TABLE 2-8
SPECIFIC PLANS, GENERAL PLAN UPDATES, AND OTHER RECENT PLANNING STUDIES IN THE STUDY AREA (2000 – 2013)

Project/Study	Lead Jurisdiction/Agency	County	Status of Project/Study	Relevancy to PCEP
Redwood City General Plan	City of Redwood City	San Mateo	Adopted, 2010	Plan prioritizes additional grade separations for improved traffic flow and encourage TOD around and improved transit connectivity at the Redwood City Station
Menlo Park General Plan Element Amendments	City of Menlo Park	San Mateo	Adopted, 2013; New process expected to begin in 2014	Circulation Plan encourages increased service and ridership at Menlo Park Station
Palo Alto Comprehensive Plan	City of Palo Alto	Santa Clara	Adopted, 2007	Plan supports PCEP and enhanced pedestrian circulation at the Palo Alto Station
Mountain View 2030 General Plan	City of Mountain View	Santa Clara	Adopted, 2012	Plan encourages coordination with Caltrain to improve service at Mountain View Station
Sunnyvale General Plan Land Use and Transportation Element	City of Sunnyvale	Santa Clara	Currently in-progress	Ongoing study of land use and transportation improvement near Sunnyvale Station
Santa Clara General Plan Update 2010-2035	City of Santa Clara	Santa Clara	Adopted, 2010	Plan encourages TOD and improved multi-modal connectivity near Santa Clara Station, as well as supports upgraded Caltrain facilities and services
Envision San Jose 2040	City of San Jose	Santa Clara	Adopted, 2011	Plan encourages new development around San Jose Diridon Station
MASTER PLANS, LONG-, AND SHORT-RANGE TRANSPORTATION PLANS				
SFMTA Strategic Plan FY 2013-2018	SFMTA	San Francisco	Adopted, 2012	Strategic Plan discusses SFMTA coordination with other regional transit providers, including Caltrain
San Francisco Transportation Plan 2040	SFCTA	San Francisco	Adopted, 2013	PCEP identified as a efficiency and enhancement project in the Strategic Plan
SamTrans Short Range Transit Plan FY 2008-2018	SamTrans	San Mateo	Adopted, 2009	Plan identifies SamTrans annual funding contribution to JPB for operation of Caltrain

TABLE 2-8
SPECIFIC PLANS, GENERAL PLAN UPDATES, AND OTHER RECENT PLANNING STUDIES IN THE STUDY AREA (2000 – 2013)

Project/Study	Lead Jurisdiction/Agency	County	Status of Project/Study	Relevancy to PCEP
Countywide Transportation Plan (2000)	City/County Association of Governments of San Mateo County (C/CAG)	San Mateo	Adopted, 2001; update underway	Update on county-wide multi-modal transportation policies, including Caltrain stations in San Mateo County
El Camino Real Master Planning Study	City of Palo Alto	Santa Clara	Currently in-progress	Ongoing study to improve multi-modal transportation on El Camino Real near California Avenue Station
Valley Transportation Plan 2035	VTA	Santa Clara	Adopted, 2009; update underway	Update on VTA service and policies including VTA routes that connect to Caltrain Stations in Santa Clara County

2.4.7 STATE AND REGIONAL REGULATORY FRAMEWORK

This project also falls within the purview of some key state and regional long range transportation plans. This section describes the regulatory framework of these plans, including the status of implementation, as some of the plans are still in progress and not yet fully adopted.

2.4.7.1 California Transportation Plan 2030

The California Transportation Plan (CTP) 2025 was adopted in 2006 and updated in 2007. The Plan, overseen by the California Department of Transportation (Caltrans), serves as a blueprint for California's transportation system defined by goals, policies, and strategies to meet the State's future mobility needs. The goals defined in the plan fall into three categories: social equity, prosperous economy, and quality environment. Each goal is tied to performance measures. In turn, members from regional and metropolitan planning agencies report to Caltrans these performance measures (State of California, 2007). The CTP 2030 Addendum updated the CTP 2025, to comply with the Safe, Accountable, Flexible, Efficient, Transportation Equity Act – A Legacy for Users (SAFETEA-LU). This federal law authorized transportation funding through 2009 and established new requirements for statewide and metropolitan transportation planning. Caltrans is presently working on an update of the CTP that would extend to 2040.

2.4.7.2 Plan Bay Area

Plan Bay Area is the San Francisco Bay Area's plan to meet the requirements of Senate Bill 375, Sustainable Communities, signed into law in 2008. Sustainable Communities requires each of the State' MPOs to develop a Sustainable Communities Strategy (SCS) aimed at reducing greenhouse gas emissions from passenger vehicles. The law also requires the California Air Resources Board (ARB) develops Regional greenhouse gas emissions targets for 2020 and 2035. ARB also reviews each final SSC to determine whether the plan would, if implemented, achieve the set greenhouse gas emission targets (MTC, 2013).

Plan Bay Area is overseen by the MTC and the Association of Bay Area Governments (ABAG). It serves as the region's SCS and the 2040 Regional Transportation Plan (preceded by *Transportation 2035*), integrating transportation and land-use strategy to manage greenhouse gas emissions and plan for future population growth. The Regional Transportation Plan and SCS includes policies that call for shifting more travel demand to transit and accommodating growth along transit corridors in "Priority Development Areas." In July of 2013, *Plan Bay Area* was adopted by ABAG and the MTC. The Proposed Project is one of the major projects included in *Plan Bay Area*.

2.5 EXISTING BICYCLE AND PEDESTRIAN CONDITIONS

The existing pedestrian infrastructure surrounding Caltrain stations in the Study Area provides a good level of accessibility, considering the varied mix of land uses around stations. In general, bicycle facilities within the Study Area are characterized by a network of mostly continuous routes within about one-mile of stations. Demand for such facilities is relatively high due to the popularity of Caltrain's bicycle access program, described in more detail in Section 2.5.1.

2.5.1 BICYCLE FACILITIES AND PLANNED BICYCLE IMPROVEMENTS

The majority of Caltrain cyclists bring their bikes on-board the train rather than parking their bike at a Caltrain station. Of the 14 percent of Caltrain passengers who access stations via bicycle, about 13 percent bring their bicycles on-board, while about one percent of passengers park their bicycles at their origin station (Fehr & Peers, 2013). In 2013, a total of 4,900 bicycles board daily, almost equally split between northbound and southbound trains (50 percent of all daily bicycles trips head northbound, 49 percent head south) (JPB, 2013). As discussed in Section 2.1.3, walking is the most commonly used mode of access to Caltrain stations. About 36 percent of Caltrain passengers access Caltrain stations by walking.

2.5.1.1 Bikeway Facilities Connected to Caltrain Stations

Bicycle facilities are classified based on a standard typology, described in further detail below:

- Class I Bikeway (Bikeway Path): A completely separate right-of-way designated for the exclusive use of bicycles and pedestrians, with vehicle and pedestrian cross-flows minimized.
- Class II Bikeway (Bikeway Lane): A restricted right-of-way designated for the use of bicycles, with a striped lane on a street or highway. Bicycle lanes are generally five feet wide. Vehicle parking and vehicle and pedestrian cross-flows are permitted.
- Class III Bikeway (Bikeway Route): A right-of-way designated by signs or pavement markings for shared use with pedestrians or motor vehicles.

Most, but not all Caltrain stations are connected to the surrounding roadway network via some type of bicycle facility. Existing bicycle facilities connected to Caltrain stations in the Study Area are shown in Figure 2-21. Major Class I bikeways in the Study Area include the Guadalupe River Trail, Bay Trail, Los Gatos Creek Trail, and the Coyote Creek Trail. The Guadalupe Trail, Los Gatos Creek Trail, and Coyote Creek Trail are located in Santa Clara County. The San Francisco Bay Trail runs through nine counties, including all three counties within the Study Area.

The density of bicycle facilities around stations varies. Table 2-9 ranks stations in terms of the density of all bikeway facilities – Classes I, II, and III – within a one-mile radius immediately surrounding each station. The average miles of bikeway facilities surrounding Caltrain stations in the Study Area are about 13. The Sunnyvale is surrounded by the most bike facility miles, with 24.3 miles of bikeways within one-mile of the station. The Mountain View Station is almost equally matched with 24.1 miles of bike facilities surrounding the station. The majority of bike facility miles surrounding Sunnyvale are Class III routes (15.8 miles); around the Mountain View Station Class II lanes are most common (16.7 miles). The San Carlos, South San Francisco, Palo Alto, and 4th and King Stations are also surrounded by about 17 miles or more of bikeway facility miles. Santa Clara, San Bruno, and College Park Station are surrounded by fewer than five miles of bikeway facility miles. Overall, Class III bikeway routes are the most common type of bike facility surrounding stations.

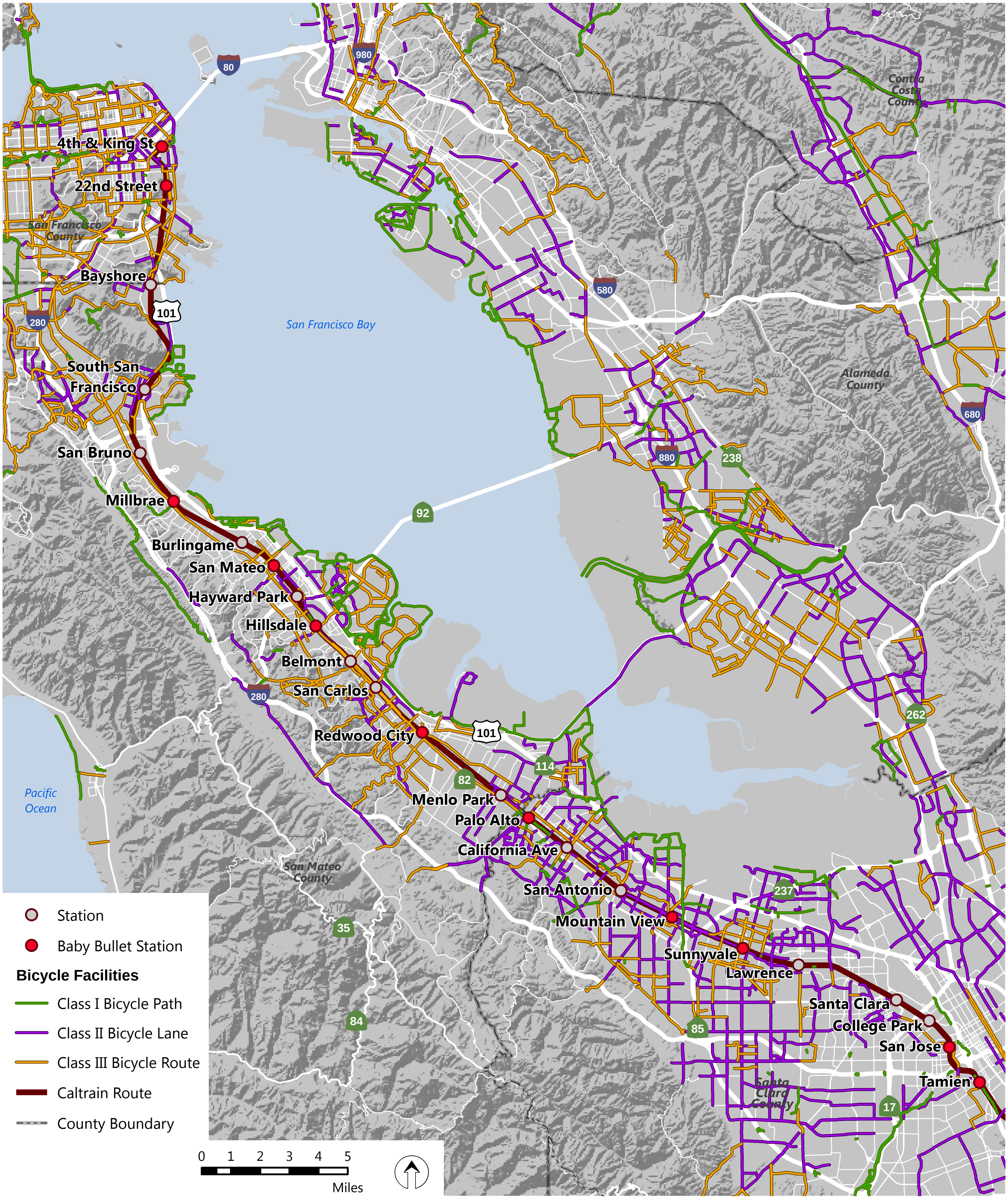

Figure 2-21

Bicycle Facilities Connected to Caltrain Stations (2013)

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**TABLE 2-9
TOTAL BICYCLE FACILITIES WITHIN ONE-MILE OF CALTRAIN STATIONS (2013)**

Rank	Station	Total Bicycle Facility Miles
1	Sunnyvale Station	24.4
2	Mountain View Station	24.1
3	San Carlos Station	19.8
4	South San Francisco Station	18.4
5	Palo Alto Station	17.5
6	4th and King St Station	16.9
7	California Avenue Station	16.8
8	San Antonio Station	16.6
9	Stanford Stadium Station	16.6
10	Redwood City Station	15.4
11	Belmont Station	15.1
12	Hillsdale Station	14.2
13	22nd Street Station	12.7
14	Menlo Park Station	12.4
15	Burlingame Station	11.6
16	Hayward Park Station	11.6
17	Lawrence Station	11.1
18	Broadway Station	9.1
19	San Mateo Station	8.8
20	Atherton Station	7.4
21	Bayshore Station	7.3
22	Millbrae Station	6.8
23	Tamien Station	5.5
24	San Jose Diridon Station	5.3

2.5.1.2 Bicycle Parking at Stations

Caltrain offers a robust bicycle access program and regularly meets to discuss bike issues with the Bicycle Advisory Committee (BAC). The BAC is comprised of nine volunteer community members and Caltrain staff meets monthly to discuss the interests and perspectives of bicyclists for integration into the Caltrain planning process (San Mateo County Transit District, "Bicycle Advisory" 2013).

Cyclists who ride Caltrain can either store their bicycles at Caltrain stations or bring their bicycles on board Both options are limited by capacity, either at the station or on-board At the station, cyclists can store their bicycles on racks, lockers, or shared access bicycle parking facilities. The San Francisco Attended Bike Parking Facility and the Palo Alto Bikestation are two such facilities serving Caltrain stations; each bike station is attended by valets who check bicycles in and out for cyclists. Station lockers are managed by Caltrain and are available for a fee of $33 for six-month reservations, plus a nominal key deposit charge. Table 2-10 provides an inventory of dedicated bike parking, by station. The majority of bike parking facilities, including racks, lockers and shared facilities are owned and administered directly by Caltrain. At some stations, however, facilities may be owned and operated by a local jurisdiction or other transit property. The only Caltrain station without dedicated bicycle parking is College Park.

TABLE 2-10
BICYCLE PARKING CAPACITY AT CALTRAIN STATIONS (2013)

Station	Bicycle Rack Spaces	Bicycle Locker Spaces	Other Bicycle Amenities
San Francisco	6	180	Attended Bicycle Parking Facility; Bay Area Bike Share station
22nd Street	27	0	None
Bayshore	18	8	None
South SF	18	20	None
San Bruno	8	16	None
Millbrae	24	28	None
Broadway	18	12	None
Burlingame	13	18	None
San Mateo	11	12	None
Hayward Park	18	4	None
Hillsdale	18	12	None
Belmont	18	24	None
San Carlos	36	48	None
Redwood City	18	50	None; Bay Area Bike Share station
Atherton	0	26	None
Menlo Park	8	50	Shared access bicycle storage shed
Palo Alto	178	94	Shared access bicycle storage shed; Electronic lockers; Bay Area Bike Share station
California Avenue	33	42	None
San Antonio	18	38	Bay Area Bike Share station
Mountain View	23	116	Shared access bicycle storage shed; Bay Area Bike Share station
Sunnyvale	18	71	None
Lawrence	18	24	None
Santa Clara	18	54	Additional bicycle lockers across the street at VTA Transit Center (adjacent)
College Park	0	0	None
San Jose Diridon	16	48	None; Bay Area Bike Share station
Tamien	18	18	None

Source: "Bicycle Parking." (2013) San Mateo County Transit District

2.5.1.3 Bicycles On-Board Trains

Bicycles are allowed on Caltrain during all operating hours. Specific cars have been retrofitted to store bicycles safely during travel. As described in Section 2.3.2 Caltrain operates two types of train equipment: Bombardier and Gallery. While each train has two bicycle cars, the number of bicycle spaces on the two types of equipment differs. In 2011, trains were modified to be equipped with two bicycles cars, increasing overall bicycle carrying capacity by 30 percent. Bike boardings on Caltrain are on the rise. The average daily bike boardings increased by 16 percent between 2011 and 2012, outpacing total ridership growth. From 2012 to 2013, bicycle boarding increased by another 16 percent, compared to a total ridership increase of 11 percent (JPB, 2013). In 2013, a total of 4,900 bicycles boarded daily.

Bombardier trains can accommodate 48 bicycles, while Gallery sets carry a maximum of 80 bicycles. Some trains use lower bicycle capacity Bombardier equipment (San Mateo County Transit District, "Bicycle General" 2013).[5] Caltrain does not charge fees to bring bicycles on-board. The bicycle car is noted with a yellow bicycle decal on the outside (San Mateo County Transit District, "Bicycle General" 2013) Caltrain's regulates the type and positioning of bicycles brought on board Only single-rider bicycles are allowed in bicycle cars; folding bicycles are allowed on any train car, provided they are no wider than 32 inches at the widest point and are folded and stored properly while the until the passenger has fully left the train. Single-rider bicycles brought on board must not exceed 80 inches nor protrude into the aisle when stored on the train (San Mateo County Transit District, "Bicycle General" 2013). A maximum of four bicycles can be stored in each bicycle rack in the bicycle cars. Caltrain encourages cyclists to use destination tags, prominently displayed on their bicycles, to indicate where they are getting off the train. Bicycle tags are provided free of charge by conductors, or passengers can print and create their own on Caltrain's website.

In addition to total bicycle boardings, bicycle mode share of ridership has also been increasing. Table 2-11 displays the top ten stations for bicycles brought on-board by passengers. Stations are ranked according to the total number of bicycles that board trains that stop or originate at a specific station throughout a full entire day (cumulative and averaged over a sample period of five days). The 4th and King Station in San Francisco is a major bike boarding station, with almost double the number of bikes that board at Palo Alto. Redwood City and San Jose Diridon are closely ranked, with about 300 total bicycles boarding throughout the day.

[5] The following Northbound trains have lower bicycle capacity Bombardier equipment: 135; 193; 195; 199; 257; 273; 287; 305; 309; 313, 319, 323; 365; and 371. The following Southbound Trains have lower capacity Bombardier equipment: 102; 142; 146; 194; 196; 206; 218; 228; 282; 288; 314; 366; 370; 380 and ("Bicycles on Bombardiers 48-bicycle capacity." (2013) *San Mateo County Transit District)*

TABLE 2-11
TOP TEN STATIONS FOR BICYCLES ON-BOARD (2013)

Station	Average Weekday Bicycle Ridership	Total Average Weekday Ridership	Proportion of Total Ridership at Station
4th and King	1,166	10,789	11%
Palo Alto	644	5,469	12%
Mountain View	464	3,876	12%
Redwood City	307	2,619	12%
San Jose Diridon	305	3,489	9%
Sunnyvale	215	2,274	9%
California Avenue	199	1,294	15%
Hillsdale	191	2,317	8%
22nd Street	174	1,312	13%
Menlo Park	169	1,526	11%

Source: "February 2013 Caltrain Annual Passenger Counts Key Findings." JPB, 2013

Table 2-12 displays the top five trains for bicycle usage. Average Weekday Bicycle Ridership captures all passengers with bicycles that boarded and alighted throughout the entire train trip. The maximum load measures the numbers of bicycles on the train when the bicycle cars were fullest and the station at which this maximum load was reached. All five of the fullest trains for bikes on-board occur in the morning or afternoon peak hours. The majority of fullest bicycle trains are northbound Limited trains. Of these four trains, three are in the evening reverse peak. However, the only northbound train in the top five is also the fullest – train 220 reached a load of 74 at Millbrae. In these conditions, more than or close to four bicycles are loaded onto a single on-board bicycle rack. Redwood City, a top bicycle boarding station, is the station at which two northbound trains first reach maximum load.

TABLE 2-12
TOP FIVE TRAINS FOR BICYCLE USAGE (2013)

Train Number	Direction	Departure Time	Average Weekday Bicycle Ridership	Maximum Load
220	Southbound	7:44 AM	110	74 (at Millbrae)
227	Northbound	7:55 AM	100	50 (at Hillsdale)
279	Northbound	5:39 PM	97	69 (at Redwood City)
269	Northbound	4:39 PM	95	69 (at San Carlos)
375	Northbound	5:23 PM	92	79 (at Redwood City)

Source: "February 2013 Caltrain Annual Passenger Counts Key Findings." *JPB*, 2013
Note: Northbound departure times are from the San Jose Diridon Station. Southbound departure times are from the 4th and King Station in San Francisco. Note: Data shown are cumulative and averaged over a sample period of five days. Departure time identifies the departure time at the stations where the maximum bike load was reached on the train's journey.

Bringing bicycles on board is limited by safety and capacity. In some instances, at his or her discretion, the train conductor may refuse transportation or revise the handling of bicycles due to crowded trains, bicycle condition, or unsafe conditions. The boarding of passengers with bicycles is on a first-come, first-serve basis. If a bicycle car is full, the cyclist will be asked to exit the train and wait for the next train, a situation commonly referred to as a "bicycle denial" or "bicycle bump." Bicycle denials can also be caused by additional circumstances, including swapped equipment and bicycle stacking that does not use the actual full capacity. In general, bicycle car capacity issues occur at the height of the morning and evening peak periods (Corey, Canapary and Galanis Research, 2010).

Because cyclists must wait until all passengers board the train before boarding or alighting with their bicycle, cyclists are encouraged to be ready to board or alight as soon as the train arrives at the station to avoid lengthened train dwell times, defined as the amount of time a train is stopped at a station (San Mateo County Transit District, "Bicycle Sharing" 2013). In 2010, Caltrain conducted on-board bicycle counts and dwell timing data to better understand bicycle boardings by station and train, number of bicycles denied boarding and dwell time for each train by station. Overall, the study found dwell times are influenced by total passenger boardings on platforms. The median dwell time at Caltrain stations was 48 seconds with Baby Bullets tended to have dwelt times of about one minute – higher in comparison to other types of service. In general, bicycle car capacity issues occur at the height of the morning and evening peak periods (Corey, Canapary and Galanis Research, 2010).

In February 2013, Caltrain conducted annual ridership counts. This effort included a tally of passengers with bicycles who were denied boarding because of bicycle capacity limitations. Data were collected over the course of 1 week and were not averaged. A total of 59 cyclists on seven trains were denied boarding. The majority of boarding denials occurred on southbound trains. In general, fewer than five bicycles are denied boarding at a time, but on occasion bike denials can affect a larger number of bicycles. Bicycle denials tend to occur at the Redwood City, Millbrae, and 22nd Street Stations but have been observed and reported throughout the system. The new passenger information system at the station (visual electronic message signs at the platforms) is able to broadcast and redirect bicyclists away from trains that are full to those that still have capacity.

TABLE 2-13
PASSENGERS WITH BICYCLES DENIED BOARDING (2013)

Day	Train	Direction	Number of Bicycle Denials	Station Denial Occurred
Monday	279	Northbound	5	Redwood City
Monday	324	Southbound	1	22nd Street
Tuesday	375	Northbound	4 2	Menlo Park Redwood City
Wednesday	279	Northbound	1	San Carlos
Wednesday	220	Southbound	1 4 2	4th and King 22nd Street Millbrae
Wednesday	322	Southbound	22 3	22nd Street Millbrae
Wednesday	324	Southbound	5	22nd Street
Wednesday	332	Southbound	3 1	22nd Street Millbrae
Thursday	371	Northbound	5	Palo Alto

Source: "February 2013 Caltrain Annual Passenger Counts Key Findings." *JPB*, 2013

2.5.1.4 Bay Area Bike Share at Caltrain Stations

Because trains have limited on-board space, Caltrain encourages customers to park their bikes at Caltrain stations or make use of the newly implemented regional bike share pilot program. In August 2013, a region-wide bike sharing pilot program launched. Bay Area Bicycle Share is a self-service service system that provides members with easy access to a network of bicycles. The pilot program, led by the Bay Area Air Quality Management District, is a partnership between SamTrans, The City of Redwood City, the County of San Mateo, SFMTA, San Francisco County Transportation Authority, Caltrain, and VTA (San Mateo County Transit District, "Bicycle Sharing" 2013).

There will be 700 bikes at 70 kiosk stations along the Peninsula corridor in San Francisco, Redwood City, Palo Alto, Mountain View, and San Jose. Daily (24-hour) and three-day memberships can be purchased online or at any kiosk using a credit or debit card, currently priced at $22 and $9, respectively. Annual memberships are also available, currently priced at $88 to $99 annually. Members will be able to check out a bike close to home or work and return it to any of the kiosk stations in San Francisco, Redwood City, Palo Alto, and Mountain View. The following Caltrain stations have a bicycle share kiosk at or within one half-mile: 4th and King, Redwood City, Palo Alto, San Antonio, Mountain View, and San Jose Diridon (Bay Area Bike Share, 2013).

Because trains have limited on-board space, Caltrain encourages customers to park their bikes at Caltrain stations or make use of the newly-implemented regional bike share pilot program, Bay Area Bicycle Share. Bay Area Bicycle Share is a self-service service system that provides members with easy access to a network of bicycles. The pilot program, led by the Bay Area Air Quality Management District (BAAQMD), was launched in August 2013 and is intended to provide easy access to a network of bicycles. The program is a partnership between SamTrans, The City of Redwood City, the County of San Mateo, SFMTA, San Francisco County Transportation Authority, Caltrain, and VTA (San Mateo County Transit District, "Bicycle Sharing" 2013).

The program proposes 700 bikes at 70 kiosk stations along the Peninsula corridor in San Francisco, Redwood City, Palo Alto, Mountain View, and San Jose. Members are able to check out a bike close to home or work and return it to any of the kiosk stations. The San Francisco 4th & King, Redwood City, Palo Alto, San Antonio, Mountain View, and San Jose Diridon Stations have a bicycle share kiosk at or within one 0.5 mile of the station. three-day memberships can be purchased online or at any kiosk using a credit or debit card, currently priced at $22 and $9, respectively. Annual memberships are also available, currently priced at $88 to $99 annually.

2.5.2 PEDESTRIAN FACILITIES AND PLANNED PEDESTRIAN IMPROVEMENTS

This section summarizes the quality of the pedestrian environment, in terms of safety, accessibility, and urban design. Overall, walking to Caltrain stations is the most popular mode of access for passengers system-wide. However, as discussed in Section 2.1.3, mode of access varies by station. Although all stations offer mostly consistent pedestrian amenities on the platform, the quality of the pedestrian environment around the station area varies. Attachment C includes more detailed information on pedestrian conditions on station platforms and within a quarter mile of each station.

In analyzing design of the pedestrian environment within one-quarter mile of each station, the following components were reviewed: directions of pedestrian access to each station, sidewalk completeness, presence of sidewalks, density of street trees, proximity to freeway(s), maximum posted speed limit, and traffic calming measures. Some built-environment factors are correlated with the proportion of passengers walking to stations, including the density of street intersections around stations. These components/variables are described in detail in Attachment C.

2.5.2.1 Accessibility for Disabled Passengers

The majority of Caltrain stations are accessible to persons with disabilities, who can board via either a lift or accessible ramp. The following stations do not have wheelchair lifts: 22nd Street, South San Francisco, Broadway, Atherton, and College Park. Disabled Accessibility at stations is detailed in Attachment C. All stations include a blue boarding assistance area, indicated with blue paint on the ground. Passengers with disabilities who would like boarding assistance from the conductor sit or stand in the blue boarding assistance area. As per the Americans with Disabilities Act (1990), trains can accommodate wheelchairs of the following dimensions: no larger than 30 inches by 48 inches, and a total weight, including the occupant, of no more than 600 pounds (San Mateo County Transit District, "Accessibility" 2013).

Every train has at least one wheelchair accessible car that can accommodate up to three wheelchairs or mobility devices (e.g. two-wheeled Segways). The accessible car is usually the second car from the north and is marked with a blue accessibility symbol next to the doors. All accessible cars are equipped with an accessible restroom.

2.5.2.2 Pedestrians and Public Crossings on the Right-of-Way

A mix of grade-separated and non-grade separated pedestrian crossings exist at Caltrain stations within the Study Area. Because trains can operate at speeds up to 79 mph, pedestrians are advised by the JPB to take great care by looking both ways and listening for oncoming trains before traversing public crossings. Failure to practice safe crossing techniques at all times can degrade pedestrian safety. For example, at San Jose Diridon and Palo Alto, passengers can access the opposing directional platform via an underground pedestrian walkway. This type of grade separated crossing does not require a passenger to cross over active railroad tracks. However, some stations, such as Mountain View and Sunnyvale allow passengers to cross tracks at non-grade separated public crossings. These designated crossings are marked by a sign and/or a gate. Caltrain distributes information to educate passengers on public crossing and platform safety on the Caltrain website, at Caltrain headquarters, in station areas, and on-board trains. In addition, Caltrain participates in three major public information campaigns to help reduce pedestrian trespassing and fatalities: Common Sense: Use It, Transit Watch and Operation Lifesaver (San Mateo County Transit District, "Safety and Security" 2013).

2.6 EXISTING TRAFFIC CONDITIONS

Existing automobile traffic along the Caltrain corridor is subject to a range of factors both directly and indirectly related to Caltrain operations. In a direct sense, existing traffic is partly comprised of automobile traffic from automobiles driving to and from stations. Indirectly, traffic is influenced by the effects of at-grade street crossings along the corridor. When gates are down due to a passing train, traffic at adjacent intersections is oftentimes affected.

In order to document existing traffic conditions and set a baseline for measuring future environmental impacts, a traffic microsimulation model was developed. A total of 82 intersections within the Study Area were included in the microsimulation model and were analyzed due to their proximity to grade crossings and/or Caltrain stations.

Most of these intersections (64) were modeled using the Synchro/SimTraffic software package. The remaining 18 intersections were intersections with high congestion levels, unique intersection layouts, or other atypical conditions and were modeled using the VISSIM microsimulation software package. For more detailed information on the traffic model development and analysis process, see Attachment E. Existing traffic conditions described in this section are for the weekday AM peak hour typically between 8:00 AM and 9:00 AM and the weekday PM peak hour typically between 5:00 PM to 6:00 PM.

2.6.1 EXISTING ROADWAY CONDITIONS

This section summarizes existing roadway conditions along major freeways and arterial streets in the Study Area.

2.6.1.1 Freeways

The Caltrain corridor within the Study Area runs parallel to major north-south oriented freeways I-280 and US 101. Figure 1-1 displays the major freeways within the Study Area. In San Francisco County, I-280 begins as at the Embarcadero and terminates in the south at the US 101 and I-680 interchange in north San Jose. Within the Study Area, US 101 connects to I-80 in San Francisco County and continues south through Santa Clara County.

East-west oriented freeways in the Study Area include I-380 in San Mateo County and I-880 in Santa Clara County. I-380 runs east-west in north San Mateo County, connecting I-280 and US 101 crossing perpendicular to the Caltrain right-of-way. In San Jose north of the US 101/I-280 interchange, I-880 crosses perpendicular to the Caltrain right-of-way in a northeast to southwest orientation. Major Study Area freeways and arterials are displayed in Table 2-14.

TABLE 2-14
EXISTING MAJOR STUDY AREA FREEWAYS, EXPRESSWAYS, AND ARTERIAL STREETS ALONG CALTRAIN CORRIDOR

County	Orientation	Name	Classification	Extent within Study Area
San Francisco	North-South	US 101	Freeway	San Francisco County to Santa Clara County
San Francisco	North-South	I-280	Freeway	San Francisco County to Santa Clara County
San Mateo	East-West	I-380	Freeway	San Mateo County
Santa Clara	Northeast-Southwest	I-880	Freeway	Santa Clara County
San Francisco	East-West	Cesar Chavez Street	Arterial	San Francisco County
San Mateo	North-South	Route 82/El Camino Real	Arterial	San Mateo County to Santa Clara County
San Mateo	East-West	Route 92	Freeway	San Mateo County
San Mateo	East-West	Route 84	Arterial/Expressway	San Mateo County
Santa Clara	East-West	Route 85	Freeway	Santa Clara County
Santa Clara	East-West	Lawrence Expressway	Arterial/Expressway	Santa Clara County
Santa Clara	North-South	Route 87	Freeway	Santa Clara County
Santa Clara	North-South	Alma/Central Expressway	Arterial/Expressway	Santa Clara County

2.6.1.2 Major Arterial Streets

The Caltrain right-of-way runs parallel to or intersects with some major arterials in the Study Area. In San Francisco, Caltrain runs as a mix of both above- and below-grade, crossing east-west arterial Cesar Chavez Street above grade. The corridor runs parallel to California State Route 82 (El Camino Real). El Camino Real is a major north-south oriented roadway that extends from San Mateo County south to Santa Clara County within the Study Area.

In San Mateo County, Route 92 connects El Camino Real with US 101 and continues to become the San Mateo Bridge, crossing the San Francisco Bay. Also in San Mateo County, Caltrain crosses Route 84 at Woodside Road in Redwood City. Route 84 eventually joins US 101 and continues east across the San

Francisco Bay as the Dumbarton Bridge. In Santa Clara County, Caltrain travels parallel to Alma Road/Central Expressway which terminates at the San Jose International Airport located west of Guadalupe Parkway.

2.6.2 ROADWAY SYSTEM PERFORMANCE

Congestion during the weekday morning and afternoon peak period is common on US 101 in both directions through San Francisco, San Mateo and Santa Clara counties. During the morning peak period, southbound congestion on US 101 is common in San Francisco, from San Francisco International Airport to San Mateo, and in Palo Alto. Northbound US 101 is regularly congested from San Jose to north of Mountain View in Santa Clara County, as well as near the San Francisco International Airport and in San Francisco during the morning peak period. During the afternoon peak period, Southbound US 101 has notable congestion from South San Francisco to Burlingame, San Carlos to Palo Alto and Mountain View to San Jose. Northbound US 101 is congested in Mountain View, San Carlos, and San Francisco during afternoon peak periods.

I-280 also runs in a north-south orientation on the San Francisco Peninsula and is prone to backups during the peak period. During the morning peak period, southbound congestion is common from Daly City to San Bruno. Northbound morning congestion is common from San Jose to Cupertino and entering San Francisco. During the evening peak period southbound traffic congestion is common in southern San Francisco, Los Altos and from Cupertino to San Jose. Northbound evening congestion typically occurs from Portola Valley to Woodside in San Mateo County.

2.6.3 EXISTING GATE DOWN TIME CONDITIONS

Currently, there are 42 at-grade crossings along the Caltrain right-of-way within the Study Area. An at-grade crossing is an intersection of Caltrain tracks, roadways, walkways, or combination of these at the same level. All other crossings in the Study Area are grade-separated, meaning that roadways, walkways, and railroads cross at different, non-conflicting elevations. Gates on both sides of the tracks are in place at all crossing locations. When no train is crossing at this location, the gates are up or inactive. A gate down event occurs when these gates come down at the crossing, due to a train either passing or crossing or stopping at a nearby upstream station. It can also be due to simulations passing of two trains in opposite directions at a crossing. Gate down times is a key measurement for both the performance of the existing and future Caltrain operations in this Study. Gate down time is a summation of multiple actions that occur in sequence in order to ensure all modes can cross safely at a grade-crossing. These actions are listed and explained in chronological order below:

1. Gate flashers, located on gate arms to increase visibility, are triggered by a gate crossing event.
2. Gate arms descend, moving from vertical to horizontal position, indicating that all vehicular, bicycle, and pedestrian traffic must stop at the crossing to allow the train(s) to pass safely.
3. Train passes and fully clears the crossing.
4. Gate arms rise, moving from horizontal to vertical position gates coming down.

After this sequence is complete, pedestrian, bicycle, and vehicular traffic can resume regular operations through the crossing.

The following is a list of locations (near study intersections) and times[6] in the AM and PM peak hour during which gate restarts[7] occur under existing conditions:

- 1st Avenue (San Mateo Station):
    - 8:42 AM - Train 226 (AM peak hour)
    - 5:03 - Train 266 (PM peak hour)
    - 5:45 - Train 274 (PM peak hour)
    - 5:56 - Train 378 (PM peak hour)
- Brewster Avenue, Broadway (Redwood City Station)
    - 8:00 AM - Train 323 (AM peak hour)
    - 8:23 - Train 225 (AM peak hour)
    - 8:30 - Train 329 (AM peak hour)
    - 4:55 - Train 264 (PM peak hour)
    - 5:25 - Train 267 (PM peak hour)
    - 5:30 Train 271 (PM peak hour)
- Maple Street (Redwood City Station)
    - 8:21 AM - Train 225 (AM peak hour)
    - No restarts in the PM peak period
- Main Street (Redwood City Station)
    - 8:13 AM - Train 218 (AM peak hour)
    - 5:07 PM - Train 368 (PM peak hour)
- Oak Grove Avenue (Menlo Park Station)
    - 7:46 AM - Train 221 (AM peak hour)
    - 7:50 AM - Train 314 (AM peak hour)
    - 8:40 AM - Train 227 (AM peak hour)
    - 4:46 PM - Train 365 (PM peak hour)
    - 5:19 PM - Train 267 (PM peak hour)
- Ravenswood Avenue (Menlo Park Station)
    - 8:25 AM - Train 329 (AM peak hour)
    - No restarts in the PM peak period

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[6] The following non-study grade crossings in Zone 2 also experience restarts: Howard, Avenue, Bayswater Avenue, 2nd Avenue, 3rd Avenue, and Broadway (Redwood City). Broadway in Burlingame (Broadway Station) and Fair Oaks Lane and Watkins Avenue in Atherton (Atherton Station) also have gate restarts but these stations offer weekend-only service under existing conditions. North Lane also has gate restarts, but not during the AM or PM peak hour.

[7] Several grade crossing locations are in close proximity to stations and trigger gate restarts. Due to this close proximity, grade crossing events function slightly differently than at other grade crossings under current operations. When a train is making a station stop that has an at-grade crossing just upstream, in front of, or at the station stop, a gate crossing event occurs. Once the signaling system detects that a train has stopped and a rest time passes, the gates rise to allow traffic to flow across the railroad tracks. When the train leaves the station, the gates lower again. This sequence of events is referred to as “gate restarts” or “double gate action.” (JPB, 2013).

- Rengstorff Avenue (San Antonio and Mountain View Station)
    - 8:10 AM - Train 216 (AM peak hour)
    - No restarts in the PM peak period
- Castro Street (Mountain View Station)
    - 8:06 AM - Train 225 (AM peak hour)
    - 8:38 AM- Train 220 (AM peak hour)
    - 9:00 AM - Train 233 (AM peak hour)
    - 5:01 PM - Train 369 (PM peak hour)
    - 5:06 PM - Train 267 (PM peak hour)
    - 5:36 - Train 266 (PM peak hour)
- Mary Avenue (Sunnyvale Station)
    - 8:02 AM - Train 314 (AM peak hour)
    - No restarts in the PM peak period

Caltrain is currently controlled by a wayside block signal system comprised of signals alongside the track that convey to the train engineer occupancy and/or routing status ahead. It controls train separation to match safe breaking needs for Caltrain's diesel-hauled trains. A key constraining factor in the existing Caltrain capacity is the current wayside signal system because it forces train separation based on the poorest performing train type (San Mateo County Transit District, "CBOSS" 2013).

Table 2-15 lists all 29 grade crossings in the Study Area that are adjacent to study intersections (at-grade study crossings). The average gate down time at each crossing is also listed. Average gate down time is a measurement of average period gates are down per each gate down time event. There are 13 additional grade crossings along the corridor not adjacent to study intersections.

Figure 2-22 displays all grade crossing locations in Zone 1. Figure 2-23 displays all grade crossing locations in Zone 2. Figure 2-24 displays all grade crossing locations in Zone 3. Figure 2-25 displays all grade crossing locations in Zone 4.

2.6.3.1 Grade Crossing Analysis Methodology (Existing Conditions)

Existing conditions gate down times were calculated empirically from gate down event records collected in the field (2013). These records included the train number, timestamp of when the gate down event sequence started, and a timestamp of when the gate down event ended (when the gate arms were fully raised and the flashing red lights were off). Data on whether two trains occupied the crossing during the same gate down event (a "2-for-1" scenario), or if the gate down sequence restarted was also used for this analysis. A similar set of data for 2020 and 2040 Plus Project scenarios was generated (LTK analysis, 2013). The results presented in this section are key inputs into the Intersection LOS Analysis presented in this section.

TABLE 2-15
EXISTING CALTRAIN GATE DOWN TIMES AT GRADE CROSSINGS ADJACENT TO STUDY INTERSECTIONS

Crossing	Jurisdiction	AM Average Gate Down Time (Minutes : Seconds)	PM Average Gate Down Time (Minutes : Seconds)
Mission Bay Drive	San Francisco	01:21	01:09
16th Street	San Francisco	01:10	00:54
Linden Avenue	South San Francisco	00:38	00:41
Scott Street	San Bruno	00:52	00:43
Broadway	Burlingame	00:41	00:50
Oak Grove Avenue	Burlingame	00:52	00:53
North Lane	Burlingame	01:03	01:06
Peninsula Avenue	Burlingame	00:56	00:53
Villa Terrace	San Mateo	00:54	00:45
First Avenue	San Mateo	01:23	01:21
Ninth Avenue	San Mateo	00:49	01:06
25th Avenue	San Mateo	01:00	00:55
Whipple Avenue	Redwood City	01:05	01:02
Brewster Avenue	Redwood City	01:21	01:18
Broadway	Redwood City	01:26	01:35
Maple Street	Redwood City	01:10	00:55
Main Street	Redwood City	01:19	01:05
Fair Oaks Lane	Atherton	00:39	00:39
Watkins Avenue	Atherton	00:54	00:56
Glenwood Avenue	Menlo Park	00:50	01:01
Oak Grove Avenue	Menlo Park	01:21	01:32
Ravenswood Avenue	Menlo Park	01:08	01:01
Palo Alto Avenue	Palo Alto	00:42	00:48
Churchill Avenue	Palo Alto	00:38	00:35
West Meadow Avenue	Palo Alto	00:40	00:39
West Charleston Avenue	Palo Alto	00:38	00:38
Rengstorff Avenue	Mountain View	00:50	00:43
Castro Street	Mountain View	01:09	01:30
Mary Avenue	Sunnyvale	00:38	00:40

Source: LTK, 2013
Note: This table reports average gate down times per event at grade crossings near study intersections. Several additional grade crossings are present along the Caltrain corridor that are not directly adjacent to designated study intersections.

Figure 2-22

Existing Grade Crossings Locations - Zone 1

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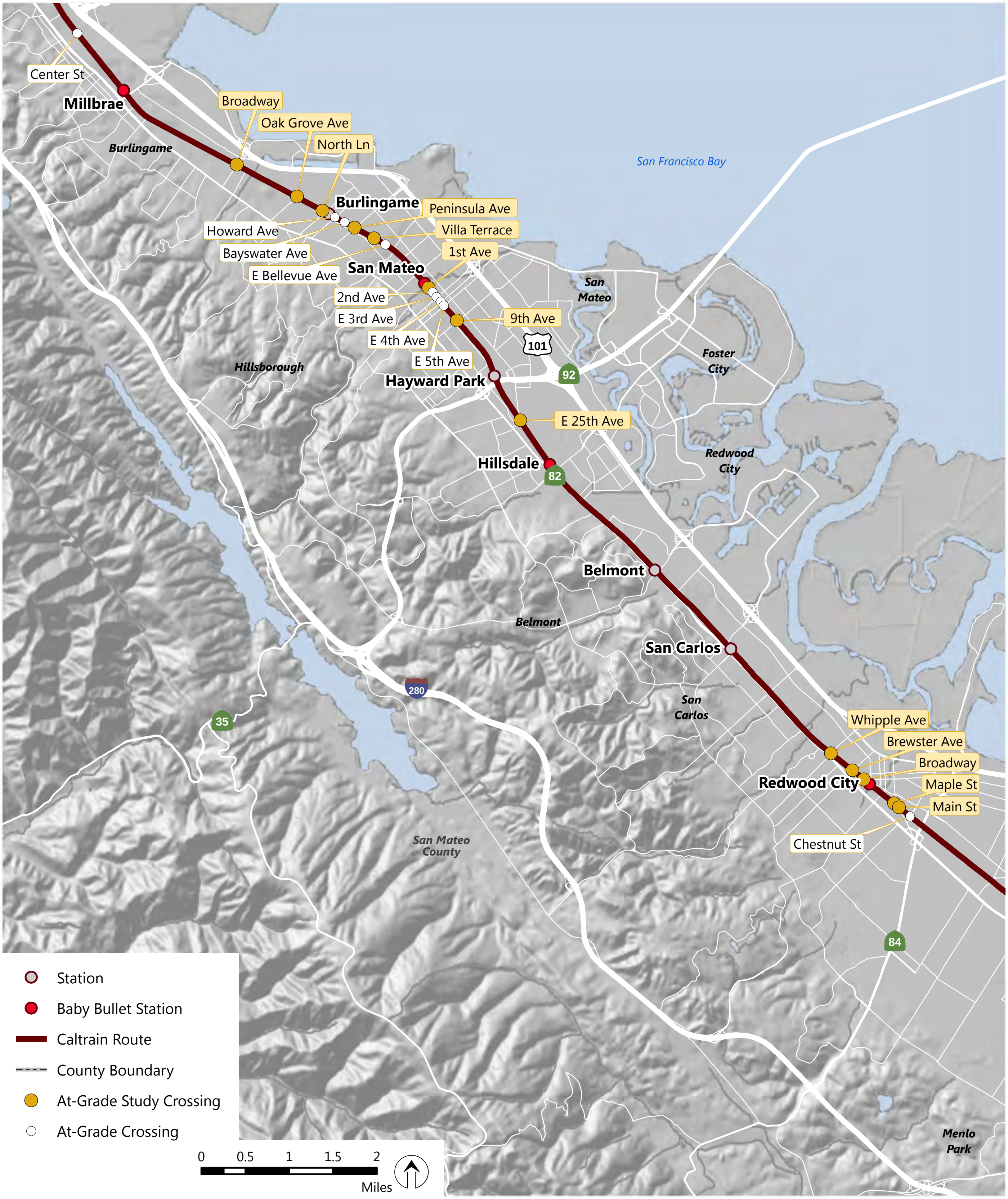

Figure 2-23

Existing Grade Crossings Locations - Zone 2

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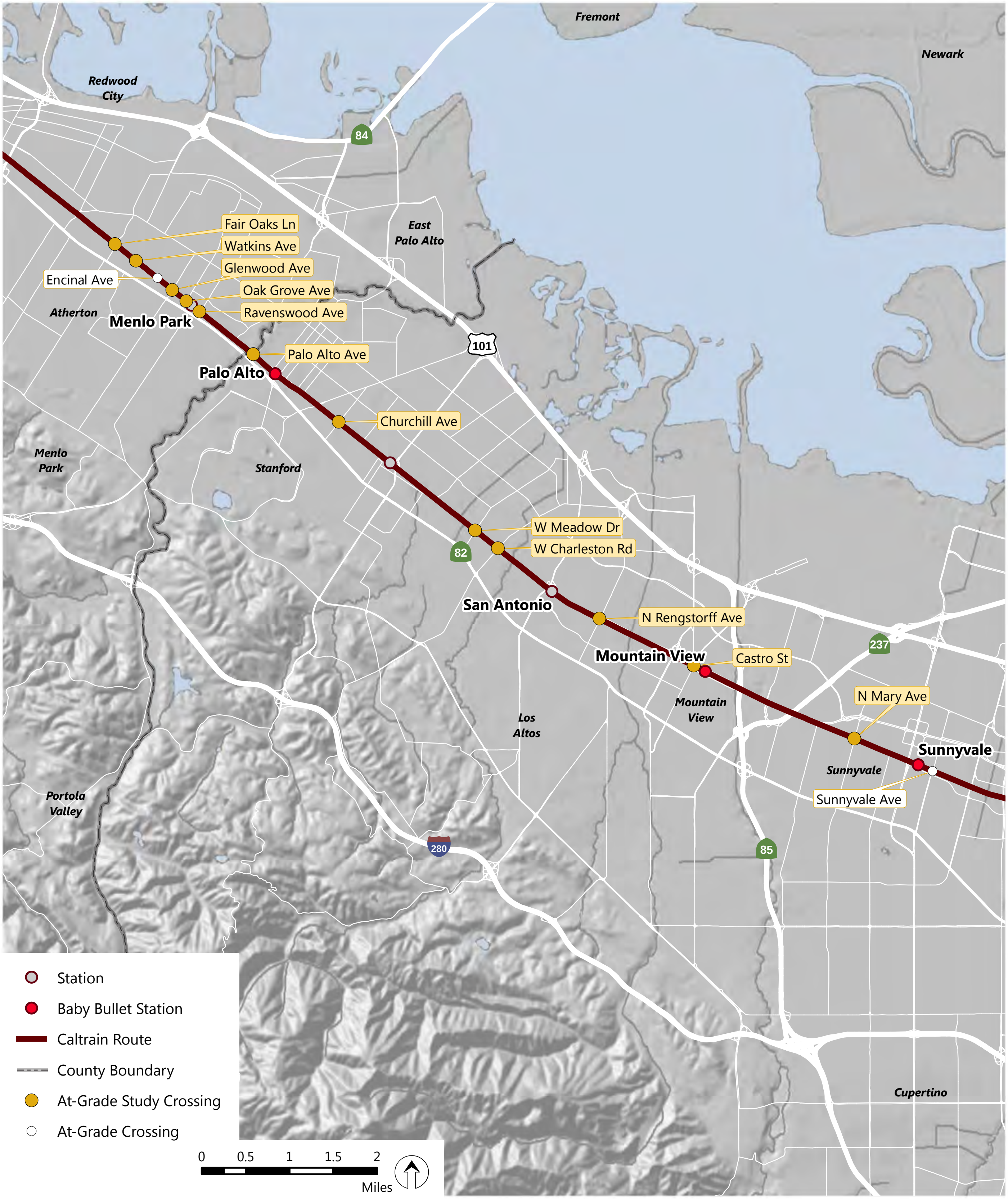

Figure 2-24

Existing Grade Crossings Locations - Zone 3

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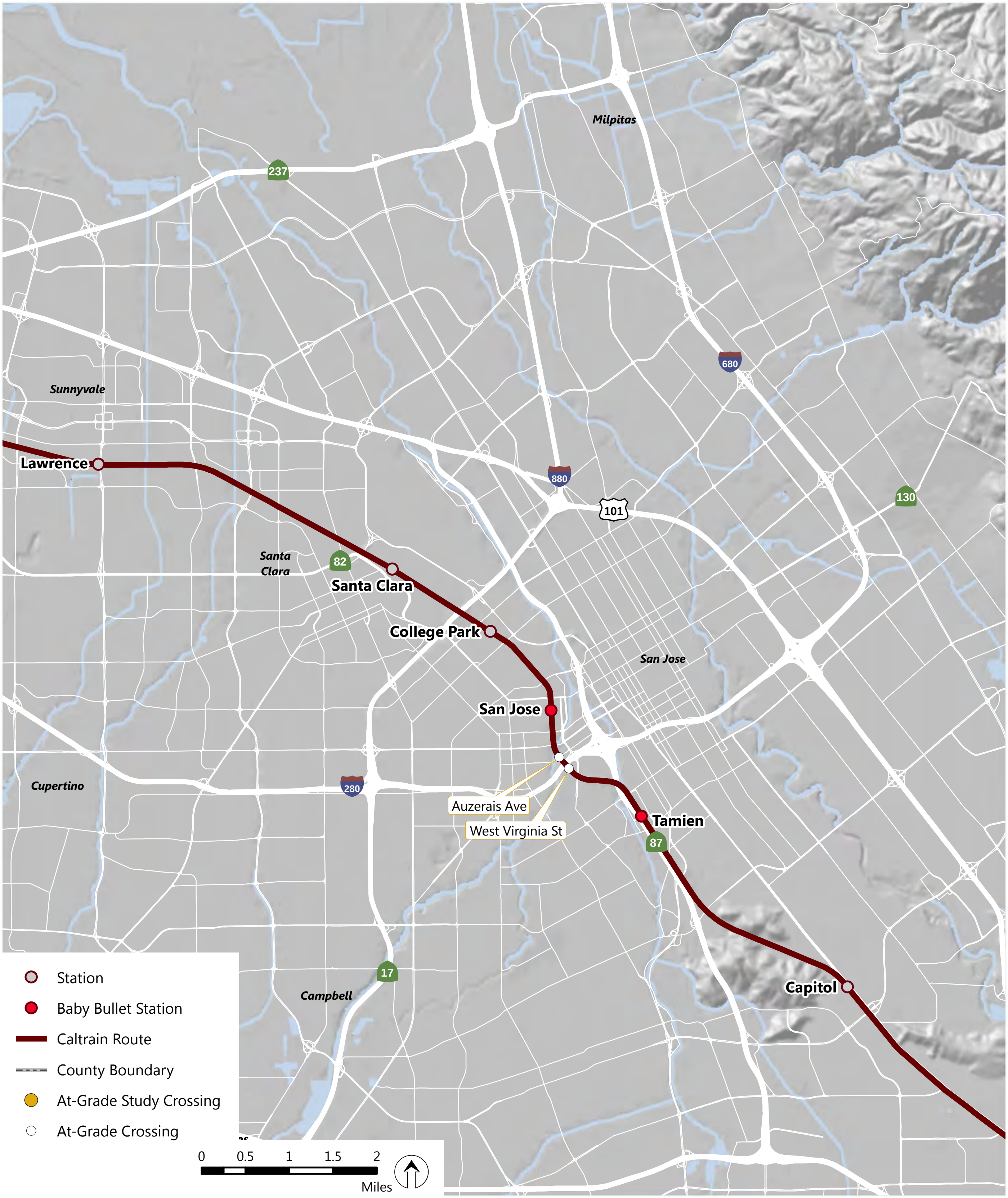

Figure 2-25

Existing Grade Crossings Locations - Zone 4

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Date: January, 2013

2.6.4 EXISTING INTERSECTION LEVELS OF SERVICE

The Caltrain Project could affect traffic operations along the Caltrain corridor in several ways. First, the number of trains will increase, increasing the number of gate down occurrences. Second, the increased train service and added train capacity will change traffic patterns as auto trips are converted to train trips (resulting in potential increases in traffic near stations coupled with reduced traffic on parallel roads).

Traffic operations models allow for intersections to be evaluated based on how people and vehicles travel through them. The intersection analysis results include a descriptive term known as level of service (LOS). LOS is a measure of traffic operating conditions, which varies from LOS A, which represents free flow conditions, with little or no delay, to LOS F, which represents congested conditions, with extremely long delays. Table 2-16 displays the LOS designations for signalized intersections. Table 2-17 displays LOS thresholds for unsignalized intersections.

In order to evaluate how the project will affect corridor traffic patterns, 82 intersections in the Study Area were analyzed. These intersections were selected for evaluation using a tiered approach based on the criteria described below.

- Intersection Operations / Level of Service (LOS): Currently operating at LOS D, E, or F during peak hours
- Transit-Oriented Development (TOD): Adjacent to station where significant TOD is planned
- Gate down times: Adjacent to grade crossing where Project would result in substantial change in gate down times
- Intersection Geometry: Unusual geometry and/or signal operations

Intersections in the Study Area that meet one or more of the criteria outlined above were selected for study using traffic operations modeling tools.

As an additional step to provide additional discussion of potential traffic changes due to the project, other intersections in the Study Area that do not meet the above criteria were reviewed qualitatively. Over 130 intersections in the Study Area were originally reviewed as potential study intersection locations. Of these intersections, 50 were ultimately not selected for detailed quantitative evaluation because they currently are operating at acceptable LOS with minimal to no delay, with no expectation of serious deterioration in the future. Although some of these non-study intersections are adjacent to or in close proximity to study intersections that are operating at LOS E or F under existing conditions or projected to under future scenarios, no impacts are expected due to queuing or other potential spillover effects. For example, although Glenwood Avenue and Middlefield Road in Atherton operates at LOS E in the AM peak and LOS F in the PM peak under existing conditions, Middlefield Road and Encinal Avenue, a nearby intersection, was not included as a study intersection because it operates well and is unlikely to experience spillover operational effects.

Because no significant traffic effects are expected at these non-study intersections, they were not analyzed using quantitative traffic operations modeling tools. Some non-study intersections have also been analyzed as part of other planning efforts in the region, including the various downtown and station area plans and the Caltrain/HSR Blended Grade Crossing and Traffic Analysis (JPB, 2013).

Most of the 82 study intersections (64) were modeled using the Synchro/SimTraffic software package. The remaining 18 intersections were modeled using the VISSIM software package, which is a more robust transportation microsimulation tool that has the ability to account for more complex intersection operations and multimodal interactions. VISSIM was used at intersections where there are high levels of congestion, frequent transit service, high automobile volumes, high pedestrian or bicycle volumes, or special traffic signal systems (such as transit signal priority). More detail on the model development and calibration process can be found in Attachment E. Synchro/SimTraffic output sheets can be found in Attachment G. VISSIM output sheets can be found in Attachment H. Traffic Volumes Count Sheets are in Attachment I.

TABLE 2-16
SIGNALIZED INTERSECTION LEVEL OF SERVICE DEFINITIONS

Level of Service	Description	Average Control Delay Per Vehicle (Seconds)
A	Operations with very low delay occurring with favorable progression and/or short cycle lengths.	≤ 10
B	Operations with low delay occurring with good progression and/or short cycle lengths.	10.1 – 20
C	Operations with average delays resulting from fair progression and/or longer cycle lengths. Individual cycle failures begin to appear.	20.1 – 35.0
D	Operations with longer delays due to a combination of unfavorable progression, long cycle lengths, and high volume-to-capacity (V/C) ratios. Many vehicles stop and individual cycle failures are noticeable.	35.1 – 55.0
E	Operations with high delay values indicating poor progression, long cycle lengths, and high V/C ratios. Individual cycle failures are frequent occurrences.	55.1 – 80
F	Operations with delays unacceptable to most drivers occurring due to over-saturation, poor progression, or very long cycle lengths.	> 80

Source: "2010 Highway Capacity Manual." (2010) Transportation Research Board

TABLE 2-17
UNSIGNALIZED INTERSECTION LEVEL OF SERVICE DEFINITIONS

Level of Service	Description	Average Control Delay Per Vehicle on Worst Approach (seconds)
A	Little or no delays	≤ 10
B	Short traffic delays	10.1 – 15.0
C	Average traffic delays	15.1 – 25.0
D	Long traffic delays	25.1 – 35.0
E	Very long traffic delays	35.1 – 50
F	Extreme traffic delays with intersection capacity exceeded	> 50

Source: 2010 Highway Capacity Manual

Table 2-18 displays current level of service and calculated delay during the morning and evening peak at all study intersections. Figure 2-26 illustrates the geographic location of each study intersection and the associated AM and PM peak period LOS in Zone 1. Figure 2-27 illustrates the geographic location of each study intersection and the associated AM and PM peak period LOS in Zone 2. Figure 2-28 illustrates the geographic location of each study intersection and the associated AM and PM peak period LOS in Zone 3. Figure 2-29 illustrates the geographic location of each study intersection and the associated AM and PM peak period LOS in Zone 4.

In Zone 1, which includes San Francisco County and a portion of San Mateo County, the majority of study intersections operate at LOS C or better. However, 4th Street and King Street operates at LOS E in the AM and F in the PM. Three other intersections operate at LOS D or worse: 7th Street and 16th Street (AM peak), Linden Avenue and Dollar Avenue (PM peak), and San Mateo Avenue and San Bruno Avenue (PM peak). In Zone 2, which includes northern and central San Mateo County, points of severe congestion (LOS E and LOS F) exist at major intersections, including El Camino Real, Alma Street, and Middlefield Road. In Zone 3, which includes parts of San Mateo and Santa Clara Counties, congestion is also clustered along El Camino Real and Alma, in addition to Central Expressway. Overall, points of severe congestion are mostly clustered in Zone 3, in the cities of Atherton, Palo Alto, and Mountain View. In Zone 4, two intersections operate at LOS D or worse: Kifer Road and Lawrence Expressway and Reed Avenue and Lawrence Expressway (AM and PM peaks).

TABLE 2-18
EXISTING INTERSECTION DELAY AND LEVELS OF SERVICE (2013)

Int. ID	Intersection	Jurisdiction	Peak Hour	Intersection Control	Delay	LOS
			ZONE 1			
1	4th Street and King Street	SF	AM PM	Signal	56.6 84.5	E F
2	4th Street and Townsend Street	SF	AM PM	Signal	28.9 28.8	C C
3	Mission Bay Drive and 7th Street	SF	AM PM	Signal	8.3 12.7	A B
4	Mission Bay Drive and Berry Street	SF	AM PM	Signal	2.3 8.4	A A
5	7th Street and 16th Street	SF	AM PM	Signal	67.3 49.5	E D
6	16th Street and Owens Street	SF	AM PM	Signal	10.6 10.7	B B
7	22nd Street and Pennsylvania Street	SF	AM PM	All-way Stop	7.6 7.3	A A
8	22nd Street and Indiana Street	SF	AM PM	All-way Stop	5.3 5.4	A A
9	Tunnel Avenue and Blanken Avenue	SF	AM PM	All-way Stop	7.9 7.2	A A
10	Linden Avenue and Dollar Avenue	SSF	AM PM	Signal	15.1 48.9	B D
11	East Grand Avenue and Dubuque Way	SSF	AM PM	Signal	7.5 7.5	A A
12	S Linden Avenue and San Mateo Avenue	SSF	AM PM	Signal	6.7 7.4	A A
13	Scott Street and Herman Street	SB	AM PM	Side-Street Stop	9.8 14.0	A B
14	Scott Street and Montgomery Avenue	SB	AM PM	Side-Street Stop	4.8 5.7	A A
15	San Mateo Avenue and San Bruno Avenue	SB	AM PM	Signal	10.9 >120	B F
			ZONE 2			
16	El Camino Real and Millbrae Avenue	MB	AM PM	Signal	43.4 42.7	D D
17	Millbrae Avenue and Rollins Road	MB	AM PM	Signal	33.0 38.8	C D
18	California Drive and Broadway	BG	AM PM	Signal	60 52.5	E D
19	Carolan Avenue and Broadway	BG	AM PM	Signal	16.6 42.1	B D
20	California Drive and Oak Grove Avenue	BG	AM PM	Signal	34.3 24.2	C C
21	Carolan Avenue and Oak Grove Avenue	BG	AM PM	Side-Street Stop	>120 92.1	F F

TABLE 2-18
EXISTING INTERSECTION DELAY AND LEVELS OF SERVICE (2013)

Int. ID	Intersection	Jurisdiction	Peak Hour	Intersection Control	Delay	LOS
22	California Drive and North Lane	BG	AM PM	Side-Street Stop	14.7 11.4	B B
23	Carolan Avenue and North Lane	BG	AM PM	Side-Street Stop	23.0 17.8	C C
24	Anita Road and Peninsula Avenue	BG	AM PM	Side-Street Stop	15.6 >120	C F
25	Woodside Way and Villa Terrace	SM	AM PM	Side-Street Stop	5.1 4.7	A A
26	North San Mateo Drive and Villa Terrace	SM	AM PM	Side-Street Stop	11.7 12.8	B B
27	Railroad Avenue and 1st Avenue	SM	AM PM	Side-Street Stop	10.4 19.0	B C
28	S B Street and 1st Avenue	SM	AM PM	Signal	22.6 30.5	C C
29	9th Avenue and S Railroad Avenue	SM	AM PM	Side-Street Stop	34.7 21.4	D C
30	S B Street and 9th Avenue	SM	AM PM	Signal	15.0 14.4	B B
31	Transit Center Way and 1st Avenue	SM	AM PM	Uncontrolled	5.1 26.7	A D
32	Concar Drive and SR 92 Westbound Ramps	SM	AM PM	Signal	6.0 6.1	A A
33	S Delaware Street and E 25th Avenue	SM	AM PM	Signal	19.1 20.6	B C
34	E 25th Avenue and El Camino Real	SM	AM PM	Signal	32.0 80.6	C F
35	31st Avenue and El Camino Real	SM	AM PM	Signal	19.2 68.7	B E
36	E Hillsdale Boulevard and El Camino Real	SM	AM PM	Signal	43.7 67.1	D E
37	E Hillsdale Blvd. and Curtiss Street	SM	AM PM	Signal	12.0 14.7	B B
38	Peninsula Avenue and Arundel Road and Woodside Way	SM	AM PM	Side-Street Stop	14.3 >120	B F
39	El Camino Real and Ralston Avenue	BL	AM PM	Signal	>120 85.4	F F
40	El Camino Real and San Carlos Avenue	SC	AM PM	Signal	25.6 47.1	C D
41	Maple Street and Main Street	RC	AM PM	Side-Street Stop	10.9 14.3	B B
42	Main Street and Beech Street	RC	AM PM	Side-Street Stop	5.2 8.6	A A
43	Main Street and Middlefield Road	RC	AM PM	Signal	12.5 20.1	B C
44	Broadway Street and California Street	RC	AM PM	Signal	60.0 >120	F F

TABLE 2-18
EXISTING INTERSECTION DELAY AND LEVELS OF SERVICE (2013)

Int. ID	Intersection	Jurisdiction	Peak Hour	Intersection Control	Delay	LOS
45	El Camino Real and Whipple Avenue	RC	AM PM	Signal	74.7 48.3	E D
46	Arguello Street and Brewster Avenue	RC	AM PM	Signal	14.7 39.4	B D
47	El Camino Real and Broadway Street	RC	AM PM	Signal	27.5 45.5	C D
48	Arguello Street and Marshall Street	RC	AM PM	Signal	15.1 48.7	B D
49	El Camino Real and James Avenue	RC	AM PM	Signal	26.2 33.7	C C
			ZONE 3			
50	El Camino Real and Fair Oaks Lane	AT	AM PM	Signal	33.6 27.6	C C
51	El Camino Real and Watkins Avenue	AT	AM PM	Side-street stop	34.5 48.1	D E
52	Fair Oaks Lane and Middlefield Road	AT	AM PM	Side-Street Stop	>120 41.3	F E
53	Watkins Avenue and Middlefield Road	AT	AM PM	Side-Street Stop	31.6 28.3	D D
54	Glenwood Avenue and Middlefield Road	AT	AM PM	Side-Street Stop	49.2 >120	E F
55	El Camino Real and Glenwood Avenue	MP	AM PM	Signal	34.1 29.6	C C
56	El Camino Real and Oak Grove Avenue	MP	AM PM	Signal	17.9 30.9	B C
57	El Camino Real and Santa Cruz Avenue	MP	AM PM	Signal	9.1 12.5	A B
58	Merrill St and Santa Cruz Avenue	MP	AM PM	All-way Stop	7.3 8.9	A A
59	Ravenswood Avenue and Alma Street	MP	AM PM	Side-Street Stop	24.4 17.1	C C
60	El Camino Real and Ravenswood Avenue	MP	AM PM	Signal	39.3 119.0	D F
61	Ravenswood Avenue and Laurel Street	MP	AM PM	Signal	31.0 26.3	C C
62	Alma Street and Palo Alto Avenue	PA	AM PM	Side-Street Stop	11.2 14.6	B B
63	Meadow Drive and Alma Street	PA	AM PM	Signal	72.6 62.0	E E
64	El Camino Real and Alma Street and Sand Hill Road	PA	AM PM	Signal	60.7 49.1	E D
65	High Street and University Avenue	PA	AM PM	Signal	12.6 14.1	B B
66	Alma Street and Churchill Avenue	PA	AM PM	Signal	66.0 64.0	E E

TABLE 2-18
EXISTING INTERSECTION DELAY AND LEVELS OF SERVICE (2013)

Int. ID	Intersection	Jurisdiction	Peak Hour	Intersection Control	Delay	LOS
67	W Meadow Drive and Park Blvd.	PA	AM PM	Side-Street Stop	>120 29.3	F D
68	Alma Street and Charleston Road	PA	AM PM	Signal	63.5 80.5	E F
69	Showers Drive and Pacchetti Way	MV	AM PM	Signal	4.5 3.7	A A
70	Central Expressway and N Rengstorff Avenue	MV	AM PM	Signal	108.0 85.0	F F
71	Central Expressway and Moffett Boulevard and Castro Street	MV	AM PM	Signal	100.2 83.0	F F
72	W Evelyn Avenue and Hope Street	MV	AM PM	Signal	3.0 4.0	A A
73	Rengstorff Avenue and California Street	MV	AM PM	Signal	50.3 55.6	D E
74	Castro Street and Villa Street	MV	AM PM	Signal	11.8 21.2	B C
75	W Evelyn Avenue and S Mary Avenue	SV	AM PM	Signal	62.4 61.5	E E
76	W Evelyn Avenue and Frances Street	SV	AM PM	Signal	16.1 23.4	B C
			ZONE 4			
77	Kifer Road and Lawrence Expressway	SCL	AM PM	Signal	96.6 >120	F F
78	Reed Avenue and Lawrence Expressway	SCL	AM PM	Signal	97.3 93.7	F F
79	El Camino Real and Railroad Avenue	SCL	AM PM	Signal	26.6 21.3	C C
80	W Santa Clara Street and Cahill Street	SJ	AM PM	Signal	10.4 12.7	B B
81	S Montgomery Street and W San Fernando Street	SJ	AM PM	Signal	7.9 9.6	A A
82	Lick Avenue and W Alma Avenue	SJ	AM PM	Signal	15.8 20.8	B C

Notes:
1. Jurisdictions:
SF San Francisco
SSF South San Francisco
SB San Bruno
MB Millbrae
BG Burlingame
SM San Mateo
BL Belmont
SC San Carlos
RC Redwood City
AT Atherton
MP Menlo Park
PA Palo Alto
MV Mountain View
SV Sunnyvale
SCL Santa Clara
SCC Santa Clara County
SJ San Jose

AM = morning peak hour, PM = afternoon peak hour
LOS designation as per 2010 Highway Capacity Manual

Delay measured in seconds.

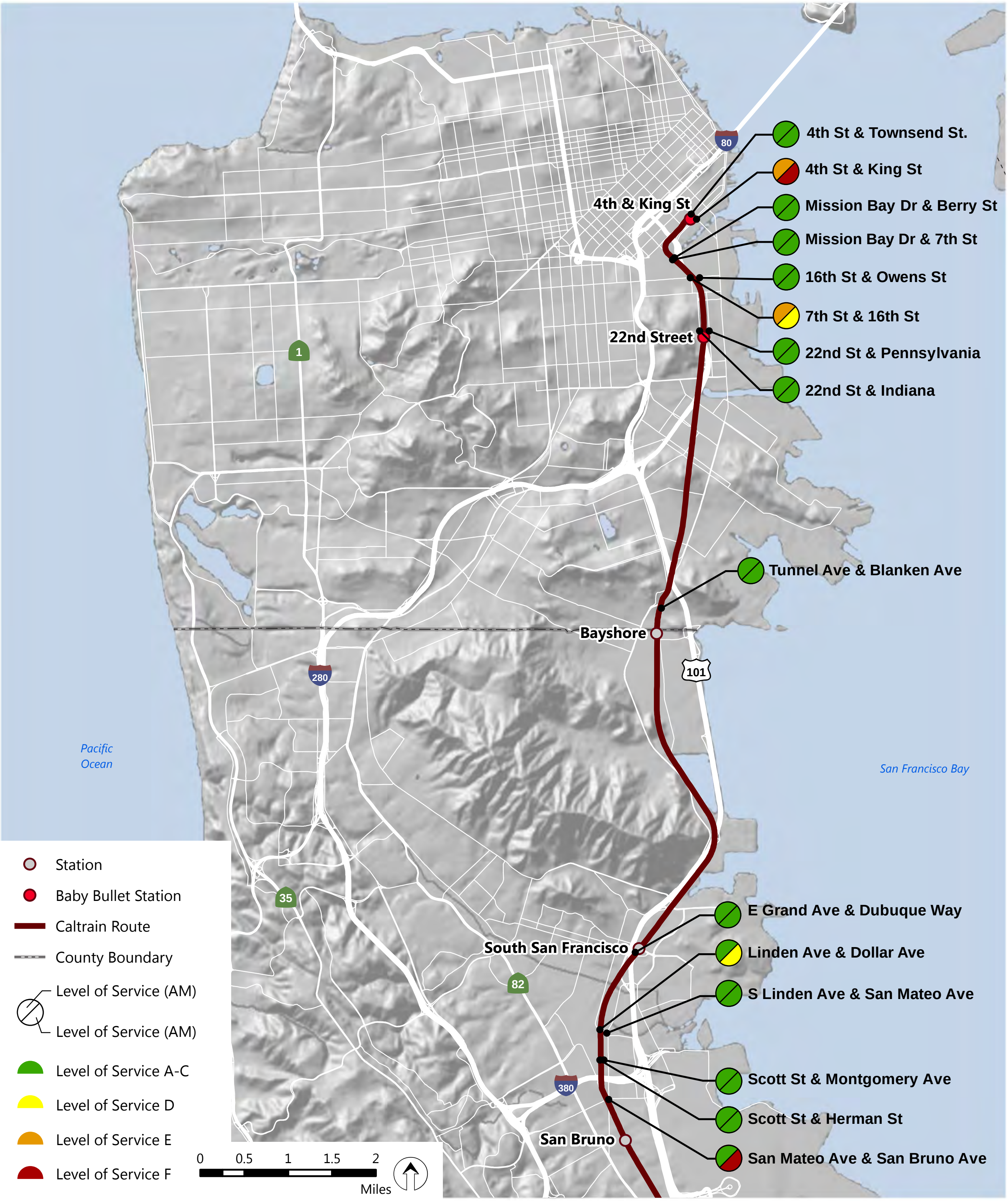

Figure 2-26

Existing AM & PM Peak Hour Intersection LOS, Zone 1

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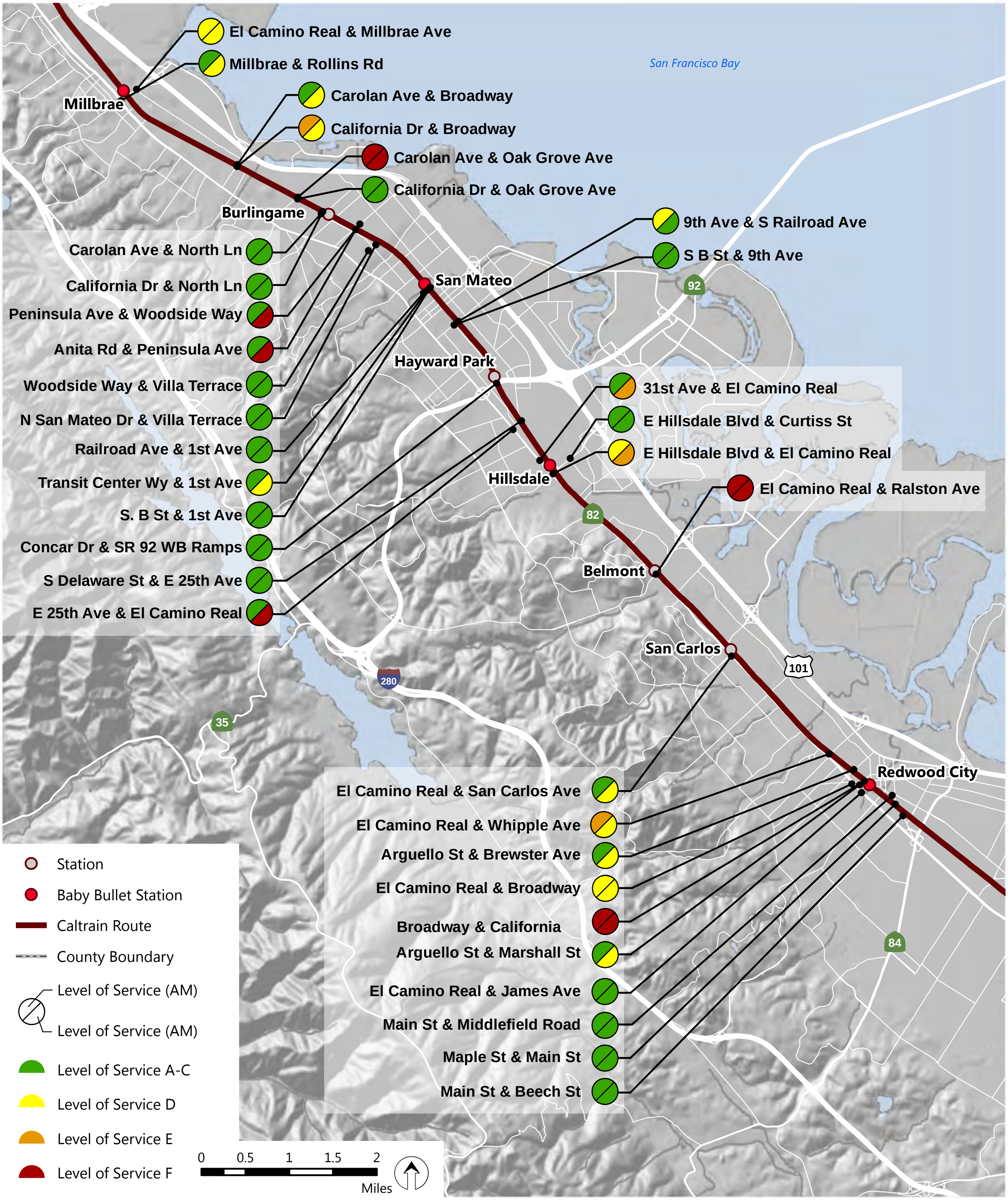

Figure 2-27

Existing AM & PM Peak Hour Intersection LOS, Zone 2

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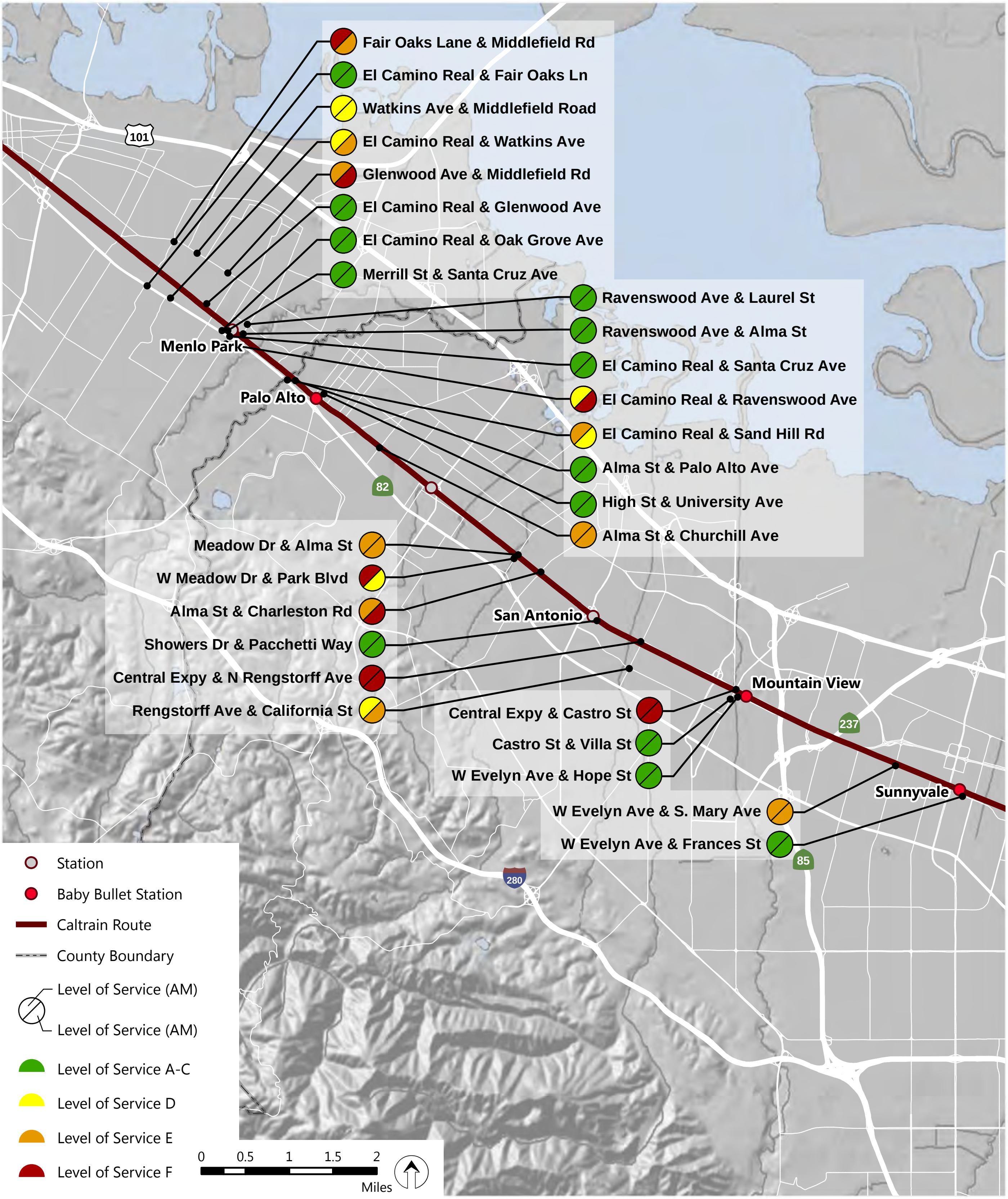

Figure 2-28

Existing AM & PM Peak Hour Intersection LOS, Zone 3

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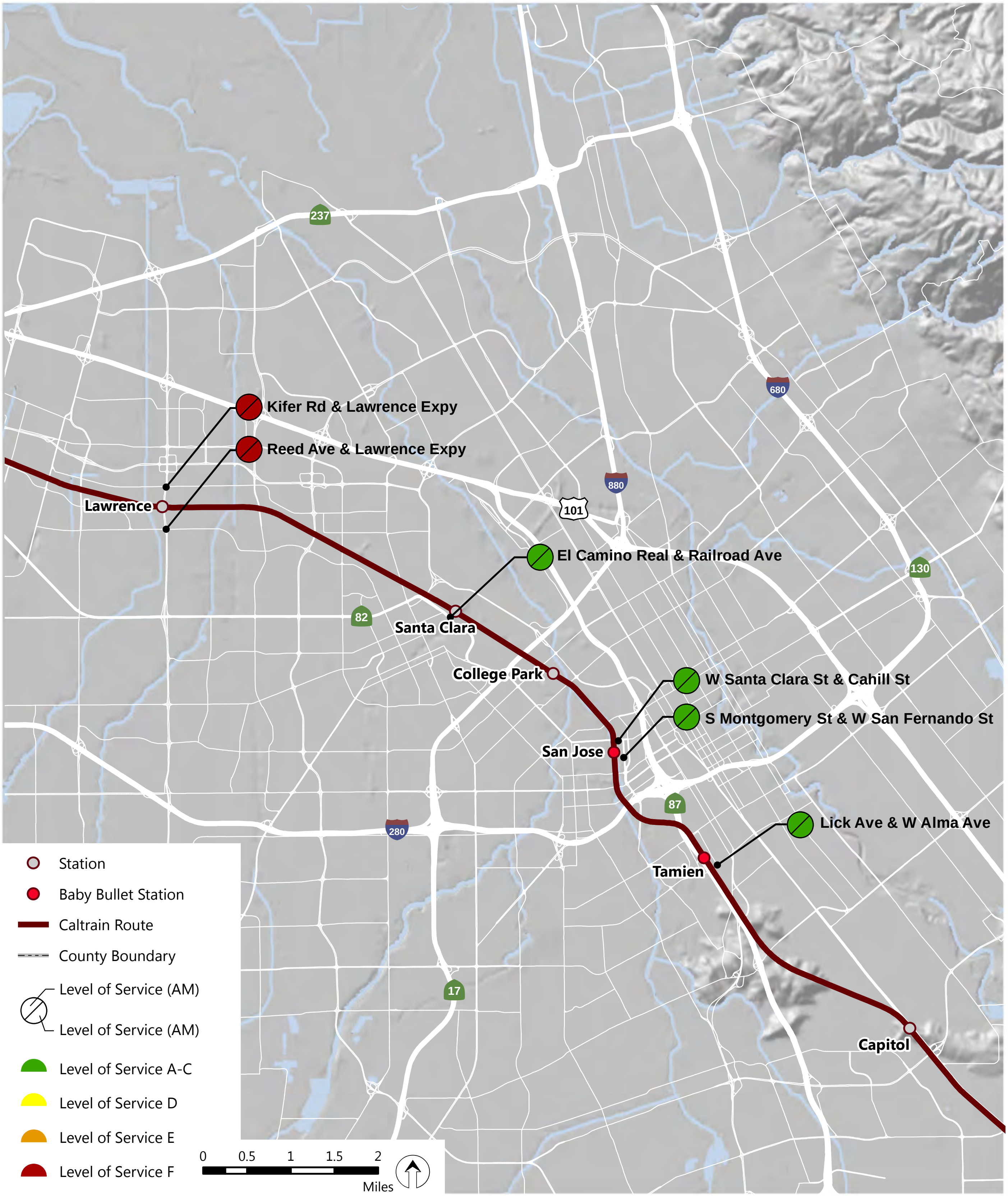

Figure 2-29

Existing AM & PM Peak Hour Intersection LOS, Zone 4

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2.7 EXISTING PARKING CONDITIONS

This section summarizes existing parking pricing, capacity, and occupancy at Caltrain parking lots located in station areas. In addition, the capacity of on-street parking and parking lots within the station areas are discussed. In general, Baby Bullet stations with Caltrain parking lots tend to experience the highest parking occupancy rates. As discussed in Section 2.1.3, about 13 percent of passengers drive alone to Caltrain stations and one percent carpool. Passengers who drove alone or carpooled, also referred to as park-and-ride passengers, generally park their car at or near the station during the duration of their trip. Some passengers may leave a second vehicle at their destination station in order to have access to a private automobile to get to their ultimate destination. In total, about 14 percent of Caltrain passengers are park-and-ride customers.

2.7.1 PARKING AT CALTRAIN STATION PARKING LOTS

The majority of Caltrain stations offer 24-hour parking. There are no Caltrain-operated parking lots at the 4th and King and 22nd Street Stations in San Francisco. Daily parking at Caltrain lots that charge for parking is currently priced at $5. Higher daily rates are charged at the San Jose Diridon Station during SAP Center events, as the SAP center is adjacent to the station parking lots. Parking is free at the Tamien Station. Figure 2-30 shows the, capacity, and occupancy for Caltrain lots in 2012. Table 2-19 displays parking capacity to occupancy at each station. Parking occupancy displayed in Table 2-19 and Figure 2-30 station is an average of monthly parking utilization at each station in Fiscal Year 2012.

Several stations are close to or beyond full parking capacity. Average daily parking is at full capacity at Sunnyvale, with 100 percent of cars parked in the lot. Parking at some Baby Bullet stations is very close to full capacity (90 percent or above), including: Mountain View, San Jose Diridon, and Tamien. Millbrae, Hillsdale, and Palo Alto Station parking lots are all between 75 percent and 90 percent full. Mode of access survey results indicate that at stations where parking is at, near, or beyond capacity, passengers who choose to drive tend to look for parking in non-Caltrain lots or on-street.

As discussed in Section 2.3.5.2, the Millbrae Station is a shared connection with BART. The parking lot facility at this station is shared between BART and Caltrain. In addition to the 170 parking stalls, BART provides 2,978 parking spots that are available to both Caltrain and BART passengers. Currently, there is available capacity at this station due to the large parking capacity at this shared parking lot.[8]

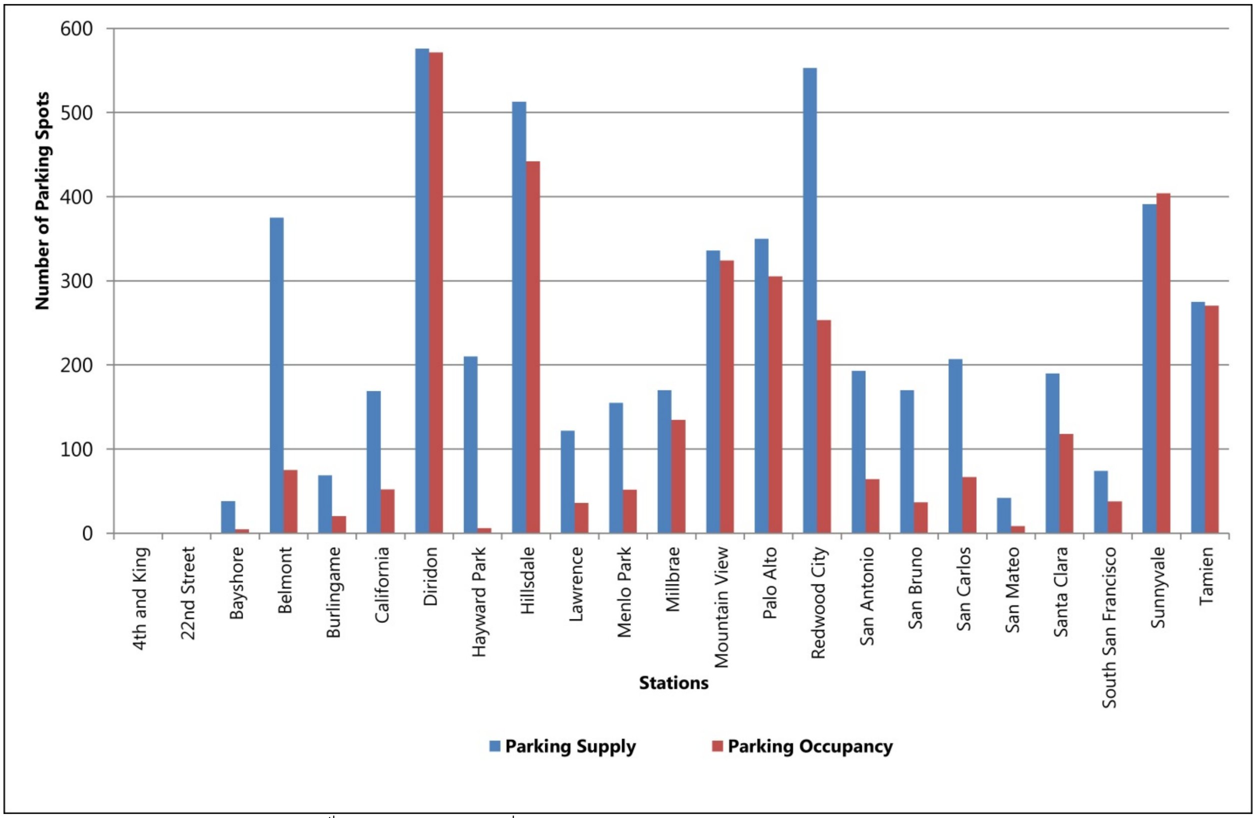
[8] Shared-parking spots with BART not reflected in Millbrae Station parking capacity discussed in this section.

TABLE 2-19
DAILY PARKING CAPACITY AND OCCUPANCY AT STATION LOTS (2012)

Station	Caltrain Parking Lot Available (Yes / No)	Parking Capacity (Number of Parking Spots)	Average Daily Parking Occupancy
4th and King	**No**	**--**	**--**
22nd Street	**No**	**--**	**--**
Bayshore	Yes	38	13%
South SF	Yes	74	51%
San Bruno	Yes	170	22%
Millbrae	**Yes**	**170**	**79%**[1]
Burlingame	Yes	69	30%
San Mateo	**Yes**	**42**	**20%**
Hayward Park	Yes	210	3%
Hillsdale	**Yes**	**513**	**86%**
Belmont	Yes	375	20%
San Carlos	Yes	207	32%
Redwood City	**Yes**	**553**	**46%**
Menlo Park	**Yes**	**155**	**33%**
Palo Alto	**Yes**	**350**	**87%**
California Avenue	Yes	169	31%
San Antonio	Yes	193	33%
Mountain View	**Yes**	**336**	**97%**
Sunnyvale	**Yes**	**391**	**100%**
Lawrence	Yes	122	30%
Santa Clara	Yes	190	62%
San Jose Diridon	**Yes**	**576**	**99%**
Tamien	**Yes**	**245**	**98%**

Source: Caltrain, 2012
Note: Stations with Baby Bullet service are displayed in **bold**.
1. Excludes shared parking with BART

Figure 2-30 Comparison of Parking Capacity to Occupancy at Station Lots (2012)



Source: Caltrain, 2012 Note: The 4th and King and 22nd Street Stations do not currently have Caltrain parking lots.

3.0 TRANSPORTATION IMPACT ANALYSIS

This section presents an analysis of transportation impacts for the 2020 and 2040 scenarios with and without the Proposed Project. First, the assumptions underlying all No Project and Project scenarios are presented along with the transportation significance criteria. The analysis of future conditions is presented in the following order: Ridership, Traffic, Pedestrian and Bike Systems, Safety Hazards, Emergency Vehicle Access, and Station Parking and Access.

3.1 2020 CHANGES IN BACKGROUND CONDITIONS

This section describes changes in conditions in the Study Area projected to occur by 2020. The changes in land use growth and regional transit connections are reflected in the inputs and assumptions used in the development of the transit ridership forecasts and projections for future traffic conditions.

3.1.1 LAND USE GROWTH BY 2020

Land use assumptions for 2020 were derived from the VTA/San Mateo City and County Association of Governments (C/CAG) Travel Demand Forecasting Model. C/CAG is the Congestion Management Agency (CMA) of San Mateo County. The VTA travel demand model was originally developed in 2009 by the Santa Clara Valley Transportation Authority to support the Grand Boulevard Initiative Corridor Project and the San Mateo Countywide Transportation Plan (CTP) update. The VTA travel demand model used in the CTP update was validated to year 2005 conditions and made use of the Association of Bay Area Governments (ABAG) Committed Regional Plans socioeconomic data forecasts (informally known as ABAG projections 2011) to develop forecast year 2035 projections.

VTA updated the C/CAG model for the Caltrain Electrification Project to reflect 2013 base year conditions, and adjusted and validated the model to reflect year 2013 Caltrain system ridership. Because Caltrain system ridership has been substantially increasing since 2005, it was important that the VTA travel demand model accurately reflects the current level of ridership. The 2013 model networks were updated from the original base year 2005 for both transit and highway network changes, including a comprehensive update of both public and private shuttles serving the Caltrain corridor, updated socioeconomic data forecasts prepared by ABAG, and updated background transportation improvements as defined in the *Plan Bay Area* Regional Transportation Plan adopted in mid-2013.

3.1.1.1 2020 Regional Population and Employment Growth

The socioeconomic data sets used as inputs to prepare the ridership forecasts were based on land use projections contained in the ABAG Sustainable Community Strategy (SCS) prepared in September 2012. These datasets are accepted by the MTC to reflect regional model consistency for models used by the Congestion Management Agencies and were used to develop the regional travel demand forecasts for *Plan Bay Area*. Table 3-1 shows households, population, and jobs for the years 2013, 2020 and 2040 for the project corridor. Overall, the Caltrain service area is projected to experience significant growth in households, population, and jobs, with fairly balanced levels of growth spread out between the three Counties that comprise the service area. In the short-term horizon from 2013 to 2020, jobs are increasing as a percentage of total faster than either households or population. As a result, the imbalance of jobs and housing in certain parts of the corridor is likely to continue, maintaining longer commute trips.

TABLE 3-1
PROJECTED POPULATION AND EMPLOYMENT IN 2013 AND 2020

San Francisco County	2013	2020	Percent Increase: 2013 to 2020
Households	355,600	379,100	6.6%
Population	824,200	884,300	7.3%
Jobs	598,000	671,600	12.3%
San Mateo County	**2013**	**2020**	**Percent Increase: 2013 to 2020**
Households	263,400	276,900	5.1%
Population	730,800	772,000	5.6%
Jobs	366,000	412,100	12.6%
Santa Clara County	**2013**	**2020**	**Percent Increase: 2013 to 2020**
Households	624,300	672,500	7.7%
Population	1,828,700	1,959,900	7.2%
Jobs	978,600	1,103,000	12.7%
Study Area Total	**2013**	**2020**	**Percent Increase: 2013 to 2020**
Households	1,243,300	1,328,500	6.9%
Population	3,383,700	3,616,200	6.9%
Jobs	1,942,600	2,186,700	12.6%

Source: VTA, 2013

3.1.2 CHANGES IN 2020 REGIONAL TRANSIT CONNECTIONS

For the forecast years, the project list from *Plan Bay Area* was used to code in improvements for the forecast year 2020 and 2040. Year of opening for projects identified in *Plan Bay Area* were provided by MTC for each project. The list of assumed background transit projects for forecast year 2020 is shown in Table 3-2. Assumed background highway projects are listed in Attachment B. This list includes projects in the Study as well as key projects a regional traveler would consider transferring to in order to complete an inter-regional trip in the San Francisco Bay Area.

TABLE 3-2
MAJOR REGIONAL BACKGROUND TRANSIT PROJECTS FOR FORECAST YEAR 2020

Description	Jurisdiction
Transbay Transit Center Phase 1	Multi-County
Caltrain Service Improvements (CBOSS, PTC)	Multi-County
SMART Rail	Multi-County
Union City Intermodal, DRC Segment G Improvement	Alameda
Oakland BRT (Telegraph BRT - AC Transit)	Alameda
Van Ness BRT "Center A" Scenario	San Francisco
MUNI T Line Central Subway to Chinatown	San Francisco
Geary BRT	San Francisco
Geneva-Harney BRT	San Francisco
SF Congestion Pricing - CBD Cordon	San Francisco
Caltrain Bayshore Intermodal Terminal	San Mateo
SamTrans BRT - Palo Alto to Daly City	San Mateo
Infrastructure to support SamTrans Rapid Bus	San Mateo
El Camino Real BRT	Santa Clara
Stevens Creek BRT	Santa Clara
BART Extension to Berryessa	Santa Clara
Tasman Express Long-T Alum Rock to Mountain View	Santa Clara

Source: VTA, 2013

3.2 2020 SCENARIOS

This section describes the assumptions included in the 2020 No Project and Project Scenarios analyzed for this impacts analysis. 2020 No Project assumptions are largely unchanged from existing conditions, with the exception of advanced train control technology and the relocation of one station in Zone 1. The key change in the 2020 Project scenario is the electrification of the Caltrain fleet working in conjunction with advanced train control technology to provide higher frequency, more dependable service to the Study Area. Section 3.2.1 provides detail on the 2020 No Project scenario. Section 3.2.2 provides detail on the 2020 Project scenario. Figure 3-1 displays the future Study Area for all 2020 and 2040 scenarios.

3.2.1 2020 NO PROJECT SCENARIO

The 2020 No Project Scenario is mostly identical to existing Caltrain capacity and operations. In terms of capacity, the 2020 No Project Scenario assumes the current fleet of diesel trains continues to operate based on current schedules. No additional vehicles are assumed to be added by 2020. Rolling stock will remain at 29 locomotives and 118 bi-level passenger cars.

The two main changes that are part of the 2020 No Project Scenario compared to existing conditions are:

- Relocation of the San Bruno Station from 297 Huntington Avenue to the new station location at the intersection of San Bruno Avenue and Huntington Avenue. The relocation includes the removal of three at-grade crossings at San Bruno, San Mateo, and Angus Avenues.
- Implementation of the Caltrain Communications Based Overlay Signal System (CBOSS) Positive Train Control (PTC) advanced signal system

3.2.1.1 Caltrain System Changes

3.2.1.1.1 Schedule and Service

As described in Section 2.3.1, the current Caltrain operating schedule is comprised of 92 trains each weekday. Currently Caltrain operates five trains per peak hour at the speed of 79 miles per hour (mph). Weekday trains are a mix of Baby Bullets, Limited, and Local trains. Weekend-only service will continue at Broadway and Atherton Stations. The schedule under the No Project Scenario in 2020 is identical to the 2013 schedule. As a result, no schedule changes will occur between 2013 and the 2020 No Project Scenario.

The location of the San Bruno Station will change in the 2020 No Project Scenario. As part of a grade-separation project currently under construction, the San Bruno Station will move from its current location at 297 Huntington Avenue to the corner of San Bruno and Huntington Avenue in 2014. The station relocation will not affect the schedule of frequency of trains at this station daily. Figure 3-1 displays the 2020 No Project Scenario, including the change of location for the San Bruno Station.

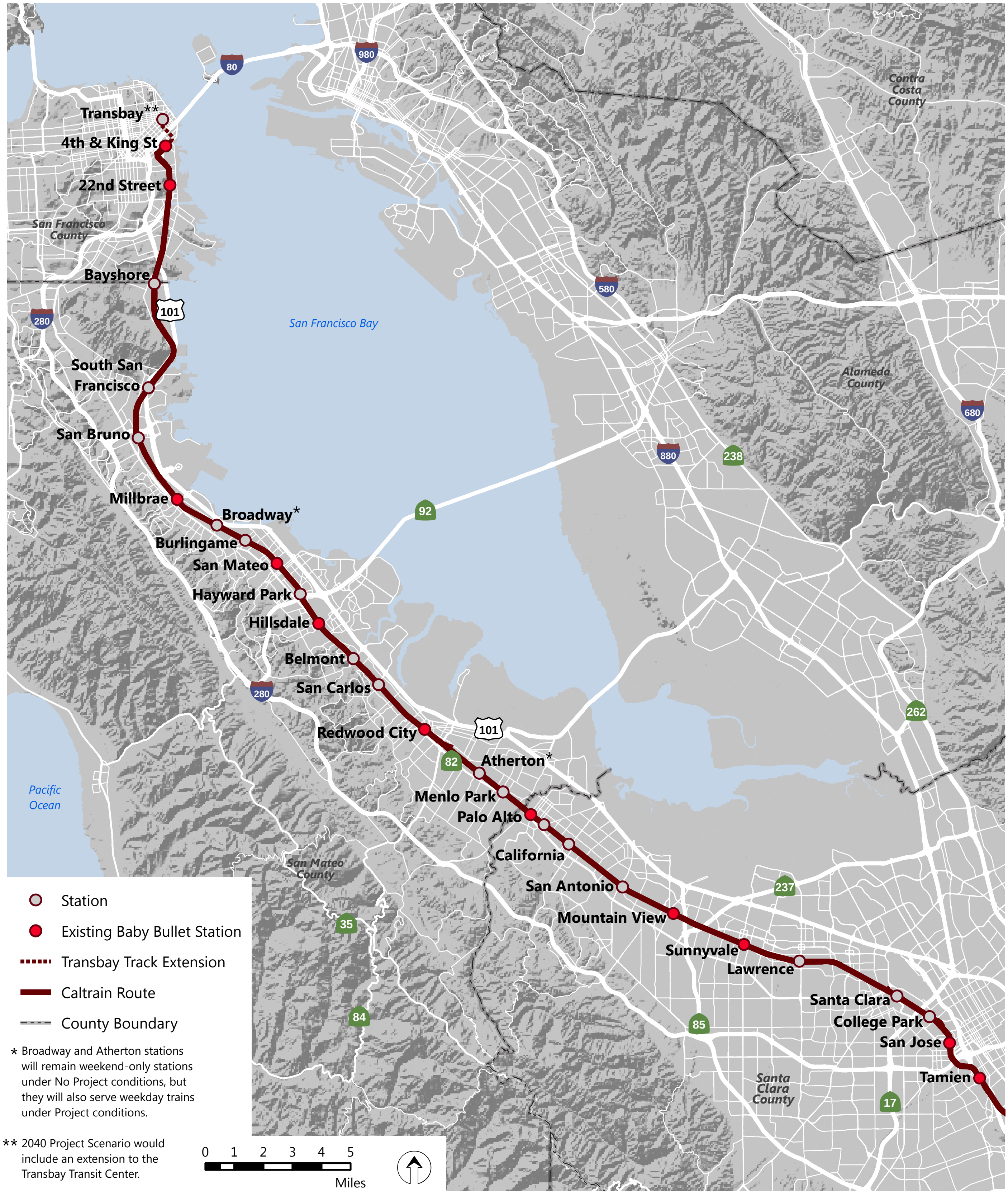


Figure 3-1

Future Study Areas:
2020 No Project Scenario, 2020 Project Scenario,
2040 No Project Scenario, and 2040 Project Scenario

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The number of daily trains on weekdays will remain at 92 in this scenario. The mix of service types – baby bullets, Limited, and Local trains – will also remain unchanged in the 2020 No Project Scenario. Further detail on daily trains on a system-wide level is displayed in Table 3-3 and Table 3-4. Table 3-3 displays the number of daily trains, by service type in the 2020 No Project Scenarios, as compared to existing. Table 3-4 displays the frequency of trains in the peak and off-peak periods in the 2020 No Project Scenarios, as compared to existing. Operating characteristics of each service type are discussed in Section 2.3.1. Because there is no change in the operating schedule between 2013 and 2020 No Project, train frequencies throughout the day remain unchanged.

TABLE 3-3
DAILY TRAINS, 2020 NO PROJECT

Service and Train Type	Existing and 2020 No Project
Daily Bullet Trains	22
Limited Trains	42
Local Trains	28
Total Daily Trains (system-wide)	92

Sources: "Schedules." (2013) *San Mateo County Transit District*; Santa Clara Valley Transportation Authority, 2013

TABLE 3-4
DAILY PEAK AND OFF-PEAK TRAIN FREQUENCIES, 2020 NO PROJECT

Service and Train Type	Existing and 2020 No Project
Early Morning Off-Peak (4:00AM – 5:59 AM)	6
AM Peak (6:00 – 8:59 AM)	27
Midday (9:00 AM – 3:59 PM)	20
PM Peak (4:00 – 6:59 PM)	30
Evening Off-Peak (7:00 PM – 2:00 AM)	9
Total Daily Trains (system-wide)	92

Sources: "Schedules." (2013) *San Mateo County Transit District*; Santa Clara Valley Transportation Authority, 2013
Note: Time periods include all trains that departed either from 4th and King Station in San Francisco (Southbound) and the San Jose Diridon Station (Northbound) within the hours specified.

Similarly, daily train frequencies at the station-level are unchanged between existing conditions and the 2020 No Project scenario. Travel times between stations also do not change between existing conditions and 2020 No Project.

3.2.1.1.2 CBOSS PTC Advanced Signal System

The 2020 No Project Scenario will include the full implementation of the CBOSS PTC advanced signal system. Caltrain is currently controlled by a wayside block signal system that constrains capacity (Section 2.6.3).

CBOSS stands for Communications Based Overlay Signal System and PTC stands for Positive Train Control. The CBOSS PTC Project is a complementary, but separate component within the Caltrain Modernization program. Currently under construction, this project will increase the operating performance of the current signal system, improve the efficiency of grade crossing warning functions, and automatically stop a train when there is violation of speed or route. This project, which includes implementation of safety improvements mandated by federal law, is scheduled to be operational by 2015 as mandated by the Federal Railroad Administration (FRA) per the *Railroad Safety Improvement Act of 2008*. CBOSS is an overlay system and the existing wayside signal system will remain intact. The interface to the any Study Area city's traffic signal system from the highway-grade crossing system will remain the same. The effect of the CBOSS PTC system will also be to remove gate restarts at stations in close proximity to grade crossings.

The CBOSS PTC system will monitor, and if necessary, control train movement in the event of human error. This will increase safety both on the tracks and at at-grade crossings by: eliminating the risk of train-to-train collisions, reduce risk of potential derailments by enforcement speed limits on the right-of-way, and provide additional safety for railroad workers on the tracks. The system will also improve reliability and operating performance by: improve management of train schedules, eliminate trains overshooting a station stop or platform, and improve grade crossing performance. Travelers crossing the tracks via car, bike, or on foot will benefit from reduced gate down times and associated reductions in delay at intersections adjacent to at-grade rail crossings. CBOSS PTC will also enable interoperability between all rail services operating on the same tracks, including freight (San Mateo County Transit District, "CBOSS" 2013).

3.2.2 2020 PROJECT SCENARIO

The 2020 Project consists of converting Caltrain from diesel-hauled to EMU trains for 75 percent of the service between the 4th and King Street Station in San Francisco and the Tamien Station in San Jose.

The 2020 Project scenario includes the following main changes from existing conditions:

- Conversion of Caltrain from diesel-hauled to EMU trains for 75 percent of the service between the 4th and King Street Station in San Francisco and the Tamien Station in San Jose.
- Installation of new electrical infrastructure, including Traction Power Supply Substations and overhead wire systems
- Operation of up to six Caltrain trains per peak hour, per direction at operating speeds of up to 79 mph
- CBOSS PTC advanced signaling system (in place by 2015)
- Inclusion of all changes in 2020 regional transit connections summarized in Section 3.1.2.

3.2.2.1 Project System Changes

By 2020, the Project would replace approximately 75 percent of the revenue service fleet with EMUs for service from San Francisco to San Jose. Diesel service would continue from Gilroy to San Jose under all scenarios.[9] Caltrain's diesel-powered locomotive service would continue to be used to provide service between the Gilroy, San Jose, and San Francisco.[10] The level of Caltrain operations and, therefore, fleet requirements under the Project scenario are based on six trains per peak hour per direction (PPHPD) from Tamien Station in San Jose to San Francisco, with a mixed EMU and diesel locomotive fleet. Caltrain service would also continue to include six diesel-powered trains per day from Gilroy to San Francisco in 2019. Fleet requirements under the Proposed Project are presented in Table 3-5.

TABLE 3-5
FLEET REQUIREMENTS FOR ELECTRIFICATION PROGRAM

Year	Diesel Locomotive	Electric Multiple Units	Diesel-Hauled Coaches/Cabs	Total Passenger Vehicles
Year 2019* (six trains per peak hour and direction)	9	96	45	150
Year 2040** (six trains per peak hour and direction)	6	138 to 150	31	175 to 187

* The majority of vehicles would be replaced in 2019 as they reach the end of their design life. Additional vehicles would be replaced after 2019 as they reach the end of their design life.
** Diesel operation limited to San Jose – Gilroy shuttle service in 2040. 2040 operations assume fully electrified operations between San Jose and San Francisco and that the San Francisco Downtown Extension (DTX) has been completed. However, the Proposed Project only includes funding for 75 percent of the rolling stock for this service at this time. The fleet estimates for 2040 are only conceptual at this time.

EMUs are more economically and environmentally efficient than the current diesel-powered locomotives. In addition, EMUs can accelerate and decelerate faster than diesel vehicles. The procurement of the full EMU vehicle fleet is considered a separate project in the Caltrain Modernization Program. The electrification system envisioned for the corridor would be configured in such a way that it would support the future operation of California HSR, if constructed in the future. High-speed rail construction and operations would be the subject of a separate environmental analysis to be conducted by CHSRA and FRA.

The Project would require the installation of 130 to 140 single-track miles of overhead contact system (OCS) for the distribution of electrical power to the electric rolling stock. The OCS would be powered from a 25 kilovolt (kV), 60 Hertz (Hz), single-phase, alternating current (AC) supply system consisting of traction power substations (TPSs), one switching station (SWS), and paralleling stations (PSs).

[9] This project only includes funding for EMUs representing approximately 75 percent of the operational fleet between San Jose and San Francisco. In 2019, some peak period service (e.g., bullet/Gilroy-SF trains) would be diesel on weekdays. All other service, including off-peak, would be EMU-based in 2019. Funding for replacement of the remainder of the diesel fleet between San Jose and San Francisco would have to come from future funding sources. It is expected that 100 percent of the San Jose to San Francisco fleet would be EMUs by 2026 to 2029, because the fleet would need to be fully electrified to operate in a Blended Service environment with HSR. Fully electrified service between San Jose and San Francisco is included in the cumulative impact analysis contained in Chapter 4, *Other CEQA-Required Analysis*, but is not part of the Proposed Project.
[10] The Proposed Project only includes electrification to a point approximately 2 miles south of Tamien Station (the JPB-owned ROW). The Union Pacific Corridor south of this point would not be electrified by this Project.

3.2.2.1.1 Schedule and Service

The 2020 Project schedule assumes a fully electrified rail corridor with CBOSS and PTC signal control. Combined, these two improvements allow for substantial capacity and operating performance improvements for all service types (Baby Bullets, Limited, and Local trains).

Table 3-6 displays the number of daily trains, system-wide, in the 2020 Project Scenario. Note that all schedule-based analysis is based on a prospective 2020 schedule that was developed only for analytical purposes for this TIA. Although the schedule has yet to be finalized, it is the best available data to be used for identifying the potential traffic operation impact of the project. The actual schedule may vary, which could influence the schedule at some of the local stations, but would not be expected to substantially change the estimated vehicle delay at the study intersections The number of daily weekday trains will increase from the current 92 to 114. Two more bullets would be added daily, in addition to four more Limited trains, and 14 more Locals, as compared to existing conditions and 2020 No Project scenario.

TABLE 3-6
SYSTEM-WIDE DAILY TRAINS, 2020 PROJECT WITH PROTOTYPICAL SCHEDULE

Service and Train Type	Existing (2013) and 2020 No Project	2020 Project
Daily Bullet Trains	22	24
Limited Trains	42	48
Local Trains	28	42
Total Daily Trains	92	114

Sources: “Schedules.” (2013) *San Mateo County Transit District*; Santa Clara Valley Transportation Authority, 2013

The frequencies of trains in the peak and off-peak also change in the 2020 Project scenario. Table 3-7 displays daily peak and off-peak train frequencies in the 2020 Project scenario. Although the number of early morning off-peak trains decrease, trains in all other time period categories increase, as compared to existing conditions and 2020 No Project. In the AM Peak, 11 more trains are added. In the PM peak period six more trains Caltrain would add to the schedule. Midday trains increase by six and one more evening train Caltrain would add to the schedule. The greatest service gains, as measure by train frequencies, occur in the AM and PM peak.

TABLE 3-7
DAILY PEAK AND OFF-PEAK TRAIN FREQUENCIES, 2020 PROJECT SCENARIO WITH PROTOTYPICAL SCHEDULE

Service and Train Type	2013 (Existing) and 2020 No Project	2020 Project
Early Morning Off-Peak (4:00AM – 5:59 AM)	6	4
AM Peak (6:00 – 8:59 AM)	27	38
PM Peak (4:00 – 6:59 PM)	30	36
Midday (9:00 AM – 3:59 PM)	20	26
Evening Off-Peak (7:00 PM – 2:00 AM)	9	10
Total Daily Trains (system-wide)	92	114

Sources: "Schedules." (2013) *San Mateo County Transit District*; Santa Clara Valley Transportation Authority, 2013
Note: Time periods include all trains that departed either from 4th and King Station in San Francisco (Southbound) and the San Jose Diridon Station (Northbound) within the hours specified.

Table 3-8 displays daily trains by station in the 2020 Project Scenario as compared to existing conditions and 2020 No Project Scenario. The total number of daily trains serving each station increases across the Study Area, with the exception of College Park, which Caltrain will continue to serve with four trains daily. Two stations that do not have weekday service in existing conditions and the 2020 No Project conditions will have weekday service in the 2020 Project conditions: Broadway and Atherton Stations.

TABLE 3-8
DAILY CALTRAIN TRAINS BY STATION, 2020 NO PROJECT AND 2020 PROJECT WITH PROTOTYPICAL SCHEDULE

Stations	Existing (2013) and 2020 No Project	2020 Project Daily Trains	Change with Project
4th and King	92	114	+22
22nd Street	58	90	+42
Bayshore	40	66	+26
South San Francisco	46	78	+32
San Bruno	56	66	+10
Millbrae	82	114	+32
Broadway	0	54	+54
Burlingame	58	66	+8
San Mateo	70	96	+26
Hayward Park	40	66	+26
Hillsdale	74	102	+28
Belmont	46	66	+20
San Carlos	64	78	+14
Redwood City	72	102	+30
Atherton	0	54	+54
Menlo Park	66	96	+30
Palo Alto	86	108	+22
California Avenue	52	66	+14
San Antonio	46	66	+20
Mountain View	80	108	+28
Sunnyvale	62	84	+22
Lawrence	56	66	+10
Santa Clara	58	66	+8
College Park	4	4	No change
San Jose Diridon	92	114	+22
Tamien	40	48	+8

Source: "Stations." (2013) San Mateo County Transit District.
Note: Transbay Terminal Station will not be in place until the 2040 Project Scenario

3.2.2.1.2 CBOSS PTC Advanced Signal System

Like the 2020 No Project Scenario, the 2020 Project Scenario will include the full CBOSS PTC system. CBOSS PTC combined with the EMU fleet would improve headways and operation flexibility by allowing trains to travel closer together along the right-of-way. This translates to more frequent and dependable passenger service. In addition, Because EMU trains are more efficient than the current diesel-powered locomotives, EMUs would help improve operational capacity as they can accelerate and decelerate faster than diesel-hauled vehicles. As a result, EMUs would provide faster and or more frequent service to more stations and by extension, more passengers.

3.3 2040 CHANGES IN BACKGROUND CONDITIONS

This section describes changes in background and existing conditions in the Study Area projected to occur by 2040. The changes in land use growth and regional transit connections are reflected in the inputs and assumptions used in the preparation of the direct ridership and traffic models.

3.3.1 LAND USE GROWTH BY 2040

Land use assumptions for 2040 were derived from the VTA Model. The 2013 VTA travel demand model networks were updated from the original base year 2005 for both transit and highway network changes, including a comprehensive update of both public and private shuttles serving the Caltrain corridor, updated 2040 socioeconomic data forecasts prepared by ABAG, and updated background transportation improvements as defined in the recently adopted *Plan Bay Area* Regional Transportation Plan.

3.3.1.1 Regional Population and Employment Growth

The socioeconomic data sets used as inputs to prepare the ridership forecasts were based on the ABAG Sustainable Community Strategy (SCS) prepared in September 2012. These datasets are accepted by the MTC to reflect regional model consistency for models used by the Congestion Management Agencies and were used to develop the regional travel demand forecasts for *Plan Bay Area*. Table 3-9 shows households, population, and jobs for the years 2013, 2020 and 2040 for the project corridor. Overall, the Caltrain service area is projected to experience significant growth in households, population, and jobs, with fairly balanced levels of growth spread out among the three Counties that comprise the service area. In the long-term horizon from 2013 to 2040, households and population increase as a percentage basis at a similar pace as jobs. Santa Clara County households, population, and jobs grow at a slightly faster rate than San Francisco and San Mateo Counties on both a percentage and absolute basis.

TABLE 3-9
PROJECTED POPULATION AND EMPLOYMENT IN 2020 AND 2040

San Francisco County	2013	2020	Percent Increase 2013 to 2020	2040	Percent Increase 2013 to 2040
Households	355,600	379,100	6.6%	447,200	25.8%
Population	824,200	884,300	7.3%	1,076,300	30.6%
Jobs	598,000	671,600	12.3%	760,200	27.1%
San Mateo County	**2013**	**2020**	**Percent Increase 2013 to 2020**	**2040**	**Percent Increase 2013 to 2040**
Households	263,400	276,900	5.1%	316,900	20.3%
Population	730,800	772,000	5.6%	899,200	23.0%
Jobs	366,000	412,100	12.6%	462,900	26.5%
Santa Clara County	**2013**	**2020**	**Percent Increase 2013 to 2020**	**2040**	**Percent Increase 2013 to 2040**
Households	624,300	672,500	7.7%	819,600	31.3%
Population	1,828,700	1,959,900	7.2%	2,411,700	31.9%
Jobs	978,600	1,103,000	12.7%	1,263,800	29.1%
Study Area Total	**2013**	**2020**	**Percent Increase 2013 to 2020**	**2040**	**Percent Increase 2013 to 2040**
Households	1,243,300	1,328,500	6.9%	1,583,700	27.4%
Population	3,383,700	3,616,200	6.9%	4,387,200	29.7%
Jobs	1,942,600	2,186,700	12.6%	2,486,900	28.0%

Source: VTA, 2013

3.3.2 CHANGES IN 2040 REGIONAL TRANSIT SERVICE

For the forecast years, the project list from *Plan Bay Area* was used to code in improvements for the forecast year 2020 and 2040. Year of opening for projects identified in *Plan Bay Area* were provided by MTC for each project. The list of assumed background transit projects for forecast year 2040 is shown in Table 3-10, and background highway projects are listed in Attachment B. These lists include projects in the Study as well as key projects a regional traveler would consider transferring to in order to complete an inter-regional trip in the San Francisco Bay Area. All 2020 projects are also included in Table 3-10

TABLE 3-10
MAJOR REGIONAL BACKGROUND TRANSIT PROJECTS FOR FORECAST YEAR 2040

Description	Jurisdiction
SMART Rail	Multi-County
Caltrain Service Improvements (CBOSS, PTC)	Multi-County
Transbay Center and Caltrain DTX Phase 2	Multi-County
Union City Intermodal, DRC Segment G Improvement	Alameda
Commuter Rail service - Peninsula and East Bay (DRC service)	Alameda
Oakland BRT (Telegraph BRT - AC Transit)	Alameda
Southern Intermodal Terminal - MUNI T line to Caltrain Bayshore	San Francisco
SF Congestion Pricing - CBD Cordon	San Francisco
Van Ness BRT "Center A" Scenario	San Francisco
MUNI T Line Central Subway to Chinatown	San Francisco
MUNI E Line	San Francisco
Ferry Service to Treasure Island	San Francisco
Geary BRT	San Francisco
Geneva-Harney BRT	San Francisco
Central Subway to North Beach	San Francisco
Redwood City to SF Ferry Service	San Mateo
Caltrain Bayshore Intermodal Terminal	San Mateo
SamTrans BRT - Palo Alto to Daly City	San Mateo
Infrastructure to support SamTrans Rapid Bus	San Mateo
Mineta San Jose APM Connector	Santa Clara
El Camino Real BRT	Santa Clara
Stevens Creek BRT	Santa Clara
BART Extension to Berryessa	Santa Clara
BART Extension to Santa Clara (Phase 2)	Santa Clara
Tasman Express Long-T Alum Rock to MTV	Santa Clara

Source: VTA, 2013

3.4 2040 SCENARIOS

This section describes the assumptions included in the 2040 No Project and Project scenarios analyzed for this impacts analysis. The 2040 No Project scenario assumptions are identical to 2020 No Project scenario assumptions for Caltrain service, but land use is different. The key change in the 2040 Project scenario as compared to the 2020 Project scenario is the addition of the Downtown Rail Extension, which will extend Caltrain and HSR service to the Transbay Transit Center in Downtown San Francisco. Section 3.4.1 provides an overview of the 2040 No Project scenario. Section 3.4.2 provides detail on the 2040 Project scenario. Figure 3-1 displays the future Study Area for all 2020 and 2040 scenarios.

3.4.1 2040 NO PROJECT SCENARIO

The 2040 No Project scenario assumptions are identical the 2020 No Project scenario assumptions described in Section 3.2.1. The operating schedule and rolling stock will remain as it is in existing conditions. As with the 2020 No Project scenario, the 2040 No Project scenario assumes the relocation of the San Bruno Station and the inclusion of the CBOSS PTC system. Figure 3-1 displays the 2040 No Project scenario.

3.4.2 2040 PROJECT SCENARIO

The 2040 Project scenario includes the following main assumptions

- Continued use EMU trains and the accompanying electrical infrastructure in the Study Area
- Operation of up to six Caltrain trains per peak hour, per direction at operating speeds of up to 79 mph
- Inclusion of all changes in 2020 regional transit connections summarized in Section 3.1.2 and all 2040 regional transit connections summarized in Section 3.3, most notably the Downtown Rail Extension to the Transbay Transit Center.
- Continued use of CBOSS PTC advanced signaling system

Gilroy Shuttle Service will continue to operate on diesel-hauled locomotives from Gilroy to San Jose Diridon.

3.4.2.1 System Changes

The major change assumed in the 2040 Project scenario is the extension of service from the current northern terminus of Caltrain service at 4th and King to the Transbay Transit Center located at in downtown San Francisco at Main and 2nd Streets and is currently under construction. The addition of the Transbay Transit Center increases the total number of stations in the Study Area from 27 to 28.[11]

The extension of service from 4th and King to the Transbay Transit Center has been addressed in a separate environmental review process. When completed, the Transbay Transit Center will not only service Caltrain but a number of other regional and state-wide transit systems, improving connectivity from the Caltrain system to other systems. More information on the Transbay Transit Center and the Downtown Rail Extension is in Section 2.4.2.1. Figure 3-1 displays the 2040 Project scenario including the new Caltrain station at the Transbay Transit Center and the extension of track to this location.

3.4.2.1.1 Schedule and Service

The 2040 Project scenario operating schedule differs from the 2020 Project scenario schedule. While both the 2020 and 2040 schedules assume six Caltrain trains per peak hour, per direction at a maximum speed of 79 miles per hour, the 2040 Project schedule is a mix of Baby Bullet, Limited (skip-stop), and Local trains

[11] 2040 Project conditions assume the Caltrain Downtown Extension to the Transbay Transit Terminal.

at differing frequencies than assumed in 2020. Northbound trains in the Study Area begin service at either Tamien or Diridon Stations and terminate at 4th and King or the Transbay Transit Center. Southbound trains in the Study Area begin service at either the Transbay Transit Center or the 4th and King Station and terminate at either Tamien or San Jose Diridon Stations.

The Gilroy Shuttle Service will continue to operate on diesel-hauled locomotives to San Jose Diridon. The three northbound trains that depart from Gilroy in the AM peak operate as bullet trains upon reaching San Jose Diridon until terminating at the 4th and King Station. Southbound, trains that serve Gilroy operate in a similar fashion, with the exception of Local train 467 with a longer travel time due to stopping at almost all stations along the corridor.

Table 3-11 displays daily trains in the 2040 Project scenario by service type. In the AM peak, NB bullet trains are tall trains with travel time of less than or equal to one hour and five minutes (1:05) and southbound bullet trains are those with a total travel time of less than or equal to one hour and ten minutes (1:10). In the PM peak, northbound bullet trains are all trains with a total travel time less than or equal to one hour and six minutes (1:06) and southbound bullet trains are those with a total travel time of less than one hour and ten minutes (1:10). Table 3-12 displays train frequencies system-wide by time period. Compared to the 2040 No Project scenario, the number of trains increases in all time periods except for early morning (4:00 AM – 5:59 AM).

TABLE 3-11
SYSTEM-WIDE DAILY TRAINS, 2040 PROJECT WITH PROTOTYPICAL SCHEDULE

Service and Train Type	Existing (2013)	2020 Project	2040 Project
Baby Bullet Trains	22	24	35
Limited Trains	42	48	37
Local Trains	28	42	42
Total Daily Trains	92	114	114

Sources: "Schedules." (2013) *San Mateo County Transit District*; Santa Clara Valley Transportation Authority, 2013

TABLE 3-12
DAILY PEAK AND OFF-PEAK TRAIN FREQUENCIES, 2040 PROJECT WITH PROTOTYPICAL SCHEDULE

Service and Train Type	2013 and 2020 No Project and 2040 No Project	2020 Project	2040 Project
Early Morning Off-Peak (4:00AM – 5:59 AM)	6	4	4
AM Peak (6:00 – 8:59 AM)	27	38	36
PM Peak (4:00 – 6:59 PM)	30	36	28
Midday (9:00 AM – 3:59 PM)	20	26	36
Evening Off-Peak (7:00 PM – 2:00 AM)	9	10	10
Total Daily Trains (system-wide)	92	114	114

Sources: "Schedules." (2013) *San Mateo County Transit District*; Santa Clara Valley Transportation Authority, 2013
Note: Time periods include all trains that departed either from 4th and King Station in San Francisco (Southbound) and the San Jose Diridon Station (Northbound) within the hours specified.

Table 3-13 displays daily trains serving stations in the Study area in the 2040 Project scenario as compared to existing conditions and 2020 No Project and 2040 No Project and 2020 Project scenarios. Compared to the 2040 No Project scenario, the total number of daily trains serving the majority of stations increases, with the exception of College Park where trains would decrease from four to one daily. In comparison to the 2020 Project scenario, the 2040 Project scenario introduces some gains in train frequency at the station-level. Many stations would experience an increase in the number of trains, while some experience slight decreases, including: 4th and King, 22nd Street, Bayshore, South San Francisco, Broadway, San Mateo, Hayward Park, Menlo Park, College Park, and Tamien.

TABLE 3-13
DAILY CALTRAIN TRAINS BY STATION, 2040 PROJECT WITH PROTOTYPICAL SCHEDULE

Station	Existing (2013),2020 No Project, and 2040 No Project	2020 Project Daily Trains	2040 Project Daily Trains
Transbay Center	Not applicable	Not applicable	66
San Francisco	92	114	48
22nd Street	58	90	84
Bayshore	40	66	54
South San Francisco	46	78	60
San Bruno	56	66	66
Millbrae	82	114	114
Broadway	0	54	51
Burlingame	58	66	66
San Mateo	70	96	90
Hayward Park	40	66	54
Hillsdale	74	102	102
Belmont	46	66	66
San Carlos	64	78	78
Redwood City	72	102	102
Atherton	0	54	54
Menlo Park	66	96	90
Palo Alto	86	108	114
California Avenue	52	66	66
San Antonio	46	66	66
Mountain View	80	108	114
Sunnyvale	62	84	90
Lawrence	56	66	66
Santa Clara	58	66	66
College Park	4	4	1
San Jose Diridon	92	114	114
Tamien	40	48	46

Sources: "Schedules." (2013) *San Mateo County Transit District*; Santa Clara Valley Transportation Authority, 2013

Bullet Trains in the 2040 Project scenario would have more scheduled stops than existing bullet trains, meaning bullet trains would serve more stations. An average of 13 stops are made by baby bullet trains in the 2040 Project scenario compared to the average of seven stops made by bullet trains in all other scenarios and existing conditions. The following stations would have bullet service only in the 2040 Project scenario: Bayshore; South San Francisco; San Bruno; Broadway; Hayward Park; Belmont; San Carlos; Atherton; Menlo Park; California Avenue; San Antonio; Lawrence; and Santa Clara. Tamien would not have bullet trains in the 2040 Project scenario, but would have Local and Limited trains.

3.4.2.1.2 CBOSS PTC Advanced Signal System

Like all other future project and no project scenarios, the 2040 Project scenario will include the full CBOSS PTC system. Federal law requires the CBOSS PTC system to be interoperable with all rail service along the Caltrain corridor including high-speed rail. Caltrain is working in close coordination with the California High Speed Rail Authority (CHSRA) to ensure the project is compatible with future high-speed rail service.

3.4.2.2 Cumulative Plus 2040 Project Scenario and California High-Speed Rail Blended Service

As discussed below, HSR service could change station area traffic patterns around the San Jose Diridon, Millbrae, and Transbay Terminal Stations (as well as the Redwood City Station if ultimately proposed). For the reasons disclosed below, the specific effect of HSR service on the Caltrain corridor around stations and on gate-down time for remaining grade crossing locations was not analyzed as part of the traffic analysis. This section provides background on the HSR blended system planning to date.

In 2009, CHSRA began project-level analysis of a grade separated four-track system between San Jose and San Francisco including completing an alternatives analysis and a supplemental alternatives analysis. The four-track proposals by CHSRA were controversial along the Peninsula Corridor with a diversity of opinions about the project. Taking into account these concerns, CHSRA decided in 2012 to change its current approach for the Peninsula Corridor and embrace a "Blended Service" concept in which Caltrain and CHSRA would share operations on the corridor and CHSRA would primarily be located within the Caltrain right of way.

Blended Service would consist of electrified Caltrain trains[12] and High Speed Rail trains mostly using the same tracks between San Jose and San Francisco with a section of passing tracks for scenarios with more HSR trains. There would be no blended service south of San Jose. Caltrain and CHSRA have engaged in planning level studies of Blended Service and thus the details of Blended Service are only preliminary at this time. Conceptual and design-level studies of Blended Service will be done later and evaluated in a separate NEPA and CEQA evaluation of Blended Service by CHSRA.

In concept, Blended Service would occur under two scenarios: the "6-2" scenario and the "6-4" scenario.

- Under the "6-2" scenario, there would be up to 2 HSR trains per peak hour per direction (PPHPD) in addition to the 6 Caltrain trains PPHPD planned under the Project. This scenario would not require passing tracks.
- Under the "6-4" scenario, there would be up to 4 HSR trains PPHPD in addition to 6 Caltrain trains PPHPD planned under the Project.

[12]The Peninsula Corridor Electrification Project would replace approximately 75% of the service fleet with EMUs between San Jose and San Francisco. Additional funding would need to be secured beyond that available for the Project to provide sufficient rolling stock to have 100% electrified service from San Jose to San Francisco. Diesel service will continue from Gilroy to San Jose under all scenarios.

Additional “Core Capacity” projects (as described in the nine-party MOU for the High Speed Rail Early Investment Strategy For a Blended System in the San Francisco to San Jose Segment Known as the Peninsula Corridor of the Statewide High-Speed Rail System) including needed upgrades to stations, tunnel, bridges, potential passing tracks, other track modifications and rail crossing improvements including selected grade separations will be required to accommodate the mixed traffic capacity requirements of high-speed rail service and commuter services on the Caltrain corridor. However the specific Core Capacity projects have not been identified or defined at this time. These projects would be identified in future discussions and evaluations between CHSRA and Caltrain and other agencies. Core Capacity projects would be subject to separate, project-level environmental evaluation by the implementing agency/agencies.

Table 3-14 presents some key conceptual assumptions about Blended Service known at this time. Based on the Revised 2012 Business Plan and the Draft 2014 Business Plan,, HSR service could be extended to San Jose and San Francisco sometime between 2026 and 2029. As noted above, while TTC is under construction, the exact timing for the DTX and Core Capacity Projects is not known at present.

TABLE 3-14
HIGH SPEED RAIL BLENDED SERVICE CONCEPTUAL DESCRIPTION, KEY ASSUMPTIONS

Subject	Assumption	Source
Number of HSR Trains (per peak hour per direction)	Up to 4	CHSRA 2012 Business Plan, Estimating High-Speed Train Operating and Maintenance Cost for the CHSRA 2012 Business Plan (CHSRA, "Estimating High-Speed Train Operating and Maintenance" 2012)
Number of Trains per Day	Up to 40 round trips (80 trains)[a]	CHSRA 2012 Business Plan, Estimating High-Speed Train Operating and Maintenance Cost for the CHSRA 2012 Business Plan (CHSRA, "Estimating High-Speed Train Operating and Maintenance" 2012)
Study Speeds	Up to 79 mph and up to 110 mph[b]	Caltrain and California HSR Blended Operations Analysis (LTK, 2012)
Ridership Forecasts	See Table 3-15	
Merging HSR Tracks from Diridon to Santa Clara	Two tracks from San Jose Diridon to Santa Clara Station	Conceptual locations described in Caltrain and California HSR Blended Operations Analysis (LTK, 2012) and Caltrain and HSR Blended Service Plan Operations Considerations Analysis (LTK, 2013)
Potential Number of Passing Tracks (Shared)	One location (see description in the PCEP Draft EIR Chapter 4)	Same as above.
Storage Yards and Maintenance Facilities	Specific location(s) not known (see discussion in the PCEP Draft EIR Chapter 4)	Caltrain and HSR Blended Service Plan Operations Considerations Analysis (LTK, 2013)
HSR Station Descriptions	Transbay Terminal (San Francisco)	Transbay Transit Center Program Final SEIS and EIR (2004) and subsequent addenda (TJPA, 2004)
	Millbrae Redwood City (TBD)	San Francisco to San Jose Supplemental Alternatives Analysis Report (CHSRA, "San Francisco to San Jose, Supplemental" 2010)
	San Jose Diridon	San Francisco to San Jose Supplemental AA (CHSRA, "San Francisco to San Jose, Supplemental" 2010) San Jose Visual Design Guidelines (CHSRA & City of San Jose, 2012) San Jose to Merced Preliminary Alternatives Analysis (CHSRA, "San Francisco to San Jose, Preliminary" 2010)
Planned grade separations	Center Street (if Millbrae Station constructed as in SF - SJ Supplemental Alternatives Analysis Report) Other grade separations (to be determined)	San Francisco to San Jose Supplemental Alternatives Analysis Report (CHSRA, "San Francisco to San Jose, Supplemental" 2010)

Source: Chapter 4, Table 4-4 of the PCEP EIR

[a] The CHSRA 2012 Revised Business Plan Ridership and Revenue Forecasting and the Draft 2014 Business Plan Ridership and Revenue Technical Memorandum, presume Phase 1 Blended Service would have up to four trains per peak hour and up to four trains per off-peak hour. This EIR presumes up to 40 HST daily round-trip trains in 2040 based on the CHSRA 2012 Business Plan, Estimating High-Speed Train Operating and Maintenance Cost for the CHSRA 2012 Business Plan. The Draft 2014 Business Plan Service Planning Methodology document includes an assumption of 53 daily round trip trains starting in 2029 and continuing to 2040 and beyond. Caltrain's blended service planning to date has not studied the 2014 Business Plan estimates because it was just released on February 7, 2014 and conceptual blended service studies were completed in 2012 and 2013. Thus this EIR is based on the 40 HST daily round-trip trains consistent with blended service studies by Caltrain completed to date. The subsequent CHSRA project-level environmental evaluation will address proposed HST service levels along the San Francisco Peninsula.

[b] Caltrain has simulated Blended Service operations for speeds up to 79 mph and up to 110 mph and thus this EIR evaluates these two speed scenarios in this cumulative analysis. If it is determined to be necessary to analyze speeds greater than 110 mph in the future, additional simulations will be performed to understand the viability and implications of the 100 to 125 mph speed range identified by CHSRA in the 2012 Partially Revised Program EIR. If speeds beyond 110 mph are ultimately proposed by CHSRA for the Caltrain corridor, they will be evaluated in the separate environmental document for evaluating HST service on the San Francisco Peninsula.

[c] Blended Service is not defined as a fully grade-separated system. See discussion in the EIR, Section 4.1, Cumulative Impacts, about other potential grade separations.

3.4.2.2.1 High-Speed Rail Ridership

HSR ridership has been evaluated by CHSRA for the year 2030 under low and high ridership scenarios. Table 3-15 shows Blended Service ridership estimates for 2030 under the low and high scenarios for the Peninsula corridor stations. These estimates are for HSR ridership only; no joint HSR and Caltrain service ridership modeling has been completed. No estimate of blended system ridership with a HSR station at Redwood City was included in the 2012 Revised Business Plan. For the purposes of this EIR, all HSR ridership is assumed to be in addition to Caltrain ridership to analyze maximum potential traffic and other impacts due to increased ridership at combined HSR and Caltrain stations. CHSRA Draft 2014 Business Plan estimated ridership for 2029 are also included in Table 3-15.

TABLE 3-15
PROJECTED BLENDED SYSTEM HIGH-SPEED RAIL RIDERSHIP AT PENINSULA CORRIDOR STATIONS WITHOUT OPTIONAL REDWOOD CITY HSR STATION (2030)

Station	Revised 2012 Business Plan		Draft 2014 Business Plan
	2030 Low Scenario	2030 High Scenario	2029 – Phase 1 Blended
San Francisco (Transbay Transit Center)	11,500	20,500	15,400
Millbrae	2,600	4,200	6,900
San Jose	3,300	6,100	8,200

Source: California High Speed Rail 2012 Business Plan, Final Technical Memorandum – Ridership and Revenue Forecasting, Table 5.17 (CHSRA, "2012 Business Plan, Estimating…" 2012); California High Speed Rail Draft 2014 Business Plan, Service Planning Methodology.

3.4.2.2.2 High-Speed Rail Grade Crossing Improvements and Grade Separations

Apart from the grade separation assumed in the 2010 HSR Alternatives Analysis at Center Street in Millbrae and the grade separations that would be necessary for the HSR aerial section from San Jose Diridon Station to north of the Santa Clara Caltrain Station (described previously above), no decisions have been made regarding the potential additional at-grade crossing improvements or grade separations necessary for Blended Service. To date, Blended Service has been defined as a partially grade-separated system, not a fully grade-separated system.

FRA's regulatory requirements for at-grade crossings greater than 79 mph are as follows (FRA 2014):

- For 110 mph or less: At-grade crossings are permitted. States and railroads cooperate to determine the needed warning devices, including passive crossbucks, flashing lights, two quadrant gates (close only "entering"' lanes of road), long gate arms, median barriers, and various combinations. Lights and/or gates are activated by circuits wired to the track (track circuits).
- For 110 to 125 mph: FRA permits crossings only if an "impenetrable barrier" blocks highway traffic when train approaches.
- Above 125 mph: No at-grade crossings permitted.

As noted above, at this time, Caltrain has only studied Blended Service operations up to 110 mph which have been shown to meet Prop 1A required timeframes for HSR service. For speeds greater than 79 mph up to 110 mph, there may be a need for additional at-grade crossing improvements; specific improvements would need to be identified during subsequent Blended Service design.

Additional grade separations may also be desirable for operational purposes. Further, when combining HSR service with Caltrain and other tenant railroads, cumulative localized traffic and noise impacts are likely at many locations along the corridor and grade separations at some locations may be considered in the environmental analysis for Blended Service as mitigation.

The separate environmental process for the Blended Service will need to analyze all impacts related to Blended Service including noise and traffic impacts related to increased train trips along the Caltrain corridor as well as the impacts of any proposed passing tracks and any proposed at-grade crossing or grade-separation improvements.

3.5 METHODS OF ANALYSIS

This section provides an overview of the analysis methods used for various aspects of the impacts analysis: Caltrain ridership, mode of access, of mode of egress models regional vehicle miles traveled, Intersection levels of service analysis, grade crossing analysis, and station capacity and parking demand. The Thresholds of Significance for the transportation impacts analysis are detailed at the close of this section.

3.5.1 CALTRAIN RIDERSHIP, MODE OF ACCESS, AND MODE OF EGRESS

Ridership forecasting provides estimates of the total number of passengers that will ride Caltrain as a result of the project, and it also provides information on how access to individual stations along the Caltrain corridor will change in the future, specifically 2020 and 2040.

The VTA travel demand model estimates trips throughout the metropolitan area by various modes, including Caltrain and access-modes to Caltrain. The model is sensitive to multiple factors including population and employment densities, auto ownership rates, demographics (age, income level, household size, etc.), and transit network connections. However, because its scope is regional, it is not able to capture all of the details of extremely localized conditions at the station-level. Ridership projections for transit systems that are assumed to connect to Caltrain in years 2020 and 2040 are from the VTA travel demand model. Appendix I of the EIR contains more detailed information on the development and application of the VTA travel demand model for this Study. Detailed results from the MOE/MOA models can be found in Attachment D.

On behalf of the JPB, Fehr & Peers developed a calibration process that adjusts the VTA travel demand model outputs using factors found to be correlated to Caltrain station level ridership as well variables for which the VTA travel demand model might be over- or undercompensating. For purposes of this Study, calibration was conducted for all stations providing service all day during weekdays and participating in electrification. This includes 26 stations between Tamien and San Francisco 4th and King, but excludes Stanford Stadium and all stations south of Tamien. The result of this calibration process is the direct ridership model. Attachment C contains more information on the development of the direct ridership model used for this Study. Detailed results from the direct ridership model are in Attachment D.

Fehr & Peers also developed Mode of Access (MOA) and Mode of Egress (MOE) models to estimate access and egress mode shares to Caltrain stations during the AM peak periods. Using intercept passenger surveys conducted in 2013, the model estimates the proportions of riders accessing and egressing by auto (park-ride, kiss-ride), transit, walking, and bicycling. See Section 2.1.3.1 for more detailed information on the 2013 Caltrain Intercept Survey. The VTA travel demand model predicts the combined walk and bike mode share and the calibrated model prepared for this study disaggregates the combined share based on the individual station access survey results. Attachment C includes detailed information on the development and application of these models.

3.5.2 REGIONAL VEHICLE MILES TRAVELED

A performance measure used to quantify the amount of vehicle travel is vehicle miles traveled (VMT). VMT measures the amount of miles vehicles travel along over roadway networks and is highly correlated to greenhouse gas emissions related to transportation. VMT measurement has one primary limitation: it is not directly observed and therefore cannot be directly measured. It is calculated based on the number of vehicles multiplied by the distance traveled by each vehicle. The amount of VMT can be obtained through extensive surveys of residents, visitors, and employees, or using a validated travel demand model (TDF) that estimates vehicle demand. VMT estimates derived from TDF models are dependent on the level of detail in the network and other variables related to vehicle movement through the network. The volume of traffic and distance traveled depends on land use types, density and intensity, and patterns as well as the supporting transportation system. The VTA travel demand model was used to provide regional VMT stratified by time of day and by speed, by scenario.

3.5.3 INTERSECTION LEVELS OF SERVICE

Detailed traffic microsimulation models were developed by Fehr & Peers on behalf of the JPB to analyze the environment impacts of all No Project and Project Scenarios. The Study Area for the microsimulation models included 82 intersections along the Caltrain line in San Francisco, San Mateo, and Santa Clara Counties. Most of these intersections (65) were modeled using the Synchro and SimTraffic software packages. The remaining 17 intersections were modeled using the VISSIM software package which has the ability to account for more complex intersection operations. VISSIM was used at intersections where there are high levels of congestion, frequent transit service, high automobile volumes, high pedestrian or bicycle volumes, or special traffic signal systems (such as transit signal priority). The microsimulation tools are used to account for the impact of increased grade crossing activity on nearby intersections. Results from the existing conditions models reported in 2.6.4 were the basis for all 2020 and 2040 No Project and Project Scenarios. Attachment E contains more detailed information on the model development process.

Traffic analysis is based on a prospective 2020 schedule that was developed only for analytical purposes for this TIA. Although the schedule has yet to be finalized, it is the best available data to be used for identifying the potential traffic operation impact of the project. The actual schedule may vary, which could influence the schedule at some of the local stations, but would not be expected to substantially change the estimated vehicle delay at the study intersections

3.5.4 GRADE CROSSINGS

For the existing conditions, 2020 Project and 2040 Project scenarios, the average single-train gate down time per event was calculated and input into the traffic microsimulation models. CBOSS PTC will provide increased efficiency for gate down times along the corridor, particularly at or near Caltrain stations. These improvements have been accounted for in all future scenarios. The average was calculated over the vehicular peak hour for study intersections at or near each grade crossing. The AM vehicular peak hour of travel is the greatest 60 minute period of vehicular traffic volumes in the 7:00-9:00 AM period. The PM vehicular peak hour of travel is the greatest 60 minute period of vehicular traffic volumes in the 4:00-6:00 PM period. Single-train events occur when one train triggers a gate down times event in order to pass through a grade crossing. A 2-for-1 event is when two trains traveling in opposite directions (one southbound and one northbound) pass through an at-grade crossing at the same time, triggering a joint gate down times event. Based on schedule data for the appropriate year (existing and 2020 No Project and 2040 No Project, 2020 Project, or 2040 Project), the VISSIM models will exactly replicate 2-for-1 events, and the SimTraffic models will estimate 2-for-1 events.[13] For all future scenarios, the gate down restarts in the existing conditions data were removed from the calculation to more accurately reflect the implementation of CBOSS PTC as a No Project improvement.

3.5.5 CALTRAIN STATION PARKING

In order to forecast parking demand, first, forecasts for daily boardings per station per scenario were generated by the calibrated direct ridership model. The ratio of boardings occurring before noon to 2013 daily boardings was applied to the daily boardings forecasts in order to generate forecasts for boardings occurring before noon by station in future scenarios. In order to forecast the number of Caltrans riders arriving to the station and parking before noon by station and scenario, the park and ride access mode share from the AM mode of access model was then applied to the forecasts of boardings occurring before noon. An average vehicle occupancy rate of 1.1 (based on VTA travel demand model factors) was applied to these values in order to forecast vehicle parking demand per station and scenario.

As confirmed by the intercept surveys, not all Caltrain park and riders park in Caltrain lots; some park on-street or in non-Caltrain lots. For most stations, however, the majority of PNR passengers parked in a Caltrain lot. Therefore it was assumed that, generally, PNR demand generated would park in a Caltrain lot if space was available. However, for seven stations (Bayshore, San Bruno, Millbrae, Hayward Park, San Carlos, Menlo Park, and Lawrence) the intercept survey found that at least two-thirds of PNR demand parked on street or in non-Caltrain parking lots, even though the Caltrain lots had ample available parking. Therefore, for those seven stations, the proportion of PNR demand parking in a Caltrain lot was assumed to be the same as the proportion recorded from the intercept surveys.

Impacts of the Proposed Project on station access were evaluated by identifying whether project operations would have any effect on routes of access to the Caltrain stations.

3.5.6 THRESHOLDS OF SIGNIFICANCE

This section details the significance criteria developed by Caltrain, with input from local jurisdictions, for use in the transportation impacts analysis for this Study. For the overall project, a project impact is considered significant if any of the following criteria are met or exceeded:

- TR-1: The project would result in an increase in VMT per service population in the Study Area; or
- TR-2: The project interferes with, conflicts with, or precludes other planned improvements such as transit projects, roadway extensions and expansions, pedestrian or bicycle facility improvements, etc.; or,
- TR-3: The project conflicts or creates inconsistencies with adopted regional transportation plans; or
- TR-4: The project would result in unsafe access between Caltrain stations and adjacent streets.

[13] The VISSIM models have a higher level of detail and allow for the actual coding of train schedules, making it possible to model the precise time when trains arrive at a particular grade crossing thus it is more accurate at modeling 2-for-1 events. SimTraffic models, while they do not allow for the input of the actual train schedule, are capable of estimating 2-for-1 events based on average gate down times at a specific grade crossing.

3.5.6.1 Traffic and Roadway System Significance Criteria

The project would create a significant impact to the traffic and roadway system if any of the following criteria are met or exceeded:

- TR-5: The project conflicts or creates inconsistencies with local traffic plans.
- TR-6: The project disrupts existing traffic operations, as defined below:

  For signalized intersections, the significance criteria are based on the typical average criteria for jurisdictions along the Caltrain corridor. Specifically, a significant project impact to a signalized intersection occurs if the project results in one of the following conditions:

  - The project causes an intersection to deteriorate from LOS D conditions or better to LOS E or F conditions, or
  - The project causes an intersection currently operating at LOS E or F conditions to increase in overall delay by four (4) seconds or more.

  The criteria above apply to all signalized intersections except where a jurisdiction has adopted criteria permitting higher levels of congestion in certain areas or at certain intersections, in which case these criteria are used. Redwood City and the City of Santa Clara both permit higher levels of congestion in certain areas.[14]

  For unsignalized intersections, the significance criteria are defined to occur if the project results in both of the following conditions:

  - The project results in a change from LOS A-E to LOS F conditions for the worst case approach, and
  - The intersection satisfies one or more traffic signal warrants.

- TR-7: The project creates a temporary but prolonged impact due to lane closures, need for temporary signals, emergency vehicle access, traffic hazards to bikes and pedestrians, damage to roadbed, truck traffic on roadways not designated as truck routes, etc.

3.5.6.2 Transit System Significance Criteria

The project would create a significant impact related to transit service if any of the following criteria are met or exceeded:

- TR-8: The project creates demand for public transit services above the capacity which is provided, or planned; or,
- TR-9: The project disrupts existing transit services or facilities; or,
- TR-10: The project interferes with planned transit services or facilities; or
- TR-11: The project conflicts or creates inconsistencies with adopted transit system plans, guidelines, policies, or standards.

[14] Downtown Redwood City has no level of service standard for intersections in the Downtown Precise Plan Area (Policy BE-29.4) therefore, no street widening will occur with development. The City of Santa Clara level of service exemptions exist for new development in order to facilitate alternate transportation in Station Focus Areas.

The main text of the EIR also analyzes potential impacts related to transit system safety, but this impact is not analyzed in this document.

3.5.6.3 Pedestrian System Significance Criteria

The project would create a significant impact related to the pedestrian system if any of the following criteria are met or exceeded:

- TR-12: The project disrupts existing pedestrian facilities; or
- TR-13: The project interferes with planned pedestrian facilities, or
- TR-14: The project conflicts or creates inconsistencies with adopted pedestrian system plans, guidelines, policies, or standards.

3.5.6.4 Bicycle System Significance Criteria

The project would create a significant impact related to facilities if any of the following criteria are met or exceeded:

- TR-15: The project substantially disrupts existing bicycle facilities; or
- TR-16: The project substantially interferes with planned bicycle facilities; or
- TR-17: The project conflicts or creates substantial inconsistencies with adopted bicycle system plans.

3.5.6.5 Emergency Vehicles Significance Criteria

The project would create a significant impact if the following criterion is met or exceeded:

- TR-18: The project results in inadequate emergency vehicle circulation and/or access.

3.5.6.6 Station Vehicle Parking and Access Significance Criteria

The project would create a significant impact if either of the following criteria is met or exceeded:

- TR-19: The project does not meet Caltrain's Comprehensive Access Policy or Bicycle Access and Parking Plan; or
- TR-20: The project would result in the construction of off-site parking facilities that would have secondary physical impacts on the environment.

3.5.6.7 Freight Service Significance Criteria

Freight Analysis is not included in this appendix. Freight Service analysis is presented in the main text of this EIR.

3.6 FUTURE ROADWAY SYSTEM

This section summarizes the results of the 2020 and 2040 forecast year traffic models for all No Project and Project scenarios. First, the results of the grade crossing analyses for 2020 and 2040 are reported. Next, the LOS results for 2020 and 2040 are presented. Lastly, traffic impact evaluation and mitigation measures are presented and discussed. More detail on the methodology and calibration of these traffic models can be found in Attachments E and F.

3.6.1 FUTURE PROGRAMMED ROADWAY NETWORK IMPROVEMENTS IN STUDY AREA

A summary of future programmed roadway networks in forecast year 2020 and 2040 include currently programmed and/or funded projects and can be found in Attachment B. These lists include projects in the Study as well as key projects a regional traveler would consider transferring to in order to complete an inter-regional trip in the San Francisco Bay Area. All projects assumed to be functioning by 2020 were included as inputs into the 2020 traffic forecasting models. All projects assumed to be functioning by 2040 were inputs into the 2040 traffic forecasting models.

3.6.2 REGIONAL VEHICLE MILES TRAVELED

This section presents estimated regional vehicle miles traveled (VMT) by scenario (within the Bay Area region). Transportation is a major contributor to greenhouse gas emissions and a direct result of population and employment growth, which generates vehicle trips to move goods, provide public services, and connect people with work, school, shopping, and other activities. Growth in travel (especially vehicle travel) is due in large part to changes in urban development patterns (i.e., the built environment).

VMT measures the amount of miles vehicles travel on roadway networks. The VTA travel demand model as used to provide regional VMT stratified by time of day and by speed, by scenario. VMT is separated into five mph increments, referred to as speed bins. The results of the 2020 VMT analysis for the VTA model region, by speed bin and by time of day are displayed in Table 3-16.The results of the 2040 VMT analysis are displayed in Table 3-17.

Overall, regional VMT is expected to increase between 2013 and 2020 and from 2020 to 2040. However, regional VMT across all speed bins in the peak and off-peak periods would be less under the 2020 Project scenario than 2020 No Project scenario. Total daily VMT under the 2020 Project scenario is projected to decrease by approximately 235,000 miles compared to the 2020 No Project scenario. This means that while certain locations on the Caltrain corridor may experience increases in traffic due to more automobiles driving to and from stations, many streets along the Caltrain corridor will see reduced traffic volumes as a result of the project. In particular, parallel street corridors, such as El Camino Real, I-280 and US-101, will see reductions in vehicle traffic, as the project shifts travel demand from driving trips to transit trips.

In 2040, regional VMT would also be less under the 2040 Project scenario than 2040 No Project scenario. Similarly, Total daily VMT under the 2040 Project scenario is projected to decrease by nearly 619,000 miles compared to the 2040 No Project scenario.

TABLE 3-16
DAILY REGIONAL VEHICLE MILES TRAVELED, EXISTING CONDITIONS, 2020 NO PROJECT, AND 2020 PROJECT

Speed (mph)	Existing Conditions (2013)			2020 No Project			2020 Project		
	Peak	Off-peak	All	Peak	Off-peak	All	Peak	Off-peak	All
0-5	190,000	89,000	280,000	291,000	126,000	417,000	290,000	128,000	418,000
6-10	383,000	124,000	507,000	453,000	162,000	616,000	448,000	160,000	608,000
11-15	3,087,000	2,238,000	5,325,000	3,447,000	2,340,000	5,787,000	3,422,000	2,333,000	5,755,000
16 - 20	6,586,000	3,925,000	10,511,000	7,334,000	4,305,000	11,639,000	7,370,000	4,315,000	11,685,000
21 - 25	16,157,000	11,154,000	27,311,000	18,763,000	12,528,000	31,291,000	18,672,000	12,518,000	31,190,000
26 - 30	10,435,000	5,729,000	16,163,000	12,333,000	6,527,000	18,860,000	12,243,000	6,553,000	18,796,000
31 - 35	10,763,000	5,827,000	16,589,000	11,920,000	6,585,000	18,505,000	11,952,000	6,562,000	18,514,000
36 - 40	6,422,000	2,493,000	8,916,000	7,601,000	2,815,000	10,416,000	7,269,000	2,806,000	10,074,000
41 - 45	6,692,000	3,564,000	10,256,000	6,872,000	3,704,000	10,575,000	7,130,000	3,701,000	10,831,000
46 - 50	5,910,000	1,654,000	7,564,000	7,505,000	2,679,000	10,184,000	7,524,000	2,639,000	10,163,000
51 - 55	7,726,000	4,387,000	12,114,000	7,046,000	5,228,000	12,274,000	7,079,000	5,218,000	12,296,000
56 - 60	8,784,000	15,728,000	24,512,000	8,474,000	16,383,000	24,857,000	8,417,000	16,471,000	24,888,000
61 - 65	13,124,000	25,489,000	38,612,000	12,666,000	27,287,000	39,954,000	12,702,000	27,221,000	39,923,000
Total	**96,260,000**	**82,401,000**	**178,660,000**	**104,705,000**	**90,669,000**	**195,375,000**	**104,518,000**	**90,625,000**	**195,141,000**

Source: VTA, 2013
Note: Peak travel is defined as travel occurring between 5:00 AM to 9:00 AM and 3:00 PM to 7:00 PM; Off-peak travel is defined as travel occurring between 9:00 AM to 3:00 PM and from 7:00 PM to 5:00 AM

TABLE 3-17
DAILY REGIONAL VEHICLE MILES TRAVELED, 2040 NO PROJECT, 2040 PROJECT

Speed (mph)	2040 No Project			2040 Project		
	Peak	Off-peak	All	Peak	Off-peak	All
0-5	542,000	175,100	717,100	506,100	164,600	670,700
6-10	1,033,400	262,500	1,295,800	1,020,200	266,600	1,286,800
11-15	5,443,800	2,882,200	8,326,000	5,309,700	2,891,600	8,201,300
16 - 20	9,744,800	5,153,200	14,898,000	9,710,100	5,137,200	14,847,300
21 - 25	24,701,600	15,450,700	40,152,300	24,512,600	15,469,100	39,981,700
26 - 30	15,993,100	8,447,300	24,440,400	15,882,300	8,411,200	24,293,500
31 - 35	15,110,900	8,968,500	24,079,400	15,170,300	8,874,300	24,044,600
36 - 40	9,683,600	4,885,300	14,568,900	9,601,300	4,967,100	14,568,400
41 - 45	8,023,400	6,531,900	14,555,300	8,171,000	6,431,800	14,602,800
46 - 50	6,453,400	4,568,700	11,022,100	6,390,500	4,602,200	10,992,800
51 - 55	5,773,300	5,747,300	11,520,700	5,974,300	5,929,500	11,903,800
56 - 60	7,417,000	16,895,300	24,312,300	7,041,700	16,729,500	23,771,200
61 - 65	10,756,200	25,878,300	36,634,500	10,869,100	25,870,000	36,739,100
Total	**120,676,500**	**105,846,300**	**226,522,800**	**120,159,200**	**105,744,700**	**225,903,900**

Source: VTA, 2013
Note: Peak travel is defined as travel occurring between 5:00 AM to 9:00 AM and 3:00 PM to 7:00 PM; Off-peak travel is defined as travel occurring between 9:00 AM to 3:00 PM and from 7:00 PM to 5:00 AM

3.6.3 CITY-LEVEL VEHICLE MILES TRAVELED

Table 3-18 displays daily VMT within each city in the Study area for 2020 and 2040 No Project and Project scenarios. City-level VMT is calculated by accounting for the total mileage of all vehicle trips that occur within each city's boundaries, which known as the "boundary method" calculation.

Daily VMT in all cities along the corridor would decrease due under the 2020 Project scenario compared to the 2020 No Project scenario. Total daily VMT under the 2020 Project scenario is projected to decrease by an average of 1.8 percent in all cities along the corridor compared to the 2020 No Project scenario. While certain locations on the Caltrain corridor may experience increases in traffic due to more automobiles driving to and from stations, the total effect is that total vehicle miles in each city will decrease due to the Project.

In 2040, daily VMT in nearly cities would also be lower under the 2040 Project scenario than 2040 No Project scenario. The only exception is the City of San Mateo which would experience a very small increase in VMT due to the project, likely attributable to slight increases in automobile traffic coming to an from San Mateo, Hayward Park and Hillsdale Stations. Total daily VMT under the 2040 Project scenario is projected to decrease by an average of 0.7 percent in all cities along the corridor compared to the 2040 No Project scenario.

TABLE 3-18
DAILY REGIONAL VEHICLE MILES TRAVELED WITHIN EACH CITY, 2020 AND 2040 SCENARIOS

City	2020 No Project			2020 Project			2040 No Project			2040 Project		
	Peak	Off-peak	All	Peak	Off-peak	All	Peak	Off-peak	All	Peak	Off-peak	All
San Francisco	4,153,000	3,526,000	7,680,000	4,141,000	3,497,000	7,638,000	4,676,000	3,931,000	8,607,000	4,625,000	3,919,000	8,544,000
South San Francisco	700,000	574,000	1,275,000	695,000	506,000	1,200,000	824,000	662,000	1,487,000	813,000	659,000	1,472,000
San Bruno	499,000	363,000	862,000	496,000	360,000	856,000	587,000	415,000	1,003,000	576,000	414,000	989,000
Millbrae	210,000	164,000	374,000	209,000	136,000	344,000	248,000	183,000	431,000	242,000	182,000	424,000
Burlingame	480,000	427,000	906,000	476,000	422,000	898,000	609,000	529,000	1,138,000	596,000	526,000	1,122,000
San Mateo	1,260,000	1,114,000	2,374,000	1,252,000	1,101,000	2,354,000	1,476,000	1,298,000	2,774,000	1,482,000	1,293,000	2,775,000
Belmont	165,000	120,000	285,000	163,000	119,000	282,000	185,000	126,000	311,000	182,000	125,000	307,000
San Carlos	701,000	263,000	963,000	315,000	260,000	574,000	383,000	315,000	698,000	377,000	314,000	690,000
Redwood City	785,000	712,000	1,497,000	780,000	703,000	1,483,000	866,000	779,000	1,645,000	853,000	776,000	1,630,000
Atherton	65,000	38,000	104,000	65,000	38,000	103,000	90,000	49,000	139,000	87,000	49,000	136,000
Menlo Park	636,000	611,000	1,247,000	632,000	602,000	1,234,000	716,000	660,000	1,376,000	705,000	658,000	1,362,000
Palo Alto	800,000	664,000	1,464,000	795,000	657,000	1,451,000	947,000	751,000	1,698,000	926,000	749,000	1,675,000
Mountain View	1,006,000	872,000	1,878,000	1,002,000	865,000	1,867,000	1,157,000	953,000	2,110,000	1,137,000	951,000	2,088,000
Sunnyvale	1,379,000	1,099,000	2,478,000	1,372,000	1,077,000	2,449,000	1,601,000	1,226,000	2,827,000	1,577,000	1,223,000	2,800,000
Santa Clara	1,199,000	753,000	1,952,000	1,193,000	747,000	1,940,000	1,545,000	928,000	2,473,000	1,526,000	927,000	2,454,000
San Jose	9,722,000	7,750,000	17,473,000	9,705,000	7,673,000	17,378,000	11,024,000	8,814,000	19,838,000	10,953,000	8,812,000	19,765,000
TOTAL	**23,760,000**	**19,050,000**	**42,812,000**	**23,291,000**	**18,763,000**	**42,051,000**	**26,934,000**	**21,619,000**	**48,555,000**	**26,657,000**	**21,577,000**	**48,233,000**

Source: VTA, 2013

Note: Peak travel is defined as travel occurring between 5:00 AM to 9:00 AM and 3:00 PM to 7:00 PM; Off-peak travel is defined as travel occurring between 9:00 AM to 3:00 PM and from 7:00 PM to 5:00 AM

3.6.4 GRADE CROSSING ANALYSIS

This section summarizes future gate down times under all No Project and Project scenarios. All future year scenarios include the CBOSS PTC advanced signal system. Section 3.2.2.1.2 includes a summary of this separate project within the Caltrain Modernization Program.

3.6.4.1 Projected 2020 Grade Crossing Conditions

This section presents results from the 2020 gate down times analysis. The results presented in this section are key inputs into the Intersection LOS Analysis presented in the next section. As discussed in Section 3.2.1.1.2, CBOSS PTC is included in all 2020 scenarios. Once in place, CBOSS PTC will improve the efficiency of grade crossing warning functions, thus improving safety for pedestrians and vehicles at grade crossing locations in the Study Area. More detail on methodology for the gate down times analysis can be found in Section 3.5.4

3.6.4.1.1 2020 Scenarios

Table 3-19 displays projected gate down times for 2020 No Project and Project scenarios at crossings adjacent to Study Intersections during the AM and PM peak hours. Existing conditions gate down times are also presented for comparison purposes. Between existing and 2020 No Project and Project scenarios, gate down times generally improve overall due to the introduction of CBOSS PTC. Table 3-20 compares gate down times between 2020 No Project and Project scenarios. Overall, the average gate down time per event is reduced at many crossings under the 2020 Project scenario. However, the increase in the number of trains (from the current average of 10 per hour to 12 per hour with project implementation) is expected to result in an increase in the aggregate gate down time over the peak hour at some locations. The increase in number of gate down events, along with increasing the number of corresponding signal preemption events, may degrade intersection operations even though the gate down time per event is lower.

TABLE 3-19
AGGREGATE GATE DOWN TIMES AT GRADE CROSSINGS ADJACENT TO STUDY INTERSECTIONS, 2020 PROJECT AND 2020 NO PROJECT

Crossing	Jurisdiction	Existing Conditions		2020 No Project		2020 Project	
		AM Peak Hour	PM Peak Hour[1]	AM Peak Hour	PM Peak Hour[1]	AM Peak Hour	PM Peak Hour[1]
Mission Bay Drive	San Francisco	0:13:30	0:11:30	0:13:30	0:11:30	0:13:24	0:13:12
16th Street	San Francisco	0:10:30	0:08:06	0:10:30	0:08:06	0:11:39	0:11:38
Linden Avenue	South San Francisco	0:06:20	0:06:09	0:06:20	0:06:09	0:09:04	0:09:04
Scott Street	San Bruno	0:08:40	0:06:27	0:08:40	0:06:27	0:07:27	0:08:08
Broadway	Burlingame	0:06:50	0:07:30	0:06:50	0:06:27	0:10:25	0:10:05
Oak Grove Avenue	Burlingame	0:08:40	0:08:50	0:08:40	0:08:50	0:10:09	0:09:59
North Lane	Burlingame	0:10:30	0:11:00	0:10:30	0:11:00	0:09:49	0:10:24
Peninsula Avenue	Burlingame	0:09:20	0:08:50	0:09:20	0:08:50	0:09:19	0:09:17
Villa Terrace	San Mateo	0:09:00	0:07:30	0:09:00	0:07:30	0:07:31	0:08:11
First Avenue	San Mateo	0:13:50	0:14:51	0:13:00	0:09:32	0:08:48	0:09:05
Ninth Avenue	San Mateo	0:07:21	0:09:54	0:07:21	0:09:54	0:08:11	0:08:13
25th Avenue	San Mateo	0:09:00	0:08:15	0:08:42	0:08:15	0:07:30	0:08:11
Whipple Avenue	Redwood City	0:09:45	0:10:20	0:09:45	0:10:20	0:09:15	0:09:10
Brewster Avenue	Redwood City	0:17:33	0:14:18	0:12:34	0:10:05	0:07:38	0:07:56
Broadway	Redwood City	0:18:38	0:17:25	0:15:49	0:11:22	0:09:57	0:10:46
Maple Street	Redwood City	0:10:30	0:08:15	0:08:24	0:08:15	0:08:50	0:09:57
Main Street	Redwood City	0:11:51	0:09:45	0:10:48	0:09:00	0:09:14	0:10:35
Fair Oaks Lane	Atherton	0:06:30	0:05:12	0:06:30	0:05:12	0:08:45	0:08:40
Watkins Avenue	Atherton	0:09:00	0:07:28	0:09:00	0:07:28	0:08:18	0:08:19
Glenwood Avenue	Menlo Park	0:09:10	0:09:09	0:09:10	0:07:30	0:08:37	0:08:53
Oak Grove Avenue	Menlo Park	0:13:30	0:15:20	0:10:40	0:12:40	0:09:51	0:10:01
Ravenswood Avenue	Menlo Park	0:11:20	0:08:08	0:09:40	0:08:08	0:10:20	0:10:11
Palo Alto Avenue	Palo Alto	0:07:00	0:07:12	0:07:00	0:07:12	0:09:40	0:09:33
Churchill Avenue	Palo Alto	0:06:20	0:05:50	0:06:20	0:05:50	0:08:07	0:08:10
West Meadow Avenue	Palo Alto	0:07:20	0:07:09	0:07:20	0:07:09	0:08:02	0:07:23
West Charleston Avenue	Palo Alto	0:06:58	0:06:58	0:06:58	0:06:58	0:08:03	0:08:04
Rengstorff Avenue	Mountain View	0:08:20	0:06:27	0:07:40	0:06:27	0:08:05	0:08:09
Castro Street	Mountain View	0:11:30	0:12:00	0:09:30	0:07:52	0:09:06	0:09:07
Mary Avenue	Sunnyvale	0:06:20	0:06:40	0:06:20	0:06:40	0:08:13	0:08:05

Source: LTK, 2013

TABLE 3-20
COMPARISON OF GATE DOWN TIMES AT GRADE CROSSINGS ADJACENT TO STUDY INTERSECTIONS, 2020 NO PROJECT AND PROJECT

Crossing	Jurisdiction	Change in Gate down times Between 2020 Project and 2020 No Project	
		AM Peak Hour	PM Peak Hour
Mission Bay Drive	San Francisco	-0:00:06	0:01:42
16th Street	San Francisco	0:01:09	0:03:32
Linden Avenue	South San Francisco	0:02:44	0:02:55
Scott Street	San Bruno	-0:01:13	0:01:41
Broadway	Burlingame	0:03:35	0:03:38
Oak Grove Avenue	Burlingame	0:01:29	0:01:09
North Lane	Burlingame	-0:00:41	-0:00:36
Peninsula Avenue	Burlingame	-0:00:01	0:00:27
Villa Terrace	San Mateo	-0:01:29	0:00:41
First Avenue	San Mateo	-0:04:12	-0:00:27
Ninth Avenue	San Mateo	0:00:50	-0:01:41
25th Avenue	San Mateo	-0:01:12	-0:00:04
Whipple Avenue	Redwood City	-0:00:30	-0:01:10
Brewster Avenue	Redwood City	-0:04:56	-0:02:09
Broadway	Redwood City	-0:05:52	-0:00:36
Maple Street	Redwood City	0:00:26	0:01:42
Main Street	Redwood City	-0:01:34	0:01:35
Fair Oaks Lane	Atherton	0:02:15	0:03:28
Watkins Avenue	Atherton	-0:00:42	0:00:51
Glenwood Avenue	Menlo Park	-0:00:33	0:01:23
Oak Grove Avenue	Menlo Park	-0:00:49	-0:02:39
Ravenswood Avenue	Menlo Park	0:00:40	0:02:03
Palo Alto Avenue	Palo Alto	0:02:40	0:02:21
Churchill Avenue	Palo Alto	0:01:47	0:02:20
West Meadow Avenue	Palo Alto	0:00:42	0:00:14
West Charleston Avenue	Palo Alto	0:01:05	0:01:06
Rengstorff Avenue	Mountain View	0:00:25	0:01:42
Castro Street	Mountain View	-0:00:24	0:01:15
Mary Avenue	Sunnyvale	0:01:53	0:01:25

Source: LTK, 2013

3.6.4.2 Projected 2040 Grade Crossing Conditions

This section presents results from the 2040 gate down times analysis. The results presented in this section are key inputs into the Intersection LOS Analysis presented in the next section. As discussed in Section 3.2.1.1.2, CBOSS PTC would continue to operate in all 2040 scenarios.

3.6.4.2.1 2040 Scenarios

Gate down times for the 2040 No Project scenario are equivalent to gate down times for the 2020 No Project scenario, as discussed in Section 3.6.4.1.1. Table 3-21 displays projected gate down times for 2040 No Project and Project scenarios at crossings adjacent to Study Intersections during the AM and PM peak hours. CBOSS PTC would continue to operate under the 2040 No Project scenario. Table 3-22 compares gate down times for the 2040 No Project and Project scenarios. As was the case with the 2020 Project scenario, the average gate down times per event is generally reduced at many crossings under the 2040 Project scenario. However, the increase in number of gate down events, along with increasing the number of corresponding signal preemption events, may degrade intersection operations even though the gate down time per event is lower.

TABLE 3-21
GATE DOWN TIMES AT GRADE CROSSINGS ADJACENT TO STUDY INTERSECTIONS, 2040 PROJECT AND 2040 PROJECT

Crossing	Jurisdiction	2040 No Project		2040 Project	
		AM Peak Period	PM Peak Period	AM Peak Period	PM Peak Period
Mission Bay Drive	San Francisco	0:13:30	0:11:30	0:13:34	0:13:34
16th Street	San Francisco	0:10:30	0:08:06	0:11:45	0:11:45
Linden Avenue	South San Francisco	0:06:20	0:06:09	0:09:05	0:09:05
Scott Street	San Bruno	0:08:40	0:06:27	0:08:08	0:08:08
Broadway	Burlingame	0:06:50	0:06:27	0:08:28	0:08:28
Oak Grove Avenue	Burlingame	0:08:40	0:08:50	0:10:01	0:10:01
North Lane	Burlingame	0:10:30	0:11:00	0:08:54	0:08:54
Peninsula Avenue	Burlingame	0:09:20	0:08:50	0:09:14	0:09:14
Villa Terrace	San Mateo	0:09:00	0:07:30	0:08:09	0:08:09
First Avenue	San Mateo	0:13:00	0:09:32	0:08:44	0:08:44
Ninth Avenue	San Mateo	0:07:21	0:09:54	0:08:10	0:08:10
25th Avenue	San Mateo	0:08:42	0:08:15	0:08:11	0:08:11
Whipple Avenue	Redwood City	0:09:45	0:10:20	0:09:12	0:09:12
Brewster Avenue	Redwood City	0:12:34	0:10:05	0:07:56	0:07:56
Broadway	Redwood City	0:15:49	0:11:22	0:10:49	0:10:49
Maple Street	Redwood City	0:08:24	0:08:15	0:09:23	0:09:23
Main Street	Redwood City	0:10:48	0:09:00	0:09:40	0:09:40
Fair Oaks Lane	Atherton	0:06:30	0:05:12	0:08:41	0:08:41
Watkins Avenue	Atherton	0:09:00	0:07:28	0:08:17	0:08:17
Glenwood Avenue	Menlo Park	0:09:10	0:07:30	0:08:35	0:08:35
Oak Grove Avenue	Menlo Park	0:10:40	0:12:40	0:09:35	0:09:35
Ravenswood Avenue	Menlo Park	0:09:40	0:08:08	0:10:20	0:10:20
Palo Alto Avenue	Palo Alto	0:07:00	0:07:12	0:09:33	0:09:33
Churchill Avenue	Palo Alto	0:06:20	0:05:50	0:08:07	0:08:07
West Meadow Avenue	Palo Alto	0:07:20	0:07:09	0:08:05	0:08:05
West Charleston Avenue	Palo Alto	0:06:58	0:06:58	0:08:06	0:08:06
Rengstorff Avenue	Mountain View	0:07:40	0:06:27	0:08:07	0:08:07
Castro Street	Mountain View	0:09:30	0:07:52	0:09:14	0:09:14
Mary Avenue	Sunnyvale	0:06:20	0:06:40	0:08:49	0:08:49

Source: LTK, 2013

TABLE 3-22
COMPARISON OF GATE DOWN TIMES AT GRADE CROSSINGS ADJACENT TO STUDY INTERSECTIONS, 2040 NO PROJECT AND PROJECT SCENARIOS

Crossing	Jurisdiction	Change in Gate down times Between 2040 Project and 2040 No Project	
		AM Peak Hour	PM Peak Hour
Mission Bay Drive	San Francisco	0:00:04	0:03:04
16th Street	San Francisco	0:01:15	0:03:39
Linden Avenue	South San Francisco	0:02:45	0:01:25
Scott Street	San Bruno	-0:00:32	0:01:41
Broadway	Burlingame	0:01:38	0:01:41
Oak Grove Avenue	Burlingame	0:01:21	0:01:00
North Lane	Burlingame	-0:01:36	-0:02:30
Peninsula Avenue	Burlingame	-0:00:06	0:00:23
Villa Terrace	San Mateo	-0:00:51	0:00:39
First Avenue	San Mateo	-0:04:16	-0:00:44
Ninth Avenue	San Mateo	0:00:49	-0:01:44
25th Avenue	San Mateo	-0:00:31	-0:00:04
Whipple Avenue	Redwood City	-0:00:33	-0:01:09
Brewster Avenue	Redwood City	-0:04:38	-0:02:17
Broadway	Redwood City	-0:05:00	-0:00:35
Maple Street	Redwood City	0:00:59	0:01:09
Main Street	Redwood City	-0:01:08	0:00:58
Fair Oaks Lane	Atherton	0:02:11	0:04:05
Watkins Avenue	Atherton	-0:00:43	0:00:51
Glenwood Avenue	Menlo Park	-0:00:35	0:00:59
Oak Grove Avenue	Menlo Park	-0:01:05	-0:03:09
Ravenswood Avenue	Menlo Park	0:00:40	0:02:08
Palo Alto Avenue	Palo Alto	0:02:33	0:02:20
Churchill Avenue	Palo Alto	0:01:47	0:02:16
West Meadow Avenue	Palo Alto	0:00:45	0:00:56
West Charleston Avenue	Palo Alto	0:01:08	0:01:08
Rengstorff Avenue	Mountain View	0:00:27	0:01:40
Castro Street	Mountain View	-0:00:16	0:01:21
Mary Avenue	Sunnyvale	0:02:29	0:01:26

Source: LTK, 2013

3.6.5 INTERSECTION LEVEL OF SERVICE ANALYSIS

Traffic operations at all 82 intersections in the Study Area were analyzed under the future No Project and Project scenarios. To obtain the LOS and the delay, the existing AM and PM peak hour VISSIM and SimTraffic models were updated to reflect future peak hour operating conditions. This included updates to forecasted traffic volumes, signal timings, gate down times, and frequencies of Caltrain at at-grade crossings.

3.6.5.1 2020 Intersection Volumes and Level of Service Analysis

This section presents the results of the intersection level of service analysis for the 2020 No Project and 2020 Project scenarios. Table 3-23 displays the 2020 No Project scenario and the 2020 Project scenario levels of service and calculated delay during the morning and evening peak at all study intersections.

3.6.5.1.1 2020 No Project Scenario

Figure 3-2 illustrates the geographic location of each study intersection and the associated AM and PM peak hour LOS in Zone 1. Figure 3-3 illustrates the geographic location of each study intersection and the associated AM and PM peak hour LOS in Zone 2. Figure 3-4 illustrates the geographic location of each study intersection and the associated AM and PM peak hour LOS in Zone 3. Figure 3-5 illustrates the geographic location of each study intersection and the associated AM and PM peak hour LOS in Zone 4.

- In Zone 1, which includes San Francisco County and a portion of San Mateo County, the majority of study intersections would operate at LOS C or better. However, some intersections would operate below LOS C. Both 4th Street and King Street and 4th and Townsend are points of severe congestion (LOS E or F) and would operate at LOS F during AM and PM peak hours. The intersection of 7th Street and 16th Street would operate at LOS F in the AM peak and LOS E in the PM peak hour. The intersection of Tunnel Avenue and Blanken Avenue in South San Francisco would operate at LOS E in the PM peak hour.
- In Zone 2, which includes northern and central San Mateo County, points of severe congestion (LOS E and LOS F) would occur at major intersections, including El Camino Real, Alma Street, Carolan Avenue, and Middlefield Road, as well as around the Redwood City Station. The intersection of Carolan Avenue and Oak Grove Avenue would operate at LOS F in both the AM and PM peak hours.
- In Zone 3, which includes parts of San Mateo and Santa Clara Counties, congestion would be clustered along El Camino Real, Broadway, Alma Street, and Middlefield Road in addition to Central Expressway. Overall, points of severe congestion would mostly be clustered in in the cities of Atherton, Palo Alto and Mountain View.
- In Zone 4, which includes central Santa Clara County, about half of the intersections would operate at LOS C or better. Points of severe congestion occur in the City of Santa Clara at the intersections of Kifer Road and Lawrence Expressway and Reed Avenue and Lawrence Expressway. Both of these intersections would operate at LOS F in the AM and PM peak hours.

3.6.5.1.2 2020 Project Scenario

Figure 3-6 illustrates the geographic location of each study intersection and the associated AM and PM peak hour LOS in Zone 1. Figure 3-7 illustrates the geographic location of each study intersection and the associated AM and PM peak hour LOS in Zone 2. Figure 3-8 illustrates the geographic location of each study intersection and the associated AM and PM peak hour LOS in Zone 3. Figure 3-9 illustrates the geographic location of each study intersection and the associated AM and PM peak hour LOS in Zone 4.

- In Zone 1, the majority of study intersections would operate at LOS D or better with the exception of three intersections. Similar to the 2020 No Project Scenario, the intersections on 4th Street in San Francisco would operate at LOS F during both the AM and PM peaks. 7th Street and 16th Street would operate at LOS F in the AM peak and LOS E in the PM peak hour.
- In Zone 2, levels of congestion sever congestion would occur in around the Millbrae and Redwood City Stations. In Belmont, El Camino Real and Ralston Avenue would operate at LOS F in both the AM and PM peak hours.
- In Zone 3, about half of the intersections would operate at LOS E or F, particularly along El Camino Real, Alma Street, Middlefield Road, and Central Expressway. Points of congestion are clustered in Atherton and Menlo Park.
- In Zone 4, which includes central Santa Clara County, about half of the intersections operate at LOS C or better. As with the 2020 No Project scenario, points of severe congestion occur in the City of Santa Clara along Lawrence Expressway. In addition, the intersection of South Montgomery Street and West San Fernando Street would operate at LOS F in the PM peak hour.

While traffic conditions would worsen at some intersections along the corridor and around stations, other locations would have improved traffic operations due to the project. Several major travel corridors parallel to the Caltrain line would experience reduced travel volumes due to the project, including El Camino Real, US-101 and I-280. This is evidenced by the reduction in countywide vehicle miles travelled that would occur due to the project. Therefore, while some intersections would experience increased congestion levels, on the aggregate congestion and vehicle travel would decrease.

Potential mitigation measures for impacted intersections under 2020 scenario are discussed in the following section.

TABLE 3-23
INTERSECTION DELAY AND LEVELS OF SERVICE, 2020 NO PROJECT AND PROJECT SCENARIOS

Int. ID	Intersection	Juris-diction	Peak Hour	Intersec-tion Control	2020 No Project		2020 Project		Change in Delay
					Delay	LOS	Delay	LOS	
				ZONE 1					
1	4th Street and King Street	SF	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	0 **34.2**
2	4th Street and Townsend Street	SF	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	-31.6 **35.1**
3	Mission Bay Drive and 7th Street	SF	AM PM	Signal	10.1 13.4	B B	10.5 14.3	B B	0.4 0.9
4	Mission Bay Drive and Berry Street	SF	AM PM	Signal	1.9 6.9	A A	1.5 9.8	A A	-0.4 0.9
5	7th Street and 16th Street	SF	AM PM	Signal	**90.9** **67.7**	**F** **E**	**>120** **64.5**	**F** **E**	**29.7** -3.2
6	16th Street and Owens Street	SF	AM PM	Signal	11.3 13.4	B B	11.6 13.7	B B	0.3 0.3
7	22nd Street and Pennsylvania Street	SF	AM PM	All-way Stop	9.2 7.3	A A	9.5 8.4	A A	0.3 1.1
8	22nd Street and Indiana Street	SF	AM PM	All-way Stop	6.1 5.4	A A	5.7 6.0	A A	-0.4 0.6
9	Tunnel Avenue and Blanken Avenue	SF	AM PM	All-way Stop	15.3 39.8	C E	23.1 37.8	C E	7.8 -2.0
10	Linden Avenue and Dollar Avenue	SSF	AM PM	Signal	15.9 40.9	B D	18.0 54.1	B D	2.1 13.2
11	East Grand Avenue and Dubuque Way	SSF	AM PM	Signal	8.9 10.9	A B	10.4 12.3	B B	1.5 1.4
12	S Linden Avenue and San Mateo Avenue	SSF	AM PM	Signal	8.0 8.6	A A	8.0 19.4	A B	0 10.8
13	Scott Street and Herman Street	SB	AM PM	Side-Street Stop	11.3 15.1	A C	9.6 14.6	A B	-1.7 -0.5
14	Scott Street and Montgomery Avenue	SB	AM PM	Side-Street Stop	5.9 6.2	A A	6.4 6.9	A A	0.5 0.7
15	San Mateo Avenue and San Bruno Avenue	SB	AM PM	Signal	19.9 20.8	B C	21.5 19.1	C C	1.6 -1.7
				ZONE 2					
16	El Camino Real and Millbrae Avenue	MB	AM PM	Signal	**75.7** **85.1**	**E** **F**	**105.4** **>120**	**F** **F**	**29.7** **53.4**

TABLE 3-23
INTERSECTION DELAY AND LEVELS OF SERVICE, 2020 NO PROJECT AND PROJECT SCENARIOS

Int. ID	Intersection	Juris-diction	Peak Hour	Intersec-tion Control	2020 No Project		2020 Project		Change in Delay
					Delay	LOS	Delay	LOS	
17	Millbrae Avenue and Rollins Road	MB	AM PM	Signal	38.0 **58.6**	D **E**	49.4 **88.2**	D **F**	11.4 **29.6**
18	California Drive and Broadway	BG	AM PM	Signal	**61.2** **58.0**	**E** **E**	**65.2** **62.4**	**E** **E**	**4.0** **4.4**
19	Carolan Avenue and Broadway	BG	AM PM	Signal	20.7 48.6	C D	28.8 44.5	C D	8.1 -4.1
20	California Drive and Oak Grove Avenue	BG	AM PM	Signal	**91.3** 26.8	**F** C	53.2 29.9	D C	-38.1 3.1
21	Carolan Avenue and Oak Grove Avenue	BG	AM PM	Side-Street Stop	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**>60** **>60**
22	California Drive and North Lane	BG	AM PM	Side-Street Stop	16.3 11.2	C B	15.5 12.9	C B	-0.8 1.7
23	Carolan Avenue and North Lane	BG	AM PM	Side-Street Stop	32.9 13.5	D B	38.5 15.4	E C	5.6 1.9
24	Anita Road and Peninsula Avenue	BG	AM PM	Side-Street Stop	17.2 **53.3**	C **F**	14.4 33.4	B D	-2.8 -19.9
25	Woodside Way and Villa Terrace	SM	AM PM	Side-Street Stop	5.1 5.5	A A	5.2 5.3	A A	0.1 -0.2
26	North San Mateo Drive and Villa Terrace	SM	AM PM	Side-Street Stop	12.0 15.8	B C	11.6 16.0	B C	-0.4 0.2
27	Railroad Avenue and 1st Avenue	SM	AM PM	Side-Street Stop	12.6 17.8	B C	8.9 14.3	A B	-3.7 -3.5
28	S B Street and 1st Avenue	SM	AM PM	Signal	21.6 47.6	C D	16.3 50.8	B D	-5.3 3.2
29	9th Avenue and S Railroad Avenue	SM	AM PM	Side-Street Stop	41.8 41.8	E E	44.5 35.7	E E	2.7 -6.1
30	S B Street and 9th Avenue	SM	AM PM	Signal	15.3 21.8	C C	16.6 18.5	B B	1.3 -3.3
31	Transit Center Way and 1st Avenue	SM	AM PM	Uncontrolled	5.3 12.5	A B	4.2 11.4	A B	-1.1 -1.1
32	Concar Drive and SR 92 Westbound Ramps	SM	AM PM	Signal	7.0 9.2	A A	7.1 18.0	A B	0.1 8.8

TABLE 3-23
INTERSECTION DELAY AND LEVELS OF SERVICE, 2020 NO PROJECT AND PROJECT SCENARIOS

Int. ID	Intersection	Juris-diction	Peak Hour	Intersec-tion Control	2020 No Project		2020 Project		Change in Delay
					Delay	LOS	Delay	LOS	
33	S Delaware Street and E 25th Avenue	SM	AM PM	Signal	16.4 **69.5**	B **E**	15.5 43.2	B D	-0.9 -26.3
34	E 25th Avenue and El Camino Real	SM	AM PM	Signal	34.5 **90.6**	C **F**	30.9 **82.2**	C **F**	-3.6 -8.4
35	31st Avenue and El Camino Real	SM	AM PM	Signal	21.7 37.9	C D	21.2 44.2	C D	-0.5 6.3
36	E Hillsdale Boulevard and El Camino Real	SM	AM PM	Signal	**77.6** 49.9	**E** D	**<u>86.6</u>** 46.6	**<u>F</u>** D	**<u>9.0</u>** -3.3
37	E Hillsdale Boulevard and Curtiss Street	SM	AM PM	Signal	30.7 10.8	C B	38.1 10.2	D B	7.4 -0.6
38	Peninsula Avenue and Arundel Road and Woodside Way	SM	AM PM	Side-Street Stop	18.8 **54.5**	C **F**	16.8 31.2	C D	-2.0 -23.3
39	El Camino Real and Ralston Avenue	BL	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	-8.3 1.6
40	El Camino Real and San Carlos Avenue	SC	AM PM	Signal	21.5 **67.9**	C **E**	21.9 42.3	C D	0.4 -25.6
41	Maple Street and Main Street+	RC	AM PM	Side-Street Stop	39.3 51.5	E F	35.4 31.7	E D	-3.9 -19.8
42	Main Street and Beech Street	RC	AM PM	Side-Street Stop	6.4 12.8	A B	7.9 42.4	A E	1.5 29.6
43	Main Street and Middlefield Road+	RC	AM PM	Signal	24.2 >120	C F	25.7 >120	C F	1.5 >60
44	Broadway Street and California Street+	RC	AM PM	Side-Street Stop	>120 >120	F F	>120 >120	F F	>-60 >-60
45	El Camino Real and Whipple Avenue	RC	AM PM	Signal	**59.0** 53.5	**E** D	48.7 45.2	D D	-10.3 -8.3
46	Arguello Street and Brewster Avenue+	RC	AM PM	Signal	36.9 >120	D F	46.6 115.3	D F	9.7 -49.0
47	El Camino Real and Broadway Street+	RC	AM PM	Signal	60.6 108.7	E F	58.9 114.1	E F	-1.7 5.4

TABLE 3-23
INTERSECTION DELAY AND LEVELS OF SERVICE, 2020 NO PROJECT AND PROJECT SCENARIOS

Int. ID	Intersection	Juris-diction	Peak Hour	Intersec-tion Control	2020 No Project		2020 Project		Change in Delay
					Delay	LOS	Delay	LOS	
48	Arguello Street and Marshall Street+	RC	AM PM	Signal	47.2 95.7	D F	34.4 82.7	C F	-12.8 -13.0
49	El Camino Real and James Avenue+	RC	AM PM	Signal	29.2 79.2	C E	28.8 91.1	C F	-0.4 11.9
					ZONE 3				
50	El Camino Real and Fair Oaks Lane	AT	AM PM	Signal	37.1 30.2	D C	40.5 33.5	D C	3.4 3.3
51	El Camino Real and Watkins Avenue	AT	AM PM	Side-street stop	35.3 **>120**	E **F**	43.1 **>120**	E **F**	7.8 **>60**
52	Fair Oaks Lane and Middlefield Road	AT	AM PM	Side-Street Stop	**>120** **>120**	**F** **F**	**>120** **77.8**	**F** **F**	>-60 >-60
53	Watkins Avenue and Middlefield Road	AT	AM PM	Side-Street Stop	**52.5** **>120**	**F** **F**	**49.5** **91.5**	**F** **F**	-3.1 -30.3
54	Glenwood Avenue and Middlefield Road	AT	AM PM	Side-Street Stop	**70.9** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**50** **>60**
55	El Camino Real and Glenwood Avenue	MP	AM PM	Signal	53.6 **72.1**	D **E**	**94.6** **111.8**	**F** **F**	**41.0** **39.7**
56	El Camino Real and Oak Grove Avenue	MP	AM PM	Signal	56.3 50.9	E D	66.6 40.1	E D	10.3 -10.8
57	El Camino Real and Santa Cruz Avenue	MP	AM PM	Signal	30.5 27.9	C C	21.9 29.4	C C	-8.6 1.5
58	Merrill St and Santa Cruz Avenue[15]	MP	AM PM	All-way Stop	12.9 **20.3**	B **C**	11.2 **>120**	B **F**	-1.7 >60
59	Ravenswood Avenue and Alma Street	MP	AM PM	Side-Street Stop	40.6 41.8	E E	29.8 27.1	D D	-10.8 -14.7
60	El Camino Real and Ravenswood Avenue	MP	AM PM	Signal	**73.6** **>120**	**E** **F**	**75.0** **>120**	**E** **F**	1.4 1.8

[15] Intersection #58 not satisfy signal warrants and therefore is not a significant impact under 2020 Project conditions.

TABLE 3-23
INTERSECTION DELAY AND LEVELS OF SERVICE, 2020 NO PROJECT AND PROJECT SCENARIOS

Int. ID	Intersection	Juris-diction	Peak Hour	Intersec-tion Control	2020 No Project		2020 Project		Change in Delay
					Delay	LOS	Delay	LOS	
61	Ravenswood Avenue and Laurel Street	MP	AM PM	Signal	**73.4** **>120**	**E** **F**	37.0 50.1	D D	-36.4 >-60
62	Alma Street and Palo Alto Avenue	PA	AM PM	Side-Street Stop	8.4 12.4	A B	13.3 31.4	B D	4.9 19.0
63	Meadow Drive and Alma Street	PA	AM PM	Signal	104.2 >120	F F	110 >120	F F	5.8 29.1
64	El Camino Real and Alma and Sand Hill Road	PA	AM PM	Signal	**58.5** 54.9	**E** D	**78.7** 53.5	**E** D	**20.2** -1.4
65	High Street and University Avenue	PA	AM PM	Signal	10.1 18.6	B B	12.8 18.4	B B	2.7 -0.2
66	Alma Street and Churchill Avenue	PA	AM PM	Signal	**83.9** **>120**	**F** **F**	**108.9** **>120**	**F** **F**	**25.0** **9.2**
67	W Meadow Drive and Park Blvd.	PA	AM PM	Side-Street Stop	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	>-60 >-60
68	Alma Street and Charleston Road	PA	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**28.4** **9.0**
69	Showers Drive and Pacchetti Way	MV	AM PM	Signal	4.4 5.0	A A	4.8 5.3	A A	0.4 0.3
70	Central Expressway and N Rengstorff Avenue	MV	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	-10.9 **18.7**
71	Central Expressway and Moffett Boulevard and Castro Street	MV	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**37.2** **11.7**
72	W Evelyn Avenue and Hope Street	MV	AM PM	Signal	3.8 5.7	A A	3.8 5.8	A A	0 0.1
73	Rengstorff Avenue and California Street	MV	AM PM	Signal	29.5 **55.6**	C **E**	31.4 40.5	C D	1.9 -15.1
74	Castro Street and Villa Street	MV	AM PM	Signal	11.7 **65.5**	B **E**	14.7 **68.5**	B **E**	3.0 3.0
75	W Evelyn Avenue and S Mary Avenue	SV	AM PM	Signal	**68.7** **80.1**	**E** **F**	**56.7** **97.3**	**E** **F**	-12.0 **17.2**
76	W Evelyn Avenue and Frances Street	SV	AM PM	Signal	20 26.3	B C	31.9 36.6	C D	11.9 10.3

TABLE 3-23
INTERSECTION DELAY AND LEVELS OF SERVICE, 2020 NO PROJECT AND PROJECT SCENARIOS

Int. ID	Intersection	Juris-diction	Peak Hour	Intersec-tion Control	2020 No Project		2020 Project		Change in Delay
					Delay	LOS	Delay	LOS	
				ZONE 4					
77	Kifer Road and Lawrence Expressway*	SCL/ SV	AM PM	Signal	111.4 >120	F F	114.6 >120	F F	3.2 2.9
78	Reed Avenue and Lawrence Expressway	SCL/ SV	AM PM	Signal	**107.3** **86.4**	**F** **F**	**107.4** **68.1**	**F** **F**	0.1 -18.3
79	El Camino Real and Railroad Avenue*	SCL	AM PM	Signal	17.8 21.9	B C	20.1 22.1	C C	2.3 0.2
80	W Santa Clara Street and Cahill Street	SJ	AM PM	Signal	25.8 47.8	C D	23.0 **62.8**	C **E**	-2.8 **15.0**
81	S Montgomery Street and W San Fernando Street	SJ	AM PM	Signal	22.8 **64.3**	C **E**	29.0 **>120**	C **F**	6.2 **>60**
82	Lick Avenue and W Alma Avenue	SJ	AM PM	Signal	23.2 30.3	C C	31.4 45.6	C D	8.2 15.3

Notes:
Jurisdictions:

SF	San Francisco
SSF	South San Francisco
SB	San Bruno
MB	Millbrae
BG	Burlingame
MP	Menlo Park
SM	San Mateo
BL	Belmont
SC	San Carlos
RC	Redwood City
AT	Atherton
PA	Palo Alto
MV	Mountain View
SV	Sunnyvale
SCL	Santa Clara
SCC	Santa Clara County
SJ	San Jose

Bold font represents an LOS that is below the established threshold of significance as per the Significance Criteria

Bold Underline font represents an LOS that is below the established threshold of significance as per the Significance Criteria compared to the No Project scenario

+Downtown Redwood City has no level of service standard for intersections in the Downtown Precise Plan Area (Policy BE-29.4).
*The City of Santa Clara allows level of service exemptions on a case by case basis to facilitate alternate transportation in Station Focus Areas. If exemption is allowed, this intersection may not be impacted.

AM = morning peak hour, PM = afternoon peak hour

LOS designation as per 2010 Highway Capacity Manual

Delay measured in seconds

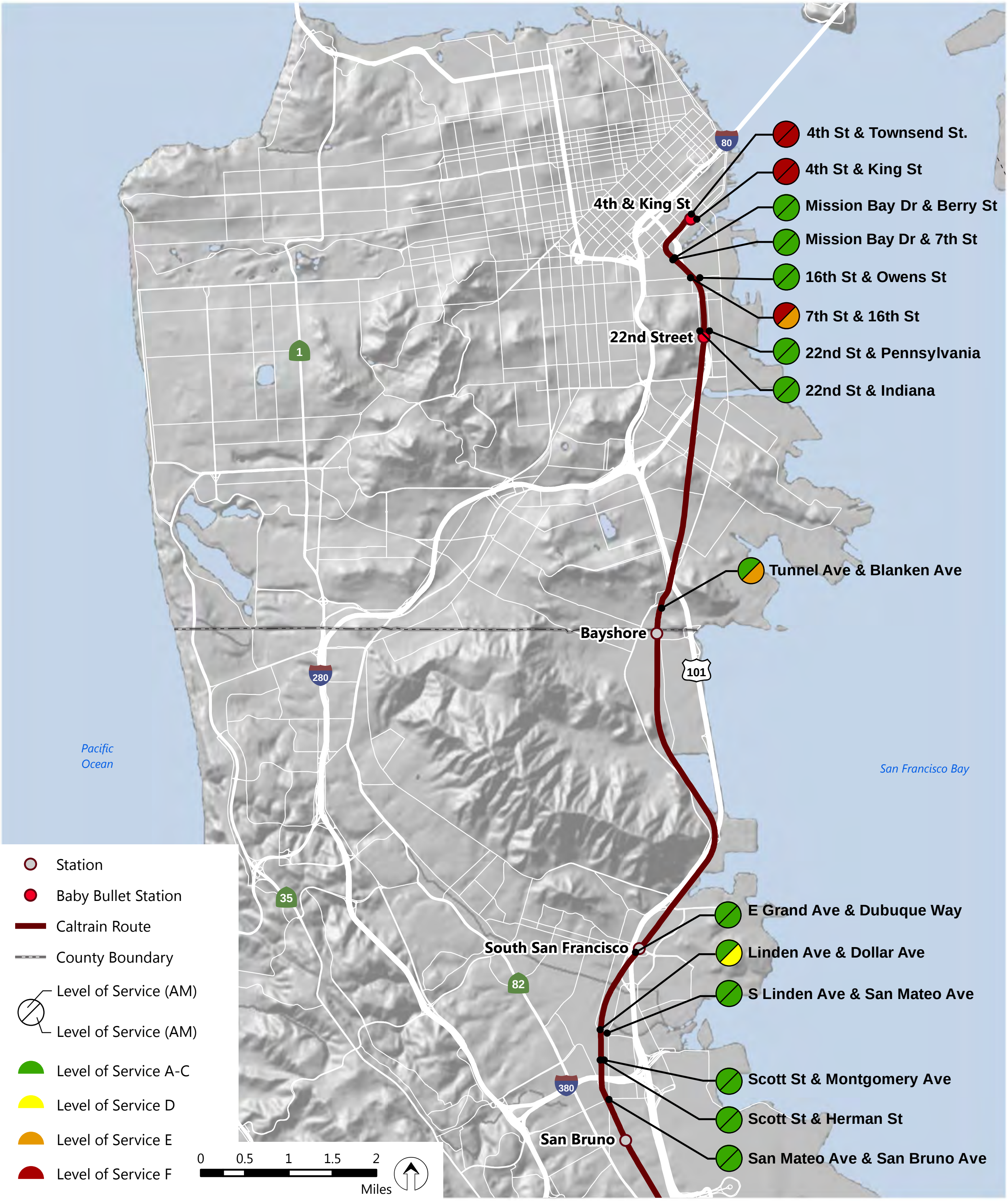

Figure 3-2

2020 No Project AM & PM Peak Hour Intersection LOS, Zone 1

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Date: January, 2014

FEHR PEERS

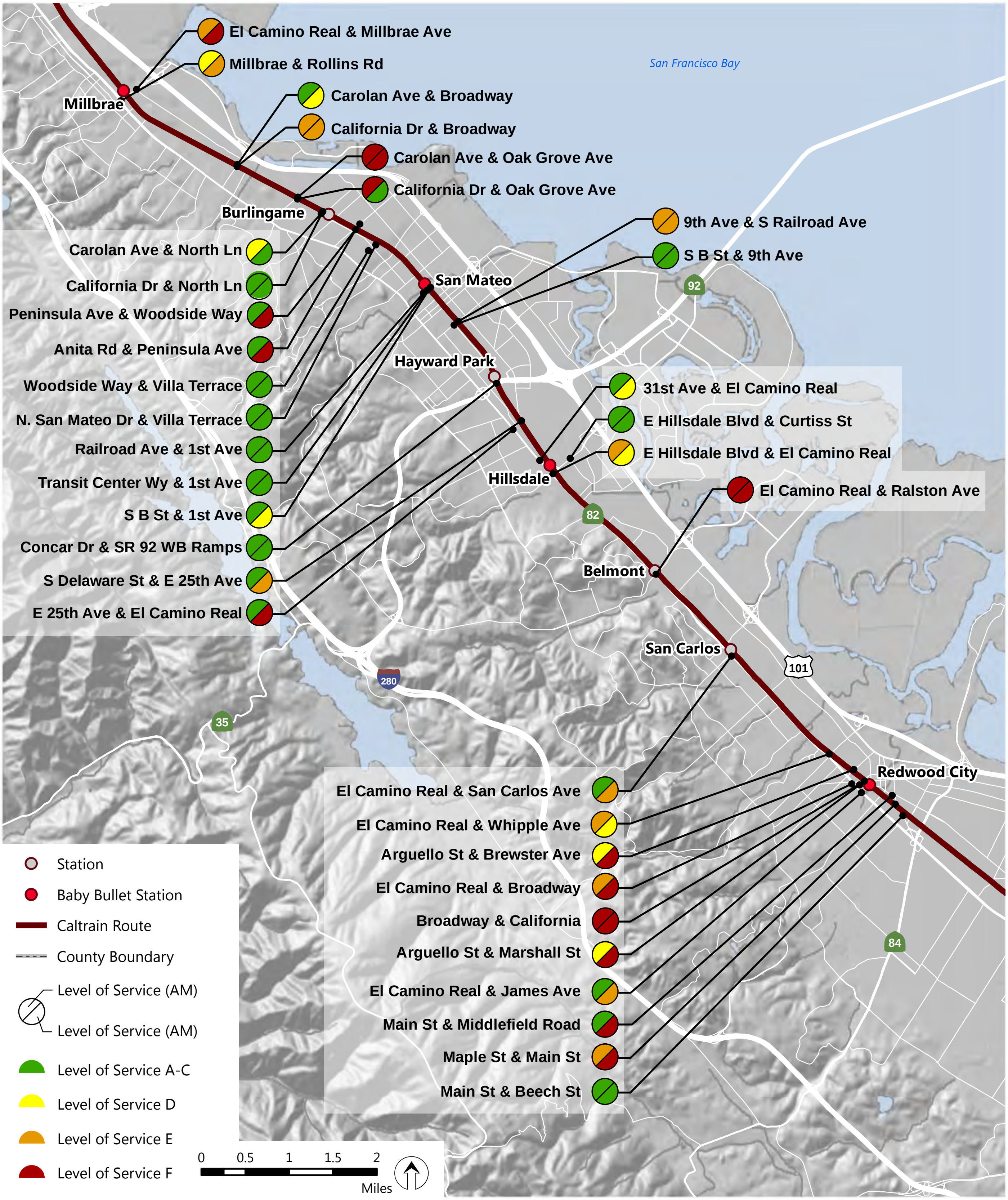

Figure 3-3

2020 No Project AM & PM Peak Hour Intersection LOS, Zone 2

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Date: January, 2014

FEHR & PEERS

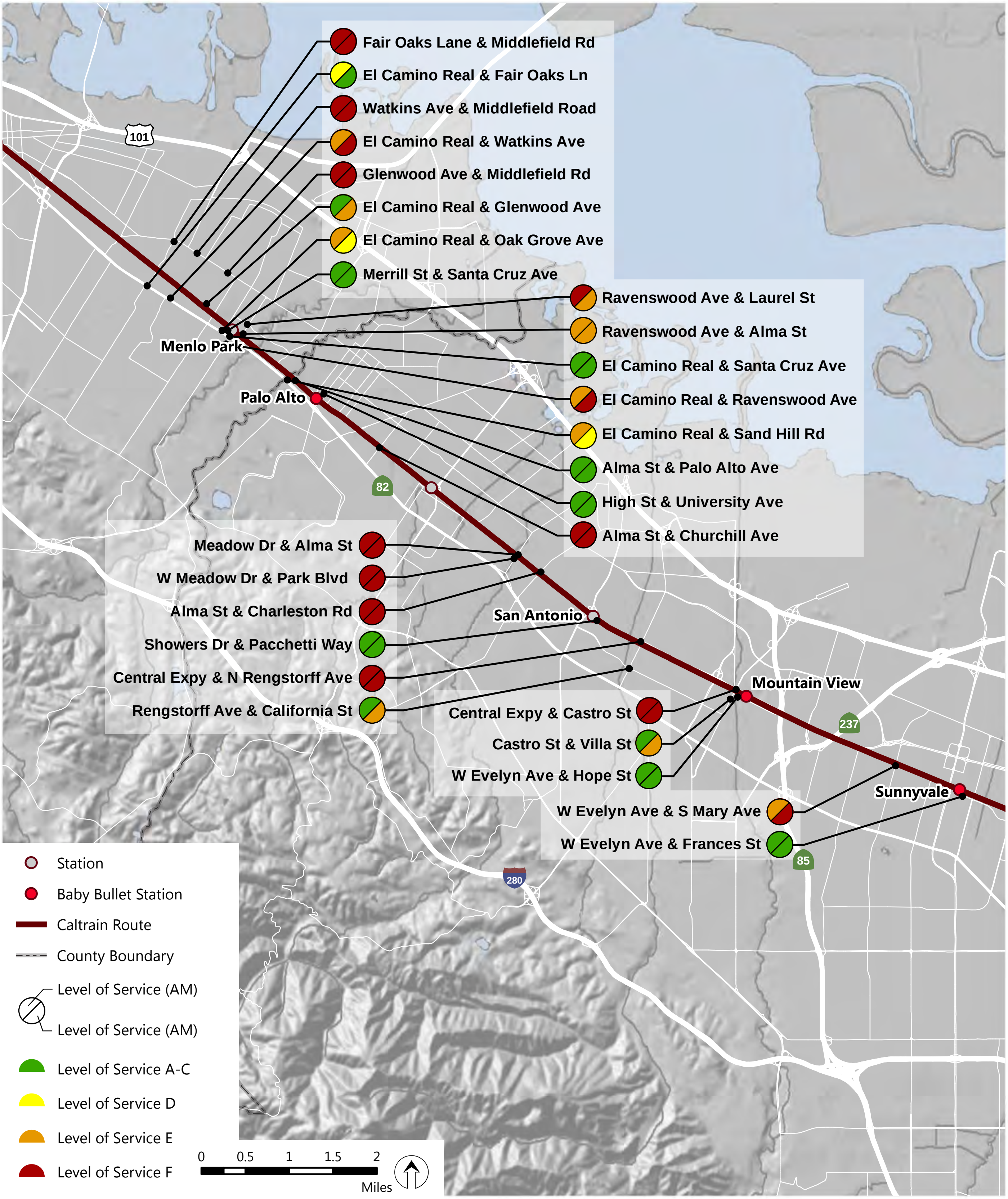

Figure 3-4

2020 No Project AM & PM Peak Hour Intersection LOS, Zone 3

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FEHR & PEERS

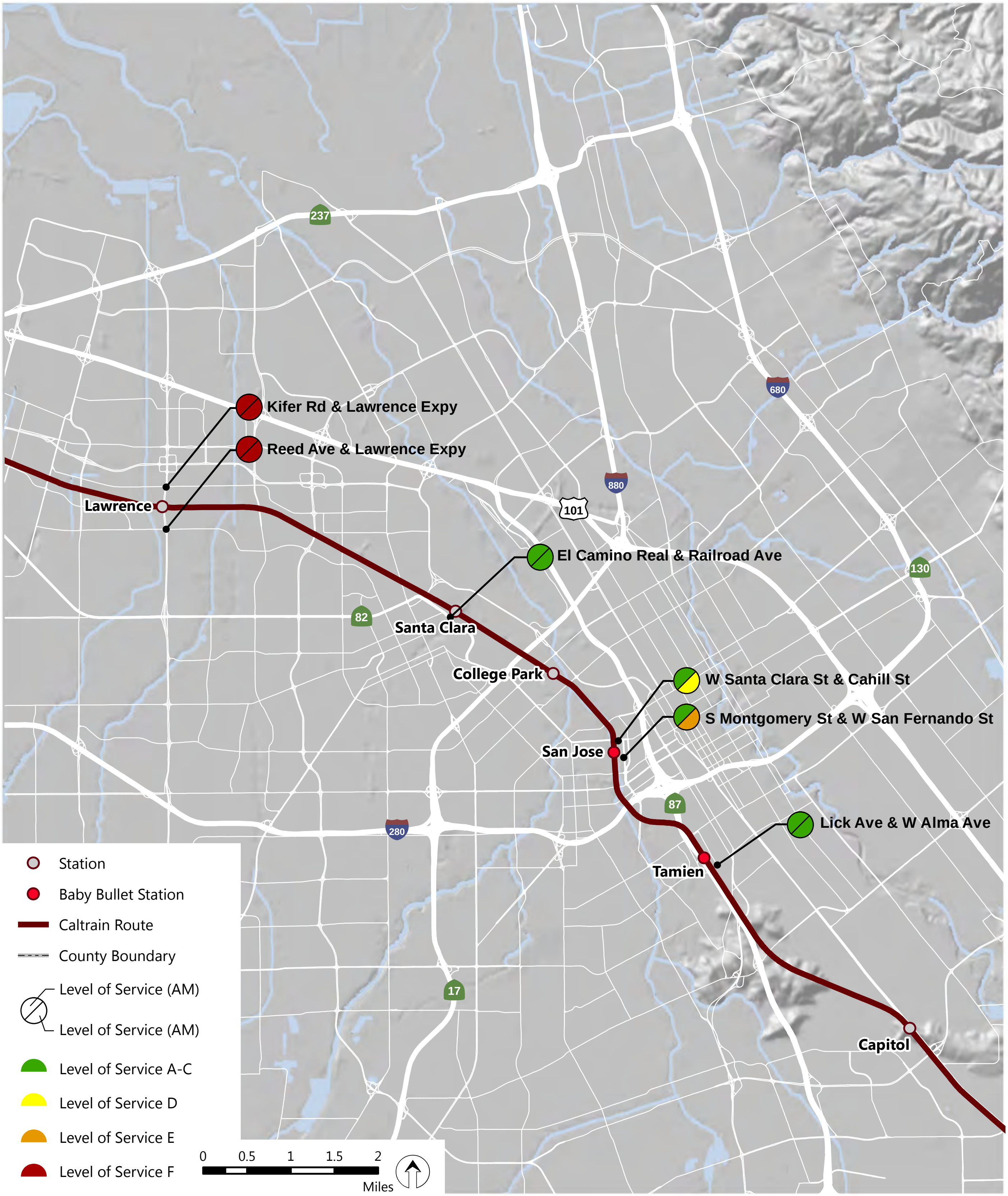

Figure 3-5

2020 No Project AM & PM Peak Hour Intersection LOS, Zone 4

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Date: January, 2014

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