MEMORANDUM

To: Jim Lightbody and Aruna Bodduna, City of Mountain View

From: Sam Corbett and Kim Voros, Alta

Date: March 18, 2021

Re: North Bayshore Bicycle and Pedestrian Capacity Analysis Results for 2040 and Infrastructure Recommendations

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Introduction

Major redevelopment and construction planned for North Bayshore will result in the addition of up to ten thousand new residential units along with significant increases in office space and other supportive land uses at full build out. In order to accommodate the new population without excessive increases in motor vehicle trips, investment in bicycle and pedestrian infrastructure and supportive Transportation Demand Management (TDM) programs are required. The purpose of the *2020 North Bayshore Bicycle and Pedestrian Circulation Study* (Circulation Study*)* was to model estimated future bicycle and pedestrian activity, and to assess whether the proposed infrastructure is sufficient to accommodate the number of estimated riders and recommend modifications if necessary. The results of this assessment will help create world-class walking and bicycling facilities within North Bayshore. While the focus of the analysis was on district gateways—the primary modal connections between external facilities and North Bayshore—internal circulation was also assessed. TDM strategies are only discussed briefly in this study and further detail may be necessary as part of another study. The findings of this study support and in some instances refine the bicycle and pedestrian infrastructure recommendations described in the *North Bayshore Precise Plan* (Precise Plan).

District Background and Context

North Bayshore is located at the northern end of Mountain View and borders Mountain View Regional Park to the north, Highway 101 to the south, Palo Alto to the west, and Stevens Creek to the east (see Map 1). North Bayshore is home to many tech companies and includes large Google, Microsoft, and Intuit campuses. The residential population is currently small. A vision and associated guiding principles for the redevelopment of the district are laid out in the *2014* Precise Plan and subsequent amendments*.* The Precise Plan includes recommendations for land use, green building, habitat, mobility, infrastructure, implementation, and a 10 percent active mode share for all commute trips and 25 percent active mode share for all internal trips.

Due to the separation of North Bayshore from the rest of Mountain View created by Highway 101, access to the district is constrained to five major entry points referred to as gateways (see Map 1). These gateways include San Antonio Road, North Rengstorff Avenue, North Shoreline Boulevard, the Permanente Creek Trail and the Stevens Creek Trail. Each gateway has an associated motor vehicle trip cap, which is intended to help maintain the quality of access to and circulation within the district. High quality, connected bicycle and pedestrian infrastructure and supportive TDM strategies are employed as part of the strategy to maintain high-quality access. In spring 2020, the Rengstorff Avenue gateway exceeded its trip cap during the afternoon commute, while the North Shoreline Boulevard gateway exceeded its trip cap during the morning commute.[1] With projected growth, the North Shoreline Boulevard gateway will likely be over the motor vehicle capacity during both commute periods before 2030.

[1] The report for the North Bayshore Transportation Monitoring Report was published in April of 2020, but the actual counts were conducted in February 2020, before the pandemic. See the following footnote, taken directly from the report: *"COVID-19 Note: The North Bayshore Gateway observations reported in this document were collected at the beginning of February 2020 prior to voluntary shelter-in-place policies by large technology firms in the Bay Area beginning the first week in March 2020 or the shelter-in-place rules issued by Santa Clara County Public Health Department that took effect on March 17, 2020 to slow the spread of COVID-19. This data was collected before these substantial changes in travel patterns occurred. Looking ahead, these changes in travel patterns are likely to prevail for many months, which will be considered when embarking upon future monitoring efforts."*

Background Document Review

Over 40 relevant planning and policy documents—such as master plans, TDM plans, transportation monitoring reports, site-specific drawings, and traffic analyses—were reviewed to accurately assess existing and future travel patterns and infrastructure in North Bayshore. The documents were reviewed to identify and understand the location of relevant bicycle and pedestrian counts, infrastructure recommendations, and TDM measures. The review was focused on infrastructure information on street sections and facility types. For the full document review, see Appendix A.

Subsets of these documents were also reviewed for potential company incentive programs and other related TDM measures including: *North Bayshore Precise Plan, 2015 North Bayshore TDM Plan Guidelines, 2018 Citywide Multimodal Improvement Plan, 2018 North Bayshore Residential TDM Guidelines, the 2017 – 2019 North Bayshore District Transportation Monitoring Reports,* and the *2015 Mountain View Bicycle Master Plan Update.*

In addition to infrastructure and TDM measures, documents were also reviewed for bicycle and pedestrian counts to understand existing and estimated future bicycle and pedestrian activity. The Precise Plan established vehicle trip caps as part of the City's TDM requirements. Bi-annual traffic counts, including bicycle and pedestrian counts, are collected through the Transportation Monitoring Reports to assess the North Bayshore District's vehicle trip cap performance. The Transportation Monitoring Reports provided the most consistent and robust bicycle and pedestrian count data, which is measured at each of the District's five gateways, although these documents provide counts at various intersections throughout the District.

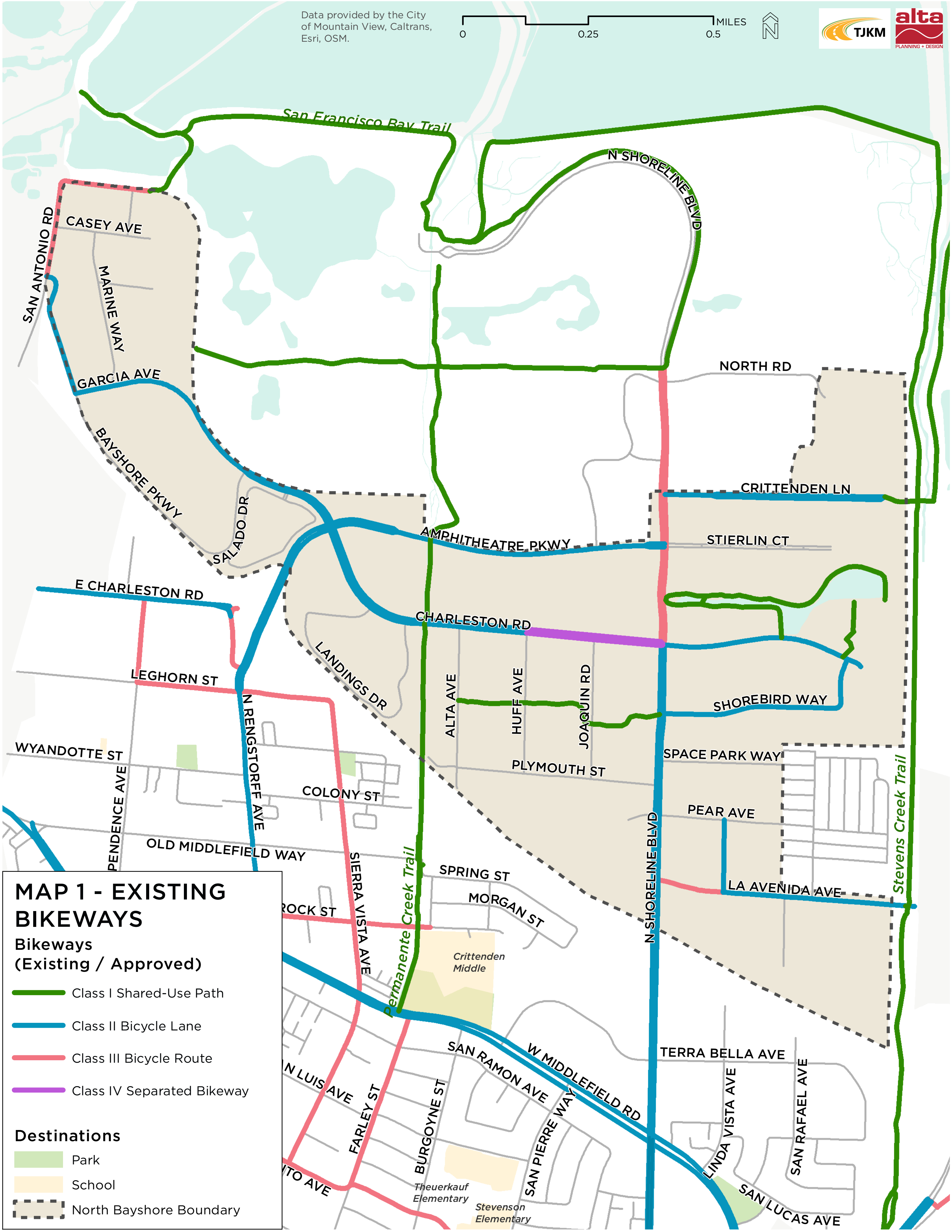
Existing, Approved, and Planned Bicycle and Pedestrian Infrastructure and Network Quality

This Circulation Study uses existing, approved, and planned bicycle and pedestrian infrastructure that was mapped as part of the *AccessMV Comprehensive Modal Plan* (AccessMV) as a foundation for the Circulation Study's existing and future infrastructure and network quality assessment. The existing, approved, and planned infrastructure information was refined based on more detailed district- and site-level plans reviewed during the background document review. The Circulation Study also relies on an assessment of existing and future bicycle network quality. The assessment technique is known as a Bicycle Level of Traffic Stress (BLTS) analysis and was completed as part of the AccessMV development effort. BLTS is a simple 1 – 4 scale that is used to quantify the bicycling user experience. A BLTS of 1 is considered an All Ages and Abilities facility while a BLTS of 4 is considered a facility that is appropriate for highly confident bicyclists.[2] See Appendix B for more information on the BLTS.

[2] A quality assessment of pedestrian activity was also developed as part of the Modal Plan development effort but is not used in the Circulation Study.

Existing, Approved and Planned Bicycle Infrastructure

Existing, approved, and planned bicycle facilities and their BLTS are shown on Maps 1 – 4. Currently, high-quality bicycle access to North Bayshore is provided by the Stevens Creek, Permanente Creek, and Bay Trails. High quality existing and approved bicycle facilities within North Bayshore include the Google Green Loop and Class IV facilities along part of Charleston Road. Class II facilities exist on most major roadways (see Map 1). While trails provide a low-stress user experience, most of the major roadways within North Bayshore are currently rated as a BLTS 3, a high-stress user experience (see Map 2). Map 3 shows the planned future bicycle infrastructure, which includes conversion of many Class II facilities to Class IV and development or construction of a network of low-stress greenway circulators and access streets. Map 4 shows a future BLTS based on planned facilities. Almost all of the transportation infrastructure within North Bayshore is projected to be a BLTS 1 once the planned network is completed.



MAP 1 - EXISTING BIKEWAYS
Bikeways
(Existing / Approved)
Class I Shared-Use Path
Class II Bicycle Lane
Class III Bicycle Route
Class IV Separated Bikeway
Destinations
Park
School
North Bayshore Boundary
Data provided by the City of Mountain View, Caltrans, Esri, OSM.
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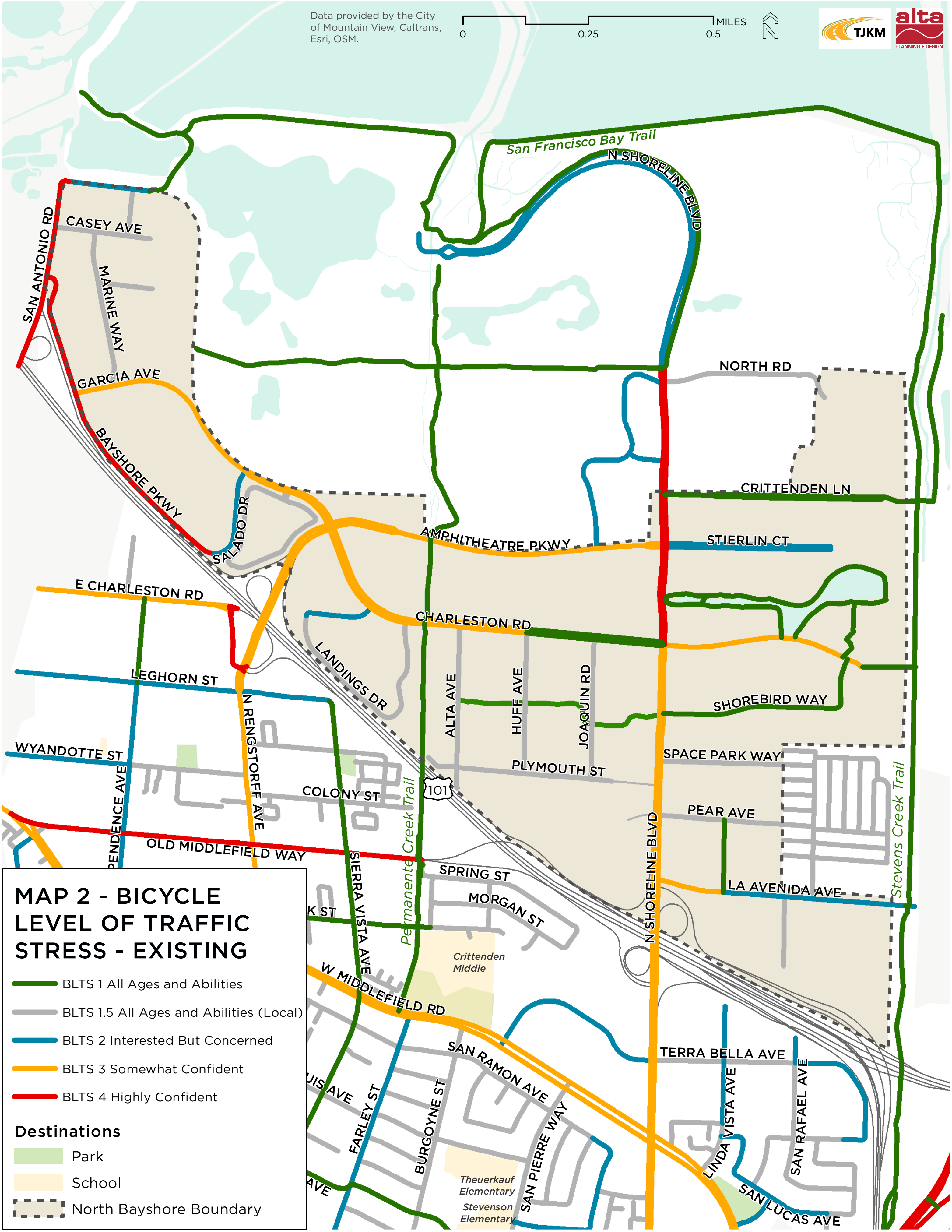
FARLEY ST
Theuerkauf Elementary
Stevenson Elementary



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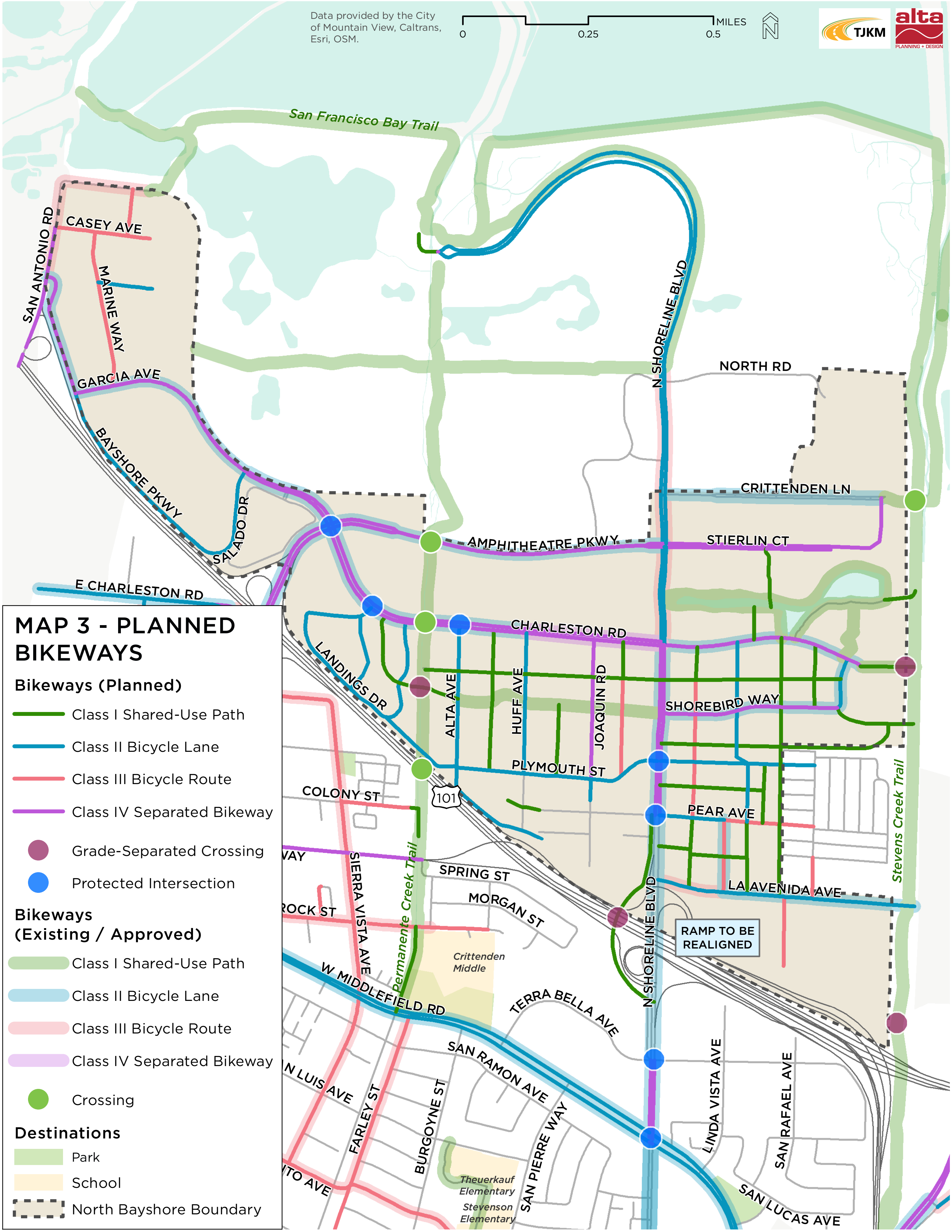
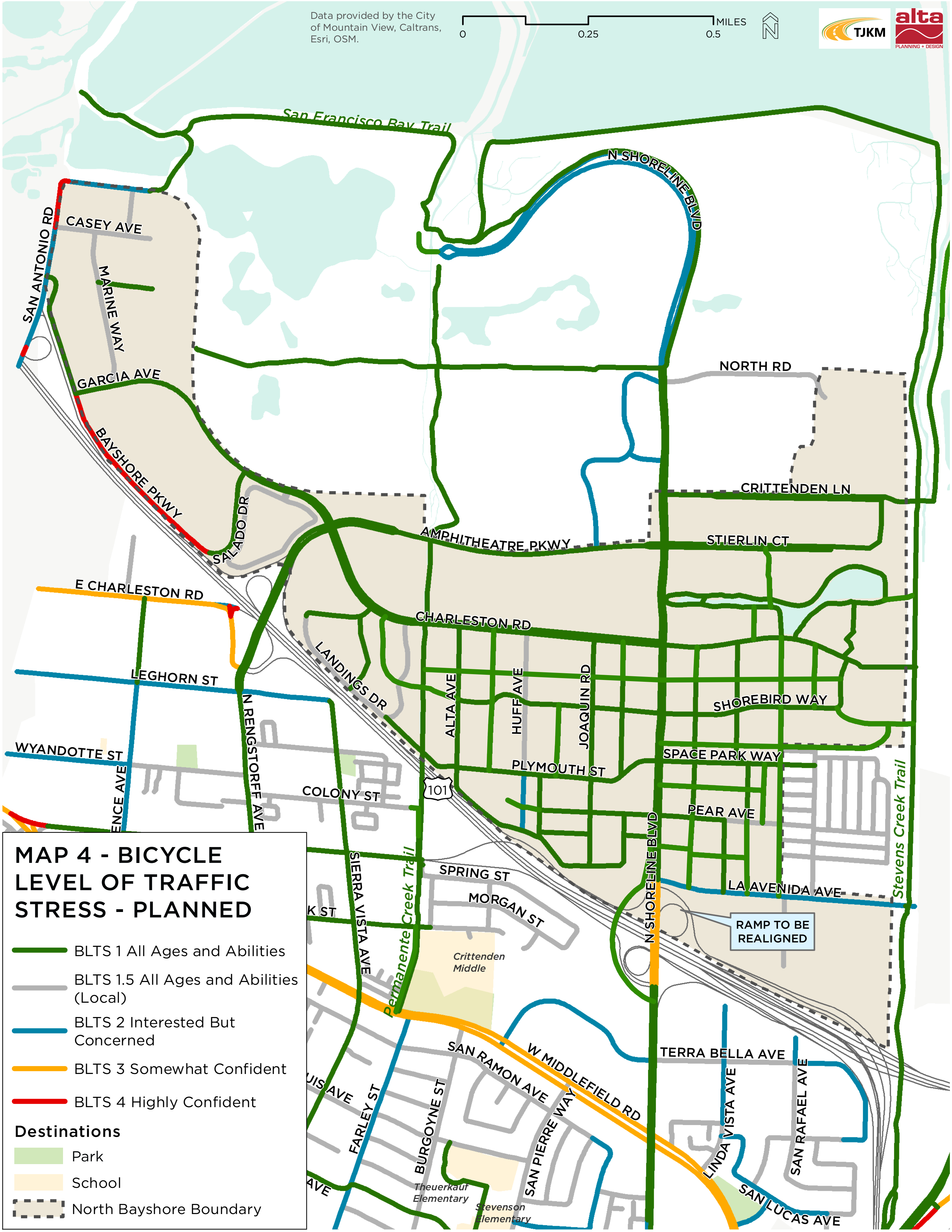
FARLEY ST
BURGOYNE ST
SAN PIERRE WAY
Theuerkauf Elementary
Stevenson Elementary
SAN LUCAS AVE
MAP 2 - BICYCLE LEVEL OF TRAFFIC STRESS - EXISTING
BLTS 1 All Ages and Abilities
BLTS 1.5 All Ages and Abilities (Local)
BLTS 2 Interested But Concerned
BLTS 3 Somewhat Confident
BLTS 4 Highly Confident
Destinations
Park
School
North Bayshore Boundary

MAP 3 - PLANNED BIKEWAYS

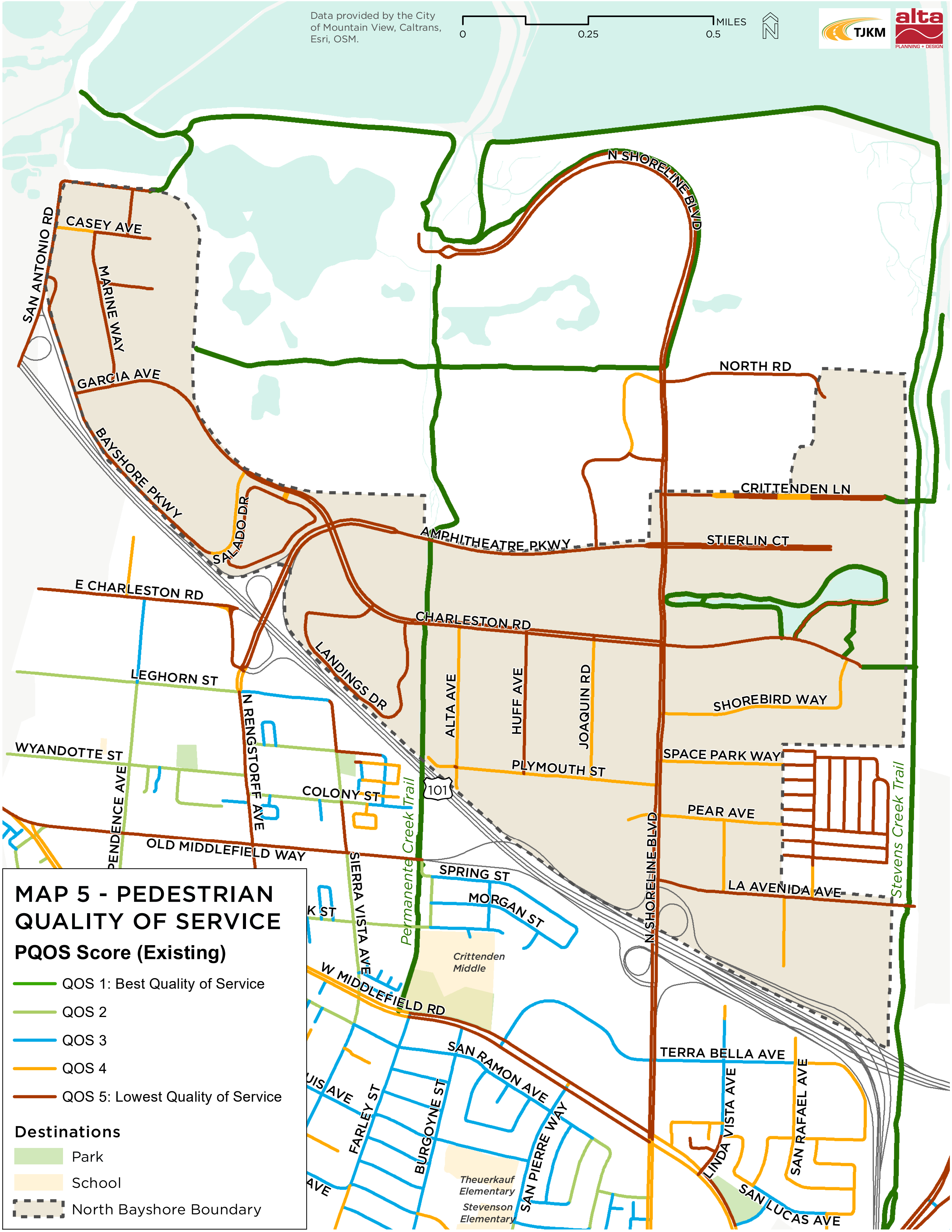


MAP 4 - BICYCLE LEVEL OF TRAFFIC STRESS - PLANNED



Existing, Approved, and Planned Pedestrian Infrastructure

Maps 5 – 8 show the existing, approved, and planned pedestrian infrastructure and the Pedestrian Quality of Service (PQOS). The PQOS is shown on Map 5 while existing pedestrian infrastructure is shown on Maps 6 and 7. Specifically, Map 6 shows the location of traffic signals, trails and the status of sidewalks (complete, missing on one side, existing with gaps or completely missing) and Map 7 shows the location of trails, stop signs and crosswalks. Map 5 shows that most roadways in North Bayshore have at least some sidewalk infrastructure. Sidewalks are missing along the North Shoreline Boulevard overcrossing of US 101, Stierlin Court, portions of Rengstorff Avenue and the access roadway for the Google GWC1 building. Sidewalks are present but fragmented or present along only one side of Landings Drive, Bayshore Parkway, portions of Amphitheatre Parkway, Garcia Avenue, Alta Avenue, Crittenden Lane, and San Antonio Road. Sidewalks are typically either five or six feet wide. Planned facilities are shown on Map 8. Planned improvements include infill of sidewalk gaps, protected crossings, and new roadways with complete sidewalks. The future PQOS was not calculated as the methodology relies in part upon Walk Score data. It is expected that the upcoming Mountain View Pedestrian Master Plan will provide further detail on evaluating the quality of future pedestrian improvements (beyond the capacity analysis described in this report).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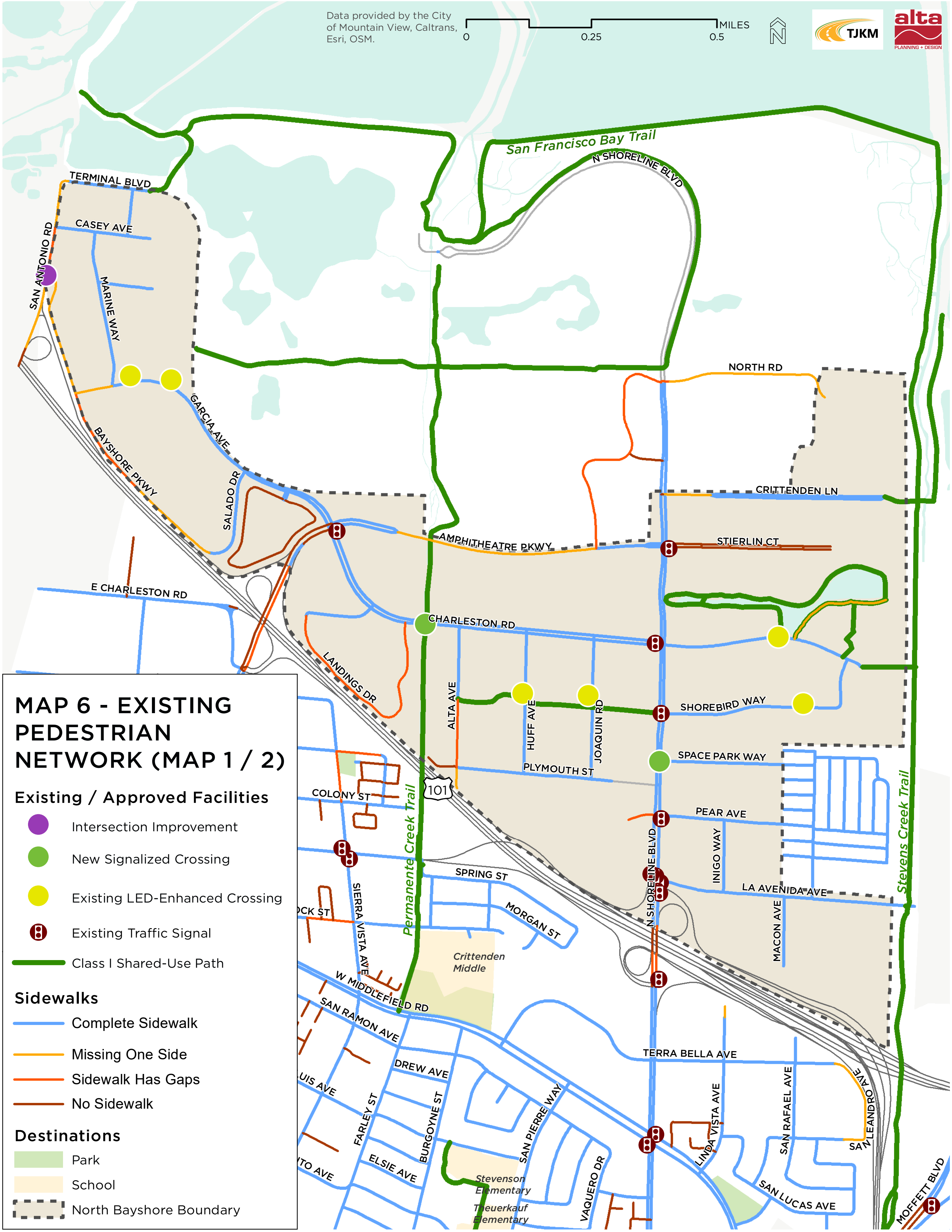
FARLEY ST
BURGOYNE ST
SAN PIERRE WAY
SAN LUCAS AVE
Theuerkauf Elementary
Stevenson Elementary
MAP 5 - PEDESTRIAN QUALITY OF SERVICE
PQOS Score (Existing)
QOS 1: Best Quality of Service
QOS 2
QOS 3
QOS 4
QOS 5: Lowest Quality of Service
Destinations
Park
School
North Bayshore Boundary


MAP 6 - EXISTING PEDESTRIAN NETWORK (MAP 1 / 2)
Existing / Approved Facilities
Intersection Improvement
New Signalized Crossing
Existing LED-Enhanced Crossing
Existing Traffic Signal
Class I Shared-Use Path
Sidewalks
Complete Sidewalk
Missing One Side
Sidewalk Has Gaps
No Sidewalk
Destinations
Park
School
North Bayshore Boundary
Data provided by the City of Mountain View, Caltrans, Esri, OSM.
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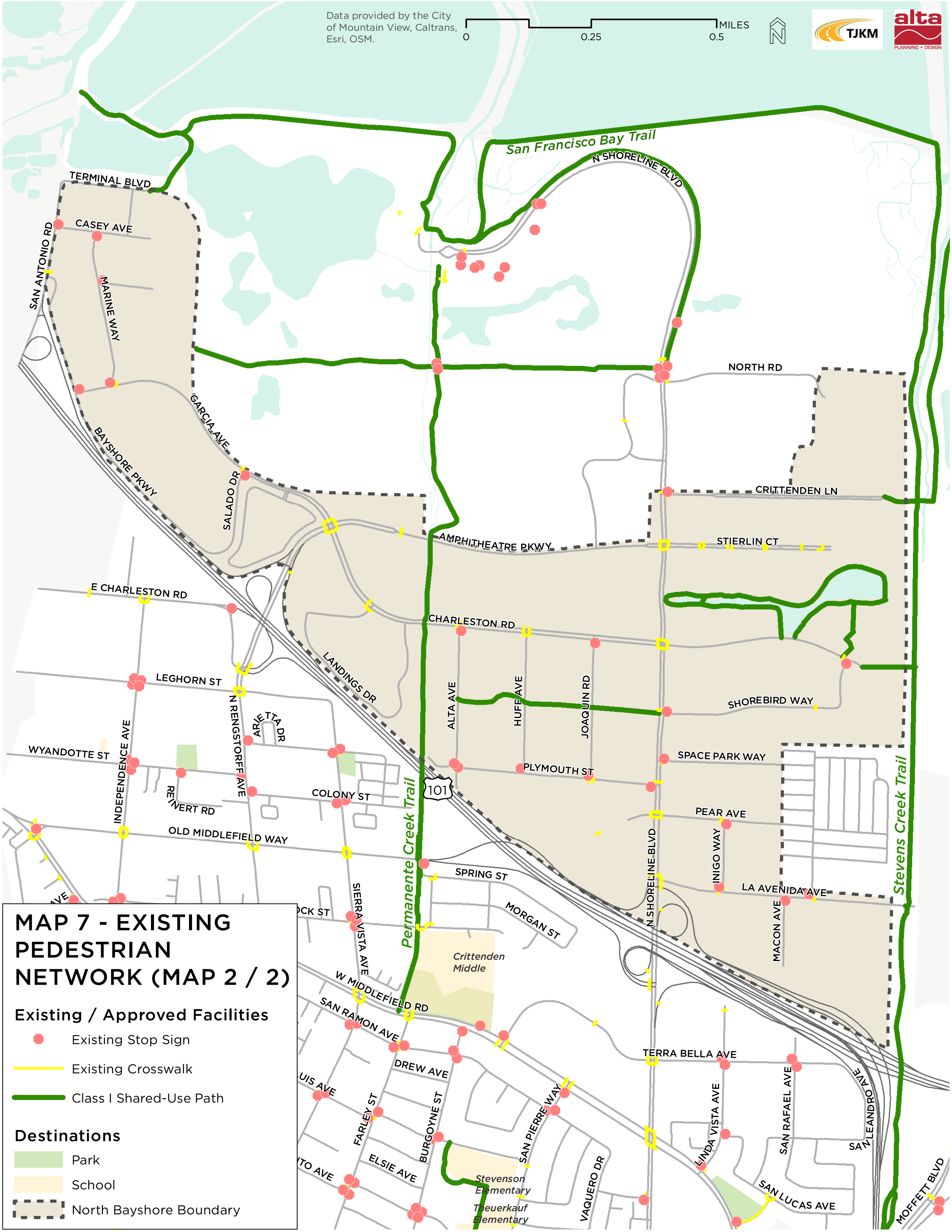
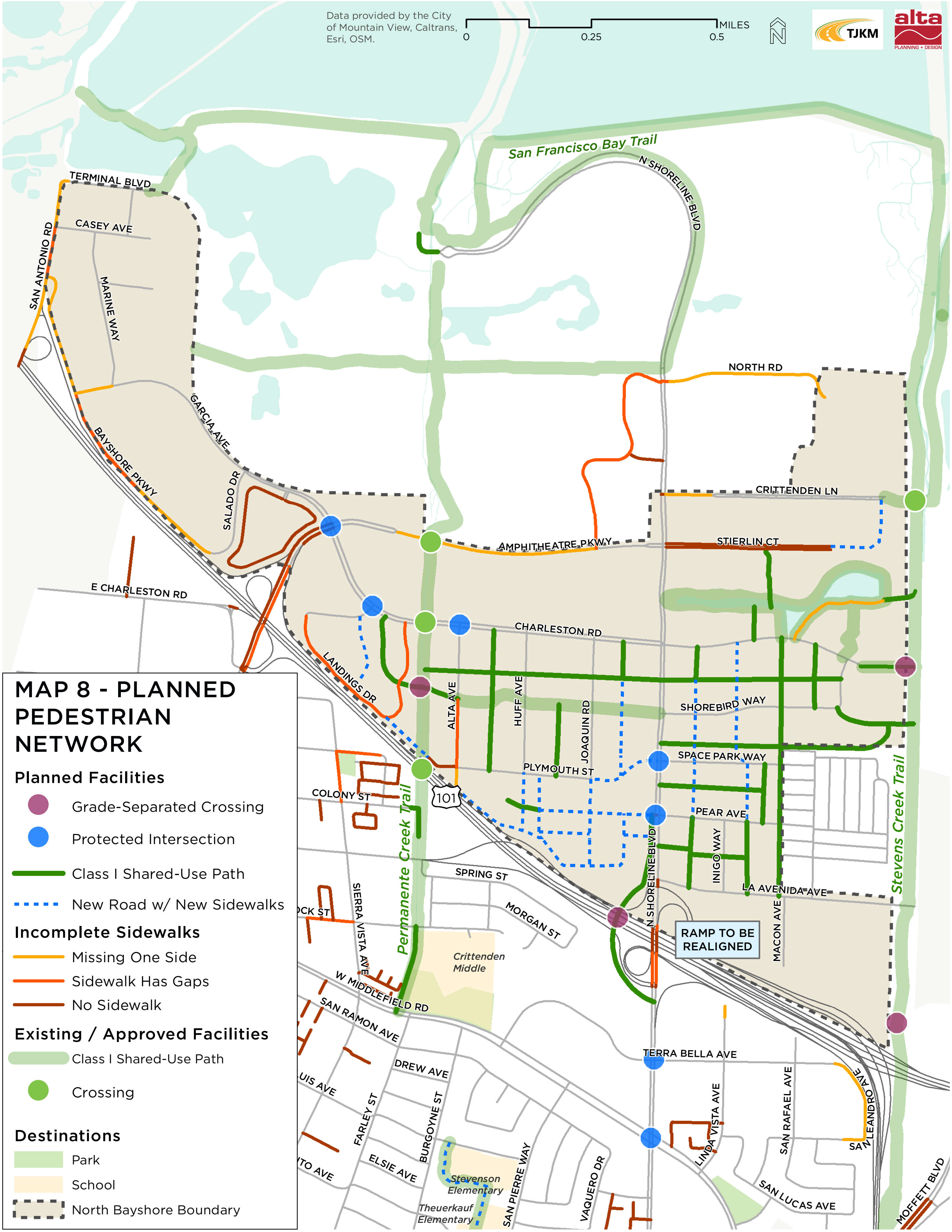
MOFFETT BLVD

MAP 7 - EXISTING PEDESTRIAN NETWORK (MAP 2 / 2)




MAP 8 - PLANNED PEDESTRIAN NETWORK
Planned Facilities
Grade-Separated Crossing
Protected Intersection
Class I Shared-Use Path
New Road w/ New Sidewalks
Incomplete Sidewalks
Missing One Side
Sidewalk Has Gaps
No Sidewalk
Existing / Approved Facilities
Class I Shared-Use Path
Crossing
Destinations
Park
School
North Bayshore Boundary
Data provided by the City of Mountain View, Caltrans, Esri, OSM.
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MOFFETT BLVD

Existing Bicycle and Pedestrian Activity

Existing bicycle and pedestrian activity was assessed through an employer survey, analysis of observed counts, and modeling of existing flows.

Employer Bicycle and Pedestrian Survey

During the summer of 2020, an employer survey of Google, Microsoft, and Intuit was conducted to understand bicycle and pedestrian commuter activity. The survey was prepared prior to the spread of COVID-19 and reports on travel patterns observed in 2019. The survey was targeted with the employer's transportation coordinator and included questions about number of employees, mode share, travel behavior, existing and potential TDM strategies, and desired infrastructure improvements. See Appendix C for a copy of the employer survey. The results of the survey are briefly summarized below and assume pre-COVID travel activity patterns.

Number of Employees, Mode Share, and Travel Activity

Based on the survey results and city staff, between 23,000 and 25,000 people are estimated to work in North Bayshore by the end of 2020. Employers report that less than five percent of their employees currently live within one mile of work and the percentage of people that live within three miles varies significantly by employer from a low of 13 percent to a high of 39 percent. Google has the highest percentage of employees that commute by bicycle at about six percent. All three companies have a higher percentage of people that commute by bicycle than commute by walking. Employers report that there is some seasonal variation in commute mode share and fewer people bicycle in winter months; changes in pedestrian travel patterns were not reported.

Employers all report that personal trips are made during daytime hours. Intuit employees typically use car share while Google employees divide their trips between shuttles, car share, and bike share services. Microsoft employees currently use car share and expressed interest in a future bike share program.

Barriers to Walking and Bicycling

When asked about barriers to walking and bicycling, all three employers reported that distance and/or perception of distance was a factor. Concerns about physical safety and lack of bicycle and pedestrian infrastructure were also mentioned by all employers.

Supportive Programs

When asked about what types of walking and bicycling encouragement programs currently exist, the response was varied. While Intuit does not offer programs, Google provides robust support for bicycle commuters with amenities like bicycle parking, private showers, and on-site repairs as well as numerous programs and events like Bike to Work Day. Google also offers commuter bikes (or e-bikes) to current employees who are interested in becoming bicycle commuters. Microsoft offers bike tune-ups and monthly rewards to employees who walk and bicycle to work but did not report participation in any events.

Requested Infrastructure Upgrades and Supportive Programs

When asked what was needed to achieve ten percent active mode share, employers reported that both infrastructure and programmatic strategies were needed. Employers noted that much of the needed infrastructure was already in the works. The following specific recommendations were called out:

- Improved connections from both Rengstorff Avenue and San Antonio Boulevard
- Improved bicycle and pedestrian facilities leading to gateways, such as new bicycle facilities along Middlefield Road

- Physical separation for bicycle and pedestrian facilities at each of the existing gateways
- Widening of the Permanente Creek and Stevens Creek Trails, and completion of the Bay Trail
- Exploration of a new connection to the Moffett Federal Airfield/NASA Ames Center, a connection via Farley Street to extend the Permanente Creek trail, and new connections to Palo Alto
- Improved internal high-quality continuous east-west bicycle connections between the Shorebird and Joaquin neighborhoods as well as between North Shoreline Boulevard and the Stevens Creek Trail
- Improved internal high-quality connections along major roadways including North Shoreline Boulevard, Rengstorff Avenue, Charleston Road, Garcia Avenue and Amphitheatre Parkway
- Supportive programs like mobility hubs, secure bike parking, bike share services, and wayfinding

In order to improve safety, employers recommended prioritizing improvements at Rengstorff Avenue, facilities on major roadways, intersection improvements like bicycle signal phasing, installation of RRFBs, and minimizing pedestrian crossing distances at all crossings.

Additional general programmatic recommendations included more marketing, outreach, and education about new and existing bicycle facilities, as well as using tactical urbanism approaches to build infrastructure more quickly. Education and encouragement programs for new residents were also recommended as was development of a city-wide bike share program.

Count-Based Activity Assessment

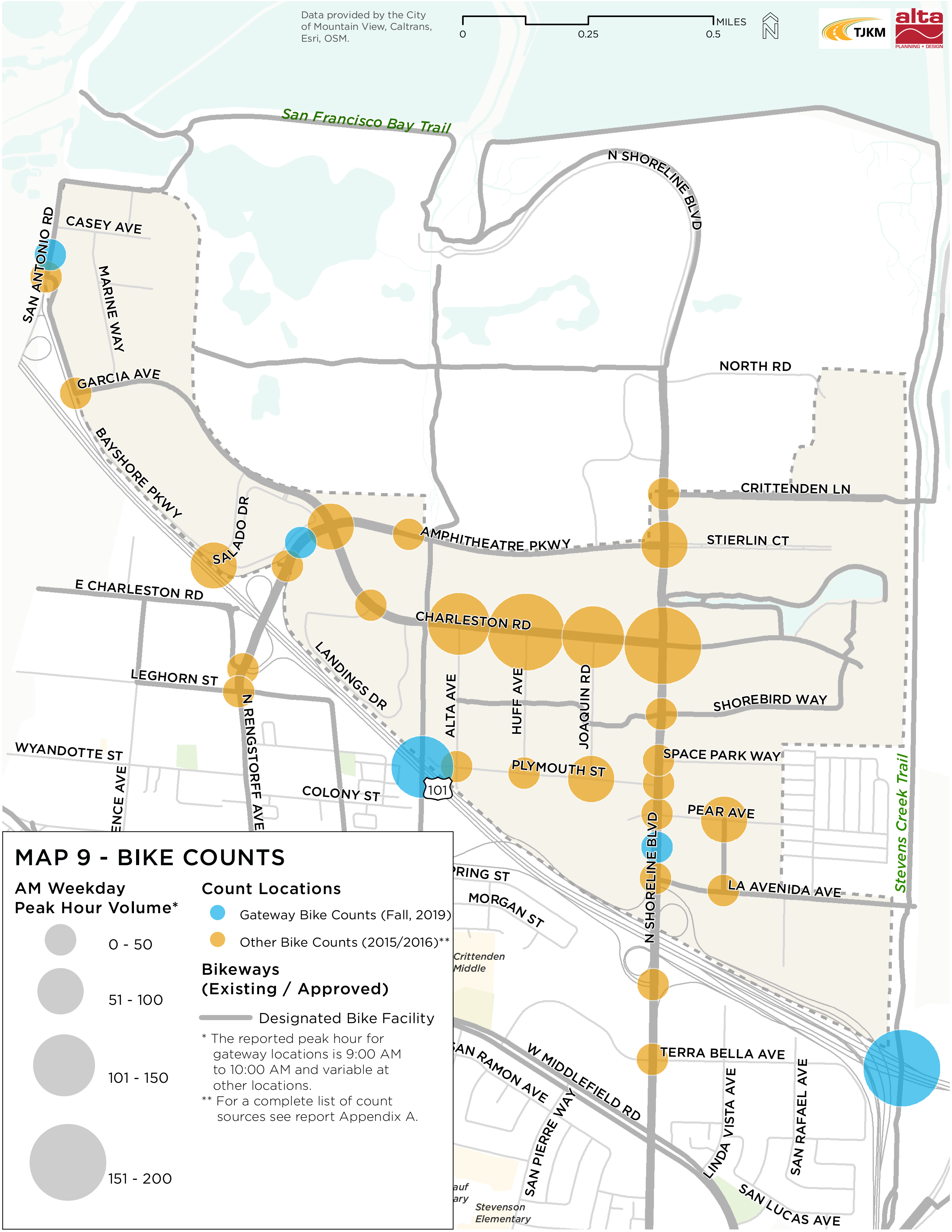
Gateway Activity Patterns

According to the *Spring 2020 District Monitoring Report*, approximately four percent of people entering North Bayshore were using active modes. In the AM peak hour, 73 percent of people using active modes enter via the Permanente Creek Trail (34 percent) or Stevens Creek Trail (39 percent). Rengstorff Avenue accounted for 11 percent of active users, followed by North Shoreline Boulevard (7.5 percent) and San Antonio Road (7.5 percent). This pattern is generally consistent with activity patterns observed at gateways during the PM peak hour.

Gateway and Internal Activity Counts

Counts from the District Monitoring Report series and other sources were compiled and mapped to develop a picture of current bicycle and pedestrian activity at 17 locations throughout North Bayshore. Counts were available for the AM and PM peak hour and shown on Maps 9 – 12. Maps 9 and 11 show AM and PM peak bicycle counts. Gateway counts, shown in blue, are highest for Permanente Creek and Stevens Creek Trails. The Rengstorff Avenue, North Shoreline Boulevard, and San Antonio Road gateways all had lower user counts. Internally, the observed count volumes were highest along Charleston Road. The PM peak hour (see Map 11) shows similar patterns, though afternoon volumes are lower than those observed during the AM peak hour. This activity pattern is consistent with motor vehicle activity patterns and the longer “shoulder” of tech workers who leave at various times throughout the evening.

Maps 10 and 12 show the AM and PM peak hour pedestrian counts. Observed pedestrian volumes are similar at all North Bayshore district gateways. Internally, the highest pedestrian volumes are observed on Charleston Road. The AM and PM pedestrian peak hours show less variation than bicycle and motor vehicle activity patterns. Several lower counts were observed along Charleston Road. Otherwise, observed count volumes were similar during both time periods.


MAP 9 - BIKE COUNTS
AM Weekday Peak Hour Volume*
0 - 50
51 - 100
101 - 150
151 - 200
Count Locations
Gateway Bike Counts (Fall, 2019)
Other Bike Counts (2015/2016)**
Bikeways (Existing / Approved)
Designated Bike Facility
* The reported peak hour for gateway locations is 9:00 AM to 10:00 AM and variable at other locations.
** For a complete list of count sources see report Appendix A.
Data provided by the City of Mountain View, Caltrans, Esri, OSM.
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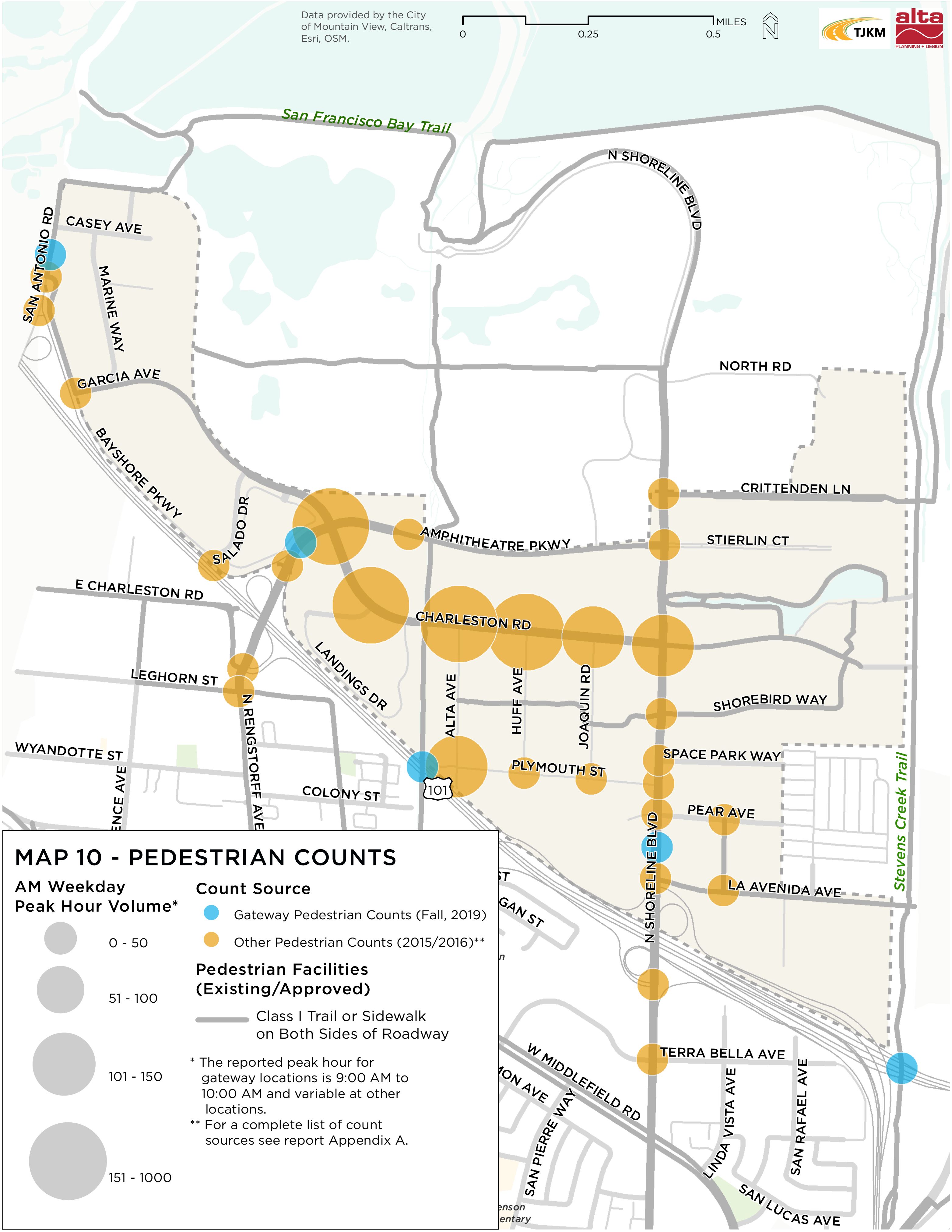

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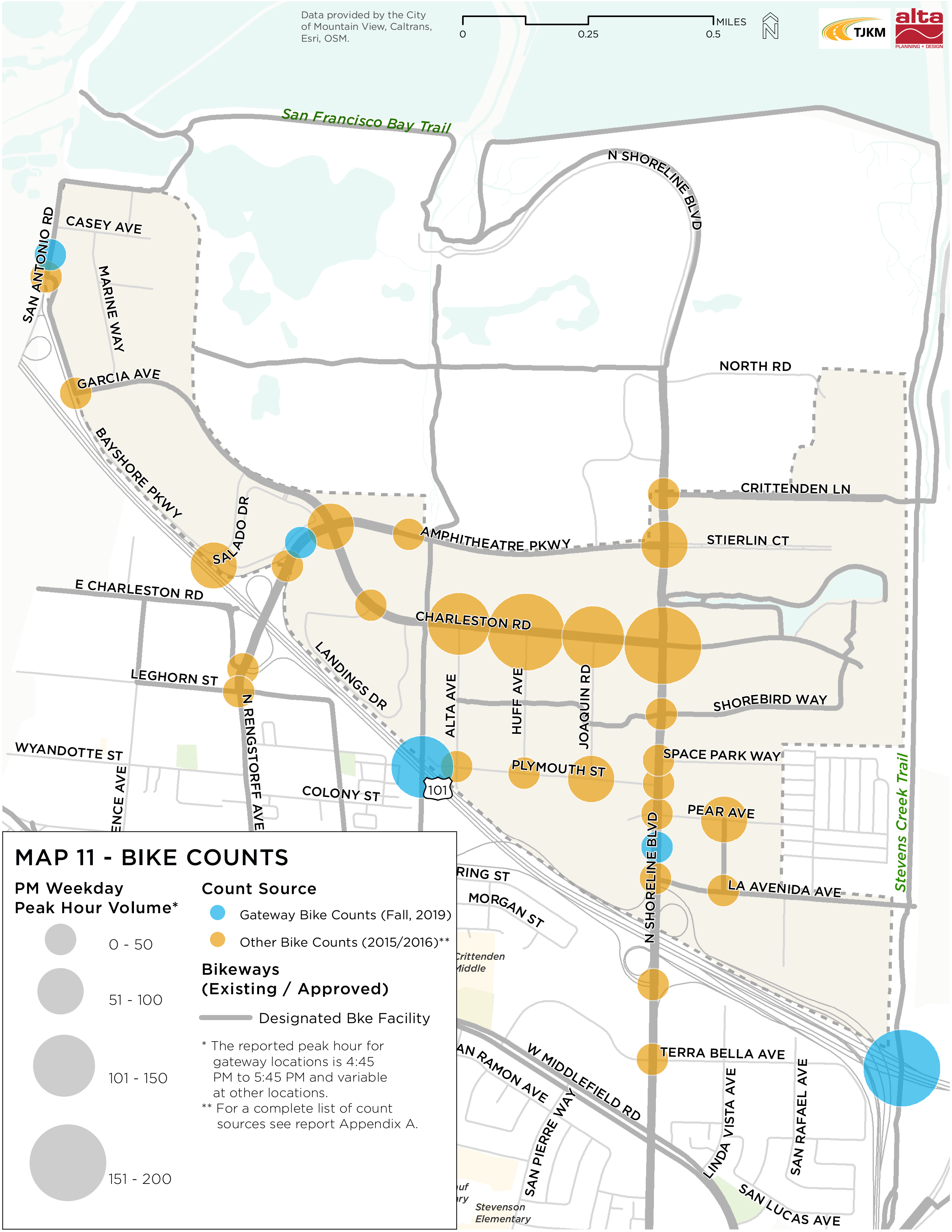
MAP 10 - PEDESTRIAN COUNTS
AM Weekday Peak Hour Volume*
0 - 50
51 - 100
101 - 150
151 - 1000
Count Source
Gateway Pedestrian Counts (Fall, 2019)
Other Pedestrian Counts (2015/2016)**
Pedestrian Facilities (Existing/Approved)
Class I Trail or Sidewalk on Both Sides of Roadway
* The reported peak hour for gateway locations is 9:00 AM to 10:00 AM and variable at other locations.
** For a complete list of count sources see report Appendix A.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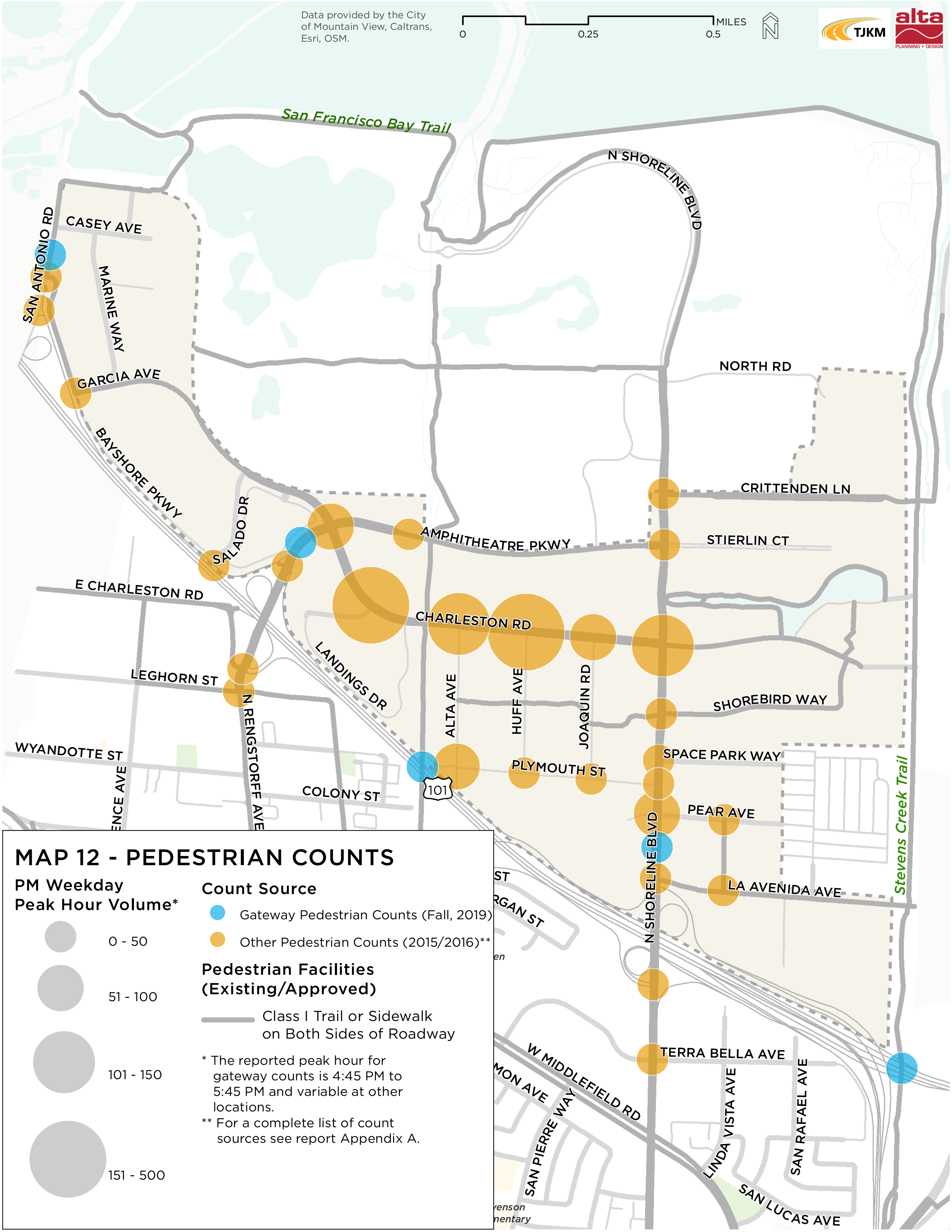
RING ST
LA AVENIDA AVE
Stevens Creek Trail
MORGAN ST
Crittenden Middle
TERRA BELLA AVE
W MIDDLEFIELD RD
SAN RAMON AVE
SAN PIERRE WAY
LINDA VISTA AVE
SAN RAFAEL AVE
SAN LUCAS AVE
Stevenson Elementary
MAP 11 - BIKE COUNTS
PM Weekday Peak Hour Volume*
0 - 50
51 - 100
101 - 150
151 - 200
Count Source
Gateway Bike Counts (Fall, 2019)
Other Bike Counts (2015/2016)**
Bikeways (Existing / Approved)
Designated Bke Facility
* The reported peak hour for gateway locations is 4:45 PM to 5:45 PM and variable at other locations.
** For a complete list of count sources see report Appendix A.


Data provided by the City of Mountain View, Caltrans, Esri, OSM.
0
0.25
0.5
MILES
N
TJKM
alta
PLANNING + DESIGN
San Francisco Bay Trail
N SHORELINE BLVD
CASEY AVE
SAN ANTONIO RD
MARINE WAY
GARCIA AVE
BAYSHORE PKWY
SALADO DR
NORTH RD
CRITTENDEN LN
STIERLIN CT
AMPHITHEATRE PKWY
E CHARLESTON RD
CHARLESTON RD
LANDINGS DR
LEGHORN ST
N RENGSTORFF AVE
WYANDOTTE ST
COLONY ST
101
ALTA AVE
HUFF AVE
JOAQUIN RD
SHOREBIRD WAY
SPACE PARK WAY
PLYMOUTH ST
PEAR AVE
LA AVENIDA AVE
Stevens Creek Trail
TERRA BELLA AVE
W MIDDLEFIELD RD
SAN PIERRE WAY
LINDA VISTA AVE
SAN RAFAEL AVE
SAN LUCAS AVE
MAP 12 - PEDESTRIAN COUNTS
PM Weekday Peak Hour Volume*
0 - 50
51 - 100
101 - 150
151 - 500
Count Source
Gateway Pedestrian Counts (Fall, 2019)
Other Pedestrian Counts (2015/2016)**
Pedestrian Facilities (Existing/Approved)
Class I Trail or Sidewalk on Both Sides of Roadway
* The reported peak hour for gateway counts is 4:45 PM to 5:45 PM and variable at other locations.
** For a complete list of count sources see report Appendix A.

Network-Based Activity Assessment

Existing and Future Flow Estimation Methods

The methods used to estimate existing and future flows utilize similar methodologies and are both explained in this section for simplicity. For a more detailed description of methods, see Appendix D and Appendix F.

Generation of Estimated Existing and Future Flows

Estimated existing and future bicycle and pedestrian flows were generated using data from the following sources:

- Roadway and trail network extracted from Open Street Map (OSM)
- Existing bicycle and pedestrian infrastructure
- Origin-destination travel activity data from Metropolitan Transportation Commission (MTC) travel demand model
- Network travel experience (perceived distance adjustment factors)
- Future housing and employment estimates from Valley Transportation Authority (VTA)
- Future housing and employment (microzone) estimates for North Bayshore from the City of Mountain View
- Observed bicycle and pedestrian counts (flow calibration data) in North Bayshore
- Estimates of future bus, bicycle, and pedestrian activity in the Charleston corridor

Existing Flow Methods

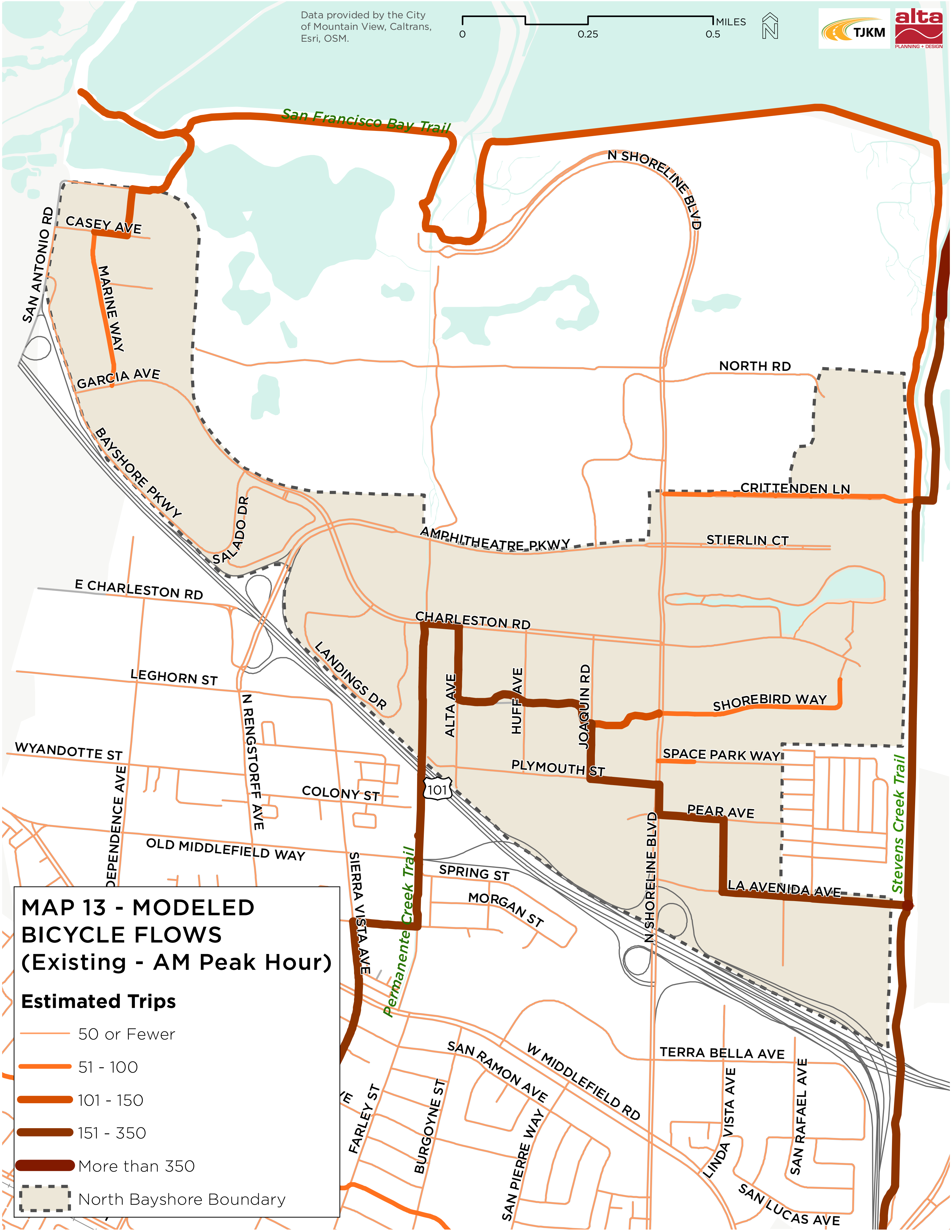
The MTC travel demand model provides flow estimates between large Transportation Analysis Zones (TAZs). In order to more precisely estimate activity in North Bayshore, the MTC TAZs were subdivided into microzones based on data from VTA and the City of Mountain View. Flows between zones were calculated using the MTC trip tables that represent both 2015 and 2040 development conditions. This resulted in modeling scenarios that were used in sensitivity testing. Flows from the baseline scenario were mapped to the roadway and trail network and the shortest path between origins and destination pairs was calculated. The shortest path distances were calculated using perceived distance travel adjustment factors that take the user experience into account. Finally, the estimated flows were calibrated using observed bicycle and pedestrian counts. Further, forecasts of future bus ridership provided by the client allowed Alta to add access and egress pedestrian activity to scenarios representing future conditions. Because comparable transit data were not available for existing conditions, pedestrian activity from transit access and egress was not explicitly included in the 'existing' scenarios.

Future Flow Methods

A statistical model was used to estimate relationships between perceived travel distance, which takes safety into account, and bicycle and pedestrian mode share. These relationships were used to estimate how changes to perceived travel distance due to infrastructure improvements affect future bicycle and pedestrian mode share. Using 2015 as the base year and 2040 as the future forecast year, several scenarios were developed to understand the change in estimated activity both due to installation of new infrastructure as well as growth in population and employment numbers and supportive TDM measures. The final estimates were mapped onto the network and calibrated against observed bicycle and pedestrian counts using the same methods employed to map existing flows to the network. A final step was to add a factor accounting for people arriving by transit. The estimated future flows were then used as an input into the facility capacity analysis.

Results - Estimated Existing Bicycle and Pedestrian Activity

Estimated bicycle and pedestrian flows for 2015 are shown on maps on the following pages. Maps 13 and 14 divide the estimated flows into a series of numeric categories and map the results using color gradation and line thickness. The Stevens Creek and Permanente Creek Trails both show higher bicycle and pedestrian activity estimates than other gateway locations; it is predicted that more than 150 bicyclists and more than 50 pedestrians enter North Bayshore via these routes during the peak AM hour. Modeled bicycle activity estimates are higher than pedestrian estimates, which is due largely to the longer commute trip that can be made by bicycle and the current lack of residential units in the district which limits walk-to-work opportunities.



MAP 13 - MODELED BICYCLE FLOWS (Existing - AM Peak Hour)
Estimated Trips
50 or Fewer
51 - 100
101 - 150
151 - 350
More than 350
North Bayshore Boundary
Data provided by the City of Mountain View, Caltrans, Esri, OSM.
0
0.25
0.5
MILES
N
TJKM
alta
PLANNING + DESIGN
San Francisco Bay Trail
N SHORELINE BLVD
SAN ANTONIO RD
CASEY AVE
MARINE WAY
GARCIA AVE
NORTH RD
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CRITTENDEN LN
AMPHITHEATRE PKWY
STIERLIN CT
E CHARLESTON RD
CHARLESTON RD
LANDINGS DR
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ALTA AVE
HUFF AVE
JOAQUIN RD
SHOREBIRD WAY
WYANDOTTE ST
N RENGSTORFF AVE
SPACE PARK WAY
PLYMOUTH ST
COLONY ST
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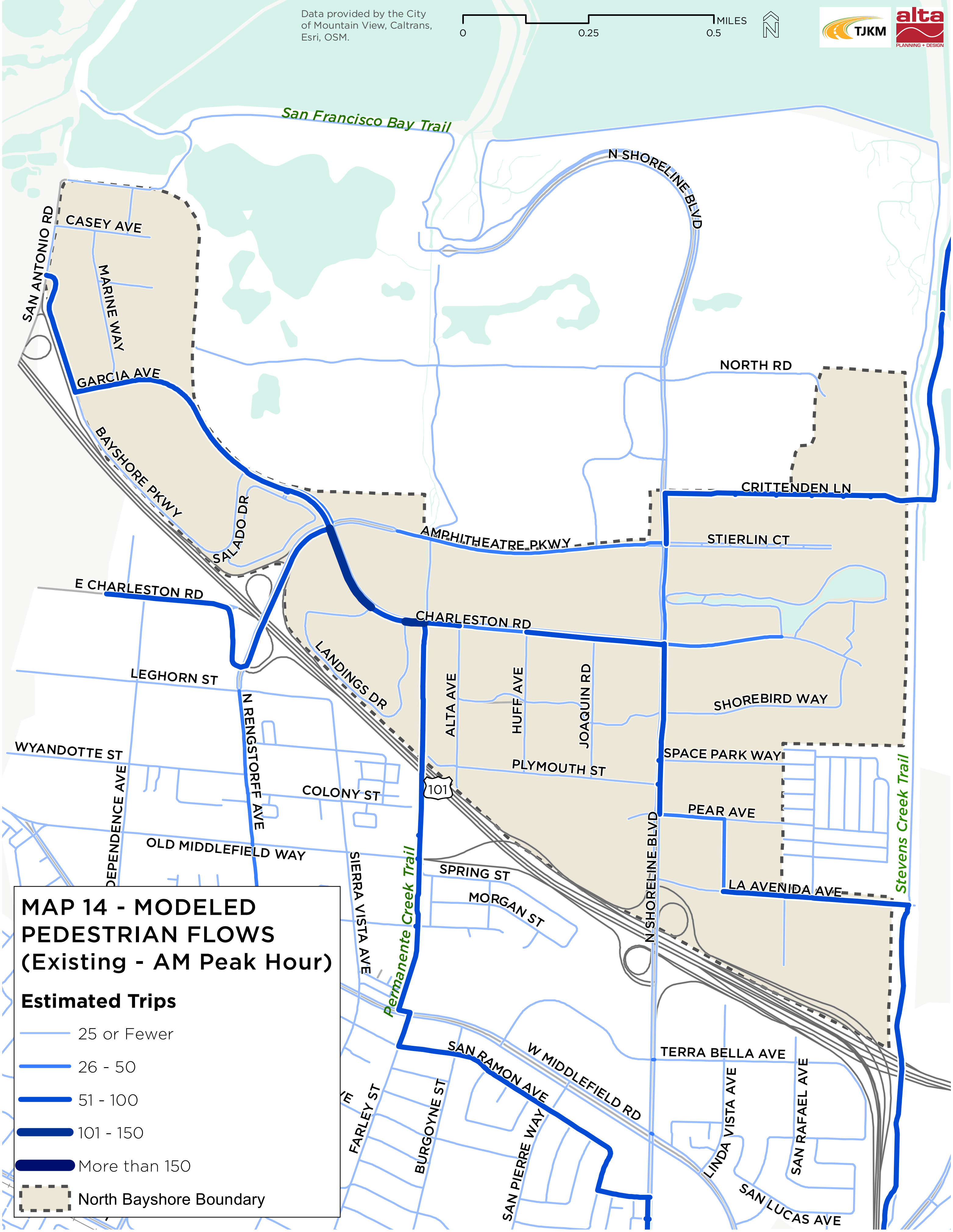
PEAR AVE
INDEPENDENCE AVE
OLD MIDDLEFIELD WAY
SIERRA VISTA AVE
Permanente Creek Trail
SPRING ST
MORGAN ST
LA AVENIDA AVE
Stevens Creek Trail
TERRA BELLA AVE
SAN RAMON AVE
W MIDDLEFIELD RD
FARLEY ST
BURGOYNE ST
SAN PIERRE WAY
LINDA VISTA AVE
SAN RAFAEL AVE
SAN LUCAS AVE



MAP 14 - MODELED PEDESTRIAN FLOWS (Existing - AM Peak Hour)
Estimated Trips
25 or Fewer
26 - 50
51 - 100
101 - 150
More than 150
North Bayshore Boundary
Data provided by the City of Mountain View, Caltrans, Esri, OSM.
0
0.25
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PLANNING + DESIGN
San Francisco Bay Trail
N SHORELINE BLVD
SAN ANTONIO RD
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BAYSHORE PKWY
SALADO DR
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STIERLIN CT
E CHARLESTON RD
CHARLESTON RD
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SPACE PARK WAY
PLYMOUTH ST
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SIERRA VISTA AVE
Permanente Creek Trail
SPRING ST
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N SHORELINE BLVD
LA AVENIDA AVE
Stevens Creek Trail
SAN RAMON AVE
W MIDDLEFIELD RD
TERRA BELLA AVE
FARLEY ST
BURGOYNE ST
SAN PIERRE WAY
LINDA VISTA AVE
SAN RAFAEL AVE
SAN LUCAS AVE

Results - Estimated Future Bicycle and Pedestrian Activity

Alta developed a series of scenarios to estimate how infrastructure improvements and transportation demand management (TDM) would likely affect bicycle and pedestrian traffic in the context of expected growth within North Bayshore. The degree to which mode shares could be attributed to individual factors could then be analyzed by comparing scenarios.

On their own, population and land use changes incorporated into the 2040 projection for the MTC travel demand model forecast substantial growth in use of active modes—110% growth in walking and 255% growth in bicycling—compared with a 2015 baseline.

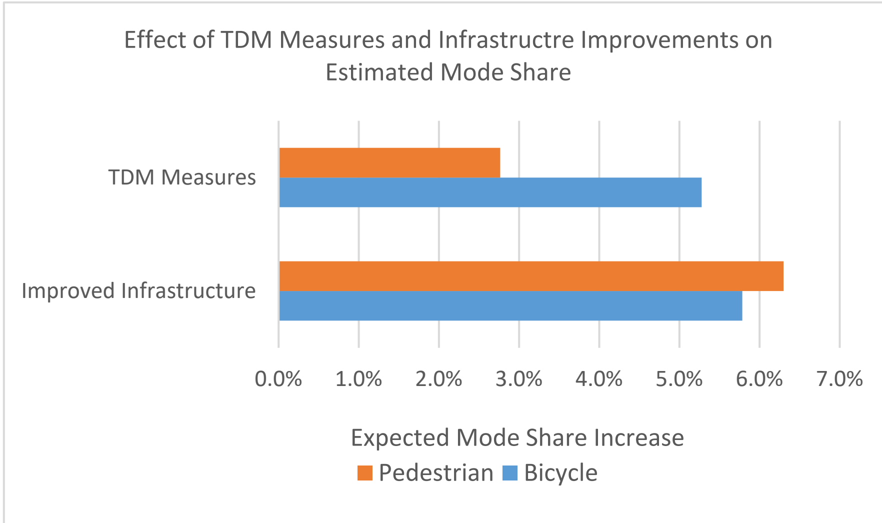


Figure 1. Effects of infrastructure improvements and TDM measures on pedestrian and bicycle mode share

Alta also modeled how infrastructure improvements might affect walking and bicycling by providing more direct and attractive routes for these users. These models predict additional growth up to 6.3% in walking and 5.8% in bicycling.

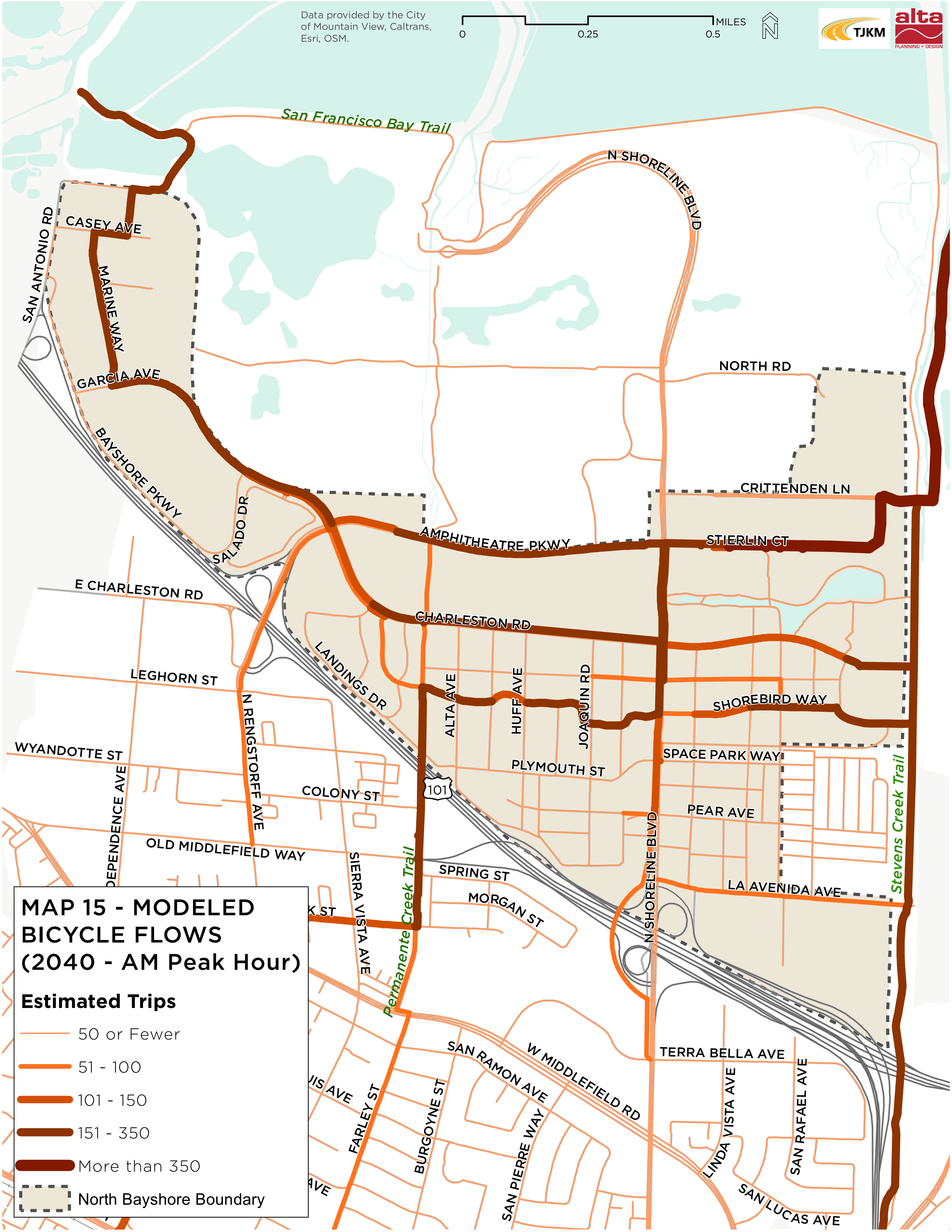
Finally, Alta modeled how TDM measures that increase bicycle and pedestrian commute mode share to at least ten percent, or non-work mode share to at least 25 percent, would further increase overall walking and bicycling mode share. Walking trips were projected to increase by 2.8% and bicycling by 5.3%. The increases were lower for walking because so many areas of North Bayshore are already projected to have high rates of walking in future development scenarios.

Overall, this scenario modeling indicated growth in North Bayshore walking and bicycling trips on the order of 300% and 150% respectively by 2040 compared with a 2015 baseline. This projected growth may be attributable to infrastructure improvements and TDM programs, as well as population increase and land use changes, particularly the introduction of more mixed land uses that bring residential units within walkable and bikeable distances of workplaces and commercial areas.

Results of Future Network Analysis

Future bicycle and pedestrian flows for 2040 are shown on maps on the following pages. Maps 15 and 16 use the same categories to illustrate the estimated future flows to capture the increased walking and bicycling activity that is anticipated on various network links. Bicycling activity is expected to increase significantly at most gateway locations, with the trails experiencing the greatest volume increase. Bicyclists using the Bay Trail to access North Bayshore will enter the roadway network at Marine Way and travel along Garcia Avenue and Charleston Road into the heart of the District, turning this route into a major bicycling corridor. Shorebird Way, Charleston Road, and Stierlin Court will serve the same role as major bicycling routes for the Stevens Creek Trail and are expected to see a high number of bicyclists. La Avenida Avenue, which experiences heavy bicycle use today, is expected to carry a lower number of bicyclists and become a more minor bicycling route due to planned infrastructure enhancements along major corridors and new formalized trail connections that are planned at Charleston Road and Shorebird Way, causing bicyclists to divert to these routes. Bicyclists entering North Bayshore via the Permanente Creek Trail will utilize the Google Green Loop to access the roadway network at a number of points, meaning that no one route is expected to carry the bulk of this traffic. Bicyclists are also expected to utilize the new bicycle-pedestrian bridge at Shoreline Boulevard and a moderate increase of bicycling activity is expected at Rengstorff Avenue, although the activity at both gateways is expected to be lower than the Permanente Creek Trail and the Stevens Creek Trail gateways. It is also important to note that the increased bicycling activity on Rengstorff Avenue assumes the addition of a Class I or Class IV facility as part of the planned interchange upgrade project. Installation of a Class II facility would likely result in lower estimated bicycle activity. Major east-west bicyclist circulation within North Bayshore is expected to occur via the Google Green Loop, Charleston Road, and Amphitheatre Parkway.

Overall, most roadways in North Bayshore are expected to see some increase in pedestrian activity. While significant pedestrian activity increases are expected along the Stevens Creek Trail and Permanente Creek Trail, major activity increases are also expected to result from pedestrians arriving via transit and the addition of up to 10,000 new housing units in North Bayshore. These factors combined result in the estimated activity increases shown on Charleston Road, the Google Green Loop, North Shoreline Boulevard, Alta Avenue, Huff Avenue, and Joaquin Road near the Shoreline Gateway development located south of Plymouth Street. Some increase in pedestrian-transit activity is also expected near the Intuit campus located off Marine Way. Pedestrian activity estimates for this area are dependent upon the location of future transit stops. The analysis also shows an increase in estimated pedestrian activity at the North Shoreline Boulevard and Rengstorff Avenue gateways, albeit in lower numbers.


Data provided by the City of Mountain View, Caltrans, Esri, OSM.
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PLANNING + DESIGN
San Francisco Bay Trail
N SHORELINE BLVD
CASEY AVE
SAN ANTONIO RD
MARINE WAY
GARCIA AVE
NORTH RD
BAYSHORE PKWY
SALADO DR
CRITTENDEN LN
STIERLIN CT
AMPHITHEATRE PKWY
E CHARLESTON RD
CHARLESTON RD
LEGHORN ST
LANDINGS DR
N RENGSTORFF AVE
ALTA AVE
HUFF AVE
JOAQUIN RD
SHOREBIRD WAY
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PLYMOUTH ST
COLONY ST
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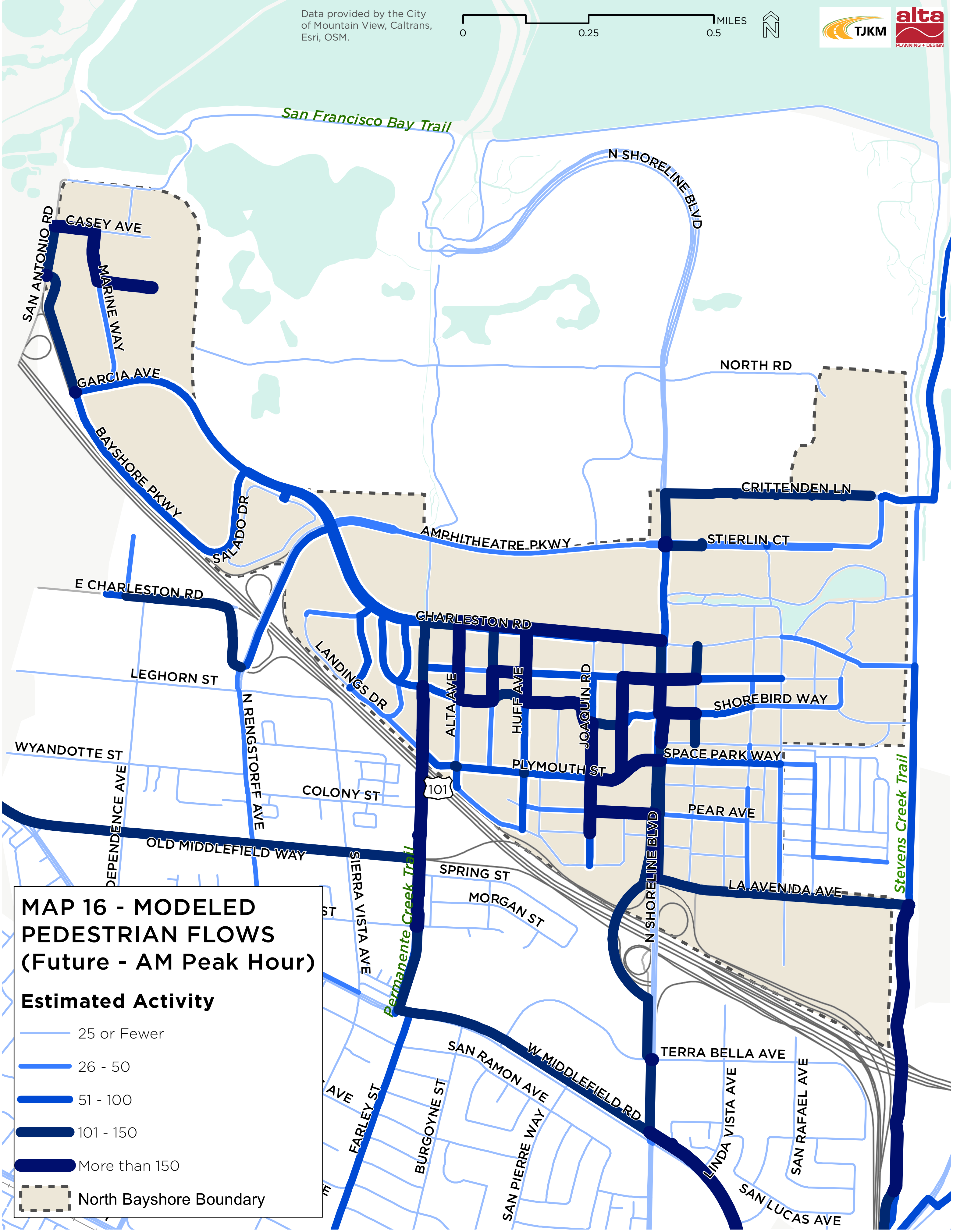
PEAR AVE
OLD MIDDLEFIELD WAY
SIERRA VISTA AVE
SPRING ST
Permanente Creek Trail
MORGAN ST
LA AVENIDA AVE
Stevens Creek Trail
TERRA BELLA AVE
SAN RAMON AVE
W MIDDLEFIELD RD
FARLEY ST
BURGOYNE ST
SAN PIERRE WAY
LINDA VISTA AVE
SAN RAFAEL AVE
SAN LUCAS AVE
MAP 15 - MODELED BICYCLE FLOWS (2040 - AM Peak Hour)
Estimated Trips
50 or Fewer
51 - 100
101 - 150
151 - 350
More than 350
North Bayshore Boundary



MAP 16 - MODELED PEDESTRIAN FLOWS (Future - AM Peak Hour)

Capacity Analysis

Capacity Analysis Methods

Several techniques were used to assess future facility capacity in 2040. Using future estimated flows and facility width information drawn from relevant plans, a volume-to-capacity (v/c) ratio was calculated for each bicycle facility segment, and Level of Service (LOS) values were calculated for each sidewalk and multi-use trail segment. A variety of techniques were used to calculate the LOS values based on the type of facility and user. Results were assessed for the AM peak hour, when the heaviest flows of users are expected. This assumption is based on observed trip volumes from the quarterly North Bayshore Traffic Monitoring Reports. See Appendix E for a list of assumptions associated with each analysis technique.

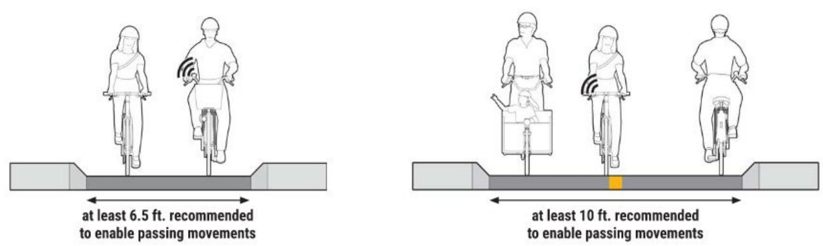
Pedestrian Sidewalk Capacity Analysis

The method used to assess sidewalk capacity is based on the *2010 Highway Capacity Manual Chapter 17 Urban Street Segments* and *National Cooperative Highway Research Program Report (NCHRP) 616: Multimodal Level of Service Analysis for Urban Streets*. The pedestrian capacity analysis considers the amount of space that users have to move freely along a sidewalk facility and does not consider other elements of the pedestrian experience such as street trees and pedestrian-scale lighting. However, the capacity LOS is useful when assessing whether the proposed sidewalks provide adequate width. The pedestrian LOS values presented are based on the average square footage per person during the peak hour.

Bicycle Capacity Analysis

The bicycle capacity analysis is based on the MassDOT *Separated Bike Lane Planning & Design Guide*, exhibits 3H and 3I, and reported as v/c ratios, which are based on the facility widths and capacities shown in Figure 2. The bicycle capacity analysis uses the following assumptions:

- When both a striped bike lane and cycle track are available options, 90% of people biking will opt for the cycle track
- Modeled flows are not split 50/50 by direction, but rather 100% of flow is assumed to travel in the same direction (e.g., northbound to work during the AM peak)



Same Direction Bicyclists/ Peak Hour	Bike Lane Width (ft.)	
	Rec.	Min.*
<150	6.5	5.0
150-750	8.0	6.5
>750	10.0	8.0

* A design exception is required for designs below the minimum width.

EXHIBIT 3H: Bike Lane Widths for One-way Operation

Bidirectional Bicyclists/ Peak Hour	Bike Lane Width (ft.)	
	Rec.	Min.*
<150	10.0	8.0
150-400	11.0	10.0
>400	14.0	11.0

* A design exception is required for designs below the minimum width.

EXHIBIT 3I: Bike Lane Widths for Two-way Operation

Figure 2. Bicyclist user flows and associated recommended facility widths. Source: MassDOT Separated Bike Lane Planning & Design Guide.

The Bicycle Shared-Use Path Level of Service, based on *HCM 2010 Chapter 23 Off-Street Pedestrian and Bicycle Facilities*, and was calculated using the Federal Highway Administration (FHWA) Shared Use Path Level of Service Calculator to produce a score and corresponding grade of A to F that quantifies the user experience. LOS A represents optimal conditions, LOS B and C represent some conflicts, and LOS D, E, and F represent conditions that include reduced travel speeds and a diminished user experience for people biking. The inputs into the LOS calculation include facility width, number (and type) of users, average travel speeds, centerline striping, and the assumed directional split. The primary considerations of the analysis are pathway width and directional split of traffic. These factors affect the ability of bicyclists to pass each other easily without having to change speed or trajectory. As the number of users increases and the pathway narrows, the number of passing events a bicyclist experiences increases along with difficulty of passing.

Pedestrian Shared-Use Path Level of Service

The Pedestrian Shared-Use Path Level of Service is also based on *HCM 2010 Chapter 23 Off-Street Pedestrian and Bicycle Facilities*. The pedestrian LOS is calculated based on the number of people walking during the peak hour, average walking and biking speeds, and the assumed directional split. LOS grades are presented on a similar A to F scale that quantifies the user experience. LOS A corresponds to optimal conditions, LOS B represents few pedestrian/bicyclist conflicts, LOS C represents conditions where it is difficult to walk two abreast, while LOS D, E, and F represent conditions with frequent user conflicts that result in disrupted travel as well as a diminished pedestrian experience. The primary considerations of this analysis are the number of encounters between pedestrians and bicyclists and the ease of passing which is facilitated by a wider path. Figure 3 shows the number of effective lanes for a given range of pathway widths. A pathway width of 8 to 10.5 feet will allow comfortable passing of only two parties. A pathway width of 11 feet allows multiple groups to pass simultaneously, which can have a substantial impact on level of service.

Path Width (ft)	Lanes
8.0–10.5	2
11.0–14.5	3
15.0–20.0	4

Source: Hummer et al. (7).

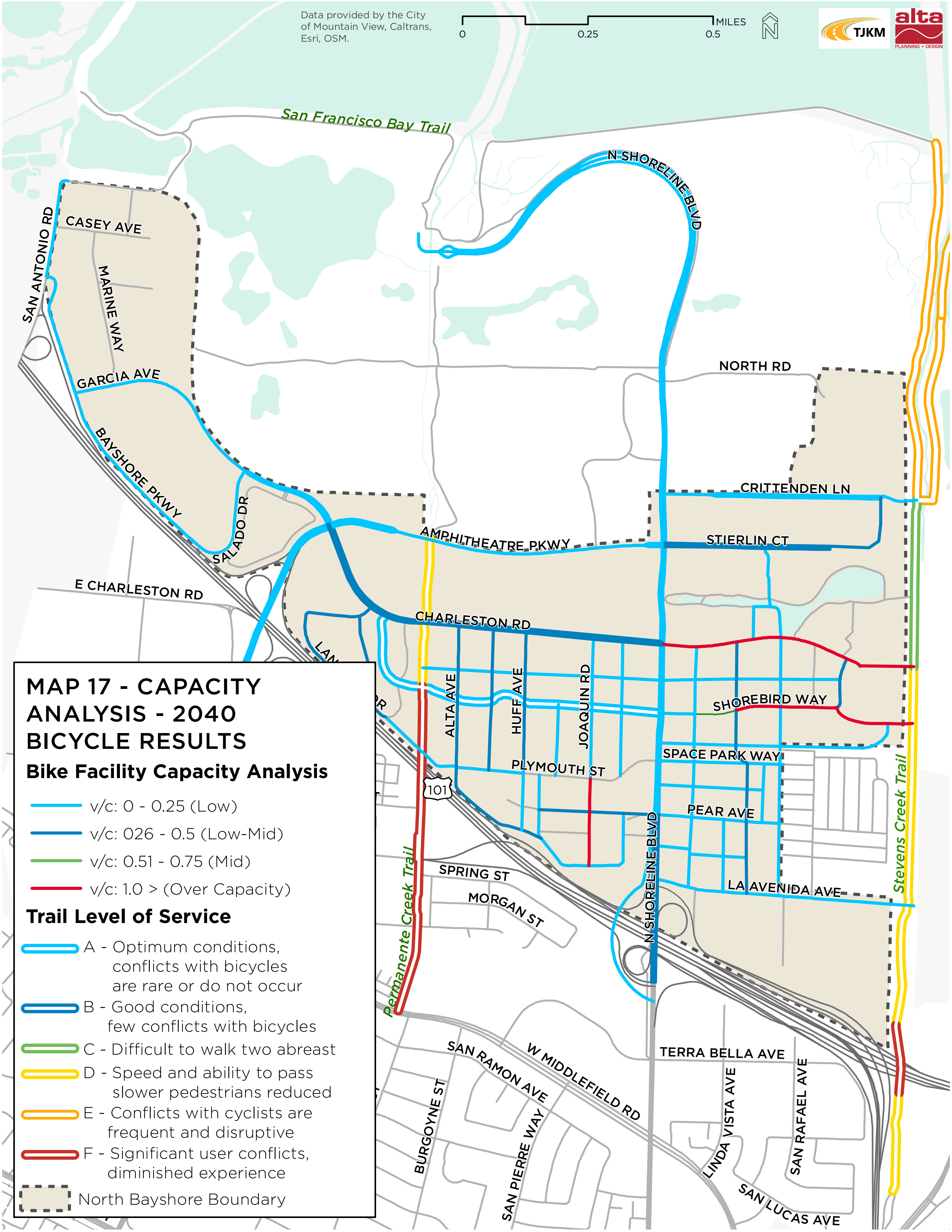
Exhibit 23-14
Effective Lanes by Path Width

Figure 3. Path width and number of effective lanes. Source: HCM 2010 Chapter 23 Off-Street Pedestrian and Bicycle Facilities.

Capacity Analysis Results

Preliminary findings for future capacity assessment are presented on Map 17 and 18. The pedestrian capacity analysis found that all sidewalks have sufficient capacity (see Map 18). The Green Loop has a high level of bicycle and pedestrian service. Potential capacity problems exist on the much of the Stevens Creek Trail and portions of the Permanente Creek Trail, where projected increases in bicycle and pedestrian flows will likely lead to increased user conflicts and a diminished pedestrian user experience. Other opportunities for crossing improvements are shown on preliminary recommendations maps attached to this memorandum.

The bicycle capacity analysis results show more variability (see Map 17). The majority of Class II, III and IV facilities are below a v/c ratio of 1.0 and will provide bicyclists with a comfortable travel experience. There are some facilities that are near or over a v/c ratio of 1.0 and people biking will face a diminished user experience on these segments. The roadways that are projected to be over capacity include Terminal Boulevard, portions of Charleston Road, Marine Way, the planned public plaza at the southern end of Joaquin Road, portions of Shorebird Way, and Broderick Way. Bicyclists will also likely experience crowded travel conditions and a degraded LOS on the Permanente Creek Trail. Stevens Creek Trail is also over capacity with the exception of the section between Crittenden Lane and Charleston Road, which has a LOS C. This section of the trail sees lighter bicycle flows due to the number of southbound users exiting the trail system at Crittenden and the number of northbound users exiting onto the roadway network at La Avenida Avenue, Shorebird Way, and Charleston Road.


MAP 17 - CAPACITY ANALYSIS - 2040 BICYCLE RESULTS
Bike Facility Capacity Analysis
v/c: 0 - 0.25 (Low)
v/c: 026 - 0.5 (Low-Mid)
v/c: 0.51 - 0.75 (Mid)
v/c: 1.0 > (Over Capacity)
Trail Level of Service
A - Optimum conditions, conflicts with bicycles are rare or do not occur
B - Good conditions, few conflicts with bicycles
C - Difficult to walk two abreast
D - Speed and ability to pass slower pedestrians reduced
E - Conflicts with cyclists are frequent and disruptive
F - Significant user conflicts, diminished experience
North Bayshore Boundary
Data provided by the City of Mountain View, Caltrans, Esri, OSM.
0
0.25
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MILES
N
TJKM
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PLANNING + DESIGN
San Francisco Bay Trail
N SHORELINE BLVD
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CASEY AVE
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SHOREBIRD WAY
SPACE PARK WAY
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HUFF AVE
JOAQUIN RD
PLYMOUTH ST
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MORGAN ST
LA AVENIDA AVE
Stevens Creek Trail
Permanente Creek Trail
TERRA BELLA AVE
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BURGOYNE ST
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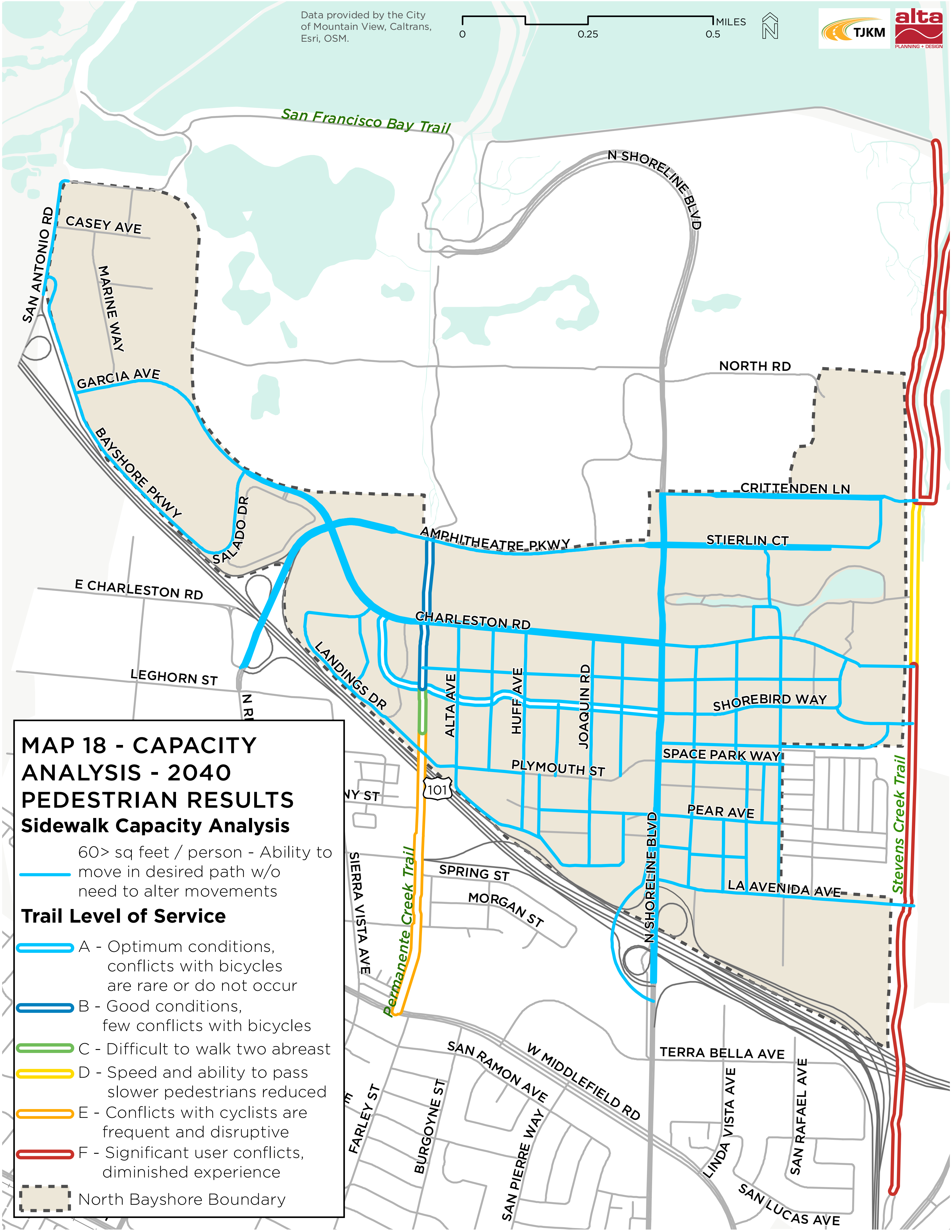
SAN RAFAEL AVE
SAN LUCAS AVE



MAP 18 - CAPACITY ANALYSIS - 2040 PEDESTRIAN RESULTS
Sidewalk Capacity Analysis
60> sq feet / person - Ability to move in desired path w/o need to alter movements
Trail Level of Service
A - Optimum conditions, conflicts with bicycles are rare or do not occur
B - Good conditions, few conflicts with bicycles
C - Difficult to walk two abreast
D - Speed and ability to pass slower pedestrians reduced
E - Conflicts with cyclists are frequent and disruptive
F - Significant user conflicts, diminished experience
North Bayshore Boundary
Data provided by the City of Mountain View, Caltrans, Esri, OSM.
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Infrastructure Recommendations

The North Bayshore Precise Plan, the foundational blueprint for development in North Bayshore, already includes robust bicycle and pedestrian infrastructure recommendations. The bicycle and pedestrian recommendations presented here refine those recommendations. These refinements are presented in the maps accompanying this memorandum. The maps contain the current planned facility or spot recommendations, recommended capacity enhancements for over-capacity corridors, additional point-specific recommendations that were identified during the capacity analysis, and several potential new connections that could be created to further enhance the bicycle and pedestrian network. While the Precise Plan and these recommendations lay out a path forward that can lead to a world-class bicycling and pedestrian experience, the ultimate challenge lies in implementation of these plans. For example, the Precise Plan and the refinements recommended here includes wide sidewalks and bicycle facilities that do not currently exist in roadway cross sections. Roadway reconfiguration completed in conjunction with new construction is critical for full implementation of the Precise Plan.

Based on the capacity analysis, the Alta team recommends retaining most infrastructure recommendations as is. Wider facilities have the potential to increase user comfort and provide a higher quality experience. Recommended changes are detailed below and illustrated on Maps 19 and 20- and Tables 1 and 2.

- **Increase minimum sidewalk widths from five feet to six feet on all roadways within the Access Street functional class.** While the Precise Plan calls for six-foot wide sidewalks for most roadways, a five-foot sidewalk is recommended when roadways are classified as Access Streets. A minimum six-foot sidewalk is recommended whenever sidewalks are constructed or reconstructed to help facilitate a world-class pedestrian experience in North Bayshore regardless of the roadway classification.

- **Ensure ADA accessibility of existing infrastructure.** Older existing sidewalks, bridges, and trails that were built prior to the adoption of the ADA may not meet current accessibility standards and should be checked for compliance. For example, planning is underway for upgrades of the bicycle and pedestrian bridge across Stevens Creek at Crittenden Lane.

- **Increase bicycle capacity on Charleston Road and Shorebird Way.** As mentioned above, over-capacity bicycle facilities include portions of Charleston Road and portions of Shorebird Way. An increase in bicycle capacity is recommended to maintain a high-quality user experience. This could be accomplished through increasing facility width or improvement of parallel routes.

- **Monitor bicycle volumes along Access Streets that are projected to be over capacity.** The modeled results indicate that several Access Streets including Marine Way, Terminal Boulevard and Broderick Way may be over capacity during the AM peak hour. The facility would be adequate for most of the day but may experience crowding during peak conditions spilling out into the adjacent travel lanes. To safely accommodate increased numbers of bicyclists, peak hour volumes along the planned bike facilities should be monitored over time to identify where and when additional roadway modifications should occur. It is recommended that the painted bike lanes that are planned for the identified Access Streets also include a painted buffer to better accommodate the anticipated increase in volumes. Any protective features located within the buffer area should be permeable to bicyclists to allow for passing of other bicyclists, if the operating width of the bikeway is 6' or less.

- **Provide connections to the east of North Bayshore.** North Bayshore would benefit from improved connections to Moffett Park to the east. Key connection points already under consideration or study for near- to mid-term improvements include a new bridge across Stevens Creek south of La Avenida Street, upgrades to the existing bridge at Crittenden Lane and construction of a bicycle / pedestrian bridge at Charleston Road.

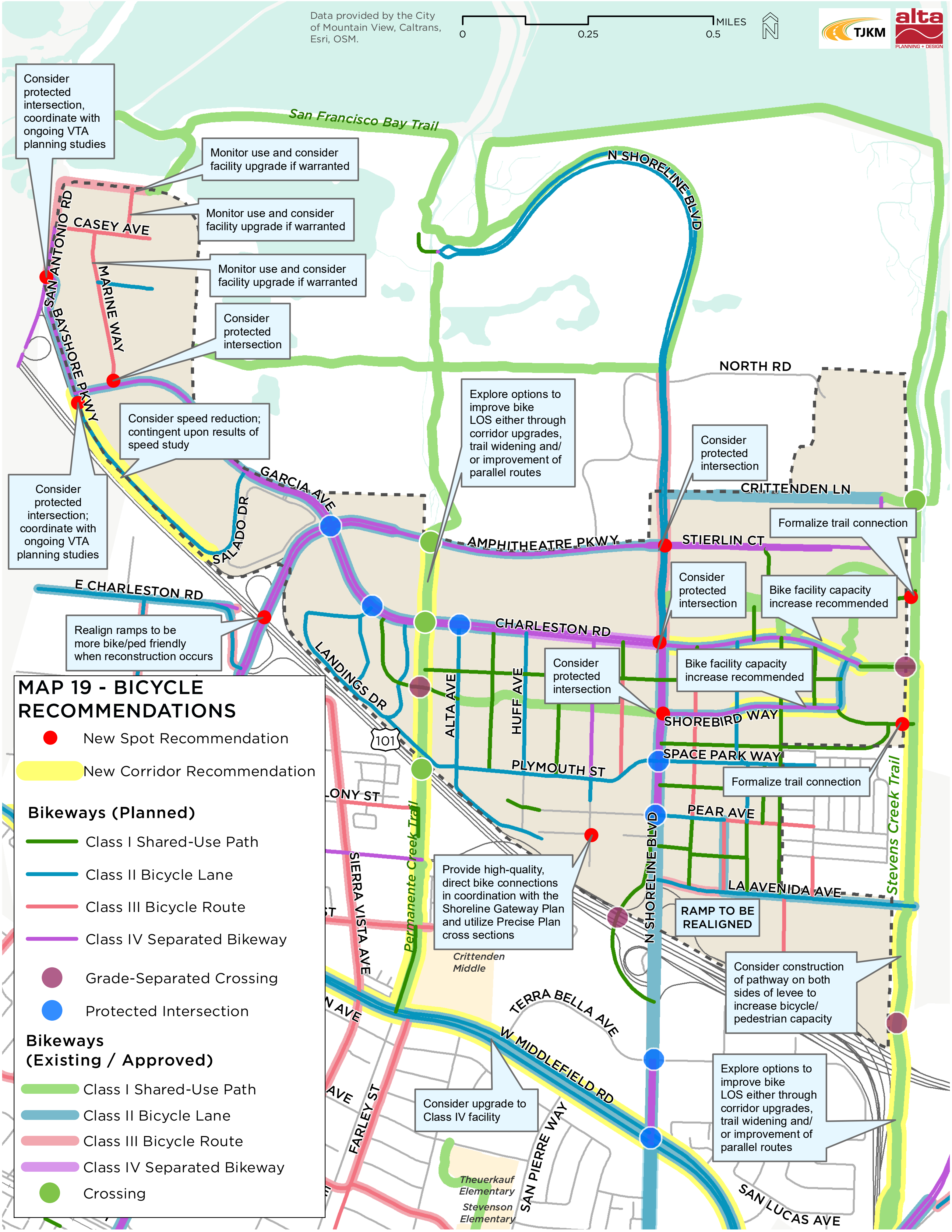
- **Provide connections to the west of North Bayshore.** North Bayshore will benefit from improved connections to Palo Alto. For example, the current planning of improvements to the crossing of Adobe Creek should be coordinated with improvements undertaken as part of the Precise Plan. The City should also coordinate with work currently underway by the VTA to upgrade the San Antonio Road / US 101 interchange.

- **Refine current Precise Plan bicycle recommendations on key corridors to better reflect projected demand.** There were several areas where significant excess bicycle capacity was observed and the potential to reduce the capacity exists if facilities have not yet been constructed. These conditions exist along Amphitheatre Parkway, Charleston Road, Bayshore Parkway (where designated as a Transit Boulevard), and Shoreline Boulevard (where designated as a Gateway Boulevard). This excess capacity does not create any problems but it may represent an opportunity for cost efficiencies to save money as the projected flows do not seem to require the planned facility type at these locations. For example, rather than recommending construction of two-way cycle tracks on both sides of Amphitheatre Parkway, the section could be modified to construct a single two-way cycle track or construct one-way cycle tracks on each side of the roadway. These modifications could adequately handle the projected flows of bicyclists and could represent cost savings that could be reallocated to other bicycle and pedestrian improvements elsewhere within North Bayshore.

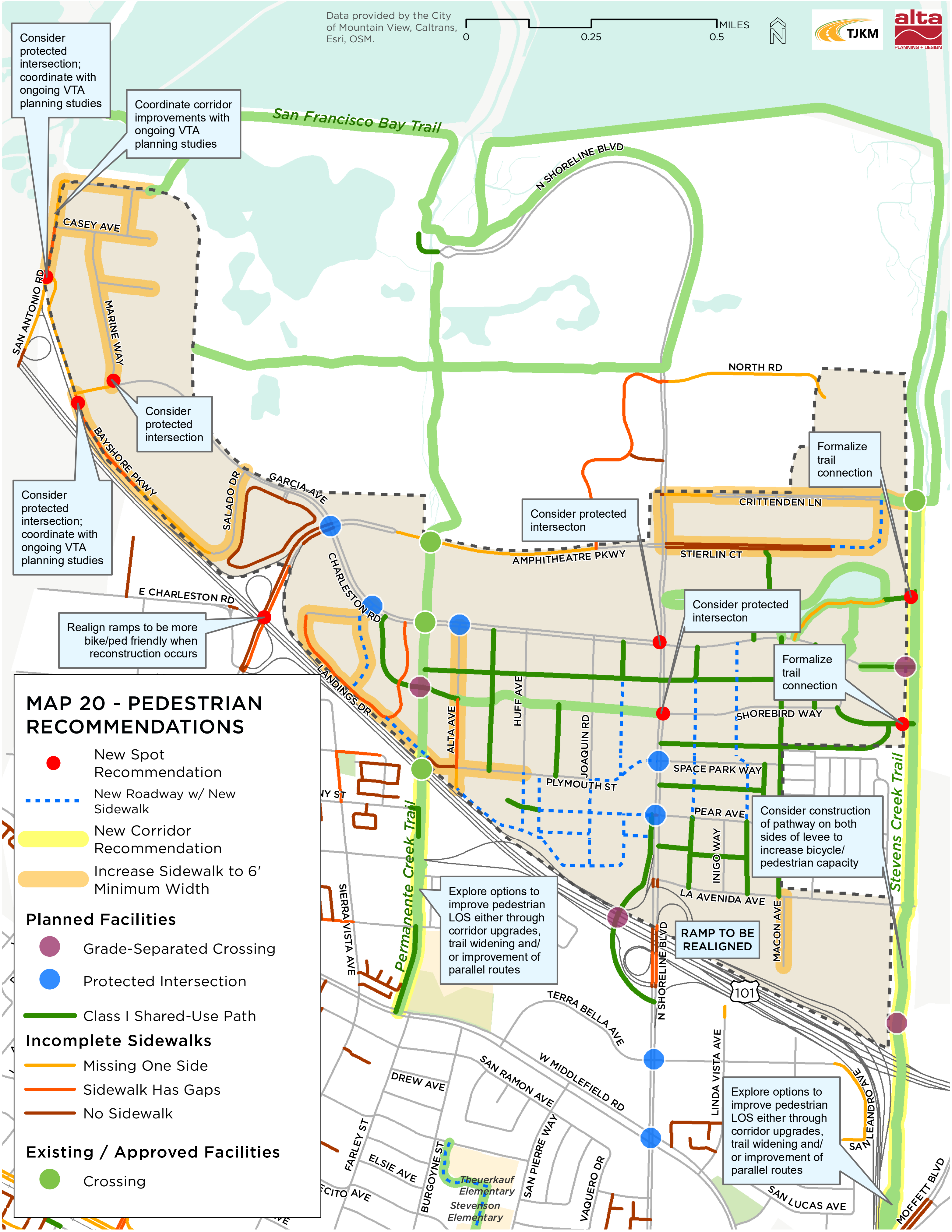
- **Consider corridor upgrades to increase existing trail capacity.** A key finding of the capacity analysis is the expected low LOS for bicyclists and pedestrians on many portions of the Stevens Creek and Permanente Creek Trails. For pedestrians, the degraded LOS is primarily driven by trail width and the number of expected meetings with bicyclists. For bicyclists, the lower levels of service are driven by the expected increase in number of users and the current trail width, which limits the number of users that can pass each other at one time and leads to user delay. One simple recommendation to improve the bicycle LOS includes the removal of the pathway centerline striping. Striping removal will slightly improve the bicycle LOS by making bicyclists more willing to leave their demarcated lane when passing other users. Other potential strategies to improve flow on the existing trail include installation of comprehensive and consistent warning and wayfinding signs as well as consistent trimming of vegetation to maintain sightlines and pathway shoulders. Finally, on the Stevens Creek Trail, consider utilizing both sides of the levee to construct separated bicycle and pedestrian pathways. The construction of a parallel pathway would allow user flows to disperse and could substantially improve the user experience for both bicyclists and pedestrians, while increasing the overall transportation potential of the corridor. Construction of an additional trail would require the permission of the Santa Clara Valley Water District, which is currently opposed to the idea.

- **Explore opportunities for pathway widening and/or development of parallel routes.** It is also recommended that the city explore other alternatives to increase path capacity either through path widening or improvement of travel conditions along adjacent corridors such as improvement of parallel gravel maintenance roads to serve as pedestrian pathways. As another example, the new bicycle and pedestrian bridge planned for North Shoreline Boulevard could potentially serve trips that would have been made on either the Stevens Creek Trail or Permanente Creek Trail. Providing high quality connections, such as a Class IV facility along West Middlefield Road would allow users to easily access multiple gateways thus balance the bicycle or pedestrian traffic. The new bridge is also expected to support new trips generated by residential growth planned for the Terra Bella neighborhood.

- **Explore improved connections to the Terra Bella Neighborhood.** The Terra Bella Neighborhood, directly south of North Bayshore, is comprised of both residential and commercial land and is anticipated to continue redeveloping in response to the planned changes in North Bayshore. Specific development and detailed site planning for developments like the Shoreline Gateway should consider opportunities to construct high-quality bicycle and pedestrian connections both through the neighborhood and to North Bayshore. For example, construction of high-quality bicycle routes can promote intra-neighborhood trips and access to North Bayshore via the North Shoreline Boulevard bicycle and pedestrian bridge.



MAP 19 - BICYCLE RECOMMENDATIONS
New Spot Recommendation
New Corridor Recommendation
Bikeways (Planned)
Class I Shared-Use Path
Class II Bicycle Lane
Class III Bicycle Route
Class IV Separated Bikeway
Grade-Separated Crossing
Protected Intersection
Bikeways (Existing / Approved)
Class I Shared-Use Path
Class II Bicycle Lane
Class III Bicycle Route
Class IV Separated Bikeway
Crossing
Data provided by the City of Mountain View, Caltrans, Esri, OSM.
0
0.25
0.5
MILES
TJKM
alta
PLANNING + DESIGN
San Francisco Bay Trail
Consider protected intersection, coordinate with ongoing VTA planning studies
Monitor use and consider facility upgrade if warranted
Monitor use and consider facility upgrade if warranted
Monitor use and consider facility upgrade if warranted
Consider protected intersection
Consider speed reduction; contingent upon results of speed study
Consider protected intersection; coordinate with ongoing VTA planning studies
Explore options to improve bike LOS either through corridor upgrades, trail widening and/ or improvement of parallel routes
Consider protected intersection
Formalize trail connection
Consider protected intersection
Bike facility capacity increase recommended
Consider protected intersection
Bike facility capacity increase recommended
Realign ramps to be more bike/ped friendly when reconstruction occurs
Formalize trail connection
Provide high-quality, direct bike connections in coordination with the Shoreline Gateway Plan and utilize Precise Plan cross sections
RAMP TO BE REALIGNED
Consider construction of pathway on both sides of levee to increase bicycle/ pedestrian capacity
Consider upgrade to Class IV facility
Explore options to improve bike LOS either through corridor upgrades, trail widening and/ or improvement of parallel routes
N SHORELINE BLVD
NORTH RD
CRITTENDEN LN
STIERLIN CT
SAN ANTONIO RD
CASEY AVE
MARINE WAY
BAYSHORE PKWY
GARCIA AVE
SALADO DR
AMPHITHEATRE PKWY
E CHARLESTON RD
CHARLESTON RD
LANDINGS DR
ALTA AVE
HUFF AVE
SHOREBIRD WAY
SPACE PARK WAY
PLYMOUTH ST
PEAR AVE
LA AVENIDA AVE
101
Permanente Creek Trail
Stevens Creek Trail
SIERRA VISTA AVE
Crittenden Middle
TERRA BELLA AVE
W MIDDLEFIELD RD
FARLEY ST
SAN PIERRE WAY
Theuerkauf Elementary
Stevenson Elementary
SAN LUCAS AVE



MAP 20 - PEDESTRIAN RECOMMENDATIONS
New Spot Recommendation
New Roadway w/ New Sidewalk
New Corridor Recommendation
Increase Sidewalk to 6' Minimum Width
Planned Facilities
Grade-Separated Crossing
Protected Intersection
Class I Shared-Use Path
Incomplete Sidewalks
Missing One Side
Sidewalk Has Gaps
No Sidewalk
Existing / Approved Facilities
Crossing
Data provided by the City of Mountain View, Caltrans, Esri, OSM.
0
0.25
0.5
MILES
TJKM
alta
PLANNING + DESIGN
Consider protected intersection; coordinate with ongoing VTA planning studies
Coordinate corridor improvements with ongoing VTA planning studies
Consider protected intersection
Consider protected intersection; coordinate with ongoing VTA planning studies
Realign ramps to be more bike/ped friendly when reconstruction occurs
Consider protected intersecton
Consider protected intersecton
Formalize trail connection
Formalize trail connection
Consider construction of pathway on both sides of levee to increase bicycle/ pedestrian capacity
Explore options to improve pedestrian LOS either through corridor upgrades, trail widening and/ or improvement of parallel routes
RAMP TO BE REALIGNED
Explore options to improve pedestrian LOS either through corridor upgrades, trail widening and/ or improvement of parallel routes
San Francisco Bay Trail
N SHORELINE BLVD
NORTH RD
CASEY AVE
SAN ANTONIO RD
MARINE WAY
BAYSHORE PKWY
SALADO DR
GARCIA AVE
CHARLESTON RD
E CHARLESTON RD
LANDINGS DR
AMPHITHEATRE PKWY
CRITTENDEN LN
STIERLIN CT
ALTA AVE
HUFF AVE
JOAQUIN RD
PLYMOUTH ST
SHOREBIRD WAY
SPACE PARK WAY
PEAR AVE
INIGO WAY
LA AVENIDA AVE
MACON AVE
N SHORELINE BLVD
Permanente Creek Trail
Stevens Creek Trail
SIERRA VISTA AVE
TERRA BELLA AVE
SAN RAMON AVE
W MIDDLEFIELD RD
LINDA VISTA AVE
DREW AVE
FARLEY ST
ELSIE AVE
BURGOYNE ST
SAN PIERRE WAY
VAQUERO DR
Theuerkauf Elementary
Stevenson Elementary
SAN LEANDRO AVE
SAN LUCAS AVE
MOFFETT BLVD
101

Table 1. Spot and Intersection Recommendations

Mode	Intersection 1 (N/S)	Intersection 2 (E/W)	Recommendation
Bike/Ped	Bayshore Parkway	Garcia Avenue	Protected intersection, future planning should be coordinated with the VTA study of the San Antonio interchange
Bike	Gateway Park	Gateway Park	Provide high-quality, direct bike connections in coordination with the Shoreline Gateway Plan and utilize Precise Plan cross sections
Bike/Ped	Marine Way	Garcia Avenue	Protected intersection
Bike/Ped	North Rengstorff Avenue	Bayshore Freeway Onramps	Realign ramps to be more bike/ped friendly when reconstruction occurs
Bike/Ped	North Shoreline Boulevard	Amphitheatre Parkway	Protected intersection
Bike/Ped	North Shoreline Boulevard	Charleston Road	Protected intersection
Bike/Ped	North Shoreline Boulevard	Shorebird Way	Protected intersection
Bike/Ped	San Antonio Road	Bayshore Parkway	Protected intersection, future planning should be coordinated with the VTA study of the San Antonio interchange
Bike/Ped	Stevens Creek Trail	Fitness Trail	Formalize trail connection
Bike/Ped	Stevens Creek Trail	Shorebird Way	Formalize trail connection

Table 2. Corridor Recommendations

Mode	Corridor	From	To	Recommendation Details	Length (Mi)*
Ped	Alta Avenue	Charleston Road	Plymouth Street	Construct/reconstruct minimum 6' sidewalk	0.32
Bike	Bayshore Parkway	Garcia Avenue	Salado Drive	Consider speed reduction to reduce the speed differential between bicyclists and motor vehicles. This recommendation is contingent upon results of speed study.	0.42
Ped	Bayshore Parkway	Garcia Avenue	Salado Drive	Construct/reconstruct minimum 6' sidewalk	0.43
Ped	Broderick Way	Terminal Boulevard	Casey Avenue	Construct/reconstruct minimum 6' sidewalk	0.01
Ped	Casey Avenue	San Antonio Road	Eastern Terminus	Construct/reconstruct minimum 6' sidewalk	0.19
Bike	Charleston Road	North Shoreline Boulevard	Shorebird Way	Increase bicycle capacity	0.40
Ped	Coast Avenue	Marine Way	Eastern Terminus	Construct/reconstruct minimum 6' sidewalk	0.11
Ped	Crittenden Lane	North Shoreline Boulevard	Stevens Creek Access Point	Construct/reconstruct minimum 6' sidewalk	0.51
Ped	Landings Drive	Charleston Road (West)	Plymouth Street	Construct/reconstruct minimum 6' sidewalk	0.57
Ped	Macon Avenue	La Avenida Street	Southern Terminus	Construct/reconstruct minimum 6' sidewalk	0.14
Ped	Marine Way	Casey Avenue	Garcia Avenue	Construct/reconstruct minimum 6' sidewalk	0.31
Ped	North Shoreline Boulevard	Crittenden Lane	Stierlin Court	Construct/reconstruct minimum 6' sidewalk	0.10
Bike	Permanente Creek Trail	Amphitheatre Parkway	West Middlefield Road	Explore options to improve bike LOS either through trail widening or improvement of parallel routes	1.15
Ped	Permanente Creek Trail	Charleston Road	West Middlefield Road	Explore options to improve pedestrian LOS either through trail widening or improvement of parallel routes	0.56

Mode	Corridor	From	To	Recommendation Details	Length (Mi)*
Ped	Plymouth Street	Landings Drive	Huff Avenue	Construct/reconstruct minimum 6' sidewalk	0.18
Ped	Salado Drive	Garcia Avenue	Bayshore Parkway	Construct/reconstruct minimum 6' sidewalk	0.19
Ped	San Antonio Road	Terminal Boulevard	Bayshore Parkway	Construct/reconstruct minimum 6' sidewalk	0.20
Bike	Shorebird Way	Unconstructed Access Street	Informal Stevens Creek Access Point	Increase bicycle capacity	0.20
Bike	Stevens Creek Trail	Charleston Road	East Middlefield Road	Explore options to improve bike LOS either through trail widening or improvement of parallel routes	1.93
Ped	Stevens Creek Trail	Crittenden Lane	East Middlefield Road	Explore options to improve pedestrian LOS either through trail widening or improvement of parallel routes	1.93
Ped	Stierlin Court	North Shoreline Boulevard	Crittenden Lane	Construct/reconstruct minimum 6' sidewalk	0.52
Ped	Terminal Boulevard	San Antonio Road	Eastern Terminus	Construct/reconstruct minimum 6' sidewalk	0.16
Bike	West Middlefield Road	San Antonio Road	North Wishman Road	Consider upgrade to Class IV facility	2.19

* The length for sidewalk construction/reconstruction projects is given in terms of the corridor's roadway centerline. The actual amount of sidewalk requiring construction or reconstruction is dependent how much (if any) sidewalk is already present within the corridor that is six feet wide.

Appendices

Appendix A – Background Document Review

Appendix B – Mountain View Bicycle Level of Traffic Stress

Appendix C – Bicycle and Pedestrian Travel Survey

Appendix D - Existing and Future Activity Assessment Methods

Appendix E - Capacity Analysis Assumptions

Appendix F - VISSIM Model Assumptions

Appendix A – Background Document Review

MEMORANDUM

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To: Jim Lightbody, City of Mountain View

From: Sam Corbett and Kim Voros, Alta Planning + Design

Date: August 3, 2020

Re: North Bayshore Bicycle and Pedestrian Circulation Study

Introduction

The North Bayshore Bicycle and Pedestrian Circulation Study will assess the ability of existing and proposed bicycle and pedestrian infrastructure to meet the needs of residents and commuters in 2030, and will recommend potential changes, additions, or upgrades. This memorandum will provide a reference for the location of relevant counts, infrastructure recommendations, and TDM measures. A review of relevant planning and policy documents provides context, bicycle and pedestrian activity estimates, and possible infrastructure recommendations. A subset of these documents were also reviewed for potential company incentive programs and other related actions including: North Bayshore Precise Plan (2014), North Bayshore TDM Plan Guidelines (2015), Citywide Multimodal Improvement Plan (2018), North Bayshore Residential TDM Guidelines (2018), North Bayshore District Transportation Monitoring Reports (2017 – 2020), Mountain View Bicycle Master Plan Update (2015).

This memorandum concludes with a list of identified data gaps. A table summarizing the documents and drawings reviewed can be found in Appendix A.

Document Review

NASA AMES Development Plan (2002)

The NASA Ames Development Plan is the guiding document for the transformation of the original NASA Ames Research Center and Moffett Field into a multi-use, collaborative, research and development campus. Partners include multiple universities and industry leaders. The plan considers TDM elements, internal multi-modal circulation and off-street parking. Public access is mandated as part of the plan. The plan does not significantly change the internal roadway network. The TDM program is detailed in the Ames Commute Alternatives Program documentation. A proposed circulation plan is also included.

Deficiency Plan Requirements, Santa Clara Transportation Authority Congestion Management Program (2010)

The Deficiency Plan outlines offsetting measures designed to improve transportation conditions of the Congestion Management Program (CMP) in lieu of making physical traffic capacity improvements. The motor vehicle Level of Service (LOS) standard for Santa Clara County is LOS E. If a CMP system facility exceeds the LOS standard and does not have a Congestion Management Agency approved deficiency plan, then the local jurisdiction is at risk of losing new gas tax revenues. Updates are required when there are significant changes in the deficiency plan assumptions. Deficiency plans are developed through several methods, but all require an implementation plan and must demonstrate how the identified improvements improve transportation and air quality.

Mountain View 2030 General Plan (2012)

The 2030 General Plan provides land use and transportation planning guidance for how the city will grow over time. Of specific interest are details of the North Bayshore Change Area, where land use densities are planned to increase. Shoreline Boulevard is recognized as the district spine and the North Shoreline Boulevard / Highway 101 area is designated as a district gateway. The district's large block pattern will be supplemented with new pedestrian and bicycle connections. Details are shown on the General Plan Land Use Map. Detailed vision and policy direction for the area is provided in the Land Use and Design Element of the plan. Citywide maps of the existing and planned bicycle network are included; the network is described in more detail in the Mountain View Bicycle Transportation Plan.

Stevens Creek Crossings Project: Initial Study/Environmental Assessment (2012)

This study analyzes the environmental impacts of the proposed multimodal improvements connecting office parks in North Bayshore with the proposed facilities in the Bay View Area, specifically the NASA ARC location. The project would create two new two-lane vehicular bridges extending Charleston Road and Crittenden Lane across Stevens Creek as well as a bicycle and pedestrian bridge just south of the Charleston Road vehicular bridge.[1] NASA, as part of their proposed development on their site, was required to create a TDM plan aimed at reducing trip generation by 22%. This proposal was not included in the NBPP.

North Bayshore Precise Plan (2014)

Elaborating on the 2012 General Plan, the 2014 North Bayshore Precise Plan (NBPP) provides an update to the area's zoning and development standards through a precise plan process. The NBPP replaces the land use and development regulations contained in Mountain View City Code and other Precise Plans used to govern this area. The NBPP study area is bordered by the Shoreline Mountain View Regional Park to the north, Highway 101 to the south, Palo Alto to the west and Stevens Creek to the east. Guided by the General Plan Vision and Goals, the NBPP provides detailed plans for land use, mobility, infrastructure, site design, and implementation. Notable development principles include new bicycle and pedestrian improvements, walkable, human-scaled blocks, and sustainability. This plan is considered the authoritative source of bicycle and pedestrian network recommendations unless updated or modified by more recent city planning documents.

The NBPP sets a target active mode share of 10%, with a map describing bicycle and pedestrian connections. The plan outlines detailed land use principles such as lot coverage and frontage requirements. The NBPP establishes street typologies, including Gateway Boulevards (defined as major entries to North Bayshore and other arterials with facilities for walking and biking - e.g., Shoreline Boulevard). The Plan also presents a proposed bicycle network and improved pedestrian accommodation, and it establishes priority transportation improvements.

As part of the TDM approach outlined in the plan, the City of Mountain View plans to utilize a Transportation Management Authority (TMA) to coordinate amongst employers and employees who do not have employer-based TDM services. The TMA's role is to ensure a publicly accessible employee shuttle service, report and monitor data related to TDM measures, assist TMA members in meeting their TDM goals, and develop TDM strategies. Every employer and property owner that applies for new development greater than 1,000 square feet is required to create a TDM plan with an SOV mode split goal of 45% over time, join the TMA, and provide a transportation coordinator. Retail and non-office applicants, as well as small businesses with 50 employees or less, do not have to provide a TDM plan; these employers and property owners are encouraged through incentives and benefits offered by the TMA.

Shoreline Boulevard Corridor Study (2014)

The Shoreline Boulevard Corridor study is a comprehensive corridor plan that provides a vision and recommended short- and long-term transformation of the roadway into a multi-modal corridor. The preferred recommendations include dedicated transit lanes, standard and protected bike lanes, a new bicycle/pedestrian bridge, and

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[1] More recent iterations of this plan include a new crossing for active modes; new motor vehicle crossings have been removed from the project.

intersection improvements throughout the corridor. The study includes detailed corridor improvements and provides a recommended phasing strategy.

Joint Cities Coordinated Stevens Creek Trail Feasibility Study (2015)

This is a feasibility study to extend the Stevens Creek Trail to Sunnyvale, Cupertino, Los Altos, and Mountain View. The plan includes corridor assessment for on-street bicycle facilities in Mountain View.

North Bayshore Transportation Demand Management (TDM) Plan Guidelines (2015)

The North Bayshore TDM Plan proposes implementation guidelines for future project applications, including a method to calculate project-level vehicle caps, project level TDM plan development guidelines, and guidance for creation of a Transportation Management Association (TMA). The Project Level Vehicle Trip Cap is required for all new development or building additions of more than 1,000 square feet.

Baseline TDM programs include priority carpool or vanpool parking, an on-site transportation coordinator who serves as a liaison to the TMA, bicycle parking and shower and changing facilities, bike sharing, telecommute/flexible work schedule programs, guaranteed ride home programs, TMA membership, rideshare matching services, shuttle services, and marketing and information. A variety of optional programs are also included in the document. Part of the TDM monitoring requirements include participation in the annual TMA employee mode share survey. If the applicant/employer exceeds the vehicle trip cap, then they must revise their TDM plan.

North Bayshore Transportation Demand Management (TDM) Plan Guidelines 2nd Addendum (2015)

This addendum provides additional details of gateway capacity and vehicle trip distribution that is required of all applications. The goal is to meet the 2014 Precise Plan target of only 45% SOV trips for new projects. Failure to meet this goal will result in failure of North Bayshore gateway locations in the AM peak period. The addendum outlines application requirements which include building location, infrastructure, and programmatic improvements for bicycle, pedestrian, and transit access, as well as strategies to shift trips outside the AM peak period.

Mountain View Bicycle Master Plan Update (2015)

This plan implements the bicycle-related mobility goals of the City's 2030 Comprehensive Plan and includes recommendations focused on bicycle infrastructure, policies, education, encouragement, and enforcement. Current bicycle ridership is estimated at 6.5% with 4,900 commuters and a total estimated 9,800 daily bicycle trips based upon data from the ACS and National SRTS survey. Two different bicycle count locations were located in North Bayshore including North Shoreline Boulevard and Charleston Road--this location had the most bicycle counts in the entire City--and at Amphitheatre Parkway and Charleston Road. A recommended system map, including recommended upgrades for North Bayshore, is included. Key recommendations in North Bayshore include Class IV upgrades to Amphitheatre Parkway and Charleston Road and Class II and Class III facilities on other roadways throughout the district. Improvements to Shoreline Boulevard are identified as a plan priority.

As part of the plan's encouragement policies, the City notes that it should collaborate with and support local businesses in their active transportation encouragement efforts.

1625 Plymouth Street Site Specific Traffic Analysis (SSTA) (2016)

The plan provides a supplemental traffic analysis that builds on the NBPP. The plan includes a summary of the site's trip generation, impact analysis of intersection and freeway impact, review of site access and circulation, and an assessment of improvements and coordination with Gateway Study findings.

North Bayshore Development Impact Fee Nexus Study (2016)

The North Bayshore Development Impact Fee Nexus Study is intended to provide Mountain View with technical documentation to support adoption of a new Area-wide Impact Fee for new development within the NBPP area. The report establishes a relationship between the impacts of new development and the need for new infrastructure to serve the projected growth. The report addresses the purpose of fees and specific uses. Fees are expected to cover transportation and utilities infrastructure among other costs.

Shashi Hotel Project Site-Specific Traffic Analysis (SSTA) (2016)

The plan presents the results of the Shashi Hotel Project SSTA, which is located in the NBPP Area. This SSTA provides an on-site and off-site analysis of transportation impacts as a result of the proposed hotel project and provides recommendations for transportation improvements (on-site and off-site), which will then be considered in the City of Mountain View Gateway Study.

2000 N Shoreline Boulevard Site-Specific Traffic Analysis (SSTA) (2017)

The plan presents the results of the N Shoreline Blvd SSTA, which is located in the NBPP Area. This SSTA provides an on-site and off-site analysis of transportation impacts as a result of the proposed hotel project and provides recommendations for transportation improvements (on-site and off-site), which will then be considered in the City of Mountain View Gateway Study. The plan also includes bicycle and pedestrian infrastructure recommendations and a site plan map.

Memo: North Bayshore Precise Plan with Residential – Project Trip Generation Estimates (2017)

This memo provides trip generation estimates after considering the proposed residential units within the NBPP. This analysis included local residential and non-residential trip generation surveys, which included bicycle and pedestrian counts.

Microsoft Silicon Valley Campus Project: Site-Specific Traffic Analysis (SSTA) (2017)

The plan presents the SSTA results for the Microsoft campus located in the NBPP Area. This SSTA provides an on-site and off-site analysis of transportation impacts as a result of the proposed improvements to the Microsoft campus and provides recommendations for transportation improvements (on-site and off-site), which will then be considered in the City of Mountain View Gateway Study.

North Bayshore District Transportation Monitoring Reports (2017-2020)

This series of reports has been completed in the spring and fall of each year since 2014. Reports include a summary of findings and describe data collection methods, the existing transportation network, existing travel patterns, traffic trends over time and gateway queuing observations. The reports track traffic during the morning three-hour peak period. In Fall 2017, monitoring studies were expanded to observe a four-hour period in the morning and added a four-hour evening period.

As of Spring 2020, motor vehicle volumes at the three gateway locations combined were below the total gateway vehicle trip cap. Individually, two out of the three gateway locations are below the total gateway vehicle trip cap in the morning and evening. Shoreline Boulevard exceeds its vehicle trip cap in the morning by 2% and Rengstorff Avenue exceeds its vehicle trip cap by 3% in the afternoon. About 80% of morning traffic enters the district on Rengstorff Avenue and Shoreline Boulevard, while Shoreline is most heavily used in both the morning and afternoon peak periods by people both entering and exiting the district. The Stevens Creek Trail is used most frequently in the morning and evening. The reports show that active transportation mode split has decreased slightly since 2017. The report notes that the near-term growth assessment of upcoming developments indicates that the Shoreline Boulevard gateway could exceed capacity if each gateway is not more effectively utilized and recommends implementation of additional NBPP strategies for infrastructure to accommodate this finding.

Gateway trip reduction, if necessary, is said to be achieved by adding more residential units within the district and by implementing TDM programs at existing buildings. The reports take into account scenarios for trip generation by gateway with and without additional buildings implementing TDM programs. The document recommends applying most of the North Bayshore TDM Plan Guidelines (2015).

North Bayshore SEIR Appendix G – Precise Plan with Residential Project Trip Generation Estimates (2017)

The report describes the potential changes to vehicle demand based on the addition of residential uses above and beyond the original NBPP. These travel demand estimates include 9,850 residential dwelling units including the following approved and potential projects:

- Approved development: the Sobrato development at 1255 Pear Avenue, and the Intuit Marine Way and Bayshore buildings
- Potential development: Broadreach (1625 Plymouth), Microsoft, Sobrato Mixed-Use, Shashi Hotel, Charleston East, Shoreline Commons, Landings, Huff rebuild, and Rees.

Trip estimates are generated through a variety of means including trip generation rates, assumed achievement of the NBPP trip cap, trip generation rates observed elsewhere, and the potential for trip reduction as a result of mixed land uses. The memo provides a summary of scenario comparisons and found that the growth in vehicle trips associated with new employment is modest when considering the magnitude of growth and indicates efficiency in linking residential and employment use within North Bayshore.

North Bayshore Precise Plan Residential Uses Traffic Impact Analysis (TIA) (2017)

This plan presents the results of the transportation impact analysis conducted for the NBPP. It outlines a strategy consistent with City Council policy direction that no substantial new transportation infrastructure to accommodate motor vehicles should occur as part of the district's redevelopment. This study identifies three primary gateways to the district and three scenarios were assessed: 1) Existing Conditions, 2) Existing with Project Conditions and 3) Year 2030 Cumulative with Project Conditions. This TIA explores the effects of adding residential land uses to North Bayshore to help achieve trip targets. This project is determined to have a less-than-significant impact to both bicycle and pedestrian facilities but does recommend pursuing improvements to further enhance the bicycling network. These scenarios find that motor vehicle activity generally leads to LOS E in a number of locations.

Pear Avenue Mixed-Use Development Draft Traffic Impact Analysis (TIA) (2017)

This report describes the TIA for the transformation of an existing complex of office buildings to an office/residential mixed-use development site. The site is located at the eastern end of Pear Avenue and is bounded by Space Park Way on the north, Inigo Way on the west, La Avenida on the south and the Santiago Villa mobile home park to the east. The project would build a new north-south roadway (Inigo Way Extension) with sidewalks and bike lanes between Pear Avenue and Space Park Way. New trip estimates were based on methods and assumptions prepared for the NBPP TIA.

Plymouth Street and Space Park Way Realignment (2017)

This is a synchro report coupled with engineering drawings for a realignment of Plymouth Street with Space Park Way. The drawings extend from west of Joaquin Road to east of Shoreline Boulevard, and include proposals for bicycle lanes (Class II and Class II buffered), sidewalks, and marked crosswalks. This plan has been updated as a result of approval of the Landings project.

Charleston Corridor South Transit Shelter Stop (2018)

This document contains engineering drawings for a street redesign on Charleston Road between Huff Road and Joaquin Road that include plans for new pedestrian facilities, street furniture and trees, transit facilities and shelters, Class IV cycle tracks, and bicycle corrals.

Citywide Multimodal Improvement Plan (MIP) (2018)

The Citywide MIP identifies measures to improve transportation conditions that are consistent with the state CMP. The plan includes infrastructure and programmatic bicycle, pedestrian and transit recommendations. Key recommendations for North Bayshore include North Shoreline Boulevard, Amphitheatre Parkway, and Charleston Road.

TDM management strategies for the City are outlined and a recommended timeline provided. These strategies include the adoption of a Residential Parking Permit Program, Downtown Paid Parking Study, adoption of a city-wide TDM ordinance, and the development of a North Bayshore Congestion Pricing Strategy.

North Bayshore Residential Transportation Demand Management (TDM) Guidelines (2018)

This report provides direction on how to implement and monitor a TDM program for future residential developments in North Bayshore. New developments in North Bayshore are required to meet the residential vehicle trip performance standard for peak hour vehicle trips and attain a minimum 50% non-driving mode share for a site's daily trips. A trip performance standard can be calculated by multiplying the District's average trip rate by the number of planned residential units. Strategies to meet mode shift targets and expected impact are provided.

All new residential development projects must join the TMA and provide a TDM plan if they exceed the NBPP's maximum allowed parking ratios. Residential developments can also hire an on-site transportation coordinator that would work with the TMA.

Shorebird Transportation Demand Management (TDM) Plan (2018)

The Shorebird Master Plan describes a comprehensive approach to TDM. The Shorebird area is a 66.3-acre area east of Shoreline Boulevard and north of Space Park Way and is one of three Complete Neighborhoods (also including Pear and Joaquin neighborhoods) permitted to assist the city in implementation of the NBPP. The Shorebird neighborhood will be home to about 8,550 office workers and 4,550 residents. Shorebird is closest to the Shoreline gateway, while Amphitheatre Parkway is a secondary gateway and San Antonio is the furthest away. Primary vehicular access will occur via Shoreline Boulevard, Charleston Road, or Space Park Way. The Joaquin neighborhood is also described in detail within this Plan. This planning document was developed by Google and has not been formally adopted by the City of Mountain View.

Shorebird Trip Cap Assessment (2018)

This document focuses on evaluation of the Shorebird development project on the AM period trip cap. This report estimates that the Shorebird development will produce a number of trips in the AM peak that will keep gateways below the AM peak hour trip cap by 20 to 450 trips, based on the gateway. The report notes these findings are preliminary and may be subject to change as more detailed operational analysis is completed. These estimates were generated using the methods laid out in the NBPP EIR. This planning document was developed by Google and has not been formally adopted by the City of Mountain View.

Shoreline Gateway Master Plan (2018)

This is a plan for a mixed-use development, including a large open space and surrounding walking and biking paths, that aims to bring the vision of the NBPP to life. Streetscape improvements including bicycle and pedestrian access and potential cross sections are included. An update to this planning document is expected in Fall 2020.

Shoreline / US 101 Ramp Realignment 65% Plan Set (2018)

This document contains engineering drawings for a ramp realignment on US 101 from 0.2 miles south of the N Shoreline Boulevard overpass to the N Shoreline Boulevard Overpass and on La Avenida from Inigo Way to N Shoreline Boulevard. The drawings contain proposals for pedestrian facilities, marked crosswalks, and bike lanes.

Charleston Corridor Improvements Phase 2 and 3 Project No. 21-37 95% Submittal (2019)

This document contains engineering drawings for a street redesign on Charleston Road from west of Salado Drive to Huff Avenue. The drawings contain proposals for pedestrian facilities, marked crosswalks, transit facilities, and Class IV cycle tracks. The drawings also include a protected intersection design for Charleston Road and Alta Avenue.

Shoreline Boulevard Bus Lane (2019)

This document contains engineering drawings for a street redesign of Shoreline Boulevard from Pear Avenue to just South of Middlefield Road. The plans include proposals for pedestrian facilities, transit facilities, and Class II buffered bicycle lanes.

Council Report: Google Landings Office Development Project (2020)

This document contains a City Council review of the proposed office, garage, and bike and pedestrian greenway. The proposed office is located on Landings Drive south of Charleston Road, west of Permanente Creek, and north of Highway 101. The proposed garage is located between Alta Avenue and Huff Avenue, midblock between Charleston Road and Plymouth Street. The proposed greenway will connect the projects along Permanente Creek.

Googleplex Proposed Green Loop Experience (2020)

This document contains a diagram of the area north of Charleston Road Between Permanente Creek and Shoreline Boulevard and includes a proposed Class I shared-use path.

Identified Data Gaps

Based on a review of documents provided by Mountain View staff, we have identified the following potential data that would be useful in completing the 2020 North Bayshore Bicycle and Pedestrian Circulation Study.

- Specific plans that update the NBPP planned bicycle / pedestrian network
  - Huff
  - Landing
  - Rees[2]
- Any additional plans (e.g., site plans) that update bicycle or pedestrian infrastructure recommendations included in the NBPP
- Updated land use data to show currently anticipated residential dwelling unit density, and employee and commercial density[3]
- Fall monitoring reports for 2017, 2018, and 2019 and spring 2020
- Preliminary VISSIM bicycle and pedestrian travel activity estimates[4]

The data gaps identified above were addressed by the client and updated information has been incorporated into this final memorandum.

[2] City staff reported that a development proposal has not yet been completed for this site
[3] City staff noted this information is included in the NBPP
[4] City staff are currently working to provide this information

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MEMORANDUM

Appendix A. Summary of Plan Review Documents and Drawings

Table 1 – Summary of Reviewed Documents and Drawings

		Elements of interest			Plan Type			
Year	Plan Name	Infrastructure Recommendations	Counts	TDM Measures	Site Plan	Area / Modal Plan	Traffic Monitoring	Policy
2002	NASA Ames Development Plan	X		X	X			
2010	Deficiency Plan Requirements, Santa Clara Transportation Authority Congestion Management Program							X
2012	Mountain View 2030 General Plan							X
2012	Stevens Creek Crossing Environmental Assessment	X			X	X		
2014	North Bayshore Precise Plan	X		X		X		X
2014	Shoreline Boulevard Corridor Study	X			X	X		
2015	Joint Cities Coordinated Stevens Creek Trail Feasibility Study (2015)	X			X			
2015	North Bayshore Transportation Demand Management (TDM) Plan Guidelines							X
2015	North Bayshore Transportation Demand Management (TDM) Plan Guidelines 2nd Addendum							X
2015	Mountain View Bicycle Master Plan Update	X	X	X		X		X
2016	1625 Plymouth Street Site Specific Traffic Analysis	X			X			
2016	North Bayshore Development Impact Fee Nexus Study							X

		Elements of interest			Plan Type			
Year	Plan Name	Infrastructure Recommendations	Counts	TDM Measures	Site Plan	Area / Modal Plan	Traffic Monitoring	Policy
2016	Shashi Hotel Project SSTA		X	X	X		X	X
2017	2000 N Shoreline Blvd SSTA	X	X	X	X		X	X
2017	MEMO: North Bayshore Precise Plan with Residential – Project Trip Generation Estimates		X	X				
2017	Microsoft Silicon Valley Campus Project: Site Specific Traffic Analysis	X	X	X	X		X	X
2017	North Bayshore District Transportation Monitoring Reports		X				X	
2017	North Bayshore SEIR Appendix G - Precise Plan with Residential Project Trip Generation Estimates		X				X	
2017	North Bayshore Precise Plan Residential Uses TIA						X	
2017	Pear Avenue Mixed-Use Development Draft Traffic Impact Analysis (TIA)	X	X	X	X			
2017	Plymouth Street and Space Park Way Realignment	X	X		X			
2018	Charleston Corridor South Transit Shelter Stop	X			X			
2018	Citywide Multimodal Improvement Plan	X						X
2018	North Bayshore District Transportation Monitoring Reports		X				X	

		Elements of interest			Plan Type			
Year	Plan Name	Infrastructure Recommendations	Counts	TDM Measures	Site Plan	Area / Modal Plan	Traffic Monitoring	Policy
2018	North Bayshore Residential Transportation Demand Management Guidelines			X				X
2018	Shorebird Transportation Demand Management (TDM) Plan			X	X			
2018	Shorebird Trip Cap Assessment						X	
2018	Shoreline Gateway Master Plan	X			X	X		
2018	Shoreline / US 101 Ramp Realignment 65% Plan Set	X			X			
2019	Charleston Corridor Improvements Phase 2 and 3 Project No. 21-37 95% Plans	X			X			
2019	North Bayshore District Transportation Monitoring Reports		X				X	
2019	Shoreline Boulevard Bus Lane	X			X			
2020	Council Report: Google Landings Office Development Project	X		X	X	X		
2020	Googleplex Proposed Green Loop Experience	X			X			
2020	North Bayshore District Transportation Monitoring Reports	X					X	

Appendix B – Mountain View Bicycle Level of Traffic Stress

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MEMORANDUM

To: Nayan Amin and Ian Lin, TJKM

From: Sam Corbett and Aaron Fraint, Alta Planning + Design

Date: April 10, 2020

Re: Mountain View Bicycle Level of Traffic Stress

Introduction

This memo catalogs the process of creating a Bicycle Level of Traffic Stress (BLTS) assessment for the City of Mountain View. This includes the acquisition of source data, the methodology to classify stress levels, as well as a discussion of the results, which are also graphically displayed in the attached set of maps. The methodology described in this document is adapted from the Mineta Transportation Institute's *Low Stress Bicycling and Network Connectivity* (2012)[1], and has been adjusted to reflect the data available within Mountain View.

Background

BLTS is a numeric value assigned to each segment and intersection of a road network, aiming to approximate the level of stress experienced by bicyclists. BLTS is calculated directly from available street network data, considering the following built environment parameters:

- Street Segments
  - Number of through travel lanes
  - Posted speed limit
  - Class of bicycle facility (if any)
- Intersections
  - BLTS of intersecting segments
  - Presence of traffic signal
  - Presence of crossing island at least 6 feet in width

The BLTS analysis is conducted twice:

- the first includes all existing and approved bicycle facilities identified in the Capital Improvement Plan
- the second also includes all planned bicycle infrastructure improvements

[1] https://transweb.sjsu.edu/sites/default/files/1005-low-stress-bicycling-network-connectivity.pdf

Data Inputs

A line feature class named "Road_Centerlines" was used as the source of roadway feature geometry and attributes reflecting posted speed limits. A second feature class, named "Pavement_Marking_Lines" was used to identify roadways with lane lines, and a manual process was employed to interpolate the number of through travel lanes for motor vehicles to the roadway geometries. A similar process was used to interpolate bicycle facility data from "Street_Bike_Network" and "BikeNetwork2019".

A GIS layer representing intersection points within Mountain View was created by transforming each line segment into its constituent start- and end-points. Using a "Signals" feature class, all signalized intersections were flagged using spatial analysis, and all non-signalized intersections with a crossing island in the median were flagged using a manual interpolation process from the "Street_Curbs" feature class.

The final set of data attributes used as inputs into this analysis were created through Tasks 2A & 2B in the Mountain View Comprehensive Modal Plan. This consisted of tagging roadway features where projects have already been approved (as identified in the Capital Improvement Plan), and where projects have been planned in the Mountain View Bicycle Transportation Plan (2015), the Santa Clara Countywide Bicycle Plan (2018), and the Caltrans D4 Bicycle Plan (2018). Attributes from these plans were combined to identify the approved and/or planned designs (if any) for each street segment in Mountain View. Additionally, new on- and off-street roadway geometries were merged into the GIS layer where brand-new facilities are planned.

Definition of LTS Values

BLTS values have a range between 1 and 4, with lower numbers signifying lower traffic stress levels. These BLTS values are defined as follows:

- BLTS 1: roadway is comfortable for all ages and abilities
- BLTS 1.5: roadway is comfortable for people of most ages and abilities, but does not feature a bicycle facility
- BLTS 2: roadway is comfortable for interested but concerned cyclists
- BLTS 3: roadway is comfortable for enthused and confident cyclists
- BLTS 4: roadway is comfortable for strong and fearless cyclists

Methodology

Segment-Based Methodology

The process for defining segment-specific BLTS consists of assigning initial values based upon the combination of speed limit and roadway width (defined by number of travel lanes). This initial classification is adapted from the Mineta Transportation Institute report, and is shown in Table 1 below.

Table 1 - Segment BLTS

		Street Width			
		2 lanes without centerline	2 - 3 lanes with centerline	4 - 5 lanes	6 + lanes
Speed Limit	<= 25 mph	1.5	2	3	4
	30 mph	2	3	4	4
	>= 35 mph	4	4	4	4

Where bicycle facilities exist, the BLTS is updated as shown in Table 2 below.

Table 2 - BLTS Adjustment for Bike Facilities

Bicycle Facility Class	**BLTS**
Class 1 Trail	1
Class 2 Bike Lane	See tables below
Class 3 Bike Route on initial LTS 1.5	1
Class 3 Bike Route on initial LTS 2+	Keep base LTS
Class 4 Protected Bike Lane	1

These adjustments on Class 1 and 4 facilities account for the physical separation inherent to these designs, and the associated reduction in stress for bicyclists. The adjustment to Class 3 facilities on roads with an initial LTS of 1.5 accounts for the fact that Class 3 bicycle routes reduce stress on residential streets, but do not substantially reduce stress on wider, faster streets. Where Class 2 bicycle lanes exist, the BLTS value will be calculated as shown in Table 3 on the following page.

Table 3 - Class II Bike Lane BLTS

Speed Limit	Street Width: Less than 4 lanes	Street Width: 4 or more lanes
<= 25 mph	1	3
30 mph	2	3
35 mph	3	3
>= 40 mph	4	4

Intersection-Based Methodology

A bicyclist's experience of stress at an intersection is impacted both by the street they're travelling along as well as the street that they must cross. As a result, the preliminary intersection BLTS is calculated as the worst BLTS of all intersecting street segments. For example, an intersection of BLTS 4 and BLTS 2 streets will be coded as BLTS 4.

The Mineta Transportation Institute identifies unsignalized intersections as a specific factor that can increase stress, particularly where the intersecting roadways feature higher speed limits, greater numbers of travel lanes, or both. Their classification is identified in the following two tables, and will be applied to all unsignalized intersections in Mountain View.

Where unsignalized intersections feature a median refuge that is at least 6 feet wide, the values in Table 4 will be used:

Table 4 - Unsignalized Intersections with Median (6'+ wide)

Speed Limit	Street Width: 2 - 3 lanes	Street Width: 4 - 5 lanes	Street Width: 6 + lanes
<= 30 mph	1.5	2	3
>= 35 mph	2	3	4

Where unsignalized intersections do not have a median refuge 6 feet or wider, the values in Table 5 on the following page will be used.

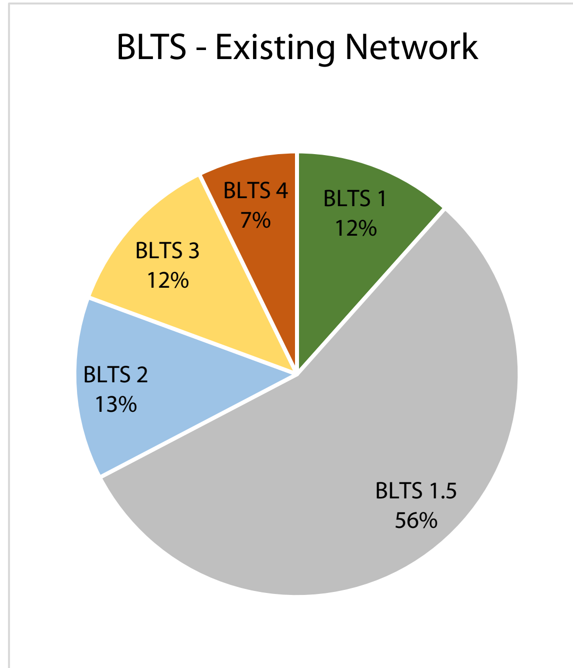
Table 5 - Unsignalized Intersections without Median

Speed Limit	Street Width: 2 - 3 lanes	4 - 5 lanes	6 + lanes
<= 30 mph	2	3	4
>= 35 mph	3	4	4

The final intersection-level BLTS values will be identified as follows:

- Signalized intersections will use the worst BLTS of the intersecting segments
- Unsignalized intersections will take whichever value provides a worse BLTS score:
    - Unsignalized BLTS as identified in Tables 4 and 5
    - Worst BLTS of intersecting segments

BLTS: Existing and Approved Projects

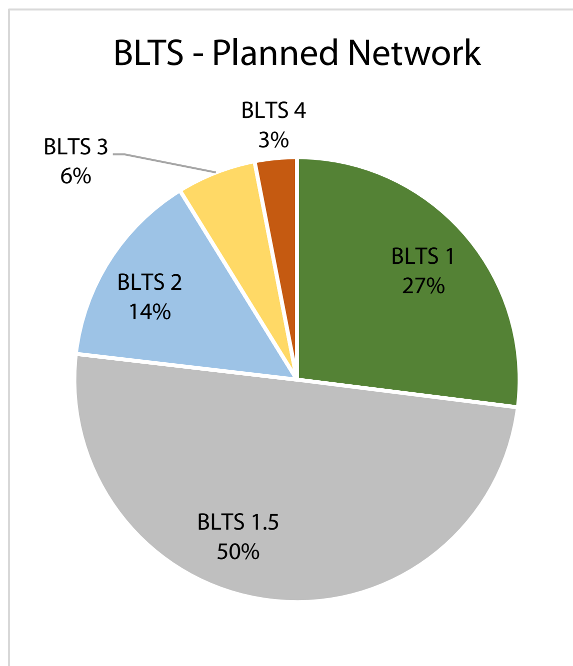


The initial BLTS analysis considers the stress levels of the existing street network in Mountain View. Additionally, it also incorporated a review of all bicycle-related projects identified in the Capital Improvement Plan. Any approved projects that are expected to be completed in the near future are considered to be "existing".

The results are summarized in the graph at right, which shows that the BLTS 1.5 classification is the most common condition, representing 56% of all centerline miles in Mountain View.

These results are also visualized spatially in a series of maps. Maps 1 and 2 on the following pages provide a citywide view of the Existing/Approved and Planned BLTS results, using line color to illustrate each BLTS level. A detailed zoomed-in view by quadrant can be found at the end of the document. Map 7 identifies the extents of the four quadrants, Maps 8 – 11 identify existing, approved, and planned bicycle facilities,[2] and Maps 12 – 15 show the BLTS results for the existing/approved network.

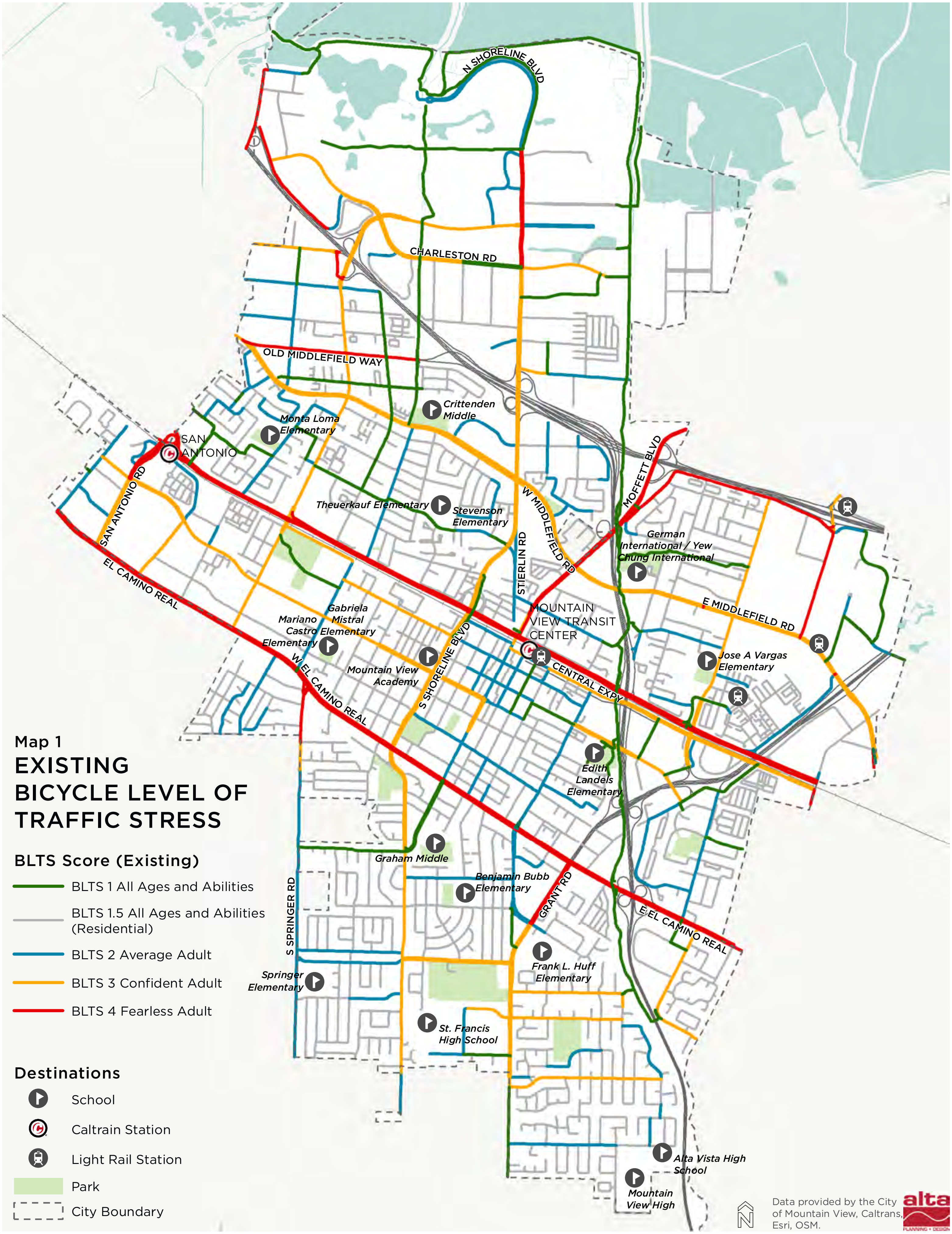
BLTS: Planned Projects



The second BLTS analysis assumes that all planned projects have been implemented, and the results are shown in Maps 16 – 19 using the same symbol styles as the Existing/Approved BLTS maps.

The graph at right summarizes the centerline mileage of the planned network, and it shows that the major change between the two scenarios is the proportion of BLTS 1 streets – it increases in the planned network to 27% of all centerline miles (from 12% in the existing/approved network).

[2] Existing/approved facilities are shown with a thin line, while planned facilities are shown with a thick underline. In both cases, the facilities feature the same colors (class 1 is dark green, class 2 is blue, class 3 is purple, and class 4 is bright green), but the planned facility colors use a lighter shade than the existing/approved facilities.

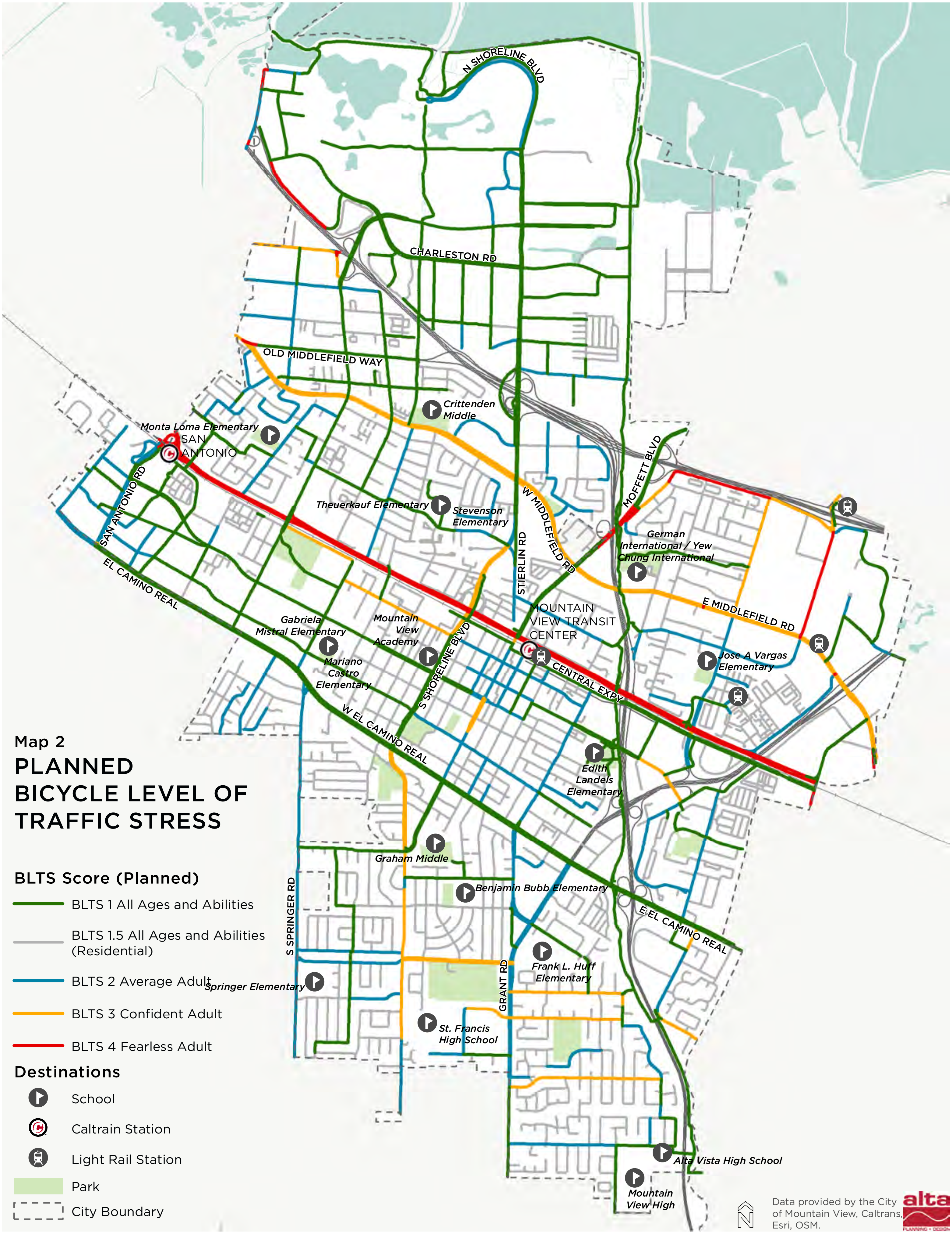


Map 1

EXISTING BICYCLE LEVEL OF TRAFFIC STRESS

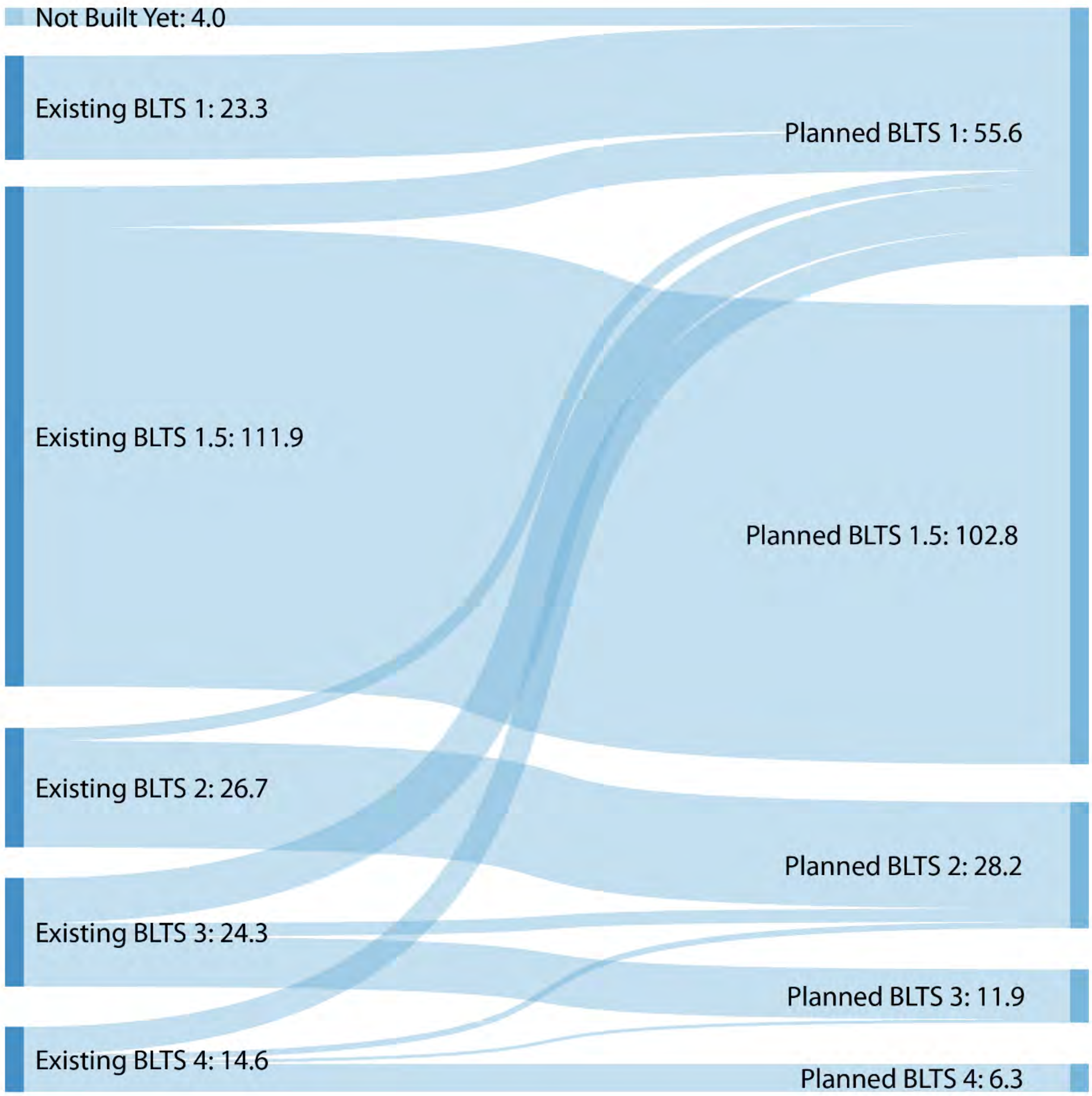
Map 2

PLANNED BICYCLE LEVEL OF TRAFFIC STRESS



To better understand the nuance in the change between the existing/approved and the planned scenarios, the Sankey diagram on the follow page identifies the change in mileage between the BLTS classes across scenarios. It shows that BLTS 1 accounted for 23.3 centerline miles in the existing scenario, and in the planned scenario accounts for 55.6 centerline miles. In addition to 4 miles of brand-new low-stress facilities, much of the growth is attributable to improved stress levels from streets that had been classified as BLTS 4, 3, or 1.5 in the existing scenario.

Change in BLTS by Centerline Miles between Scenarios: Existing (left) and Planned (right)



Low Stress Network Comparison

The existing and planned networks were analyzed to identify "islands" of low-stress connectivity. These islands are characterized as contiguous low-stress road segments (BLTS of 1, 1.5, or 2). The issue with the low-stress islands is that bicyclists traveling between them encounter higher-stress conditions which expose them to greater risks and may even preclude them from making the trip by bicycle. The process of identifying low-stress islands consisted of:

- Filtering the roadway network to only include low-stress segments (BLTS 1, 1.5, or 2)
- Removal of portions of low-stress segments within 100' of high-stress intersections (BLTS 3 or 4)
- Clustering of the remaining segments, buffering by 300', and filtering the resulting polygons to those that have an area greater than or equal to one-tenth of a square mile (0.1 sq. mi.).

A citywide summary of the existing and planned low-stress islands can be seen in Maps 3 and 4 respectively (pages 12 and 13). A detailed quadrant view of the existing network's low-stress islands can be seen in Maps 20 – 23, and the planned network's low-stress islands can be seen in Maps 24 – 27.

Key findings include:

- In the existing network, there are 26 distinct low-stress islands. The average size is 0.33 sq. mi. and the largest island is comprised of the roadways connected to Steven's Creek Trail, covering 2.63 sq. mi. However, it should be noted that some of these connections require circuitous routing around high-stress or impermeable barriers such as Middlefield Road and Caltrain tracks.
- In the planned network, the number of distinct low-stress islands decreases to 11 as many existing low-stress islands are connected into a single island in the planned network via new or improved bicycle facilities. The average size grows to 0.89 sq. mi. and the largest island will span 6.92 sq. mi., as new low-stress bicycle facilities connect to the Steven's Creek island.
- In the planned network, there are a few key streets that are preventing a citywide low-stress network from forming. These streets include Miramonte Ave / Shoreline Blvd, Rengstorff Ave, and Middlefield Rd
- Many of the smaller islands in the existing network are merged together in the planned network by the Class 4 improvement to El Camino Real

All Ages and Abilities Comparison

In 2017, the National Association of City Transportation Officials (NACTO) published *Designing For All Ages & Abilities: Contextual Guidance for High-Comfort Bicycle Facilities*.[3] This document uses motor vehicle speeds, the number of motor vehicle travel lanes, traffic volumes, and other operational considerations to identify the ideal bicycle facility design that would feel safe for users of all ages and abilities (AAA).

To better understand the existing and planned bicycle networks in Mountain View, each bicycle facility was graded with a value that reflects whether or not the combination of bicycle facility class, posted speed limit, and number of travel lanes meets NACTO's thresholds for an all ages and abilities facility. Since volume and operational data were

[3] https://nacto.org/wp-content/uploads/2017/12/NACTO_Designing-for-All-Ages-Abilities.pdf

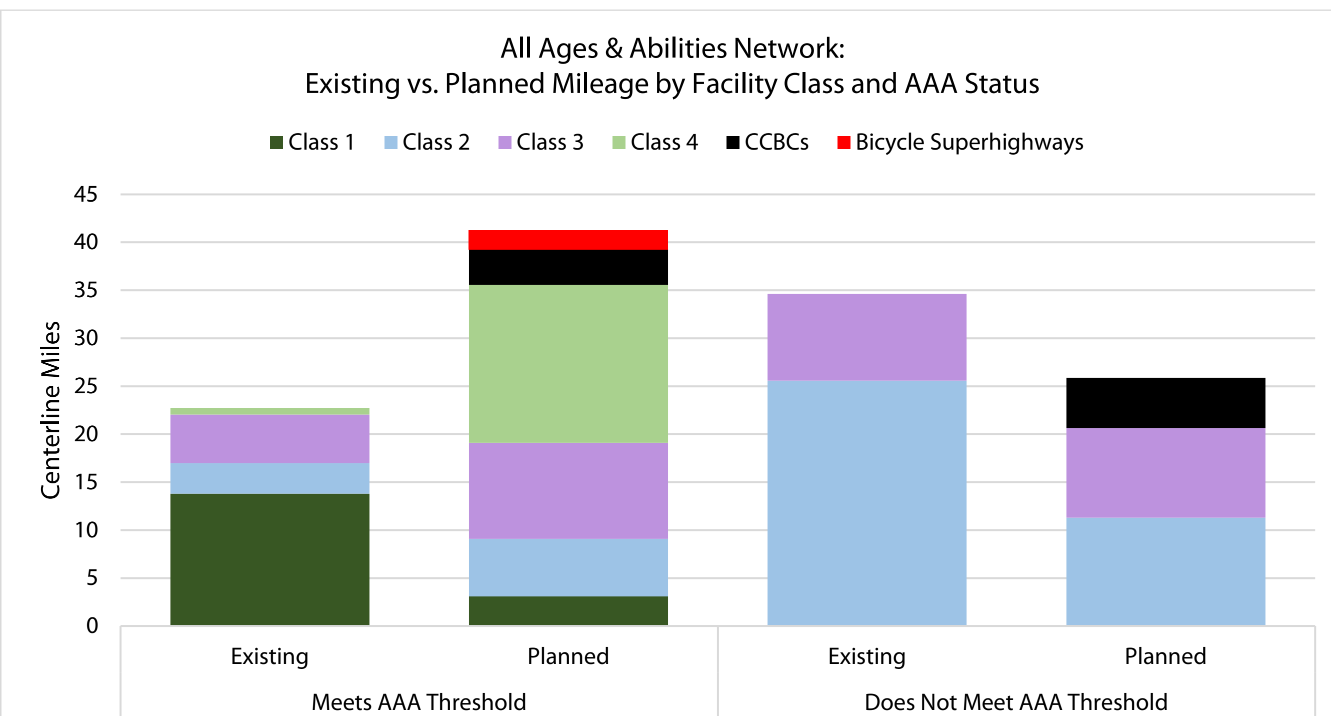
not provided as inputs to this analysis, the table has been adapted (as shown on the following page) to pair bicycle facilities with motor vehicle speeds and lane counts.

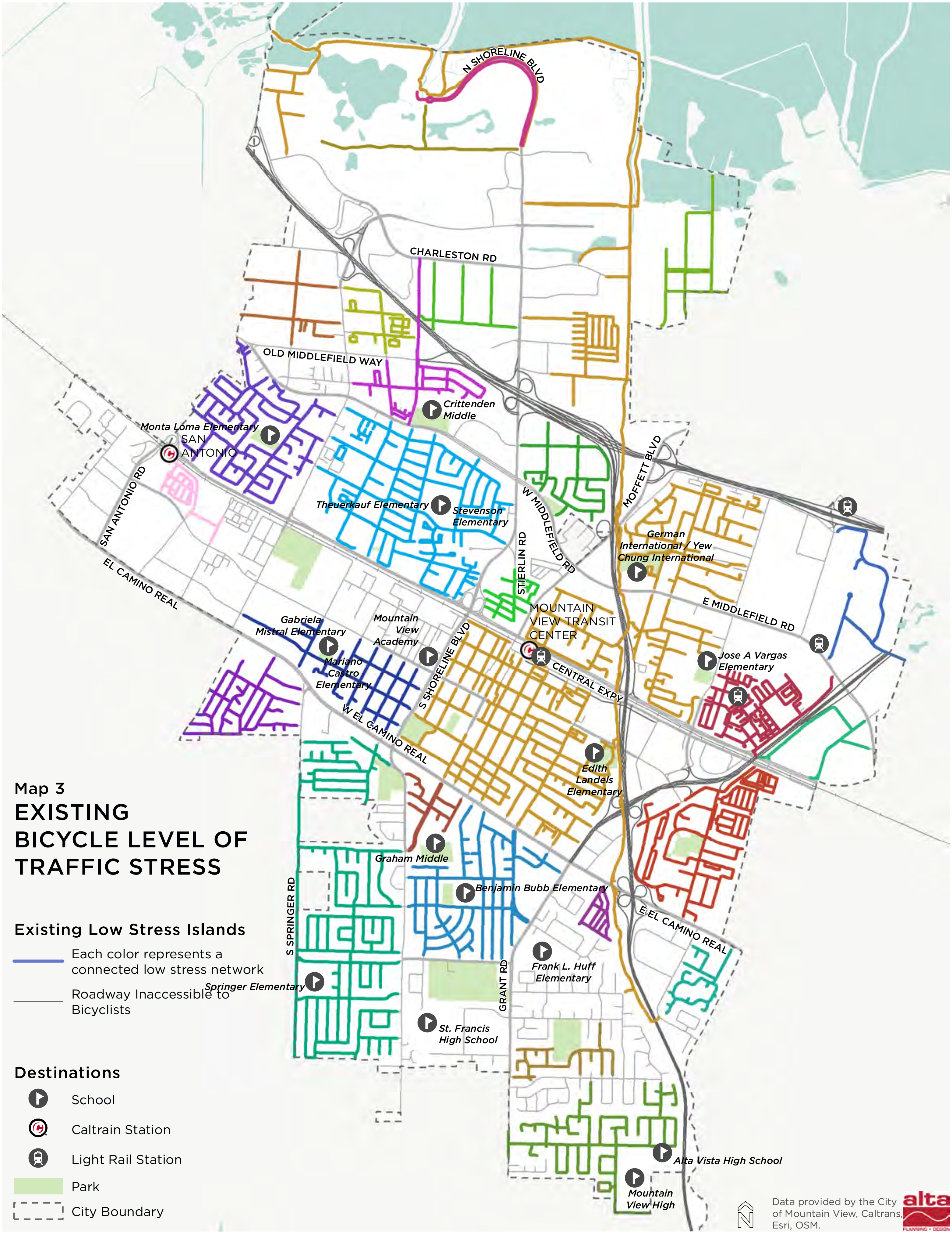
Thresholds for classifying a bicycle facility as "All Ages & Abilities"

Bicycle Facility	Posted Speed Limit	Motor Vehicle Lanes
Class 1	Any	Any
Class 4	Any	Any
Class 2	<= 25 MPH	1 lane in each direction (or less)
Class 3	<= 25 MPH	No centerline

In the planned network, there are two bicycle facility typologies that are not described in "Class" terminology. Both come from the Caltrans D4 Bicycle Plan, and are "Cross County Bicycle Corridors" (CCBCs) and "Bicycle Superhighways". CCBCs are described as a flexible context-sensitive design that achieves a BLTS of 2 or better. As a result, for the purposes of the AAA analysis these features were considered as Class 2 bicycle lanes. Similarly, bicycle superhighways are described as low-stress separated facilities, and as a result these features were considered to be Class 4 facilities.

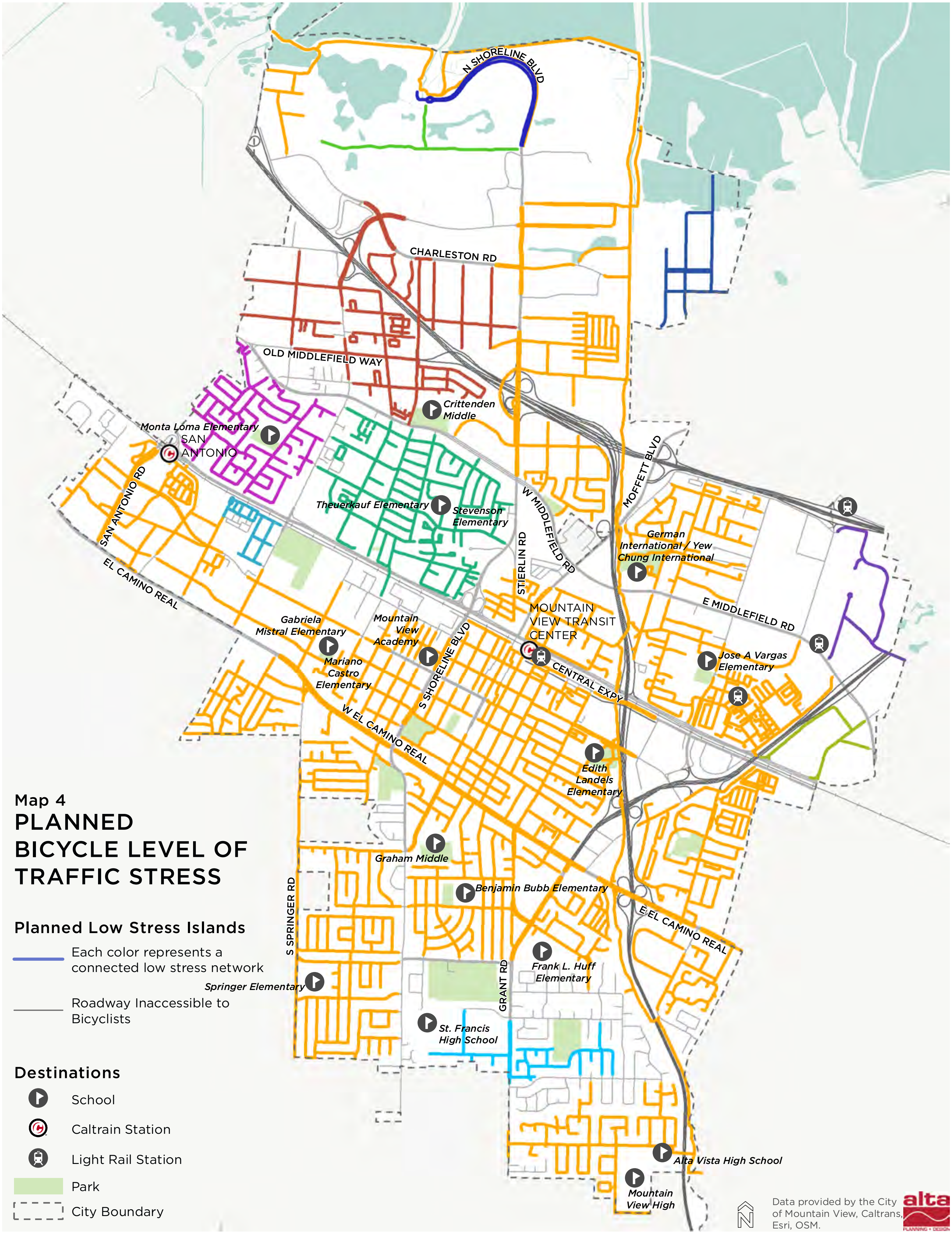
Maps 5 and 6 show the existing/approved and planned bicycle networks (respectively), and each bicycle facility is classified as meeting NACTO's AAA threshold (in blue) or not meeting the threshold (in red). The graph below compares the mileage of AAA networks between the existing and planned scenarios. It clearly demonstrates the growth in mileage of the AAA network, from 22 miles in the existing network to 41 miles in the planned network.




Map 3
EXISTING BICYCLE LEVEL OF TRAFFIC STRESS
Existing Low Stress Islands
Each color represents a connected low stress network
Roadway Inaccessible to Bicyclists
Destinations
School
Caltrain Station
Light Rail Station
Park
City Boundary
N SHORELINE BLVD
CHARLESTON RD
OLD MIDDLEFIELD WAY
Crittenden Middle
Monta Loma Elementary
SAN ANTONIO
SAN ANTONIO RD
Theuerkauf Elementary
Stevenson Elementary
W MIDDLEFIELD RD
MOFFETT BLVD
German International / Yew Chung International
STIERLIN RD
EL CAMINO REAL
E MIDDLEFIELD RD
MOUNTAIN VIEW TRANSIT CENTER
Gabriela Mistral Elementary
Mountain View Academy
Mariano Castro Elementary
S SHORELINE BLVD
CENTRAL EXPY
Jose A Vargas Elementary
W EL CAMINO REAL
Edith Landels Elementary
Graham Middle
Benjamin Bubb Elementary
S SPRINGER RD
E EL CAMINO REAL
Frank L. Huff Elementary
Springer Elementary
GRANT RD
St. Francis High School
Alta Vista High School
Mountain View High
Data provided by the City of Mountain View, Caltrans, Esri, OSM.

Map 4

PLANNED BICYCLE LEVEL OF TRAFFIC STRESS

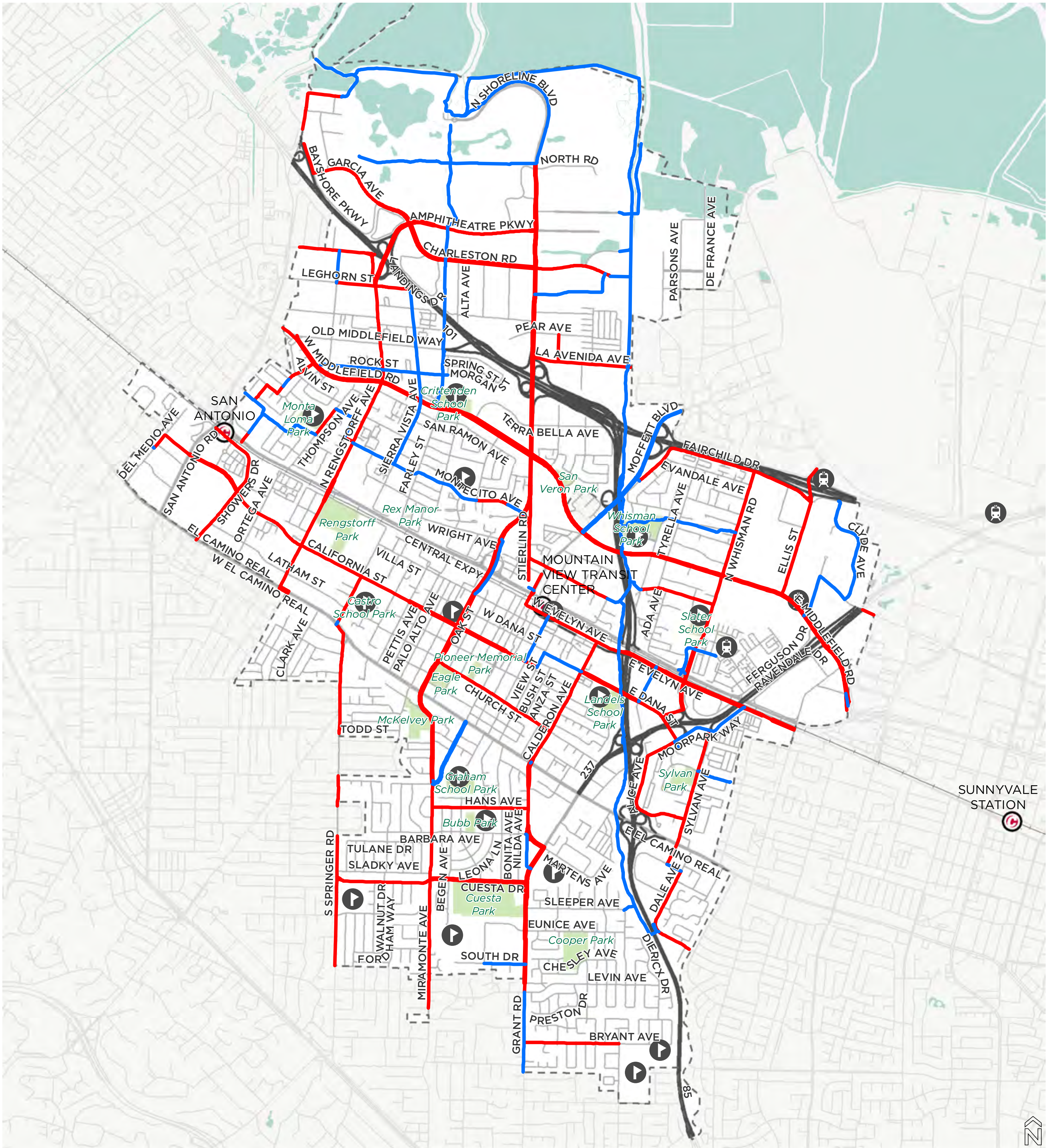


Planned Low Stress Islands

- Each color represents a connected low stress network
- Roadway Inaccessible to Bicyclists

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary



EXISTING NETWORK: ALL AGES & ABILITIES

Map 5

0 0.5 1 MILE

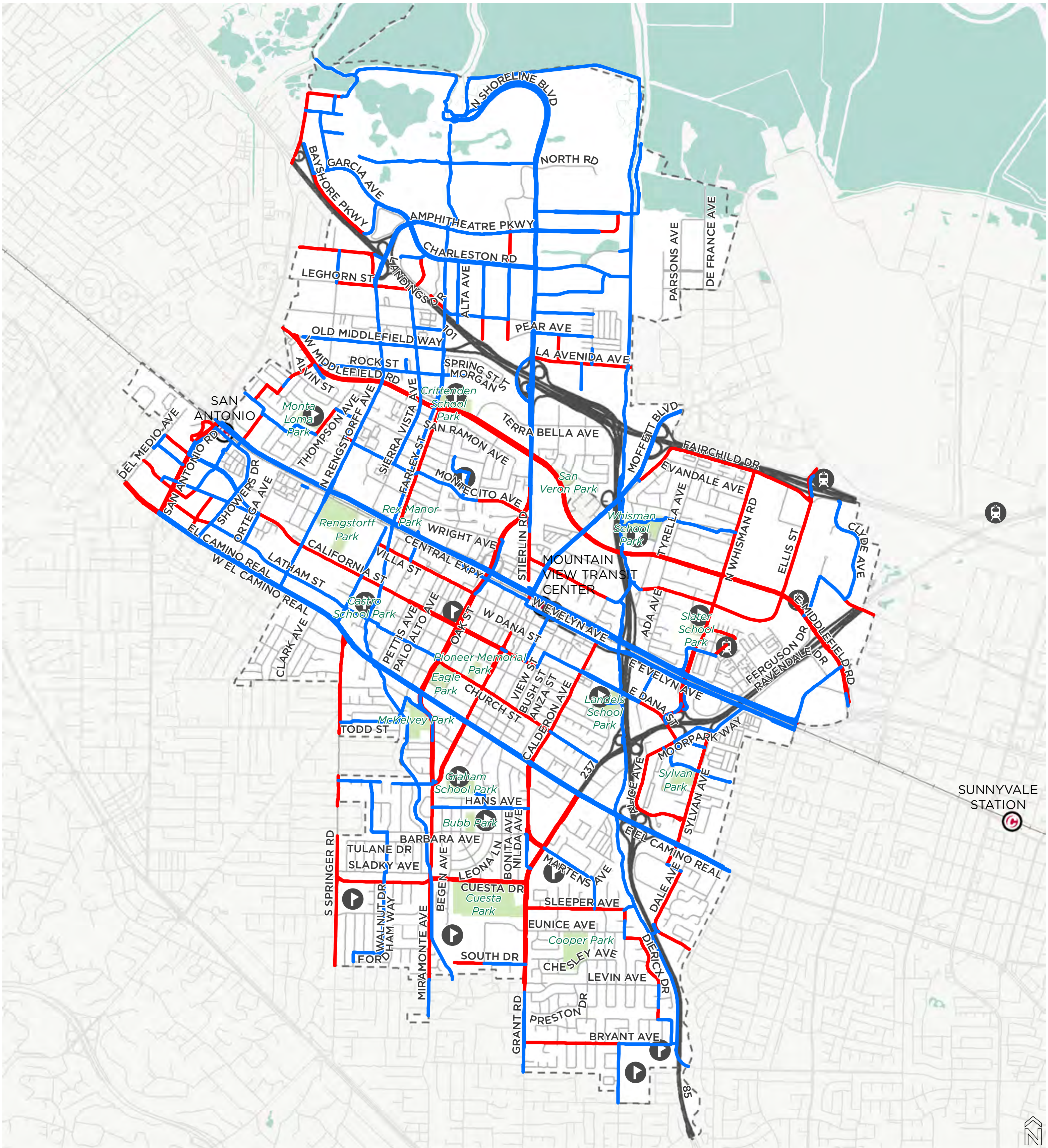
Existing Bicycle Facilities

- Meets AAA Threshold (21.9 Miles)
- Does Not Meet AAA Threshold (36.5 Miles)

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary

Data provided by the City of Mountain View, Caltrans, Esri, OSM.



PLANNED NETWORK: ALL AGES & ABILITIES

Map 6

Planned Bicycle Facilities

Meets AAA Threshold (60.2 Miles)

Does Not Meet AAA Threshold (31.8 Miles)

Destinations

School

Caltrain Station

Light Rail Station

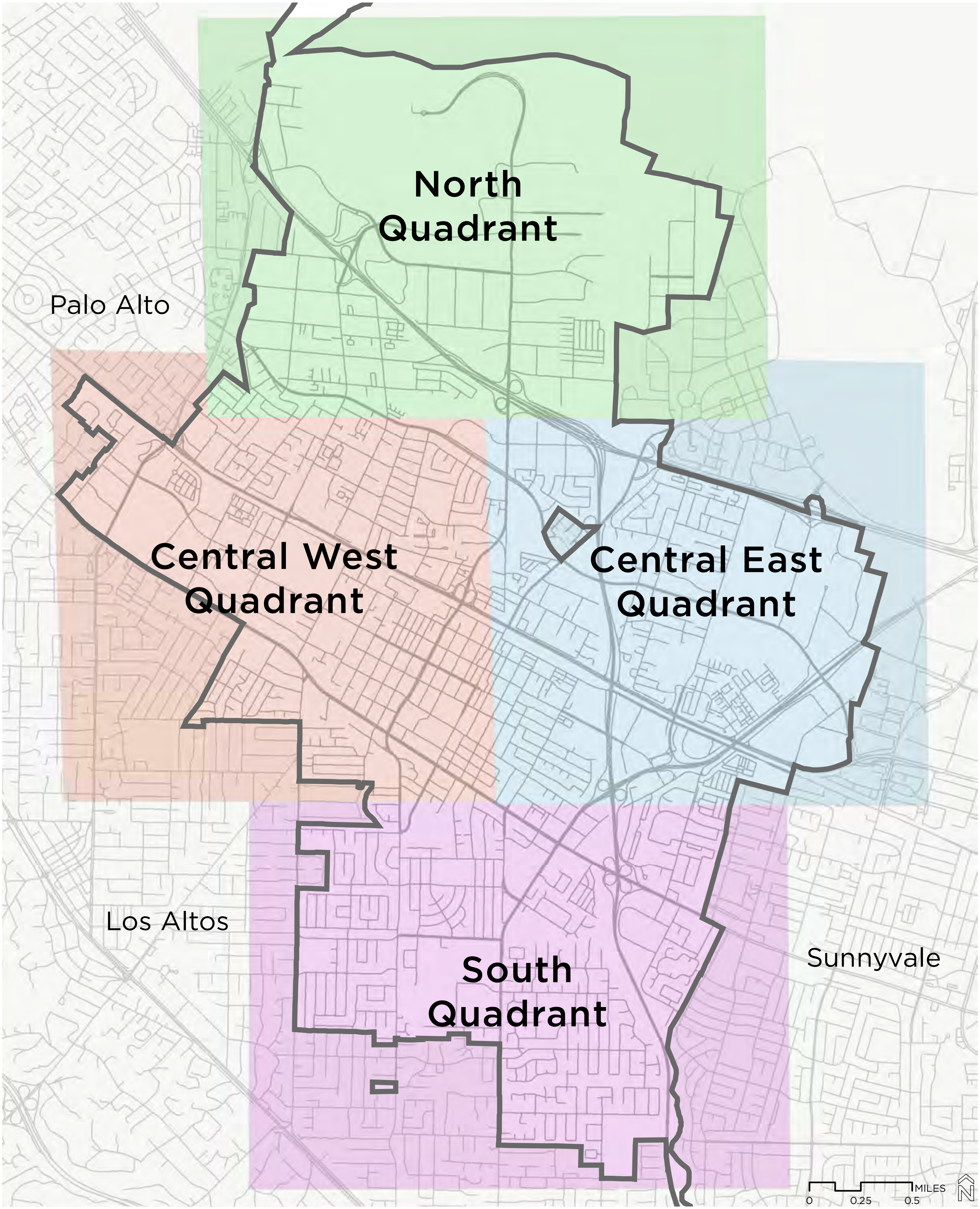
Park

City Boundary

0 0.5 1 MILE

Data provided by the City of Mountain View, Caltrans, Esri, OSM.

Maps

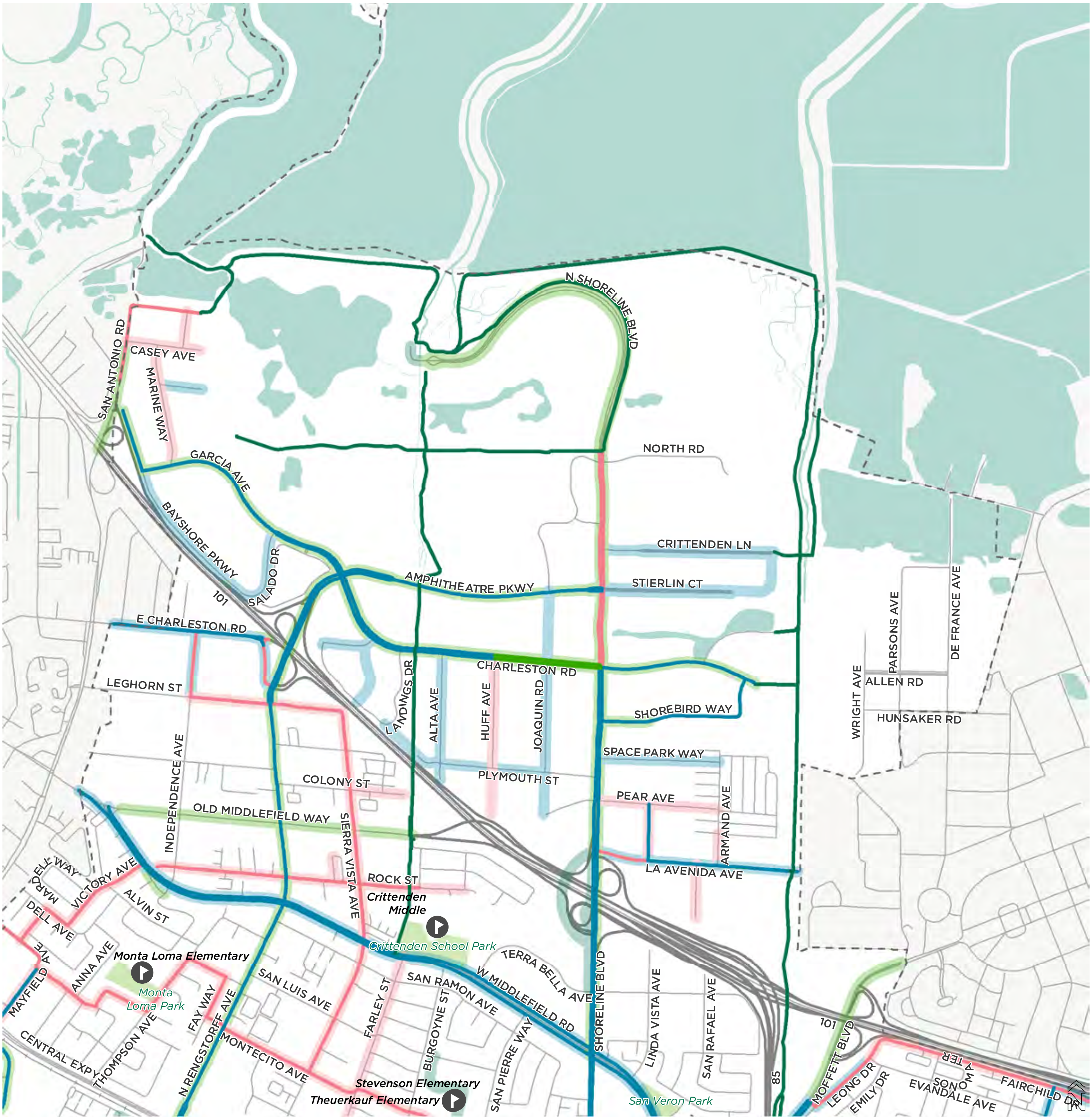


MOUNTAIN VIEW QUADRANTS

Map 7

City Boundary

Data provided by the City of Mountain View, Caltrans, Esri, OSM.



0 0.25 0.5 MILES

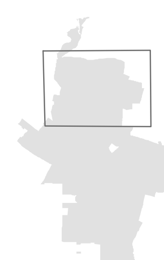
BICYCLE NETWORK

Map 8 NORTH QUADRANT

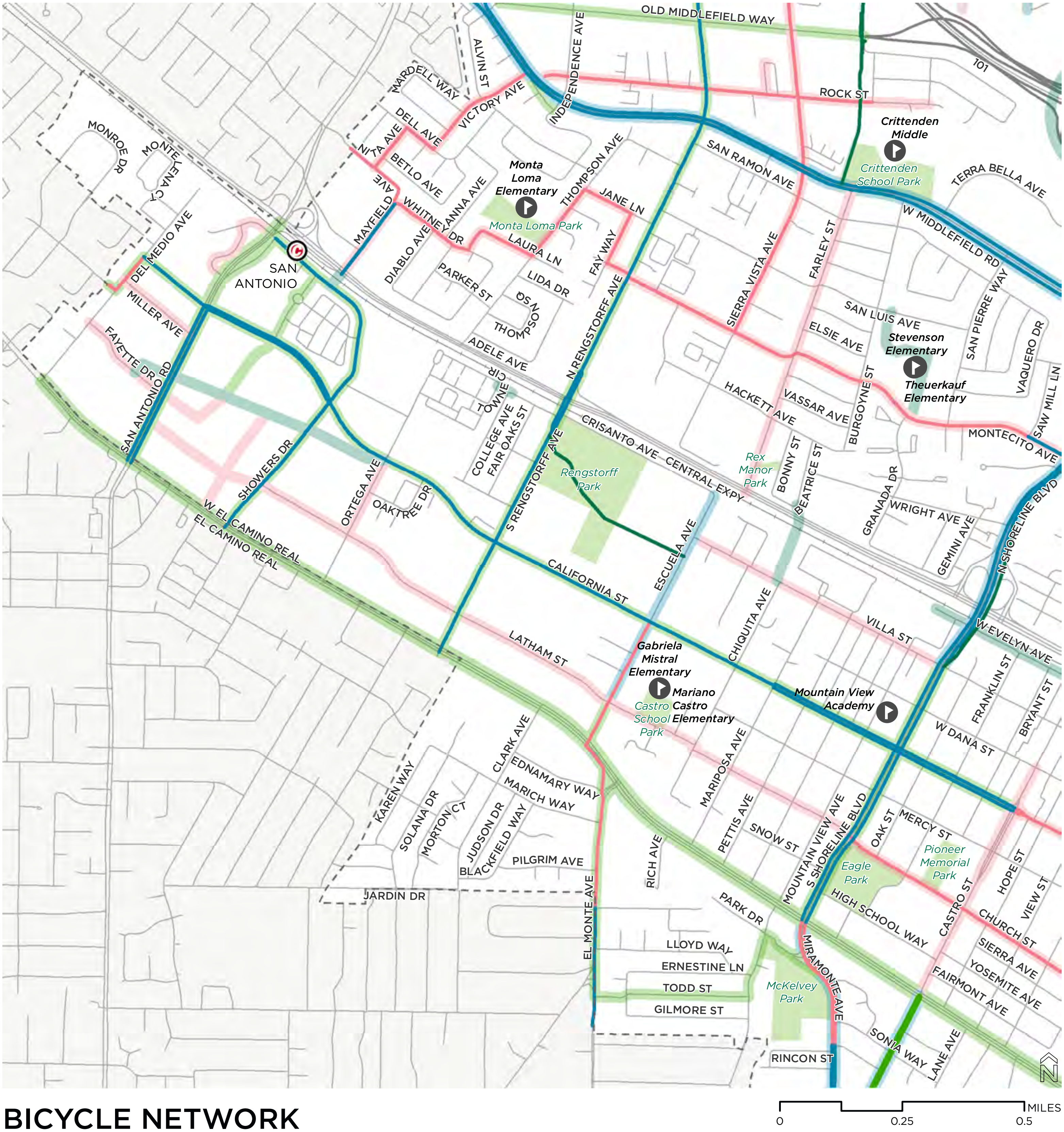
Planned
Existing
- Class I Shared-Use Path
- Class II Bicycle Lane
- Class III Bicycle Route
- Class IV Separated Bikeway

Other Roadway Features
- Roadway Inaccessible to Bicyclists

Destinations
- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary



Data provided by the City of Mountain View, Caltrans, Esri, OSM.



BICYCLE NETWORK

Map 9 CENTRAL WEST QUADRANT

Planned
Existing

- Class I Shared-Use Path
- Class II Bicycle Lane
- Class III Bicycle Route
- Class IV Separated Bikeway

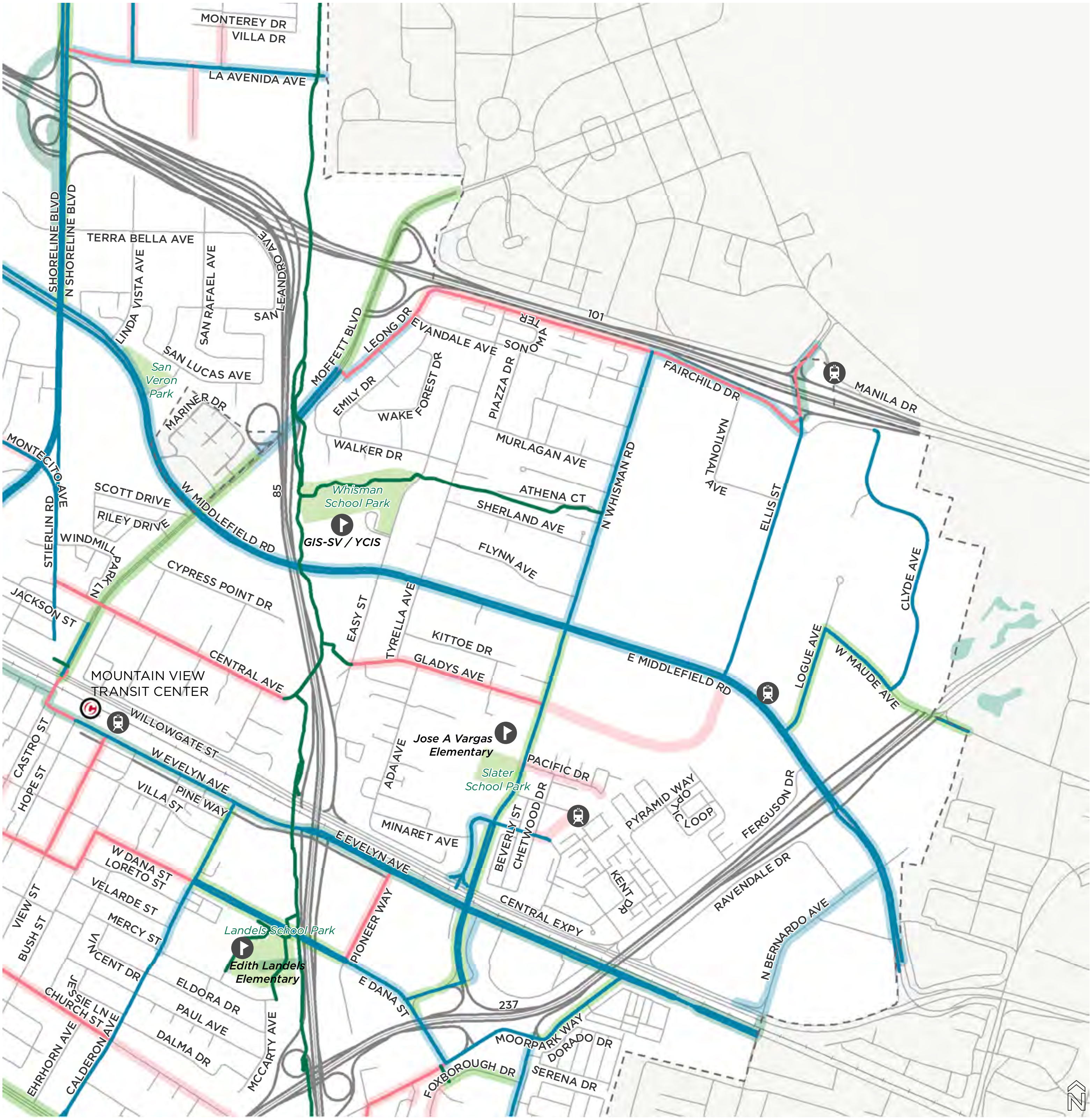
Other Roadway Features

- Roadway Inaccessible to Bicyclists

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary

Data provided by the City of Mountain View, Caltrans, Esri, OSM.



BICYCLE NETWORK

Map 10 CENTRAL EAST QUADRANT

Planned
Existing

- Class I Shared-Use Path
- Class II Bicycle Lane
- Class III Bicycle Route
- Class IV Separated Bikeway

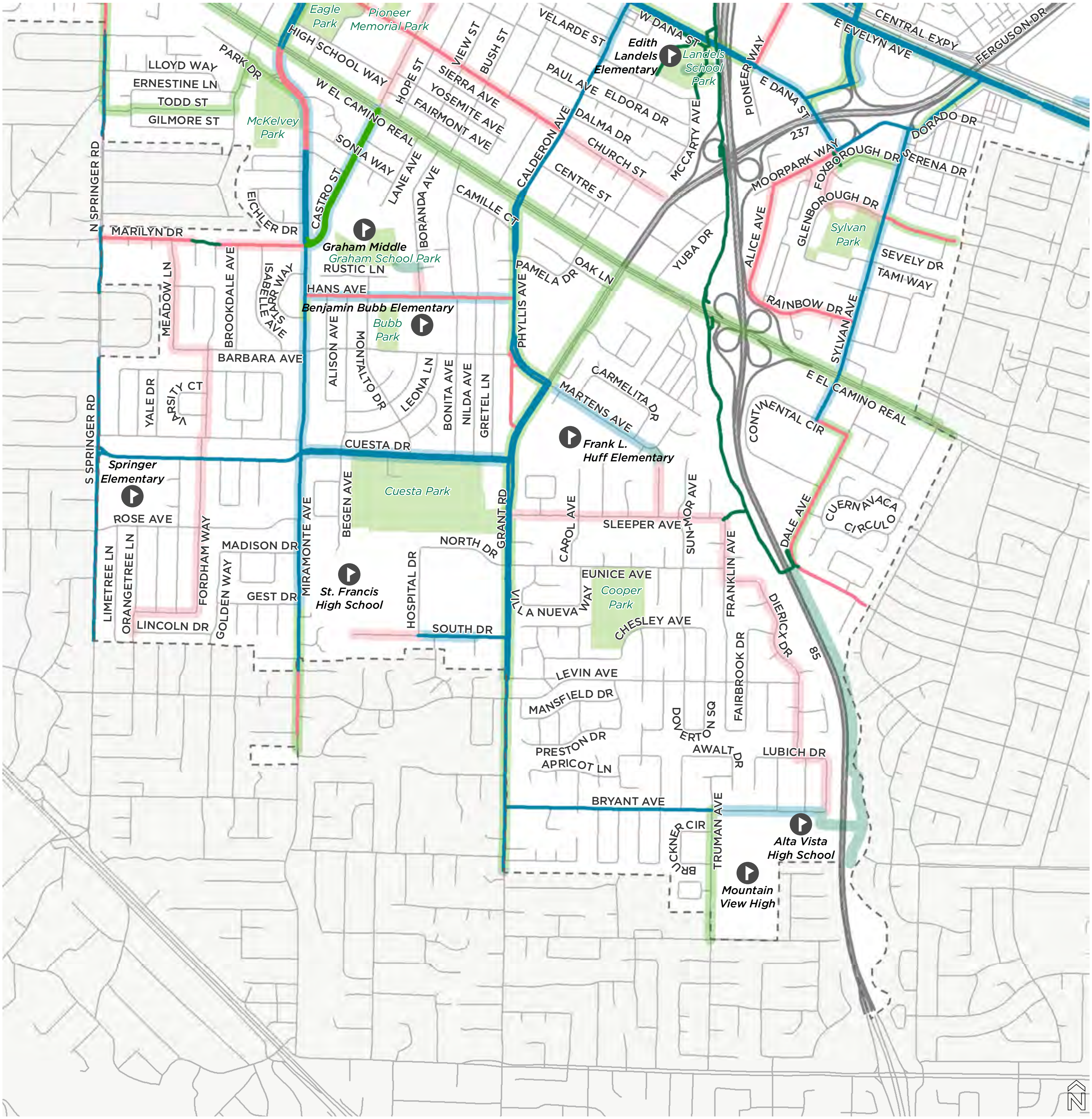
Other Roadway Features

- Roadway Inaccessible to Bicyclists

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary

Data provided by the City of Mountain View, Caltrans, Esri, OSM.



BICYCLE NETWORK

Map 11 SOUTH QUADRANT

0 0.25 0.5 MILES

Planned

Existing

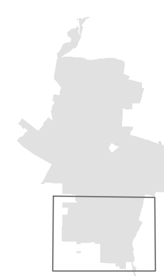
- Class I Shared-Use Path
- Class II Bicycle Lane
- Class III Bicycle Route
- Class IV Separated Bikeway

Other Roadway Features

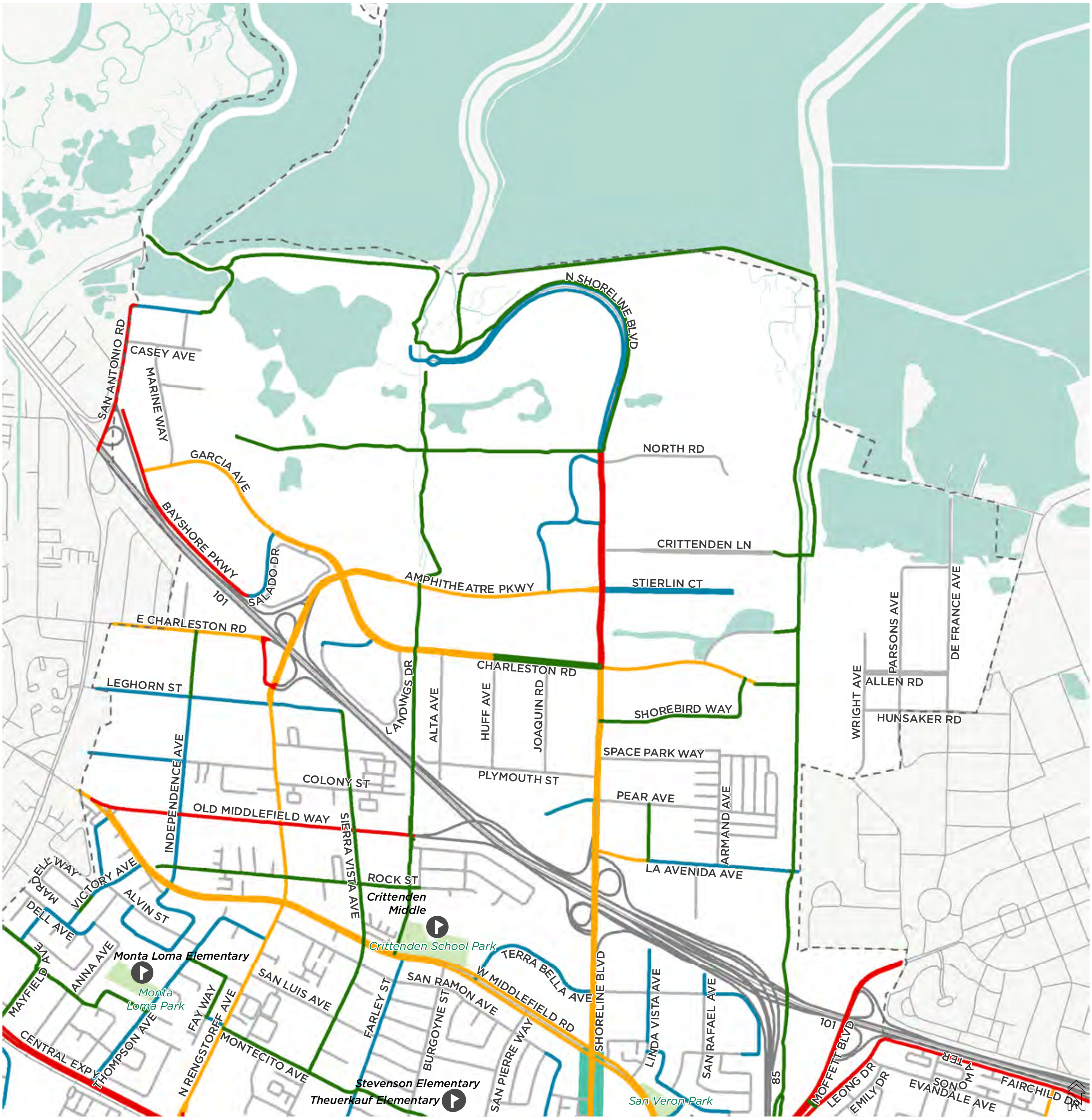
- Roadway Inaccessible to Bicyclists

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary



Data provided by the City of Mountain View, Caltrans, Esri, OSM.



EXISTING BICYCLE LEVEL OF TRAFFIC STRESS

Map 12 NORTH QUADRANT

BLTS Score (Existing)

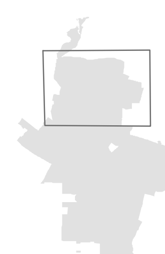
- BLTS 1 All Ages and Abilities
- BLTS 1.5 All Ages and Abilities (Residential)
- BLTS 2 Average Adult
- BLTS 3 Confident Adult
- BLTS 4 Fearless Adult

Other Roadway Features

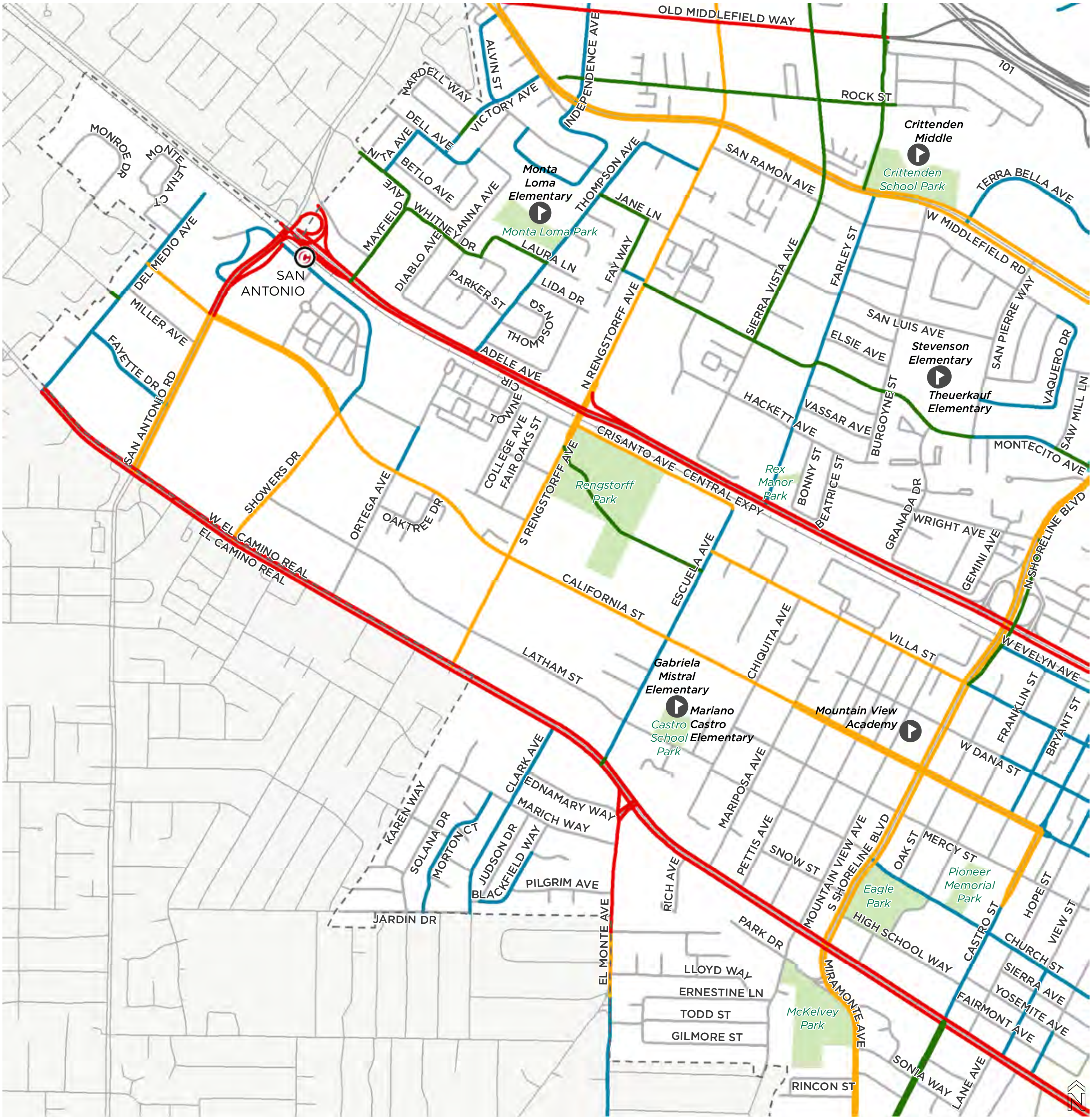
- Teal Highlight Indicates Approved CIP Project
- Roadway Inaccessible to Bicyclists

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary



Data provided by the City of Mountain View, Caltrans, Esri, OSM.



EXISTING BICYCLE LEVEL OF TRAFFIC STRESS

Map 13 CENTRAL WEST QUADRANT

BLTS Score (Existing)

- BLTS 1 All Ages and Abilities
- BLTS 1.5 All Ages and Abilities (Residential)
- BLTS 2 Average Adult
- BLTS 3 Confident Adult
- BLTS 4 Fearless Adult

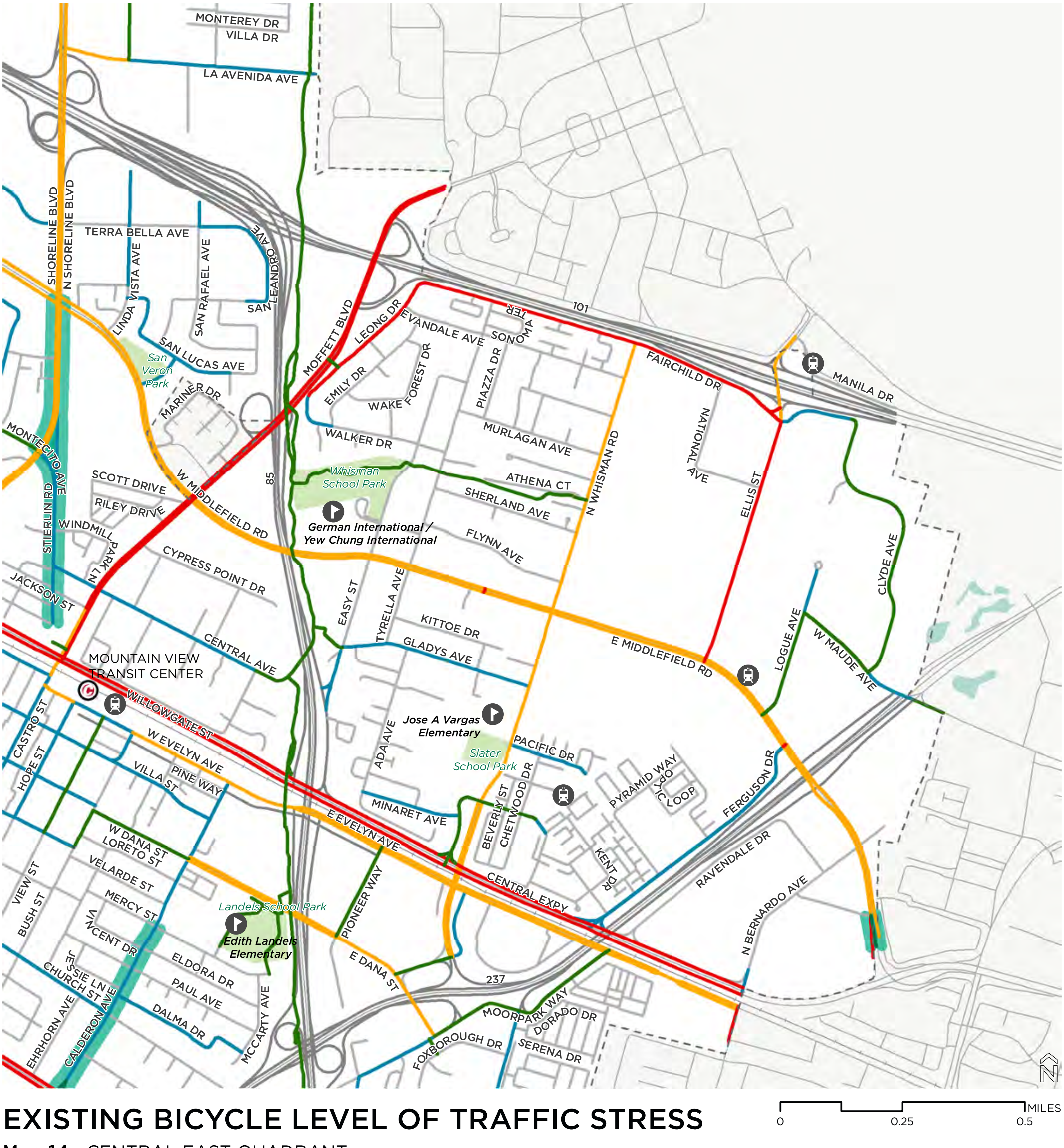
Other Roadway Features

- Teal Highlight Indicates Approved CIP Project
- Roadway Inaccessible to Bicyclists

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary

Data provided by the City of Mountain View, Caltrans, Esri, OSM.



EXISTING BICYCLE LEVEL OF TRAFFIC STRESS

Map 14 CENTRAL EAST QUADRANT

BLTS Score (Existing)

- BLTS 1 All Ages and Abilities
- BLTS 1.5 All Ages and Abilities (Residential)
- BLTS 2 Average Adult
- BLTS 3 Confident Adult
- BLTS 4 Fearless Adult

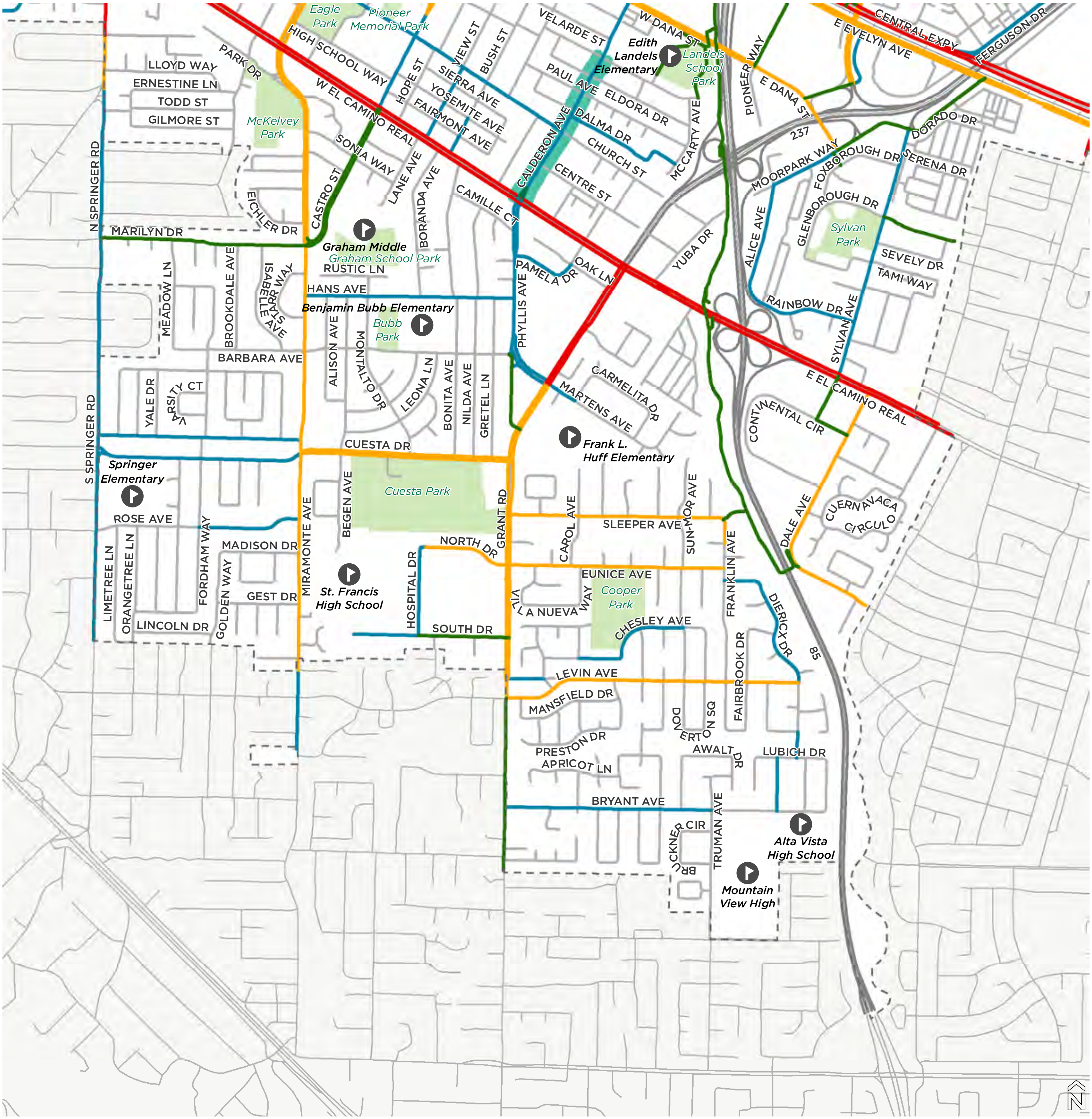
Other Roadway Features

- Teal Highlight Indicates Approved CIP Project
- Roadway Inaccessible to Bicyclists

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary

Data provided by the City of Mountain View, Caltrans, Esri, OSM.



EXISTING BICYCLE LEVEL OF TRAFFIC STRESS

0 | 0.25 | 0.5 MILES

Map 15 SOUTH QUADRANT

BLTS Score (Existing)

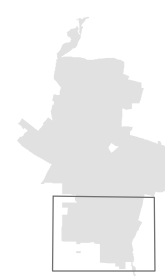
- BLTS 1 All Ages and Abilities
- BLTS 1.5 All Ages and Abilities (Residential)
- BLTS 2 Average Adult
- BLTS 3 Confident Adult
- BLTS 4 Fearless Adult

Other Roadway Features

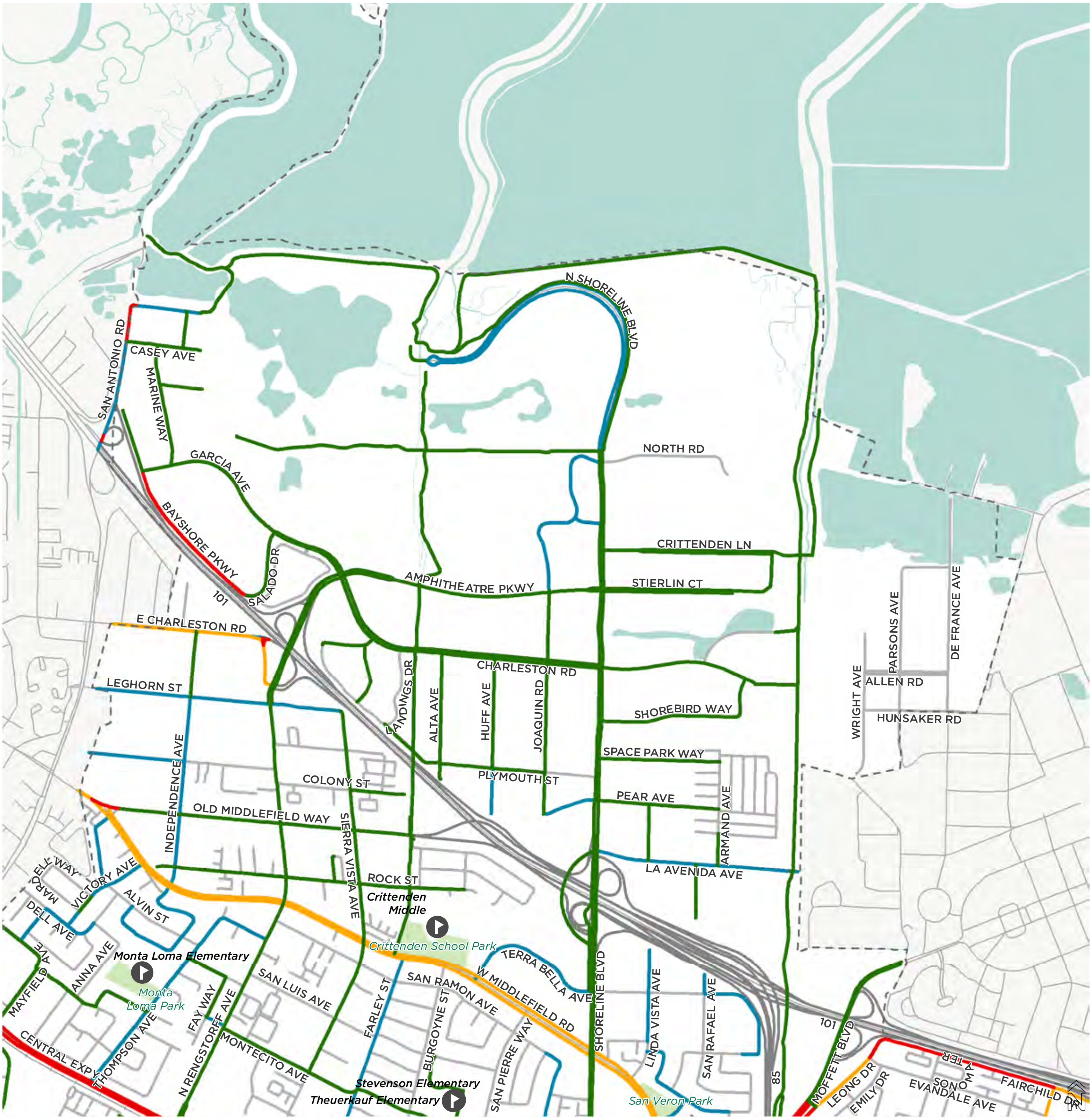
- Teal Highlight Indicates Approved CIP Project
- Roadway Inaccessible to Bicyclists

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary



Data provided by the City of Mountain View, Caltrans, Esri, OSM.



PLANNED BICYCLE LEVEL OF TRAFFIC STRESS

Map 16 NORTH QUADRANT

BLTS Score (Planned)

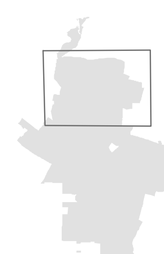
- BLTS 1 All Ages and Abilities
- BLTS 1.5 All Ages and Abilities (Residential)
- BLTS 2 Average Adult
- BLTS 3 Confident Adult
- BLTS 4 Fearless Adult

Other Roadway

- Roadway Inaccessible to Bicyclists

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary



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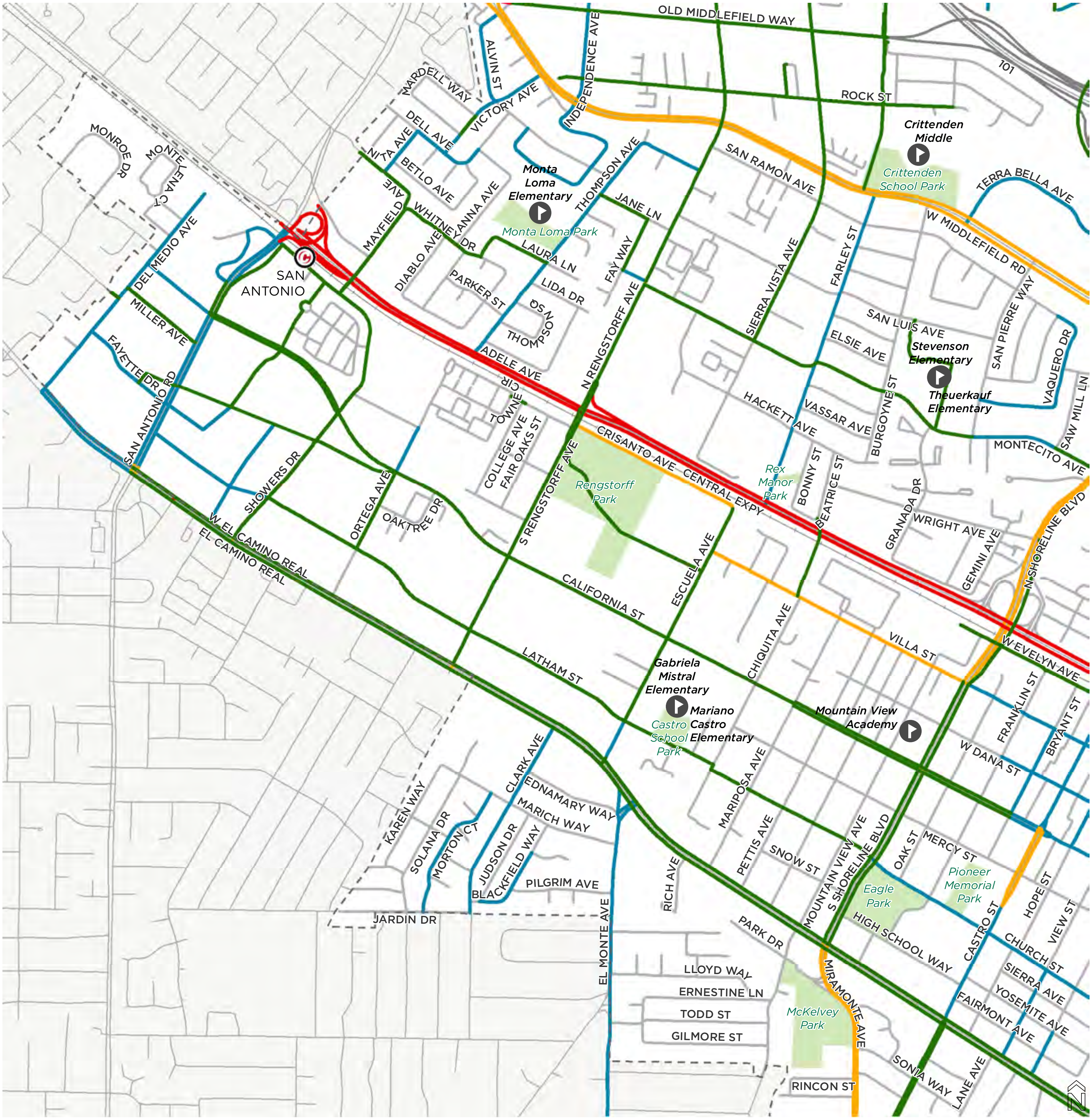


PLANNED BICYCLE LEVEL OF TRAFFIC STRESS

Map 17 CENTRAL WEST QUADRANT

BLTS Score (Planned)

- BLTS 1 All Ages and Abilities
- BLTS 1.5 All Ages and Abilities (Residential)
- BLTS 2 Average Adult
- BLTS 3 Confident Adult
- BLTS 4 Fearless Adult

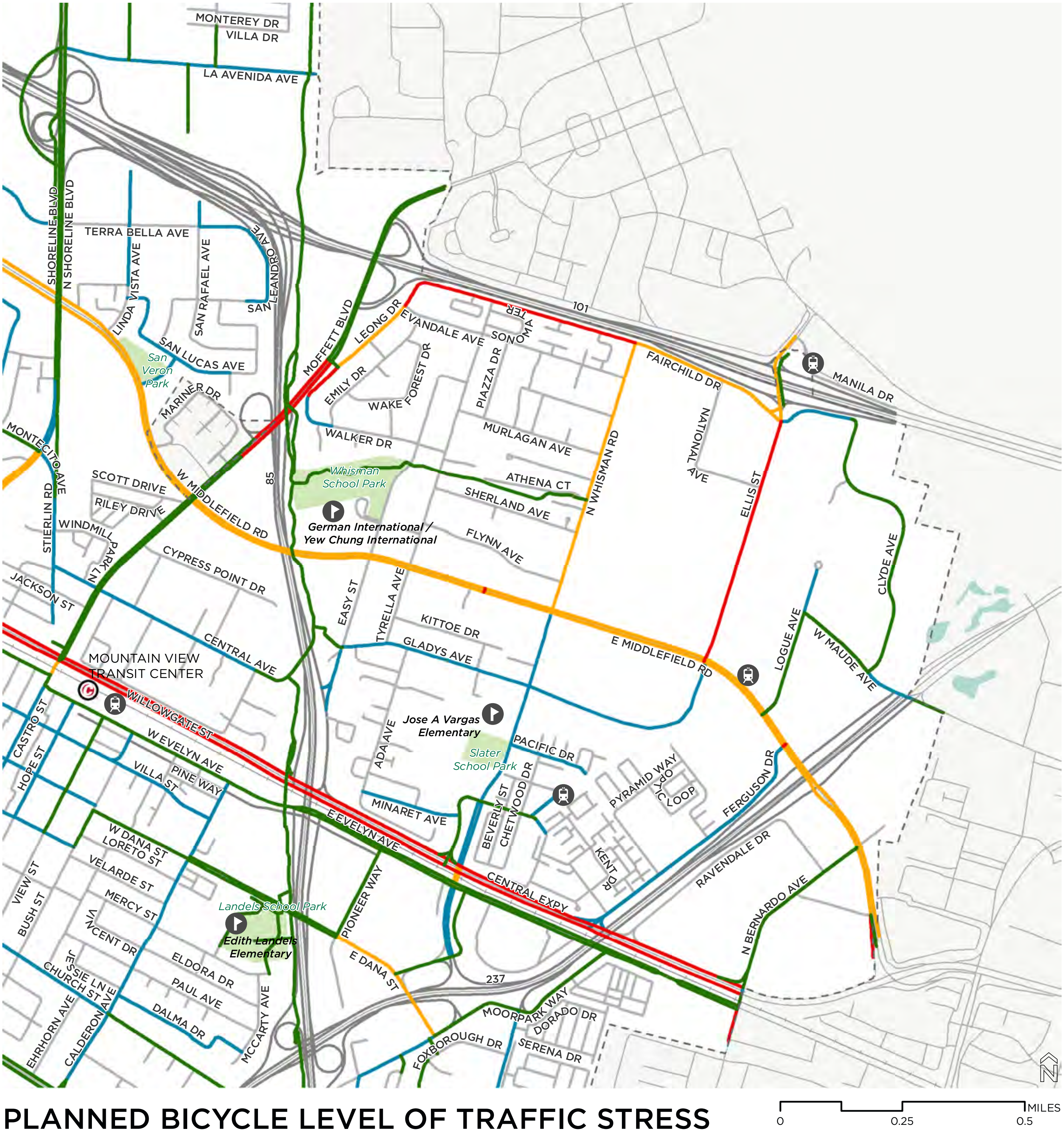
Other Roadway

- Roadway Inaccessible to Bicyclists

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary

Data provided by the City of Mountain View, Caltrans, Esri, OSM.



PLANNED BICYCLE LEVEL OF TRAFFIC STRESS

Map 18 CENTRAL EAST QUADRANT

BLTS Score (Planned)

- BLTS 1 All Ages and Abilities
- BLTS 1.5 All Ages and Abilities (Residential)
- BLTS 2 Average Adult
- BLTS 3 Confident Adult
- BLTS 4 Fearless Adult

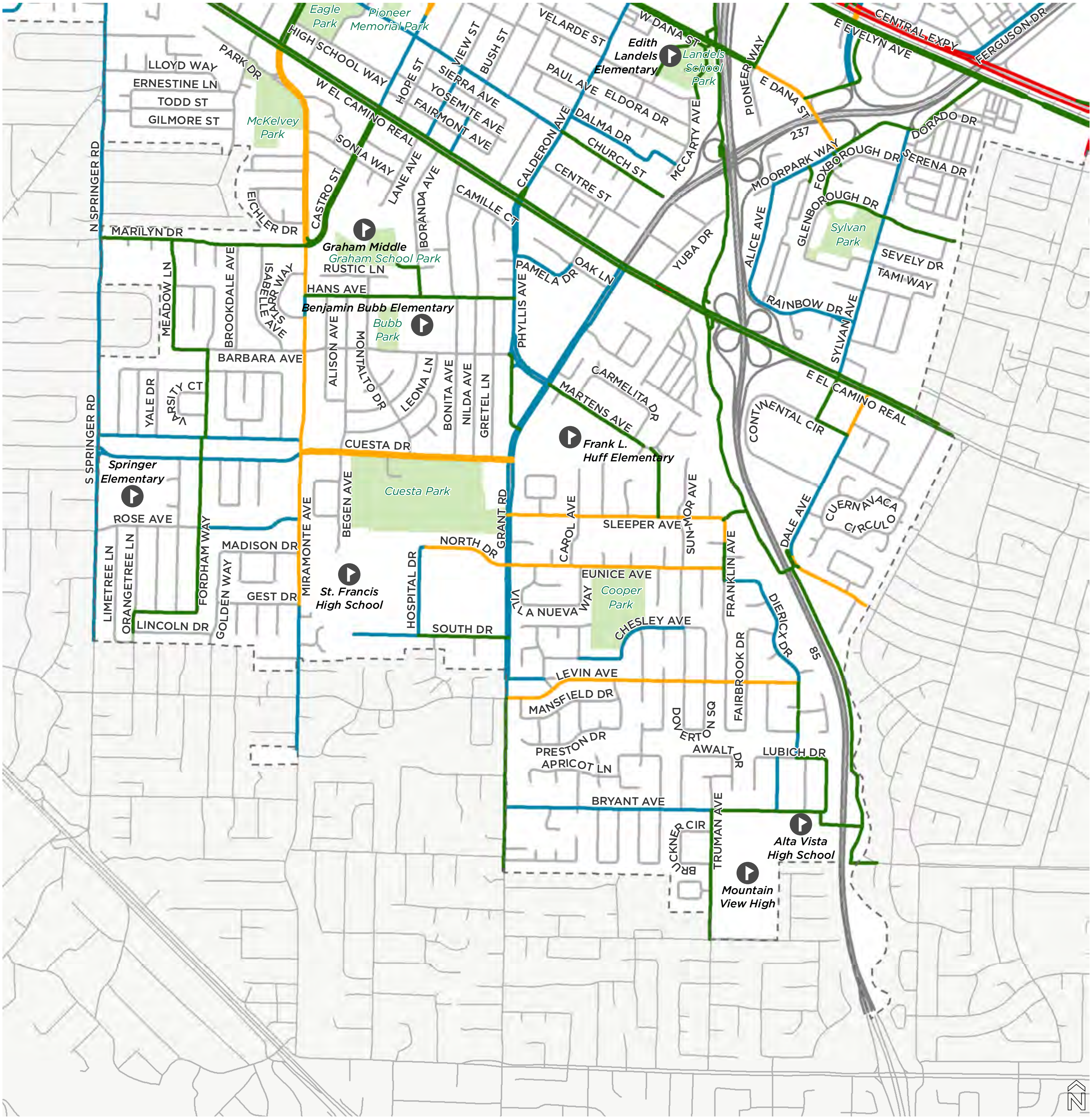
Other Roadway

- Roadway Inaccessible to Bicyclists

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary

Data provided by the City of Mountain View, Caltrans, Esri, OSM.



PLANNED BICYCLE LEVEL OF TRAFFIC STRESS

0 0.25 0.5 MILES

Map 19 SOUTH QUADRANT

BLTS Score (Planned)

- BLTS 1 All Ages and Abilities
- BLTS 1.5 All Ages and Abilities (Residential)
- BLTS 2 Average Adult
- BLTS 3 Confident Adult
- BLTS 4 Fearless Adult

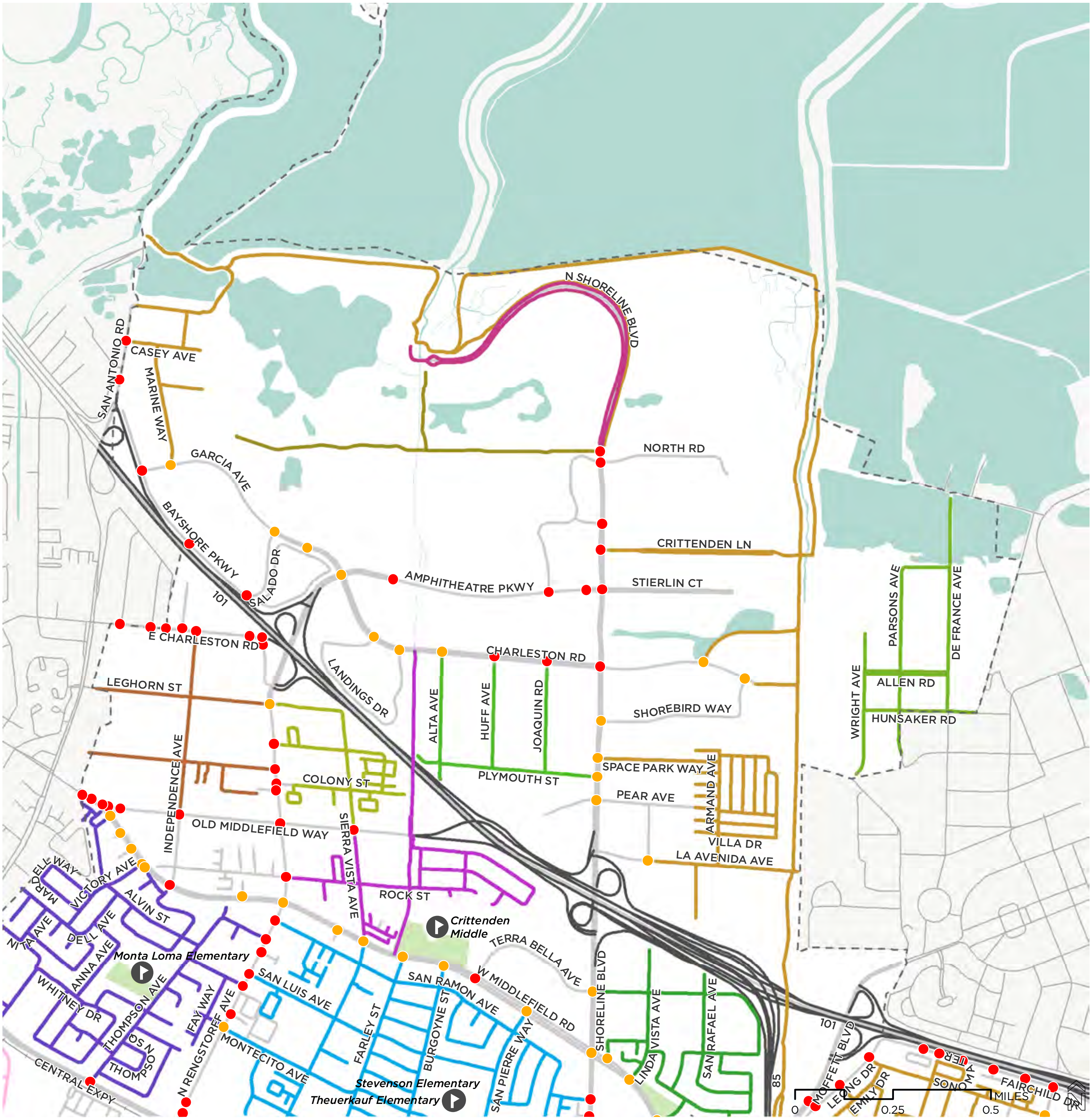
Other Roadway

- Roadway Inaccessible to Bicyclists

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary

Data provided by the City of Mountain View, Caltrans, Esri, OSM.



EXISTING BICYCLE LEVEL OF TRAFFIC STRESS ISLANDS

Map 20 NORTH QUADRANT

Existing Low Stress Islands

Each color represents a connected low stress network

High Stress Intersections

LTS 3

LTS 4

Roadways

Roadway Inaccessible to Bicyclists

Destinations

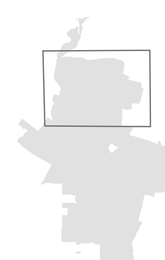
School

Caltrain Station

Light Rail Station

Park

City Boundary



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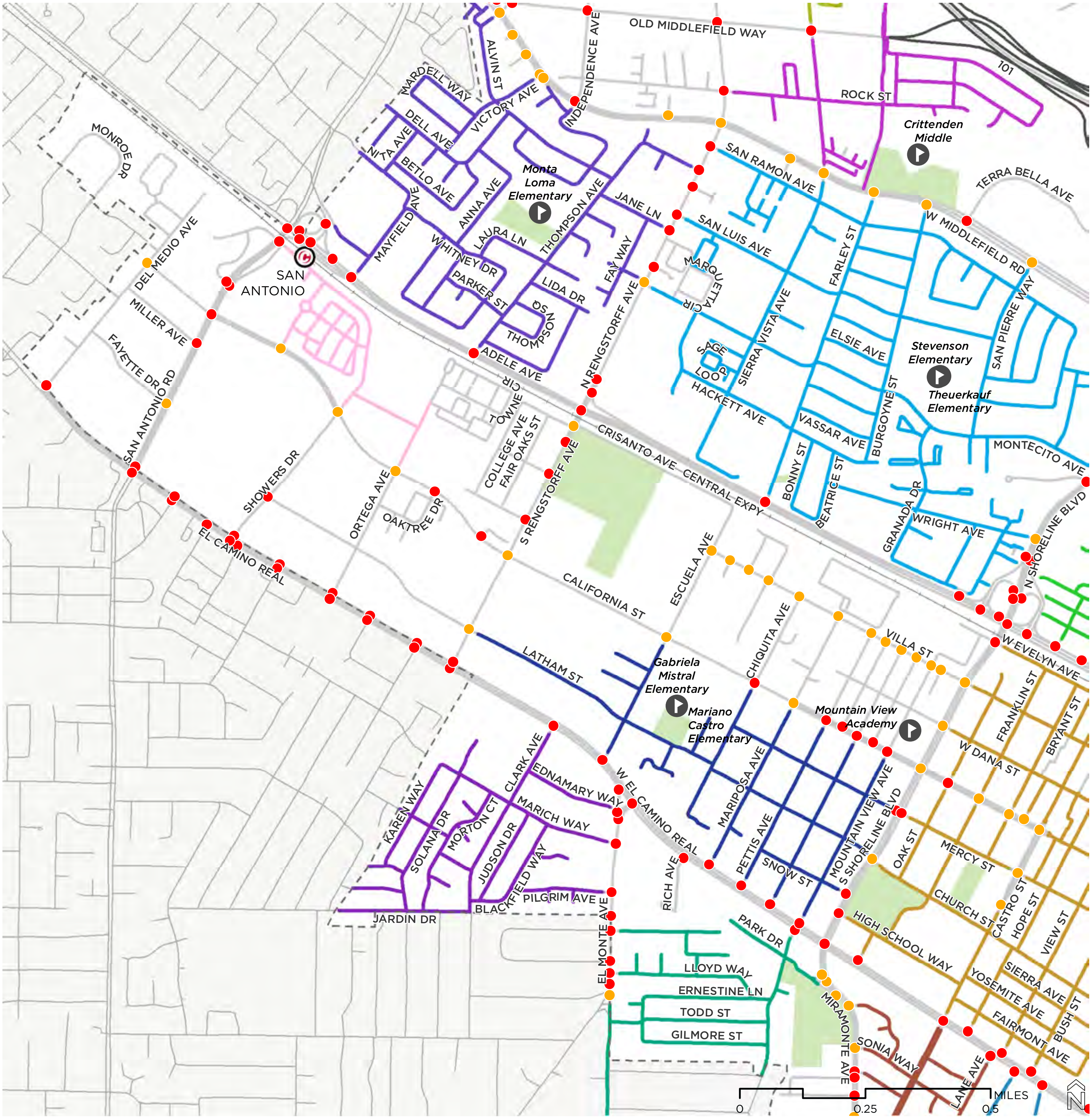


EXISTING BICYCLE LEVEL OF TRAFFIC STRESS ISLANDS

Map 21 CENTRAL WEST QUADRANT

Existing Low Stress Islands

Each color represents a connected low stress network

High Stress Intersections

LTS 3

LTS 4

Roadways

Roadway Inaccessible to Bicyclists

Destinations

School

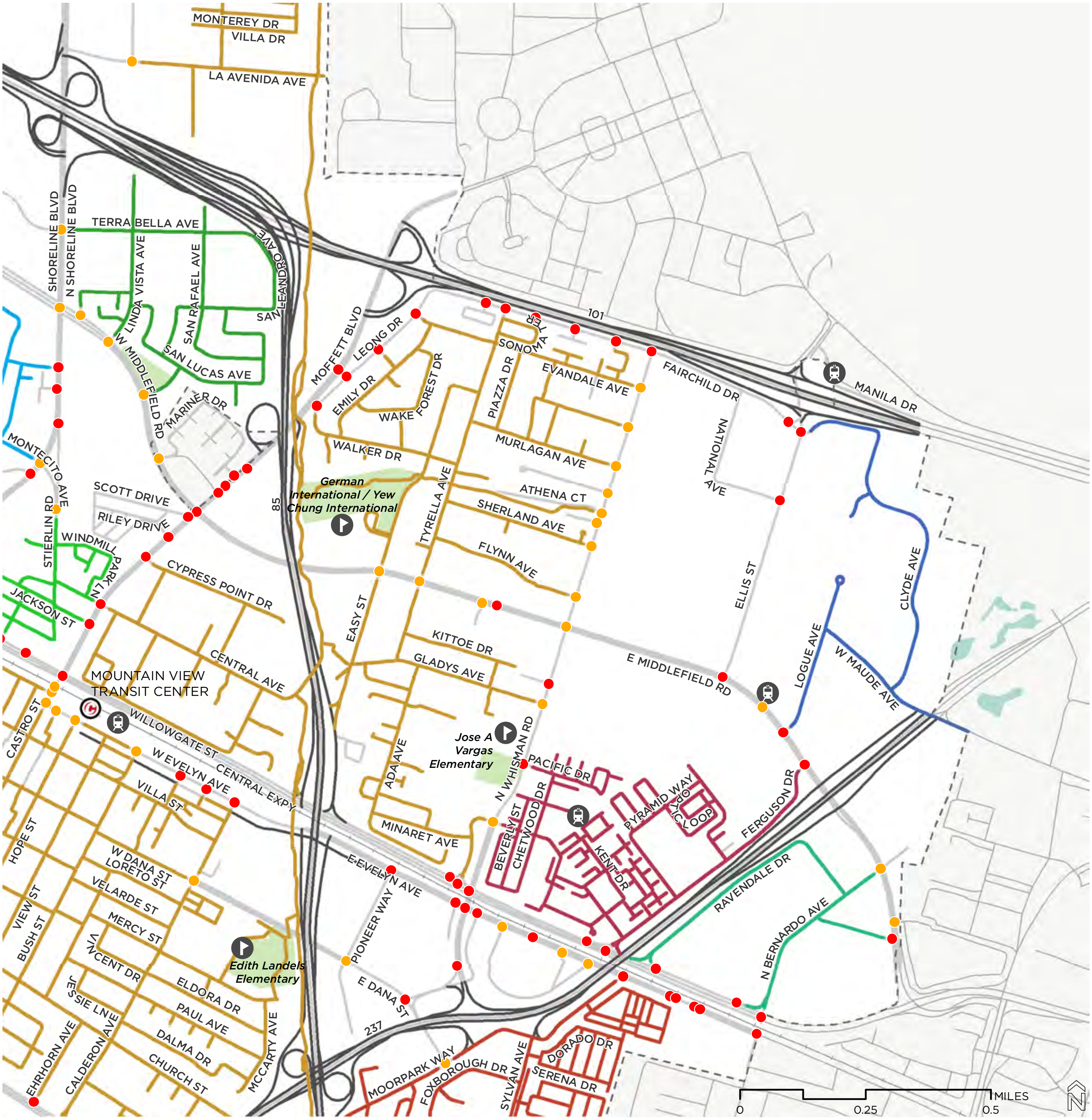
Caltrain Station

Light Rail Station

Park

City Boundary

Data provided by the City of Mountain View, Caltrans, Esri, OSM.



EXISTING BICYCLE LEVEL OF TRAFFIC STRESS ISLANDS

Map 22 CENTRAL EAST QUADRANT

Existing Low Stress Islands

Each color represents a connected low stress network

High Stress Intersections

LTS 3

LTS 4

Roadways

Roadway Inaccessible to Bicyclists

Destinations

School

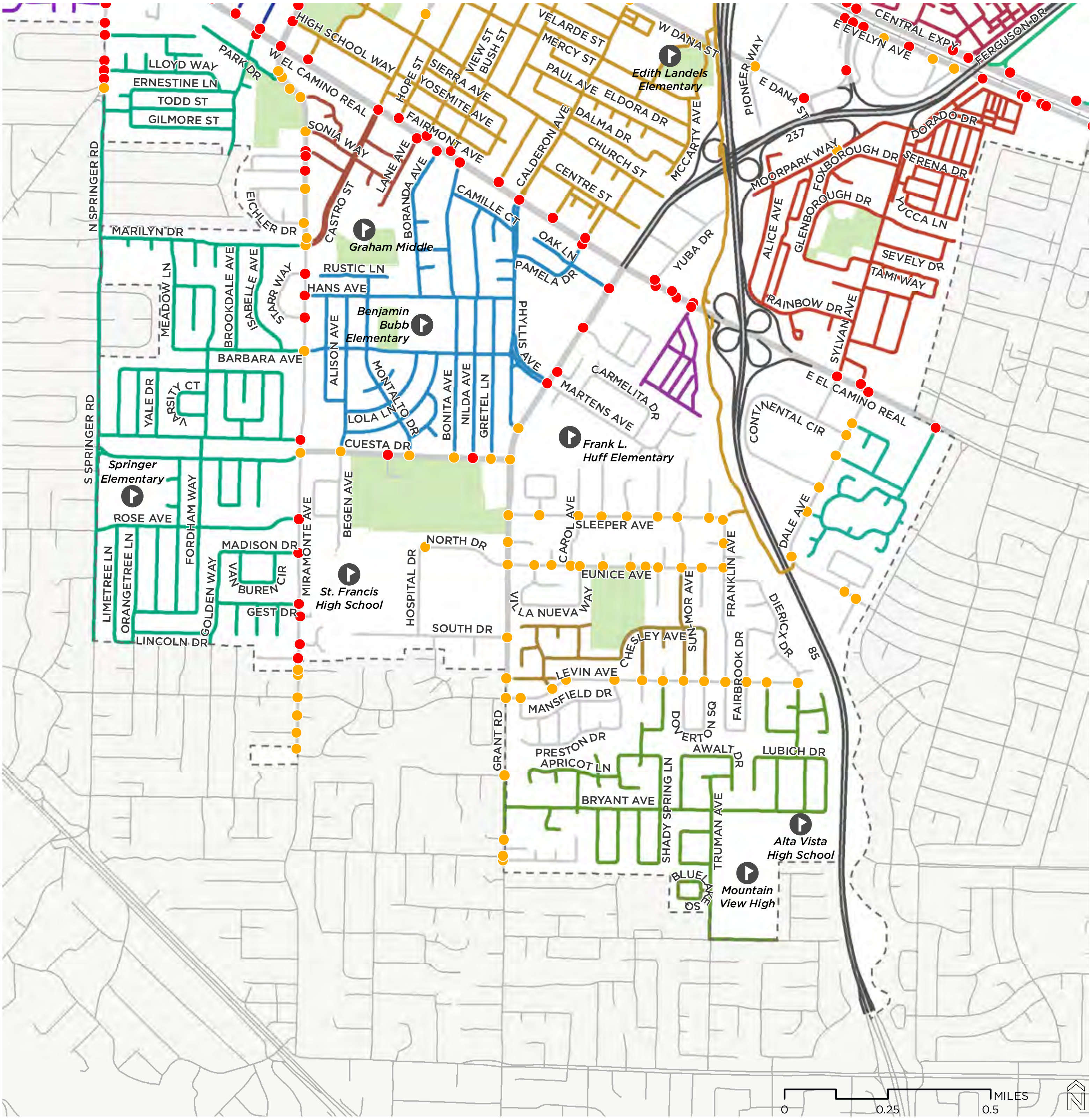
Caltrain Station

Light Rail Station

Park

City Boundary

Data provided by the City of Mountain View, Caltrans, Esri, OSM.



EXISTING BICYCLE LEVEL OF TRAFFIC STRESS ISLANDS

Map 23 SOUTH QUADRANT

Existing Low Stress Islands

Each color represents a connected low stress network

High Stress Intersections

- LTS 3
- LTS 4

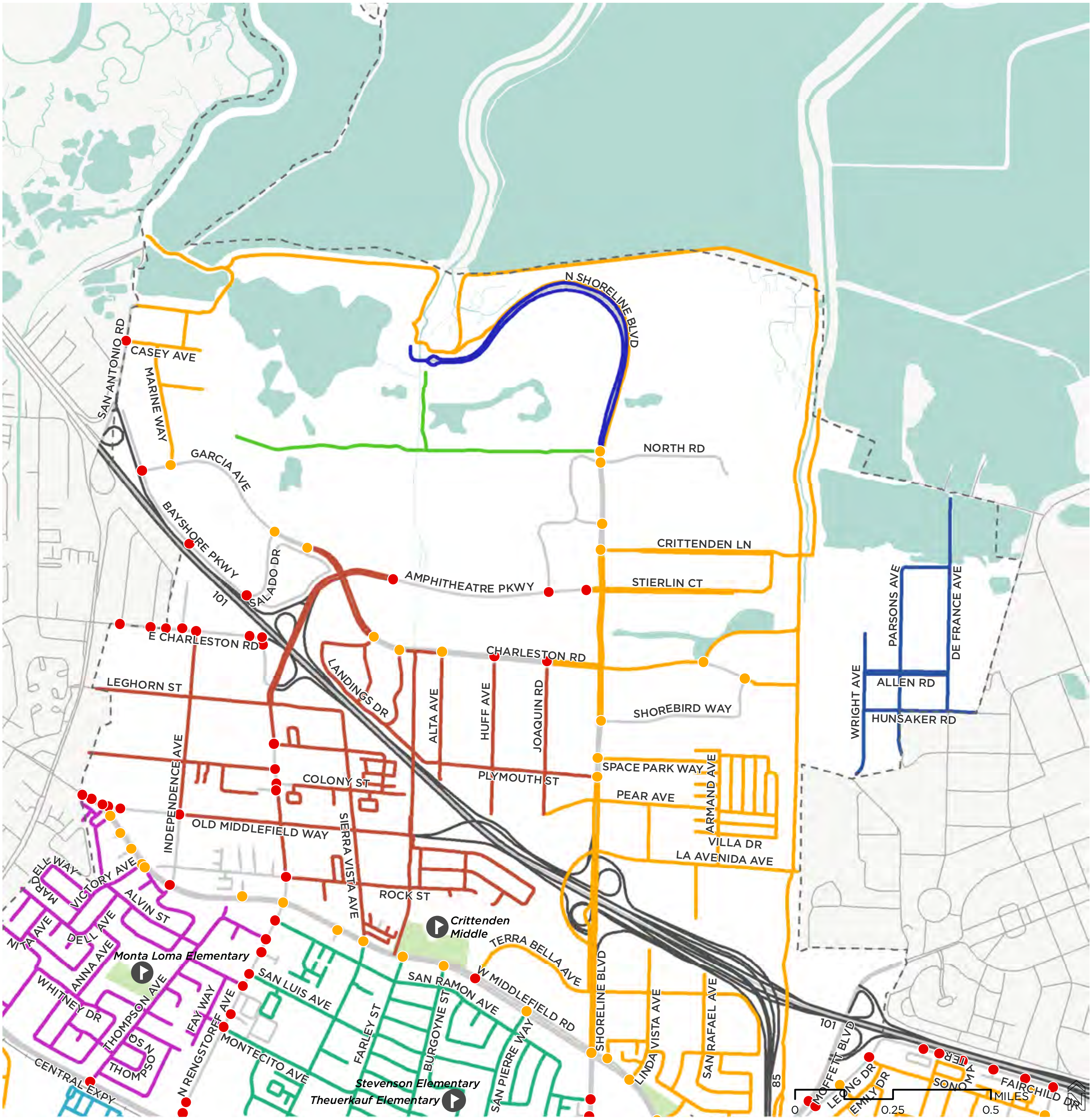
Roadways

Roadway Inaccessible to Bicyclists

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary

Data provided by the City of Mountain View, Caltrans, Esri, OSM.



PLANNED BICYCLE LEVEL OF TRAFFIC STRESS ISLANDS

Map 24 NORTH QUADRANT

Planned Low Stress Islands

Each color represents a connected low stress network

High Stress Intersections

- BLTS 3
- BLTS 4

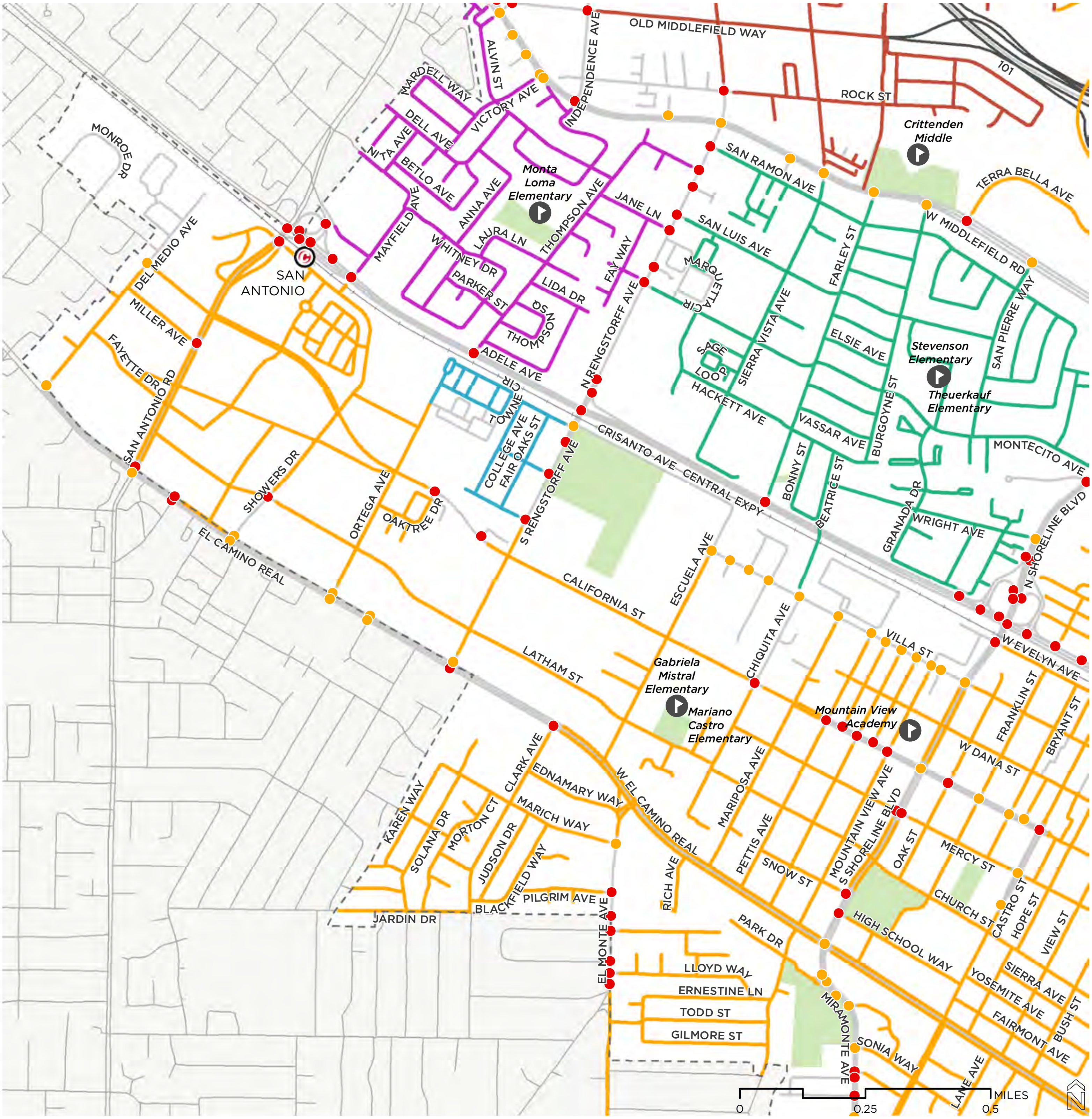
Roadways

Roadway Inaccessible to Bicyclists

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary

Data provided by the City of Mountain View, Caltrans, Esri, OSM.



PLANNED BICYCLE LEVEL OF TRAFFIC STRESS ISLANDS

Map 25 CENTRAL WEST QUADRANT

Planned Low Stress Islands

Each color represents a connected low stress network

High Stress Intersections

BLTS 3

BLTS 4

Roadways

Roadway Inaccessible to Bicyclists

Destinations

School

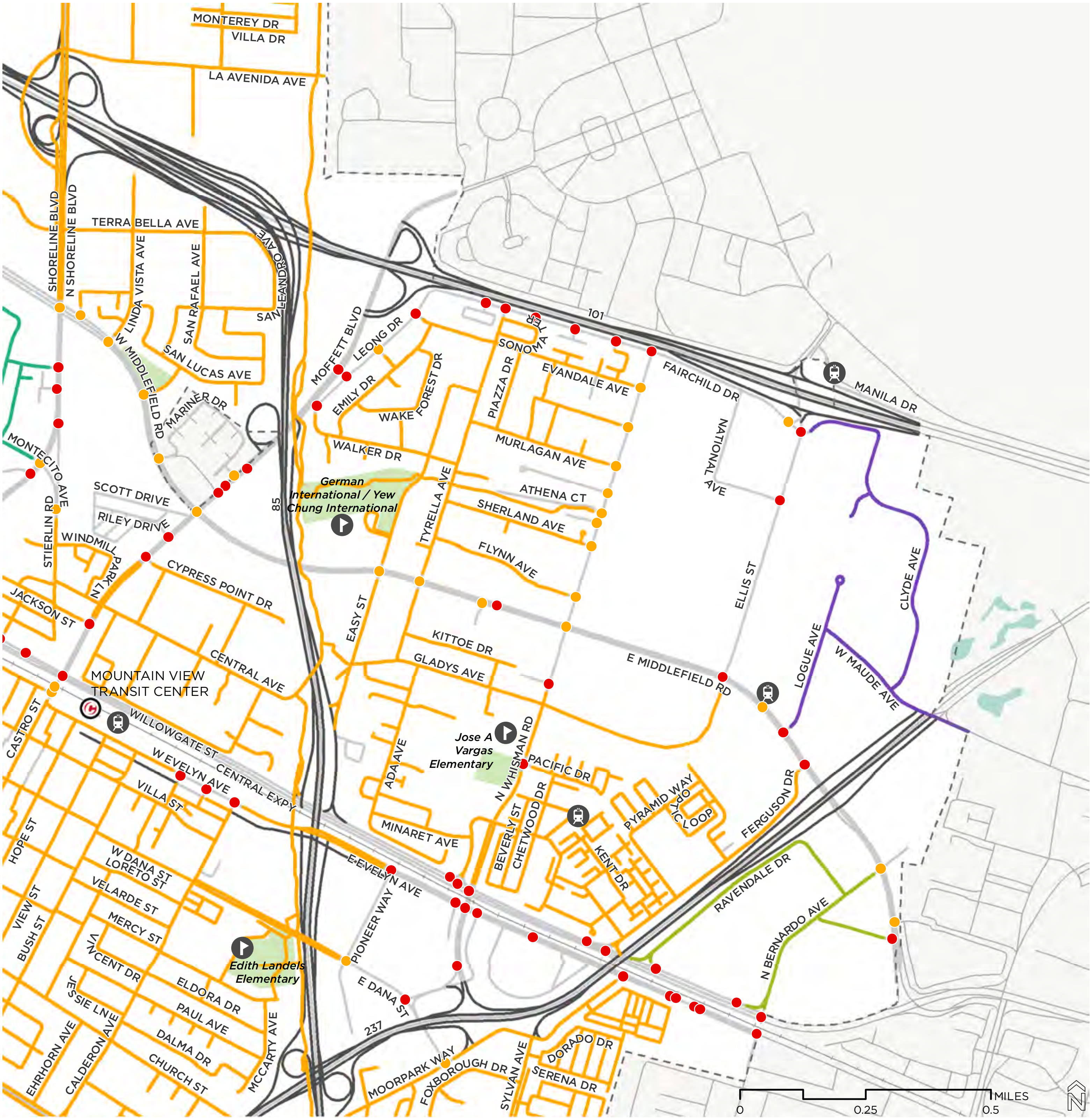
Caltrain Station

Light Rail Station

Park

City Boundary

Data provided by the City of Mountain View, Caltrans, Esri, OSM.



PLANNED BICYCLE LEVEL OF TRAFFIC STRESS ISLANDS

Map 26 CENTRAL EAST QUADRANT

Planned Low Stress Islands

Each color represents a connected low stress network

High Stress Intersections

BLTS 3

BLTS 4

Roadways

Roadway Inaccessible to Bicyclists

Destinations

School

Caltrain Station

Light Rail Station

Park

City Boundary

Data provided by the City of Mountain View, Caltrans, Esri, OSM.

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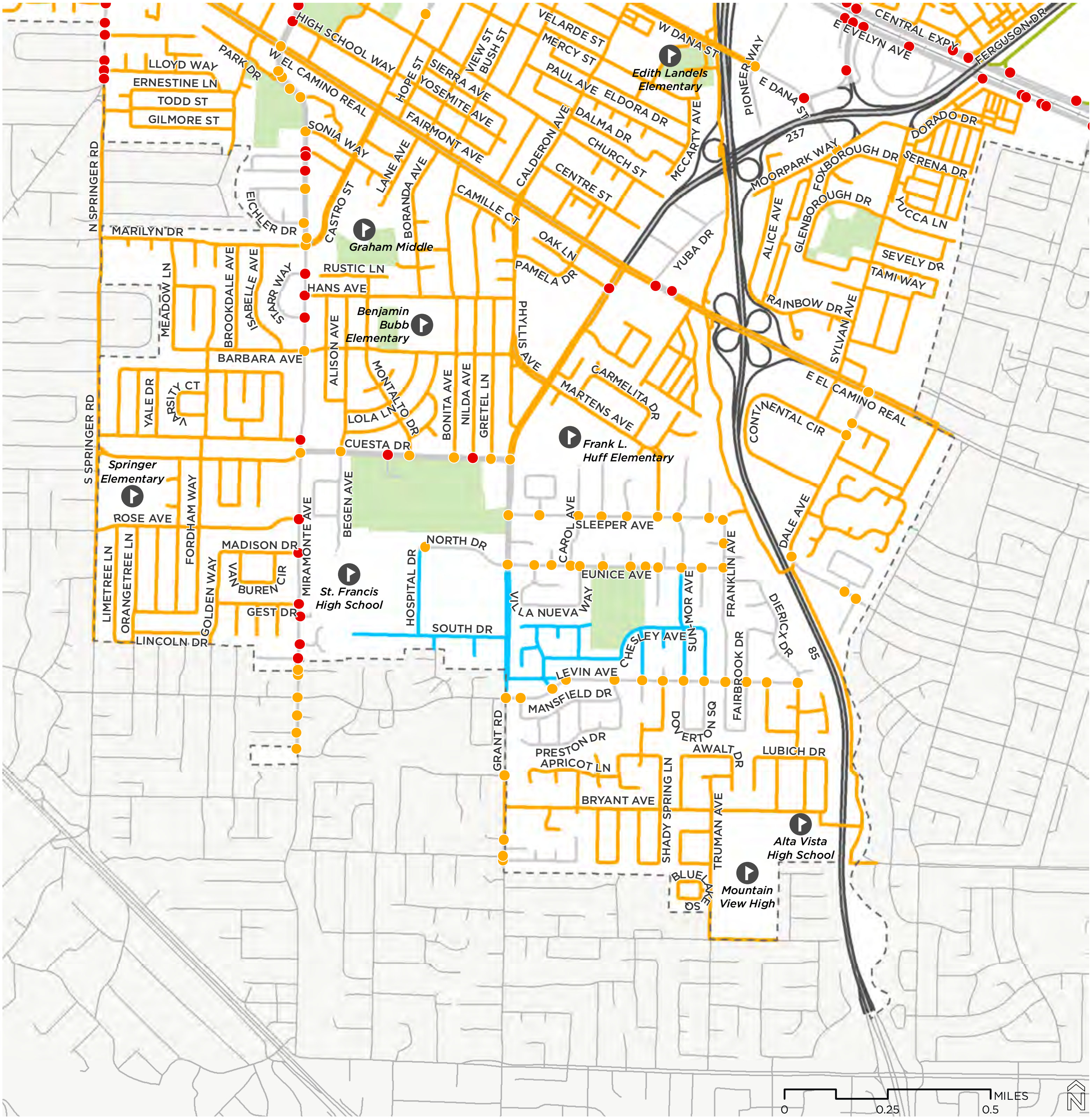


PLANNED BICYCLE LEVEL OF TRAFFIC STRESS ISLANDS

Map 27 SOUTH QUADRANT

Planned Low Stress Islands

Each color represents a connected low stress network

High Stress Intersections

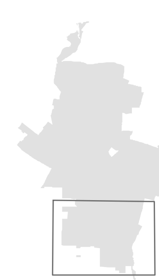
- BLTS 3
- BLTS 4

Roadways

Roadway Inaccessible to Bicyclists

Destinations

- School
- Caltrain Station
- Light Rail Station
- Park
- City Boundary



Data provided by the City of Mountain View, Caltrans, Esri, OSM.

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Appendix C – Bicycle and Pedestrian Travel Survey

North Bayshore Circulation Study –
Bicycle and Pedestrian Travel Survey

Employee Demographics and Commute Patterns

If possible, please provide site-specific answers to these questions:

1. How many employees do you have that work in North Bayshore?

2. Do you survey your employees about how they get to work? If yes, what percentage of commute trips are made by the following modes:
    a. walking
    b. biking

3. Do employee commute patterns change throughout the year? i.e., do fewer employees commute by bicycle in the winter months? If yes, please elaborate on the seasonal differences:

4. How many employees do you have that live:
    a. Within one mile of their work site

    b. Within three miles of their work site

    c. Within five miles of their work site

5. As far as you know, do employees make personal trips during the day off campus for meetings, lunch, or happy hour? Do you know how these trips are made? What percentage of these trips is made on foot or bike?

6. What barriers do employees face for commuting by foot and bike? (e.g. distance from work, perception of unsafe bicycling conditions, lack of showers, etc.)

7. Do you offer any programs or incentives to encourage and/or support your employees in walking and biking to work? If so, please describe.

Potential Bicycle and Pedestrian Improvements

The North Bayshore Precise Plan establishes an active transportation commute mode share of 10%. We would like to know what improvements you think are necessary to achieve this goal.

8. What additional bicycle and pedestrian infrastructure do you think is necessary to increase walking and biking levels to meet or exceed the 10% active mode share target?

9. Are you aware of any pedestrian or bicycle capacity constraints or safety concerns that should be prioritized for improvement?

10. What additional programmatic efforts to include incentives, education, events and other related activities do you think are necessary to meet or exceed the 10% active mode share target?

11. Do you have any other thoughts on potential actions by the City, the TMA and/or North Bayshore employers that should be completed to prioritize walking and bicycling to achieve the 10% active mode share target?

Appendix D - Existing and Future Activity Assessment Methods

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MEMORANDUM

To: Jim Lightbody and Aruna Bodduna, City of Mountain View

From: Sam Corbett and Kim Voros, Alta Planning + Design

Date: August 21, 2020

Re: North Bayshore Bicycle and Pedestrian Circulation Study

Introduction

In order to assess the ability of existing and future bicycle and pedestrian to accommodate network flow, Alta is assessing current and anticipated use. The following memorandum provides a general overview of analysis methods.

Data Inputs

The following data inputs will be used to estimate existing bicycle and pedestrian network flows:

- **Roadway network**. The base roadway and trail network is extracted from Open Street Map (OSM).
- **Existing bicycle and pedestrian infrastructure**. The roadway network is augmented with existing bicycle and pedestrian facility information to create an accurate dataset that can be used in our pedestrian and bicycle analysis.
- **MTC Travel Demand Data.** The regional travel demand model provides information about existing (2015) and projected (2040) travel demand. This information is used as the basis of estimated travel activity between different portions of the region known as Transportation Analysis Zones (TAZ). The model contains travel information for 24 hour flows as well as AM and PM peak flows between these zones.
- **Detailed (Microzone) Population and Employment Projections for North Bayshore.** Population, household, and employment data for zones that are smaller than the regional travel model TAZs. These are used to estimate the distribution travel patterns at the sub-TAZ level.[1]
- **Network Travel Experience.** Bicycle Level of Traffic Stress (LTS) is a metric that relates the type and experience of different users to the type of infrastructure provided. The North Bayshore Circulation Study takes advantage of network analysis conducted as part of the larger *Mountain View Comprehensive Modal Plan.* The pedestrian experience is also affected by existing infrastructure and peer reviewed research is used to describe the experience
- **Flow calibration data.** Existing employer commute data will be used to calculate the proportion of travel attributable to walking and bicycling within the North Bayshore context. Count data (e.g., from the North Bayshore District Transportation Monitoring Report series and other available data sources) will be used to calibrate model flows along high-traffic corridors.

---

[1] For more information see: Fehr & Peers. *North Bayshore Transportation Monitoring Report and Near Term Growth Assessment.* 2019.

Analysis Process

The existing conditions network activity estimates will be developed using the following steps:

1. **Validate existing roadway network and associated existing facility information.** This step includes updating district maps developed for the Mountain View Comprehensive Modal Plan with existing infrastructure identified through a background document review and subsequent review by City staff.

2. **Update calculation of existing BLTS sores.** Existing BLTS scores for the bicycle network will be updated based on the findings of Step 1. The scores will be used to assign a measure of perceived distance to each network link. The weighting builds on academic research that indicates people walking or bicycling on high-volume and high-speed streets perceive their travel to take longer than those using more comfortable, low-stress streets. To achieve an estimate of perceived distance, the actual distance traveled is multiplied by a weight that is derived from the score of a segment. A sample weighting table based on academic research is included here used in the bicycle network analysis is shown here.

Table 1. Sample LTS Weights

LTS	Examples	Weight
1	Trails	0.500
1	Local streets	1.125
2	Bike facilities on low volume streets	2.00
3	Bike facilities on high volume streets	4.50
4	No bike facility	8.00

3. **Determine perceived distance weighting for pedestrian infrastructure.** Peer reviewed research was used to determine perceived distances used in the pedestrian network analysis. Where sidewalk is missing on one side distance was assumed to be 25 percent greater and 51 percent greater when sidewalk was missing on both sides of the street.[2]

4. **Estimation of travel flows between microzones** The MTC travel demand model provides flow estimates between large TAZs. A single TAZ, for example, is used to represent all of North Bayshore. In order to more precisely estimate where bicycle and pedestrian trips are flowing from and to, MTC TAZs will be subdivided into "microzones" based on the boundaries of smaller TAZs from the Santa Clara Valley Transportation Authority (VTA) travel demand model and development analysis zones provided by the City of Mountain View, for which existing a future population estimates are available. The following process is used to estimate travel flows between microzones:
    a. Reaggregate trips from the MTC travel demand model into tour-sides: the inbound and outbound sides of a tour, each characterized by a single primary mode and purpose. For simplicity, these tour-sides are herein referred to as "trips."
    b. Summarize population within each microzone as a proxy for travel activity.
    c. Distribute MTC tour origins and destinations to the microzones contained within them based on the proportion to their population. For example, of an MTC zone contained two microzones with populations of 100 and 300 respectively, the first would be assigned one quarter of trip origins and

[2] [2] Broach, Joseph. 2016. "Travel Mode Choice Framework Incorporating Realistic Bike and Walk Routes." Portland State University. http://ppms.trec.pdx.edu/media/project_files/jbroach_dissertation_v12_rev1.pdf.

destinations from or to that MTC zone while the second would be assigned three quarters of trip origins and destinations.

Travel flows between microzones will be calculated twice, using MTC trip tables that represent both 2015 and 2040 development conditions. Microzone distributions for the 2040 condition will be based on future population estimates for the VTA and City of Mountain View zones, providing a forward-looking estimate of development and travel patterns both regionally and within the North Bayshore context. These two sets of flows form the basis for two modeling scenarios that will be used for sensitivity testing:

- *Baseline*: Existing bicycle and pedestrian infrastructure; current population and development patterns;
- *Future Development Only*: Existing bicycle and pedestrian infrastructure; future population and development patterns;

5. *Three additional scenarios, described in Future Network Activity Assignment Memo, are calculated at this stage based on the Baseline and Future Development Only scenarios.*

6. **Assignment of travel flows to network links.** Travel flows between microzones need to be assigned to routes along the roadway network in order to estimate bicycle and pedestrian volumes for each network link. The following process will be used for network assignment:
   a. Randomized points will be generated within each TAZ that will be used to model trip start points and trip ending points
   b. Assign a portion of all trips to trip start points generated in previous step. For example, each microzone might have 8 randomly generated start points. If a given pair of microzones had 80 trips between the origin and destination zone, 10 trips would be assigned to each starting point
   c. Use GIS software to determine the shortest network path between the zones using the perceived travel distance scores developed in Step 2.
   d. Summarize modeled activity on each network link.

7. **Calibrate flows.** Employer commute data will be used to determine locally specific mode shares, which will be used to estimate the proportional flows attributable to bicycles and pedestrians. Bicycle and pedestrian counts will be used to assess model accuracy based on the Baseline scenario (current development and infrastructure) at key points within the network and calibrate the model to more realistically represent bicycle and pedestrian volumes. Calibration parameters developed for the Baseline scenario will be applied to the Future Development Only scenario. Calibration was accomplished by mapping available count data to the network, based on observed activity trends the AM peak hour was selected as the study hour assumed to have the greatest flows of traffic. Counts were assessed and outliers were discarded through box plot assessment.

Products

- Volume estimates for the following model scenarios. Flow maps are also produced for the Baseline scenario:

- **Baseline:** Represents current population and development patterns with existing bicycle and pedestrian infrastructure
- **Future Development Only:** Represents future population and development patterns with existing bicycle and pedestrian infrastructure

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MEMORANDUM

To: Jim Lightbody and Aruna Bodduna, City of Mountain View

From: Sam Corbett and Kim Voros, Alta Planning + Design

Date: September 9, 2020

Re: North Bayshore Bicycle and Pedestrian Circulation Study, Future Flow Estimation Methodology

Introduction

In order to assess the ability of existing and future bicycle and pedestrian to accommodate demand, Alta is assessing current and anticipated use. The following memorandum provides an overview of analysis methods to estimate future flow volumes. The methods outlined here build on methods used to calculate existing flows.

Data Inputs

The development of future bicycle and pedestrian flows utilizes the following data:

- **Households and employment estimates obtained from the Valley Transportation Authority (VTA) travel demand model for North Bayshore.** These estimates are a refined estimate of data generated by the MTC regional travel demand model and have been used by the City for previous studies of North Bayshore, including the 2015 Mountain View Shuttle Study. The refined data provides a more granular estimate of where future population and employment in North Bayshore are likely to be located by subdividing the Metropolitan Transportation Commission (MTC) Transportation Analysis Zone (TAZ) data from one zone into seven.
- **Detailed (Microzone) Population and Employment Projections for North Bayshore.** Population, household, and employment data for zones that are smaller than the regional travel model TAZs. These are used to estimate the distribution travel patterns at the sub-TAZ level.[1]
- **Origin-destination data from the MTC travel demand model.** These flows allow assignment of bicycle and pedestrian activity to various network links used to access North Bayshore. This method will assess the relative change in expected use of various routes.
- **Bicycle and pedestrian mode-share data from the MTC travel demand model.** Mode share estimates are available for each origin-destination flow, allowing mode share to be related sensitively to localized infrastructure.
- **Perceived travel distance between origin-destination pairs**. Modeling the change (reduction) in perceived travel distance between these pairs for both 2015 and 2040 allows us to understand the relative effect of changes in bicycle and pedestrian flows that can be attributed to changes in infrastructure quality or changes in households and employment

[1] For more information see: Fehr & Peers. *North Bayshore Transportation Monitoring Report and Near Term Growth Assessment.* 2019.

- **VISSIM Travel Demand Model Data.** The assumptions used to estimate bus-related pedestrian activity along the Charleston corridor was used to augment pedestrian future pedestrian flow estimates.

Analysis Process

Three additional network activity scenarios of that account for future bicycle and pedestrian infrastructure will be calculated based on the existing infrastructure scenarios described in the Existing Network Activity Assignment Memo. The following steps are used to calculate these scenarios

Note: Numbering reflects how these steps relate to steps relate to the process described in Existing Network Activity Assignment memo.

4. **Estimation of travel flows between microzones** Travel flows are estimated with both the 2015 and 2040 MTC trip tables, yielding Baseline and Future Development Only trip counts for each microzone origin-destination pair.
5. **Adjust bicycle and pedestrian mode share to reflect infrastructure improvements**
    a. **Calculate reductions in actual and perceived travel distance between microzones** Average network distances between microzones will be calculated using both existing and future networks, with network assignment for both bicycle and pedestrian users, using the randomized point method described in Step 5 of the Existing Network Activity Assignment memo. Perceived distances will be calculated by multiplying the actual distances of network links by their BLTS (for bicycle) or PQOS (for pedestrian) weights, as described in Step 2 of the Existing Network Activity Assignment memo. Network distance reductions, both actual and perceived, will calculated as the difference between existing and future distances.
    b. **Adjust trip volumes based on distance reductions** Future bicycle and pedestrian trip volumes are expected to increase if the actual or perceived distances between microzones decreases owing to infrastructure improvements. Based on research by Broach (2016),[2] the following coefficients are used to estimate volume increases as a result of infrastructure improvements:
        i. Bicycle:
            1. 0.5% increase in bicycling trips per 1% decrease in actual route distance
            2. 0.9% increase in bicycling trips per 1% decrease in additional perceived route distance (beyond decreased actual distance)
        ii. Pedestrian:
            1. 1% increase in bicycling trips per 1% decrease in actual route distance
            2. 1% increase in bicycling trips per 1% decrease in additional perceived route distance (beyond decreased actual distance)

    Using this approach, the Baseline and Future Development Only scenarios will be adjusted into parallel scenarios that additionally account for infrastructure improvements:

    - *Future Network*: Future bicycle and pedestrian infrastructure; current population and development patterns

[2] Broach, Joseph. 2016. "Travel Mode Choice Framework Incorporating Realistic Bike and Walk Routes." Portland State University. http://ppms.trec.pdx.edu/media/project_files/jbroach_dissertation_v12_rev1.pdf.

- *Future Network and Development*: Future bicycle and pedestrian infrastructure; future population and development patterns

c. **Adjust trip volumes for TDM** Bicycle and pedestrian volumes between certain microzones will be further amplified to estimate the effects of TDM programming. The following assumptions will be applied:
   i. At least 10% bicycle and pedestrian mode share for commute trips that start or end in North Bayshore
      1. At least 7.5% mode share for bicycles
      2. At least 2.5% mode share for pedestrians
      3. Existing mode shares above these thresholds were maintained as-is
   ii. At least 25% bicycle and pedestrian mode share for non-work trips that are entirely within (start and end in) North Bayshore
      1. At least 18.75% mode share for bicycles
      2. At least 6.25% mode share for pedestrians
      3. Existing mode shares above these thresholds were maintained as-is

   This approach will adjust the Future Network and Development scenario into the following additional scenario:

   - *Future Network and Development + TDM*: Future bicycle and pedestrian infrastructure; future population and development patterns; TDM programming

6. **Assignment of travel flows to network links** Additional scenarios representing the future network will be assigned to network links using the approach described in the Existing Network Activity Assignment memo.

7. **Calibrate flows** Additional scenarios representing the future network will be calibrated using the parameters developed from the Baseline scenario, as described in the Existing Network Activity Assignment memo.

8. **Assign Transit Related Pedestrian Flows.** The VISSIM travel demand model developed for the Charleston Corridor assumes 55 eastbound and westbound buses with a capacity of 40 passengers traversing the corridor during the AM peak. A conservative capacity estimate assumes buses are about 85 percent full and assigns pedestrians to bus stops along the corridor. Bus stops are assigned an activity level of high, medium, or low based on surrounding land use. Pedestrians are then randomly assigned to nearby parcels with employment land use; the number of pedestrians assigned is scaled by the projected amount of employment activity in each parcel. Finally, the shortest path between the bus stop (origin) and employment parcel (destination) is calculated and the flows are assigned to the network. VISSIM Model assumptions are found in Appendix G.

Products

- Volume estimates for the following model scenarios. Flow maps will also be produced for the Future Network and Development + TDM Scenario:
  - ***Future Network Only:*** Represents infrastructure buildout in the context current population and development patterns (if the infrastructure were put in place immediately).
  - ***Future Network and Development:*** Represents infrastructure and development patterns at the end of a 25-year-long buildout. This is the likely future condition without additional TDM.
  - ***Future Network and Development + TDM***: An extension of the Future Network and Development scenario to reflect TDM goals of 10% bike/ped mode share among North Bayshore commutes and 25% bike/ped mode share among internal North Bayshore trips for nonwork purposes.

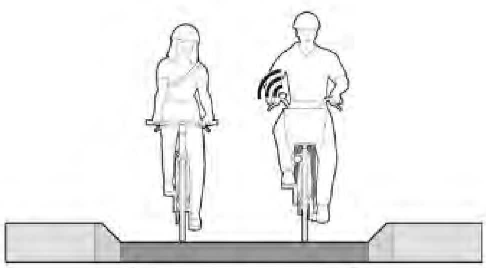
Appendix E - Capacity Analysis Assumptions

Segment Analysis Assumptions

- Pear Ave through the Shoreline Gateway area reflected by Cross Section 5 from the Shoreline Gateway Master Plan.
- Shoreline Gateway reflected by Access Street per the Precise Plan.
- San Antonio Rd and Bayshore Pkwy transit boulevard sections are reflected by the Garcia Transit Boulevard cross section as shown in Figure 33 of the Precise Plan.
- Shoreline Blvd Gateway Boulevard assumed to be reflected by the Ampitheatre cross section as shown in Figure 29 of the Precise Plan.
- South end of Joaquin Rd assumed to contain a 5’ sidewalk.

Bicycle Capacity Analysis Notes and Assumptions

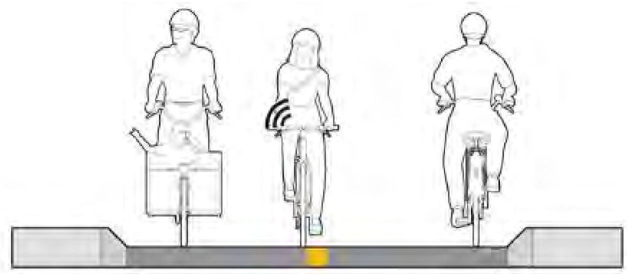
Capacities based on MassDOT Separated Bike Lane Planning & Design Guide, exhibits 3H and 3I, and reported as v/c ratios:



Same Direction Bicyclists/ Peak Hour	Bike Lane Width (ft.)	
	Rec.	Min.*
<150	6.5	5.0
150-750	8.0	6.5
>750	10.0	8.0

* A design exception is required for designs below the minimum width.

EXHIBIT 3H: Bike Lane Widths for One-way Operation



Bidirectional Bicyclists/ Peak Hour	Bike Lane Width (ft.)	
	Rec.	Min.*
<150	10.0	8.0
150-400	11.0	10.0
>400	14.0	11.0

* A design exception is required for designs below the minimum width.

EXHIBIT 3I: Bike Lane Widths for Two-way Operation

ASSUMPTIONS

- Upper range of bidirectional bikeway capacity = 750 bidirectional bicyclists per peak hour.
- When both a striped bike lane and cycle track are available options, 90% of people biking will opt for the cycle track.
- Modeled flows are not split 50/50 by direction, but rather 100% of flow is assumed to travel in the same direction (e.g. NB to work during the AM peak).

Pedestrian Sidewalk Capacity Analysis Notes and Assumptions

Pedestrian Walkway LOS (Density) based on HCM 2010 Chapter 17 and NCHRP 616:

A third measure is based on the concept of "circulation area." It represents the average amount of sidewalk area available to each pedestrian walking along the segment. A larger area is more desirable from the pedestrian perspective. Exhibit 17-16 provides a qualitative description of pedestrian space that can be used to evaluate sidewalk performance from a circulation-area perspective.

Exhibit 17-16
Qualitative Description of Pedestrian Space

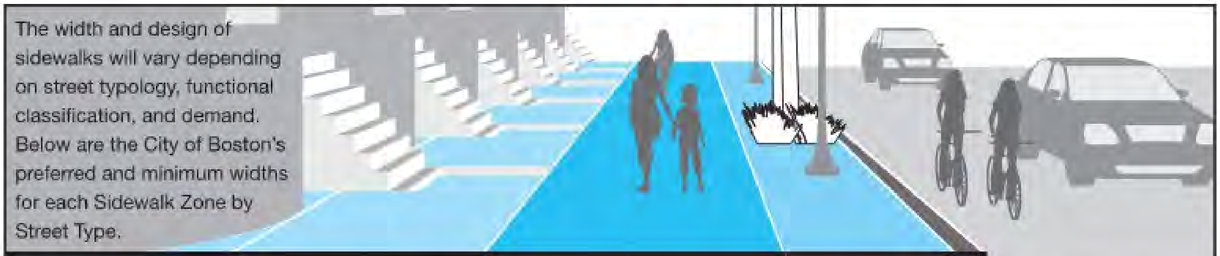
Pedestrian Space (ft^2/p) Random Flow	Platoon Flow	Description
>60	>530	Ability to move in desired path, no need to alter movements
>40–60	>90–530	Occasional need to adjust path to avoid conflicts
>24–40	>40–90	Frequent need to adjust path to avoid conflicts
>15–24	>23–40	Speed and ability to pass slower pedestrians restricted
>8–15	>11–23	Speed restricted, very limited ability to pass slower pedestrians
≤8	≤11	Speed severely restricted, frequent contact with other users

The first two columns in Exhibit 17-16 indicate a sensitivity to flow condition. Random pedestrian flow is typical of most segments. Platoon flow is appropriate for shorter segments (e.g., in downtown areas) with signalized boundary intersections.

LOS	Minimum Pedestrian Space Per Person	Equivalent Maximum Flow Rate per Unit Width of Sidewalk
A	> 60 SF per person	≤ 300 peds/hr/ft
B	>40	≤ 420
C	>24	≤ 600
D	>15	≤ 900
E	>8	≤ 1380
F	≤ 8 SF	> 1380

ASSUMPTIONS

- Shoreline Gateway Master Plan sidewalks of two different widths were assumed to be the average of the two widths.
- Assumed walking speed of 3.5 ft/s.



Street Type	Frontage Zone		Pedestrian Zone*		Greenscape/ Furnishing Zone		Curb Zone	Total Width	
	Preferred	Minimum	Preferred	Minimum	Preferred	Minimum		Preferred	Minimum
Downtown Commercial	2'	0'	12'	8'	6'	1'-6"	6"	20'-6"	10'
Downtown Mixed-Use	2'	0'	10'	8'	6'	1'-6"	6"	18'-6"	10'
Neighborhood Main	2'	0'	8'	5'	6'	1'-6"	6"	16'-6"	7'
Neighborhood Connector	2'	0'	8'	5' (4')*	5'	1'-6"	6"	15'-6"	7'
Neighborhood Residential	2'	0'	5'	5' (4')*	4'	1'-6"	6"	11'-6"	7'
Industrial Street	2'	0'	5'	5' (4')*	4'	1'-6"	6"	11'-6"	7'
Shared Street	2'	0'	Varies	5' (4')*	N/A	N/A	N/A	Varies	Varies
Parkway	N/A	N/A	6'	5'	10'	5'	6"	16'-6"	10'-6"
Boulevard	2'	0'	6'	5'	10'	5'	6"	18'-6"	11'-6"

Street Classification	Parking Lane/ Enhancement Zone	Furnishing Zone/ Landscape Buffer	Pedestrian Through Zone	Frontage Zone	Total
Local Residential/ Streets	7 feet (if used)	2-5 feet	4-6 feet	1+feet	6.5-10 feet
Main Street Areas	7 feet (if used)	4-6 feet	6-12 feet	2.5-10 ft	11-28 feet
Suburban Arterials	7 feet (if used)	6+ feet	6+ feet	Varies	12+ feet
Urban Arterials	7 feet (if used)	4-6 feet	6+ feet	Varies	10+ feet

Local or collector streets	1.5 m (5 ft)
Arterial or major streets	1.8 to 2.4 m (6 to 8 ft)
CBD areas	2.4 to 3.7 m (8 to 12 ft)*
Along parks, schools, and other major pedestrian generators	2.4 to 3.0 m (8 to 10 ft)

***2.4-m (8-ft) minimum in commercial areas with a planter strip, 3.7-m (12-ft) minimum in commercial areas with no planter strip.**

Bicycle Shared Use Path Capacity Analysis Notes and Assumptions

Based on HCM 2010 Chapter 23, calculated using the FHWA Shared Use Path Level of Service Calculator spreadsheet:

Exhibit 23-5
LOS Criteria for Bicycles on Shared-Use and Exclusive Paths

LOS	Bicycle LOS Score	Comments
A	>4.0	Optimum conditions, ample ability to absorb more riders
B	>3.5–4.0	Good conditions, some ability to absorb more riders
C	>3.0–3.5	Meets current demand, marginal ability to absorb more riders
D	>2.5–3.0	Many conflicts, some reduction in bicycle travel speed
E	>2.0–2.5	Very crowded, with significantly reduced bicycle travel speed
F	≤2.0	Significant user conflicts and diminished experience

A: Excellent. Trail has optimum conditions for individual bicyclists and retains ample space to absorb more users of all modes, while providing a high-quality user experience. Some newly built trails will provide grade-A service until they have been discovered or until their ridership builds up to projected levels.

B: Good. Trail has good bicycling conditions, and retains significant room to absorb more users, while maintaining an ability to provide a high-quality user experience.

C: Fair. Trail has at least minimum width to meet current demand and to provide basic service to bicyclists. A modest level of additional capacity is available for bicyclists and skaters; however more pedestrians, runners, or other slow-moving users will begin to diminish LOS for bicyclists.

D: Poor. Trail is nearing its functional capacity given its width, volume, and mode split. Peak-period travel speeds are likely to be reduced by levels of crowding. The addition of more users of any mode will result in significant service degradation. Some bicyclists and skaters are likely to adjust their experience expectations or to avoid peak-period use.

E: Very Poor. Given trail width, volume, and user mix, the trail has reached its functional capacity. Peak-period travel speeds are likely to be reduced by levels of crowding. The trail may enjoy strong community support because of its high usage rate; however, many bicyclists and skaters are likely to adjust their experience expectations, or to avoid peak-period use.

F: Failing. Trail significantly diminishes the experience for at least one, and most likely for all user groups. It does not effectively serve most bicyclists; significant user conflicts should be expected.

LOS CRITERIA

The LOS thresholds defined for each of the off-street pedestrian and bicycle facilities are presented in this section. Three types of service measures are defined:

- For pedestrians on exclusive pedestrian facilities, *pedestrian space* (square feet per pedestrian);
- For pedestrians on facilities shared by pedestrians and bicycles, the number of *bicycle meeting and passing events per hour*; and
- For bicycles on both shared-use and exclusive paths, a *bicycle LOS score* incorporating meetings per minute, active passings per minute, presence of a centerline, path width, and delayed passings.

OFF-STREET BICYCLE FACILITIES

On shared-use paths, the presence of other bicyclists and other path users can be detrimental to bicyclists by increasing bicycle delay, decreasing bicycle capacity, and reducing bicyclists' freedom of movement. Research (*7*) correlating user perceptions of comfort and enjoyment of path facilities with an objective measure of path and user characteristics serves as the basis for the LOS thresholds and methodology described in this section. The following key criteria are considered through this methodology:

- The ability of a bicyclist to maintain an optimum speed,
- The number of times that bicyclists meet or pass other path users, and
- The bicyclist's freedom to maneuver.

The results of a perception survey were used to fit a linear regression model in which the survey results served as the dependent variable. The methodology incorporates the effects of five path modes that may affect bicycle LOS: other bicyclists, pedestrians, runners, inline skaters, and child bicyclists. Five variables—meetings per minute, active passings per minute, path width, presence of a centerline, and delayed passings—are used in the model. In the special case of an exclusive off-street bicycle facility, the volume for all nonbicycle modes is assumed to be zero, and the number of passings and meetings is determined solely by the volume of bicycles.

With the exception of the special cases discussed in Step 8 below, the bicyclist perception index is used directly with Exhibit 23-5 to determine bicyclist LOS on off-street facilities. As was the case with shared pedestrian facilities, the LOS E–F threshold does not reflect the capacity of an off-street bicycle facility, but rather a point at which the number of meeting and passing events results in a severely diminished experience for bicyclists using the path.

ASSUMPTIONS

- Average bike speed = 10 MPH
- 50/50 directional split
- Bicyclists are 95% adults and 5% children
- Pedestrians are 67% walking and 33% running
- Stevens Creek cross section assumed to be 10’ wide (8’ wide under Hwy 101) with a striped centerline.
- Permanente Creek Trail cross section equivalent to the Stevens Creek Trail cross section.

Pedestrian Shared Use Path Capacity Analysis Notes and Assumptions

Based on HCM 2010 Chapter 23:

Exhibit 23-4
Pedestrian LOS Criteria for Shared-Use Paths

LOS	Weighted Event Rate/h	Related Measure Bicycle Service Flow Rate per Direction (bicycles/h)	Comments
A	≤38	≤28	Optimum conditions, conflicts with bicycles rare
B	>38–60	>28–44	Good conditions, few conflicts with bicycles
C	>60–103	>44–75	Difficult to walk two abreast
D	>103–144	>75–105	Frequent conflicts with cyclists
E	>144–180	>105–131	Conflicts with cyclists frequent and disruptive
F	>180	>131	Significant user conflicts, diminished experience

Notes: An "event" is a bicycle meeting or passing a pedestrian.
Bicycle service volumes are shown for reference and are based on a 50/50 directional split of bicycles; LOS is based on number of events per hour and applies to any directional split.

LOS CRITERIA

The LOS thresholds defined for each of the off-street pedestrian and bicycle facilities are presented in this section. Three types of service measures are defined:

- For pedestrians on exclusive pedestrian facilities, *pedestrian space* (square feet per pedestrian);
- For pedestrians on facilities shared by pedestrians and bicycles, the number of *bicycle meeting and passing events per hour*; and
- For bicycles on both shared-use and exclusive paths, a *bicycle LOS score* incorporating meetings per minute, active passings per minute, presence of a centerline, path width, and delayed passings.

Bicycles—because of their markedly higher speeds—have a negative effect on pedestrian capacity and LOS on shared-use paths. However, it is difficult to establish a bicycle–pedestrian equivalent because the relationship between the two differs depending on their respective flows and directional splits, among other factors. This section covers pedestrian LOS on shared-use paths. Bicyclists have a different perspective, as discussed in the following section.

Step 1: Gather Input Data

The following input data are required for the analysis:

- Hourly pedestrian and bicycle demands by direction, and
- Average pedestrian and bicycle speeds.

Step 3: Determine LOS

Exhibit 23-4 is used to determine shared-use-path pedestrian LOS based on the total events per hour calculated in Step 2. Unlike the case for exclusive pedestrian facilities, the LOS E–F threshold does not reflect the capacity of a shared-use path but rather a point at which the number of bicycle meeting and passing events results in a severely diminished experience for the pedestrians sharing the path.

ASSUMPTIONS

- Walking speed = 3.5 ft/s
- 50/50 directional split
- Permanente Creek Trail cross section equivalent to the Stevens Creek Trail cross section.

Appendix F - VISSIM Model Assumptions

VISSIM Model Assumptions

The following assumptions were used to estimate pedestrian and bicycle demands along Charleston Road intersections for North Bayshore Circulation Study Project. The following assumptions were applied to the Existing Ped/Bike counts to estimate baseline conditions demands.

- 55 Eastbound Bus Trips and 55 Westbound Bus Trips during AM Peak Hour
  - Assumed capacity per bus – 40 Passengers
  - Estimated Pedestrian Trips generated in AM Peak Hour – 2,200 per direction
- 51 Eastbound Bus Trips and 51 Westbound Bus Trips during PM Peak Hour
  - Assumed capacity per bus – 40 Passengers
  - Estimated Pedestrian Trips generated in PM Peak Hour – 2,040 per direction