Figure 2-26

Existing AM & PM Peak Hour Intersection LOS, Zone 1

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Date: January 2014

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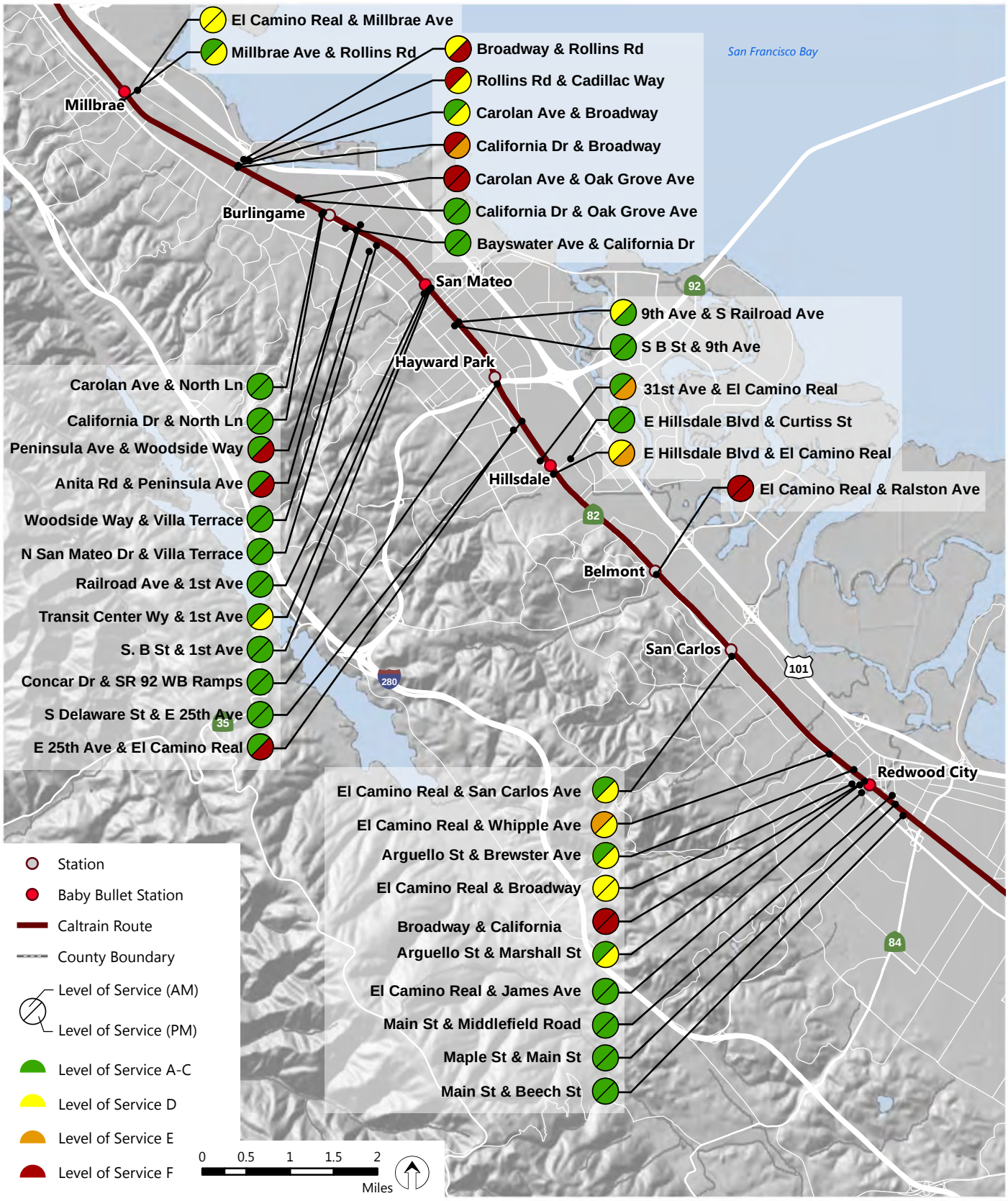

Figure 2-27

Existing AM & PM Peak Hour Intersection LOS, Zone 2

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Date: January 2014 (Revised September 2014)
*This figure replaces Figure 2-27 from the Draft EIR (TIA)

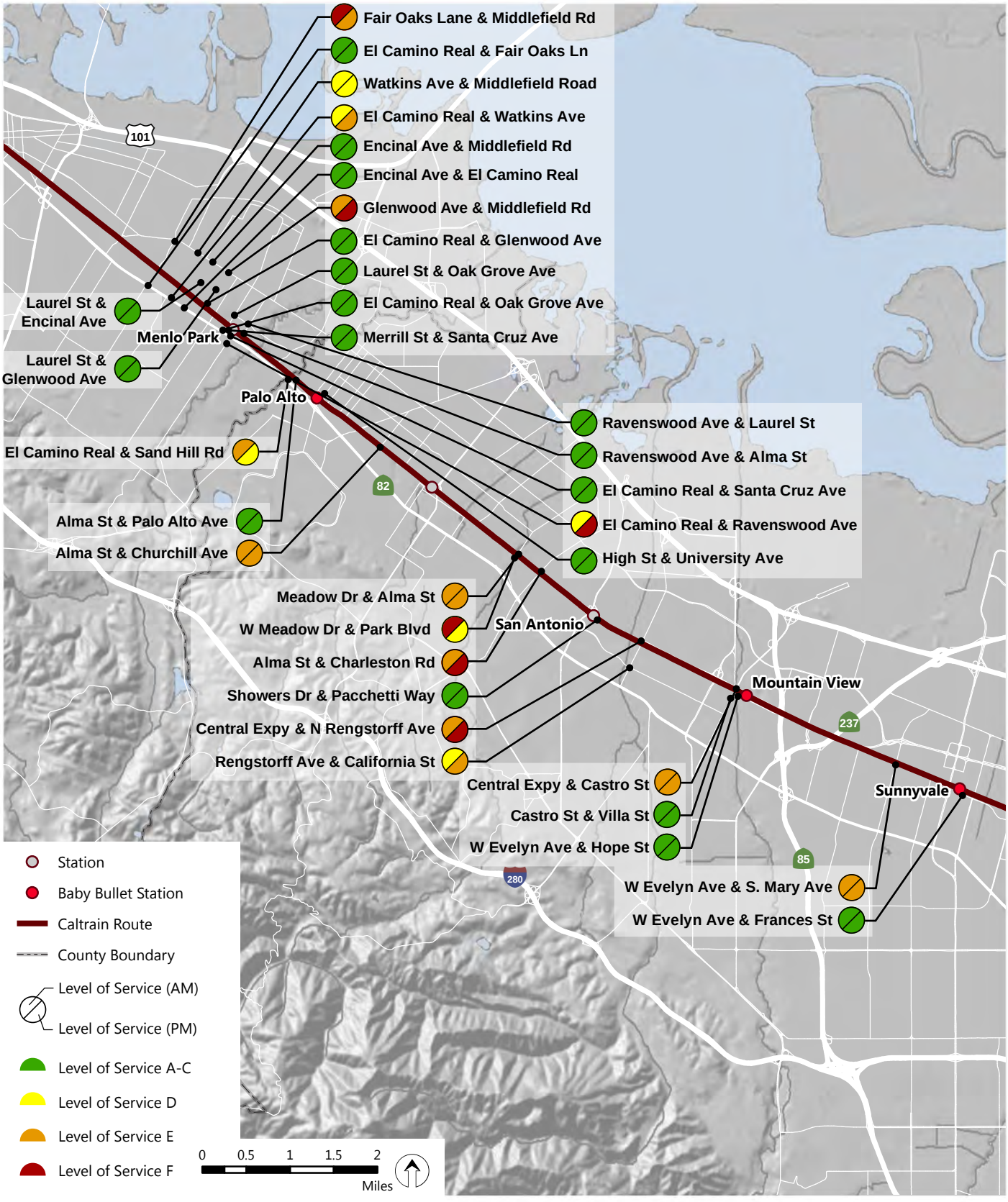

Figure 2-28

Existing AM & PM Peak Hour Intersection LOS, Zone 3

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Date: January 2014 (Revised September 2014)
*This figure replaces Figure 2-28 from the Draft EIR (TIA)

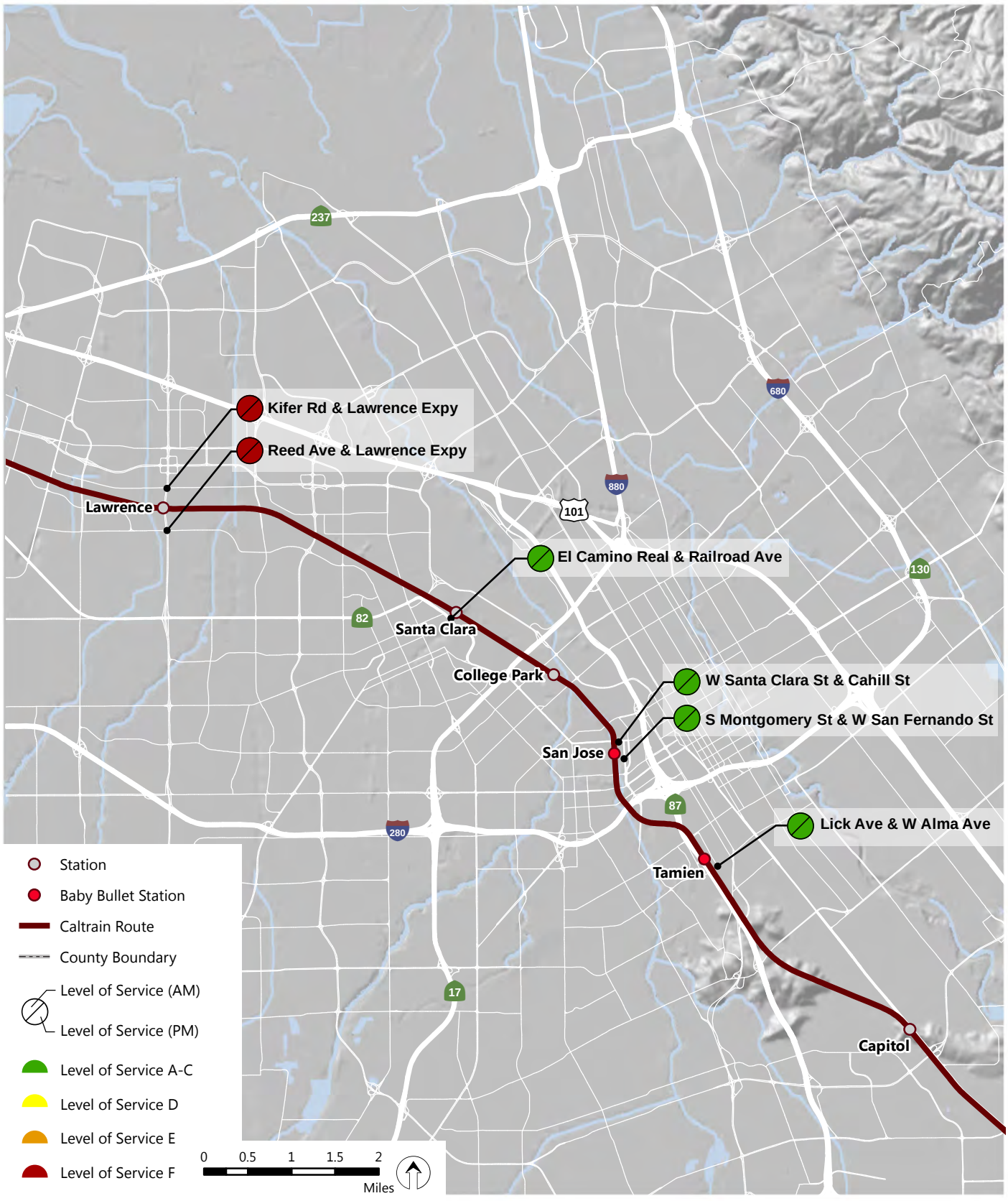

Figure 2-29

Existing AM & PM Peak Hour Intersection LOS, Zone 4

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Date: December 2013

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 Caltrain 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.[9]

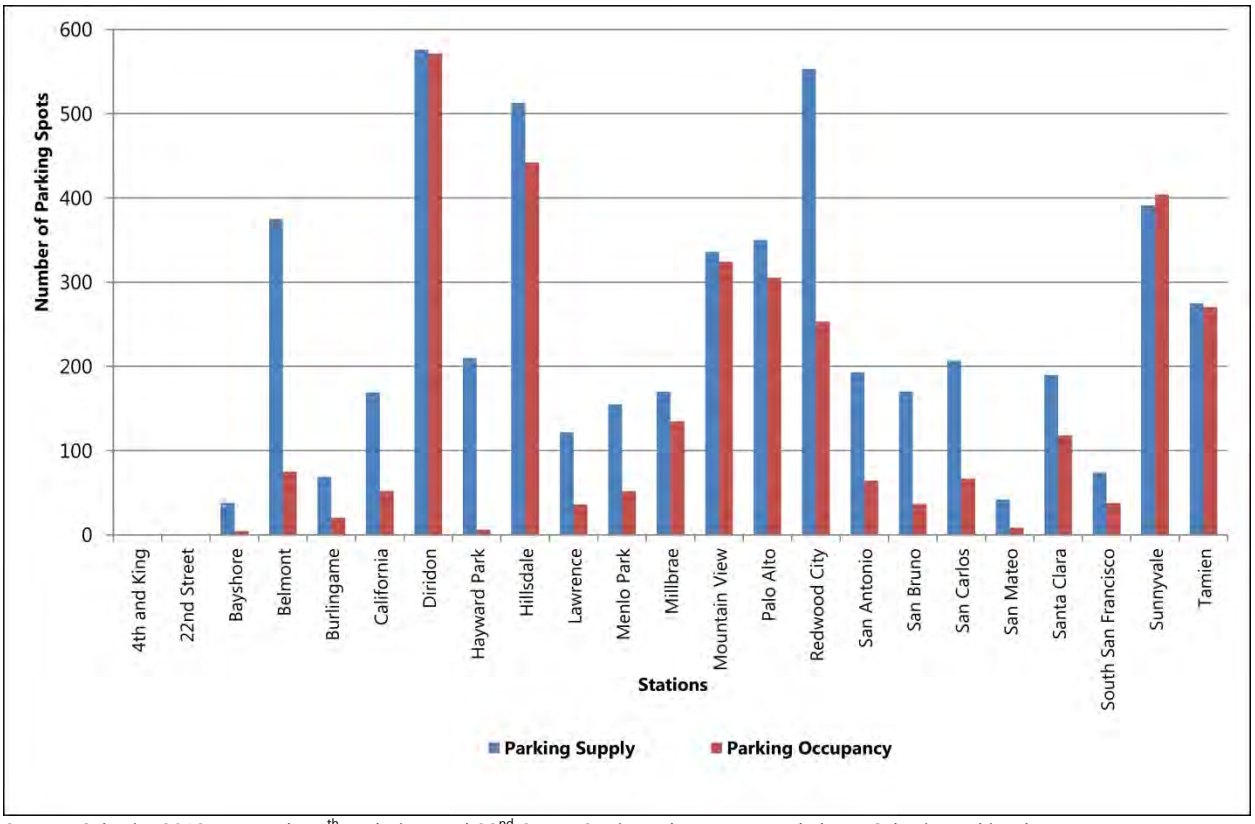
[9] Shared-parking spots with BART ~~not reflected~~ included in Millbrae Station parking capacity discussed in this section.

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**	**490**[1] ~~**170**~~	**80** ~~**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~~ There are 170 Caltrain parking spaces. There are approximately 2,980 spaces in shared parking with BART and the lot is 80% utilized, leaving approximately, 640 available spaces. This analysis assumes that approximately 50% of those spaces (320 spaces) are available for Caltrain riders.

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~~,~~ and 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.

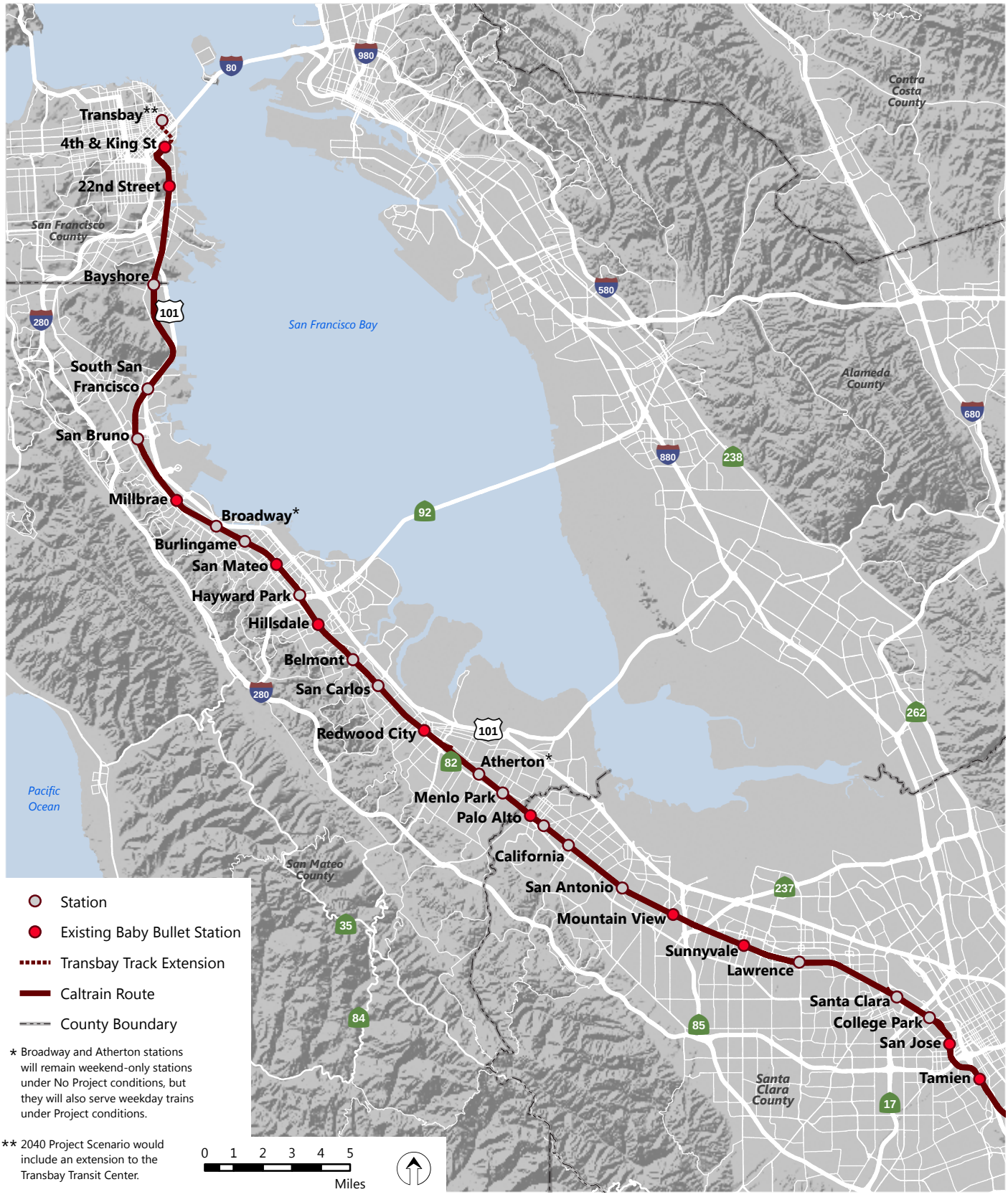


Figure 3-1

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

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Date: February 2013

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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~~ Baby Bullet, 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 of 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: improving management of train schedules, eliminating trains overshooting a station stop or platform, and improving 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.[10] Caltrain's diesel-powered locomotive service would continue to be used to provide service between ~~the~~ Gilroy, San Jose, and San Francisco.[11] 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).

[10] This project only includes funding for EMUs representing approximately 75 percent of the operational fleet between San Jose and San Francisco. In 2020 ~~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 2020 ~~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.
[11] 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 protypical 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 based on the prototypical schedule. 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~~ Baby Bullet trains 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 Caltrain would add six more trains ~~Caltrain would add~~ to the schedule. The number of Midday trains increases by six and evening trains by one ~~more evening train Caltrain would add to the schedule~~. The greatest service gains, as measured 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: The Transbay Transit Center ~~Terminal Station~~ will not be in place until after 2020 and is thus only included in 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, ~~B~~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, service 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 Transit 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 of 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.[12]

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 prototypical 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 prototypical schedule is a mix of ~~Bullet~~ Peak

[12] 2040 Project conditions assume the Caltrain Downtown Extension to the Transbay Transit Center ~~Terminal~~.

Hour Limited,[13] Limited (skip-stop), and Local trains 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~~ stop at all stations along the corridor until terminating at ~~upon reaching~~ San Jose Diridon ~~until terminating~~ ,where riders traveling further north would transfer to an EMU train. ~~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~~ northbound Peak Hour Limited ~~bullet~~ trains are ~~t~~all trains with travel time of less than or equal to one hour and five minutes (1:05) and southbound Peak Hour Limited ~~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 Peak Hour Limited ~~bullet~~ trains are all trains with a total travel time less than or equal to one hour and six minutes (1:06) and southbound Peak Hour Limited ~~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).

[13] Baby Bullet service would continue in the 2020 Project scenario prototypical schedule. In the 2040 Project scenario prototypical schedule, "Peak Hour Limited" trains operate as skip stop trains with a shorter overall travel time during the peak hour. Trains with a trip length of approximately one hour and ten minutes or less would be considered Peak Hour Limited service in the 2040 Project scenario. The "Peak Hour Limited" trains would make more scheduled stops than existing Bullet trains, but with approximately the same total existing travel time. The project does not necessarily exclude Baby Bullets in 2040; the schedule used is only a prototypical schedule showing a greater amount of limited type trains.

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 (Existing/2020) or Peak Hour Limited Trains (2040)	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 Transit 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~~ Peak Hour Limited trains in the 2040 Project scenario would have more scheduled stops than existing Baby Bullet trains, meaning ~~Bullet~~ these trains would serve more stations. An average of 13 stops are made by ~~baby bullet~~ Peak Hour Limited 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~~ Peak Hour Limited 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~~ Peak Hour Limited 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 station, Millbrae station, and Transbay Transit Center ~~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[14] 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.

[14]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.

- 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.

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.[15]

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.

[15] Reference to "Core Capacity" projects does not include DTX/TTC which is a previously approved, environmentally cleared independent project by TJPA.

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 to 53 round trips (80 to 106 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) CHSRA 2014 Business Plan. 2014 Business Plan Service Planning Methodology.
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 Transit Center ~~Terminal~~ (San Francisco) 4th and King Interim Station (San Francisco), if necessary	Transbay Transit Center Program Final SEIS and EIR (2004) and subsequent addenda (TJPA, 2004) CHSRA 2014 comment letter on the PCEP DEIR (see Volume II)
	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 to 53 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 which included 40 round-trip trains and the ~~Draft~~ 2014 Business Plan Service Planning Methodology document which 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.~~ There is no explicit statement in the 2014 Business Plan of the daily number of HSR trains for the San Francisco to San Jose segment. The exact number of HSR trains is unknown. 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	2040 – Phase 1 Blended
San Francisco (Transbay Transit Center)	11,500	20,500	15,400	19,700
Millbrae	2,600	4,200	6,900	8,500
San Jose	3,300	6,100	8,200	10,200

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. Citywide growth within the VTA travel demand model generally matches ABAG growth forecasts as included in the Plan Bay Area. 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~~ 91 intersections along the Caltrain line in San Francisco, San Mateo, and Santa Clara Counties. Most of these intersections (~~65~~ 70) were modeled using the Synchro and SimTraffic software packages. The remaining ~~17~~ 21 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.[16] 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,

[16] 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.

- 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.

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.[17]

  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,

[17] 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.

- 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.

The criteria on disruption or interference with existing or planned transit facilities is limited to ridership impacts and does not include physical impacts such as design for two reasons. First, the details of the Proposed Project design are not developed enough to determine what or if there would be physical impacts. Caltrain would work with other transit providers and jurisdictions when developing projects to prevent needless disruption and interference. Additionally, based on CEQA guidelines, disruption need not be evaluated at a fine-grained level of detail if the design is not yet known. Based on these factors, it is reasonable to examine disruption from the perspective of whether ridership would be accommodated or disrupted.

The main text of the EIR also analyzes potential impacts related to transit system safety, but this impact is not analyzed in this document (see Chapter 3.14 of the Final EIR).

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 was 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~~ 0.9 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
Brisbane	431,000	397,000	827,000	428,000	395,000	823,000	492,000	464,000	956,000	486,000	460,000	946,000
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~~ 317,000	263,000	~~963,000~~ 579,000	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~~ 23,807,000	~~19,050,000~~ 19,447,000	~~42,812,000~~ 43,255,000	~~23,291,000~~ 23,719,000	~~18,763,000~~ 19,158,000	~~42,051,000~~ 42,874,000	~~26,934,000~~ 27,426,000	~~21,619,000~~ 22,083,000	~~48,555,000~~ 49,511,000	~~26,657,000~~ 27,143,000	~~21,577,000~~ 22,037,000	~~48,233,000~~ 49,179,000

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
Bayswater Avenue	Burlingame	0:09:16	0:08:51	0:08:30	0:08:51	0:08:36	0:09:23
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
Encinal Avenue	Menlo Park	0:08:00	0:07:15	0:08:00	0:07:15	0:07:34	0:08:18
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
Bayswater Avenue	Burlingame	0:00:06	0:00:32
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
Encinal Avenue	Menlo Park	-0:00:26	0:01:03
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
Bayswater Avenue	Burlingame	0:08:30	0:08:51	0:09:21	0:09:21
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
Encinal Avenue	Menlo Park	0:08:00	0:07:15	0:08:13	0:08:53
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
Bayswater Avenue	Burlingame	0:00:51	0:00:30
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
Encinal Avenue	Menlo Park	0:00:13	0:01:38
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

Initially, traffic operations at ~~all~~ 82 intersections in the Study Area were analyzed under the future No Project and Project scenarios. Additional analysis was conducted at eight intersections, resulting in 90 study intersections analyzed for future scenarios:

- Intersection # 83 – Broadway / Rollins Road (Burlingame)
- Intersection # 84 – Rollins Road / Cadillac Way (Burlingame)
- Intersection # 84a – Broadway/US 101 Southbound Ramps (Burlingame)
- Intersection # 85 – Bayswater Avenue/California Drive (Burlingame)
- Intersection # 86 – Encinal Avenue/El Camino Real (Menlo Park)
- Intersection # 87 – Encinal Avenue/Middlefield Road (Atherton)
- Intersection # 88 – Laurel Street /Oak Grove Avenue (Menlo Park)
- Intersection # 89 – Laurel Street/Glenwood Avenue (Menlo Park) - unsignalized
- Intersection # 90 – Laurel Street/Encinal Avenue (Menlo Park) - unsignalized

The intersection of Broadway and US 1010 Southbound Ramps in Burlingame was added to the list of intersections as a result of the US 101/Broadway Interchange Reconstruction project, however this intersection does not exist under Existing Conditions. 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~~ along El Camino Real~~, Alma Street~~, Broadway (in Burlingame), Rollins Road, 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 severe congestion would occur in around the Millbrae, Burlingame, 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	**133.7** **157.2**	**F** **F**	**>120** **>120**	**F** **F**	-0.7 **6.8**
19	Carolan Avenue and Broadway	BG	AM PM	Signal	46.3 52.1	D D	46.0 52.7	D D	-0.3 0.6
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 4.2
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	Uncontr olled	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 12.0

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	**86.6** 46.6	**F** D	**9.0** -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[18]	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

[18] Intersection #58 does 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	
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
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	SCC	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**4.2** **46.6**
71	Central Expressway and Moffett Boulevard and Castro Street	SCC	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	2.5 **5.8**
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

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	
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
				ZONE 4					
77	Kifer Road and Lawrence Expressway	SCC	AM PM	Signal	**111.4** **>120**	**F** **F**	**114.6** **>120**	**F** **F**	3.2 2.9
78	Reed Avenue and Lawrence Expressway	SCC	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
				Additional Intersections					
				ZONE 2					
83	Broadway and Rollins Road	BG	AM PM	Signal	50.6 **94.8**	D **F**	50.8 **96.8**	D **F**	0.2 2.0
84	Rollins Road and Cadillac Way	BG	AM PM	Signal	10.1 5.7	B A	9.9 5.9	A A	-0.2 0.2
84a	Broadway and US 101 Southbound Ramps	BG	AM PM	Signal	**59.1** **100.0**	**E** **F**	49.0 **85.4**	D **F**	-10.1 -14.6
85	Bayswater Avenue and California Drive	BG	AM PM	Signal	11.0 11.8	B B	11.1 11.7	B B	0.1 -0.1
				ZONE 3					
86	Encinal Avenue and El Camino Real	MP	AM PM	Signal	15.0 **111.9**	B **F**	16.6 **79.1**	B **E**	1.6 -32.8

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	
87	Encinal Avenue and Middlefield Road	AT	AM PM	Signal	21.0 15.1	C B	22.7 14.2	C B	1.7 -0.9
88	Laurel Street and Oak Grove Avenue	MP	AM PM	Signal	11.1 10.7	B B	11.1 13.0	B B	0.0 2.3
89	Laurel Street and Glenwood Avenue	MP	AM PM	All-way Stop	6.9 8.4	A A	6.9 7.1	A A	0.0 -1.3
90	Laurel Street and Encinal Avenue	MP	AM PM	All-way Stop	5.6 6.6	A A	5.7 6.3	A A	0.1 -0.3

Source: Fehr & Peers, 2014

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

This table replaces Table 3-23 from the Draft EIR (TIA)

+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

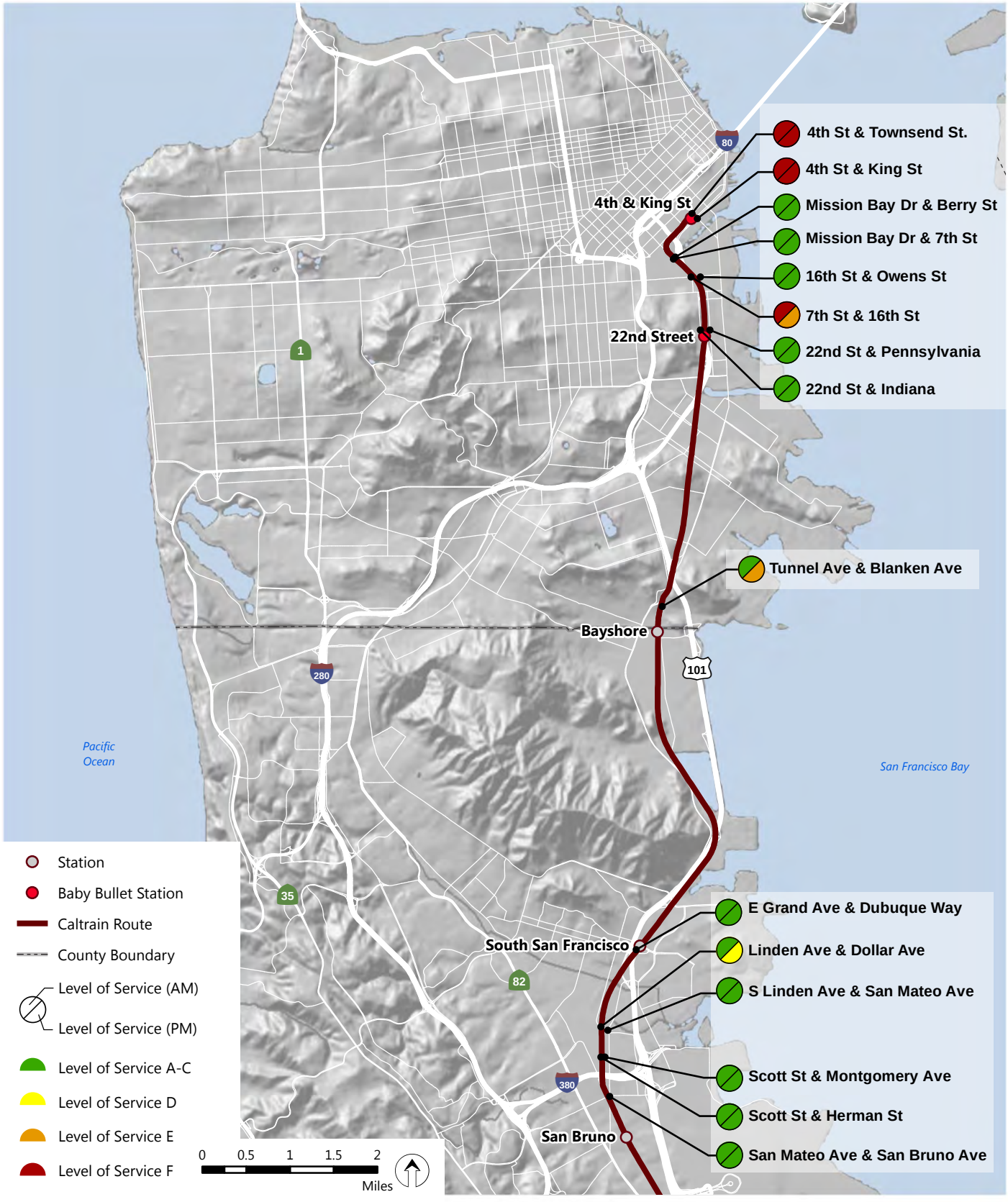

Figure 3-2

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

Document Path: N:\Projects_SJ13_Projects\SJ13_1440_Caltrain_Electrification\Graphics\ADOBE\Fig_3-02_LOS_Zone1_2020_NP.ai
Date: January 2014

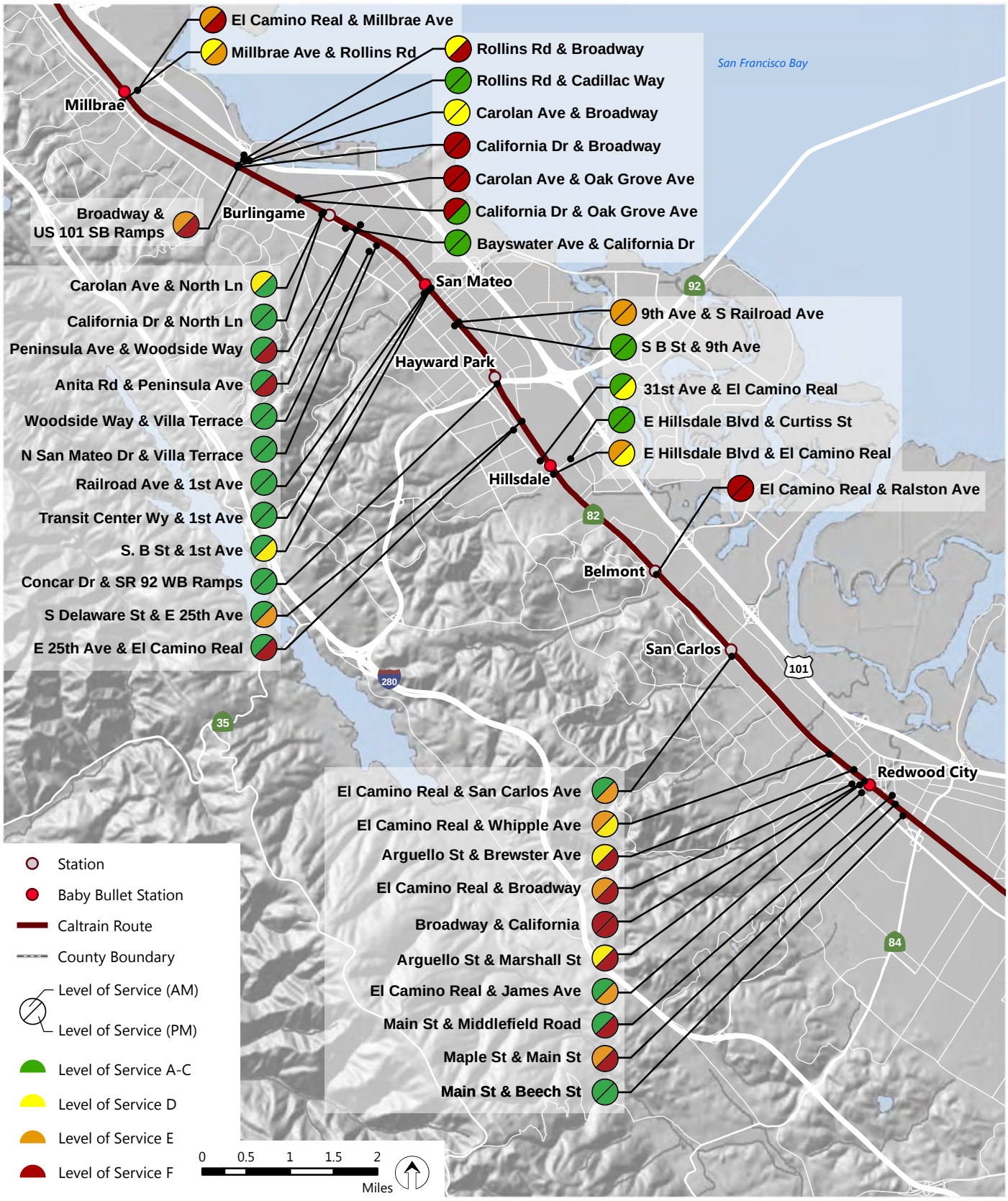

Figure 3-3

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

Document Path: N:\Projects_SJ13_Projects\SJ13_1440_Caltrain_Electrification\Graphics\ADOBE\Fig_3-03_LOS_Zone2_2020_NP.ai
Date: January 2014 (Revised September 2014)
*This figure replaces Figure 3-3 from the Draft EIR (TIA)

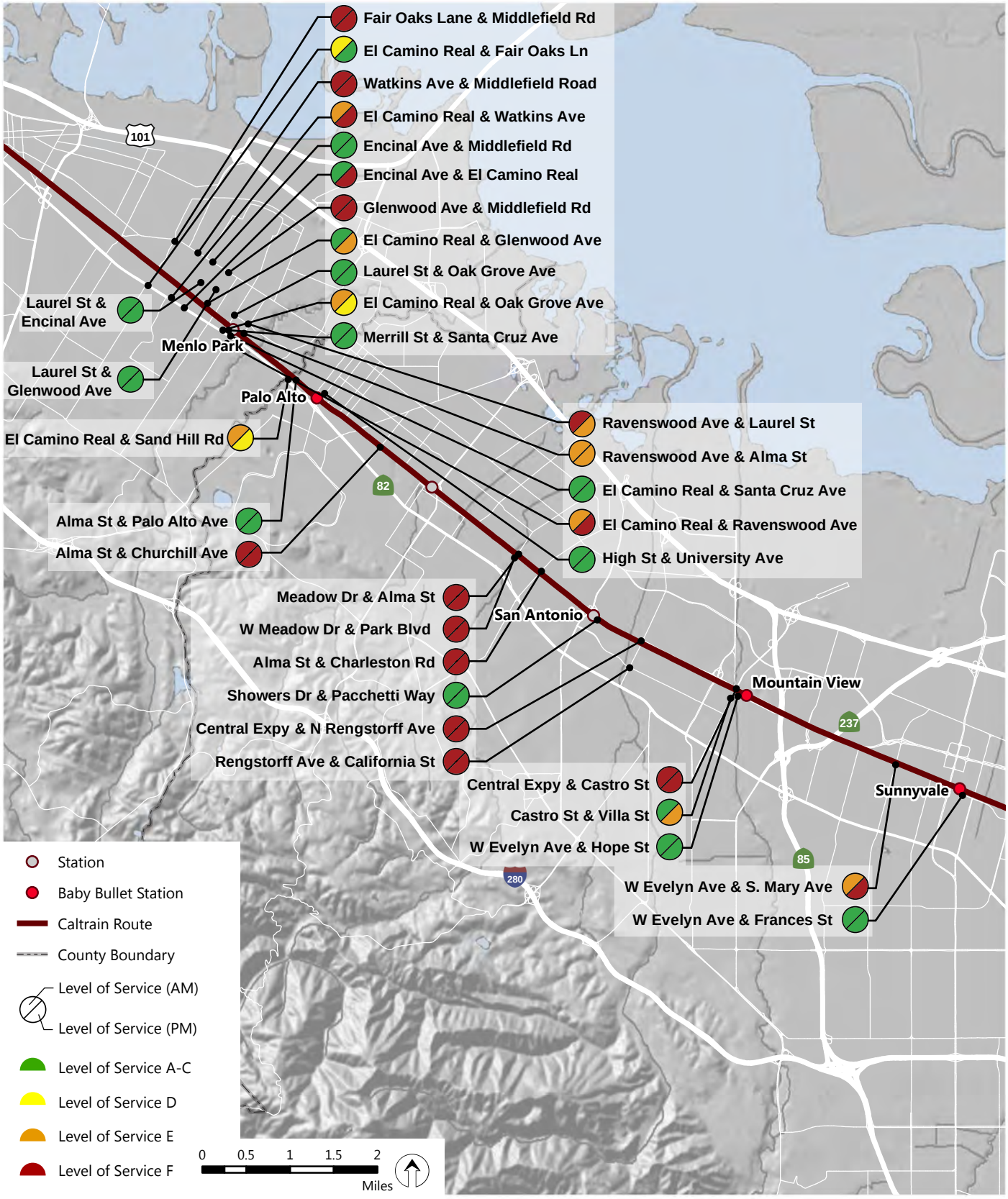

Figure 3-4

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

Document Path: N:\Projects_SJ13_Projects\SJ13_1440_Caltrain_Electrification\Graphics\ADOBE\Fig_3-04_LOS_Zone3_2020_NP.ai
Date: January 2014 (Revised September 2014)
*This figure replaces Figure 3-4 from the Draft EIR (TIA)

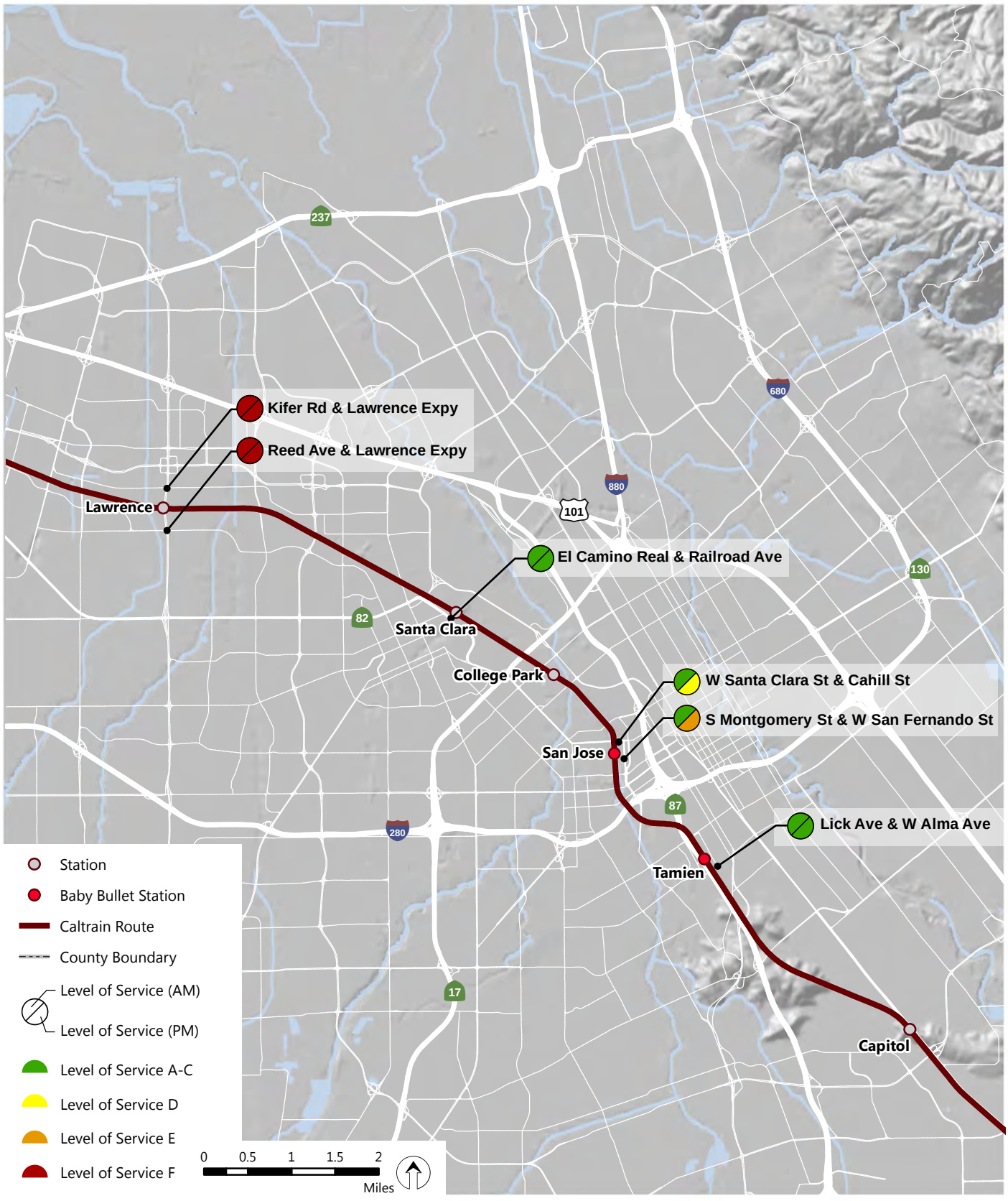

Figure 3-5

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

Document Path: N:\Projects_SJ13_Projects\SJ13_1440_Caltrain_Electrification\Graphics\ADOBE\Fig_3-05_LOS_Zone4_2020_NP.ai
Date: January 2014

FEHR PEERS

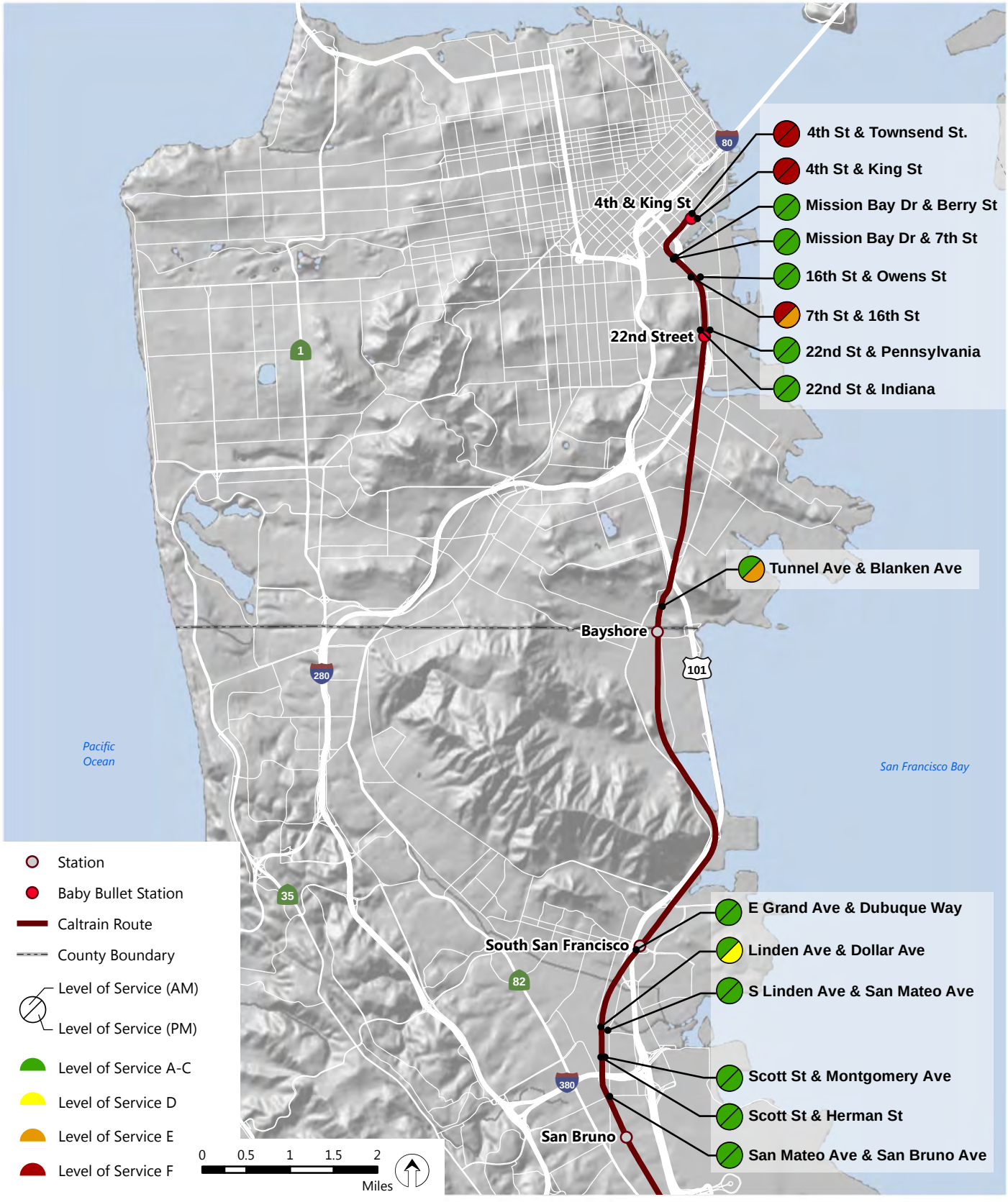

Figure 3-6

2020 Project AM & PM Peak Hour Intersection LOS, Zone 1

Document Path: N:\Projects_SJ13_Projects\SJ13_1440_Caltrain_Electrification\Graphics\ADOBE\Fig_3-06_LOS_Zone1_2020_PCEP.ai
Date: January 2014

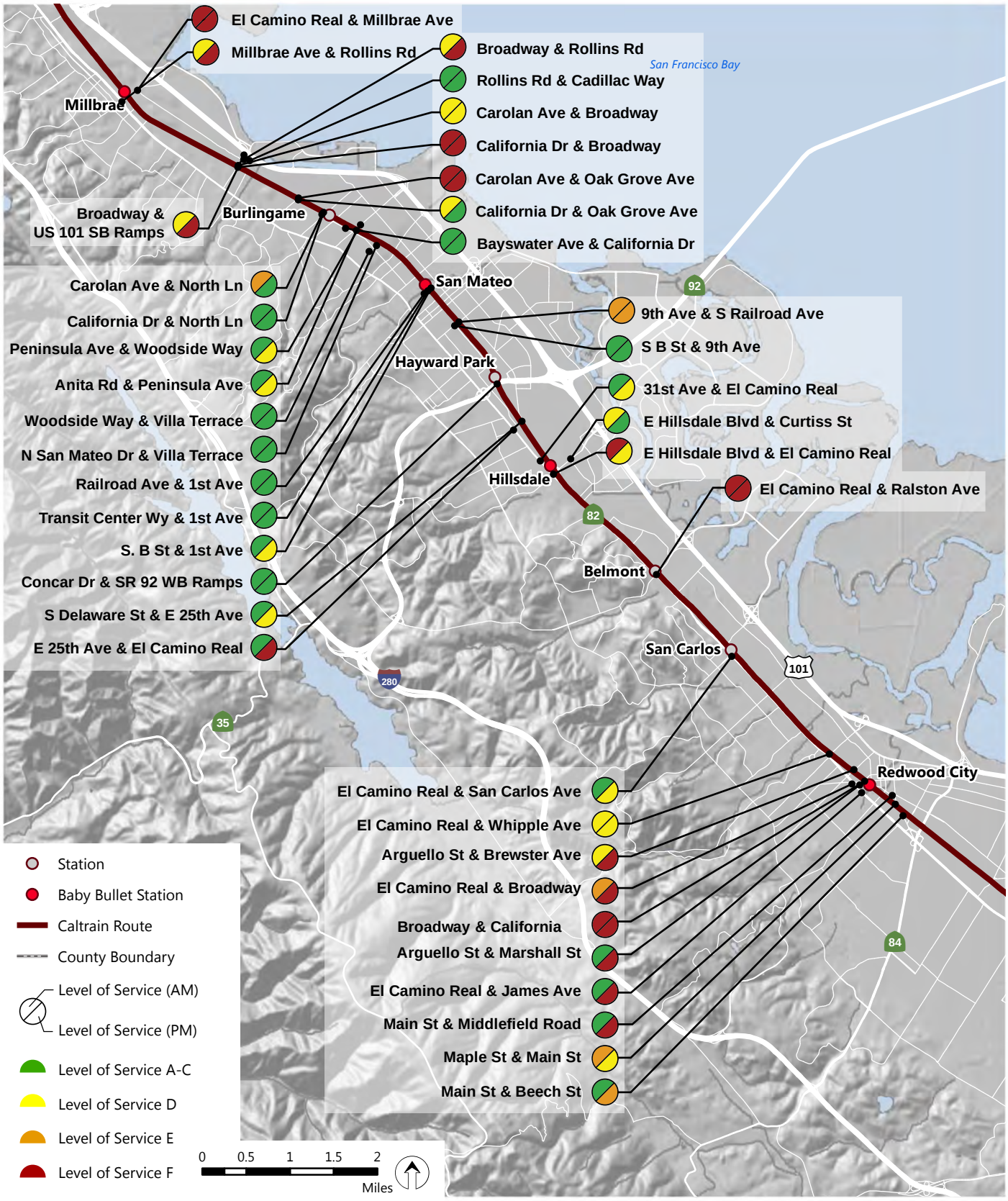

Figure 3-7

2020 Project AM & PM Peak Hour Intersection LOS, Zone 2

Document Path: N:\Projects_SJ13_Projects\SJ13_1440_Caltrain_Electrification\Graphics\ADOBE\Fig_3-07_LOS_Zone2_2020_PCEP.ai
Date: January 2014 (Revised September 2014)
*This figure replaces Figure 3-7 from the Draft EIR (TIA)

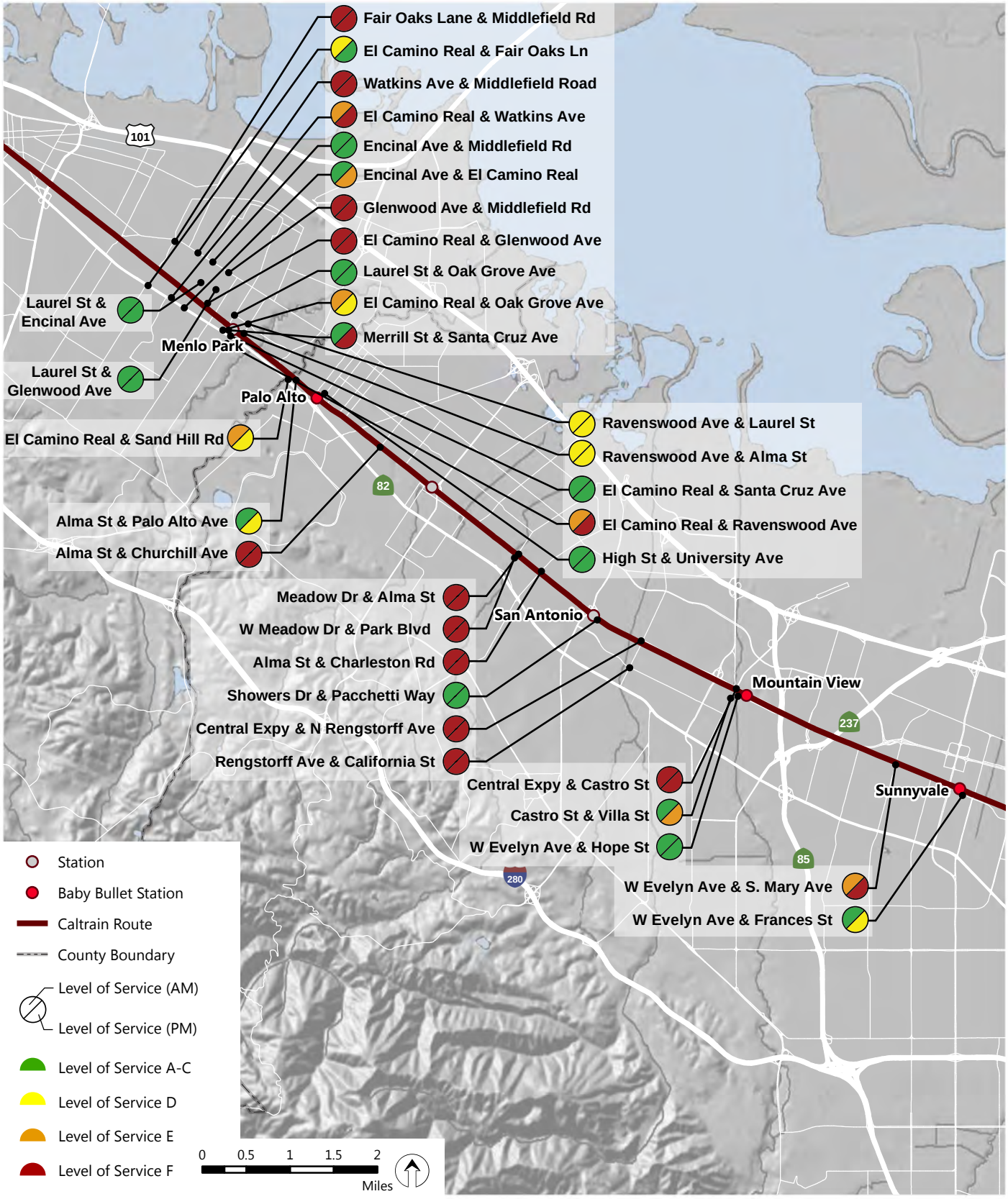

Figure 3-8

2020 Project AM & PM Peak Hour Intersection LOS, Zone 3

Document Path: N:\Projects_SJ13_Projects\SJ13_1440_Caltrain_Electrification\Graphics\ADOBE\Fig_3-08_LOS_Zone3_2020_PCEP.ai
Date: January 2014 (Revised September 2014)
*This figure replaces Figure 3-8 from the Draft EIR (TIA)

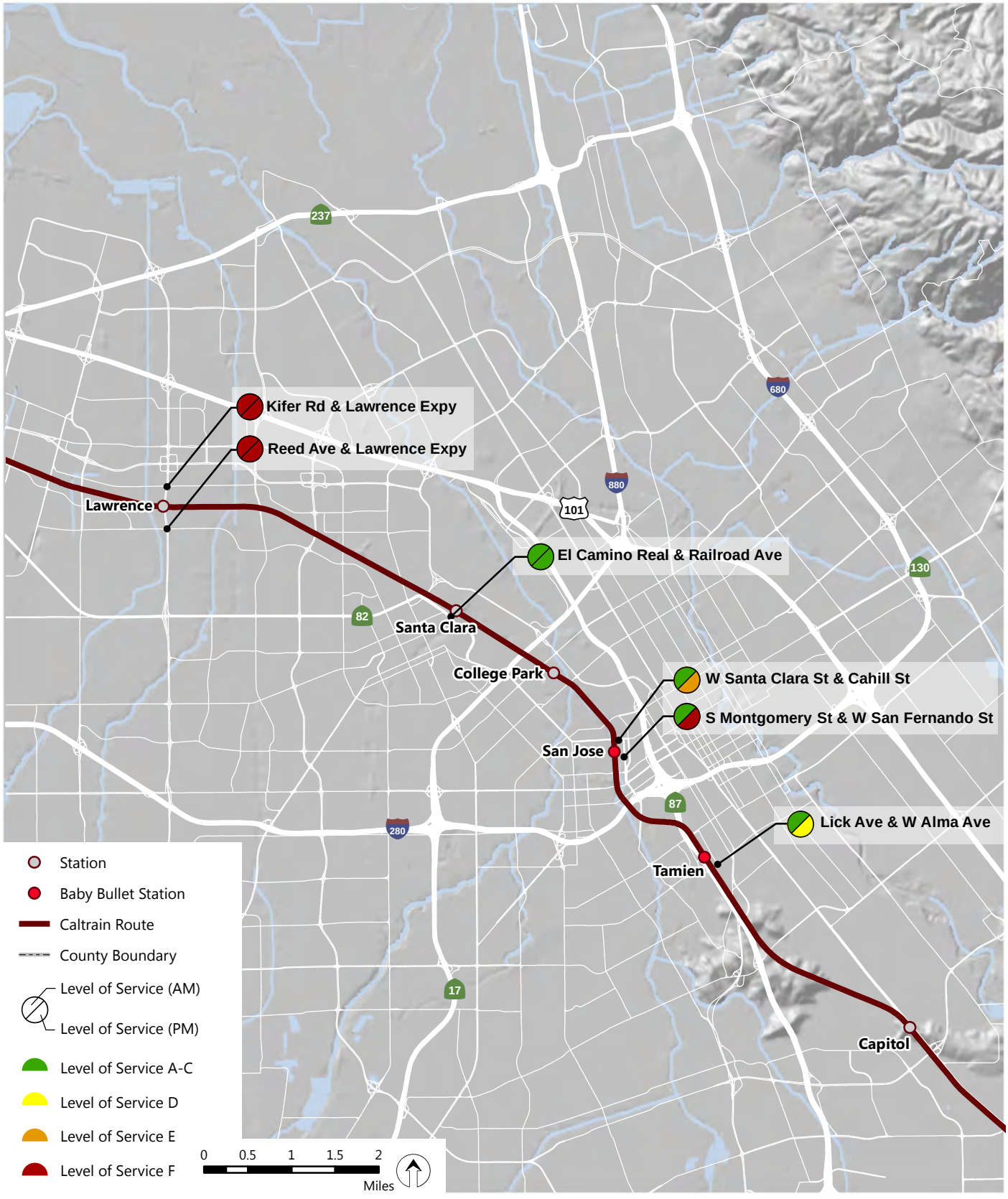

Figure 3-9

2020 Project AM & PM Peak Hour Intersection LOS, Zone 4

Document Path: N:\Projects_SJ13_Projects\SJ13_1440_Caltrain_Electrification\Graphics\ADOBE\Fig_3-09_LOS_Zone4_2020_PCEP.ai
Date: January 2014

FEHR PEERS

3.6.5.2 2040 Intersection Volumes and Level of Service Analysis

This section presents the results of the intersection level of service analysis for the 2040 No Project and 2040 Project scenarios. Table 3-24 displays the 2040 No Project scenario and the 2040 Project scenario levels of service and calculated delay during the morning and evening peak at all study intersections.

3.6.5.2.1 2040 No Project Scenario

Figure 3-10 illustrates the geographic location of each study intersection and the associated AM and PM peak hour LOS in Zone 1. Figure 3-11 illustrates the geographic location of each study intersection and the associated AM and PM peak hour LOS in Zone 2. Figure 3-12 illustrates the geographic location of each study intersection and the associated AM and PM peak hour LOS in Zone 3. Figure 3-13 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 E in the AM and 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 PM peaks. The intersection of Tunnel Avenue and Blanken Avenue in South San Francisco would operate at LOS F in peak hours.
- 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~~ along El Camino Real, Broadway (in Burlingame), Rollins Road, ~~, Alma Street~~, Carolan Avenue, and Middlefield Road. 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.

3.6.5.2.2 2040 Project Scenario

Figure 3-14 ~~Figure 3-10~~ illustrates the geographic location of each study intersection and the associated AM and PM peak hour LOS in Zone 1. Figure 3-15 ~~Figure 3-11~~ illustrates the geographic location of each study intersection and the associated AM and PM peak hour LOS in Zone 2. Figure 3-16 ~~Figure 3-13~~ illustrates the geographic location of each study intersection and the associated AM and PM peak hour LOS in Zone 3. Figure 3-17 ~~Figure 3-12~~ illustrates the geographic location of each study intersection and the associated AM and PM peak hour LOS in Zone 4.

- In Zone ~~4~~ 1, which includes San Francisco County and a portion of San Mateo County, about half of the study intersections would operate at LOS C or better. However, points of severe congestion exist at 4th Street and King Street, 4th and Townsend Street, and Tunnel Avenue and Blanken Avenue. All of these intersections would operate at LOS F in the AM and F in the PM. In the AM peaks, the intersection of Linden Avenue and Herman Street would operate at LOS F. 16th Street and Owens Street in San Francisco would operate at LOS E in the AM peak. S Linden Avenue and San Mateo Avenue in South San Francisco and Scott Street and Herman Street in San Bruno would operate at LOS E in the PM peak hour.
- In Zone ~~3~~2, which includes northern and central San Mateo County, points of severe congestion, generally in the AM and PM peak hours, would be clustered in Millbrae, Burlingame and near the Redwood City Station.
- In Zone ~~2~~3, which includes parts of San Mateo and Santa Clara Counties, congestion would occur along El Camino Real, Alma Street, Middlefield Road, and Central Expressway. Overall, points of severe congestion would mostly be clustered in the cities of Atherton, Menlo Park, and some parts of Palo Alto.
- In Zone 4, which includes central Santa Clara County, points of severe congestion would occur 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. West Santa Clara Street and Cahill Street, near the San Jose Diridon Station, would operate at LOS F in the AM peaks. South Montgomery Street and West San Fernando Street would operate at LOS F in the PM peak hour. Near the Tamien Station the intersection of Lick and West Alma Street would operate at LOS E in both the AM and PM peak hours.

Similar to what would occur under the 2020 Project scenario, traffic congestion under the 2040 Project scenario 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. Countywide vehicle miles travelled that would be reduced due to the project in 2040. While some intersections would experience increased congestion, regional congestion and vehicle travel would decrease.

Potential mitigation measures for impacted intersections under 2040 scenarios are discussed in the following section.

TABLE 3-24
INTERSECTION DELAY AND LEVELS OF SERVICE, 2040 NO PROJECT AND PROJECT SCENARIOS

Int. ID	Intersection	Juris-diction	Peak Hour	Intersec-tion Control	2040 No Project		2040 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**	**36.7** **-10.3**
2	4th Street and Townsend Street	SF	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	-20.3 -0.3
3	Mission Bay Drive and 7th Street	SF	AM PM	Signal	12.5 16.2	B B	16.6 17.0	B B	4.1 0.8
4	Mission Bay Drive and Berry Street	SF	AM PM	Signal	3.7 8.8	A A	2.1 8.6	A A	-1.6 -0.2
5	7th Street and 16th Street	SF	AM PM	Signal	**>120** **119.9**	**F** **F**	**>120** **>120**	**F** **F**	**14.2** **14.4**
6	16th Street and Owens Street	SF	AM PM	Signal	11.3 40.2	B D	10.6 **55.8**	B **E**	-0.7 **15.6**
7	22nd Street and Pennsylvania Street	SF	AM PM	All-way Stop	13.5 9.6	B A	14.2 11.2	B B	0.7 1.6
8	22nd Street and Indiana Street	SF	AM PM	All-way Stop	7.4 6.4	A A	7.1 6.4	A A	-0.3 0.0
9	Tunnel Avenue and Blanken Avenue	SF	AM PM	All-way Stop	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**>60.0** **>60.0**
10	Linden Avenue and Dollar Avenue	SSF	AM PM	Signal	**81.8** 41.6	**F** D	**>120** 46.1	**F** D	**>60.0** 4.5
11	East Grand Avenue and Dubuque Way	SSF	AM PM	Signal	12.4 13.8	B B	13.2 15.1	B B	0.8 1.3
12	S Linden Avenue and San Mateo Avenue	SSF	AM PM	Signal	27.9 10.6	C B	**74.9** 13.4	**E** B	**47.0** 2.8
13	Scott Street and Herman Street	SB	AM PM	Side-Street Stop	26.3 18.2	D C	45.9 18.4	E C	19.6 0.2
14	Scott Street and Montgomery Avenue	SB	AM PM	Side-Street Stop	7.2 7.1	A A	8.8 6.8	A A	1.6 -0.3
15	San Mateo Avenue and San Bruno Avenue	SB	AM PM	Signal	33.3 24.6	C C	40.7 32.5	D C	7.4 7.9
				ZONE 2					
16	El Camino Real and Millbrae Avenue	MB	AM PM	Signal	**112.0** **68.5**	**F** **E**	**>120** **84.7**	**F** **F**	**11.1** **16.2**
17	Millbrae Avenue and Rollins Road	MB	AM PM	Signal	**74.9** **110.2**	**E** **F**	**84.4** **>120**	**F** **F**	**9.5** **29.3**
18	California Drive and Broadway	BG	AM PM	Signal	**154.1** **170.3**	**F** **F**	**138.5** **160.4**	**F** **F**	-15.6 -9.9

TABLE 3-24
INTERSECTION DELAY AND LEVELS OF SERVICE, 2040 NO PROJECT AND PROJECT SCENARIOS

Int. ID	Intersection	Juris-diction	Peak Hour	Intersec-tion Control	2040 No Project		2040 Project		Change in Delay
					Delay	LOS	Delay	LOS	
19	Carolan Avenue and Broadway	BG	AM PM	Signal	**101.5** **92.4**	**F** **F**	**112.5** **97.4**	**F** **F**	**11.0** **5.0**
20	California Drive and Oak Grove Avenue	BG	AM PM	Signal	**>120** **76.9**	**F** **E**	**91.2** **99.1**	**F** **F**	-34.1 **22.2**
21	Carolan Avenue and Oak Grove Avenue	BG	AM PM	Side-Street Stop	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**>60.0** **>60.0**
22	California Drive and North Lane	BG	AM PM	Side-Street Stop	28.4 18.4	D C	20.4 21.4	C C	-8.0 3.0
23	Carolan Avenue and North Lane[19]	BG	AM PM	Side-Street Stop	**>120** 43.7	**F** E	**>120** **69.4**	**F** **F**	>-60.0 25.7
24	Anita Road and Peninsula Avenue	BG	AM PM	Side-Street Stop	29.1 **67.6**	D **F**	31.9 **36.1**	D **E**	28 -31.5
25	Woodside Way and Villa Terrace	SM	AM PM	Side-Street Stop	5.1 5.5	A A	5.0 5.3	A A	-0.1 -0.2
26	North San Mateo Drive and Villa Terrace	SM	AM PM	Side-Street Stop	12.2 17.2	B C	11.8 10.2	B B	-0.4 -7.0
27	Railroad Avenue and 1st Avenue	SM	AM PM	Side-Street Stop	**>120** **>120**	**F** **F**	15.0 **>120**	B **F**	>-60.0 >-60.0
28	S B Street and 1st Avenue	SM	AM PM	Signal	48.4 **66.9**	D **F**	20.7 **>120**	C **F**	-27.7 **193.2**
29	9th Avenue and S Railroad Avenue	SM	AM PM	Side-Street Stop	**>120** **>120**	**F** **F**	**>120** **91.6**	**F** **F**	**>60.0** -37.7
30	S B Street and 9th Avenue	SM	AM PM	Signal	34.3 51.5	C D	**67.7** **69.3**	**E** **E**	**33.4** **17.8**
31	Transit Center Way and 1st Avenue	SM	AM PM	Uncontr olled	**49.0** **88.2**	**E** **F**	9.2 **69.3**	A **F**	-39.8 -18.9
32	Concar Drive and SR 92 Westbound Ramps	SM	AM PM	Signal	20.8 13.4	C B	35.3 12.3	D B	14.5 -1.1

[19] Intersection 23 does not meet signal warrants for the PM peak hour and is therefore not a significant impact under 2040 Project conditions.

TABLE 3-24
INTERSECTION DELAY AND LEVELS OF SERVICE, 2040 NO PROJECT AND PROJECT SCENARIOS

Int. ID	Intersection	Juris-diction	Peak Hour	Intersec-tion Control	2040 No Project		2040 Project		Change in Delay
					Delay	LOS	Delay	LOS	
33	S Delaware Street and E 25th Avenue	SM	AM PM	Signal	**55.7** **>120**	**E** **F**	25.6 **>120**	C **F**	-30.1 -5.3
34	E 25th Avenue and El Camino Real	SM	AM PM	Signal	**84.4** **>120**	**F** **F**	**63.4** **>120**	**E** **F**	-21.0 -0.3
35	31st Avenue and El Camino Real	SM	AM PM	Signal	**77.7** **117.7**	**E** **F**	32.6 **>120**	C **F**	-45.1 **19.0**
36	E Hillsdale Boulevard and El Camino Real	SM	AM PM	Signal	**>120** **92.0**	**F** **F**	45.6 **>120**	D **F**	>-60.0 **>60.0**
37	E Hillsdale Blvd. and Curtiss Street	SM	AM PM	Signal	**55.6** **66.7**	**E** **E**	22.5 **>120**	C **F**	-33.1 **48.5**
38	Peninsula Avenue and Arundel Road and Woodside Way	SM	AM PM	Side-Street Stop	22.0 47.4	C E	24.3 30.2	C D	2.3 -17.2
39	El Camino Real and Ralston Avenue	BL	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**41.4** 0.2
40	El Camino Real and San Carlos Avenue	SC	AM PM	Signal	20.0 46.1	B D	24.5 46.9	C D	4.5 0.8
41	Maple Street and Main Street+	RC	AM PM	Side-Street Stop	42.7 >120	E F	22.2 >120	C F	-20.5 >60.0
42	Main Street and Beech Street	RC	AM PM	Side-Street Stop	19.7 **>120**	C **F**	15.0 **>120**	B **F**	4.7 >-60.0
43	Main Street and Middlefield Road+	RC	AM PM	Signal	30.3 >120	C F	>120 >120	F F	>60.0 -1.6
44	Broadway Street and California Street+	RC	AM PM	Side-Street Stop	>120 >120	F F	>120 >120	F F	>-60.0 >-60.0
45	El Camino Real and Whipple Avenue	RC	AM PM	Signal	**71.7** **85.0**	**E** **F**	**109.2** **88.3**	**F** **F**	**37.5** 3.3
46	Arguello Street and Brewster Avenue+	RC	AM PM	Signal	>120 115.9	F F	83.4 112.1	F F	>-60.0 -3.8
47	El Camino Real and Broadway Street+	RC	AM PM	Signal	>120 >120	F F	>120 >120	F F	-41 1.3
48	Arguello Street and Marshall Street+	RC	AM PM	Signal	>120 >120	F F	>120 >120	F F	>-60.0 14.1

TABLE 3-24
INTERSECTION DELAY AND LEVELS OF SERVICE, 2040 NO PROJECT AND PROJECT SCENARIOS

Int. ID	Intersection	Juris-diction	Peak Hour	Intersec-tion Control	2040 No Project		2040 Project		Change in Delay
					Delay	LOS	Delay	LOS	
49	El Camino Real and James Avenue+	RC	AM PM	Signal	>120 >120	F F	>120 >120	F F	-22.8 4.6
					ZONE 3				
50	El Camino Real and Fair Oaks Lane	AT	AM PM	Signal	**>120** **104.2**	**F** **F**	**>120** **103.5**	**F** **F**	**46.1** -0.7
51	El Camino Real and Watkins Avenue	AT	AM PM	Side-street stop	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	>-60.0 >-60.0
52	Fair Oaks Lane and Middlefield Road	AT	AM PM	Side-Street Stop	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**>60.0** >-60.0
53	Watkins Avenue and Middlefield Road	AT	AM PM	Side-Street Stop	**75.4** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**>60.0** >-60.0
54	Glenwood Avenue and Middlefield Road	AT	AM PM	Side-Street Stop	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	>-60.0 >-60.0
55	El Camino Real and Glenwood Avenue	MP	AM PM	Signal	**93.9** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**>60.0** >-60
56	El Camino Real and Oak Grove Avenue	MP	AM PM	Signal	**81.3** **94.6**	**F** **F**	**96.9** **84.0**	**F** **F**	**15.6** **-**10.6
57	El Camino Real and Santa Cruz Avenue	MP	AM PM	Signal	46.9 **78.4**	D **E**	37.7 **>120**	D **F**	-9.2 **>60.0**
58	Merrill St and Santa Cruz Avenue	MP	AM PM	All-way Stop	14.5 **>120**	B **F**	9.8 **>120**	A **F**	-4.7 **45.9**
59	Ravenswood Avenue and Alma Street	MP	AM PM	Side-Street Stop	**75.8** **>120**	**F** **F**	**66.4** **>120**	**F** **F**	-9.4 >-60
60	El Camino Real and Ravenswood Avenue	MP	AM PM	Signal	**>120** **>120**	**F** **F**	**99.1** **>120**	**F** **F**	-21.0 -4.9
61	Ravenswood Avenue and Laurel Street	MP	AM PM	Signal	**89.2** **>120**	**F** **F**	**83.4** **>120**	**F** **F**	-5.8 >-60.0
62	Alma Street and Palo Alto Avenue	PA	AM PM	Side-Street Stop	39.5 24.3	E C	21.9 28.5	C D	-17.6 4.2
63	Meadow Drive and Alma Street	PA	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**43.3** **8.5**

TABLE 3-24
INTERSECTION DELAY AND LEVELS OF SERVICE, 2040 NO PROJECT AND PROJECT SCENARIOS

Int. ID	Intersection	Juris-diction	Peak Hour	Intersec-tion Control	2040 No Project		2040 Project		Change in Delay
					Delay	LOS	Delay	LOS	
64	El Camino Real and Alma and Sand Hill Road	PA	AM PM	Signal	**62.1** **>119.2**	**E** **F**	**85.8** **>120**	**F** **F**	**23.7** **28.0**
65	High Street and University Avenue	PA	AM PM	Signal	10.1 24.5	B C	13.6 24.5	B C	3.5 0
66	Alma Street and Churchill Avenue	PA	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**10.5** -0.7
67	W Meadow Drive and Park Boulevard[20]	PA	AM PM	Side-Street Stop	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	>60 22.6
68	Alma Street and Charleston Road	PA	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**>60** -30.4
69	Showers Drive and Pacchetti Way	MV	AM PM	Signal	5.2 4.9	A A	5.2 6.4	A A	0.0 1.5
70	Central Expressway and N Rengstorff Avenue	SCC	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**7.7** -6.2
71	Central Expressway and Moffett Boulevard and Castro Street	SCC	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	-3.1 **>60**
72	W Evelyn Avenue and Hope Street	MV	AM PM	Signal	2.8 4.7	A A	2.6 4.9	A A	-0.2 0.2
73	Rengstorff Avenue and California Street	MV	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**28.3** **>60**
74	Castro Street and Villa Street	MV	AM PM	Signal	41.6 **112.5**	D **F**	**71.4** **116.8**	**E** **F**	**29.8** **4.3**
75	W Evelyn Avenue and S Mary Avenue	SV	AM PM	Signal	**92.1** **88.8**	**F** **F**	**110.2** **96.8**	**F** **F**	**18.8** **8.0**
76	W Evelyn Avenue and Frances Street	SV	AM PM	Signal	47.5 51.7	D D	**287.9** **98.1**	**F** **F**	**>60.0** **46.4**
				ZONE 4					
77	Kifer Road and Lawrence Expressway	SCC	AM PM	Signal	>120 >120	F F	**>120** >120	**F** F	**55.4** -47.4
78	Reed Avenue and Lawrence Expressway	SCC	AM PM	Signal	**>120** **>120**	**F** **F**	**>120** **>120**	**F** **F**	**9.1** >-60

[20] Intersection 67 does not meet signal warrants for the PM peak hour and is therefore not a significant impact under 2040 Project conditions.

TABLE 3-24
INTERSECTION DELAY AND LEVELS OF SERVICE, 2040 NO PROJECT AND PROJECT SCENARIOS

Int. ID	Intersection	Juris-diction	Peak Hour	Intersec-tion Control	2040 No Project		2040 Project		Change in Delay
					Delay	LOS	Delay	LOS	
79	El Camino Real and Railroad Avenue*	SCL	AM PM	Signal	20.4 35.5	C D	**69.5** 39.2	**E** D	**49.1** 3.7
80	W Santa Clara Street and Cahill Street	SJ	AM PM	Signal	**89.4** **92.2**	**F** **F**	**84.5** 54.7	**F** D	-4.9 -37.5
81	S Montgomery Street and W San Fernando Street	SJ	AM PM	Signal	31.3 **>120**	C **F**	51.6 **86.3**	D **F**	20.3 >-60
82	Lick Avenue and W Alma Avenue	SJ	AM PM	Signal	24.6 **65.5**	C **E**	**62.1** **63.0**	**E** **E**	**37.5** -2.5
Additional Intersections									
ZONE 2									
83	Broadway and Rollins Road	BG	AM PM	Signal	**61.0** **57.5**	**E** **F**	**64.5** **58.9**	**E** **F**	3.5 1.4
84	Rollins Road and Cadillac Way	BG	AM PM	Signal	9.0 10.8	A A	11.3 8.0	B A	2.3 -2.8
84a	Broadway and US 101 Southbound Ramps	BG	AM PM	Signal	**85.5** 48.8	**F** D	**88.1** 51.1	**F** D	2.6 2.3
85	Bayswater Avenue and California Drive	BG	AM PM	Signal	44.7 20.3	D C	26.7 23.1	C C	-18.0 2.8
ZONE 3									
86	Encinal Avenue and El Camino Real	MP	AM PM	Signal	29.9 **96.0**	C **F**	39.8 **56.2**	D **E**	9.9 -39.8
87	Encinal Avenue and Middlefield Road	AT	AM PM	Signal	26.4 20.5	C C	33.5 19.0	C B	7.1 -1.5
88	Laurel Street and Oak Grove Avenue	MP	AM PM	Signal	11.2 33.5	B C	33.8 18.3	C B	22.6 -15.2
89	Laurel Street and Glenwood Avenue	MP	AM PM	All-way Stop	11.2 **37.9**	B **E**	13.7 13.4	B B	2.5 -24.5
90	Laurel Street and Encinal Avenue	MP	AM PM	All-way Stop	6.8 6.4	A A	9.3 5.9	A A	2.5 -0.5

Source: Fehr & Peers, 2014

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

This table replaces Table 3-24 from the Draft EIR (TIA)

+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