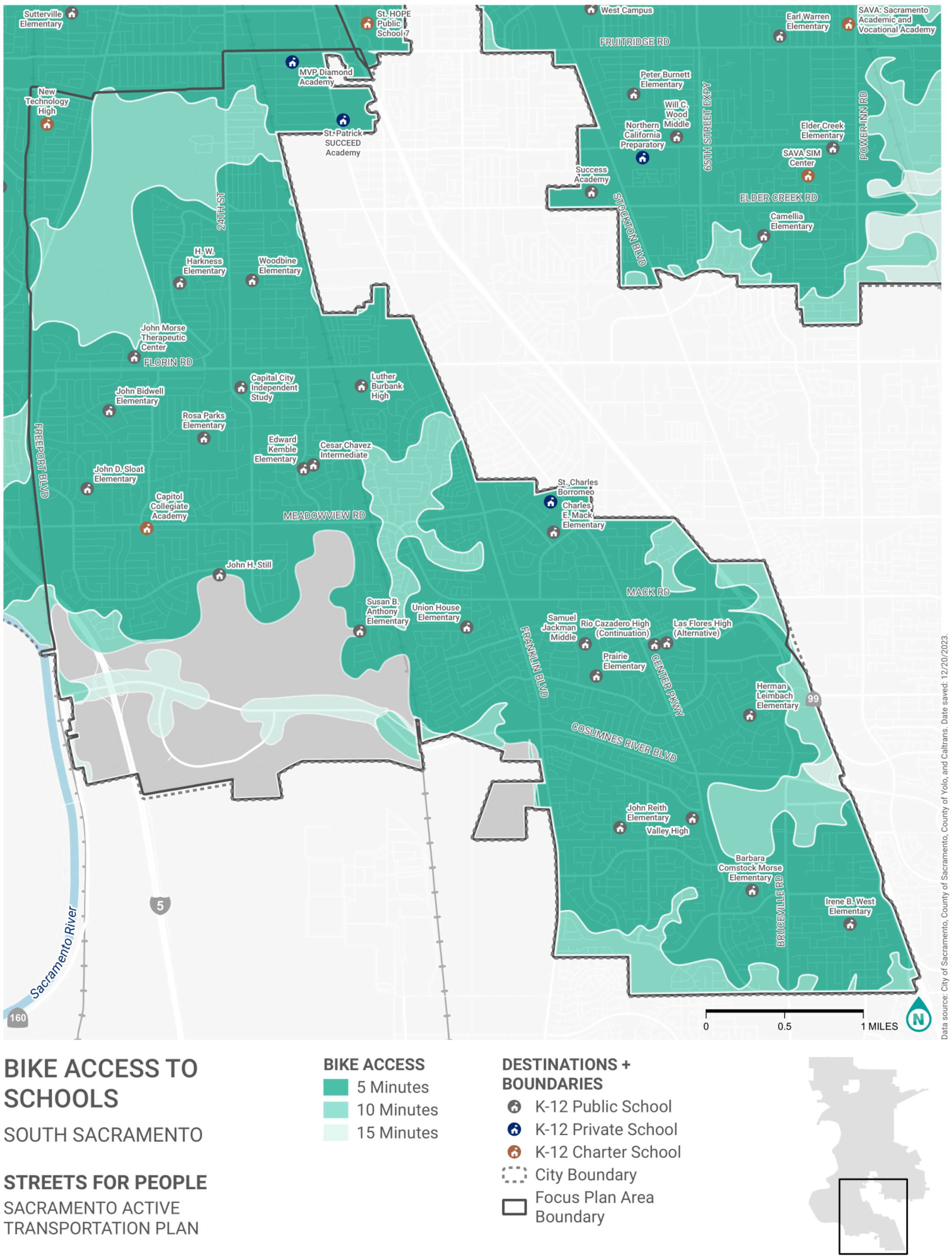


Figure 51. South Sacramento Bike Access to Schools (Scenario 1: Low-stress conditions)

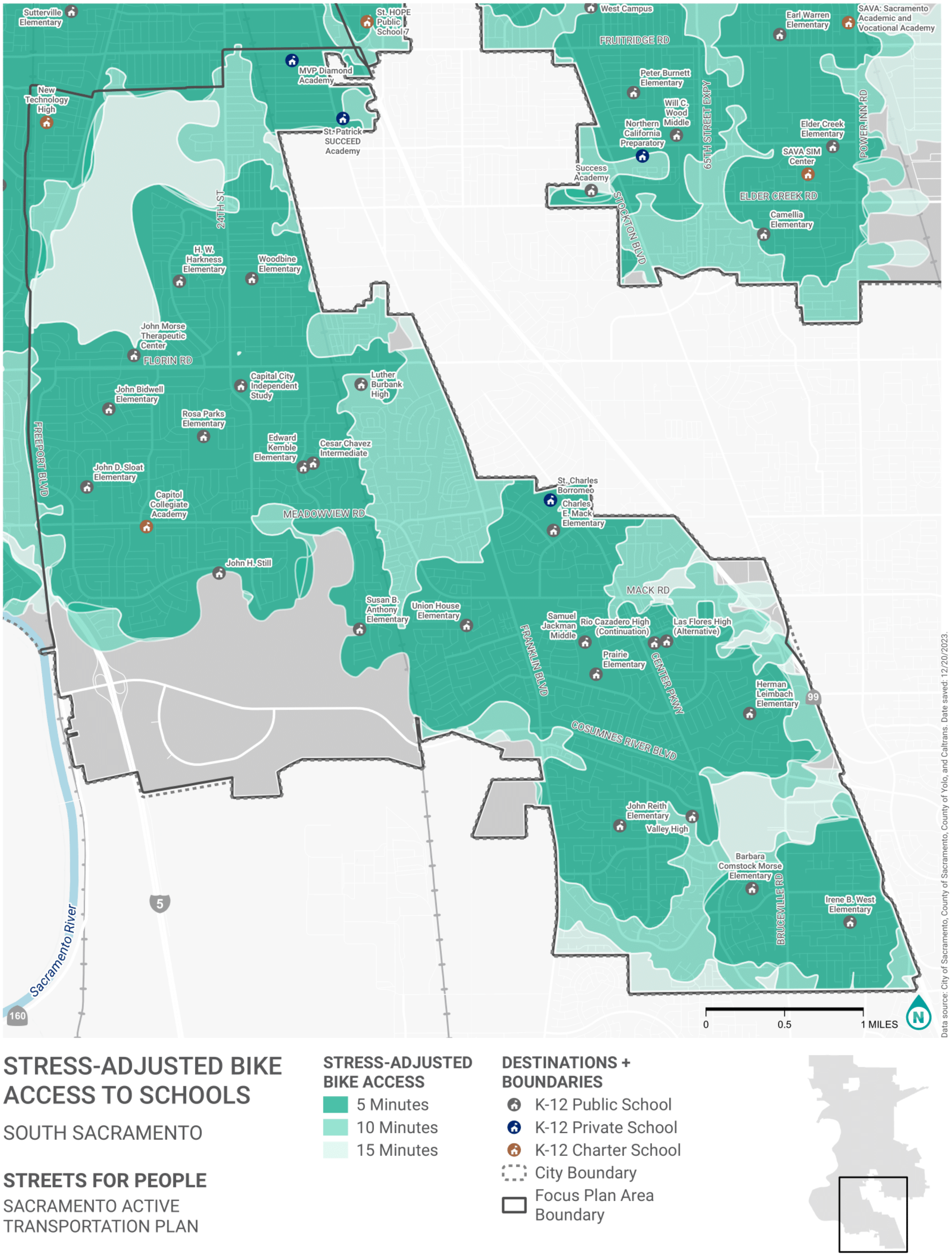


Figure 52. South Sacramento Bike Access to Schools (Scenario 2: Stressful conditions)

Summary of Findings – Transit

High-ridership bus stops were defined as those bus stops within the top 10 weekday ridership counts from 2019, before the COVID-19 pandemic, excluding bus stops at light rail stations, which were already captured in the analysis. **Figure 53** shows all bus stops across Sacramento with higher ridership shown with larger icons.

The areas of Sacramento that are within a 15-minute walk of a light rail station or high-ridership bus stop are shown in **Figure 54** and **Figure 55**. Two generalized areas were added along J Street at 19th Street and Alhambra Boulevard to represent the J & L Street bus corridor, which serves three of the most popular bus routes through downtown Sacramento. Similarly, the Florin Towne Center bus stop which lies about a quarter mile outside the Sacramento city limits was included to account for the high number of trips starting and finishing at this location.

Walksheds for high-ridership transit and light rail stations are denoted in orange (5-minute - bright orange), 10-minute - medium orange, and 15-minute -light orange and are presented below. While most trips to transit are likely to be less than a 10-minute walk, to remain consistent with the 15-minute city evaluation framework and reflect the potentially larger influence area of high-ridership stops and light rail stations, this analysis used 15-minutes to evaluate connectivity to transit.[14] The communities summarized in **Table 16** are the difference in the 15-minute (light orange) travel sheds between **Figure 54** and **Figure 55.**

Similarly, **Figure 56** and **Figure 57** provide a summary of bike access to transit. These figures are also presented in 5-minute (bright green), 10-minute (medium green), and 15-minute (light green) increments. The communities summarized in **Table 17** are represented by the difference in the 5-minute (light green) travel sheds between **Figure 56** and **Figure 57.**

Citywide Access to Transit

Approximately 24% of people in Sacramento live within a 15-minute walk of a light rail station or high-ridership bus stop (under Scenario 1: Low-stress conditions), but when adjusting for traffic stress (under Scenario 2: Stressful conditions) only 15% of Sacramento residents live within a 15-minute walk of a light rail station or high-ridership bus stop.

Similarly, when considering access for people biking, 22% of Sacramento residents live within a 5-minute bike ride of a light rail station or high-ridership bus stop (or 16% when adjusting for travel stress).

The light rail stations and high-ridership bus stops with the largest access disparity for people walking/rolling (**Table 18**) and biking (**Table 19)** between Scenario 1: Low-stress conditions and Scenario 2: Stressful conditions are shown in the tables below. Four light rail stations along the Gold Line (59th Street, University/65th Street, Power Inn, and College Greens) represent some of the most access-limited stations in the city, particularly for people walking/rolling. Only about 47% of the residents within the Scenario 1: Low-stress travel shed can still access these stations in the Scenario 2: Stressful travel shed. These stations are located along US 50, which as previously noted, serves as a major accessibility barrier to those walking, biking, and rolling since it is a limited access freeway.

[14] Guerra, E., Cervero, R., & Tischler, D. (2011). The Half-Mile Circle: Does It Best Represent Transit Station Catchments? UC Berkeley: University of California Transportation Center. Retrieved from https://escholarship.org/uc/item/68r764df

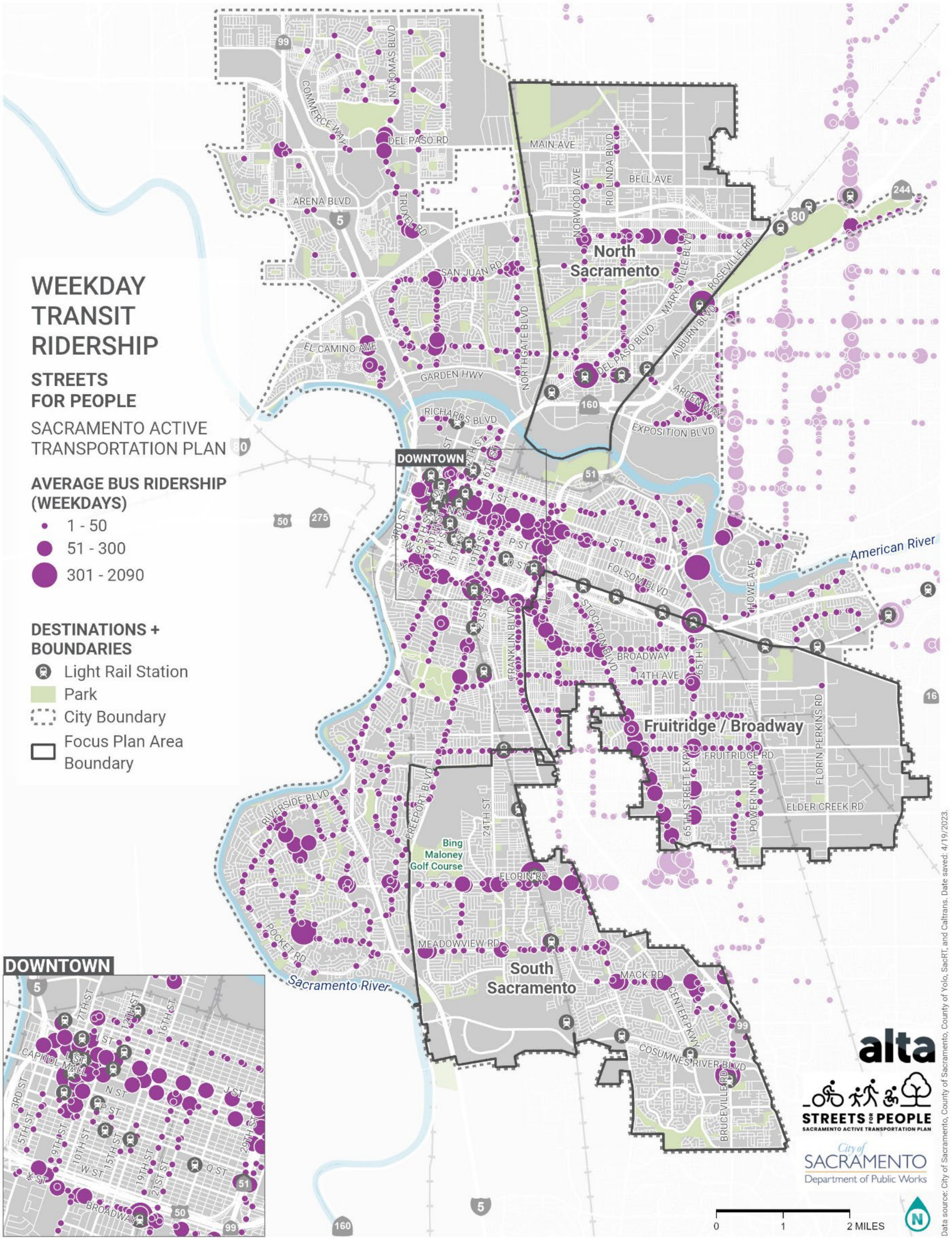


Figure 53. Transit ridership across Sacramento, Existing Conditions Analysis

*Table 16. Sacramento citywide high-ridership transit stops with the most limited access for people walking (15-minute walk)**

Stop Name	Focus Plan Area^ϕ	Persons Who Can Access the Transit Stop within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Transit Stop within Scenario 2: Stressful Travel Shed			
		Population	% Youth	% Equity **	Population	% of Low-stress Travel Shed Pop	% Youth	% Equity **
Florin Towne Center	F	1,953	25%	56%	253	13%	28%	67%
Cosumnes River College	S	3,850	27%	38%	1,005	26%	25%	40%
Power Inn	F	1,726	10%	42%	758	44%	14%	40%
59th Street	F	5,207	12%	26%	2,342	45%	11%	28%
7th & Richards/ Township	O	645	26%	83%	308	48%	28%	87%
Center Parkway	S	7,243	28%	38%	3,467	48%	29%	46%
University/65th Street	F	4,195	9%	31%	2,050	49%	9%	35%
Fruitridge	S	4,947	22%	36%	2,492	50%	22%	38%
College Greens	F	2,704	18%	37%	1,397	52%	18%	41%
Arden Fair Mall	O	1,674	17%	40%	888	53%	15%	36%

**Minimum distance-only travel shed population of 500 persons*

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

φ The focus plan area for each park is indicated by a letter: N for North Sacramento; F for Fruitridge/Broadway; S for South Sacramento; and O for outside of focus plan areas.

*Table 17. Sacramento citywide transit stops with the most limited access for people biking (5-minute bike ride)**

Stop Name	Focus Plan Areaᵠ	Persons Who Can Access the Transit Stop within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Transit Stop within Scenario 2: Stressful Travel Shed			
		Population	% Youth	% Equity **	Population	% of Low-stress Travel Shed Pop	% Youth	% Equity **
Florin Towne Center	F	2,363	25%	56%	5	0%	34%	76%
Power Inn	F	823	12%	42%	39	5%	1%	54%
Watt/Manlove	O	566	24%	20%	51	9%	28%	11%
Cosumnes River College	S	1,857	24%	37%	198	11%	25%	40%
8th & K	O	8,905	5%	35%	1,111	12%	4%	37%
Arden Fair Mall	O	1,398	14%	34%	175	13%	13%	33%
Center Parkway	S	8,778	28%	37%	1,162	13%	31%	47%
Fruitridge	S	6,030	22%	36%	975	16%	24%	42%
8th & O (Eastbound)	O	6,969	4%	32%	1,433	21%	2%	31%
Franklin	S	9,283	27%	38%	1,989	21%	28%	38%

**Minimum distance-only travel shed population of 500 persons*

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

ᵠ *The focus plan area for each park is indicated by a letter: N for North Sacramento; F for Fruitridge/Broadway; S for South Sacramento; and O for outside of focus plan areas.*

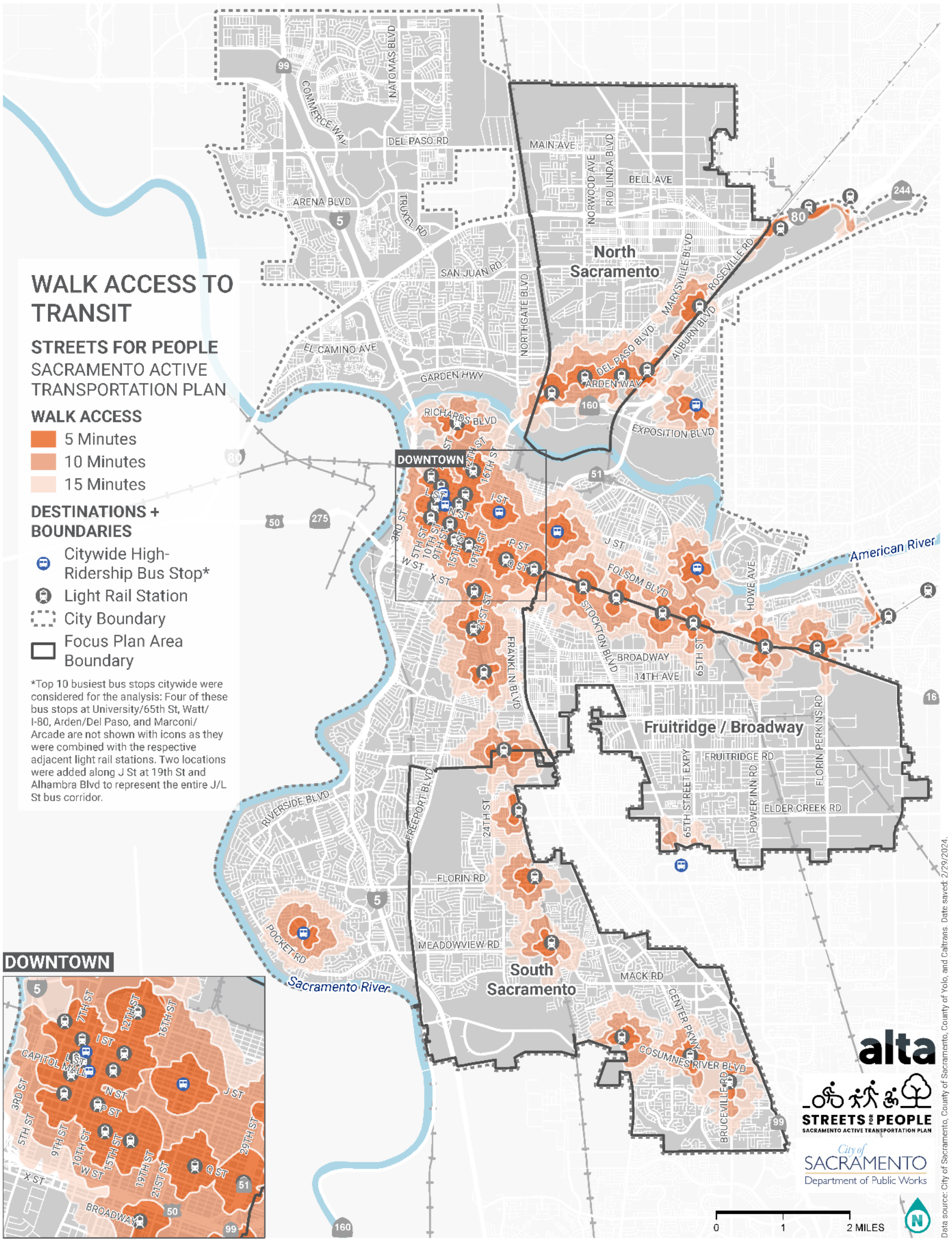


Figure 54. Walk Access to Transit (Scenario 1: Low-stress conditions)

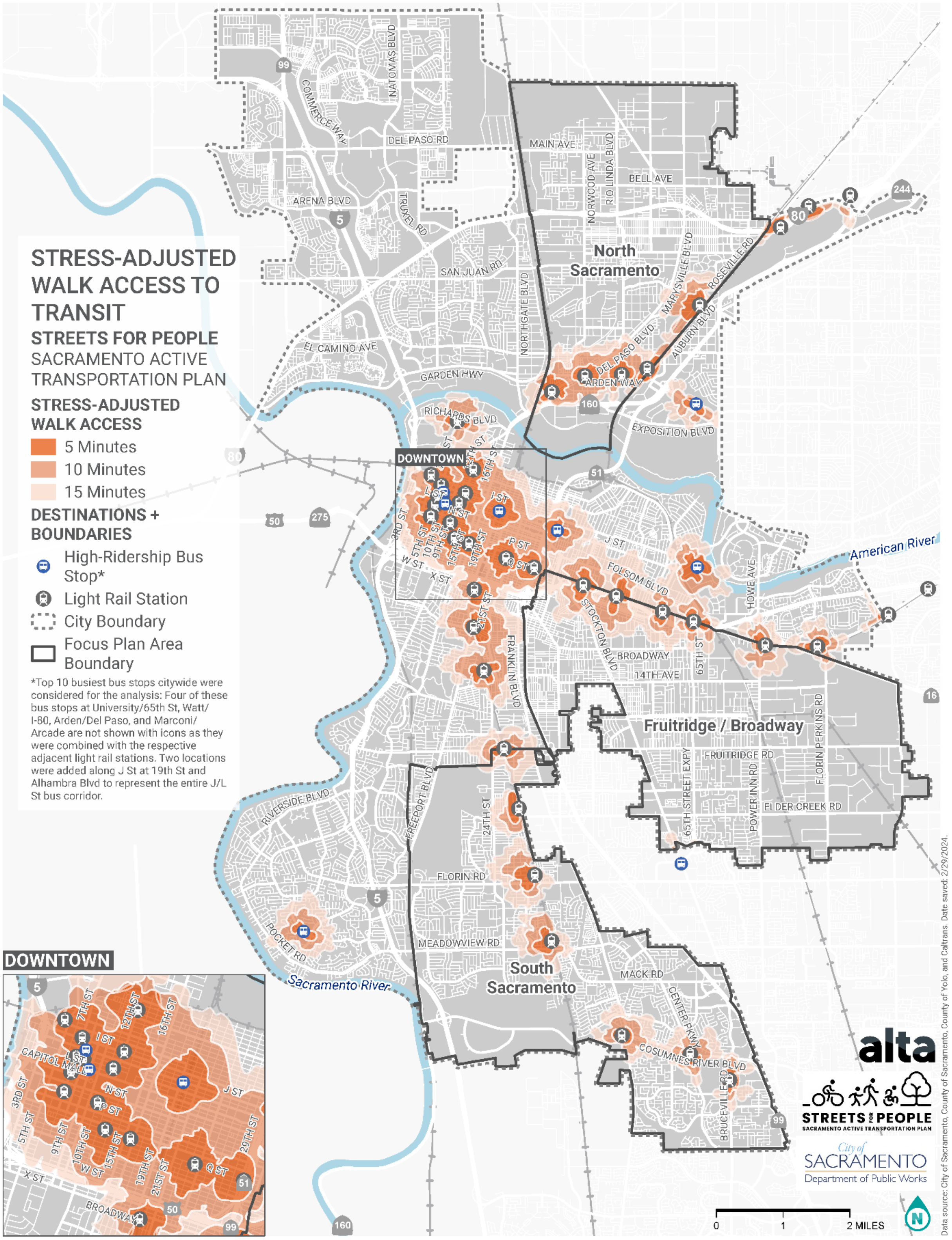


Figure 55. Walk Access to Transit (Scenario 2: Stressful conditions)

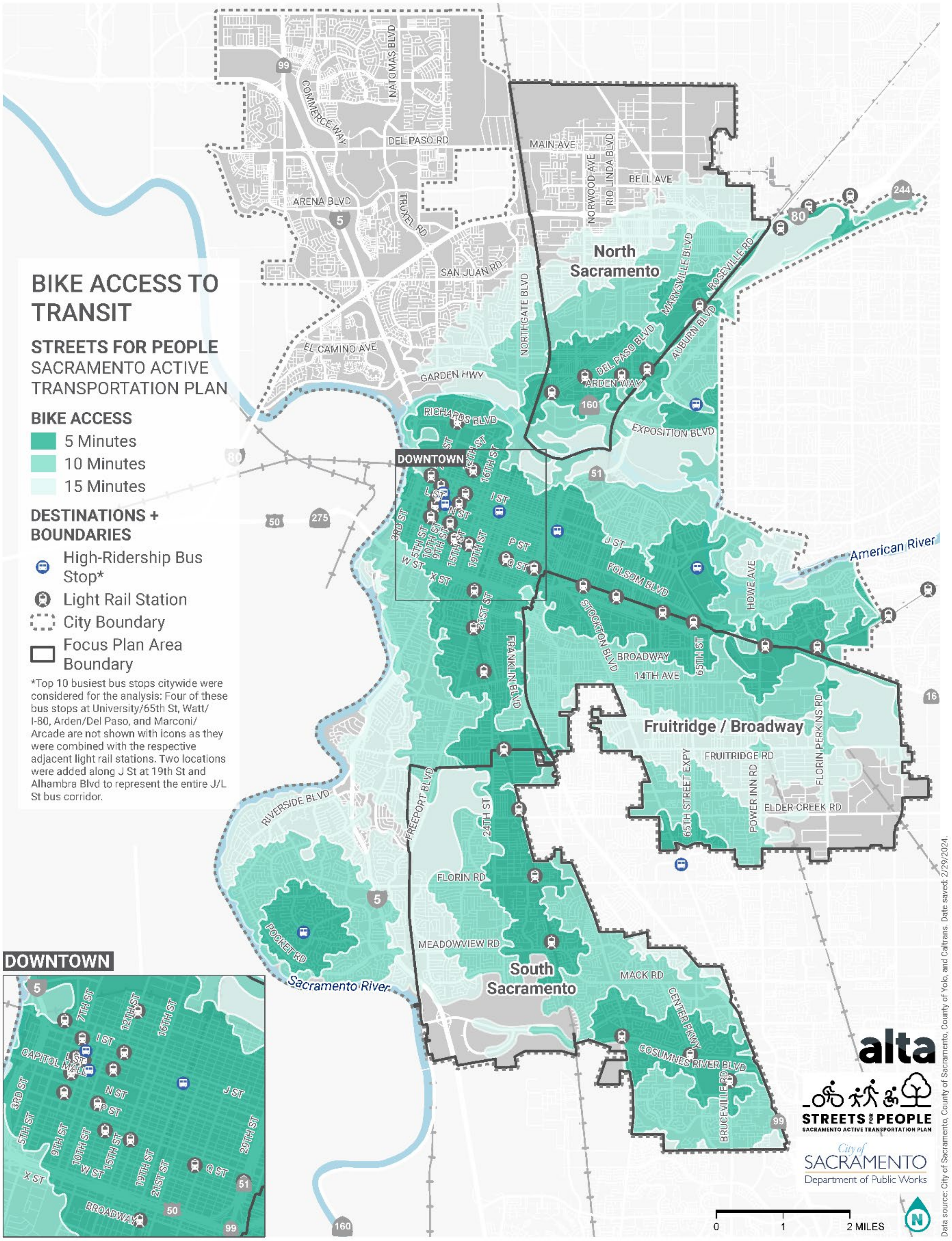


Figure 56. Bike Access to Transit (Scenario 1: Low-stress conditions)

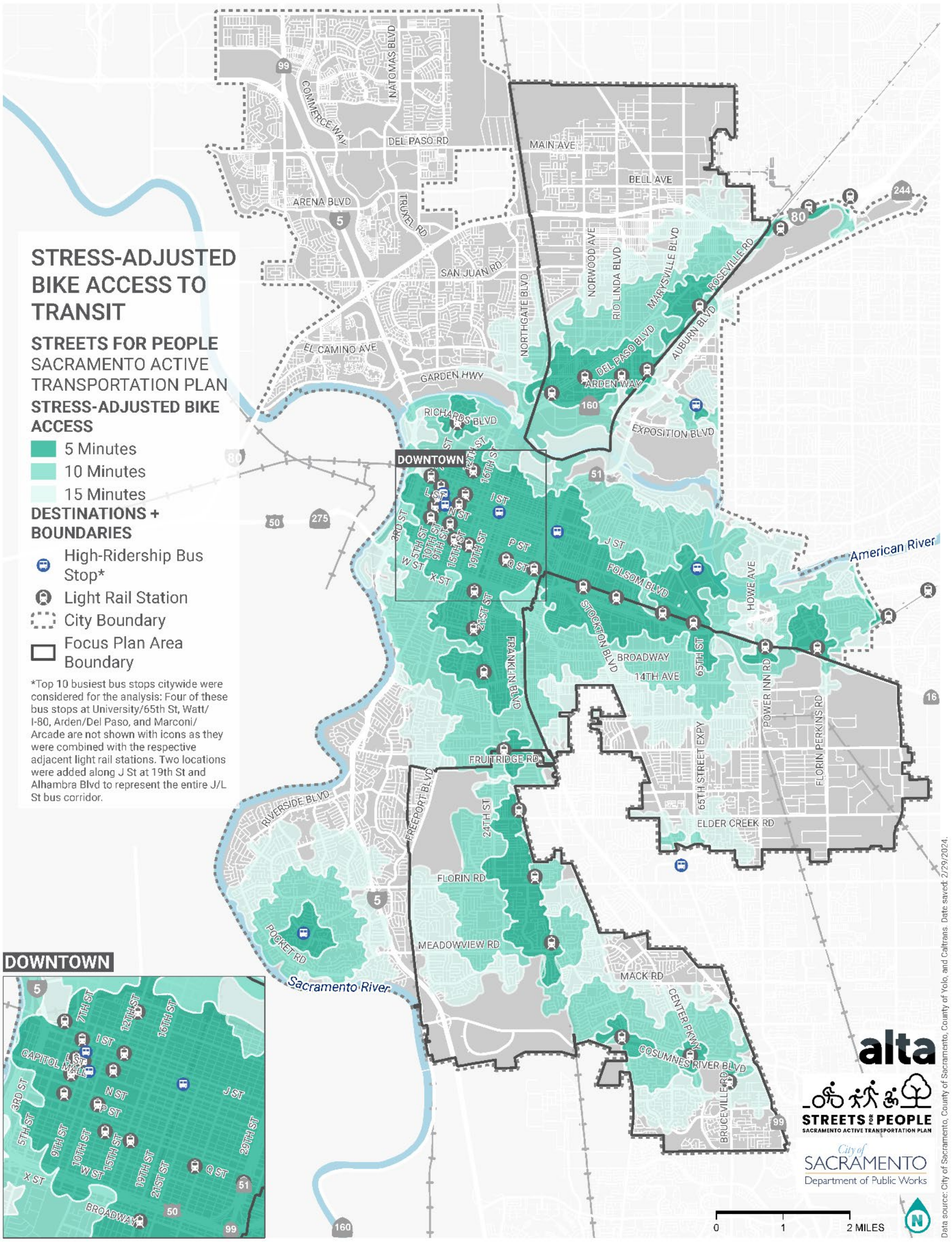


Figure 57. Bike Access to Transit (Scenario 2: Stressful conditions)

Focus Plan Area Access to Transit

This analysis considers access to light rail stations and the top 10 busiest bus stops by ridership in each focus plan area. Since the bus stops are ranked highest to lowest by ridership within the focus areas, a comparison to a different, citywide ranking of bus stops should not be conducted in this case.

As shown in **Table 18**, an average of 42% of focus plan area residents can access light rail stations or high-ridership bus stops within a 15-minute walk under Scenario 1: Low-stress conditions; this figure drops to 32% under Scenario 2: Stressful conditions. The Fruitridge/Broadway focus plan area has the lowest percentage of youth who can access a transit stop within a 15-minute walk under stressful conditions. The Fruitridge/Broadway and South Sacramento focus plan areas have the lowest percentage of equity priority populations that reach a transit stop within a 15-minute walk under stressful conditions.

Table 18. Populations within a 15-minute walk to light rail stations and top 10 high-ridership bus stops within focus areas

Focus Plan Area*	Persons Who Can Access a Transit Stop within Scenario 1: Low-stress Travel Shed			Persons Who Can Access a Transit Stop within Scenario 2: Stressful Travel Shed			
	Population	% Youth	% Equity **	Population	% of Low-stress Travel Shed Pop	% Youth	% Equity **
Fruitridge/Broadway	45,137	18%	41%	34,255	76%	18%	42%
North Sacramento	39,651	28%	51%	33,727	85%	29%	52%
South Sacramento	34,095	28%	41%	20,345	60%	29%	42%

**This table summarizes access to all light rail stations and the top 10 bus stop locations within the focus plan area, by ridership that are not also co-located with a light rail station*

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

As shown in **Table 19**, only an average of 60% of focus plan area residents can access light rail stations or high-ridership bus stops within a 5-minute bike ride under Scenario 1: Low-stress conditions; this figure drops to 31% under Scenario 2: Stressful conditions. The Fruitridge/Broadway focus plan area has the lowest percentage of youth and the lowest percentage of equity priority populations which can access a transit stop within a 5-minute bike ride under stressful conditions.

Table 19. Populations within a 5-minute bike ride to light rail stations and high-ridership bus stops across Sacramento

Focus Plan Area	Persons Who Can Access a Transit Stop within Scenario 1: Low-stress Travel Shed			Persons Who Can Access a Transit Stop within Scenario 2: Stressful Travel Shed			
	Population	% Youth	% Equity **	Population	% of Low-stress Travel Shed Pop	% Youth	% Equity **
Fruitridge/Broadway	48,693	19%	41%	24,545	50%	17%	40%
North Sacramento	43,525	28%	51%	35,663	82%	29%	52%
South Sacramento	75,433	28%	43%	27,261	36%	29%	44%

** This table summarizes access to all light rail stations and the top 10 bus stop locations within the focus plan area, by ridership that are not also co-located with a light rail station*

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

Fruitridge/Broadway

Table 20 shows the light rail stations and high-ridership bus stops in the Fruitridge/Broadway focus plan area with the greatest difference in population that can access the transit stop between the Scenario 1: Low-stress conditions and Scenario 2: Stressful conditions travel sheds. **Figure 58** through **Figure 61** show walk and bike access to transit under low-stress and stressful conditions.

Table 20. Fruitridge/Broadway light rail stations and high-ridership bus stops with the most limited access (walking and biking)

Stop Name	Mode	Persons Who Can Access a Transit Stop within Scenario 1: Low-stress Travel Shed			Persons Who Can Access a Transit Stop within Scenario 2: Stressful Travel Shed			
		Population	% Youth	% Equity **	Population	% of Low-stress Travel Shed Pop	% Youth	% Equity **
Florin Towne Center	Walking	1,953	25%	56%	253	13%	28%	67%
	Biking	2,363	25%	56%	5	0%	34%	76%
Power Inn	Walking	1,726	10%	42%	758	44%	14%	40%
	Biking	823	12%	42%	39	5%	1%	54%
59th Street	Walking	5,207	12%	26%	2,342	45%	11%	28%
	Biking	6,218	12%	26%	2,573	41%	13%	25%
Stockton Blvd & Lemon Hill Ave	Walking	5,630	27%	48%	2,563	46%	27%	49%
	Biking	6,121	27%	50%	800	13%	28%	54%
65th St Expy & Elder Creek Rd	Walking	8,598	26%	56%	3,945	46%	26%	59%
	Biking	9,654	26%	56%	1,363	14%	27%	60%
Stockton Blvd & Fruitridge Rd	Walking	5,450	21%	32%	2,729	50%	21%	32%
	Biking	6,677	21%	31%	860	13%	20%	30%
College Greens	Walking	2,704	18%	37%	1,397	52%	18%	41%
	Biking	3,229	18%	35%	2,249	70%	18%	39%
Fruitridge Blvd & 65th St Expy	Walking	8,440	24%	37%	4,681	55%	25%	33%
	Biking	9,875	24%	38%	3,483	35%	25%	31%
65th St & 14th Ave	Walking	7,091	13%	34%	4,230	60%	13%	36%
	Biking	7,832	14%	32%	1,832	23%	12%	30%
Broadway & Alhambra Blvd	Walking	9,490	13%	34%	6,353	67%	14%	38%
	Biking	10,953	13%	33%	6,542	60%	14%	35%

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

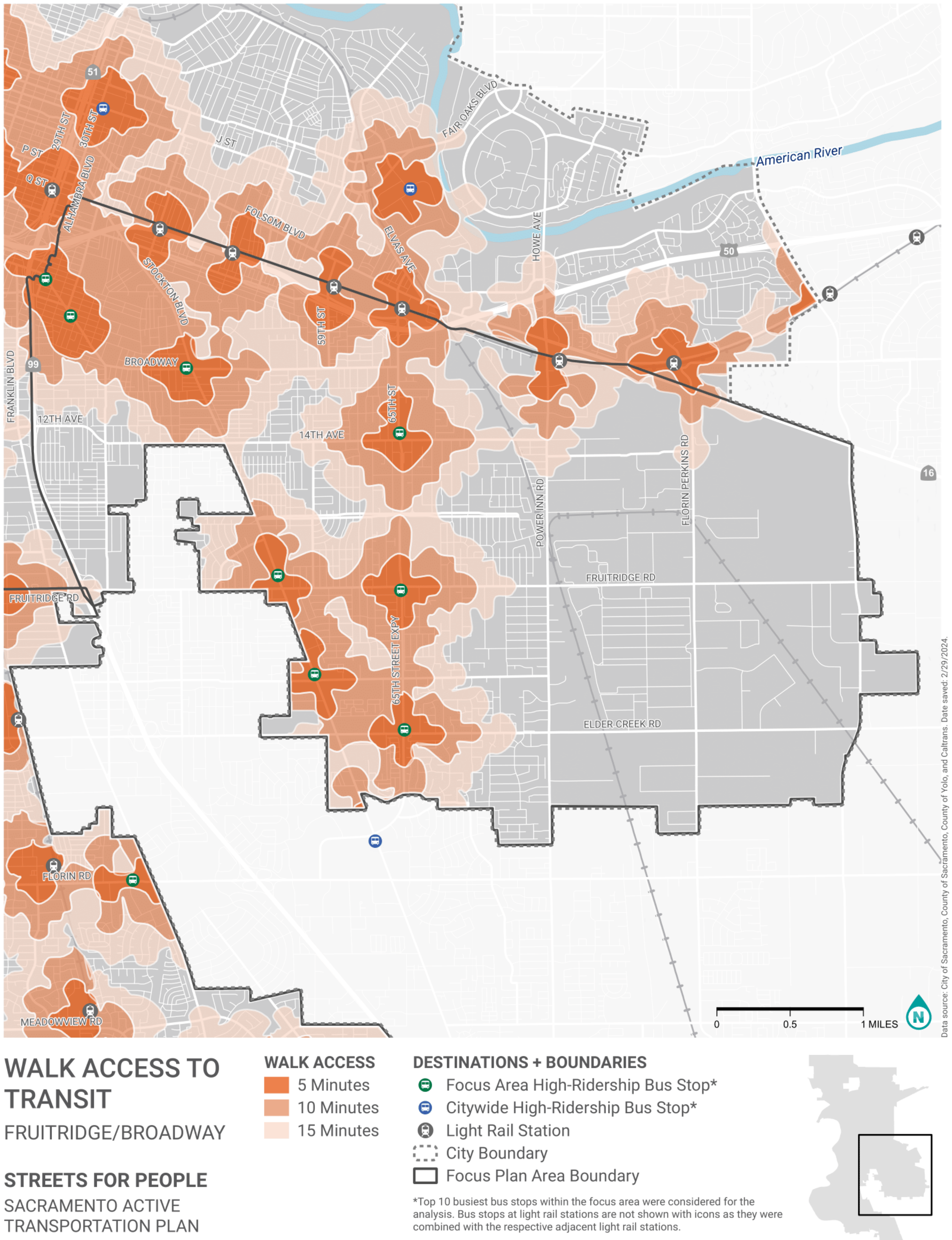


Figure 58. Fruitridge/Broadway Walk Access to Transit (Scenario 1: Low-stress conditions)

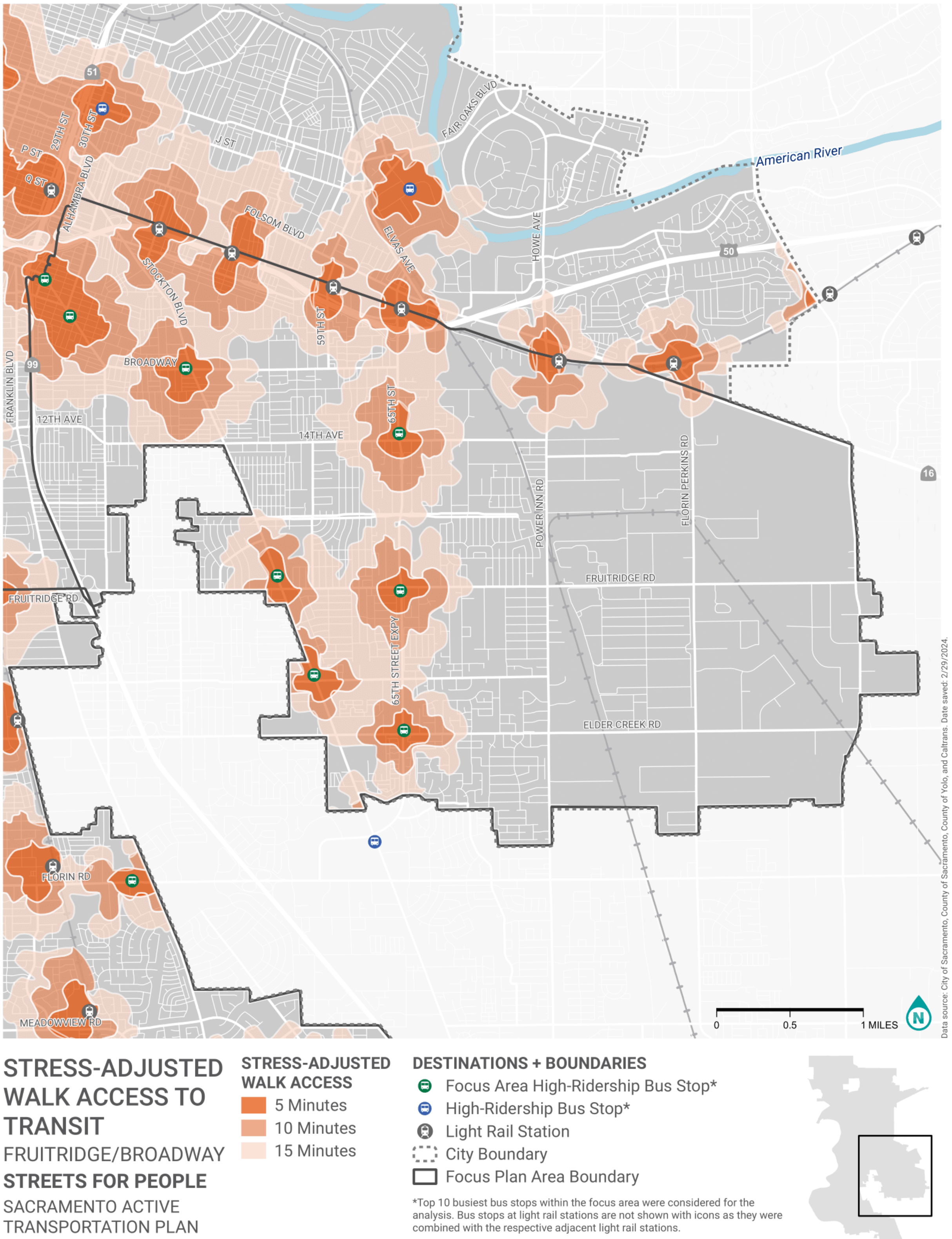
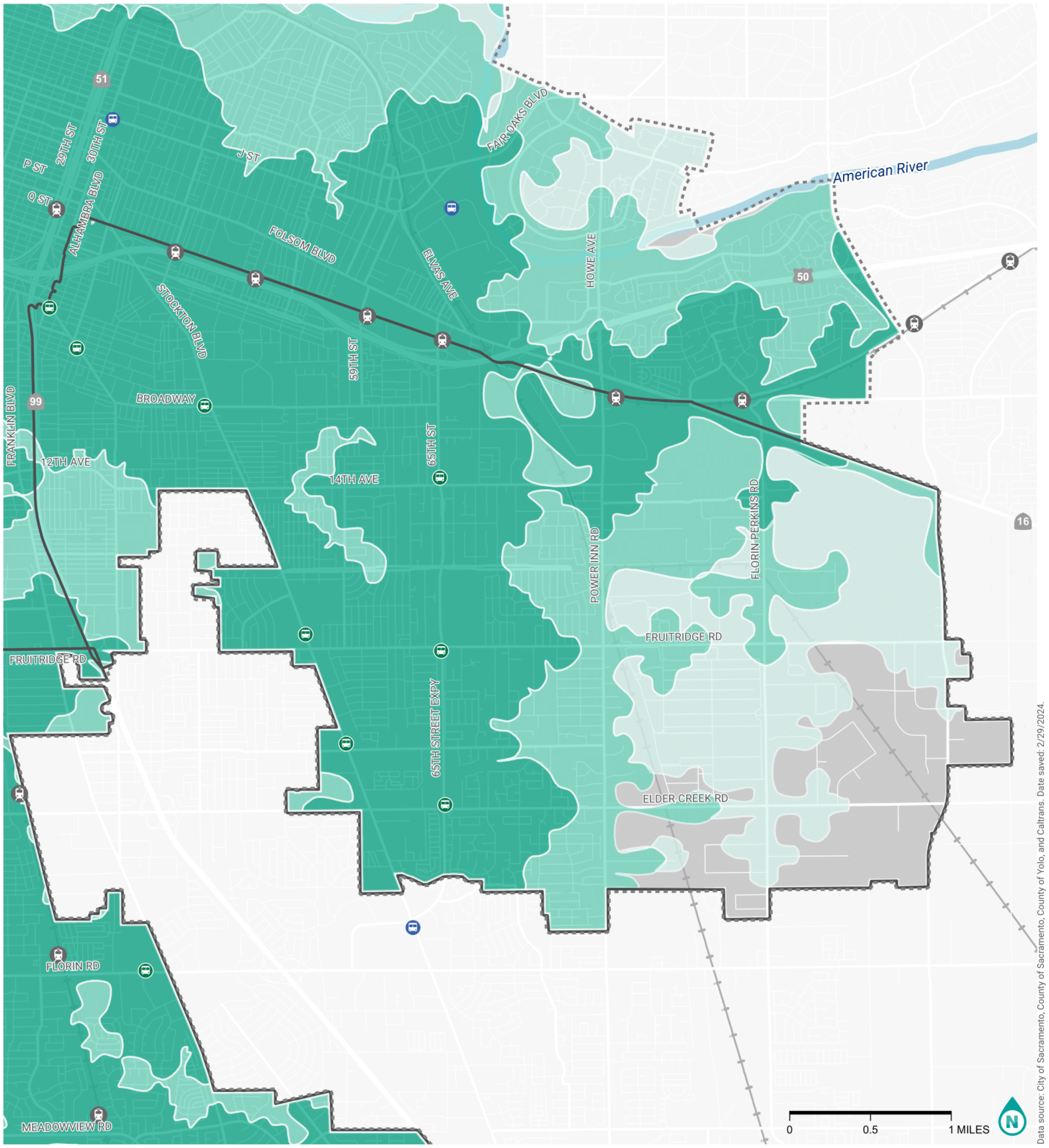


Figure 59. Fruitridge/Broadway Walk Access to Transit (Scenario 2: Stressful conditions)



BIKE ACCESS TO TRANSIT

FRUITRIDGE/BROADWAY

STREETS FOR PEOPLE

SACRAMENTO ACTIVE TRANSPORTATION PLAN

BIKE ACCESS
- 5 Minutes
- 10 Minutes
- 15 Minutes

DESTINATIONS + BOUNDARIES
- Focus Area High-Ridership Bus Stop*
- High-Ridership Bus Stop*
- Light Rail Station
- City Boundary
- Focus Plan Area Boundary

*Top 10 busiest bus stops within the focus area were considered for the analysis. Bus stops at light rail stations are not shown with icons as they were combined with the respective adjacent light rail stations.

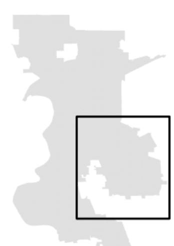


Figure 60. Fruitridge/Broadway Bike Access to Transit (Scenario 1: Low-stress conditions)

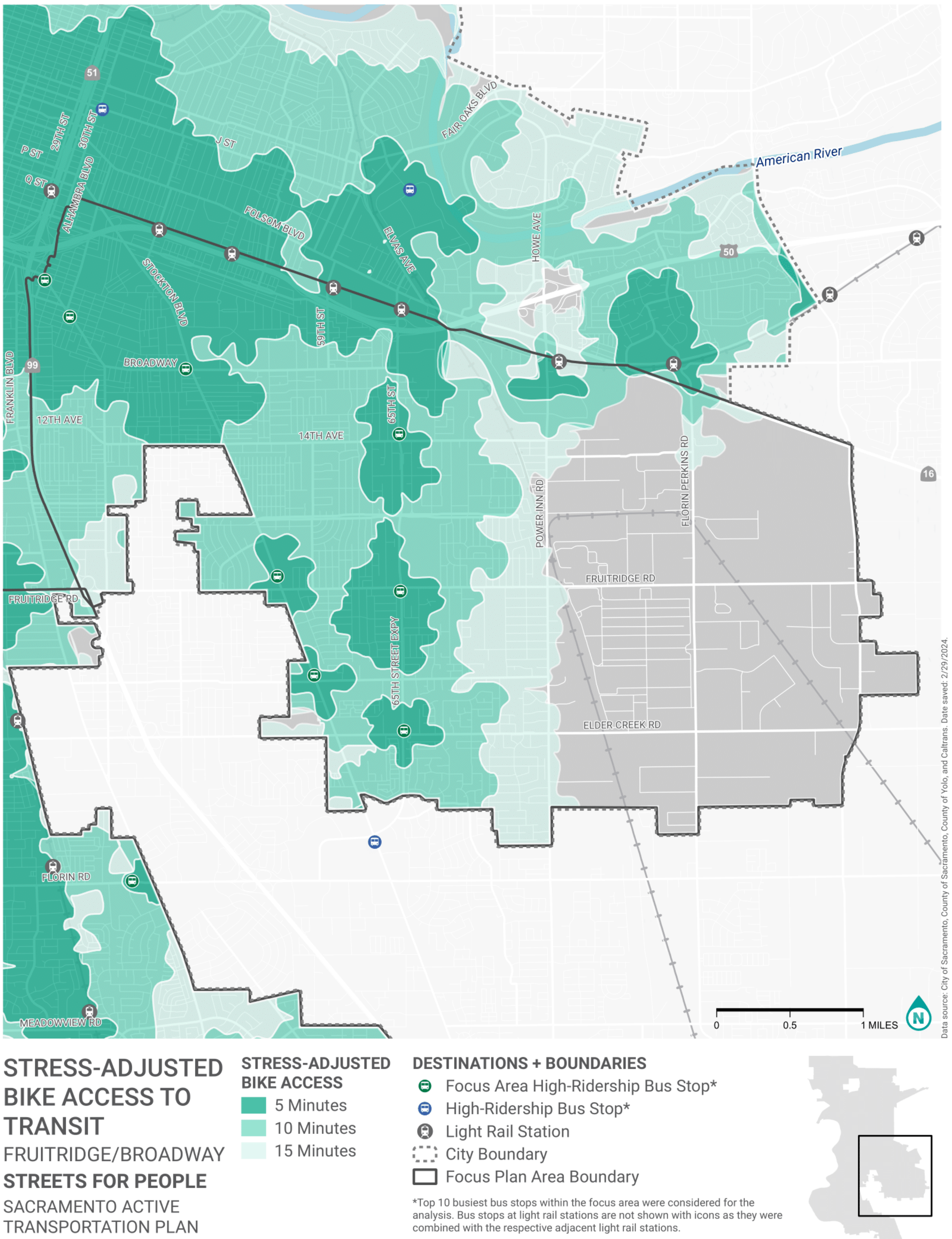


Figure 61. Fruitridge/Broadway Bike Access to Transit (Scenario 2: Stressful conditions)

North Sacramento

Table 21 shows the light rail stations and high-ridership bus stops in North Sacramento with the most limited access based on the analysis completed. **Figure 62** through **Figure 65** show walk and bike access to transit under low-stress and stressful conditions.

Table 21. North Sacramento light rail stations and high-ridership bus stops with the most limited access (walking and biking)

Stop Name	Mode	Persons Who Can Access the Transit Stop within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Transit Stop within Scenario 2: Stressful Travel Shed			
		Population	% Youth	% Equity **	Population	% of Low-stress Travel Shed Pop	% Youth	% Equity **
Rio Linda Blvd & Eleanor Ave	Walking	9,258	27%	56%	5,508	59%	28%	58%
	Biking	10,921	27%	55%	8,044	74%	28%	56%
Norwood Ave & Lindsay Ave	Walking	6,329	33%	48%	3,850	61%	35%	52%
	Biking	8,124	32%	47%	4,063	50%	35%	52%
Swanston	Walking	843	32%	75%	523	62%	33%	73%
	Biking	1,187	32%	74%	588	50%	33%	71%
Norwood Ave & Silver Eagle Rd	Walking	7,337	35%	41%	5,081	69%	37%	37%
	Biking	8,961	35%	43%	4,095	46%	38%	35%
Grand Ave & Dry Creek Rd	Walking	7,909	30%	60%	5,546	70%	31%	61%
	Biking	9,551	30%	58%	8,655	91%	31%	59%
Grand Ave & Marysville Blvd	Walking	7,558	29%	60%	5,737	76%	31%	60%
	Biking	8,832	29%	59%	7,705	87%	30%	61%
Norwood Ave & Jessie Ave	Walking	6,954	25%	47%	5,282	76%	25%	46%
	Biking	8,254	26%	47%	5,268	64%	25%	46%
Arden/Del Paso	Walking	5,161	20%	50%	3,929	76%	18%	49%
	Biking	5,689	21%	53%	2,523	44%	14%	47%
Royal Oaks	Walking	4,747	25%	65%	3,749	79%	24%	67%
	Biking	5,745	25%	64%	3,406	59%	23%	64%
Marconi/Arcade	Walking	2,799	30%	55%	2,304	82%	30%	55%
	Biking	3,610	29%	54%	2,138	59%	30%	55%

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

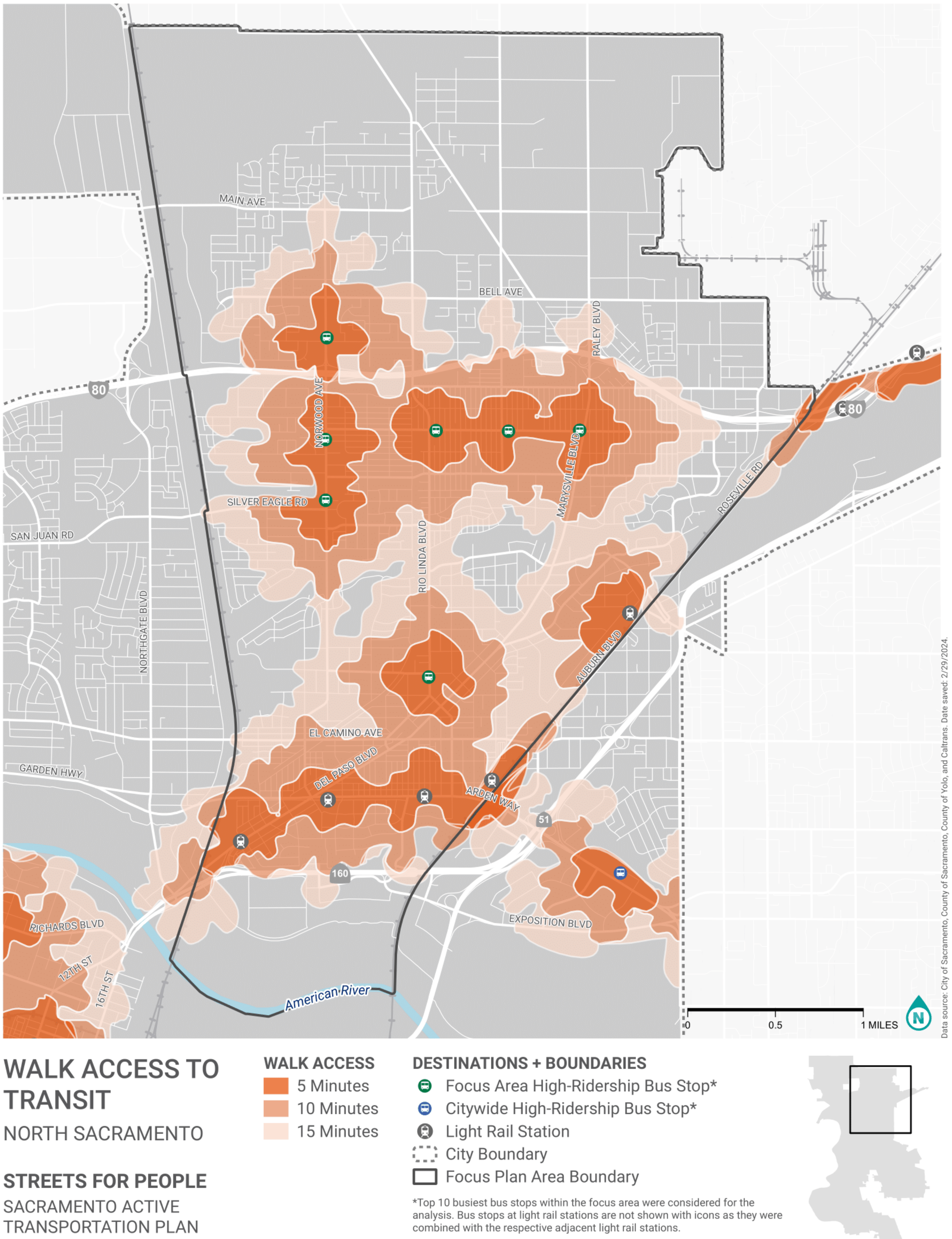


Figure 62. North Sacramento Walk Access to Transit (Scenario 1: Low-stress conditions)

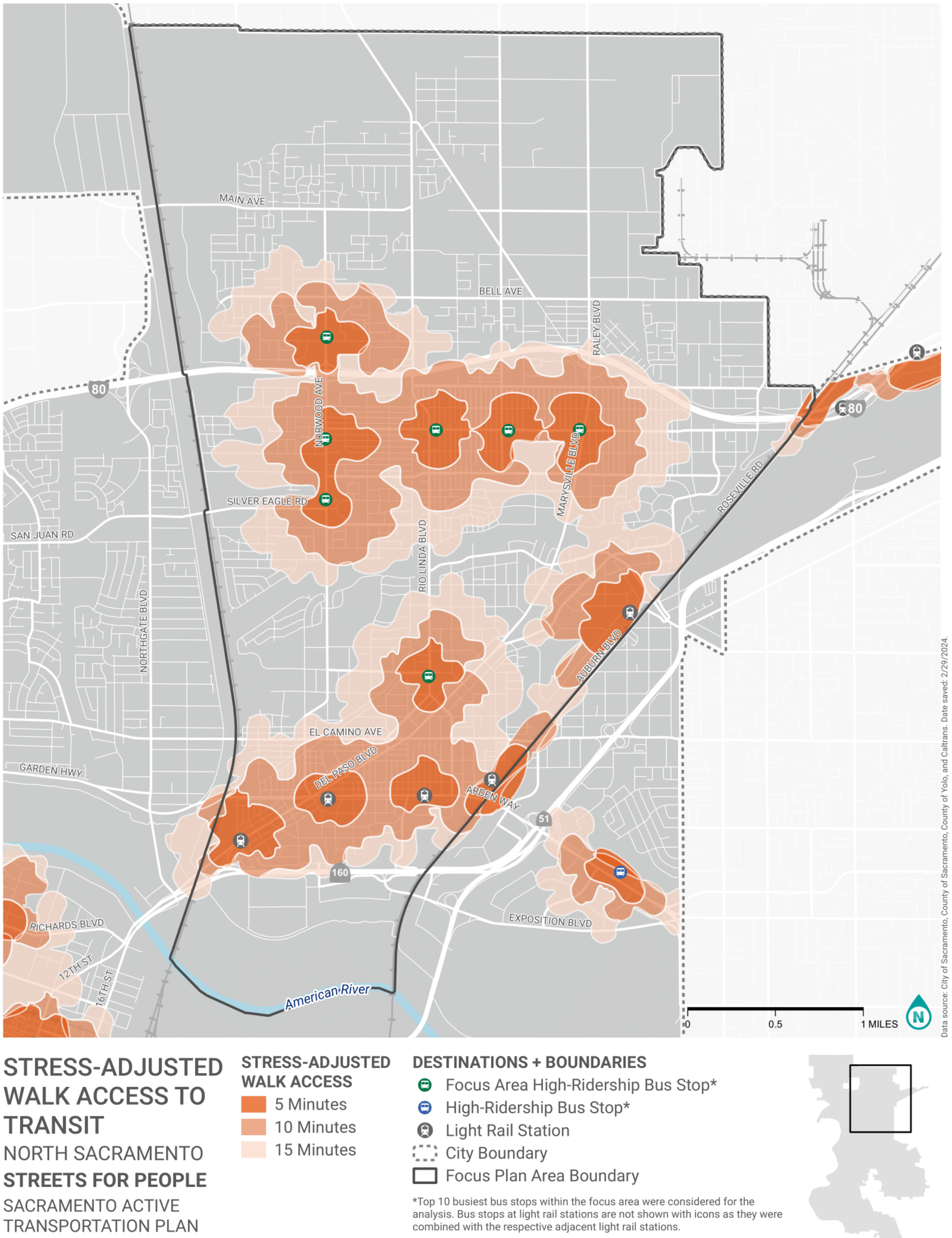


Figure 63. North Sacramento Walk Access to Transit (Scenario 2: Stressful conditions)

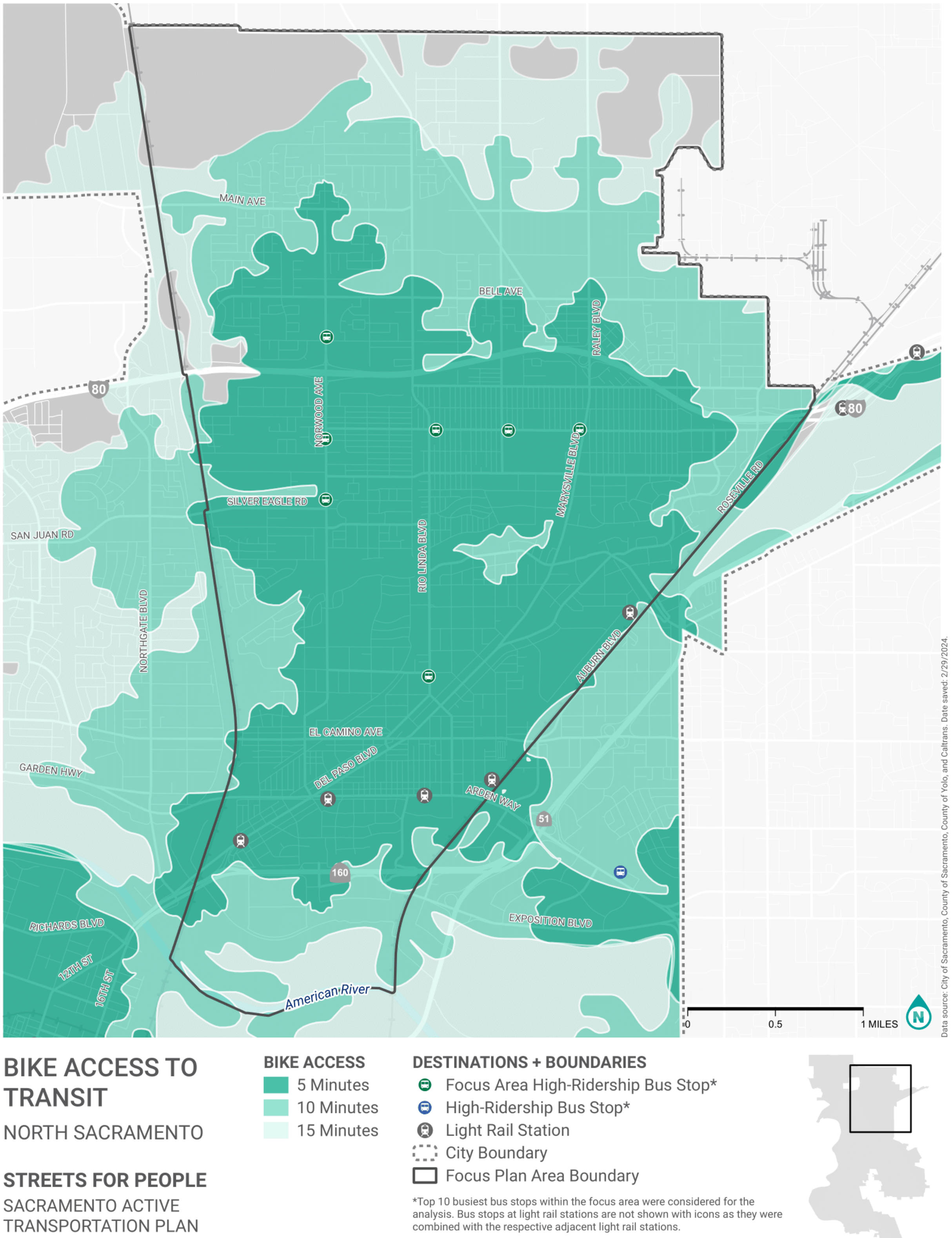


Figure 64. North Sacramento Bike Access to Transit (Scenario 1: Low-stress conditions)

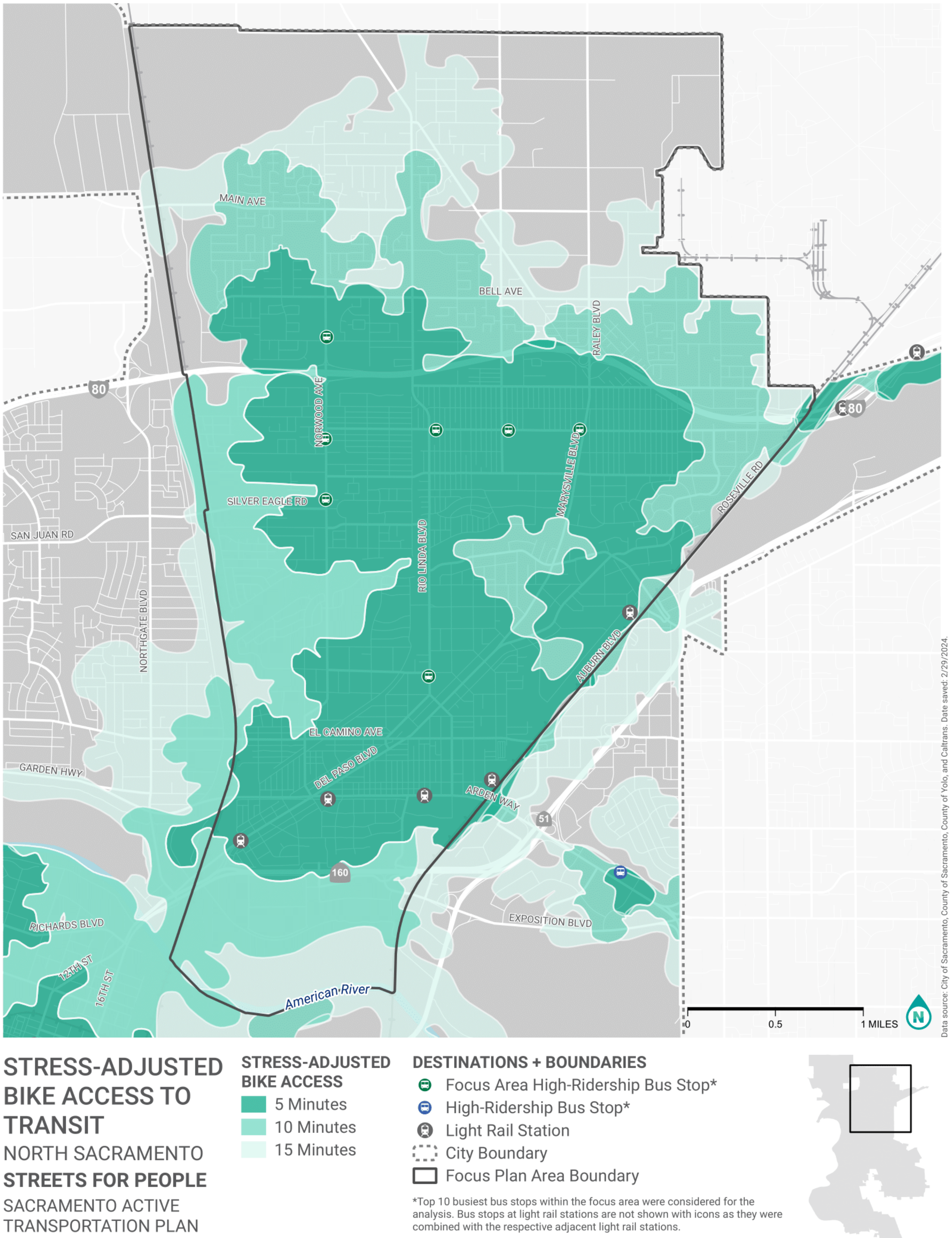


Figure 65. North Sacramento Bike Access to Transit (Scenario 2: Stressful conditions)

South Sacramento

Table 22 shows the light rail stations and high-ridership bus stops in the South Sacramento Focus Plan Area experiencing the most limited access. **Figure 66** through **Figure 69** show walk and bike access to transit under low-stress and stressful conditions.

Table 22. South Sacramento light rail stations and high-ridership bus stops with the most limited access (walking and biking)

Stop Name	Mode	Persons Who Can Access the Transit Stop within Scenario 1: Low-stress Travel Shed			Persons Who Can Access the Transit Stop within Scenario 2: Stressful Travel Shed			
		Population	% Youth	% Equity **	Population	% of Low-stress Travel Shed Pop	% Youth	% Equity **
Cosumnes River College	Walking	3,850	27%	38%	1,005	26%	25%	40%
	Biking	1,857	24%	37%	198	11%	25%	40%
Florin Rd & Munson Way	Walking	3,980	28%	40%	1,581	40%	27%	36%
	Biking	3,573	28%	44%	221	6%	27%	39%
Mack Rd & Valley Hi Dr	Walking	9,250	29%	45%	4,281	46%	29%	45%
	Biking	8,685	30%	47%	777	9%	31%	64%
Center Parkway	Walking	7,243	28%	38%	3,467	48%	29%	46%
	Biking	8,778	28%	37%	1,162	13%	31%	47%
Fruitridge	Walking	4,947	22%	36%	2,492	50%	22%	38%
	Biking	6,030	22%	36%	975	16%	24%	42%
Mack Rd & Franklin Blvd	Walking	13,198	27%	49%	6,985	53%	28%	49%
	Biking	12,560	27%	49%	656	5%	24%	53%
Franklin	Walking	8,103	27%	38%	4,553	56%	29%	35%
	Biking	9,283	27%	38%	1,989	21%	28%	38%
Meadowview Rd & Amherst St	Walking	10,147	29%	40%	6,056	60%	30%	38%
	Biking	12,233	29%	40%	7,408	61%	29%	37%
Florin Rd & 24th St	Walking	9,888	27%	40%	6,017	61%	25%	37%
	Biking	10,844	27%	40%	1,121	10%	25%	37%
Mack Rd & Center Pkwy	Walking	14,205	30%	47%	8,706	61%	32%	50%
	Biking	15,496	30%	45%	2,528	16%	35%	59%

***Equity population is defined as individuals living in households with incomes below 200% of the federal poverty level.*

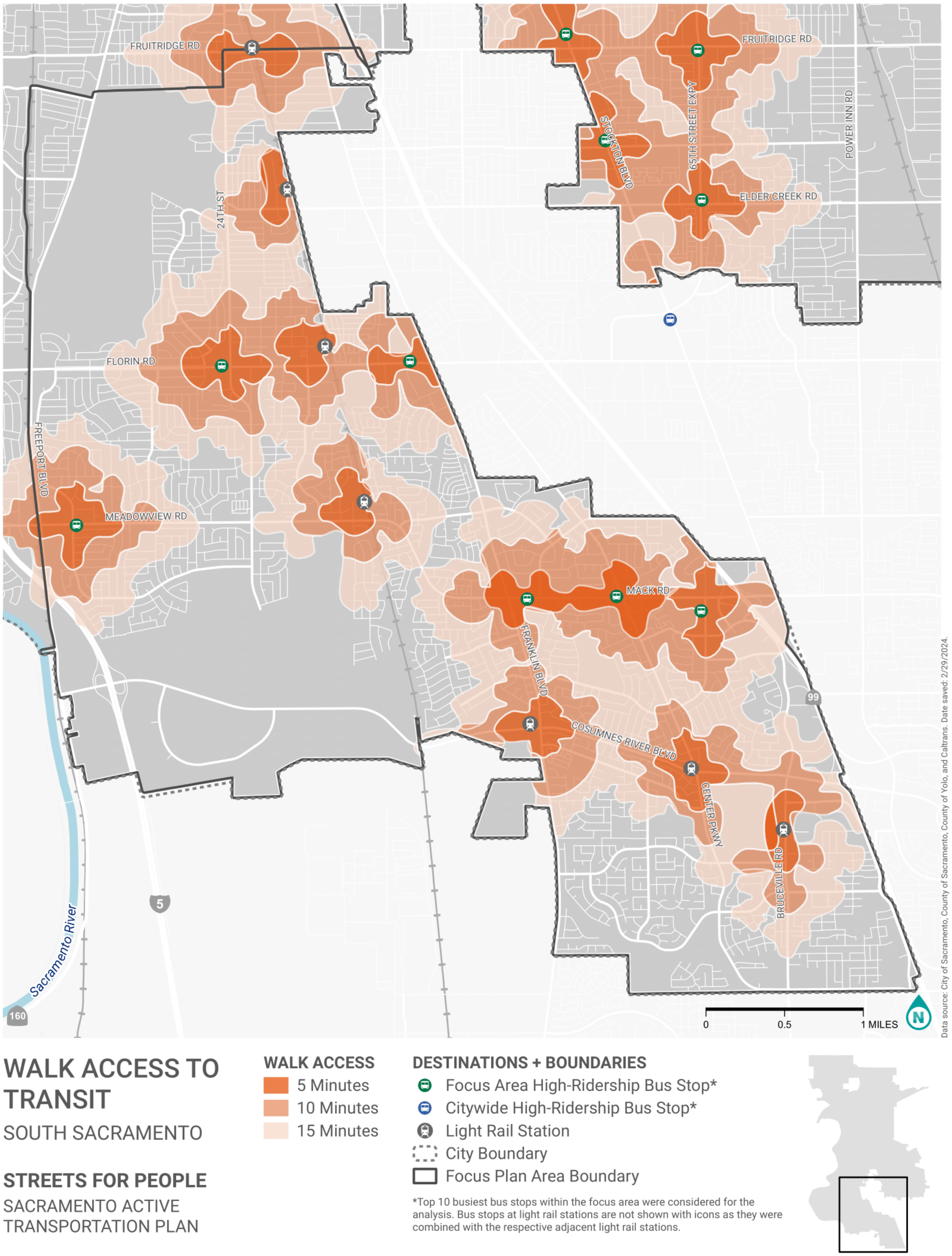


Figure 66. South Sacramento Walk Access to Transit (Scenario 1: Low-stress conditions)

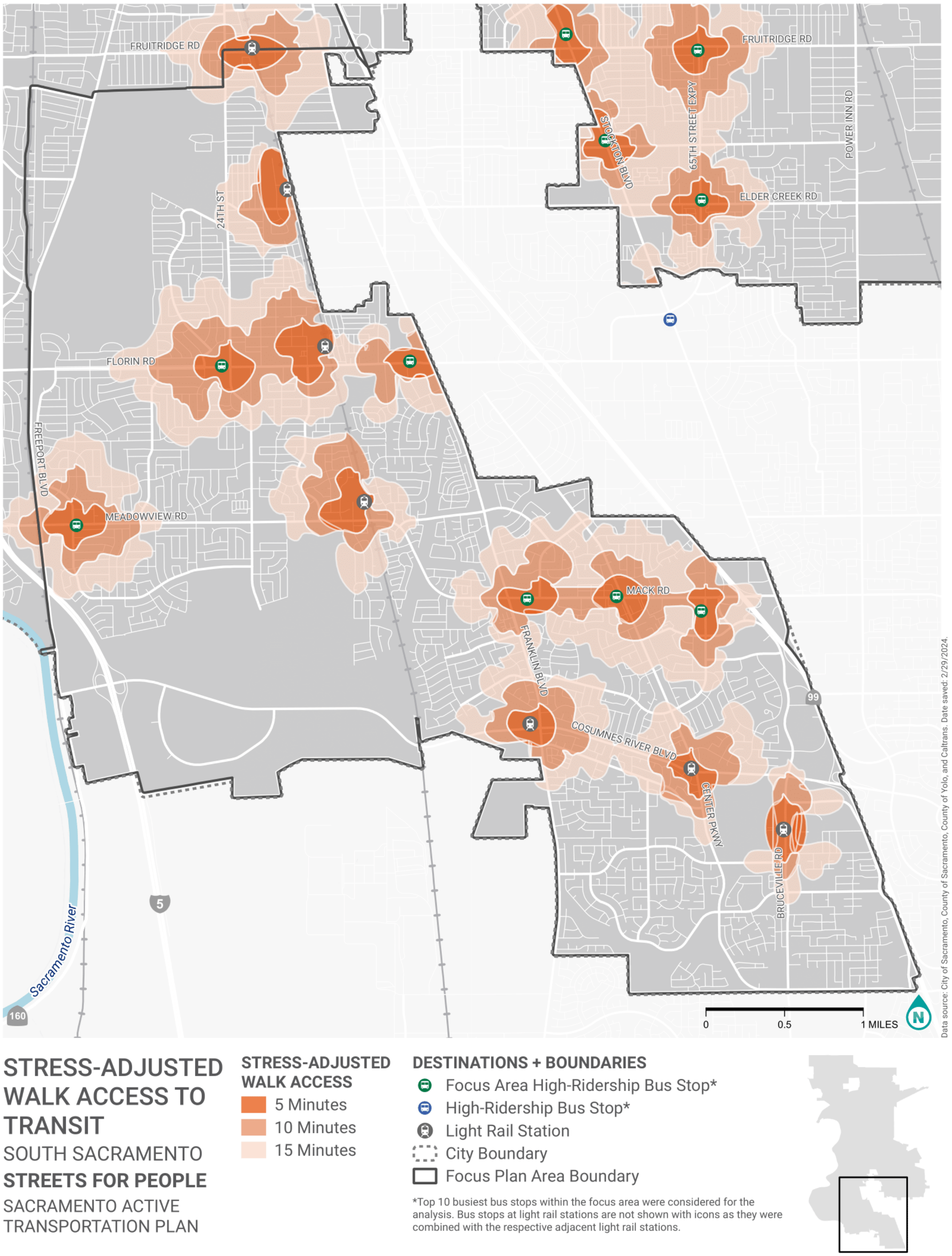


Figure 67. South Sacramento Walk Access to Transit (Scenario 2: Stressful conditions)

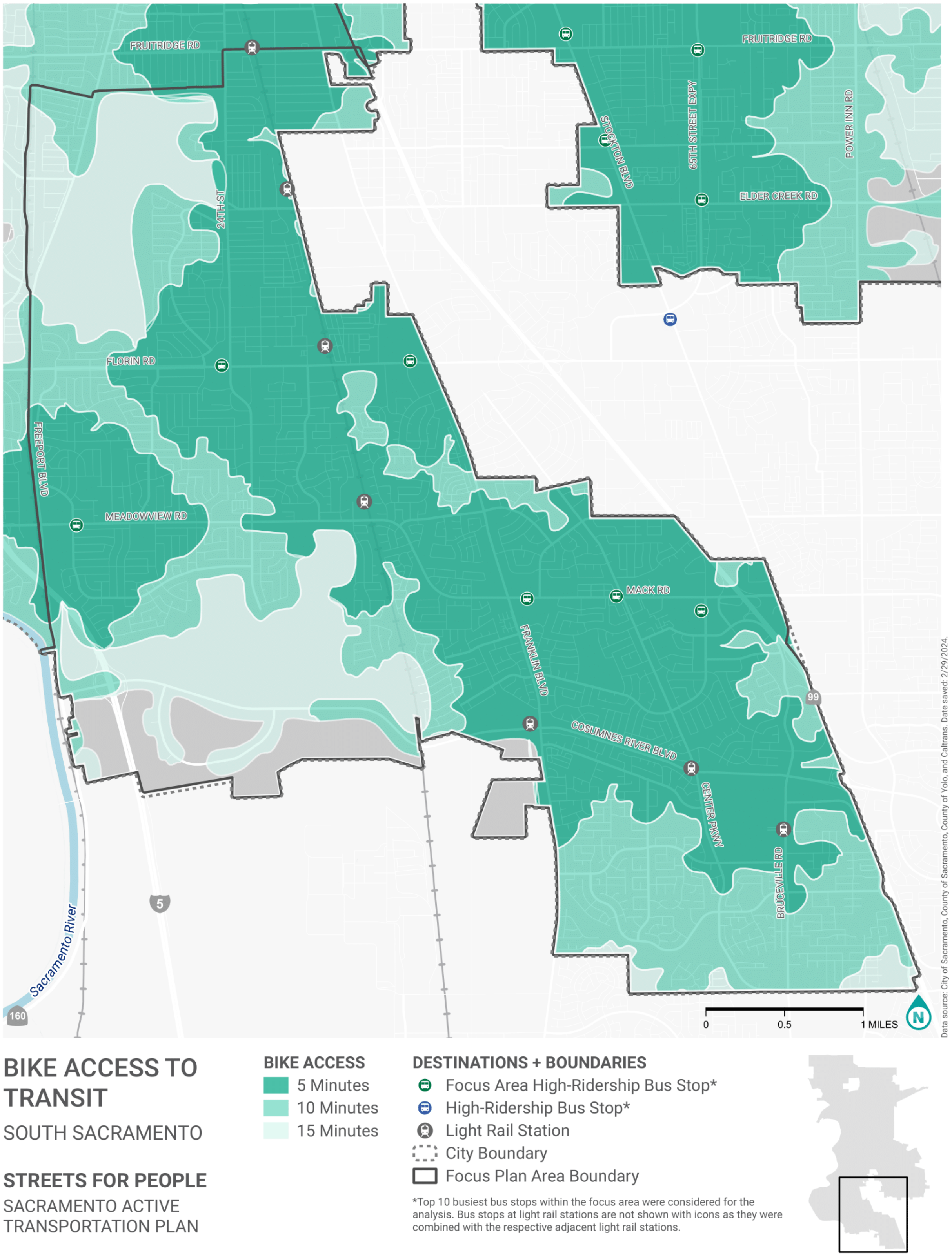


Figure 68. South Sacramento Bike Access to Transit (Scenario 1: Low-stress conditions)

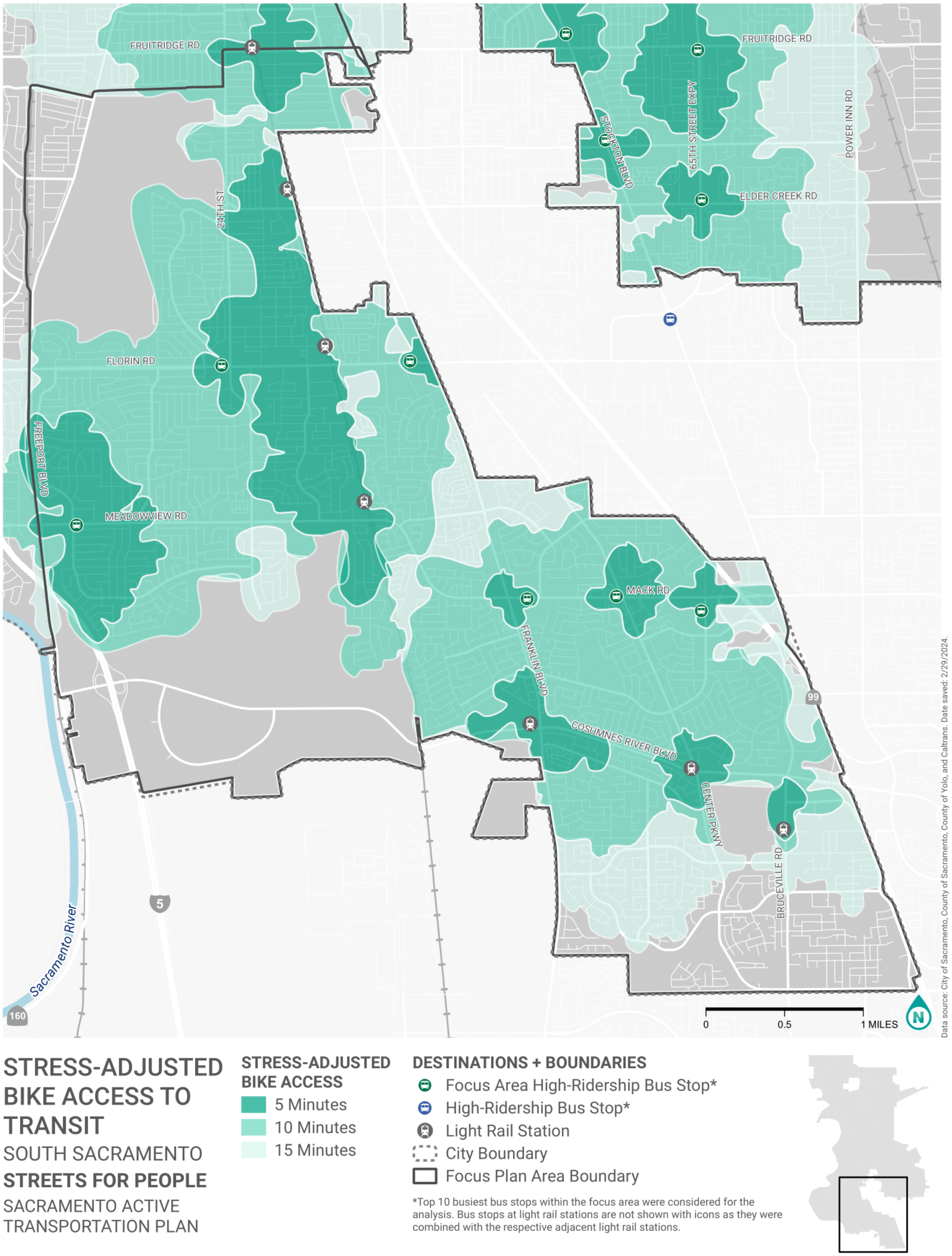


Figure 69. South Sacramento Bike Access to Transit (Scenario 2: Stressful conditions)

6. Bringing It Together: Sacramento Gap Analysis

This section identifies key gaps in Sacramento's active transportation network based on a data-driven aggregation of analyses. Identified gaps will help inform project recommendations for the plan. These in turn will be further refined at the corridor/intersection level and evaluated through the public engagement process.

Summary of Methods

Alta identified key gaps in Sacramento's transportation network for active travel based on the analyses discussed in Sections 2 through 5 of this document. The five criteria considered for this Gap Analysis are detailed in Table 23 and represent the potential demand for active travel, current user comfort, equity, safety, and connections to existing facilities. Results from each analysis were combined into a *Gap Evaluation Grid* which highlighted potential gaps citywide using hexagons which cover the city. The resulting gap areas were also compared with results of biking, walking, and rolling access to City parks, schools, light rail stations and high-ridership bus stops. A full description of the method for creating the Gap Evaluation Grid is included as Appendix G.

Table 23. Scoring Criteria for Identifying Critical Gaps

Criteria	Measures	Data Source	Hexagon Metric	Project Scoring	Weight
User Comfort	Level of Traffic Stress (LTS) along the existing network.	City of Sacramento, OSM, Alta analysis	Hexagon is scored based on intersection with LTS analysis. LTS 1 = 0; LTS 2 = 3; LTS 3 = 6; LTS 4 = 10 points.	Maximum LTS value overlapping with a bicycle or pedestrian hexagon.	20%
Equity	Equity index leveraging a combination of demographic and public health data to identify socially vulnerable populations with high investment need.	CalEnviroScreen 4.0	Hexagon is assigned the area-weighted average score from the CalEnviroScreen Demographic Index.	Percentile ranked and linearly scored to a 10- point scale.	20%
Demand	Active-Trip Potential (ATP) trips proportionally allocated to hexagons.	Replica Places	Area-weighted average of ATP for each hexagon location. Bicycle demand used a short-trip threshold of three miles, and one mile for pedestrians.	Percentile ranked and linearly scored to a 10-point scale.	20%
Existing Connections	Gaps that would connect to existing high-quality bicycle and walking infrastructure.	City of Sacramento Public Works	Hexagon is tagged based on being within 50 feet of an existing pedestrian crossing enhancement, sidewalk, trail, or bicycle facility.	Minimum point value of a facility's overlap with a bicycle or pedestrian hexagon.	20%
Safety	The percentage of overlap with the High Injury Network (HIN).	City of Sacramento	The percentage of a hexagon that overlaps with a 150 ft buffer of the HIN.	Receives a score out of 10 points based on the percentage of overlap within 150 ft of the HIN.	20%

Note: The Gap Analysis may be reevaluated in the future to include results from a Tree Opportunity Analysis.

Summary of Findings

The analysis evaluated gaps in existing infrastructure for both people walking and biking. To this end, a Gap Evaluation Grid was constructed using hexagonal partitions to best compare aggregate results from previous analyses noted above. Figure 70 shows the Gap Evaluation Grid with highest scores for gaps in pedestrian infrastructure highlighted in dark blue, and Figure 71 visualizes the highest scores for gaps in bicycling infrastructure highlighted in dark green.

Key themes of the Gap Evaluation Grid include:

- Many of the identified gaps are located along major arterials.
- Gaps are also identified along roadways with existing bike facilities (e.g., an existing bike lane along a 45+ miles per hour, four-lane roadway). This may indicate a need for improvements or greater separation along these facilities.
- Top-scoring hexagons were largely associated with high-stress corridors that lacked bicycle and pedestrian facilities and were likely to pose barriers to inter-neighborhood travel.
- Sometimes there is a line of high-scoring hexagons parallel to an existing facility, but not along that facility. This is mainly driven by nearby demand or proximity to the HIN.

Of note, the barrier aspect of freeways is not fully represented in this Gap Analysis. Where overpasses and crossings currently exist, the level of traffic stress is high; therefore, some of these crossing areas may be identified as gaps. Overall, this means that freeways are implicitly rather than explicitly captured as barriers. Freeway crossings and major arterials along them are generally higher stress and less oriented toward facilitating active travel. Alta considered including freeways as an additional scoring criterion but determined it would be duplicative with the LTS and connection scoring criterion.

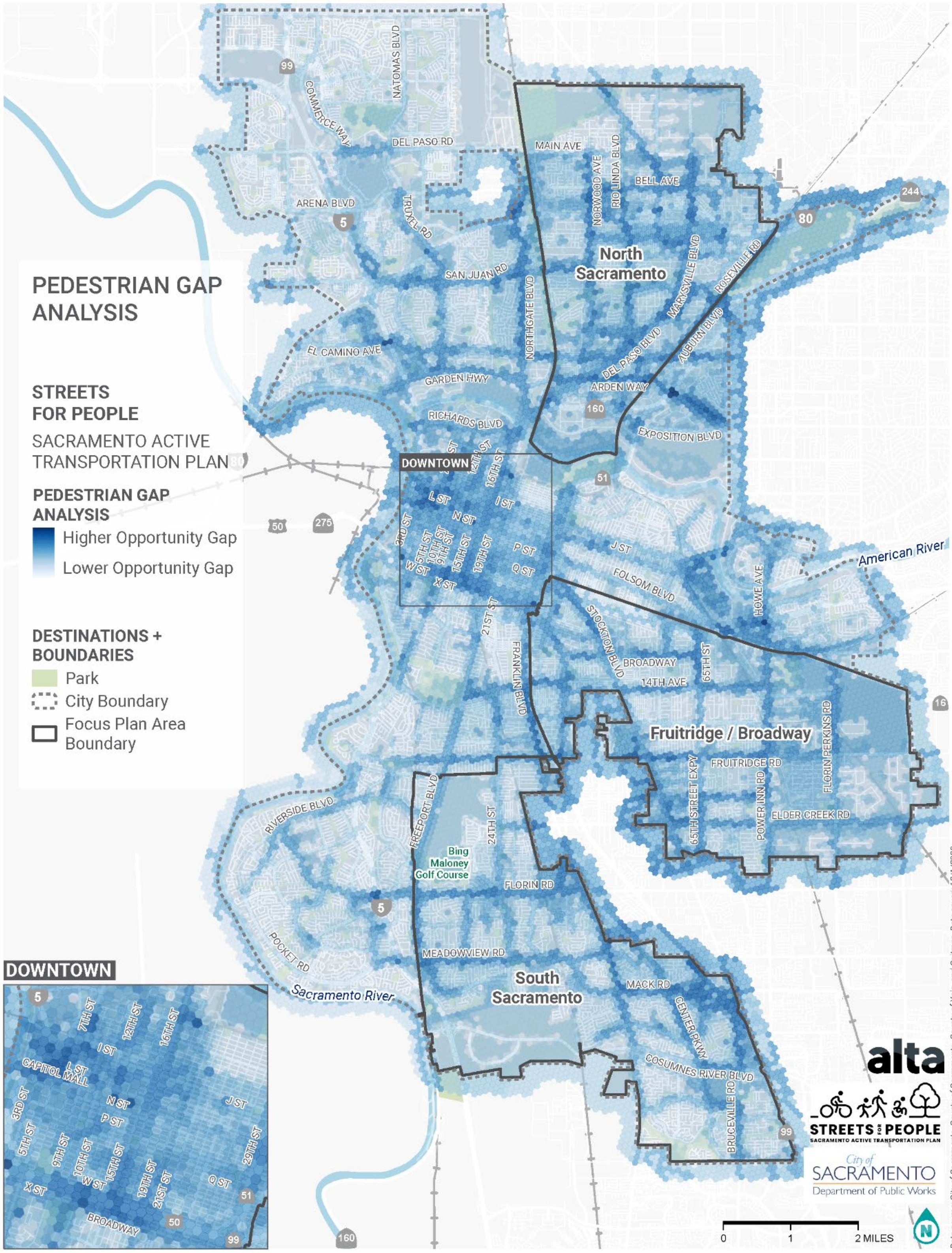


Figure 70. Gap Analysis Scoring for People Walking

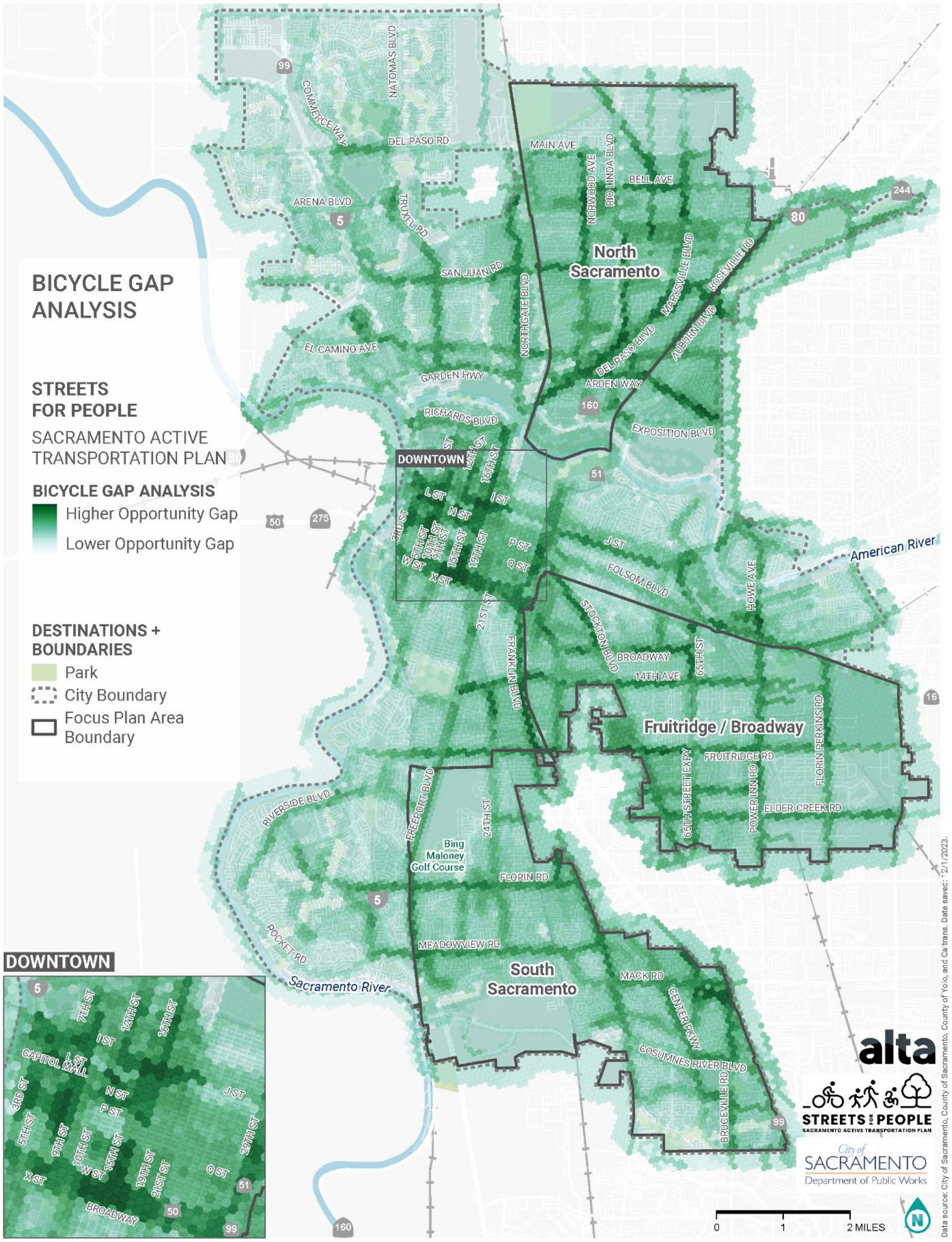


Figure 71. Gap Analysis Scoring for People Biking

Citywide Gap Findings

Using an overlay of the citywide Gap Evaluation Grid and existing facilities, Alta identified a total of 64 critical gaps throughout the city as shown in **Figure 72** and summarized in **Table 24**.

The following needs were considered in recognizing these gaps:

- Key gaps in existing bicycle networks, intersection crossing needs, and other conflict points
- Gaps in walking networks, such as sidewalk gaps, crossing needs in areas of pedestrian activities or at crossings of streets and other public rights-of-way
- Opportunities to improve existing bicycle facilities or sidewalks to provide a more comfortable user experience
- Possible new trail opportunities along waterways or other infrastructure rights-of-way, between isolated neighborhoods, or adjacent to public street rights-of-way
- Major barriers that currently prevent safe and comfortable access across Sacramento

Many of the top-scoring gaps are located along major arterials like Franklin Boulevard and Arden Way and have missing or incomplete bike facilities and/or sidewalks with minimal separation from vehicle traffic. Other gaps are identified on roads like J Street and I Street, which have bike lanes that may not provide the level of separation necessary for a comfortable user experience on multilane roads. It is important to note that some of these corridors have near-term projects either planned or in design such as on Broadway, Franklin Boulevard, Florin Road, Fruitridge Road, and Marysville Boulevard. These projects will be reviewed during the development of recommendations for the plan.

The highest scoring gaps citywide are described below.

- **Gap #48: 16th Street from Broadway to T Street**
  This gap for people walking and biking connects the existing bike lanes on Land Park Drive to the bike lane on T Street, providing a more comfortable crossing opportunity under I-80.
- **Gap #28: Franklin Boulevard from Fruitridge Road to Sutterville Road**
  The section of Franklin Boulevard from Fruitridge Road to Sutterville Road has no existing bike facilities and no separation from vehicle traffic for people walking on the sidewalks. This gap connects to existing bike lanes on Franklin Boulevard, Fruitridge Road, and Sutterville Road.
- **Gap #59: Arden Way from Harvard Street to Exposition Boulevard**
  Arden Way passes under I-80 between Harvard Street and Exposition Boulevard. There are no bike facilities and sidewalks only on one side of the road through the underpass. This gap connects to the bike lanes on Harvard Street, Heritage Lane, and Exposition Boulevard.
- **Gap #21: Norwood Avenue from Bell Avenue to Grand Avenue, including crossing over I-80**
  Norwood Avenue from Bell Avenue to Grand Avenue is an important walking and bicycling gap. This corridor connects existing bike lanes along Grand Avenue to bike lanes along Bell Avenue, Robla Community Park, and the Sacramento Northern Bike Trail.
- **Gap #51: 7th Street from T Street to O Street**
  7th Street in downtown Sacramento from T Street to O Street is a gap in the existing network for people biking. The one-way street has no bike facilities and connects from the Capitol Mall to Southside Park and the bike lanes on T Street.

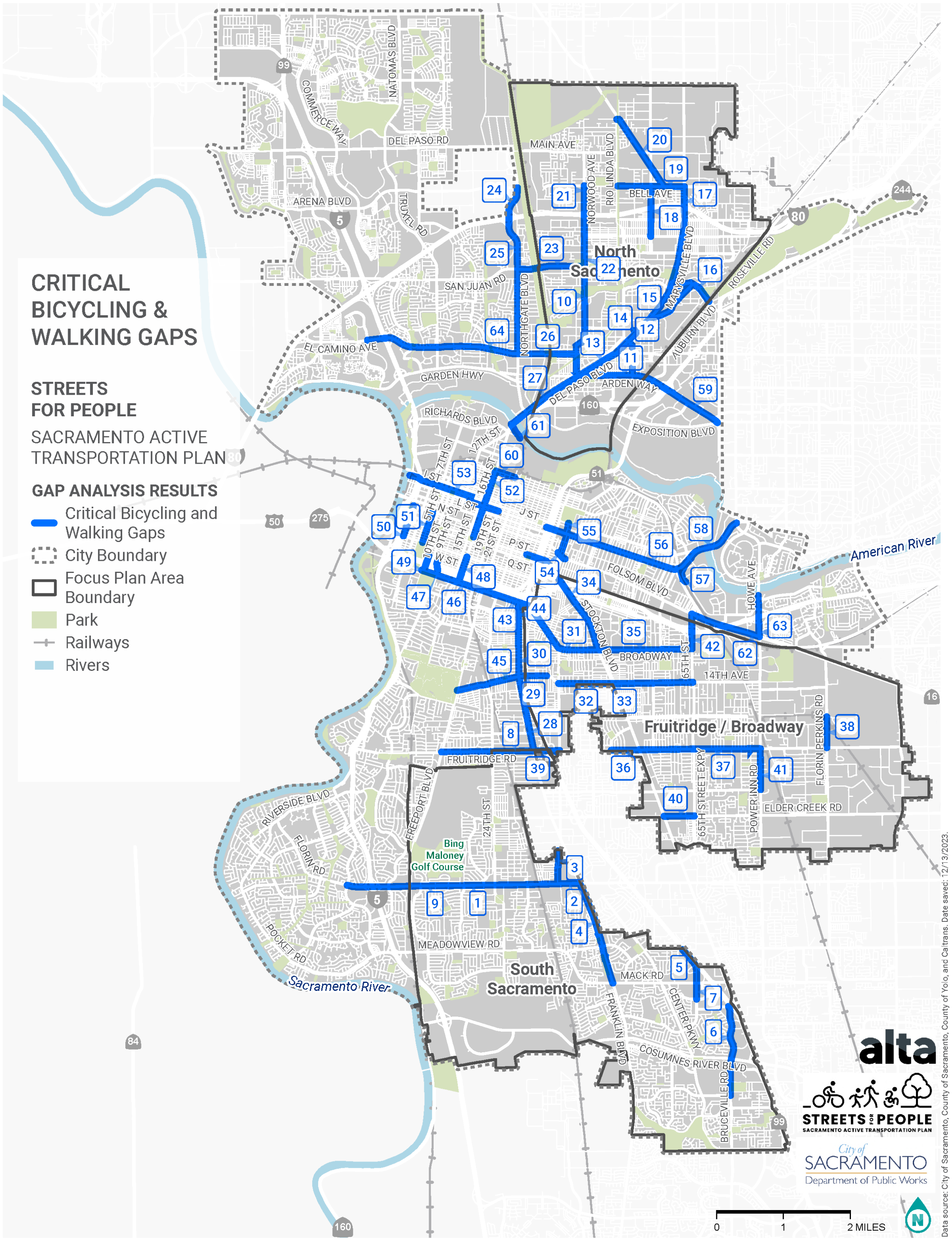


Figure 72. Citywide Critical Gaps

Table 24. Description and Scoring Results of Critical Gaps

Gap ID	Corridor	Road (From)	Road (To)	Focus Plan Area	Gap Type	On HIN	High PLTS	High BLTS	High Equity Need	High Walk ATP	High Bike ATP	High-Quality Walk Connection	High-Quality Bike Connection	Walk Gap Score	Bike Gap Score
1	Florin Rd	21st St	24th St	S. Sacramento	Bike + Walk	●	●	●	◐	●	●	◐	●	32.9	39.5
2	Florin Rd	24th St	Franklin Blvd	S. Sacramento	Bike + Walk	●	●	●	◐	◐	◐	○	◐	31.0	37.1
3	Luther Dr	Florin Rd	52nd Ave	S. Sacramento	Bike + Walk	●	●	●	●	◐	◐	◐	●	32.2	39.6
4	Franklin Blvd	Mack Rd	Florin Rd	S. Sacramento	Bike	●	●	●	◐	●	◐	○	◐	30.7	36.9
5	La Mancha Way	Mack Rd	Tangerine Ave	S. Sacramento	Walk	●	●	●	●	◐	◐	◐	◐	34.2	39.6
6	Bruceville Rd	Calvine Rd	Wyndham Dr	S. Sacramento	Bike	◐	●	●	◐	●	●	○	◐	30.0	36.5
7	Valley Hi Dr	Bruceville Rd	Mack Rd	S. Sacramento	Bike + Walk	●	●	●	◐	●	●	◐	◐	33.7	41.1
8	Fruitridge	Freeport Blvd	Franklin Blvd	S. Sacramento	Bike	●	●	●	◐	◐	◐	◐	●	29.6	37.1
9	Florin Rd	Greenhaven Dr	21st St	S. Sacramento	Bike	●	●	●	◐	◐	◐	◐	●	29.9	36.3
10	Grove Ave	Arden Wy	El Camino Ave	N. Sacramento	Bike	◐	◐	◐	●	◐	◐	○	◐	29.6	35.6
11	Arden Way	Del Paso Blvd	Harvard St	N. Sacramento	Bike + Walk	●	●	●	●	◐	◐	○	◐	33.8	39.6
12	Evergreen St	Arden Way	Del Paso Blvd	N. Sacramento	Bike + Walk	●	●	●	●	●	●	◐	◐	33.6	39.7
13	Del Paso Blvd	Arden Way	El Camino Ave	N. Sacramento	Bike	●	◐	◐	●	●	●	○	◐	31.1	39.2
14	Del Paso Blvd	Eleanor Ave	Olivera Way	N. Sacramento	Bike	●	●	●	●	◐	◐	○	◐	31.8	36.2

Gap ID	Corridor	Road (From)	Road (To)	Focus Plan Area	Gap Type	On HIN	High PLTS	High BLTS	High Equity Need	High Walk ATP	High Bike ATP	High-Quality Walk Connection	High-Quality Bike Connection	Walk Gap Score	Bike Gap Score
15	Marysville Blvd and Del Paso Blvd	Las Palmas Ave	Arcade Blvd	N. Sacramento	Bike + Walk	●	●	●	●	◐	◐	◐	●	33.5	41.2
16	Arcade Blvd	Marysville Blvd	Roseville Rd	N. Sacramento	Bike + Walk	●	●	●	●	◐	◐	◐	●	31.5	40.3
17	Raley Blvd	Near I-80	Bell Ave	N. Sacramento	Bike + Walk	●	●	●	●	◐	◐	○	◐	32.2	37.8
18	Dry Creek Rd	Near I-80	Xandria Dr	N. Sacramento	Walk	◐	●	●	●	◐	◐	◐	●	30.2	38.5
19	Bell Ave	Rio Linda Blvd	Raley Blvd	N. Sacramento	Bike	●	●	●	●	◐	◐	○	●	31.1	39.9
20	Marysville Blvd	Bell Ave	Rio Linda Blvd	N. Sacramento	Bike	●	●	●	◐	◐	◐	◐	●	29.4	36.2
21	Norwood Ave	Bell Ave	Grand Ave	N. Sacramento	Bike + Walk	●	●	●	●	◐	●	◐	●	34.3	42.0
22	Norwood Ave	Grand Ave	Carroll Ave	N. Sacramento	Bike	●	●	●	●	◐	◐	◐	●	32.5	40.0
23	Silver Eagle Rd	Northgate Blvd	Norwood Ave	N. Sacramento	Bike	◐	●	●	●	◐	◐	◐	●	31.1	37.9
24	Northgate Blvd	Rosin Ct	N Market Blvd	N. Sacramento	Bike + Walk	●	●	●	◐	◐	◐	◐	◐	33.0	38.0
25	Northgate Blvd	West El Camino Ave	Rosin Ct	N. Sacramento	Bike + Walk	●	●	●	●	●	●	○	◐	33.1	39.2

Gap ID	Corridor	Road (From)	Road (To)	Focus Plan Area	Gap Type	On HIN	High PLTS	High BLTS	High Equity Need	High Walk ATP	High Bike ATP	High-Quality Walk Connection	High-Quality Bike Connection	Walk Gap Score	Bike Gap Score
26	West El Camino Ave	Northgate Blvd	East Levee Rd	N. Sacramento	Bike	●	●	●	●	◐	◐	○	◐	30.2	35.1
27	Del Paso Blvd	Two Rivers Bike Trail	Arden Way	N. Sacramento	Bike + Walk	◐	◐	●	●	◐	◐	◐	●	29.6	36.7
28	Franklin Blvd	Fruitridge Rd	Sutterville Rd	Fruitridge/ Broadway	Bike + Walk	●	●	●	●	●	●	◐	●	34.5	42.8
29	12th Ave	Franklin Blvd	36th St	Fruitridge/ Broadway	Bike	●	●	●	◐	◐	◐	◐	●	32.2	41.0
30	Franklin Blvd	12th Ave	2nd Ave	Fruitridge/ Broadway	Bike	●	●	●	◐	●	●	◐	●	28.8	38.3
31	Broadway	Alhambra Blvd	Stockton Blvd	Fruitridge/ Broadway	Bike	●	◐	●	◐	●	●	○	◐	29.5	37.2
32	14th Ave	Martin Luther King Jr Blvd	Stockton Blvd	Fruitridge/ Broadway	Bike	◐	●	●	◐	◐	◐	◐	●	26.6	36.2
33	14th Ave	Stockton Blvd	65th St	Fruitridge/ Broadway	Bike	●	●	●	◐	◐	◐	◐	●	29.5	38.3
34	Stockton Blvd	Broadway	28th St	Fruitridge/ Broadway	Bike + Walk	●	●	●	◐	●	●	○	●	30.4	38.7
35	Broadway	Stockton Blvd	65th St	Fruitridge/ Broadway	Bike	●	●	●	◐	◐	◐	◐	●	30.5	37.7
36	Fruitridge Rd	Lawrence Dr	65th St	Fruitridge/ Broadway	Bike + Walk	●	●	●	◐	●	●	◐	●	33.5	41.6

Gap ID	Corridor	Road (From)	Road (To)	Focus Plan Area	Gap Type	On HIN	High PLTS	High BLTS	High Equity Need	High Walk ATP	High Bike ATP	High-Quality Walk Connection	High-Quality Bike Connection	Walk Gap Score	Bike Gap Score
37	Fruitridge Rd	65th St	Power Inn Rd	Fruitridge/ Broadway	Bike + Walk	●	●	●	◐	◐	◐	○	◐	31.4	37.2
38	Florin Perkins Rd	Fruitridge Rd	23rd Ave	Fruitridge/ Broadway	Bike	●	●	●	●	◐	◐	◐	●	31.5	39.2
39	Fruitridge Rd	Franklin Blvd	Martin Luther King Jr Blvd	Fruitridge/ Broadway	Bike + Walk	●	●	●	●	◐	◐	◐	●	32.9	39.0
40	Elder Creek Rd	Stockton Blvd	65th St	Fruitridge/ Broadway	Bike	●	●	●	◐	◐	◐	○	◐	32.0	38.2
41	Power Inn Rd	Lemon Hill Ave	Fruitridge Rd	Fruitridge/ Broadway	Bike + Walk	●	●	●	◐	◐	◐	○	◐	31.9	37.6
42	65th St	Broadway	Folsom Blvd	Fruitridge/ Broadway	Bike + Walk	●	●	●	◐	●	●	○	◐	30.3	35.7
43	Broadway	24th St	Alhambra Blvd	Outside Focus Plan Area	Bike	●	●	●	◐	●	●	○	●	29.3	39.0
44	Franklin Blvd	Broadway	2nd Ave	Outside Focus Plan Area	Bike	●	●	●	◐	●	●	○	●	28.1	39.3
45	Sutterville Blvd	Freeport Blvd	Franklin Blvd	Outside Focus Plan Area	Bike	●	●	●	◐	●	●	◐	●	30.1	38.3
46	Broadway	Muir Way	24th St	Outside Focus Plan Area	Bike + Walk	●	●	●	◐	●	●	○	◐	31.3	38.9
47	Riverside Blvd	Broadway	Victorian Aly	Outside Focus Plan Area	Bike + Walk	●	●	●	◐	●	●	○	◐	32.8	39.6

Gap ID	Corridor	Road (From)	Road (To)	Focus Plan Area	Gap Type	On HIN	High PLTS	High BLTS	High Equity Need	High Walk ATP	High Bike ATP	High-Quality Walk Connection	High-Quality Bike Connection	Walk Gap Score	Bike Gap Score
48	16th St	Broadway	T St	Outside Focus Plan Area	Bike + Walk	●	●	●	●	●	●	○	●	33.0	43.4
49	9th St	Broadway	V St	Outside Focus Plan Area	Bike	●	◐	●	◐	●	●	○	◐	30.3	38.9
50	3rd St	T St	N St	Outside Focus Plan Area	Bike	●	◐	●	◐	●	●	○	●	28.1	39.3
51	7th St	T St	O St	Outside Focus Plan Area	Bike	●	◐	●	◐	●	●	○	●	26.8	41.9
52	16th St	T St	C St	Outside Focus Plan Area	Bike + Walk	●	◐	●	◐	●	●	○	◐	30.6	40.9
53	J St & I St	Front St	16th St	Outside Focus Plan Area	Bike + Walk	◐	◐	●	●	●	●	○	◐	31.0	39.9
54	Folsom Blvd	32nd St	35th St	Outside Focus Plan Area	Bike	●	●	●	◐	●	●	○	◐	27.4	34.8
55	33rd St	Folsom Blvd	H St	Outside Focus Plan Area	Bike + Walk	◐	◐	◐	◐	●	●	○	◐	21.4	28.3
56	J St	29th St	55th St	Outside Focus Plan Area	Bike	●	●	●	◐	●	●	○	●	26.1	37.0
57	Off-Road Trail #1	CSUS Trail	Jedediah Smith National Recreation Trail Access	Outside Focus Plan Area	Bike + Walk	◐	◐	◐	◐	●	●	◐	◐	31.7	35.6
58	Fair Oaks Blvd	55th St	Howe Ave	Outside Focus Plan Area	Bike + Walk	◐	●	●	◐	◐	◐	◐	◐	29.3	34.1

Gap ID	Corridor	Road (From)	Road (To)	Focus Plan Area	Gap Type	On HIN	High PLTS	High BLTS	High Equity Need	High Walk ATP	High Bike ATP	High-Quality Walk Connection	High-Quality Bike Connection	Walk Gap Score	Bike Gap Score
59	Arden Way	Harvard St	Exposition Blvd	Outside Focus Plan Area	Bike + Walk	●	●	●	●	◐	◐	◐	●	34.7	42.2
60	C St	16th St	20th St	Outside Focus Plan Area	Bike + Walk	◐	◐	◐	●	●	●	◐	◐	28.7	29.2
61	Off-Road Trail #2	Two Rivers Bike Trail at 12th St		Outside Focus Plan Area	Bike + Walk	◐	◐	◐	●	◐	◐	◐	◐	26.8	26.9
62	Folsom Blvd	65th St	Power Inn Rd	Outside Focus Plan Area	Bike + Walk	●	●	●	◐	◐	◐	○	◐	30.2	36.6
63	Power Inn Rd	Folsom Blvd	Jedediah Smith National Recreation Trail Access	Outside Focus Plan Area	Bike + Walk	●	●	●	◐	●	◐	◐	◐	33.9	40.0
64	El Camino Ave	Gateway Oaks Dr	Northgate Dr	Outside Focus Plan Area	Bike + Walk	●	●	●	◐	◐	◐	◐	◐	29.2	33.2

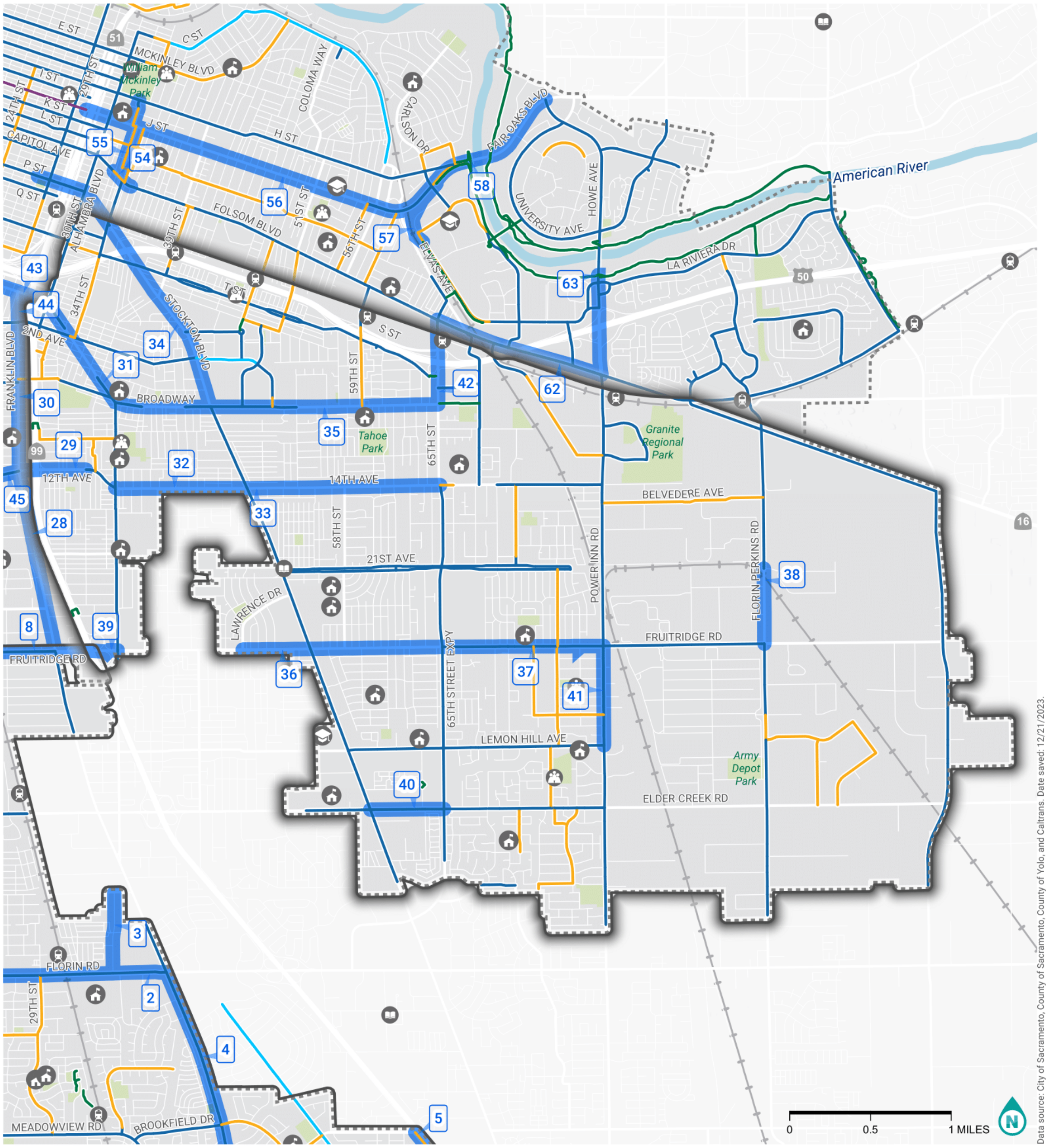
Focus Plan Area Findings

Of the 64 gaps identified citywide, 42 are located along roadways within the focus plan areas. The following sections show the gaps identified in each focus plan area and highlight the top-scoring gaps.

Fruitridge/Broadway

The following is a summary of infrastructure gaps identified within the Fruitridge/Broadway focus plan area. Figure 73 provides a geographical representation of the gaps.

- Gap #28: Franklin Boulevard from Fruitridge Road to Sutterville Road
  The section of Franklin Boulevard from Fruitridge Road to Sutterville Road has no existing bike facilities and no separation from vehicle traffic for people walking on the sidewalks. This gap connects to existing bike lanes on Franklin Boulevard, Fruitridge Road, and Sutterville Road.
- Gap #36: Fruitridge Road from Lawrence Drive to 65th Street Expressway
  Fruitridge Road from Lawrence Drive to 65th Street is an important gap for people walking and biking because there are no bike facilities and no separation between existing sidewalks and the multilane road. This gap connects to the existing bike lanes on Fruitridge Road, 65th Street Expressway, and Stockton Boulevard.
- Gap #29: 12th Avenue from Franklin Boulevard to 36th Street
  This short section of 12th Avenue includes the SR 99 overpass which has no bike facilities and no buffer for people walking between the sidewalks and vehicle traffic. This gap creates a continuous bike facility connection on 12th Avenue, connecting to the existing bike lanes to the east and west.



CRITICAL BICYCLING & WALKING GAPS

FRUITRIDGE/BROADWAY

STREETS FOR PEOPLE

SACRAMENTO ACTIVE TRANSPORTATION PLAN

GAP ANALYSIS RESULTS
- Critical Bicycling and Walking Gaps

EXISTING BIKEWAYS
- Shared-Use Path
- Bike Lane
- Buffered Bike Lane
- Bike Route
- Separated Bikeway

DESTINATIONS + BOUNDARIES
- Light Rail Station
- K-12 Public School
- College / University
- Library
- Community Center
- Park
- City Boundary
- Focus Plan Area Boundary

Figure 73. Fruitridge/Broadway Critical Gaps

North Sacramento

The following is a summary of infrastructure gaps identified within the North Sacramento focus plan area. Figure 74 provides a geographical representation of the gaps.

- **Gap #21: Norwood Avenue from Bell Avenue to Grand Avenue, including crossing over I-80**
  Norwood Avenue from Bell Avenue to Grand Avenue is an important walking and bicycling gap. This corridor connects existing bike lanes along Grand Avenue to bike lanes along Bell Avenue, Robla Community Park, and the Sacramento Northern Bike Trail.
- **Gap #15: Marysville Boulevard and Del Paso Boulevard from Las Palmas Avenue to Arcade Boulevard**
  Marysville Boulevard and Del Paso Boulevard from Las Palmas Avenue to Arcade Boulevard is a critical bicycling and walking gap. Enhancing walking and bicycling in this area may include connecting the existing bike facilities on Del Paso Boulevard, which end near Las Palmas Avenue northward, to those on Arcade Boulevard and High Street. Key destinations for those walking and bicycling in this area include commercial and industrial areas to the south, Hagginwood Elementary School, and Hagginwood Park to the north.
- **Gap #16: Arcade Boulevard from Marysville Boulevard to Roseville Road and Haggin Oaks Trail**
  Arcade Boulevard from Marysville Boulevard to Roseville Road is a critical east-west bicycling gap. Improving this area for bicycling might include connecting existing facilities on Arcade Boulevard west of Marysville Boulevard to on-street facilities east of the railroad tracks including Haggin Oaks Trail. Closing this gap would connect community destinations like Hagginwood Park and Arcade Creek to John Mackey Memorial Park and points west of Auburn Boulevard.

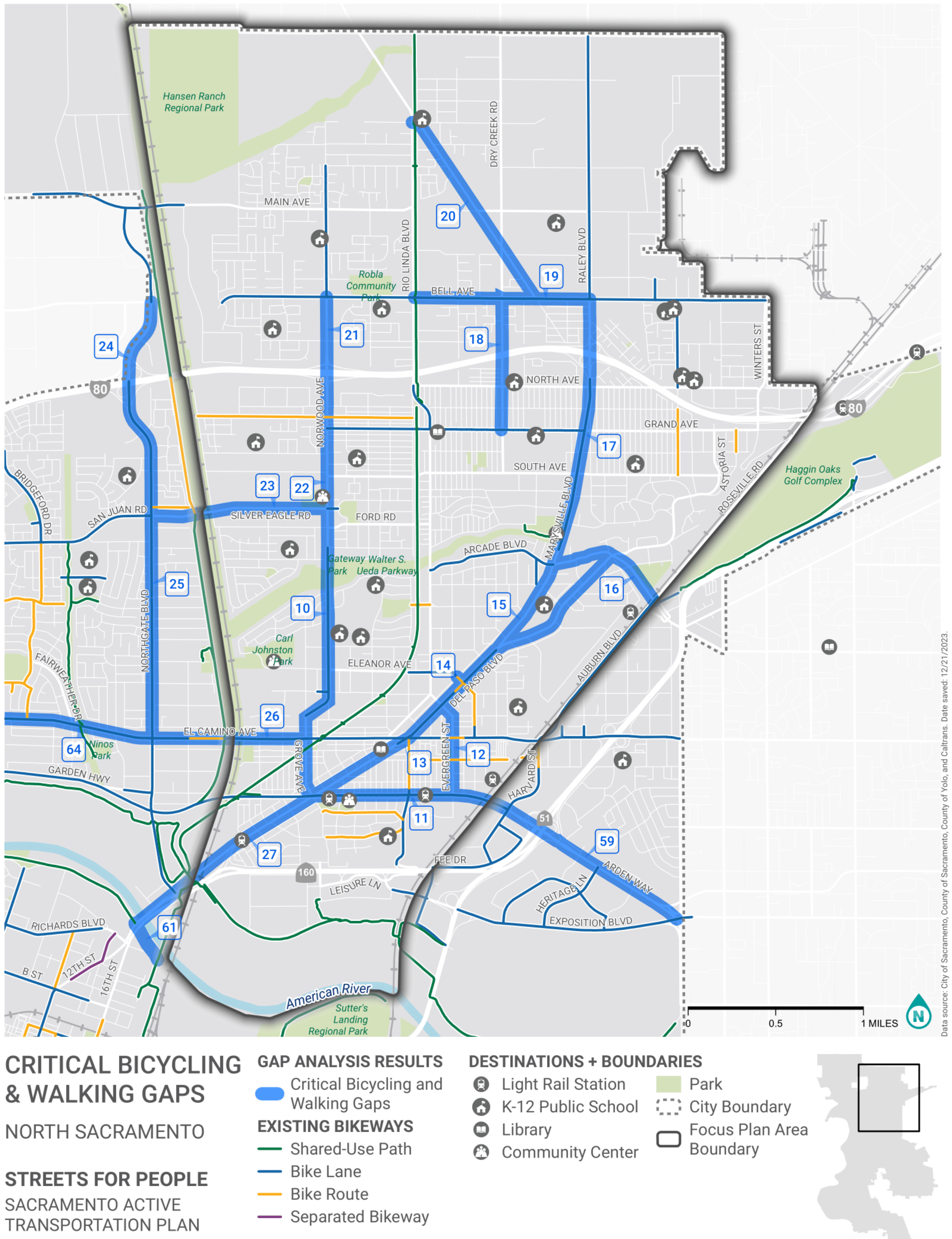


Figure 74. North Sacramento Critical Gaps

South Sacramento

The following is a summary of infrastructure gaps identified within the South Sacramento focus plan area. Figure 75 provides a geographical representation of the gaps:

- **Gap #7: Critical Gap Closure for people walking and biking along Valley Hi Drive from Bruceville Drive to Mack Road**
  There is a short (quarter-mile) gap in the bike network between the existing bike lane on Valley Hi Drive between Bruceville Road and Mack Road, breaking the continuous north-south connection in an area with some of the highest bike demand in the city. Closing this gap would create continuous connections to Kaiser Permanente Medical Center and the surrounding commercial areas from the nearby residential areas along and to the north of Mack Road.
- **Gap #3: Equity Priority Gap for people walking and biking along Luther Drive from Florin Road to 52nd Avenue**
  Luther Drive is the sole connection to the low-income mobile home community on Luther Drive, which is currently a high-stress environment for people biking. This gap currently lacks bicycle facilities. At present, the road has a posted speed limit of 40 mph with two wide travel lanes. Closing this gap would connect any students in the community to Burbank High School, utilizing the existing crossing at Florin Road and Luther Drive, as well as connect residents more broadly to the Florin light rail station and commercial center at Southgate Plaza.
- **Gap #5: Key Connection for people walking along La Mancha Way from Mack Road to Tangerine Avenue**
  This stretch of La Mancha Way is located in a destination-rich area with walking demand in the 90th percentile citywide, but it lacks a complete sidewalk on one side of the road, and a lack of separation from traffic on the existing sidewalk creates a high-stress walking environment. The gully running along the north end of Southpointe Plaza restricts connectivity for people walking from the residential area to the north to Center Parkway and La Mancha Way. Improving the facilities for people walking along this gap would provide a low-stress connection for residents of the multifamily development to the north to key destinations like grocery stores, the Kaiser Permanente Medical Center, and bus stops along Mack Road and Valley Hi Drive.

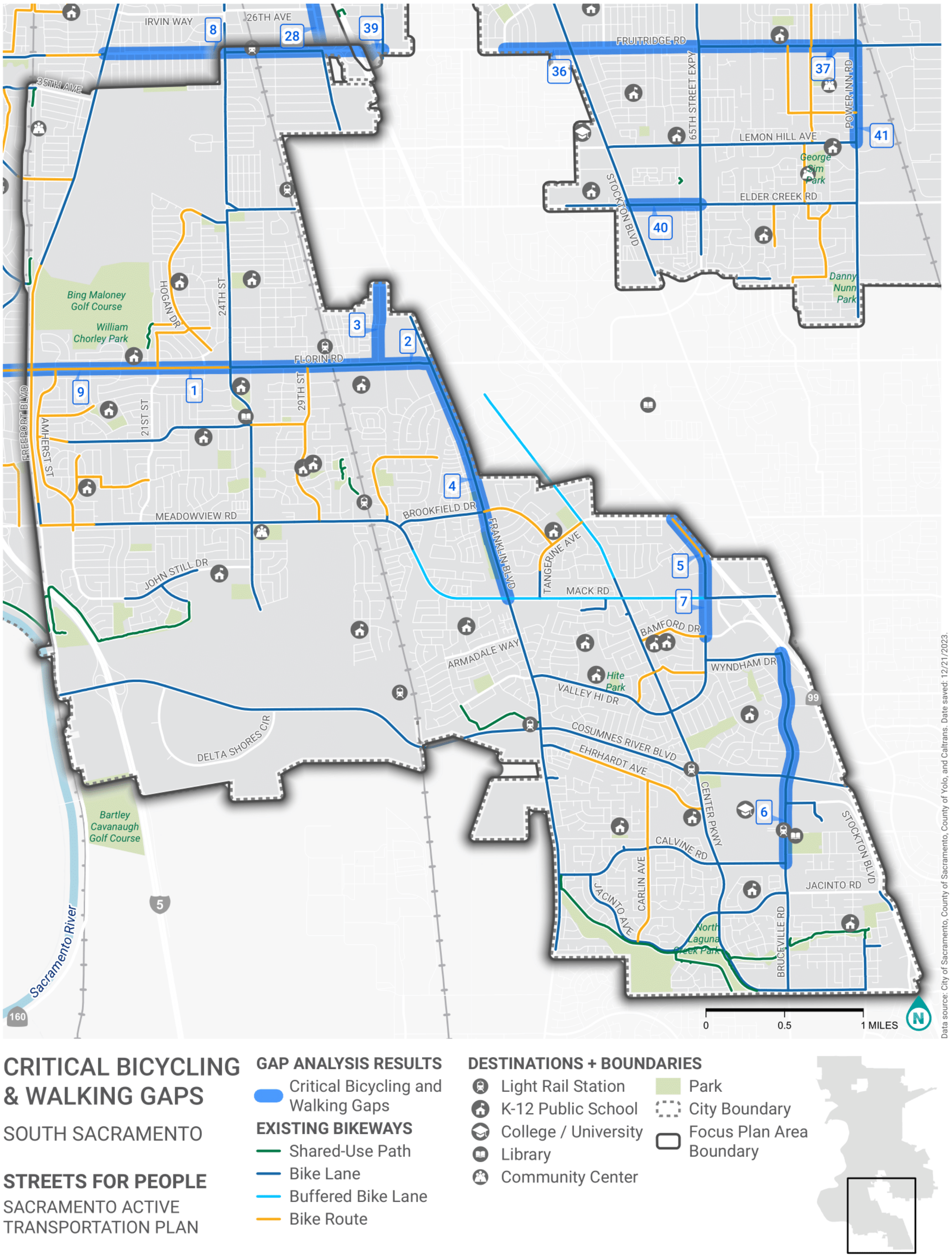


Figure 75. South Sacramento Critical Gaps

7. Next Steps

Alta anticipates using the results of this analysis coupled with feedback from public and stakeholder groups to define the final recommendations for infrastructure upgrades for City roadways. Please note that the list of projects and recommendations contained in the final *Streets for People* plan will require further evaluation on a case-by-case basis.

This evaluation would identify the most appropriate context-sensitive improvements based on the unique characteristics of that corridor, such as land-use context, available right-of-way, user comfort, and traffic conditions among others. Additionally, facility recommendations developed for the plan may also consider roadways that are important for other reasons: for example, a connection to a neighboring jurisdiction's bike network even in an area where there might be a lower Gap Evaluation Grid score. These recommendations will then be further refined and evaluated through the public engagement process.

Appendix A: Active-Trip Potential Methodology

Background

Not all locations can easily support active transportation modes due to unsupportive infrastructure or long trip distances making biking, walking, and rolling challenging. While emerging modes such as e-bikes and e-scooters provide new options, ranges, and convenience, their ability to affect change is often contextually defined by an area's land use and supporting infrastructure.

For example, a Brookings report[15] examined the trip distances in major metropolitan areas of the United States and found that neighborhoods both closer to the urban core and designed to human-scale had a greater number of trips that were less than three miles in length. In the review, the study authors found that about half of all trips in the areas studied were short trips, under four miles in length. In addition, 22-30% of all trips were one mile or less in length. These short trips represent the potential market for walking, biking, and electrified micromobility (i.e., e-scooters and e-bikes).

As one might expect, this pattern of short trips is most frequently observed in cities. In a recent review, 20 bicycle-friendly cities were "characterized by high-density urban development, diversified land-use planning, and a safe and comfortable transport network".[16] These cities not only share traits such as compact neighborhoods and small geographic areas that facilitate shorter trip distances, but also contain necessary infrastructure to unlock that potential.

Based on these reviews, the project team examined the Active-Trip Potential (ATP) in Sacramento by estimating the number of trips with suitable distances to be served by active modes.

Methodology

The project team used data from Replica Places, an activity-based travel demand model, to examine all trip ends whose overall lengths are less than one mile for potential walking trips, three miles for potential biking trips, and six miles for electric micromobility trips. Trip distance is an important factor in mode choice and trips less than one mile, three miles, and six miles are considered reasonable distances for walk, bike, and e-micromobility modes, respectively, based on trip distances from the 2017 National Household Travel Survey (NHTS).[17]

The project team mapped the percentage of trips ending in each block group that fall within the distance bands of interest to illustrate which locations are likely to be suitable for active transportation. The trips considered represent travel on a typical weekday in the fall of 2022 conducted throughout the day (12 AM – 12 AM), which was the most up-to-date modeled estimates available at the time of analysis.

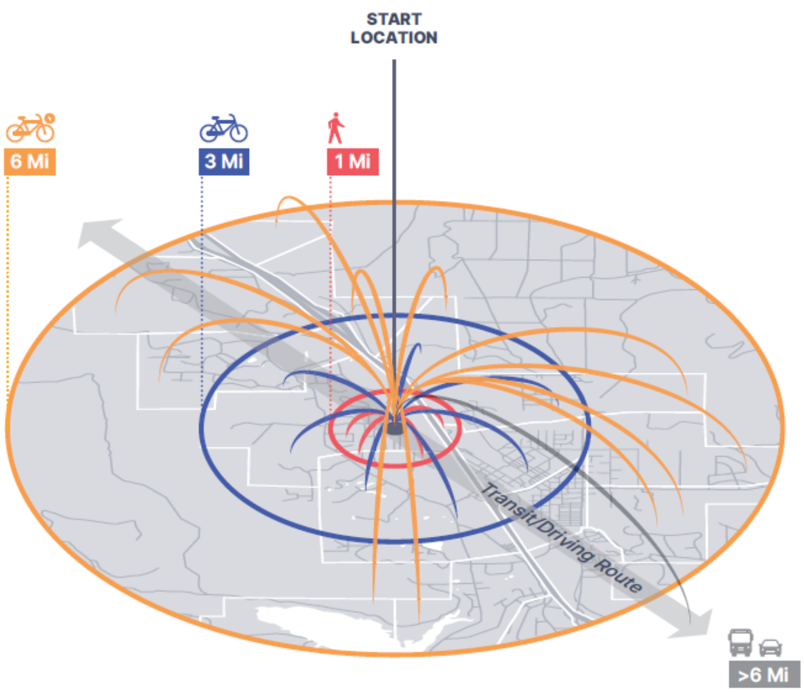
Trips were summarized to the census block group in which they terminated. Trips less than one, three, or six miles were identified and represented as a percentage of the total trips terminating in that census block group; each trip length estimates walking, biking, and e-micromobility active-trip potential for the given block group. These percentages were mapped, allowing for comparison of areas with greater or less potential for active travel. Figure A-1 visually summarizes the ATP process including the distance thresholds suitable for each mode.

[15] Brookings Institute. Tomer A., Kane J. Vey J. Connecting people and places: Exploring new measures of travel behavior. 2020. https://www.brookings.edu/interactives/connecting-people-and-places-exploring-new-measures-of-travel-behavior/

[16] Mohamed Zayed. Towards an index of city readiness for cycling. International Journal of Transportation Science and Technology 5. 210-225. 2017. https://www.sciencedirect.com/science/article/pii/S2046043016300399?via%3Dihub

[17] 2017 National Household Travel Survey Estimated Person Trips (ORNL, n.d.)

Active Trip Potential



Active Trip Potential (ATP)

Identifies trips whose distances are short enough to be accommodated by walking or biking.

Our evaluation of ATP includes looking at the number of trips less than three miles.

Different modes are suitable for different trips based on the transportation options that support them.

Walk Trip Potenial *(0-1mi)*

Bike Trip Potential *(1-3mi)*

E-Bike Trip Potential *(3-6mi)*

Drive and Transit Trip Potential *(>6mi)*

Figure A-1. Active-Trip Potential Explainer

Appendix B: Level of Traffic Stress Methodology

Background

Bicycle and pedestrian levels of service were assessed using a concept called Level of Traffic Stress (LTS). LTS analysis estimates the level of comfort for people biking or walking on a given roadway segment and identifies the degree to which roadways must be improved in order to provide a more comfortable experience for riders of all ages and abilities.

The completed LTS analysis for the bicycle and pedestrian networks ranked streets from low stress (LTS 1, suitable for all users) to high stress (LTS 4, suitable only for 'strong and fearless' bicyclists/pedestrians). The road network is derived from OpenStreetMap (OSM) data whose input attributes were augmented based on local bicycle and pedestrian facility data. Roadway characteristics like posted speed limit, number of lanes, and the presence of sidewalks or bike facilities affect LTS outcomes.

Methodology

The project team used a tiered data collection framework for LTS analysis and derived initial base analysis inputs from OSM data. Details of the assumptions used in this process are included in Appendix C. This base data was then supplemented with local datasets to provide additional infrastructure context.

Contextual Conflation

LTS analysis often requires bringing together multiple different datasets into a single unified dataset representing key attributes of the right-of-way. This is because the diversity of inputs required for this type of analysis is multimodal and is often represented in different municipal, state, or regional databases for each component. For example, sidewalk inventories for a pedestrian LTS might be maintained by a Public Works department, while the centerline network with roadway attributes related to speed limit might be maintained by another agency. To address this, conflation is the process by which the project team associated different datasets with each other to bring context and a unified understanding of the right-of-way. The process is described visually in Figure B-1.

Key Data Considerations

- The network data is derived from OSM and updated using existing bicycle infrastructure data provided by the City of Sacramento. The lane geometry, speed limit, and other input values were based on values in OSM, and the inference assumptions associated with it are detailed in Appendix C.
- Similarly, the sidewalk data provided by the City was integrated to inform the pedestrian level of traffic stress analysis.
- Intersections were not considered as part of this analysis. Crossings play a role in experience for both pedestrians and people who bike and should be considered when performing more detailed site and network assessment.

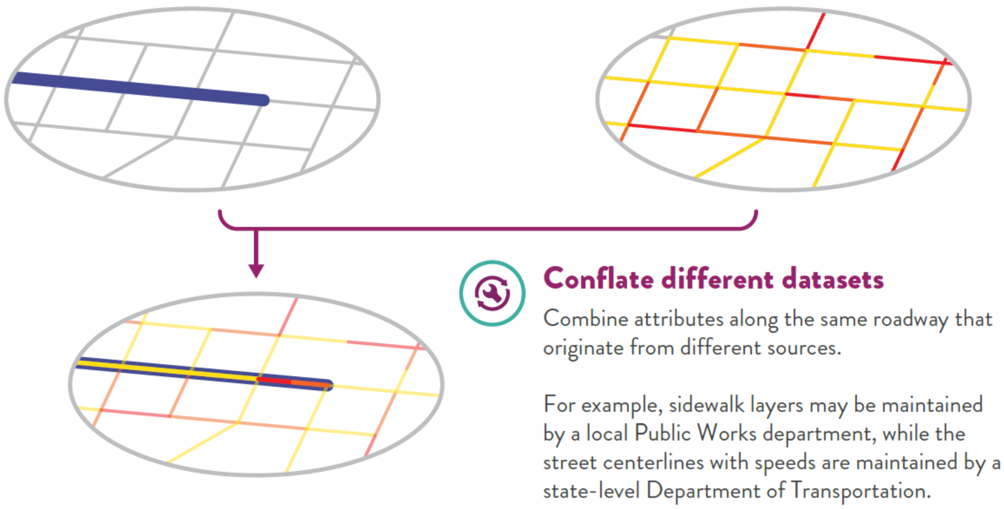


Figure B-1. Alta Conflation Explainer

Bicycle Level of Traffic Stress

The bicycle level of traffic stress (BLTS) analysis estimates the level of comfort for people biking on a given roadway segment. The BLTS analysis will identify where "gaps" or deficiencies in a bike network exist and provides a measure of how likely different types of riders, based on ability and comfort level, are to use the facility.

The BLTS analysis methodology is adapted from the 2012 Mineta Transportation Institute Report 11-19: *Low-Stress Bicycling and Network Connectivity.*[18] BLTS is determined by characteristics of a given roadway segment that affect a bicyclist's perception of safety and comfort, including posted speed limit, number of travel lanes, and the presence and character of bicycle lanes.

The combination of this criteria classifies a road segment into one of four levels of traffic stress:

- BLTS 1 represents roadways where bicyclists of all ages and abilities would feel comfortable riding. These roadways are generally characterized by low volumes, low speeds, no more than two travel lanes, and traffic control measures at intersections. These roadways may have bicycle facilities; separated shared-use paths for bicycles also fall into this category.
- BLTS 2 represents slightly less comfortable roadways, where most adults would feel comfortable riding.
- BLTS 3 represents moderately uncomfortable roadways, where most experienced bicyclists would feel comfortable riding.
- BLTS 4 represents high-stress roadways where only strong and fearless bicyclists would feel comfortable riding. These roadways are generally characterized by high volumes, high speeds, several travel lanes, and complex transitions approaching and crossing intersections.

The results of the BLTS analysis identify existing areas that are low stress for many bicyclists, as well as the degree to which roadways must be improved in order to provide a comfortable experience for riders of all ages and abilities. The specific assumptions for the BLTS are included in Appendix D.

The BLTS analysis was completed through an assessment of street segments using spatial data and some manual review of aerial imagery. In situations where bike facilities do not span the entire road segment or are available

[18] Mineta Institute. Mekuria M., Furth P., Nixon H. *Low-Stress Bicycling and Network Connectivity*. 2012. https://transweb.sjsu.edu/research/Low-Stress-Bicycling-and-Network-Connectivity.

on only one side of the street, the analysis follows a "weakest link" philosophy, and the entire segment is evaluated as though there is no facility.

Data sources for the BLTS are summarized in **Table B-1**.

Table B-1. Data Sources and Notes for BLTS Analysis

Data	Source	Notes
Posted speed limit	City of Sacramento	Cross-checked with City posted speed limit map.
Number of travel lanes	OpenStreetMap (OSM)	Roads flagged as tertiary roads with posted speed limits less than 35 mph assumed to have two lanes, unless the number of lanes was explicitly provided. Full OSM assumptions are documented in **Appendix C**.
One-way status	OSM	Divided arterials are effectively treated as one-way facilities.
Centerline presence	OSM	Residential and local roads are assumed to have no centerline.
Bike facility width	City of Sacramento bike facilities	Assumed bike lanes, buffered bike lanes, and separated bike lanes are 5 ft wide, and shared-use paths are 10 ft wide.
Bike facility buffer width	City of Sacramento bike facilities	Assumed buffered bike lanes and separated bike lanes have a 3-ft buffer.
Bike facility protection	City of Sacramento bike facilities	Assumed shared-use paths and separated bike lanes are protected facilities.

Pedestrian Level of Traffic Stress

The pedestrian level of traffic stress (PLTS) analysis estimates the level of comfort for people walking on a given roadway segment. The PLTS analysis identifies where "gaps" or deficiencies in a pedestrian network exist and provides a measure of how likely pedestrians are to use the facility, based on ability and comfort level.

The PLTS analysis methodology is adapted from the Oregon Department of Transportation's Analysis Procedures Manual; it is intended as a companion for bicycle level of traffic stress (BLTS). PLTS is determined by characteristics of a given roadway segment that affect a pedestrian's perception of safety and comfort including sidewalk presence and width, sidewalk buffer width and type, posted speed limit, and number of travel lanes.

PLTS scores classify road segments into one of four levels of traffic stress and, while similar to BLTS scores, PLTS considers the level of attention required in addition to the user experience:

- **PLTS 1** represents roadways where pedestrians of all ages and abilities would feel comfortable walking and require little attention to traffic.
- **PLTS 2** represents slightly less comfortable roadways that require more attention to traffic and are suitable for children over 10, teens, and adults.
- **PLTS 3** represents moderately uncomfortable roadways, where most able-bodied adults would feel uncomfortable but safe.
- **PLTS 4** represents high traffic stress and would be used only by able-bodied adults with limited route choices.

The results of the PLTS analysis identify existing areas that are low stress for pedestrians, as well as the degree to which roadways must be improved in order to provide a comfortable experience for pedestrians of all ages and abilities.

The analysis is intended for use in urban areas specifically; while it can be used in rural conditions where pedestrian facilities exist, the methodology will yield a high PLTS score (greatest discomfort) where high-speed traffic is present. Additional details and the specific assumptions for the PLTS are included in **Appendix E**.

Data sources for the PLTS are summarized in **Table B-2**.

Table B-2. Data Sources and Notes for PLTS Analysis

Data	Source	Notes
Posted speed limit	City of Sacramento road centerlines	Cross-checked with City posted speed limit map.
Number of travel lanes	OpenStreetMap (OSM)	Roads flagged as tertiary roads with posted speed limits less than 35 mph assumed to have two lanes, unless the number of lanes was explicitly provided. Full OSM assumptions are documented in **Appendix C**.
One-way status	OSM	Divided arterials are effectively treated as one-way facilities.
Centerline presence	OSM	Residential and local roads assumed to have no centerline.
Sidewalk presence	City of Sacramento sidewalks	Indicates if sidewalk is complete on both, one, or no sides along the road segment.
Sidewalk width	City of Sacramento sidewalks	Assumed to be 5 ft wide where width data not available.
Sidewalk buffer width	City of Sacramento sidewalks	Assumed to be 5 ft wide where planter boxes are noted.
Sidewalk buffer type	City of Sacramento sidewalks, City of Sacramento LIDAR land cover	Assumed curb only by default. If a planter box is present, assumed landscaped buffer. Presence of street trees in buffer inferred from land cover data.

Appendix C: Level of Traffic Stress and OpenStreetMap Derivation Assumptions

Overview

This appendix documents how the project team used OpenStreetMap (OSM) to develop the base data for the level of traffic stress (LTS) analyses.

Alta uses the LTS methodology presented in the 2012 Mineta Transportation Institute Report 11-19: *Low-Stress Bicycling and Network Connectivity* to score roadway segments.[19] This analysis requires information on roadway characteristics like number of lanes, posted speeds, and presence of bike or pedestrian infrastructure. In locations where OSM data included values for lanes, posted speeds, bike lanes, sidewalks, parking lanes, and one-way tags, these tags were used to populate a database for LTS inputs. This base LTS data collection was supplemented where possible by local GIS data.

OpenStreetMap Processing

When using OSM networks for LTS analysis, there are several considerations for creating a useful network for visualization and analysis. The following sections outline steps for processed OSM data for LTS and related network analyses.

Background

OSM is a crowdsourced database of geographic features including administrative boundaries, street centerlines, points of interest, building footprints, physical and natural features, and other types of geographic information. OSM is one of the most prominent examples of volunteered geographic information, where community processes drive the contributions of geographic information to a shared database.[20] These geographic features are tagged based on their attributes, and while community wiki pages provide guidance on which tags apply to which features, there is no centralized authority that authenticates these contributions.

For example, street networks in OSM may include tags where contributors denote functional classification, number of lanes, one-way classification, speed limits, presence of sidewalks, and the type of bicycle facility that might be present on the network. While OSM is not always completely accurate, it has been benchmarked against comparable map data sources such as Google and found to have comparable or better accuracy for bike paths depending on the type of error.[21] Multiple non-profits, academics, and practitioners have found OSM to be an acceptable base for initial derivation of LTS analysis.[22,23,24,25]

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[19] Mineta Institute. Mekuria M., Furth P., Nixon H. *Low-Stress Bicycling and Network Connectivity*. 2012. https://transweb.sjsu.edu/research/Low-Stress-Bicycling-and-Network-Connectivity

[20] Mocnik, F.-B., A. Mobasheri, and A. Zipf. Open-Source Data Mining Infrastructure for Exploring and Analysing OpenStreetMap. Open Geospatial Data, Software and Standards, Vol. 3, No. 1, 2018, p. 7. https://doi.org/10.1186/s40965-018-0047-6.

[21] Hochmair, H. H., D. Zielstra, and P. Neis. Assessing the Completeness of Bicycle Trail and Lane Features in OpenStreetMap for the United States. Transactions in GIS, Vol. 19, No. 1, 2014, pp. 63–81. https://doi.org/10.1111/tgis.12081.

[22] PeopleForBikes. Bicycle Network Analysis. PeopleForBikes. https://peopleforbikes.org/placesforbikes/bicycle-network-analysis/.

[23] Conveyal. Better measures of Bike Accessibility. https://blog.conveyal.com/better-measures-of-bike-accessibility-d875ae5ed831

[24] Wasserman D, Rixey A, Zhou X (Elynor), Levitt D, Benjamin M. Evaluating OpenStreetMap's Performance Potential for Level of Traffic Stress Analysis. Transportation Research Record. 2019;2673(4):284-294. doi:10.1177/0361198119836772

[25] Mineta Institute. Chester Harvey, Kevin Fang, Daniel A. Rodriguez. Evaluating Alternative Measures of Bicycling Level of Traffic Stress Using Crowdsourced Route Satisfaction Data. 2019. https://scholarworks.sjsu.edu/mti_publications/276/

Network Connectivity

OSM networks contain segments that are not ready for network analysis in most instances. There are various software processing packages such as the Open-Source Routing Machine and OpenTripPlanner that come with routines to prepare OSM networks for network analysis. Alta uses scripts built on the OSMnx Python package to derive its geospatial networks.[26] This package is used to ensure that extracted networks are valid and have appropriate end-to-end connectivity provided by network segments. This process compiles all OSM networks where the highway tag is available, and the corresponding geometry is a line. For cartographic presentations, it is often preferable to filter out features such as service roads (roads within parking lots) and footways (sidewalks drawn separately from the centerline). This is typically done to focus attention on facilities that jurisdictions and regions can reasonably improve. – —

Tag Processing

In many cases, OSM data includes tags for attributes such as lanes, posted speed, bicycle infrastructure, and other facility information recorded in the database. This data tends to more likely be completed in urbanized areas globally, and on major facilities such as arterials and highways. There can be substantial variance in tag availability from location to location, but the presence of bike paths and a consistent indicator of functional classification is generally well recorded in OSM. In the case of bike lane blockage rates, Alta assumes these instances are rare unless manual review of commercial districts indicates otherwise. When tags are missing from OSM for the purposes of LTS analysis, the assumptions outlined in **Table C-1** are used as proxy values.

Table C-1. OpenStreetMap Assumptions for Missing Inputs

Functional Class	Lanes[1,2,3]	Centerline Present[3]
Residential	2	No
Living Street	2	No
Unclassified	2	Yes
Track	2	Yes
Tertiary	3[4]	Yes
Secondary	4	Yes
Primary	4	Yes
Trunk	6	Yes
Motorway	6	Yes
OTHER	2	Yes

1. Lane assumptions for one-way streets are halved to reflect an accurate per-segment assumption. In addition, all one-way streets are assumed to have medians for the purposes of LTS computations.
2. These assumptions only apply if there is no tag provided for speed limit or number of lanes.
3. These assumptions were developed based on Wasserman et al. 2019 and Harvey et al. 2019.
4. Roads flagged as tertiary roads with posted speed limits less than 35 mph assumed to have two lanes, unless the number of lanes was explicitly provided.

LTS analysis also requires an understanding of other geometric considerations, such as bicycle facility width and parking lane width (if present). Alta begins with a "benefit of the doubt" approach for these attributes, meaning that if they are present, they are assumed to be of sufficient width. Validation is recommended for detailed LTS

[26] Boeing, G. 2017. OSMnx: New Methods for Acquiring, Constructing, Analyzing, and Visualizing Complex Street Networks. Computers, Environment and Urban Systems 65, 126-139. doi:10.1016/j.compenvurbsys.2017.05.004.

assessments, but this is typically less important for less rigorous, or large-scale (e.g., county-, region-, or statewide) LTS-based analysis. Bicycle infrastructure-related tags are processed using assumptions outlined in Table C-2.

Table C-2. OpenStreetMap Assumptions for Bicycle Facilities

Cycleway Tag[1]	Bicycle Facility Type	Assumed Bicycle Facility Width (Feet)	Is Protected
Shared	Bike Route/Class III	0	No
Shared_lane	Bike Route/Class III	0	No
Lane	Bike Lane/Class II	6	No
Shared_busway	Bike Lane/Class II	6	No
Opposite_lane	Bike Lane/Class II	6	No
Cycleway[2]	Bike Path/Class I	10	Yes
Path	Bike Path/Class I	10	Yes
Track	Separated Bikeway/Class IV	8	Yes
Opposite_track	Separated Bikeway/Class IV	8	Yes
Buffered_lane	Separated Bikeway/Class IV	8	Yes
OTHER	NA	0	No

1. Alta processes nondirectional cycleway tags and directional cycleway tags as part of its conversion. The final LTS score is the worst-case score based on the direction of facilities.
2. Highway tags including the tag “cycleway” are also considered to be Class I facilities.

When parking lane-related tags are processed, assumptions related to their width and rates of bike lane blockage are outlined in Table C-3.

Table C-3. OpenStreetMap Assumptions for Parking Facilities

Parking Lane Tag	Assumed Parking Lane Width (Feet)
Parallel	8
Marked	8
Diagonal	16
Perpendicular	20
OTHER	NA

Appendix D: Bicycle Level of Traffic Stress Analysis Details

Methodology

BLTS analysis is completed through an assessment of street segments using spatial data and aerial imagery. Each segment of the roadway is evaluated based on its characteristics; if multiple scores are present within a segment, the highest (most stressful) score is used as the overall segment score. This would occur in situations where there is a bike facility on only one side of the street, or the bike facilities do not extend the entire road segment.

Figure D-1 illustrates the overall BLTS scoring process. Notes on data inputs and assumptions are found in Table D-1. Segment scores are assigned as shown in Table D-2 through Table D-5.

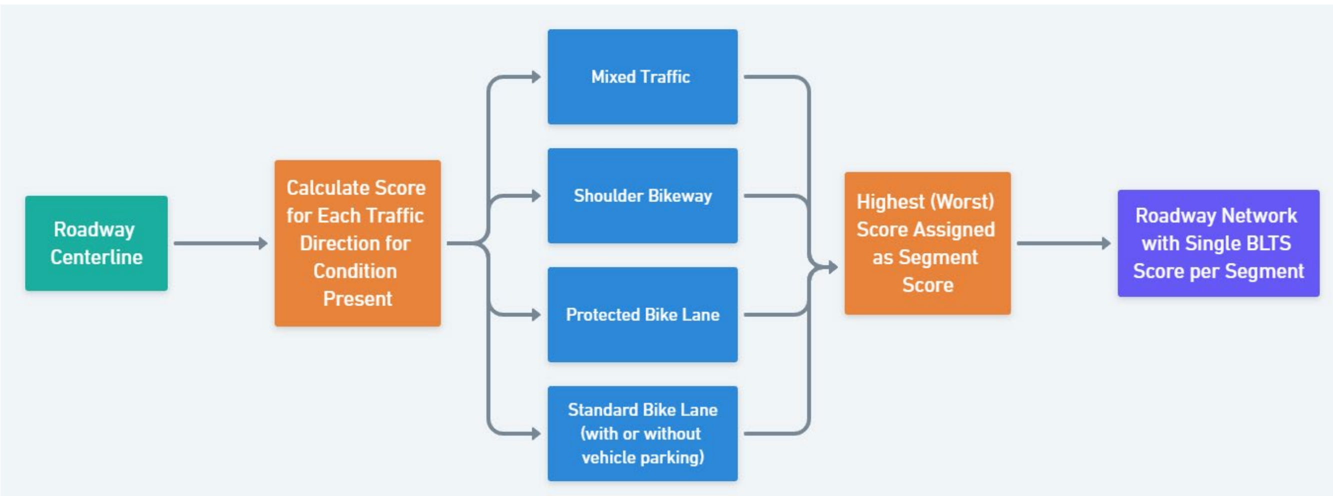

Figure D-1. Bicycle Level of Traffic Stress Generalized Segment Scoring Process

Table D-1: Data Inputs and Assumptions

Inputs	Notes	Assumptions
Bicycle Facilities	Bicycle lanes have a positive impact on BLTS and are a primary input for developing a BLTS model. The width of facilities can have an impact on the associated comfort level. Wider facilities provide greater comfort, especially on high-speed roadways.	For analysis purposes, a standard width of 5 feet was assumed for all bike lanes within the city. Buffered and separated bike lanes were assumed to have an additional 3 feet of buffer width.
Speed Limit	High-speed roadways are considered to be less comfortable for bicyclists, particularly in mixed traffic or with minimal separation from motor vehicles. Low-speed roadways are considered more comfortable.	Speed limit data was provided by the City of Sacramento.
Presence and Width of On-Street Parking Adjacent to Bicycle Lanes	On-street parking is particularly important for corridors on which bicycle lanes are present. BLTS is greater on bicycle lanes adjacent to parking than on bicycle lanes not adjacent to parking, due to the potential for "dooring" incidents.	A standard width of 8 feet was assumed for all parking lanes where tagged in OSM data. Local on-street parking data was not provided.
Number of Lanes	The number of travel lanes corresponds with an increase in the roadway width, which has an effect on bicyclists' level of stress. Roadways with fewer lanes are generally less stressful for bicyclists.	Local GIS data was not provided on the number of travel lanes. This analysis relied on assumptions about number of lanes based on the roadway's functional classification according to OpenStreetMap, as detailed in Appendix C.
Presence of Trails	Class I facilities can be a vital component of a municipality's active transportation network. Increased separation from motor vehicles can improve comfort and safety.	Class I facilities are scored as a BLTS 1.

Tables D-2 through D-4 specify the scoring criteria based on roadway configuration, speed, and bike lane/parking lane presence and width. The criteria are adapted from the original 2012 Mineta Institute report. These tables are used in combination to assign an overall BLTS score; if multiple scores are present within a segment, the highest (most stressful) score is used as the overall segment score.

Table D-2: Criteria for Bicycle Level of Traffic Stress in Mixed Traffic

Speed Limit (mph)	Street Width		
	2–3 Lanes	4–5 Lanes	6+ Lanes
≤ 25	BLTS 1 or 2	BLTS 3	BLTS 4
30	BLTS 2 or 3[1]	BLTS 4	BLTS 4
≥ 35	BLTS 4	BLTS 4	BLTS 4

1. Lower value is assigned to streets without marked centerlines or classified as residential with fewer than three lanes. Residential roadways are identified based on the Open Street Map "highway" tag.

Table D-3: Criteria for Bike Lanes Not Alongside a Parking Lane

	BLTS 1	BLTS 2	BLTS 3	BLTS 4
Street Width (through lanes per direction)	1	2	More than 2	(no effect)
Bike Lane Width	6 feet or more	5.5 feet or less	(no effect)	(no effect)
Speed Limit (mph)	30 mph or less	(no effect)	35 mph	40 mph or more
Bike Lane Blockage[1]	Rare	(no effect)	Frequent	(no effect)

1. Bike lane blockage is part of the analysis methodology but assumed to be rare by default.

Table D-4: Criteria for Bike Lanes Alongside a Parking Lane

	BLTS 1	BLTS 2	BLTS 3	BLTS 4
Street Width (through lanes per direction)	1	(no effect)	2 or more	(no effect)
Sum of Bike Lane Width + Parking Lane Width	15 feet or more	14 or 14.5 feet	13.5 feet or less	(no effect)
Speed Limit (mph)	25 mph or less	30 mph	35 mph	40 mph or more
Bike Lane Blockage[1]	Rare	(no effect)	Frequent	(no effect)

1. Bike lane blockage is part of the analysis methodology but assumed to be rare by default.

Appendix E: Pedestrian Level of Traffic Stress Analysis Details

Methodology

PLTS analysis is completed through an assessment of street segments using spatial data and aerial imagery. Each segment of the roadway is evaluated based on its characteristics; if multiple scores are present within a segment, the highest (most stressful) score is used as the overall segment score.

PLTS considers elements of the pedestrian environment both individually (e.g., buffer type), and in combinations that are known to influence each other (e.g., sidewalk width and pavement quality). The analysis uses the following overall guiding principles:

- The presence of a complete sidewalk serves as the foundation of the pedestrian network.
- As the sidewalk width increases and sidewalk condition improves, the level of stress of the pedestrian environment decreases.
- Buffering width is the total distance between the sidewalk and motor vehicle travel lanes. As width increases, the amount of separation between pedestrians and motor vehicles increases, and the pedestrian environment becomes less stressful.
- Buffer type describes the quality of the buffer that separates the sidewalk from the travel lanes. The presence of a buffer itself provides both actual and perceived safety benefits for the pedestrian, thus decreasing the stress of the pedestrian environment. A buffer with vertical elements is especially effective at increasing the safety of the pedestrian. Landscaping serves to enhance the pedestrian's travel experience.

Scores for each element of the pedestrian environment are assigned to each segment of the sidewalk centerline, and the worst (highest scoring) of the elements is used. If two sidewalks are present on a street, the worst (highest scoring) result is mapped to the centerline.

Figure E-1 illustrates the overall PLTS scoring process. Notes on data inputs and assumptions are found in **Table E-1**. Segment scores are assigned as shown in **Table E-2** through **Table E-5.**

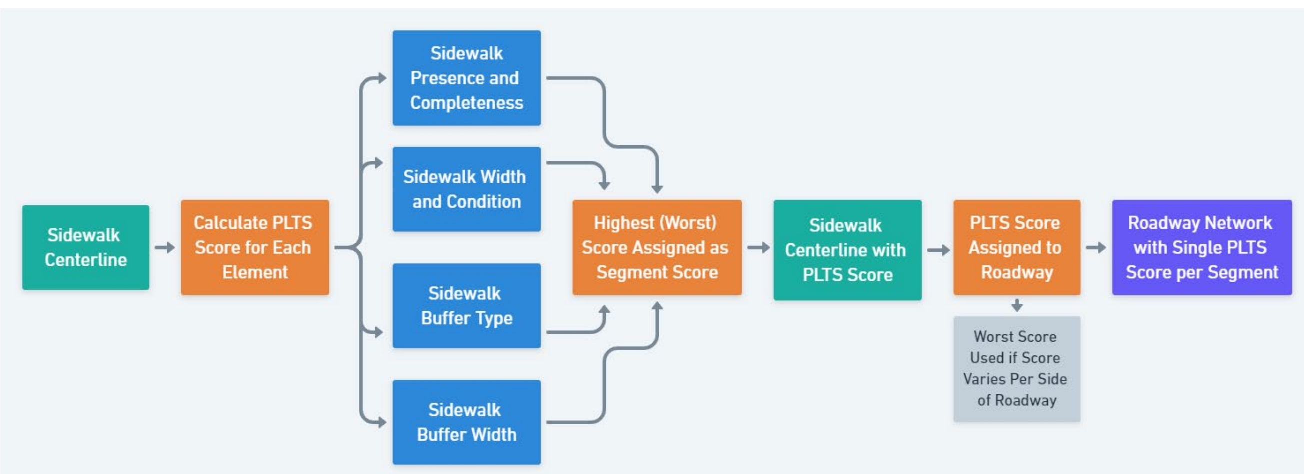

Figure E-1. The Pedestrian Level of Traffic Stress Scoring Process

Table E-1. Data Inputs and Assumptions

Pedestrian Element	Rationale	Data Inputs
Sidewalk Presence and Completeness along with Speeds and Number of Lanes (Table E-2)	The presence and completeness of sidewalk facilities is the baseline for measurement. At a minimum, sidewalks should be present and complete on most roadways to facilitate pedestrian travel.	Sidewalk and speed limit data provided by the City of Sacramento. Number of lanes data derived from OpenStreetMap (OSM) (see **Appendix C**).
Sidewalk Width and Condition (Table E-3)	The width of the sidewalk can have an impact on the associated comfort level. Wider sidewalks provide greater comfort, especially on high-speed roadways. The condition of the sidewalk is primarily based on concrete quality.	Sidewalk width data provided for most sidewalks in data from the City of Sacramento. Where width data is not available, sidewalks assumed to be 5' wide. Sidewalks assumed to be in good condition.
Sidewalk Buffer Type and Speeds (Table E-4)	The buffer type changes the pedestrian experience as it can offer a range of perceived and actual levels of protection. High-speed roadways are considered to be less comfortable, and a more substantial buffer increases pedestrian comfort.	Sidewalks flagged with a planter box in the City of Sacramento sidewalk data are assumed to have a landscaped buffer. LIDAR land cover data (2016) identifies those planter boxes with street trees. By default, buffer type is assumed to be curb only.
Sidewalk Buffer Width and Number of Travel Lanes (Table E-5)	Total buffering width is the summation of the width of buffer, width of parking, width of shoulder, width of curb and gutter, and width of the bike lane on the same side of the roadway as the pedestrian facility being evaluated.	Sidewalks flagged with a planter box in the City of Sacramento sidewalk data are assumed to have a 5' buffer, in addition to any on-street parking and bike lane width. On-street parking identified from OSM tags and bike lane data provided by the City of Sacramento.

Tables E-2 through **E-5** specify the scoring criteria based on sidewalk presence, sidewalk width and condition, buffer type, and buffer width, in relation to the existing roadway condition (factors such as speed and number of lanes). The criteria are adapted from the Oregon Department of Transportation *Analysis Procedures Manual*. These tables are used in combination to assign an overall PLTS score; if multiple scores are present within a segment, the highest (most stressful) score is used as the overall segment score.

Table E-2. Pedestrian Level of Traffic Stress Based on Sidewalk Presence and Completeness, speeds and lanes.

Number of Travel Lanes	Posted or Prevailing Speed				
	≤ 25 mph		*30–35 mph*		*≥ 40 mph*
	2 Lanes	*> 2 Lanes*	*2 Lanes*	*> 2 Lanes*	*2 Lanes*
Complete Sidewalk on Both Sides[1]	LTS 1	LTS 2	LTS 2	LTS 3	LTS 3
Complete Sidewalk on One Side	LTS 2	LTS 3	LTS 3	LTS 4	LTS 4
No Sidewalk[2]	LTS 2	LTS 4	LTS 4	LTS 4	LTS 4

1. Partial sidewalk coverage on a block is not considered complete.
2. Residential (OSM Highway class local) roadways without sidewalk default to LTS 2; other roadways without sidewalk default to LTS 4.

Table E-3. Pedestrian Level of Traffic Stress Based on Sidewalk Width and Condition

		Sidewalk Condition[3]			
		Good	*Fair*	*Poor*	*Very Poor*
Actual/Effective Width (feet)[1,2]	< 4	LTS 4	LTS 4	LTS 4	LTS 4
	≥ 4 to < 5	LTS 3	LTS 3	LTS 3	LTS 4
	≥ 5	LTS 1	LTS 2	LTS 3	LTS 4
	≥ 6	LTS 1	LTS 1	LTS 2	LTS 3

1. Effective width is the available/usable area for the pedestrian clear of obstructions. Effective width does not include areas occupied by storefronts or curbside features.
2. For analysis purposes, a standard width of 5 feet was assumed for all sidewalks if width data not provided by the City of Sacramento.
3. Sidewalk condition is assumed to be good.

Table E-4. Pedestrian Level of Traffic Stress Based on Physical Buffer Type and Speeds

Buffer Type[1]	Prevailing or Posted Speed			
	≤ 25 mph	*30 mph*	*35 mph*	*≥ 40 mph*
No Buffer (curb tight)	LTS 2[2]	LTS 3	LTS 3	LTS 4
Solid Surface	LTS 2[2]	LTS 2	LTS 2	LTS 2
Landscaped	LTS 1	LTS 2	LTS 2	LTS 2
Landscaped with Trees	LTS 1	LTS 1	LTS 1	LTS 2
Vertical	LTS 1	LTS 1	LTS 1	LTS 2

1. Combined buffer: If two or more of the buffer conditions apply, use the most appropriate (typically the lower-stress type).
2. If no centerline is present (residential street), then the PLTS can be lowered by one PLTS level.

Table E-5. Pedestrian Level of Traffic Stress Based on Physical Buffer Width[1]

Total Number of Travel Lanes (both directions)[3]	Total Buffering Width (feet)[2]				
	< 5	*≥ 5 to < 10*	*≥ 10 to < 15*	*≥ 15 to < 25*	*≥ 25*
≤ 2	LTS 2[4]	LTS 2	LTS 1	LTS 1	LTS 1
3	LTS 3[4]	LTS 2	LTS 2	LTS 1	LTS 1
4–5	LTS 4[5]	LTS 3	LTS 2	LTS 1	LTS 1
6 ≥	LTS 4[5]	LTS 4[5]	LTS 3	LTS 2	LTS 2

1. Source: Based on Oregon Department of Transportation *Analysis Procedures Manual*, Table 14-23.
2. Total buffering width is the summation of the width of buffer, width of parking, and width of the bike lane on the same side of the roadway as the pedestrian facility being evaluated.
3. One-way facilities are assumed to have their lanes multiplied by 2 to represent exposure to lane crossing.
4. If no centerline is present (residential street), then the PLTS can be lowered by one PLTS level.
5. Sections with a substantial physical barrier/tall railing between the travel lanes and the walkway (such as might be found on a bridge) can be lowered to PLTS 3.

Appendix F: Access Shed Methodology

Background

Access is defined as how well a transportation system connects destinations in a community. This aspect of the transportation system is often represented by visualizing how far a user may travel from a predetermined location. In this analysis, the project team evaluated access to parks and schools for fixed travel time sheds.

Methodology

The project team used park and school location files supplied by the City of Sacramento to conduct this analysis. Park features were converted to points for the purpose of the analysis to represent the multiple access points possible around the park. School features were provided as points which was maintained for the analysis. Next, the project team calculated 5-, 10-, and 15-minute walk and bike sheds for each point. The individual park access sheds are recombined to provide a single average access shed for each park.

The walk shed and bike sheds were calculated under both Scenario 1: Low-stress and existing travel conditions. The difference between the two access sheds is the potential gain in access that bicycle and pedestrian improvements could provide to the park or school. These differences were quantified for each destination in terms of the number of youth, low-income[27] residents, and total population[28] living within the access shed in both the Scenario 1: Low-stress and existing conditions. Destinations with large differences between the two access shed conditions are good candidates for implementing additional infrastructure for people biking, walking, and rolling because it indicates stressful travel conditions are limiting access.

[27] Low-income is defined as household income below 200% of the 2021 Federal Poverty Level.
[28] Demographic data provided by 2021 ACS five-year estimates.

Appendix G: Gap Analysis Methodology

Background

The analysis methodology is informed by preliminary evaluation criteria City staff have communicated in meetings with the project team as well as the project scope of work. This technical approach outlines key aspects of the analysis methodology.

Methodology

This assessment quantifies factors that impact walking and bicycling activity, locates network gaps as potential projects, and identifies areas with specific characteristics, for example, areas that have both a need for active transportation and a high demand. This analysis considers roadways, trails, and other independent rights-of-way within the City of Sacramento.

The project team used existing multimodal infrastructure data as well as results from other analyses such as Active-Trip Potential (ATP) and existing Level of Traffic Stress (LTS) analysis for walking and biking to develop an understanding of how well destinations and areas of demand are connected for people who want to walk and bike for both transportation and recreation. It also considers how Sacramento's networks connect regionally.

Gap Evaluation Grid

First, the project team created an active travel Gap Evaluation Grid to understand ideal locations for new facilities throughout the study area. **The Gap Evaluation Grid is scored separately for bicycle network gaps and pedestrian network gaps.** This grid[29] was created using uniform hexagons covering Sacramento, extending a quarter mile beyond the city limit. Extending the analysis slightly beyond the city limit helps the project team create a plan that is connected and useful to other planning processes of neighboring jurisdictions.

The approximate size for hexagons is smaller than a typical traffic analysis zone (small neighborhood) but larger than one downtown block. This is a flexible approach that supports finding gaps both on-street and off-street on a similar basis as equal area geographies are weighted equally to create average scores.

Whole area prioritization scoring leverages metric scores associated to a hexagonal grid across the city. Many of the datasets suggested for the Gap Evaluation Grid are provided natively at the census block group level. In these cases, scores were associated to the hex grid using an area-weighted sampling technique.

The prioritization scoring methods used for this analysis blend planning judgment and a percentile ranking of continuous data to a 10-point scale across scoring categories. The categories for evaluating gaps include **user comfort, equity, demand, existing connections, and safety.**

User Comfort

High-stress facilities were identified in the Level of Traffic Stress analysis for bicyclists and pedestrians respectively. For the Gap Analysis all hexagons were assigned user comfort points based on the highest LTS facility

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[29] This hex grid was generated using H3 at resolution level 10. H3 pulls from a global repository of hexagons at different scales. These hexagons have unique IDs and are popular for spatial analysis because in theory any aggregation to H3 grids for other analysis could be easily joined in that they reference consistent spatial grids.

they intersect. For example, if a hexagon intersects an LTS 1 segment, it was assigned 10 points. This means areas that would address high-stress gaps scored higher and can be targeted for intervention.

Equity

The project team conducted an equity analysis using a data-driven approach that identifies concentrations of historically disadvantaged or vulnerable populations using public health and demographic indicators. The project team utilized the CalEnviroScreen 4.0[30] dataset presented in the existing conditions phase to identify equity priority communities. CalEnviroScreen 4.0 examines census tracts based on the combined indicators of pollution burden (i.e., exposures and environmental effects) and population characteristics (i.e., sensitive populations and socioeconomic factors). Pollution burden and population characteristics consist of a total of 21 statewide indicators ranging from low educational attainment to existing ozone levels (more information on each indicator is available from the Office of Environmental Health Hazard Assessment). Census tracts considered the most disadvantaged at the statewide level score at or above the 75th percentile and have been identified for greenhouse gas reduction funding through Senate Bill 535.[31]

The project team allocated CalEnviroScreen 4.0 scores proportionally within the Gap Evaluation Grid hexagons. The resulting hexagon metric was then percentile ranked within the study area, and then linearly scaled to form a 10-point score. For example, a hexagon with a score at the 75th percentile within the study area will receive 7.5 points.

Demand

Demand represents the potential usage of a particular gap based on the key community destinations to which it provides connections (e.g., jobs or activities), and, relatedly, its alignment with existing short trips or trips made via active transportation (i.e., walking or bicycling). The project team utilized the previously developed ATP analyses to create demand scores specific to bicyclists (evaluating short trips <= three miles) and pedestrians (evaluating short trips <= one mile). ATP is reported at the block group level and was sampled to the hex grid using an area-weighted sampling technique. The sampled values were percentile ranked and then linearly scaled to form a 10-point score.

Existing Connections

Grid locations were given more points if they facilitate better connections to existing bicycle and pedestrian infrastructure.

Bicycle Connections

Grid locations were scored based on the type of the existing bicycle infrastructure within 50 feet of the hexagon. For example, hexagons without any nearby facilities were given 10 points. Scoring of different bicycle facility classifications is included in **Table G-1.**

[30] CalEnviroScreen 4.0 available online: https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40.
[31] Senate Bill 535 establishes minimum funding requirements and definitions for Disadvantaged Communities (DACs).

Table G-1. Existing Bicycle Connections Scoring

Criteria	Scoring
Separated Bicycle Lane or Off-Road Trail	1
Unprotected, Buffered On-Street Bicycle Lane	3
Unprotected, non-buffered On-Street Bicycle Lane	6
Bicycle Routes	8
No Bicycle facility	10

Pedestrian Connections

Grid locations were scored based on the presence of the existing pedestrian infrastructure within 50 feet of the hexagon. For example, hexagons near an existing signalized pedestrian crossing such as a High intensity Activated Crosswalk (HAWK, also known as Pedestrian Hybrid Beacons) were given 10 points. Given there are two types of infrastructure considered that have different representations (points vs. corridors), the scoring gives hexagons the points indicated by the type of existing facilities in Table G-2.

Table G-2. Existing Pedestrian Connections Scoring

Criteria	Scoring
Corridors	
Buffered sidewalk or Off-Road Trail	1
Non-buffered sidewalk	3
Non-buffered sidewalk, on one side of street	6
No sidewalk	10
Intersections/Crossings	
Pedestrian Signals	1
HAWK Crossing	2
RRFBs	4
Flashing Beacon	6
Midblock Crossings	8

Safety

Adopted in 2018, the Vision Zero Action Plan identified the citywide high injury network (HIN). Since the adoption of the Action Plan, the City has conducted a detailed review of the top five corridors from the HIN and identified focused safety improvements around 20 schools. *Gap Evaluation Grid* locations that overlap the HIN highlight gaps that address safety needs. Therefore, the percentage of each hexagon overlapping within 150 feet of the HIN determines the score.

Gap Evaluation Grid Scoring

The total score for each of the elements: user comfort, equity, demand, existing connections, and safety will be summed to provide a final score for the Gap Evaluation Grid. Applying equal weighting, areas with the highest scores will be areas of key gaps for the community. A summary table of the scoring evaluation process is provided in Table G-3.

Final Gaps and Opportunities Identification

Using an overlay of the citywide Gap Evaluation Grid, existing facilities, and information from the public outreach process designers and planners on the project team then identified:

- Key gaps in existing bicycle networks, intersection crossing needs, and other conflict points
- Gaps in pedestrian networks, such as sidewalk gaps, crossing needs in areas of pedestrian activities or at crossings of streets and other public rights-of-way
- New trail opportunities along waterways, other infrastructure rights-of-way, between isolated neighborhoods or adjacent to public street right of ways
- Major barriers that currently prevent safe and comfortable access across Sacramento

Table G-3. Gap Evaluation Grid Criteria Summary

Criteria	Measures	Data Source	Hexagon Metric	Project Scoring
User Comfort	Level of Traffic Stress (LTS) along the existing network.	City of Sacramento, OSM, Alta analysis	Hexagon is scored based on intersection with LTS analysis. LTS 1 = 0; LTS 2 = 3; LTS 3 = 6; LTS 4 = 10 points.	Maximum LTS value overlapping with a bicycle or pedestrian hexagon.
Equity	Equity index leveraging a combination of demographic and public health data to identify socially vulnerable populations with high investment need.	CalEnviroScreen 4.0	Hexagon is assigned the area-weighted average score from the CalEnviroScreen Demographic Index.	Percentile ranked and linearly scored to a 10-point scale.
Demand	Active-Trip Potential (ATP) trips proportionally allocated to hexagons.	Replica Places	Area-weighted average of ATP for each hexagon location. Bicyclists demand used a short-trip threshold of three miles, and pedestrians one mile.	Percentile ranked and linearly scored to a 10-point scale.
Existing Connections	Gaps that would connect to existing high-quality bicycle and pedestrian infrastructure.	City of Sacramento Public Works	Hexagon is tagged based on being within 50 feet of an existing pedestrian crossing enhancement, sidewalk, trail, or bicycle facility. The minimum hexagon value for bicycle and pedestrian connections respectively was used for the Grid.	Minimum point value of a facility's overlap with a bicycle or pedestrian hexagon.
Safety	The percentage of overlap with the High Injury Network.	City of Sacramento	The percentage of a hexagon that overlaps with a 150 ft buffer of the High Injury Network.	Receives a score out of 10 points based on the percentage of overlap within 150 ft of the HIN.
Note: The Gap Analysis may be reevaluated in the future to include results from a Tree Opportunity Analysis.				

MEMORANDUM

To: City of Sacramento

From: David Wasserman, AICP; Elizabeth Yarnall, AICP; Alta Planning + Design

Date: 9/7/2023

Re: Methodology for Active Trip Potential (ATP) Analysis - APPENDIX A

Active Trip Potential Analysis

Background

Not all locations can easily support active transportation modes due to unsupportive infrastructure or long trip distances making walking and biking challenging. While emerging modes such as E-Bike and E-Scooters provide new options, ranges, and convenience, their ability to affect change is often contextually defined by an area's land use and supporting infrastructure.

For example, a Brookings report examined the trip distances in major metropolitan areas of the United States and found that neighborhoods both closer to the urban core and designed to human-scale had a greater number of trips that were less than three miles in length. In review, the study authors found that about half of all trips in the areas studied where short trips, under four miles in length. In addition, 22-30% of all trips were one-mile or less in length. (1) These short trips represent the potential market for walking, biking, and electrified micromobility (i.e., motorized scooters and e-bikes).

As one might expect, this pattern of short-trips is most frequently observed in cities. In a recent review, 20 bicycle-friendly cities were "characterized by high-density urban development, diversified land-use planning and a safe and comfortable transport network". (2) These cities not only share traits such as compact neighborhoods and small geographic areas that facilitate shorter trip distances, but also contain necessary infrastructure to unlock that potential. (2)

Based on these reviews, Alta will examine the Active Trip Potential (ATP) in Sacramento by estimating the number of motor vehicle activity trips which are short-length trips.

Methodology

Alta will examine the Active Trip Potential (ATP) in Sacramento using Replica Places, an activity-based travel demand model. We will examine all trip ends whose overall lengths are less than one (1) mile for potential walking trips, three (3) miles for potential biking trips, and six (6) miles for electric micromobility trips. Trip distance is an important factor in mode choice and trips less than one mile, three miles, and six miles, are considered reasonable distances for walk, bike, and e-micromobility modes, respectively, based on trip distances from the 2017 National Household Travel Survey (NHTS). (3)

Alta will map the percentage of trip starts that fall within the distance bands of interest in order to illustrate which locations are likely be suitable for active transportation. The trips considered will represent travel on a typical weekday in the Fall of 2022 conducted throughout the day (12 AM – 12 AM). Data from 2022 will be used as the most up-to-date modeled estimates that avoid effects of the COVID-19 pandemic. The zone activity results will include all trips made from the zones of interests that Replica Data identifies as motor vehicle activity trips.

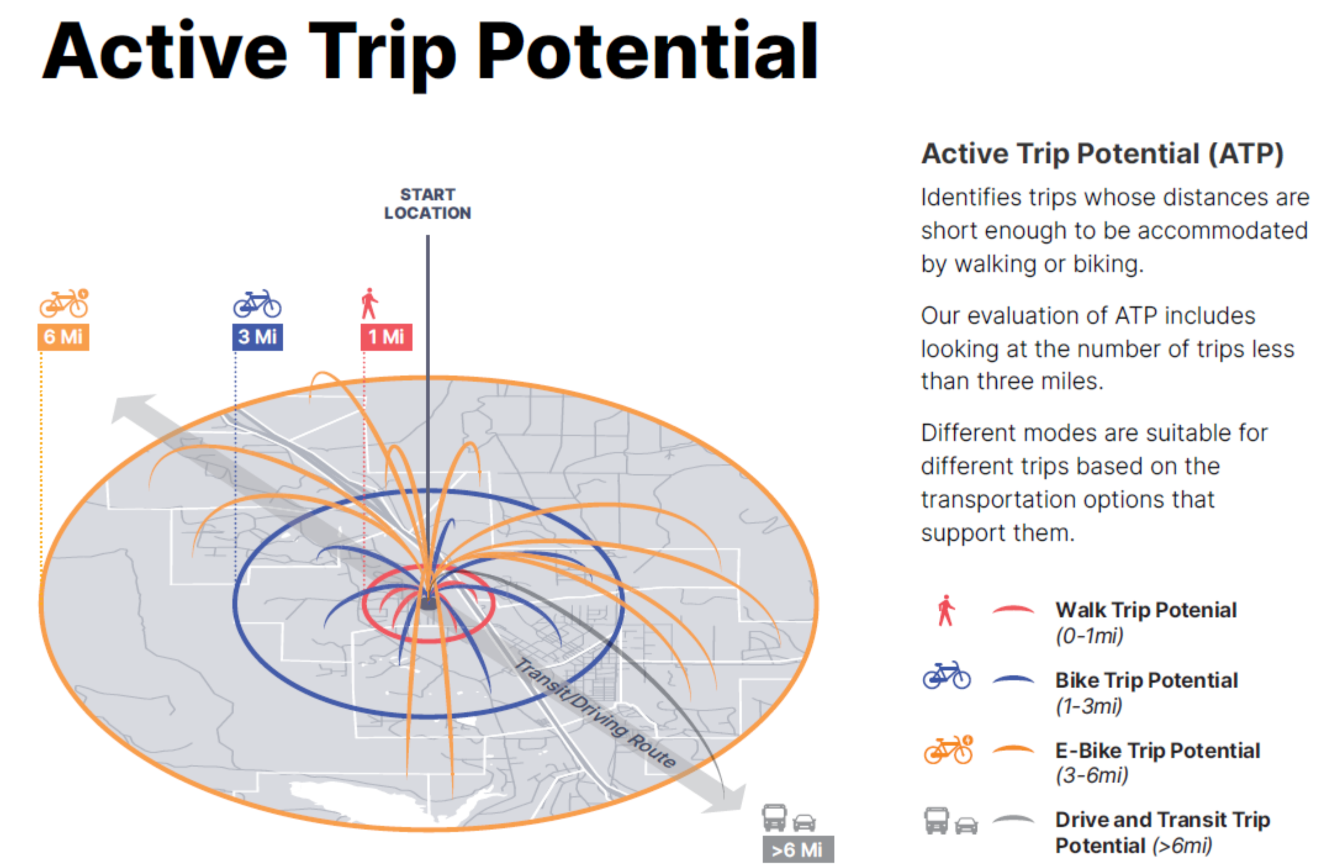

Figure 1. Active Trip Potential Explainer

Trips will be summarized to the census block group in which they terminated. Trips less than one, three, or six miles were identified and represented as a percentage of the total trips terminating in that census block group; each trip length estimates walking, biking, and e-micromobility active trip potential for the given block group. These percentages will be symbolized and mapped, allowing for comparison of areas with greater or less potential for active travel.

Citations

1. Brookings Institute. Tomer A., Kane J. Vey J. Connecting people and places: Exploring new measures of travel behavior. 2020. https://www.brookings.edu/interactives/connecting-people-and-places-exploring-new-measures-of-travel-behavior/

2. Mohamed Zayed. Towards an index of city readiness for cycling. International Journal of Transportation Science and Technology 5. 210-225. 2017. https://www.sciencedirect.com/science/article/pii/S2046043016300399?via%3Dihub

3. 2017 National Household Travel Survey Estimated Person Trips (ORNL, n.d.)

MEMORANDUM

To:	City of Sacramento
From:	David Wasserman, AICP; Elizabeth Yarnall, AICP; Alta Planning + Design
Date:	9/7/2023
Re:	Methodology for Bicycle and Pedestrian Level of Traffic Stress (LTS) Analysis - APPENDIX B-E

Level-of-Traffic Stress Analysis

Background

Bicycle and pedestrian levels of service will be assessed using a concept called Level of Traffic Stress (LTS). LTS analysis estimates the level of comfort for people biking or walking on a given roadway segment, and identifies the degree to which roadways must be improved in order to provide a more comfortable experience for riders of all ages and abilities.

The completed LTS analysis for the bicycle and pedestrian networks will rank streets from low stress (LTS 1, suitable for children) to high stress (LTS 4, suitable only to 'strong and fearless' bicyclists/pedestrians). The network will be based on the preliminary LTS analysis derived from OpenStreetMap (OSM) data whose input attributes were augmented based on local bicycle and pedestrian facility data. Roadway characteristics like posted speed limit, number of lanes, and the presence of sidewalks or bike facilities effect LTS outcomes.

Methodology

Alta uses a tiered data collection framework for level of traffic stress (LTS) analysis that derives initial analysis inputs from readily accessible data, in order to determine where additional data collection will be of the most value to meet project goals. In the case of LTS analysis, Alta derives initial base analysis inputs from OpenStreetMap (OSM) data and details of the assumptions used in this process are included in **Appendix A**. This data is then conflated with local datasets or Artificial Intelligence (AI) derived right-of-way scans to enhance the LTS analysis. If timing allows, Alta proposes engaging the vendor Ecopia to provide AI-derived satellite scans of the buffers between sidewalks and roadways, particularly for use in the pedestrian level of traffic stress analysis.

Contextual Conflation

LTS analysis often requires bringing together multiple different datasets into a single unified dataset representing key attributes of the right-of-way. This is because the diversity of inputs required for this type of analysis is multimodal and is often represented in different municipal, state, or regional databases for each component. For example, sidewalk inventories for a pedestrian LTS might be maintained by a Public Works department, while the centerline network with roadway attributes related to speed limit might be maintained by another agency. To address this, conflation is the process by which we associate different datasets with each other to bring context and a unified understanding of the right-of-way.

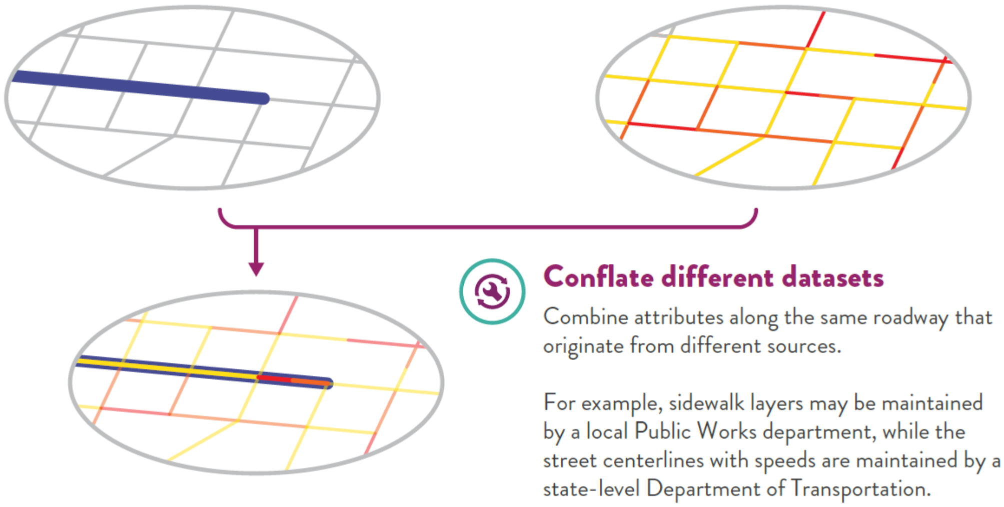

Figure 1. Alta Conflation Explainer

Key Data Considerations

- The network data will be derived from Open Street Map (OSM) and will be updated using existing bicycle infrastructure data provided by the City of Sacramento. The lane geometry, speed limit, and other input values will be based on values in OSM and our inference assumptions associated with it.
- Similarly, the sidewalk data provided by the city will be integrated to inform the pedestrian level of traffic stress analysis, and if timing allows buffer and vegetation information based on Ecopia's extractions will also be included.
- Intersections will not be considered as part of this analysis. Crossings will play a role in experience for both pedestrians and people who bike and should be considered when performing more detailed site and network assessment. If timing allows for the use of Ecopia data, a crossing-distance map could then be created to complement a pedestrian Level of Traffic Stress map. This map would illustrate the distance between pedestrian crossing opportunities throughout the city.

Bicycle Level of Traffic Stress

The bicycle level of traffic stress (BLTS) analysis will estimate the level of comfort for people biking on a given roadway segment. The BLTS analysis will identify where "gaps" or deficiencies in a bike network exist, and provides a measure of how likely different types of riders, based on ability and comfort level, are to use the facility.

Alta's BLTS analysis methodology is adapted from the 2012 Mineta Transportation Institute Report 11-19: *Low-Stress Bicycling and Network Connectivity*[1]. BLTS is determined by characteristics of a given roadway segment that affect a bicyclist's perception of safety and comfort, including posted speed limit, number of travel lanes, and the presence and character of bicycle lanes.

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[1] Mineta Institute. Mekuria M., Furth P., Nixon H. *Low-Stress Bicycling and Network Connectivity*. 2012. https://transweb.sjsu.edu/research/Low-Stress-Bicycling-and-Network-Connectivity.

The combination of this criteria classifies a road segment into one of four levels of traffic stress:

- BLTS 1 represents roadways where bicyclists of all ages and abilities would feel comfortable riding. These roadways are generally characterized by low volumes, low speeds, no more than two travel lanes, and traffic control measures at intersections. These roadways may have bicycle facilities; separated shared-use paths for bicycles also fall into this category.
- BLTS 2 represents slightly less comfortable roadways, where most adults would feel comfortable riding.
- BLTS 3 represents moderately uncomfortable roadways, where most experienced bicyclists would feel comfortable riding.
- BLTS 4 represents high-stress roadways where only strong and fearless bicyclists would feel comfortable riding. These roadways are generally characterized by high volumes, high speeds, several travel lanes, and complex transitions approaching and crossing intersections.

The results of the BLTS analysis identify existing areas that are low stress for many bicyclists, as well as the degree to which roadways must be improved in order to provide a comfortable experience for riders of all ages and abilities. The specific assumptions for the BLTS planned for the City of Sacramento are included in **Appendix B**.

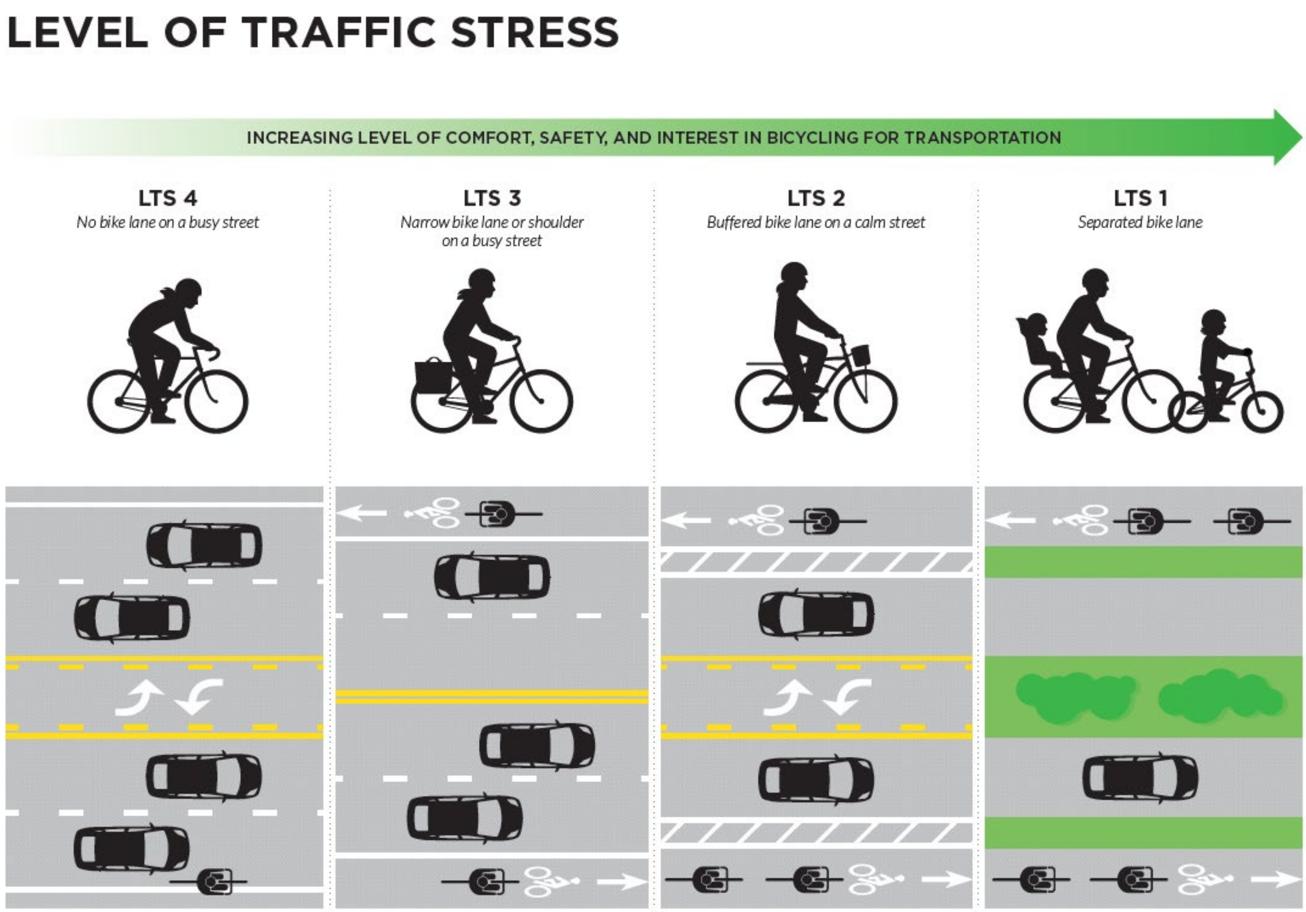

Figure 2. Bicycle Level-of-Traffic Stress

Pedestrian Level of Traffic Stress

The pedestrian level of traffic stress (PLTS) analysis estimates the level of comfort for people walking on a given roadway segment. The PLTS analysis identifies where "gaps" or deficiencies in a pedestrian network exist, and provides a measure of how likely pedestrians are to use the facility, based on ability and comfort level.

Alta's PLTS analysis methodology is adapted from the Oregon Department of Transportation's Analysis Procedures Manual; it is intended as a companion for bicycle level of traffic stress (BLTS). PLTS is determined by characteristics of a given roadway segment that affect a pedestrian's perception of safety and comfort including sidewalk presence and width, sidewalk buffer width and type, posted speed limit, and number of travel lanes.

PLTS scores classify road segments into one of four levels of traffic stress and, while similar to BLTS scores, PLTS considers the level of attention required in addition to the user experience:

- PLTS 1 represents roadways where pedestrians of all ages and abilities would feel comfortable walking and require little attention to traffic.
- PLTS 2 represents slightly less comfortable roadways that require more attention to traffic and are suitable for children over 10, teens, and adults.
- PLTS 3 represents moderately uncomfortable roadways, where most able-bodied adults would feel uncomfortable but safe.
- PLTS 4 represents high traffic stress and would be used only by able-bodied adults with limited route choices.

The results of the PLTS analysis identifies existing areas that are low-stress for pedestrians, as well as the degree to which roadways must be improved in order to provide a comfortable experience for pedestrians of all ages and abilities.

The analysis is intended for use in urban areas specifically; while it can be used in rural conditions where pedestrian facilities exist, the methodology will yield a high PLTS score (greatest discomfort) where high-speed traffic is present. Additional details and the specific assumptions for the PLTS planned for the City of Sacramento are included in **Appendix C**.

Appendix A: Level of Traffic Stress and OpenStreetMap Derivation Assumptions

Overview

Alta uses a tiered data collection framework for level of traffic stress (LTS) analysis that derives initial analysis inputs from readily accessible data, in order to determine where additional data collection will be of the most value to meet project goals. In the case of LTS analysis, Alta derives initial base analysis inputs from OpenStreetMap (OSM) data. This appendix documents how Alta develops the input variables for this analysis.

Where OSM data includes values for lanes, posted speeds, bike lanes, sidewalks, parking lanes, and one-way tags, these tags are used to populate a database for LTS inputs. Once that database is populated, Alta uses the Mekuria et al. 2012 LTS methodology to score roadway segments. This initial LTS is intended to be augmented by automated or manual review of aerial imagery, local GIS data, and/or street view data. Once the base input values have been validated, the LTS scores can be refreshed using Alta's LTS calculation scripts. This enables evaluation of new scenarios as needed in addition to standardized network analysis.

OpenStreetMap Processing

When using OSM networks for LTS analysis, there are several considerations for creating a useful network for visualization and analysis. The following sections outline how Alta processes OSM data for LTS and related network analyses.

Background

OSM is a crowdsourced database of geographic features including administrative boundaries, street centerlines, points of interest, building footprints, physical and natural features, and other types of geographic information. OSM is one of the most prominent examples of volunteered geographic information, where community processes drive the contributions of geographic information to a shared database (Mocnik et. Al. 2018). These geographic features are tagged based on their attributes, and while community wiki pages provide guidance on which tags apply to which features, there is no centralized authority that authenticates these contributions.

For example, street networks in OSM may include tags where contributors denote functional classification, number of lanes, one-way classification, speed limits, presence of sidewalks, and the type of bicycle facility that might be present on the network. While OSM is not always completely accurate, it has been benchmarked against comparable map data sources such as Google and found to have comparable or better accuracy for bike paths depending on the type of error (Hochmair et. al. 2014). Multiple non-profits, academics, and practitioners have found OSM to be an acceptable base for initial derivation of LTS analysis (PeopleForBikes; Conveyal; Wasserman et. al 2019; Mineta 2019).

Network Connectivity

OSM networks contain segments that are not ready for network analysis in most instances. There are various software processing packages such as the [Open-Source Routing Machine] and [OpenTripPlanner] that come with routines to prepare OSM networks for network analysis. Alta uses scripts built on the OSMnx Python package to derive its geospatial networks (Boeing 2017). This package is used to ensure that extracted networks are valid and have appropriate end-to-end connectivity provided by network segments. This process complies all OSM networks wherein the highway tag is available and the corresponding geometry is a line. For cartographic presentations, it is often preferable to filter out features such as service roads (roads within parking lots) and footways (sidewalks drawn separately from the centerline). This is typically done to focus attention to facilities that jurisdictions and regions can reasonably improve.

Tag Processing

In many cases, OSM data includes tags for attributes such as lanes, posted speed, bicycle infrastructure, and other facility information recorded in the database. This data tends to more likely to be completed in urbanized areas globally, and on major facilities such as arterials and highways. There can be substantial variance in tag availability from location to location, but the presence of bike paths and a consistent indicator of functional classification is generally well recorded in OSM. In the case of bike lane blockage rates, Alta assumes these instances are rare unless manual review of commercial districts indicates otherwise. When tags are missing from OSM for the purposes of LTS analysis, the assumptions outlined in Table 1 are used as proxy values.

Table 1. Alta's OpenStreetMap Assumptions for Missing Inputs

Functional Class	Lanes[1,2,3]	Speed Limit[1,2,3]	Centerline Present[3]
Residential	2	25	No
Living Street	2	25	No
Unclassified	2	25	Yes
Track	2	30	Yes
Tertiary	3	30	Yes
Secondary	4	35	Yes
Primary	4	45	Yes
Trunk	6	65	Yes
Motorway	6	65	Yes
OTHER	2	25	Yes

1. Lane assumptions for one-way streets are halved to reflect an accurate per-segment assumption. In addition, all one-way streets are assumed to have medians for the purposes of LTS computations.
2. These assumptions only apply if there is no tag provided for speed limit or number of lanes.
3. These assumptions were developed based on Wasserman et al. 2019 and Harvey et al. 2019.

LTS analysis also requires an understanding of other geometric considerations, such as bicycle facility width and parking lane width (if present). Alta begins with a "benefit of the doubt" approach for these attributes, meaning that if they are present, they are assumed to be of sufficient width. Validation is recommended for detailed LTS assessments, but this is typically less important for less rigorous, or large-scale (e.g., county-, region-, or state-wide) LTS-based analysis. Bicycle infrastructure-related tags are processed using assumptions outlined in Table 2.

Table 2. Alta's OpenStreetMap Assumptions for Bicycle Facilities

Cycleway Tag[1]	Bicycle Facility Type	Assumed Bicycle Facility Width (Feet)	Is Protected
Shared	Bike Route/Class III	0	No
Shared_lane	Bike Route/Class III	0	No
Lane	Bike Lane/Class II	6	No
Shared_busway	Bike Lane/Class II	6	No
Opposite_lane	Bike Lane/Class II	6	No
Cycleway[2]	Bike Path/Class I	10	Yes
Path	Bike Path/Class I	10	Yes
Track	Separated Bikeway/Class IV	8	Yes
Opposite_track	Separated Bikeway/Class IV	8	Yes
Buffered_lane	Separated Bikeway/Class IV	8	Yes
OTHER	NA	0	No

1. Alta processes nondirectional cycleway tags and directional cycleway tags as part of its conversion. The final LTS score is the worst-case score based on the direction of facilities.
2. Highway tags including the tag "cycleway" are also considered to be Class I facilities.

When parking lane-related tags are processed, assumptions related to their width and rates of bike lane blockage are outlined in Table 3.

Table 3. Alta's OpenStreetMap Assumptions for Parking Facilities

Parking Lane Tag	Assumed Parking Lane Width (Feet)
Parallel	8
Marked	8
Diagonal	16
Perpendicular	20
OTHER	NA

Works Cited and Consulted

1. Mineta Institute. Mekuria M., Furth P., Nixon H. *Low-Stress Bicycling and Network Connectivity*. 2012. https://transweb.sjsu.edu/research/Low-Stress-Bicycling-and-Network-Connectivity
2. Mocnik, F.-B., A. Mobasheri, and A. Zipf. Open-Source Data Mining Infrastructure for Exploring and Analysing OpenStreetMap. Open Geospatial Data, Software and Standards, Vol. 3, No. 1, 2018, p. 7. https://doi.org/10.1186/s40965-018-0047-6.
3. Hochmair, H. H., D. Zielstra, and P. Neis. Assessing the Completeness of Bicycle Bike Path and Lane Features in OpenStreetMap for the United States. Transactions in GIS, Vol. 19, No. 1, 2014, pp. 63–81. https://doi.org/10.1111/tgis.12081.
4. PeopleForBikes. Bicycle Network Analysis. PeopleForBikes. https://peopleforbikes.org/placesforbikes/bicycle-network-analysis/.
5. Conveyal. Better measures of Bike Accessibility. https://blog.conveyal.com/better-measures-of-bike-accessibility-d875ae5ed831
6. Wasserman D, Rixey A, Zhou X (Elynor), Levitt D, Benjamin M. Evaluating OpenStreetMap's Performance Potential for Level of Traffic Stress Analysis. Transportation Research Record. 2019;2673(4):284-294. doi:10.1177/0361198119836772
7. Mineta Institute. Chester Harvey, Kevin Fang, Daniel A. Rodriguez. Evaluating Alternative Measures of Bicycling Level of Traffic Stress Using Crowdsourced Route Satisfaction Data. 2019. https://scholarworks.sjsu.edu/mti_publications/276/
8. Boeing, G. 2017. OSMnx: New Methods for Acquiring, Constructing, Analyzing, and Visualizing Complex Street Networks. Computers, Environment and Urban Systems 65, 126-139. doi:10.1016/j.compenvurbsys.2017.05.004.
9. Highway Tag. Key:highway - OpenStreetMap Wiki. (n.d.). https://wiki.openstreetmap.org/wiki/Key:highway.

Appendix B: Bicycle Level of Traffic Stress Analysis

Overview

The bicycle level of traffic stress (BLTS) analysis estimates the level of comfort for people biking on a given roadway segment. The BLTS analysis identifies where "gaps" or deficiencies in a bike network exist, and provides a measure of how likely different types of riders, based on ability and comfort level, are to use the facility.

Alta's BLTS analysis methodology is adapted from the 2012 Mineta Transportation Institute Report 11-19: *Low-Stress Bicycling and Network Connectivity*.[1] BLTS is determined by characteristics of a given roadway segment that affect a bicyclist's perception of safety and comfort, including posted speed limit, number of travel lanes, and the presence and character of bicycle lanes.

The combination of this criteria classifies a road segment into one of four levels of traffic stress:

- BLTS 1 represents roadways where bicyclists of all ages and abilities would feel comfortable riding. These roadways are generally characterized by low volumes, low speeds, no more than two travel lanes, and traffic control measures at intersections. These roadways may have bicycle facilities; separated shared-use paths for bicycles also fall into this category.
- BLTS 2 represents slightly less comfortable roadways, where most adults would feel comfortable riding.
- BLTS 3 represents moderately uncomfortable roadways, where most experienced bicyclists would feel comfortable riding.
- BLTS 4 represents high-stress roadways where only strong and fearless bicyclists would feel comfortable riding. These roadways are generally characterized by high volumes, high speeds, several travel lanes, and complex transitions approaching and crossing intersections.

The results of the BLTS analysis identify existing areas that are low stress for many bicyclists, as well as the degree to which roadways must be improved in order to provide a comfortable experience for riders of all ages and abilities. Additionally, scenario testing can be used to determine how a roadway or route's level of stress may change with improvements.

Methodology

BLTS analysis is completed through an assessment of street segments using spatial data and aerial imagery. Each segment of the roadway is evaluated based on its characteristics; if multiple scores are present within a segment, the highest (most stressful) score is used as the overall segment score.

Figure 1 illustrates the overall BLTS scoring process. Notes on data inputs and assumptions are found in Table 1. Segment scores are assigned as shown in Table 2 through Table 5.

[1] Mineta Institute. Mekuria M., Furth P., Nixon H. *Low-Stress Bicycling and Network Connectivity*. 2012. https://transweb.sjsu.edu/research/Low-Stress-Bicycling-and-Network-Connectivity.

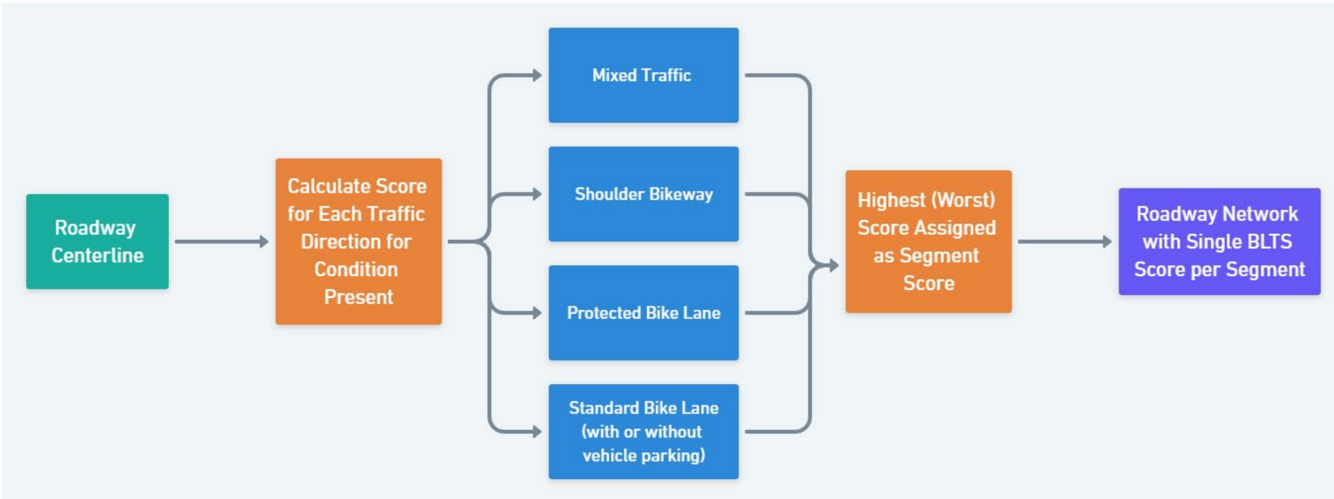

Figure 1. Bicycle Level of Traffic Stress Generalized Segment Scoring Process

Table 1: Data Inputs and Assumptions

Inputs	Notes	Assumptions
Bicycle Facilities	Bicycle lanes have a positive impact on BLTS and are a primary input for developing a BLTS model. The width of facilities can have an impact on the associated comfort level. Wider facilities provide greater comfort, especially on high-speed roadways.	For analysis purposes, a standard width of 5 feet was assumed for all bike lanes within the city. Buffered bike lanes, which provide an additional degree of separation from motor vehicles and greater operating space for bicyclists, were considered to be greater than 6 feet, meeting the requirements for a BLTS 1 score as outlined in Table 2 and Table 3.
Speed Limit	High-speed roadways are considered to be less comfortable for bicyclists, particularly in mixed traffic or with minimal separation from motor vehicles. Low-speed roadways are considered more comfortable.	Speed limit data was available for a subset of roadways within the city limits. The BLTS evaluation was completed only for those roadways in which speed limit data was available.
Presence and Width of On-Street Parking Adjacent to Bicycle Lanes	On-street parking is particularly important for corridors on which bicycle lanes are present. BLTS is greater on bicycle lanes adjacent to parking than on bicycle lanes not adjacent to parking, due to the potential for "dooring" incidents.	A standard width of 7.5 feet was assumed for all parking lanes.
Number of Lanes	The number of travel lanes corresponds with an increase in the roadway width, which has an effect on bicyclists' level of stress. Roadways with fewer lanes are generally less stressful for bicyclists.	When data was not available or was inadequate, assumptions about number of lanes were made based on the roadway's functional classification according to OpenStreetMap or other available data.
Presence of Trails	Class I facilities can be a vital component of a municipality's active transportation network. Increased separation from motor vehicles can improve comfort and safety.	Class I facilities are scored as a BLTS 1.

Tables 2 through 4 specify the scoring criteria based on roadway configuration, speed, and bike lane/parking lane presence and width. The criteria are adapted from the original 2012 Mineta Institute report. These tables are used in combination to assign an overall BLTS score; if multiple scores are present within a segment, the highest (most stressful) score is used as the overall segment score. These tables are used in combination to create the segment, approach, and intersection scores described previously.

Table 2: Criteria for Bicycle Level of Traffic Stress in Mixed Traffic

Prevailing Speed or Speed Limit (mph)	Street Width		
	2–3 Lanes	4–5 Lanes	6+ Lanes
≤ 25	BLTS 1 or 2	BLTS 3	BLTS 4
30	BLTS 2 or 3[1]	BLTS 4	BLTS 4
≥ 35	BLTS 4	BLTS 4	BLTS 4

1. Lower value is assigned to streets without marked centerlines or classified as residential with fewer than three lanes. Residential roadways are identified based on the Open Street Map "highway" tag.

Table 3: Criteria for Bike Lanes Not Alongside a Parking Lane

	BLTS 1	BLTS 2	BLTS 3	BLTS 4
Street Width (through lanes per direction)	1	2	More than 2	(no effect)
Bike Lane Width	6 feet or more	5.5 feet or less	(no effect)	(no effect)
Speed Limit (mph)	30 mph or less	(no effect)	35 mph	40 mph or more
Bike lane blockage[1]	Rare	(no effect)	Frequent	(no effect)

1. Bike lane blockage is part of Alta's analysis methodology, but assumed to be rare by default.

Table 4: Criteria for Bike Lanes Alongside a Parking Lane

	BLTS 1	BLTS 2	BLTS 3	BLTS 4
Street Width (through lanes per direction)	1	(no effect)	2 or more	(no effect)
Sum of Bike Lane Width + Parking Lane Width	15 feet or more	14 or 14.5 feet	13.5 feet or less	(no effect)
Speed Limit (mph)	25 mph or less	30 mph	35 mph	40 mph or more
Bike lane blockage[1]	Rare	(no effect)	Frequent	(no effect)

1. Bike lane blockage is part of Alta's analysis methodology, but assumed to be rare by default.

Appendix C: Pedestrian Level of Traffic Stress Methodology

Overview

The pedestrian level of traffic stress (PLTS) analysis estimates the level of comfort for people walking on a given roadway segment. The PLTS analysis identifies where "gaps" or deficiencies in a pedestrian network exist, and provides a measure of how likely pedestrians are to use the facility, based on ability and comfort level.

Alta's PLTS analysis methodology is adapted from the Oregon Department of Transportation's *Analysis Procedures Manual*[1] and is intended as a companion for bicycle level of traffic stress (BLTS). PLTS is determined by characteristics of a given roadway segment that affect a pedestrian's perception of safety and comfort including sidewalk presence and width, sidewalk buffer width and type, posted speed limit, and number of travel lanes. PLTS scores classify road segments into one of four levels of traffic stress and, while similar to BLTS scores, PLTS considers the level of attention required in addition to the user experience:

- PLTS 1 represents roadways where pedestrians of all ages and abilities would feel comfortable walking and require little attention to traffic.
- PLTS 2 represents slightly less comfortable roadways that require more attention to traffic and are suitable for children over 10, teens, and adults.
- PLTS 3 represents moderately uncomfortable roadways, where most able-bodied adults would feel uncomfortable but safe.
- PLTS 4 represents high traffic stress and would be used only by able-bodied adults with limited route choices.

The results of the PLTS analysis identifies existing areas that are low-stress for pedestrians, as well as the degree to which roadways must be improved in order to provide a comfortable experience for pedestrians of all ages and abilities. Additionally, scenario testing can be used to determine how a roadway or route's level of stress may change with improvements. The analysis is intended for use in urban areas specifically; while it can be used in rural conditions where pedestrian facilities exist, the methodology will yield a high PLTS score (greatest discomfort) where high-speed traffic is present.

Methodology

PLTS analysis is completed through an assessment of street segments using spatial data and aerial imagery. Each segment of the roadway is evaluated based on its characteristics; if multiple scores are present within a segment, the highest (most stressful) score is used as the overall segment score.

PLTS considers elements of the pedestrian environment both individually (e.g., buffer type), and in combinations that are known to influence each other (e.g., sidewalk width and pavement quality). The analysis uses the following overall guiding principles:

- The presence of a complete sidewalk serves as the foundation of the pedestrian network.
- As the sidewalk width increases and sidewalk condition improves, the level of stress of the pedestrian environment decreases.
- Buffering width is the total distance between the sidewalk and motor vehicle travel lanes. As width increases, the amount of separation between pedestrians and motor vehicles increases, and the pedestrian environment becomes less stressful.

[1] Oregon Department of Transportation, Transportation Development Division Planning Section: Transportation Planning Analysis Unit. 2020. *Analysis Procedures Manual* Version 2. https://www.oregon.gov/odot/Planning/Pages/APM.aspx.

- Buffer type describes the quality of the buffer that separates the sidewalk from the travel lanes. The presence of a buffer itself provides both actual and perceived safety benefits for the pedestrian, thus decreasing the stress of the pedestrian environment. A buffer with vertical elements is especially effective at increasing the safety of the pedestrian. Landscaping serves to enhance the pedestrian's travel experience.

Scores for each element of the pedestrian environment are assigned to each segment of the sidewalk centerline, and the worst (highest scoring) of the elements is used. If two sidewalks are present on a street, the worst (highest scoring) result is mapped to the centerline.

Figure 1 illustrates the overall PLTS scoring process. Notes on data inputs and assumptions are found in Table 1. Segment scores are assigned as shown in Table 2 through Table 5.

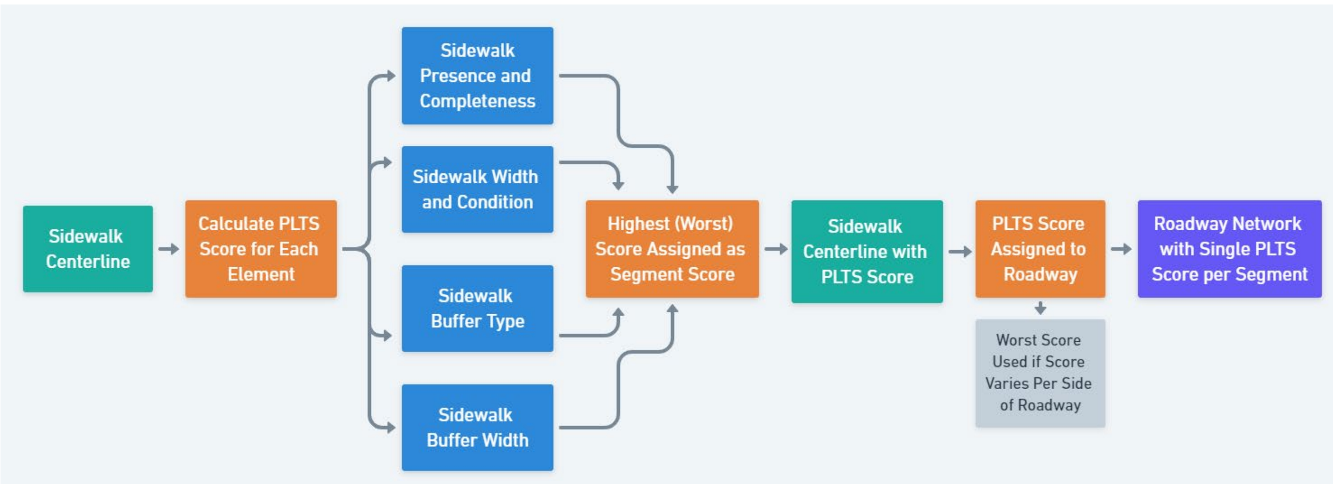

Figure 1. The Pedestrian Level of Traffic Stress Scoring Process

Table 1. Data Inputs and Assumptions

Pedestrian Element	Rationale	Data Inputs
Sidewalk Presence and Completeness along with Speeds and Number of Lanes (Table 2)	The presence and completeness of sidewalk facilities is the baseline for measurement. At a minimum, sidewalks should be present and complete on most roadways to facilitate pedestrian travel.	Based on OpenStreetMap (OSM) and Replica data, supplemented by manual review within study area.
Sidewalk Width and Condition (Table 3)	The width of the sidewalk can have an impact on the associated comfort level. Wider sidewalks provide greater comfort, especially on high-speed roadways. The condition of the sidewalk is primarily based on concrete quality.	Based on OSM data, potentially supplemented by Ecopia data or manual review within the study area.
Sidewalk Buffer Type and Speeds (Table 4)	The buffer type changes the pedestrian experience as it can offer a range of perceived and actual levels of protection. High-speed roadways are considered to be less comfortable, and a more substantial buffer increases pedestrian comfort.	Based on OSM & Replica data, potentially supplemented by Ecopia data or manual review within the study area.
Sidewalk Buffer Width and Number of Travel Lanes (Table 5)	Total buffering width is the summation of the width of buffer, width of parking, width of shoulder, width of curb and gutter, and width of the bike lane on the same side of the roadway as the pedestrian facility being evaluated.	Based on OSM & Replica data, potentially supplemented by Ecopia data or manual review within the study area.

Tables 2 through 5 specify the scoring criteria based on sidewalk presence, sidewalk width and condition, buffer type, and buffer width, in relation to the existing roadway condition (factors such as speed and number of lanes). The criteria are adapted from the Oregon Department of Transportation *Analysis Procedures Manual*. These tables are used in combination to assign an overall PLTS score; if multiple scores are present within a segment, the highest (most stressful) score is used as the overall segment score.

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Table 2. Pedestrian Level of Traffic Stress Based on Sidewalk Presence and Completeness, speeds and lanes

Number of Travel Lanes	Posted or Prevailing Speed				
	≤ 25 mph		*30–35 mph*		*≥ 40 mph*
	2 Lanes	*> 2 Lanes*	*2 Lanes*	*> 2 Lanes*	*2 Lanes*
Complete Sidewalk on Both Sides[1]	LTS 1	LTS 2	LTS 2	LTS 3	LTS 3
Complete Sidewalk on One Side	LTS 2	LTS 3	LTS 3	LTS 4	LTS 4
No Sidewalk[2]	LTS 2	LTS 4	LTS 4	LTS 4	LTS 4

1. Partial sidewalk coverage on a block is not considered complete.
2. Residential (OSM Highway class local) roadways without sidewalk default to LTS 2; roadways without sidewalk default to LTS 4.

Table 3. Pedestrian Level of Traffic Stress Based on Sidewalk Width and Condition

		Sidewalk Condition[3]			
		Good	*Fair*	*Poor*	*Very Poor*
Actual/Effective Width (feet)[1,2]	< 4	LTS 4	LTS 4	LTS 4	LTS 4
	≥ 4 to < 5	LTS 3	LTS 3	LTS 3	LTS 4
	≥ 5	LTS 1	LTS 2	LTS 3	LTS 4
	≥ 6	LTS 1	LTS 1	LTS 2	LTS 3

1. Effective width is the available/usable area for the pedestrian clear of obstructions. Effective width does not include areas occupied by storefronts or curbside features.
2. For analysis purposes, a standard width of five feet was assumed for all sidewalks.
3. Sidewalk condition is assumed to be good unless other information is available.

Table 4. Pedestrian Level of Traffic Stress Based on Physical Buffer Type and Speeds

Buffer Type[1]	Prevailing or Posted Speed			
	≤ 25 mph	*30 mph*	*35 mph*	*≥ 40 mph*
No Buffer (curb tight)	LTS 2[2]	LTS 3	LTS 3	LTS 4
Solid Surface	LTS 2[2]	LTS 2	LTS 2	LTS 2
Landscaped	LTS 1	LTS 2	LTS 2	LTS 2
Landscaped with Trees	LTS 1	LTS 1	LTS 1	LTS 2
Vertical	LTS 1	LTS 1	LTS 1	LTS 2

1. Combined buffer: If two or more of the buffer conditions apply, use the most appropriate (typically the lower-stress type).
2. If no centerline is present (residential street) or the street is traffic calmed (including sporadic vertical separation such as street furniture, street trees, lighting, planters, surface change, and so on), then the PLTS can be lowered by one PLTS level.

Table 5. Pedestrian Level of Traffic Stress Based on Physical Buffer Width[1]

Total Number of Travel Lanes (both directions)[3]	Total Buffering Width (feet)[2]				
	< 5	*≥ 5 to < 10*	*≥ 10 to < 15*	*≥ 15 to < 25*	*≥ 25*
≤ 2	LTS 2[4]	LTS 2	LTS 1	LTS 1	LTS 1
3	LTS 3[4]	LTS 2	LTS 2	LTS 1	LTS 1
4–5	LTS 4[5]	LTS 3	LTS 2	LTS 1	LTS 1
6 ≥	LTS 4[5]	LTS 4[5]	LTS 3	LTS 2	LTS 2

1. Source: Based on Oregon Department of Transportation *Analysis Procedures Manual*, Table 14-23.
2. Total buffering width is the summation of the width of buffer, width of parking, width of shoulder, width of curb and gutter, and width of the bike lane on the same side of the roadway as the pedestrian facility being evaluated.
3. One-way facilities are assumed to have their lanes multiplied by 2 to represent exposure to lane crossing.
4. If no centerline is present (residential street) or the street is traffic calmed (including sporadic vertical separation such as street furniture, street trees, lighting, planters, surface change, and so on), then the PLTS can be lowered by one PLTS level.
5. Sections with a substantial physical barrier/tall railing between the travel lanes and the walkway (such as might be found on a bridge) can be lowered to PLTS 3.

MEMORANDUM

To: City of Sacramento

From: David Wasserman, AICP; Elizabeth Yarnall, AICP; Alta Planning + Design

Date: 9/12/2023

Re: Methodology for School & Park Access Shed Analysis - APPENDIX F

School and Park Access Analysis

Background

Access is defined as how well a transportation system connects destinations in a community. This aspect of the transportation system is often represented by feature which covers how far a user may travel from a predetermined location. Travel-sheds are developed either using distances or amount of time. For active travel, often a half-mile or 10-minute walk and 3 miles or 8-minute bicycle ride are used as a typical travel-shed distance or time.

The City of Sacramento has requested that Alta conduct an access shed analysis that will measure the accessibility of schools and parks. First, Alta proposes that this accessibility be assessed including the current level of traffic stress (LTS) experienced by bicyclists and pedestrians while traveling. Then, Alta will measure accessibility assuming that this stress is eliminated with new projects and policies.

Figure 1. Depiction of travel shed analysis adjusted for traffic stress.

Methodology

Alta will utilize park and school location files supplied by the City of Sacramento to conduct this analysis. Due to the linear shape of many parks in Sacramento, park features will be rasterized and converted to points; then a 5, 10, 15 and 20 minute walk-shed and bike-shed will be created for each point. These individual access sheds will be combined to provide a full picture of access for parks. Schools are often more consolidated in form, and therefore will be represented by a centroid point, with access sheds then calculated to that point.

The walk-shed and bike-shed will be created with levels of traffic stress (LTS) included as an impedance, then without LTS in a second round. The difference between the two access sheds is the potential benefit that bicycle and pedestrian improvements could provide to the City of Sacramento. See Figures 1 and 2, for an example from Portland, Oregon of bicycle access with and without traffic stress.

Alta also proposes overlaying potential access shed benefits with equity priority areas and other key demographics, to better understand the communities within Sacramento that would benefit from the improved access. Summary statistics of these overlays can then be developed. Illustrative maps of the access sheds within the city focus areas, across the entire city and any other key areas will be created by Alta planners and designers. Narrative, statistics, and maps will then be summarized in a memorandum.

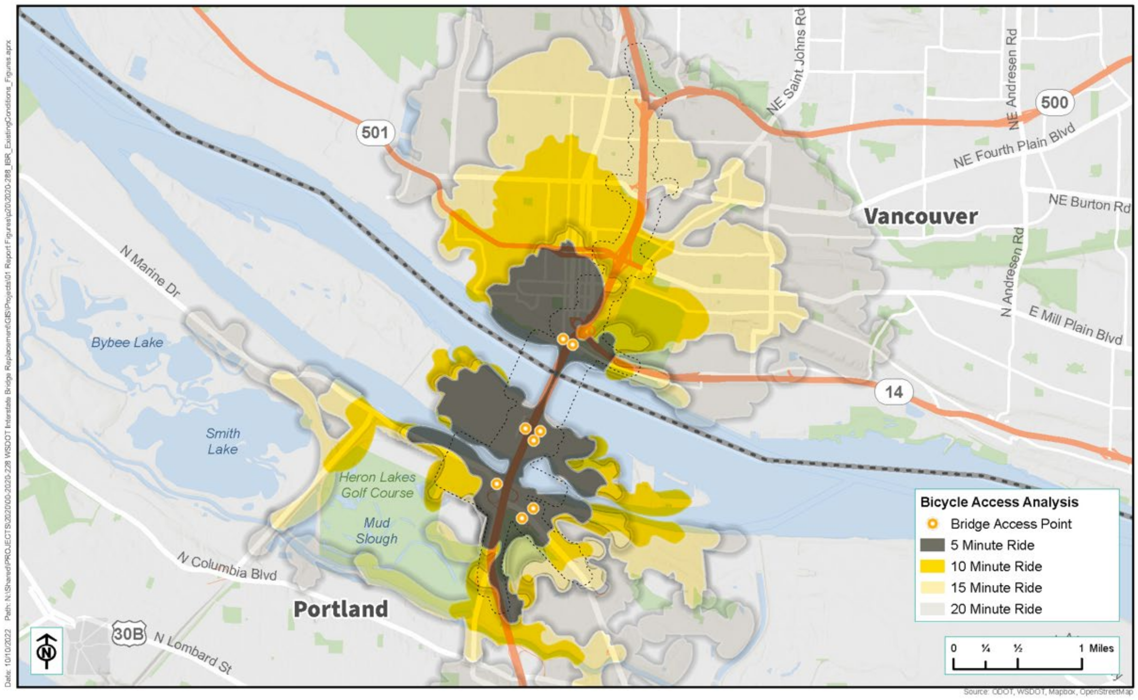

Figure 2. Bicycle Access from I-5 Bridge with current levels of traffic stress, Portland, OR

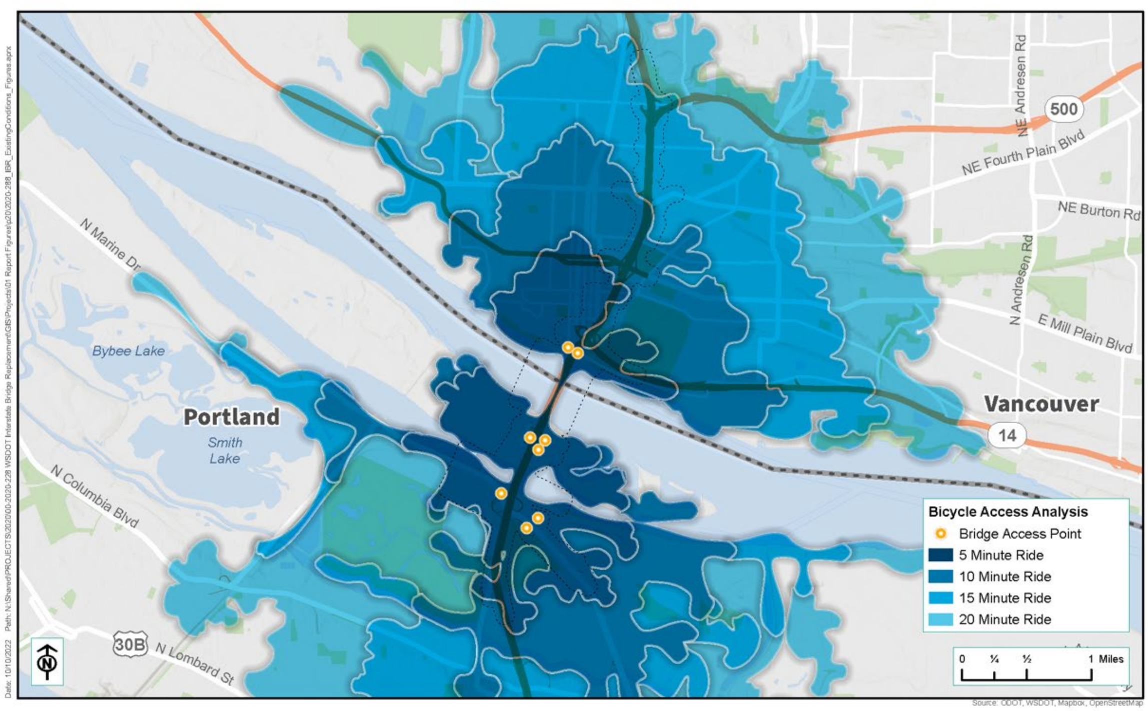

Figure 3. Potential Bicycle Access from I-5 Bridge without stress, Portland, OR

MEMORANDUM

To: City of Sacramento

From: Mauricio Hernandez; Alta Planning + Design

Date: 12/06/2023

Re: Methodology for Active Travel Facilities Gap Analysis - APPENDIX G

Active Travel Facilities Gap Analysis

Background

The analysis methodology is informed by preliminary evaluation criteria City Staff have communicated in meetings with the project team as well as the project scope of work. This technical approach outlines key aspects of the analysis methodology to build consensus within the project team on the intended analysis outcomes.

Methodology

This assessment will quantify factors that impact walking and bicycling activity, locate network gaps as potential projects, and identify areas with specific characteristics, for example, areas that have both a need for active transportation and a high demand. This analysis will consider roadways, trails, and other independent rights-of-way within the City of Sacramento.

Alta will use existing multi-modal infrastructure data as well as results from other analyses such as Active Trip Potential (ATP) and existing Level-of-Traffic Stress (LTS) analysis for walking and biking to develop an understanding of how well destinations and areas of demand are connected for people who want to walk and bike for both transportation and recreation. It will also consider how Sacramento's networks connect regionally.

Gap Evaluation Grid

First, Alta will create an active travel *Gap Evaluation Grid* to understand ideal locations for new facilities throughout the study area. **Importantly, the gap evaluation grid will be created once for bicycle network gaps and then a second time for pedestrian network gaps.** This grid[1] will be created using uniform hexagons covering Sacramento: extending a quarter-mile beyond the city limit. Extending the analysis slightly beyond the city limit will help the project team create a plan that is connected and useful to other planning processes of neighboring jurisdictions.

The approximate target size for hexagons is smaller than a typical traffic analysis zone (small neighborhood) but larger than one downtown block. This is a flexible approach that supports finding gaps both on-street and off-street on a similar basis as equal area geographies are weighted equally to create average scores.

[1] This hex grid will be based on either a generated tessellation or on using H3. The main difference is the degree of control over the resulting geometry with generated tessellations having more custom patterns they can adhere to. H3 would be pulling from a global repository of hexagons at different scales. These hexagons have unique IDs, and are popular for spatial analysis because in theory any aggregation to H3 grids for other analysis could be easily joined in that they reference consistent spatial grids.

Whole area prioritization scoring would leverage metric scores associated to a hexagonal grid across the city. Many of the datasets suggested for the *Gap Evaluation Grid* are provided natively at the census block group level. We will use the appropriate area-weighted sampling techniques to generate hexagonal scores in those cases.

The prioritization scoring methods suggested for this analysis blend planning judgment and a percentile ranking of continuous data to a 10-point scale across scoring categories. The categories for the evaluating gaps include **User Comfort, Equity, Demand, Existing Connections, and Safety.**

User Comfort

High-stress facilities will be identified in the Level-of-Traffic Stress analysis for bicyclists and pedestrians respectively. For the gap analysis all hexagons will be assigned user comfort points based on the highest LTS facility they intersect. For example, if a hexagon intersects an LTS 1 segment, it will be assigned 10 points. This means areas that would address high stress gaps will score higher and can be targeted for intervention.

Equity

Alta will conduct an equity analysis using a data-driven approach that identifies concentrations of historically disadvantaged or vulnerable populations using public health and demographic indicators. Alta will utilize the CalEnviroScreen 4.0[2] dataset presented in the existing conditions phase to identify equity priority communities. CalEnviroScreen 4.0 examines census tracts based on the combined indicators of pollution burden (i.e., exposures and environmental effects) and population characteristics (i.e., sensitive populations and socioeconomic factors). Pollution burden and population characteristics consist of a total of 21 statewide indicators ranging from low educational attainment to existing ozone levels (more information on each indicator is available from the Office of Environmental Health Hazard Assessment). Census tracts considered the most disadvantaged at the statewide level score at or above the 75th percentile, and have been identified for greenhouse gas reduction funding through Senate Bill 535.[3]

Alta will allocate CalEnviroScreen 4.0 scores proportionally within the *Gap Evaluation Grid* hexagons. The resulting hexagon metric will then be percentile ranked within the study area, and then linearly scaled to form a 10-point score. For example, a hexagon with a score at the 75th percentile will receive 7.5 points.

Demand

Demand represents the potential usage of a particular gap based on the key community destinations to which it provides connections (e.g., jobs, activities etc.), and, relatedly, its alignment with existing short trips or trips made via active transportation (i.e., walking or bicycling). Alta will utilize the previously developed Active Trip Potential analyses to create demand scores specific to bicyclists (evaluating short trips <= 3 miles) and pedestrians (evaluating short trips <= 1 mile) Scoring will use the associated demand with hexagons across the city, which will be percentile ranked and then linearly scaled to form a 10-point score.

Existing Connections

Grid locations will be given more points if they facilitate better connections to existing bicycle and pedestrian infrastructure.

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[2] CalEnviroScreen 4.0 available online: https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40.
[3] Senate Bill 535 establishes minimum funding requirements and definitions for Disadvantaged Communities (DACs).

Bicycle Connections

Grid locations will be scored based on the type of the existing bicycle infrastructure within 50 feet of the hexagon. For example, hexagons without any nearby facilities will be given 10 points. Scoring of different bicycle facility classifications is included in **Table 1.**

Table 1. Existing Bicycle Connections Scoring

Criteria	Scoring
Separated Bicycle Lane or Off-Road Trail	1
Unprotected, Buffered On-Street Bicycle Lane	3
Unprotected, non-buffered On-Street Bicycle Lane	6
Bicycle Routes	8
No Bicycle facility	10

Pedestrian Connections

Grid locations will be scored based on the presence of the existing pedestrian infrastructure within 50 feet of the hexagon. For example, hexagons near an existing signalized pedestrian crossing such as a High intensity Activated Crosswalk (HAWK, also known as Pedestrian Hybrid Beacons) will be given 10 points. Given there are two types of infrastructure considered that have different representations (points vs. corridors), the scoring gives hexagons the points indicated by the type of existing facilities in **Table 2.**

Table 2. Existing Pedestrian Connections Scoring

Criteria	Scoring
Corridors	
Buffered sidewalk or Off-Road Trail	1
Non-buffered sidewalk	3
Non-buffered sidewalk, on one side of street	6
No sidewalk	10
Intersections / Crossings	
Pedestrian Signals	1
HAWK Crossing	2
RRFBs	4
Flashing Beacon	6
Midblock Crossings	8

Safety

Adopted in 2018, the Vision Zero Action Plan identified the citywide high injury network (HIN). Since the adoption of the Action Plan, the City has conducted a detailed review of the top five corridors from the HIN and identified focused safety improvements around 20 schools. *Gap Evaluation Grid* locations that overlap the HIN highlight gaps that address safety needs. Therefore, the percentage of each hexagon overlapping within 150 feet of the HIN will determine the score.

Gap Evaluation Grid Scoring

The total score for each of the elements: User Comfort, Equity, Demand, Existing Connections, Tree Opportunity, and Safety will be summed to provide a final score for the *Gap Evaluation Grid*. Applying equal weighting, areas with the highest scores will be areas of key gaps for the community. A summary table of the scoring evaluation process is provided in **Table 3.**

Final Gaps & Opportunities Identification

Using an overlay of the city-wide *Gap Evaluation Grid*, existing facilities, and information from the public outreach process Alta designers and planners will then identify:

- Key gaps in existing bicycle networks, intersection crossing needs, and other conflict points;
- Gaps in pedestrian networks, such as sidewalk gaps, crossing needs in areas of pedestrian activities or at crossings of streets and other public rights-of-way;
- New trail opportunities along waterways, other infrastructure rights-of-way, between isolated neighborhoods or adjacent to public street right of ways;
- Major barriers that currently prevent safe and comfortable access across Sacramento.

Alta will produce maps, tables, and narratives that describe these gaps and needs, synthesizing this information into critical needs and gaps that can be addressed by the City. As project schedule allows, information from the public outreach process will also be integrated into this analysis. This gap analysis will be included in a technical memorandum, to be included in the final plan.

Table 3. Gap Evaluation Grid Criteria Summary

Criteria	Measures	Data Source	Hexagon Metric	Project Scoring	Weight
User Comfort	Level of Traffic Stress (LTS) along the existing network.	City of Sacramento, OSM, Alta analysis	Hexagon is scored based on intersection with LTS analysis. LTS 1 = 0; LTS 2 = 3; LTS 3 = 6; LTS 4 = 10 points. The maximum LTS value intersecting the hexagon will be used for the Grid.	Maximum LTS value overlapping with a bicycle or pedestrian hexagon.	16.6%
Equity	Equity index leveraging a combination of demographic and public health data to identify socially vulnerable populations with high investment need.	CalEnviron-screen 4.0	A hexagon's proportional average with the CalEnviroScreen's Demographic Index.	Percentile ranked and linearly scored to a 10-point scale.	16.6%
Demand	Active Trip Potential (ATP) trips proportionally allocated to hexagons.	Replica Places	Area-weighted average of ATP for each hexagon location. Bicyclists demand will use a short trip threshold of 3 miles, and pedestrians 1 mile.	Percentile ranked and linearly scored to a 10-point scale.	16.6%
Existing Connections	Gaps that would connect to existing high-quality bicycle and pedestrian infrastructure.	City of Sacramento Public Works	Hexagon is tagged based on being within 50 feet of an existing pedestrian crossing enhancement, sidewalk, trail, or bicycle facility. The maximum hexagon value for bicycle and pedestrian connections respectively will be used for the Grid.	Maximum point value of a facility's overlap with a bicycle or pedestrian hexagon.	16.6%
Tree Opportunity	Prioritizes gaps that also would provide opportunity to expand the urban tree canopy.	Ecopia, City of Sacramento	Average tree opportunity index score sampled to hexagon layer.	Percentile ranked and linearly scored to a 10-point scale.	16.6%
Safety	The percentage of overlap with the High Injury Network.	City of Sacramento	The percentage of a hexagon that overlaps with a 150 ft buffer of the High Injury Network.	Receives 10 points if proximate to the HIN.	16.6%
Notes: Some scores, such as the one identified here, have an unknown statistical distribution. Percentile ranks tend to result in uniform distributions that can be useful for cross-metric analysis, but when metrics are being created with different distributions, their behavior can be erratic. For example, if values skew toward very low values, regardless of their weight, the impact of the metric on the final scoring may be limited. For this reason, we may elect to percentile rank or do some type of normalization routine for this metric if we find its distribution impairs its role in a larger process.					