

Transportation Analysis

# Caltrain Peninsula Corridor Electrification Project



Submitted to:

**Peninsula Corridor  
Joint Powers Board**

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# **Caltrain Peninsula Corridor Electrification Project: Transportation Analysis**

Prepared for:  
Peninsula Corridor Joint Powers Board

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FEHR  PEERS



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## 1.0 INTRODUCTION

### 1.1 STUDY BACKGROUND

Caltrain is a diesel-hauled commuter rail system serving Santa Clara, San Mateo, and San Francisco counties in California. The tri-county Peninsula Corridor Joint Powers Board (JPB) owns and operates Caltrain. Over the last ten years, Caltrain has experienced a substantial increase in ridership. Further increases in ridership demand are expected as the region's population continues to grow.

#### 1.1.1 PROJECT DESCRIPTION

The Caltrain Modernization Program would electrify and upgrade the performance, operating efficiency, capacity, safety, and reliability of Caltrain's commuter rail service. The entire Caltrain Modernization Program, which includes installation of an advanced signal/positive train control system and electrification, is planned to be completed by 2020 or 2021 ~~2019~~ (for the purposes of the EIR, it is assumed that the project will be completed and operational in 2020). The Peninsula Corridor Electrification Project (PCEP or Proposed Project) is a component of the Caltrain Modernization program and consists of converting Caltrain from diesel-hauled to Electric Multiple Unit (EMU) trains for 75 percent of the service<sup>1</sup> within the Study Area bound by the San Francisco station at 4<sup>th</sup> and King Streets and the Tamien Station in San Jose. As part of the project, new electrical infrastructure would be installed in the Study Area, and electrified vehicles would be procured and purchased. Caltrain currently operates five trains per peak hour at a maximum speed of 79 miles per hour (mph). The Proposed Project would increase service to up to six Caltrain trains per peak hour, per direction at operating speeds of up to 79 mph.

In addition to Caltrain commuter rail service, Union Pacific Railroad (UPRR) operates approximately six daily freight trains (three round trips) between Santa Clara and San Francisco under a "Trackage Rights Agreement" with Caltrain. From Santa Clara to San Jose, on a joint use corridor, UPRR operates approximately nine daily freight trains. Three passenger train services also operate on the Santa Clara to San Jose segment: the Capitol Corridor (14 daily trains), the Altamont Commuter Express (ACE, eight daily trains during weekdays only), and the Amtrak Coast Starlight (two daily trains).

##### 1.1.1.1 Relation to California High-Speed Rail Project

The Project does not include all infrastructure needed to implement HSR service in the corridor, such as high-speed rail maintenance facilities, station improvements, or passing tracks. However, the electrical infrastructure, such as overhead wire systems, will be compatible for blended service with HSR. The blended system would be primarily a two-track system shared by Caltrain, HSR, and existing tenant passenger and freight rail operators. The Proposed Project EIR will not environmentally clear HSR construction or operations on the Caltrain corridor. High-speed rail construction and operations would be

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<sup>1</sup> The Proposed Project has funding for rolling stock to cover replacement of 75 percent of the rolling stock for the San Jose to San Francisco service. Caltrain will replace the remaining 25 percent over time as existing diesel stock reaches the end of its design life.



the subject of a later, separate environmental analysis to be conducted by the California High Speed Rail Authority (CHSRA) and the Federal Railroad Administration (FRA). The cumulative impact analysis in this document provides a qualitative discussion of the potential cumulative impacts of blended service (see Chapter 4, Section 4.1, *Cumulative Impacts*) given that HSR design for blended service has not been completed.

### 1.1.2 CALTRAIN HISTORY AND SYSTEM

Passenger service on the corridor began in 1863, under the authority of the San Francisco and San Jose Railroad Company. In 1870, the San Francisco and San Jose Railroad Company was acquired by Southern Pacific Railroad, which operated passenger service along the corridor until 1992. During Fiscal Year 1992-93, the San Mateo County Transit District (SamTrans), the Santa Clara Valley Transportation Authority (VTA), and the City and County of San Francisco assumed full responsibility for the Caltrain system from the California Department of Transportation (Caltrans). The Peninsula Corridor Joint Powers Board (JPB) operated 60 weekday trains in 1992. Spanning 77 miles over three counties, the full Caltrain system serves 16 cities with 32 stations. As of 2013, Caltrain is running 92 weekday trains including Baby Bullets (express), Limited, and Local services.

### 1.1.3 STUDY AREA

The 51-mile long Study Area, bounded by the 4<sup>th</sup> and King Station in San Francisco and a location approximately 2 miles south of the Tamien Station in San Jose, is comprised of 24 weekday stations across four fare zones (each zone is about 13 miles in length) along the Caltrain right-of-way. There are also two stations currently served only on weekends (Broadway in Burlingame and Atherton) and one station only served for special events (Stanford). The Caltrain corridor continues south of the Study Area to Gilroy, including two additional fare zones and four additional stations providing limited peak period, peak direction service. Table 1-1 displays all cities and stations within the Study Area, including stations with weekday Baby Bullet service. Figure 1-1 displays the Study Area geographic boundaries, stations and zonal boundaries.



**TABLE 1-1  
STUDY AREA JURISDICTIONS AND STATIONS**

County	City	Stations
San Francisco	San Francisco	<b>San Francisco (4<sup>th</sup> and King)</b> <b>22<sup>nd</sup> Street*</b> Bayshore
	South San Francisco	South San Francisco
San Mateo	San Bruno	San Bruno
	Millbrae	<b>Millbrae</b>
	Burlingame	Broadway (weekend only) Burlingame
	San Mateo	<b>San Mateo**</b> Hayward Park <b>Hillsdale</b>
	Belmont	Belmont
	San Carlos	San Carlos
	Redwood City	<b>Redwood City</b>
	Atherton	Atherton (weekend only)
	Menlo Park	<b>Menlo Park*</b>
	Santa Clara	Palo Alto
Mountain View		San Antonio <b>Mountain View</b>
Sunnyvale		<b>Sunnyvale**</b> Lawrence
Santa Clara		Santa Clara
San Jose		College Park <b>San Jose Diridon</b> <b>Tamien**</b>

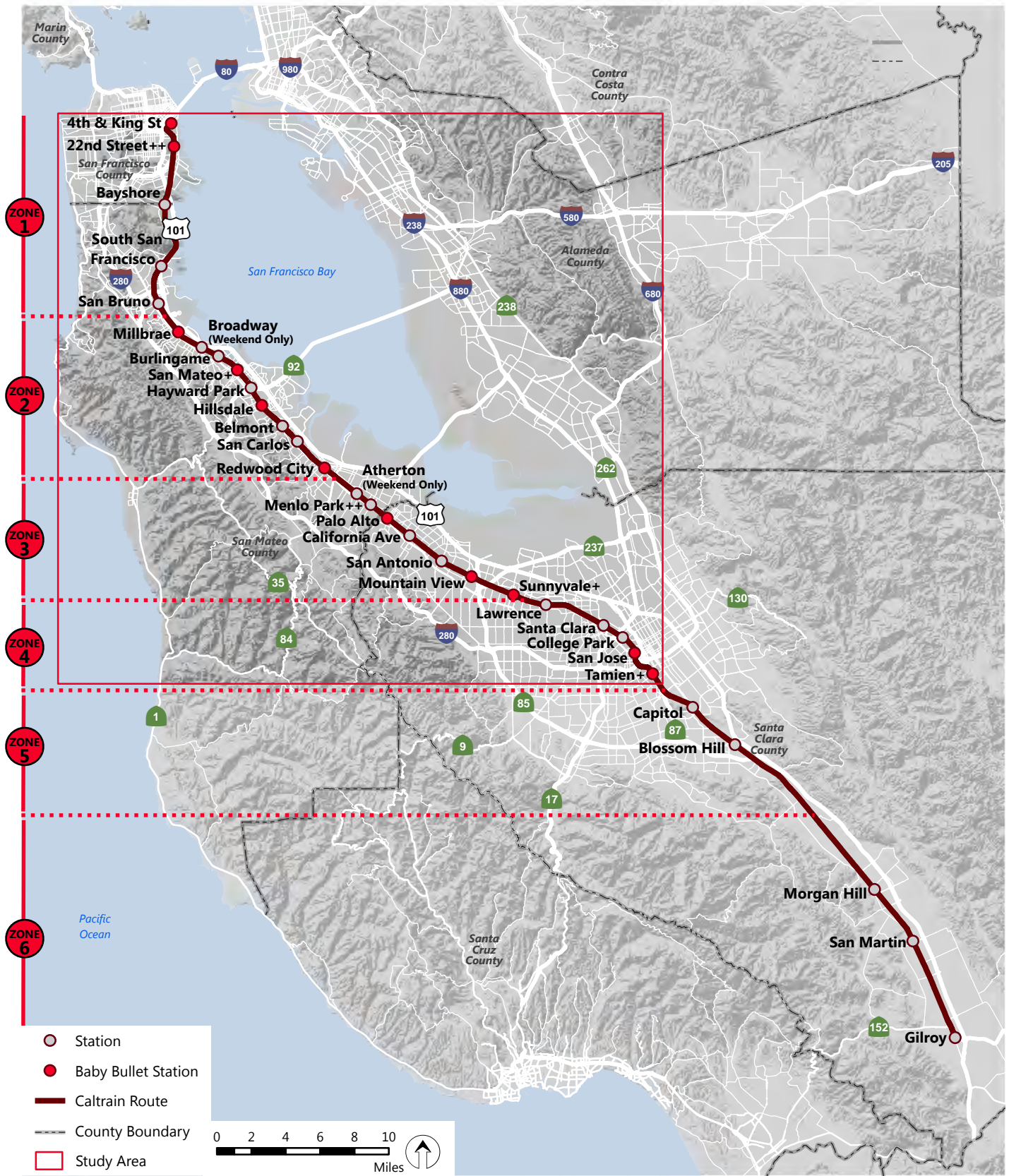
Source: "Stations." (2013) San Mateo County Transit District.

Notes: Stations with Baby Bullet service (either peak direction, off-peak direction, or both directions) are displayed in **bold**. There is no current weekday service to Broadway or Atherton Stations at present, only weekend service. Weekday service would be restored to these stations with the Proposed Project.

\*Weekday Baby Bullet service is provided in the reverse commute direction only.

\*\*Weekday Baby Bullet service is provided in the reverse commute direction only.





**Figure 1-1** + Traditional Peak Baby Bullet Service Only  
 ++ Reverse Peak Baby Bullet Service Only

## Project Study Area

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 Date: January 2014





## 1.2 REPORT PURPOSE AND STRUCTURE

This report summarizes the existing conditions for the Project areas and analyzes all transportation related impacts for 2020 No Project and Project scenarios and 2040 No Project and Project scenarios. Section 2.0 presents an assessment of the existing conditions in the Study Area. It provides a basis for the assessment of future transportation scenarios. This report includes a description of weekday travel patterns and ridership, system performance, transit connectivity, pedestrian and bicycle conditions at stations, peak traffic conditions, location of station and off-site parking, and station area land use and accessibility.

Section 3.0 presents an analysis of all transportation impacts for the 2020 and 2040 scenarios, with a few exceptions. First, the assumptions underlying all No Project and Project scenarios are presented along with the transportation significance criteria. An assessment of transportation metrics is then presented by criteria subject in the following order: Ridership, Traffic, Pedestrian and Bike Systems, Safety Hazards, Emergency Vehicle Access, and Station Parking and Access. Existing conditions and impact analysis for freight service is provided in the main text of the EIR. Potential cumulative impacts of the Proposed Project and other planned transit improvements are also presented in the main text of the EIR.





## 2.0 EXISTING CONDITIONS

This report presents an assessment of the existing conditions in the Study Area. It provides a basis for the assessment of future transportation conditions. This section includes a description of weekday travel patterns and ridership, system performance, transit connectivity, pedestrian and bicycle conditions at stations, peak traffic conditions, location of station and off-site parking, and station area land use and accessibility. All data and analysis presented is for the existing conditions in 2013, unless specified otherwise.

### 2.1 EXISTING CORRIDOR TRAVEL PATTERNS AND RIDERSHIP

Caltrain has experienced steady ridership growth since 2005 and currently carries around 47,000 passengers on a typical weekday. The trip purpose of the majority of weekday Caltrain passengers is commuting, or travel for work. The most popular modes of access to Caltrain stations are travel by foot and connecting by transit or shuttle (36 percent and 26 percent respectively).

Weekday travel along the Caltrain corridor is characterized by interregional trips that primarily occur during the AM and PM peak periods. Figure 2-1 displays the average weekday ridership (AWR) for the AM and PM peak periods. Weekday boardings<sup>2</sup> between 6:30 AM and 10:30 AM constitute the AM peak period, and PM boardings between 4:00 and 8:00 PM constitute the PM peak period. The proportion of AM and PM passengers at each station varies. Most stations have a greater proportion of boardings during either the AM or PM peak periods, but at Redwood City, San Carlos, Belmont, and Lawrence Stations, the split between AM and PM passengers is about equal. Figure 2-2 shows AWR according to the traditional ridership and reverse peak passenger ridership. The traditional peak, is defined as trips heading northbound (toward San Francisco) in the AM peak and southbound (toward San Jose) in the PM peak. The reverse peak is defined as trips heading southbound in the AM peak and northbound in the PM peak. Beginning in 2006, reverse peak ridership began showing a significantly higher rate of growth than the traditional peak direction (JPB, 2006). Since then, the ratio of passengers traveling north in the morning to those traveling south remained at about a 60 percent to 40 percent ratio; with more passengers traveling north toward San Francisco than south toward San Jose in the AM peak period (JPB, 2006).

This trend shifted again slightly in 2013, as traditional peak ridership grew slightly more than reverse peak ridership. Traditional peak ridership increased by about 10 percent and the reverse increased by about 8 percent compared to 2012 (JPB, 2006). In the AM peak, the northbound ridership remains larger than the southbound. Off-peak midday ridership is more than twice as large as the off-peak evening ridership. However, neither off-peak ridership is close to the combined passenger volume traveling north and south in the Study Area in the morning and evening peaks.

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<sup>2</sup> Regarding ridership, this appendix and the EIR report ridership on the basis of boardings, not boardings and alightings. Weekday boardings are defined as the total number of passengers who board a train at a given station. Presentation of data in terms of boardings is the standard way that Caltrans has reported ridership in the past. Once a passenger boards a train they must also alight the train to end their trip. Including both boardings and alightings in ridership numbers would result in counting the same passenger trip twice, therefore only boardings are counted as a measure of the number of riders using the system.



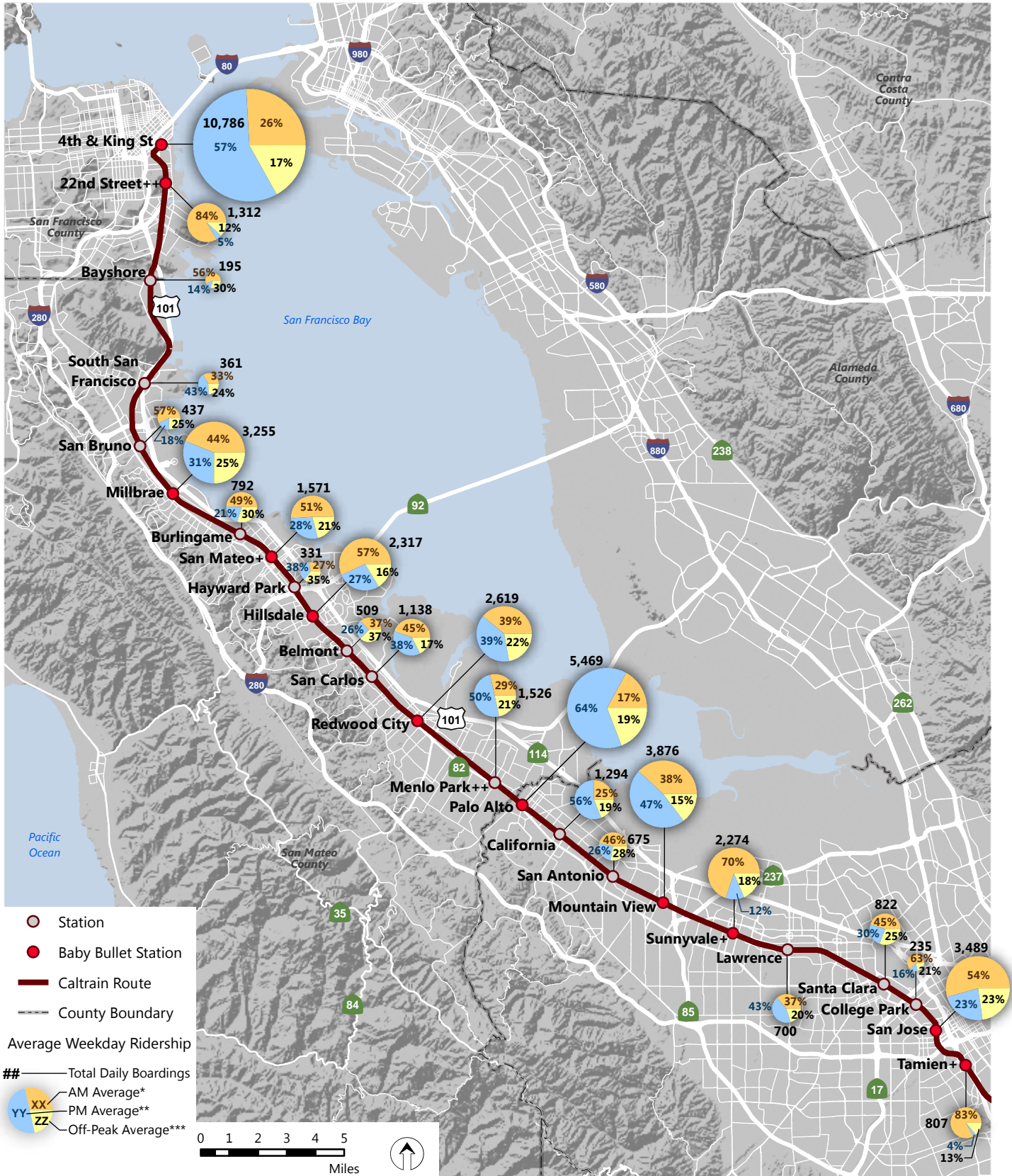


Figure 2-1

- + Traditional Peak Baby Bullet Service Only
- ++ Reverse Peak Baby Bullet Service Only
- \* AM peak period boardings occur between 6:30 AM to 10:30 AM
- \*\* PM peak period boardings occur between 4:00 PM to 8:00 PM
- \*\*\* Off-peak boardings occur between 5:00 AM to 6:29 AM, 10:30 AM to 3:59 PM, and 8:01 PM to 1:32 AM

### Caltrain Station & Zone Map



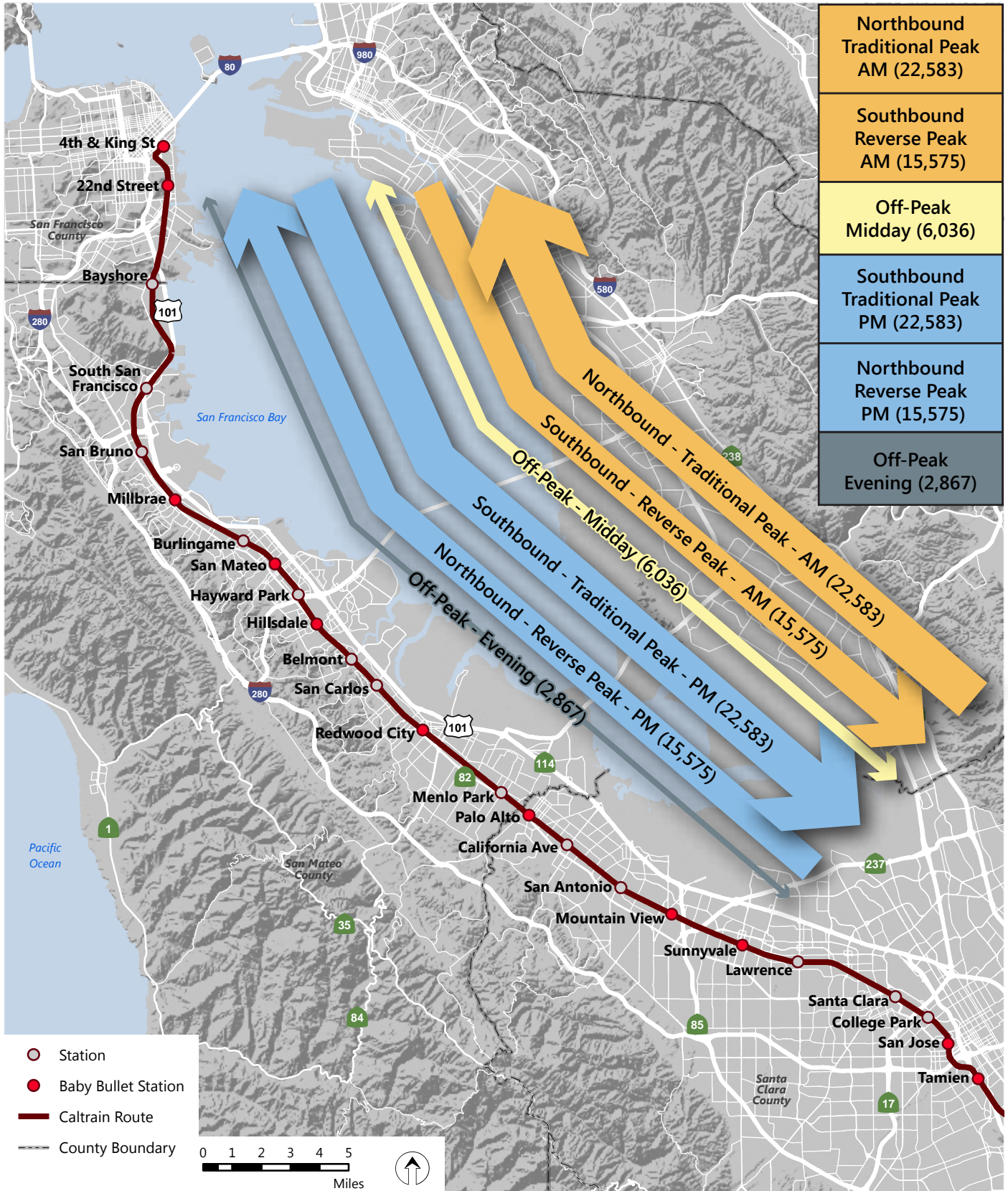


Figure 2-2

### Average Weekday Ridership in the Reverse and Traditional Peak Markets (2013)

### 2.1.1 SERVICE TYPES

Caltrain currently operates 46 northbound and 46 southbound (for a total of 92) trains per day between San Jose and San Francisco during the week. Three of these trains start in Gilroy during the morning commute period, and three terminate in Gilroy during the evening commute period.

Caltrain currently operates three types of service: Baby Bullet, Limited, and Local. Eleven trains in each direction are “Baby Bullet” express service trains that make the trip between San Francisco and San Jose in less than 1-hour. Local trains are operated at the shoulders of peak periods and serve to transition the service from peak to off-peak. They stop at almost all stations between the San Jose Diridon Station and the 4<sup>th</sup> and King Station, resulting in the longest travel times of all service types. Limited-stop trains operate as skip-stop for one-half of the route and as local trains for the other half. Skip-stop service stops at fewer stations than Local trains, skipping as many as one to three stations along the route, thus offering slightly faster travel times than Local trains.

Weekday boardings between 6:30 AM and 10:30 AM constitute the AM peak period and PM trips between 4:00 and 8:00 PM constitute the PM peak period. Table 2-1 displays the average weekday trip lengths, in miles, on Caltrain system-wide by type of service. The average trip length on Baby Bullet trains is slightly longer than trips made on Limited or Local trains (JPB, 2006).

**TABLE 2-1  
AVERAGE WEEKDAY TRIP LENGTHS ON CALTRAIN, BY SERVICE TYPE (2013)**

Service Type	Average Trip Length (miles)
Baby Bullet	28.2
Peak Limited or Local trains	20.1
Off-peak (Limited or Local trains)	20.5
All Locals	20.2

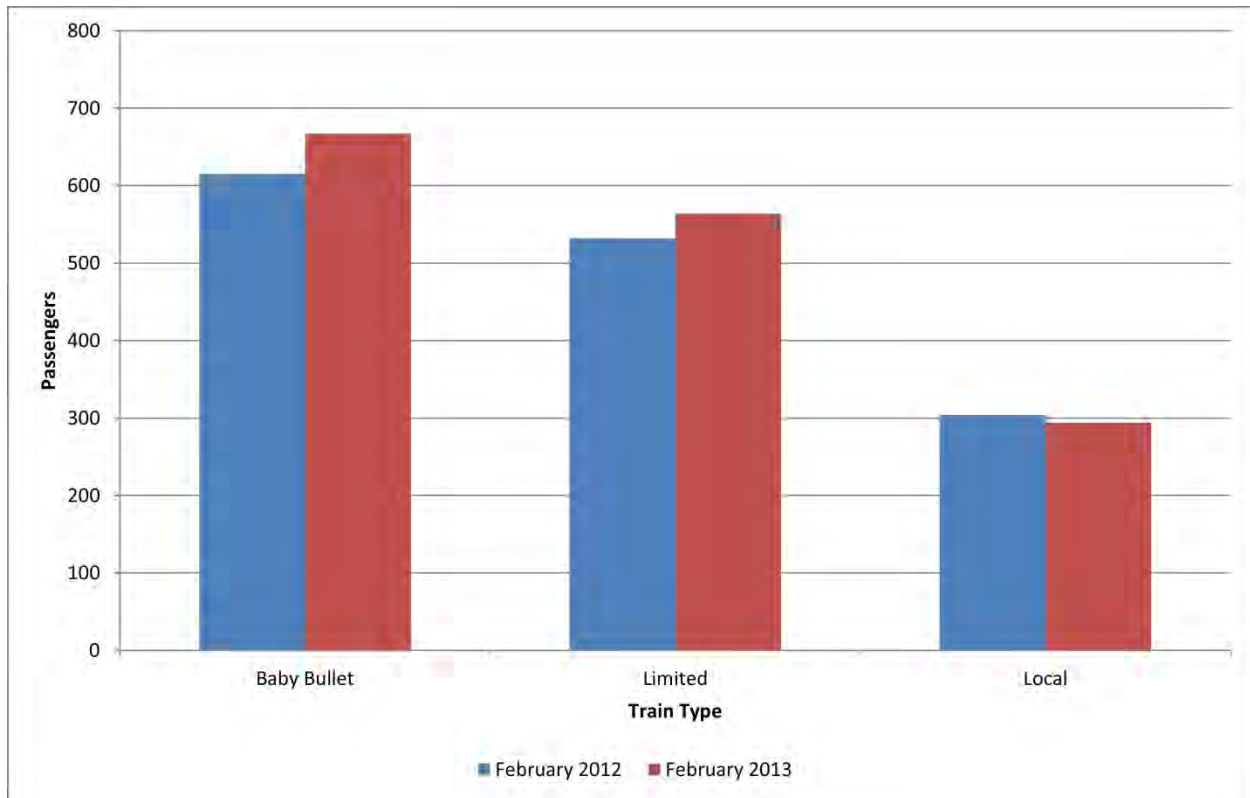
Source: “February 2013 Caltrain Annual Passenger Counts Key Findings.” JPB, 2013.

### 2.1.2 RIDERSHIP TRENDS

Caltrain weekday ridership has been steadily increasing since 2005, with the exception of a decrease in 2010 attributed to the Great Recession. As depicted in Figure 2-4, Caltrain average weekday ridership (AWR) has increased by more than 90 percent from 1997 to 2013. Between 2001 and 2004, ridership had been steadily declining. Since the implementation of Baby Bullet service in 2004, ridership has grown nearly 97 percent from around 24,000 daily boardings to over 47,000 daily boardings. Between 2012 and 2013, ridership increased by about 11 percent. This ridership increase was in-step with job growth, as the region continued to recover from the Great Recession. Figure 2-3 displays the average number of passengers on each type of service in 2012 and 2013. Total ridership in the AM and PM peak periods in 2013 increased about 10 percent compared to 2012 peak-period ridership (JPB, 2006). Ridership on Baby Bullet and Limited Trains in the peak period also increased. However, peak Local train ridership declined slightly.



**Figure 2-3 Average Passengers per Train in AM and PM Peak Periods, by Service Type**



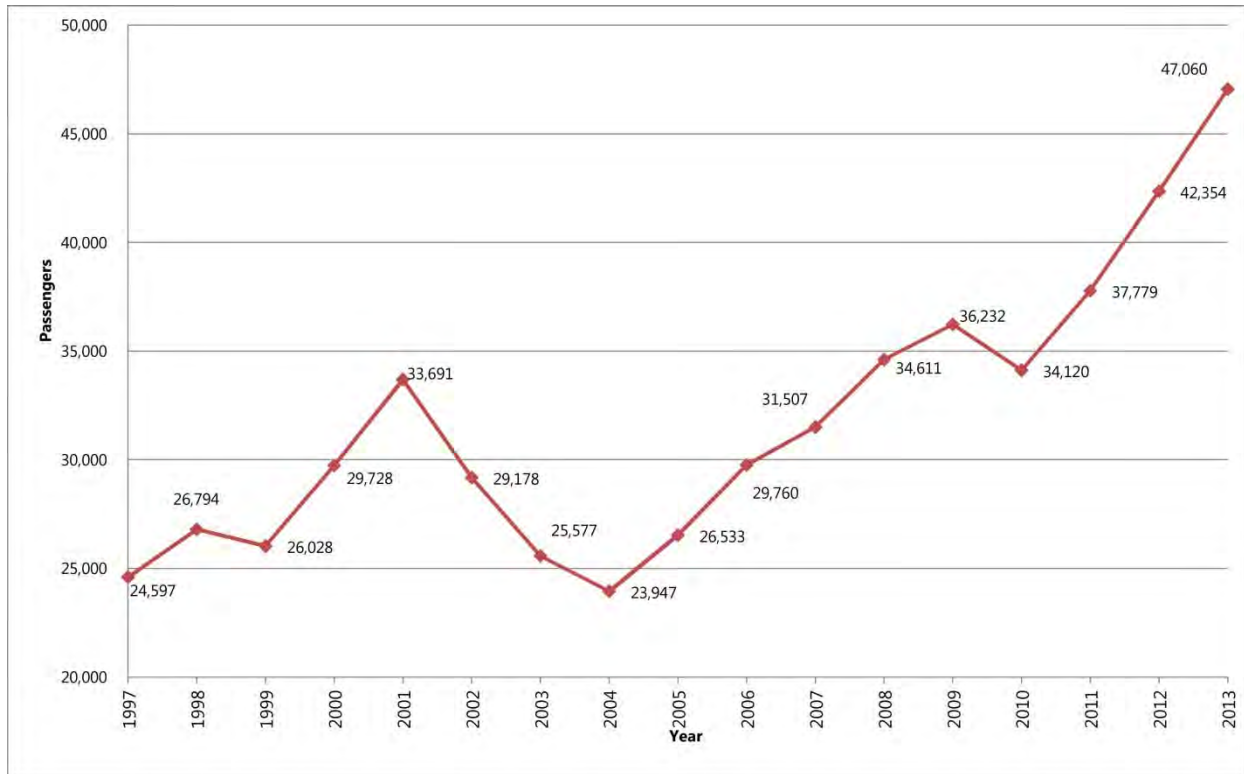
Source: JPB, 2013

Increased ridership has resulted in higher levels of crowding on some AM and PM peak period trains. In 2013, the top five fullest trains in the peak were close to or over their seated capacity at their maximum load point, varying between about 90 percent to 112 percent full.<sup>3</sup> When the maximum load point is beyond 100 percent, some passengers would be required to stand, as all seats would be taken. In response to increased ridership and the need to relieve crowded trains, JPB implemented several service changes in 2012: the addition of four midday and two evening trains; additional Limited stop service added at Sunnyvale for the traditional commute; and an additional stop at Palo Alto added for six Baby Bullet trains serving reverse peak passengers (JPB, 2006).

<sup>3</sup> Maximum load point is the point in time during a single train trip in which the number of passengers is highest.



**Figure 2-4 Caltrain Average Weekday Ridership Trends (1997-2013)**



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

Caltrain passengers begin or end trips in the three counties within the Study Area: San Francisco, San Mateo, and Santa Clara. Table 2-2 displays AWR, by county for all peak and off-peak weekday trains. The highest proportion of train boardings are in Santa Clara County, followed by San Mateo and San Francisco counties. This is consistent with the slight ridership growth in traditional peak ridership (northbound morning and southbound evening) in 2013.

**TABLE 2-2  
CALTRAIN ALL-DAY BOARDINGS, BY COUNTY (2013)**

County	Average Weekday Ridership	Proportion of Total Average Daily Ridership
San Francisco	12,292	26%
San Mateo	14,855	32%
Santa Clara	19,913	42%

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

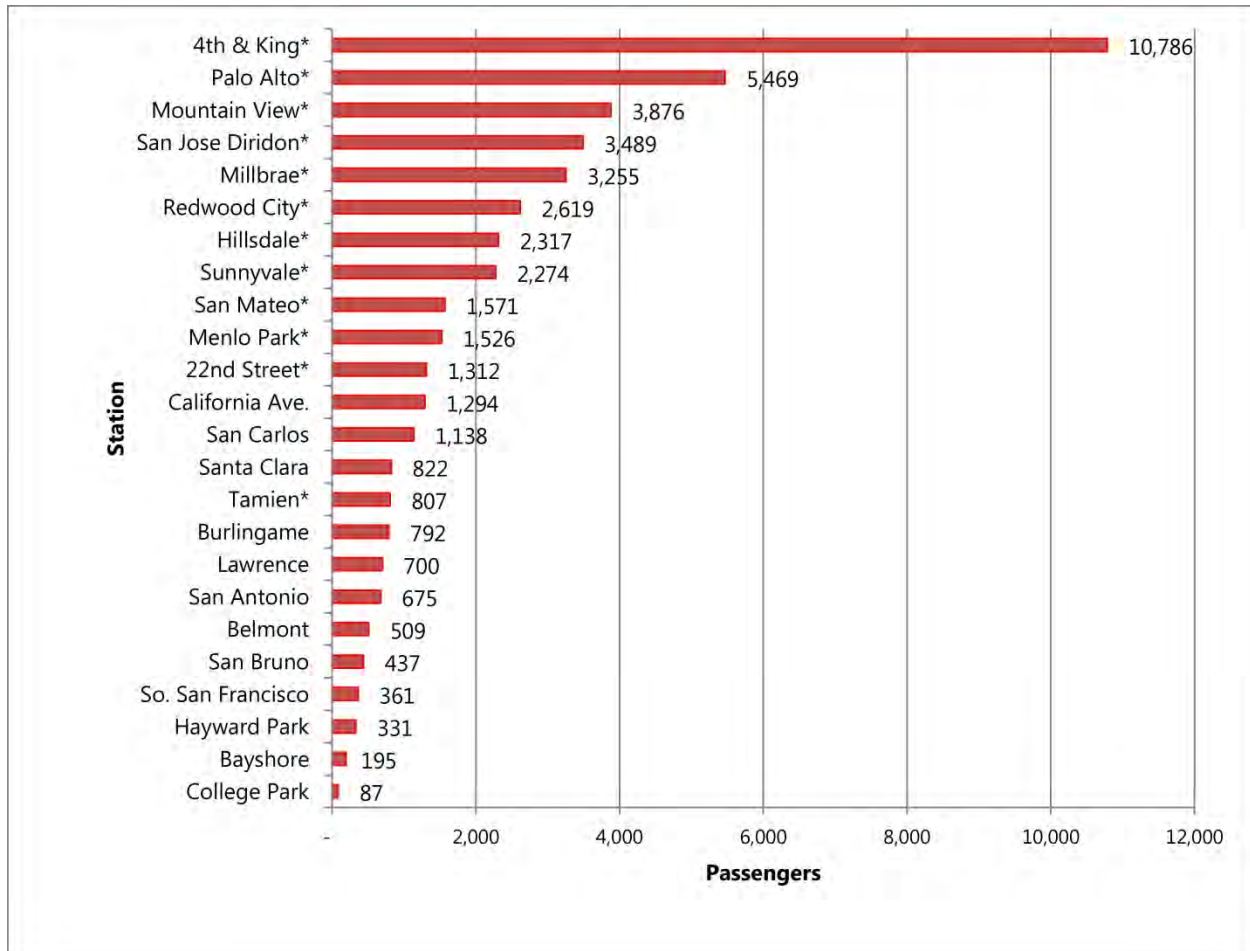
The frequency of trains at various stations throughout the day varies by service type. For example, more trains stop at Baby Bullet stations than at Local or Limited-only stations. Figure 2-5 displays weekday average boardings, by station, including all trains, both peak and off-peak. The top five stations with the highest number of boardings are: 4<sup>th</sup> and King, Palo Alto, Mountain View, San Jose Diridon, and Millbrae. The number of daily boardings at 4<sup>th</sup> and King Station is almost twice the number of daily boardings at





the Palo Alto Station. The top 11 stations with the highest boardings also offer Baby Bullet service. Analysis of historical ridership data since 2005 shows some stations have experienced substantially greater ridership growth than others.

**Figure 2-5 Average Weekday Ridership, by Station (2013)**



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

\* Stations with Baby Bullet service

Table 2-3 displays the top ten stations in terms of absolute change in AWR between 2005 and 2013. The 4<sup>th</sup> and King Station has experienced the most growth between 2005 and 2013, with an increase of approximately 4,900 average daily passengers. The Palo Alto Station experienced the second highest incidence of ridership growth, with an increase of approximately 3,000 passengers between 2005 and 2013. The Millbrae, San Jose Diridon, and Sunnyvale Stations are also in the top five highest ridership growth stations.



**TABLE 2-3  
 TOP TEN STATIONS: LARGEST ABSOLUTE CHANGE IN PASSENGERS (2005 – 2013)**

<b>Station</b>	<b>Absolute Change in Average Weekday Ridership, Feb. 2005 – Feb. 2013</b>	<b>Percent Change in Average Weekday Ridership, Feb 2005 – Feb. 2013</b>
San Francisco	4,867	45%
Palo Alto	3,004	56%
Millbrae	1,748	54%
San Jose Diridon	1,583	45%
Sunnyvale	1,304	57%
Redwood City	1,196	46%
22nd Street	767	58%
Tamien	464	57%
Mountain View	1,453	37%
Hillsdale	830	36%

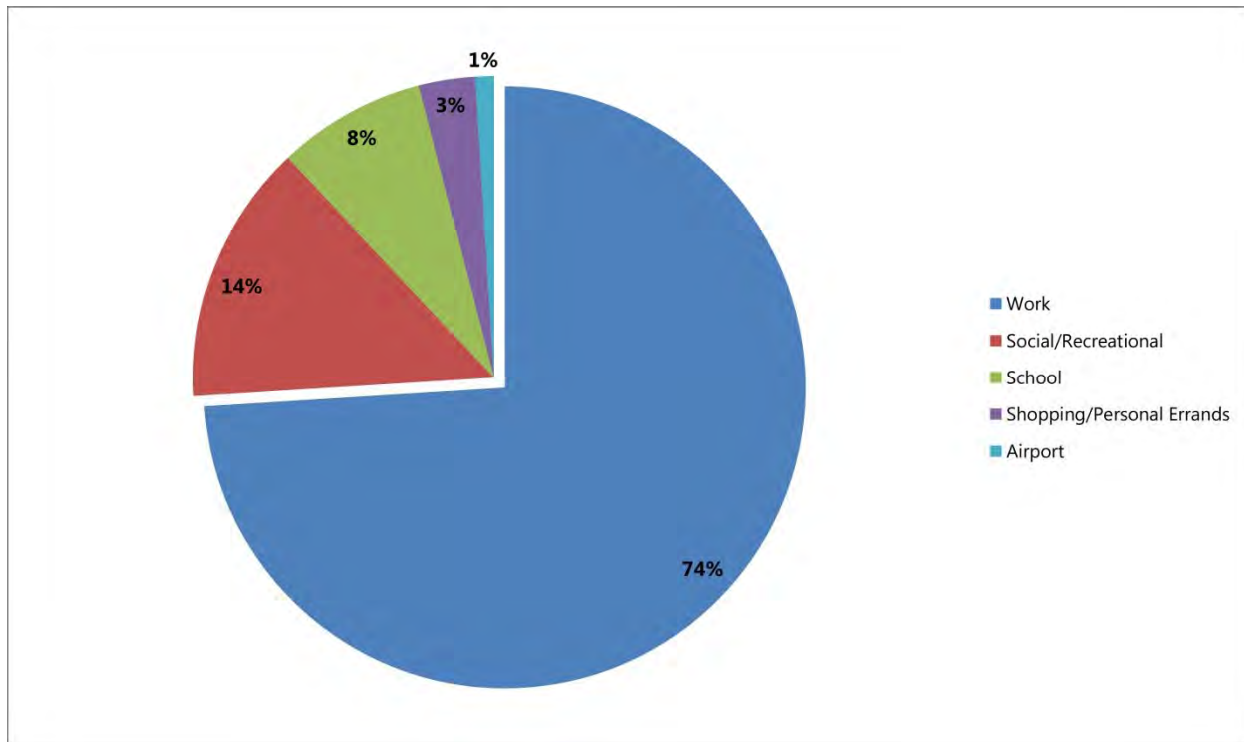
Source: "February 2013 Caltrain Annual Passenger Counts Key Findings." *JPB*, 2013.

### 2.1.3 MODES OF ACCESS AND EGRESS TO CALTRAIN STATIONS

The challenge of ensuring that a public transit user can connect to and from different transit services to their destination is often referred to as the "last mile problem" (Mineta Transportation Institute, 2009). Caltrain passengers connect to and from stations via many different travel modes, including: bicycle, car, walking, transit, public/private shuttles, motorcycle/moped, or taxi. Many factors can influence the mode choices available to a passengers, such comfort, safety, as access to a car, parking supply and cost, land use patterns, transit connectivity, and personal preferences (Litman, 2008). Trip purposes are defined by the type of activity taking place at each end of a trip. Because most trips begin or end at home, trip purposes are often defined by the destination (National Academy of Sciences, 2012). The main trip purposes of Caltrain passengers are displayed in Figure 2-6.



**Figure 2-6 Trip Purposes of Caltrain Passengers (2010)**



Source: "October 2010 Caltrain Onboard Survey Summary Report." (2010) Corey, Canapary and Galanis Research.

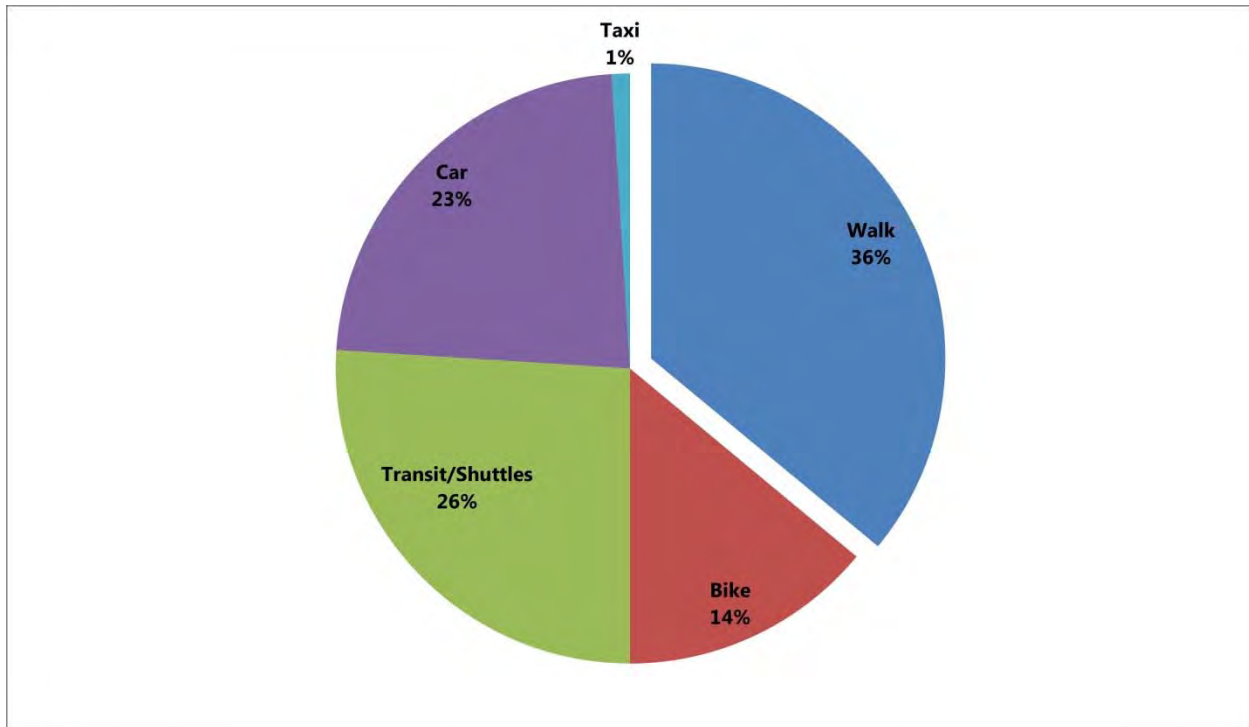
### 2.1.3.1 Mode of Access to Caltrain Station

Caltrain passengers use a range of modes to travel from their origin location to their origin station at the beginning of their trip. Variations between morning and evening access modes can vary depending on the activities and errands a passenger may engage in after alighting at a Caltrain station. In general, most trips in the morning are between a person's places of residence and work. In the evening, this pattern reverses, but a passenger may not travel directly home from a station. Instead, they may engage in "trip chaining" or a series of trips before reaching home, their final destination (Transportation Research Record, 1999). This can also occur in the morning, especially if a person has younger children and must drop them off at school or daycare on their way to a Caltrain station. Trip chaining, in turn, can influence a passenger's mode choice.

Figure 2-7 displays the daily modes of access to Caltrain stations for AM and PM peak passengers. Mode share data was derived from the 2013 Caltrain Station Intercept Survey, conducted in June 2013 at 23 Caltrain stations during the weekday morning commute period (6:30 AM to 10:30 AM). More information on the design and results of the 2013 Caltrain Station Intercept Survey can be found in Attachment A. Although the survey was conducted in the morning, the interviewers asked passengers questions about each passenger's return trip, which typically occurs during PM peak periods.



**Figure 2-7 Daily Access Mode to Caltrain Stations (2013)**



Source: 2013 Caltrain Intercept Survey, Fehr & Peers, 2013.

Daily access mode captures both the mode of access from a passenger's AM origin to the Caltrain station and their mode of egress from their destination to the station in the afternoon. For passengers making a round trip, the mode of access for both legs of the trip are included in the daily mode of access estimates in Figure 2-7. Kiss-and-ride generally describes passengers who are dropped off at a station by car. Passengers who drove alone or carpooled, also referred to as park-and-ride, generally park their car at or near the station.

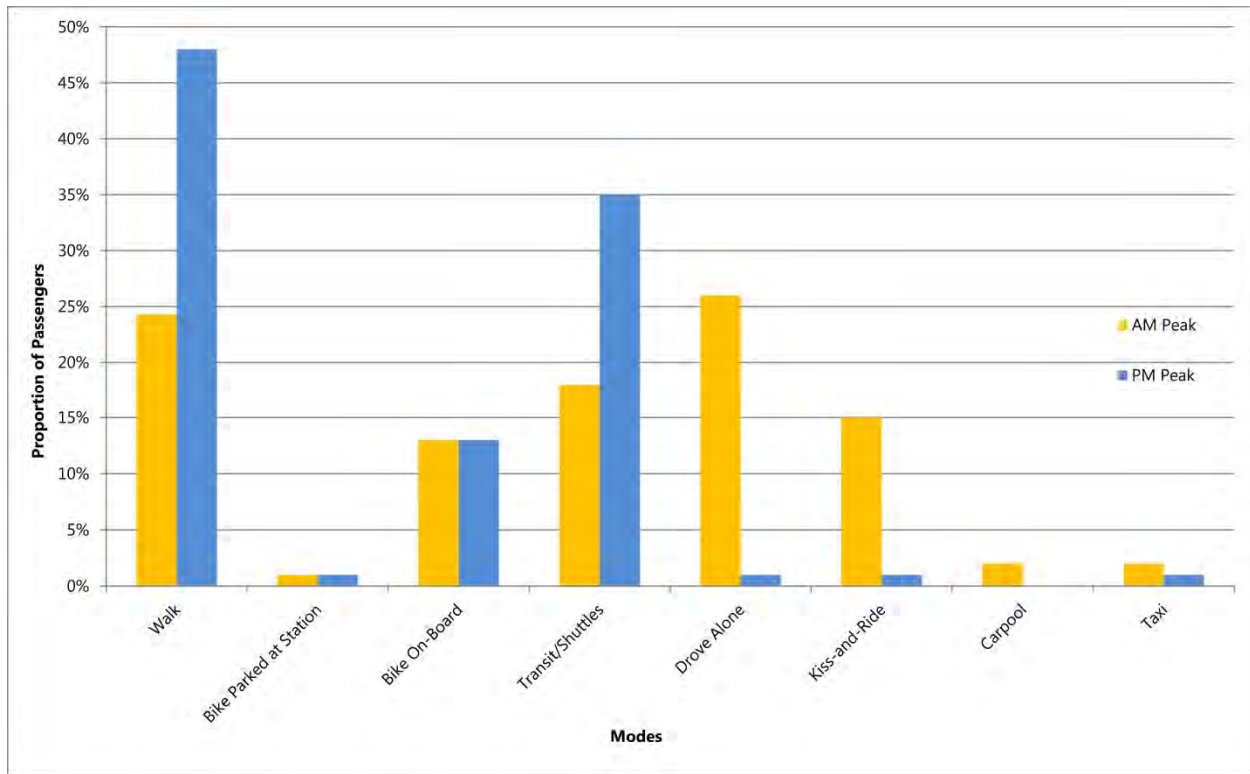
The top daily access mode for Caltrain passengers is walking (36 percent). The high mode share for walking indicates that a high volume of passengers live or work within reasonable walking distance of their origin station. Travel by transit or public/private shuttle is the second most popular access mode (26 percent) followed by car (23 percent) and bicycle (14 percent). The car mode share includes passengers who accessed the station by single occupancy vehicle (SOV), passengers who were dropped off/picked up at the station or carpooled, and motorcycle/moped users. Of the 23 percent of passengers who accessed Caltrain by car, about 13 percent drove alone, 8 percent were dropped off/picked up, and one percent carpooled.

Bringing bicycles on-board Caltrain allows passengers to use their bicycle at the destination leg of their trip as an egress mode. Caltrain's on-board bicycle program is discussed in more detail in Section 2.5.1.3. The majority of Caltrain cyclists bring their bicycles on-board rather than parking their bicycle at their origin station. About 13 percent of passengers bring their bicycles on-board compared to only one percent who store their bicycles in lockers, racks, or shared bicycle storage at or near stations.



Figure 2-8 displays mode of access to Caltrain stations in AM and PM peak periods. The top mode of access for Caltrain passengers traveling to stations in the AM peak period is driving alone (26 percent). In contrast, the top access mode for PM passengers is walking (48 percent). Walking is the second most popular access mode for AM passengers. Driving is generally more popular in the morning, than the evening, with driving alone, kiss-and-ride, and carpooling generally occurring at higher rates. Bicycle usage, both parked and on-board, is even for both access and egress.

**Figure 2-8 AM Mode of Access and PM Mode of Access (2013)**

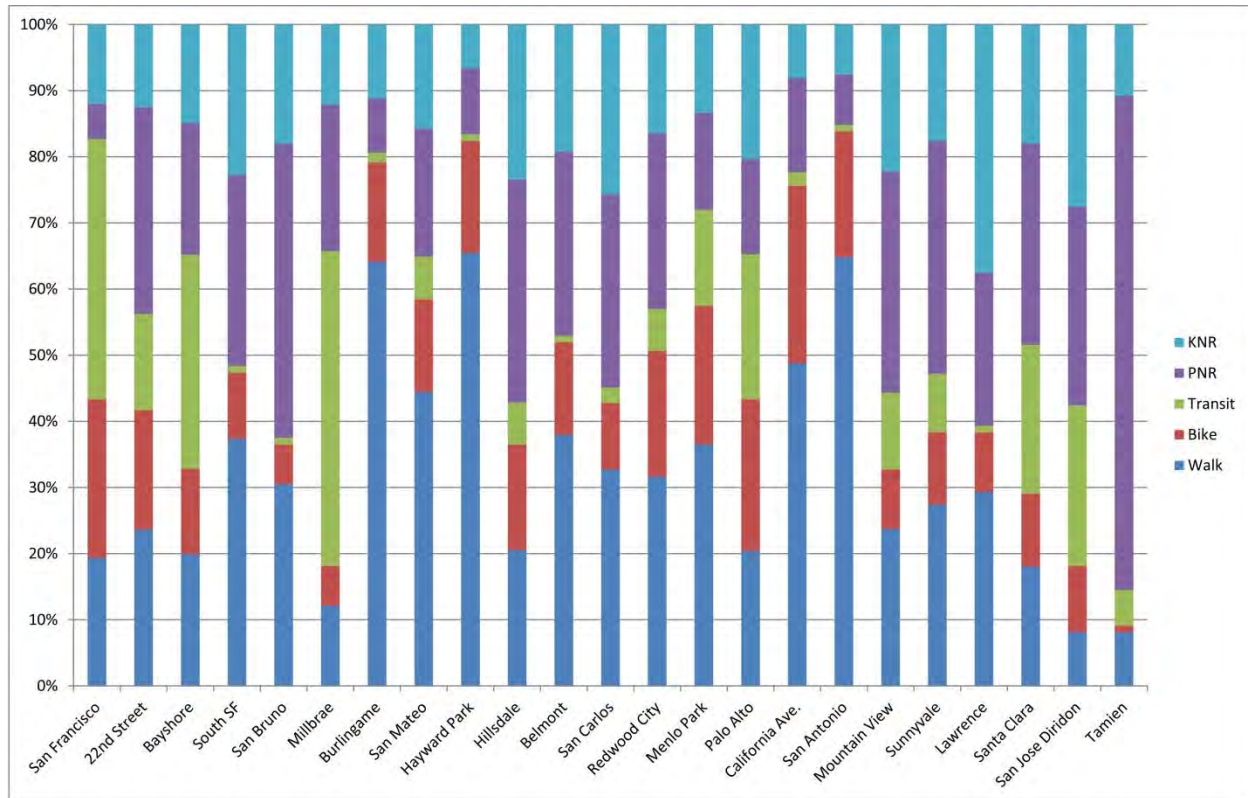


Source: 2013 Caltrain Intercept Survey, Fehr & Peers, 2013.

Figure 2-9 displays AM mode of access, by station. The stations with the highest park-and-ride mode share are Tamien and San Bruno. About 76 percent of passengers at the Tamien Station and 41 percent of passengers at San Bruno Station drive to and park at the station. The average drop off or “kiss-and-ride” mode share across all stations is 11 percent. Kiss-and-ride mode share is highest at the Lawrence Station with 37 percent of passengers dropped off by car. The stations with the highest walking mode share are Hayward Park (61 percent) and San Antonio (67 percent). The Tamien and San Jose Diridon Stations have the lowest walk mode share (8 percent). Bicycle mode share is highest at the California Avenue Station (27 percent), 4th and King Station (24 percent), and Palo Alto Station (23 percent). Transit and shuttle use is highest at the Millbrae (47 percent) and 4<sup>th</sup> and King (39 percent) stations.



**Figure 2-9 AM Mode of Access by Station (2013)**



Source: 2013 Caltrain Station Intercept Survey, Fehr & Peers, 2013.

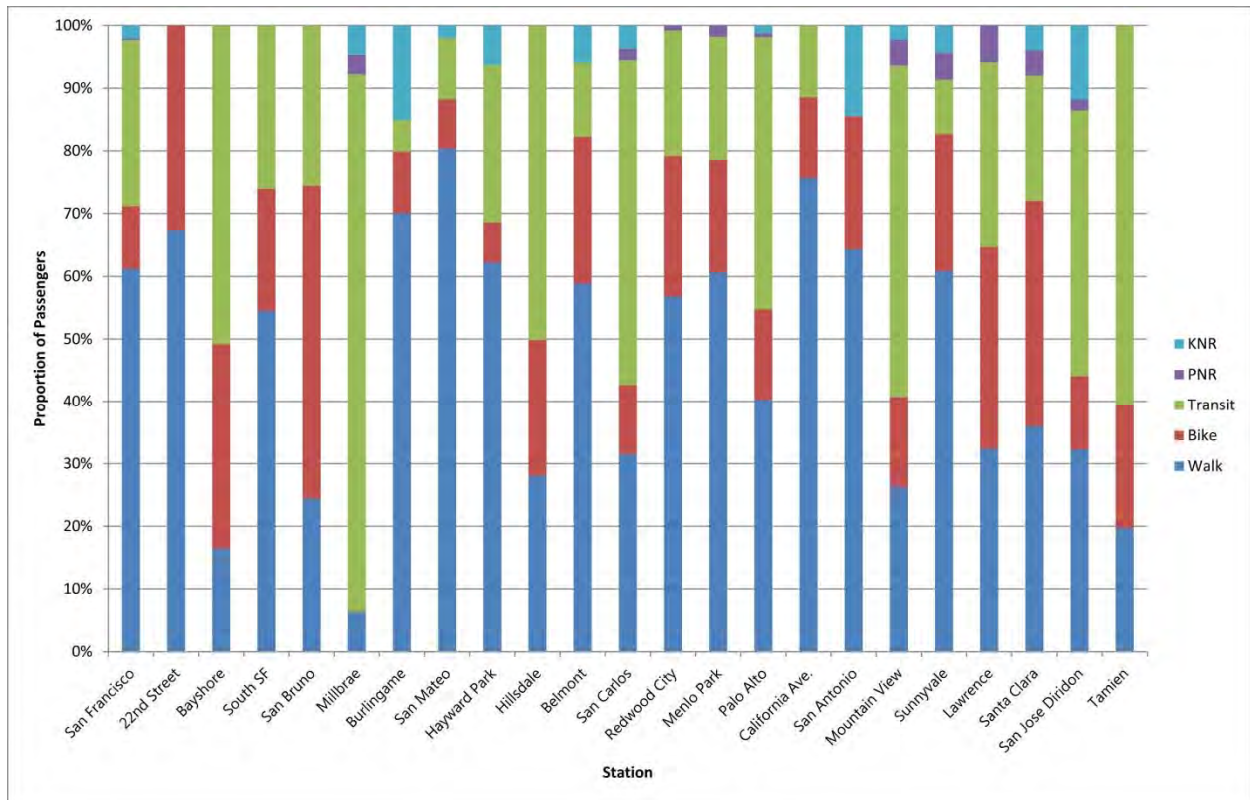
### 2.1.3.2 Mode of Egress to Caltrain Stations

The mode of egress a passenger uses on the destination side of their trip can differ from the mode of access he/she used at the start of their trip. Mode of egress is the mode a passenger makes use of at their destination station to reach their final destination point, such as a place of work or a shopping center.

Figure 2-10 displays AM mode of egress from Caltrain stations by station. On average, walking is the most common mode of egress across all stations. The San Mateo Station has the highest walking mode share with 80 percent of passengers walking from the station to their final destination. The Millbrae Station has the lowest walking mode share. Egress by bicycle is high at the Bayshore, San Bruno, 22<sup>nd</sup> Street, and Santa Clara Stations. Transit and shuttle use is highest at the Millbrae Station, also a Bay Area Rapid Transit (BART) connection point. At the Mountain View and San Jose Diridon Stations, transit/shuttle use is also high (53 and 42 percent, respectively). Overall, park-and-ride and kiss-and-ride is not as common as other modes of egress.



**Figure 2-10 AM Mode of Egress from Caltrain Stations (2013)**



Source: 2013 Caltrain Station Intercept Survey, Fehr & Peers, 2013.

### 2.1.4 ORIGIN/DESTINATION PATTERNS

Daily weekday commuters in the AM peak on Caltrain commonly travel between a specific origin station and destination station for home-based work trips. Factors including land use density, specifically the geographic distributions of jobs and housing, influence what station a passenger boards and alights at daily. This section analyzes the origin and destination pair patterns in AM peak period. Table 2-4 lists and quantifies the top ten origin destination pairs in the Study Area in the AM Peak. Figure 2-11 depicts the same data in a chord diagram fashion, with the thickness of each chord representing the number of passengers traveling between each pair of stations.



Rank	Origin Station	Destination Station	Number of AM Passengers
1	Hillsdale	4th & King	844
2	Mountain View	4th & King	727
3	Sunnyvale	4th & King	677
4	San Jose Diridon	4th & King	632
5	4th & King	Mountain View	559
6	22nd Street	Palo Alto	444
7	Millbrae	4th & King	426
8	Palo Alto	4th & King	414
9	San Mateo	4th & King	399
10	4th & King	Palo Alto	392

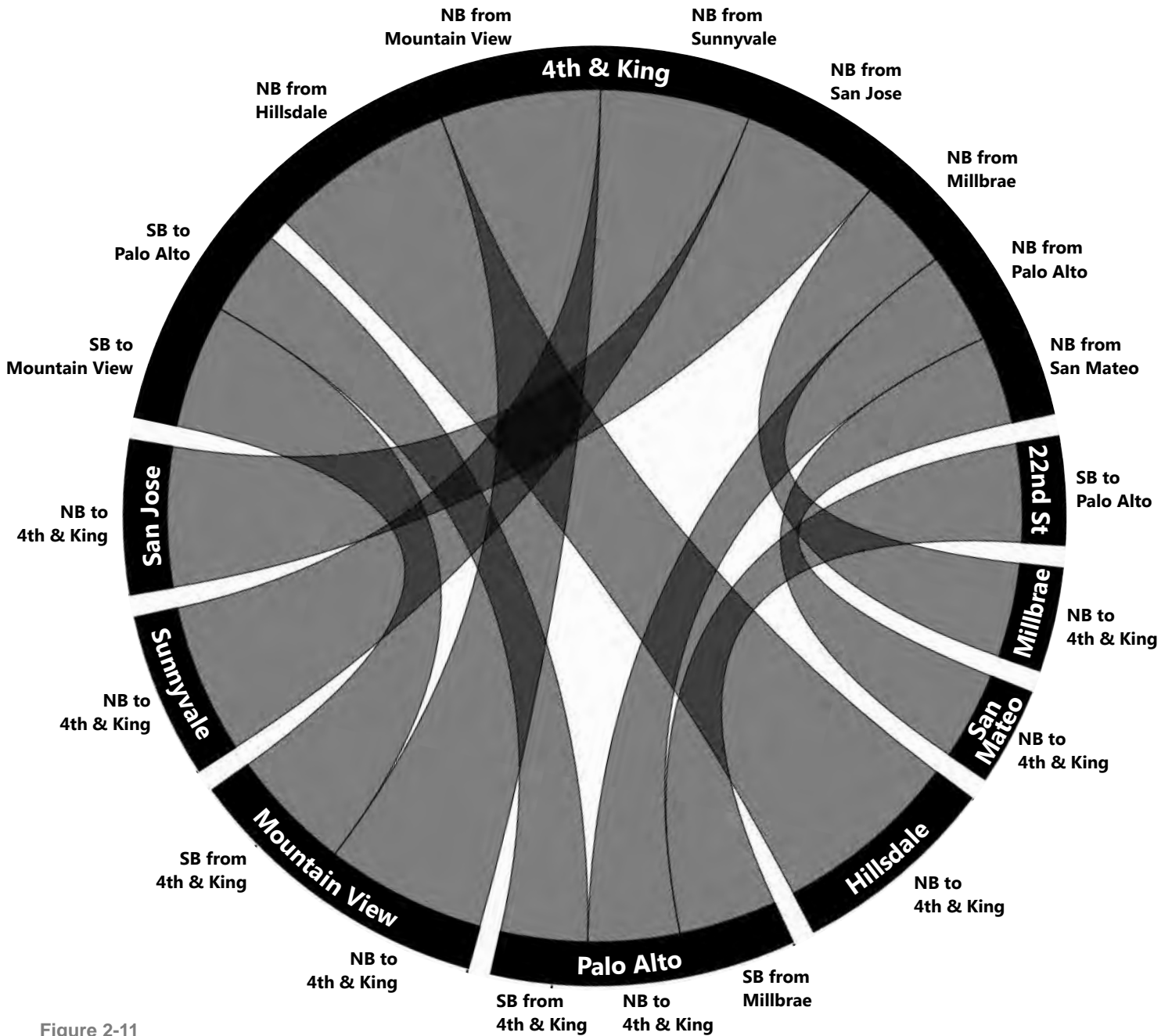


Figure 2-11

### Top Ten AM Peak Origin-Destination Pairs in Study Area (2013)





**TABLE 2-4  
 TOP TEN AM PEAK PERIOD ORIGIN-DESTINATION PAIRS IN STUDY AREA (2013)**

Rank	Origin Station	Destination Station	Direction	Number of AM Passengers
1	Hillsdale	4 <sup>th</sup> and King	Northbound	844
2	Mountain View	4 <sup>th</sup> and King	Northbound	727
3	Sunnyvale	4 <sup>th</sup> and King	Northbound	677
4	San Jose Diridon	4 <sup>th</sup> and King	Northbound	632
5	4 <sup>th</sup> and King	Mountain View	Southbound	559
6	22 <sup>nd</sup> Street	Palo Alto	Southbound	444
7	Millbrae	4 <sup>th</sup> and King	Northbound	426
8	Palo Alto	4 <sup>th</sup> and King	Northbound	414
9	San Mateo	4 <sup>th</sup> and King	Northbound	399
10	4 <sup>th</sup> and King	Palo Alto	Southbound	392

Source: 2013 Caltrain Intercept Survey, Fehr & Peers, 2013.

Note: Survey sample indexed to total Caltrain weekday northbound and southbound passengers between 6:30 – 10:30 AM (February 2013 Caltrain Annual Passenger Counts Key Findings, JPB, 2013)

Overall, passengers are traveling across at least one zone, with the shortest origin-destination pair being the Millbrae Station to 4<sup>th</sup> and King Station (Zone 2 to Zone 1). The dominant trip directional pattern in the top ten origin-destination pairs is northbound. The majority of the top pairs end at the 4<sup>th</sup> and King Station. This trend is consistent with 4<sup>th</sup> and King Station attracting the highest AWR of all stations in 2013. Three southbound origin-destination station pairs ranked in the top ten: 22<sup>nd</sup> Street to Palo Alto, 4<sup>th</sup> and King to Palo Alto, and 4<sup>th</sup> and King to Mountain View.



## 2.2 EXISTING POPULATION AND EMPLOYMENT

This section documents existing population and employment characteristics within the Study Area within the context of the larger San Francisco Bay Area. Several factors can influence the concentration of residents and jobs in a particular area, including economic development opportunities and challenges, land use patterns, and zoning regulations. Both the housing and employment market fluctuate according to a variety of critical macroeconomic factors. Overall, population and employment density fluctuates along the Caltrain corridor, with the highest densities concentrated in the northern portion of the Study Area in San Francisco.

### 2.2.1 POPULATION DENSITY

Population density is measured by number of persons residing within each transportation activity zone (TAZ), as defined by the VTA travel demand model. More detail on the VTA travel demand model can be found in Appendix I of the EIR. Figure 2-12 displays population density in the Study Area within the context of the larger San Francisco Bay Area. The darker areas in Figure 2-12 represent more heavily populated areas, while the lighter areas represent lightly populated areas. Population density occurs in clustered patterns along the Caltrain corridor with the densest concentration in San Francisco. The trend of population density generally follows the stations along the corridor, with density increasing in the southern portion of Santa Clara County near the San Jose Diridon Station. Heavier clusters of density are also present between South San Francisco and Redwood City.





Figure 2-12

### Study Area Population Density (2013)

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## 2.2.2 EMPLOYMENT DENSITY

The spatial relationship between a person's place of residence and place of work is subject to a range of dynamic socioeconomic factors. Some industries tend to cluster in the same geographic area, creating a denser area of job concentration. Figure 2-13 displays job density in the Study Area within the context of the larger San Francisco Bay Area, according to number of jobs located in each TAZ. The darker areas in Figure 2-13 represent jobs-rich areas, while the lighter areas represent areas with fewer jobs. Similar to population, San Francisco is home to the densest clustering of jobs, with other large clusters occurring in San Mateo County. Job density in the Palo Alto area is more spread out than San Francisco. Some jobs-rich areas are further than one-mile from Caltrain stations, indicating that a connecting mode other than walking may be favored by Caltrain commuters – such as shuttles, transit, or biking.





Figure 2-13

## Study Area Employment Density (2013)

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## 2.3 EXISTING TRANSIT CONDITIONS

This section summarizes existing transit conditions on Caltrain and all regional and local transit systems that connect to Caltrain stations.

### 2.3.1 CALTRAIN SERVICE AND SCHEDULE

Caltrain provides inter- and intra-county commuter rail service to the San Francisco Bay Area, from San Francisco County in the north, San Mateo County, and Santa Clara County in the southern part of the Study Area. The JPB operates Caltrain 365 days a year with reduced schedules on major U.S. holidays. The current Caltrain operating schedule is comprised of 92 trains each weekday, 36 trains on Saturdays, and 32 on Sundays. Weekday trains are a mix of Baby Bullets, Limited, and Local trains. Weekend service is a mix of weekend Baby Bullets and Local trains, with two Baby Bullet trains in each direction per day. Weekday Northbound service begins at 4:30 AM and ends at 12:01 AM. Weekday Southbound service begins at 4:55 AM and ends at 1:32 AM.

Scheduled headways, or the time between arrivals of vehicles moving in the same direction at a station, vary by time of day, station, and service type. Overall, service is frequent during the peak periods and is provided every hour in both directions during midday periods. Caltrain provides hourly service in both directions on Saturdays and Sundays (36 trains on Saturdays and 32 trains on Sundays) between San Jose and San Francisco only. The existing Caltrain schedule can be found in Attachment J.

During the AM and PM peak periods, all bullet stations are served by at least one bullet train per an hour with headways ranging between 15 to ~~30~~ 60 minutes. The higher frequency bullet stations, including San Francisco, Palo Alto, and San Jose Diridon, run at least two bullet trains per hour. Non-bullet stations operate Limited and Local trains at headways ranging between 30 minutes to 60 minutes during peak periods. During off-peak periods (early morning, midday, and after 7:00 PM), headways at all stations are generally about 60 minutes.

### 2.3.2 CALTRAIN ROLLING STOCK

Caltrain's fleet is comprised of 29 locomotives and 118 bi-level passenger cars (Fehr & Peers, 2013). Passenger cars are either Gallery or Bombardier. Gallery cars are manufactured by Nippon Sharyo and are generally older (1985 to 2000). Bombardier passenger cars are newer (2004 forward) and are bi-level. Most Baby Bullet trains operate with Bombardiers. All equipment is serviced at the Caltrain Centralized Equipment Maintenance and Operations Facility (CEMOF), located in San Jose, California. The seating capacities of passenger cars vary widely, from 78 to 148, due to dedicated space for bicycles and luggage. Each consist, defined as the sum total of the locomotive and five cars of either the Gallery or the Bombardier variety, can fit approximately 650 seated passengers.

### 2.3.3 CALTRAIN FARE CATEGORIES AND TRAVEL ZONES

Caltrain operates on a proof-of-payment system. All tickets must be purchased or validated before boarding the train. Caltrain conductors and fare inspectors walk through the trains to check tickets one or more times during each one-way trip. The JPB right-of-way is divided into six zones (Figure 1-1). Fares are

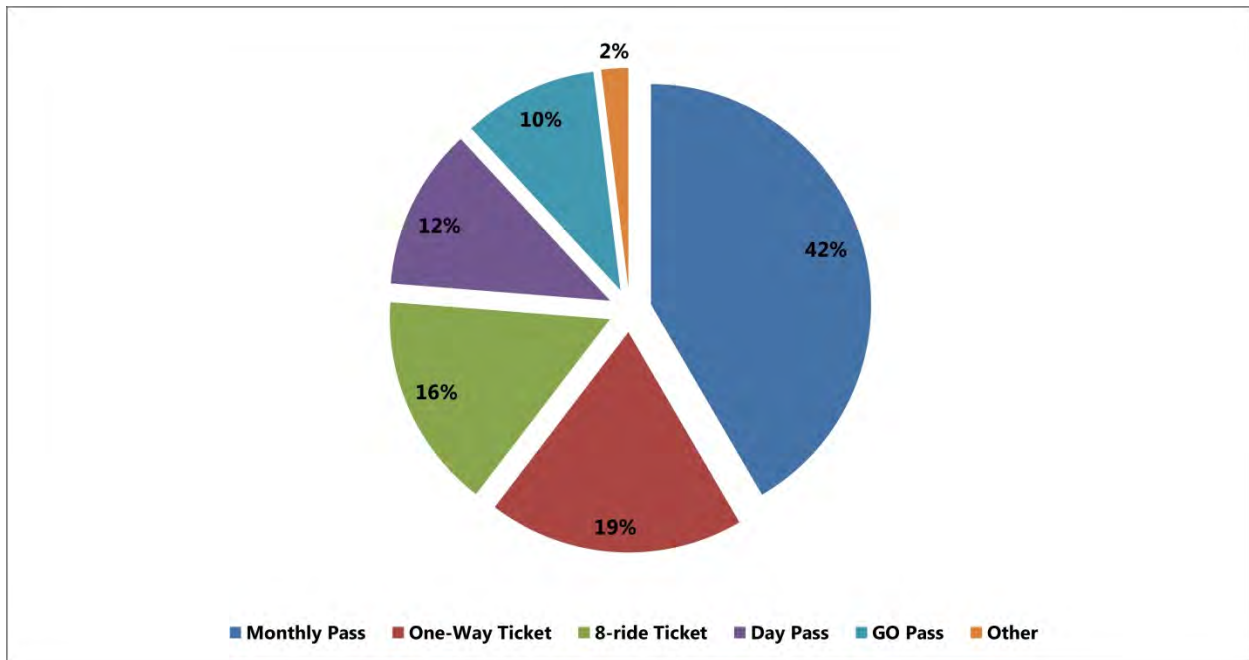


a combination of both a zone fare and a base fare. The core Caltrain Study Area is comprised of four zones approximately 13 miles in length.

Caltrain offers the following types of fares: One-way; Day pass; 8-ride, Monthly Pass; Zone Upgrade and GO Pass (employer subsidized annual fare card). Discount fares are available for those who qualify, including youths, seniors, disabled individuals, and Medicare cardholders. One Way, Day Passes and Zone Upgrades can be purchased in paper form at ticket vending machines located in station areas. Monthly passes, 8-ride tickets, or Clipper Cash ~~cash~~ can also be purchased and stored on Clipper fare payment cards. Clipper is a reloadable fare payment card that is accepted on a number of regional transit systems, including BART, Caltrain, MUNI, Santa Clara Valley Transportation Authority, and AC Transit. Clipper purchases can be made online at the Clipper website, over the phone, at ticket vending machines, and in-person at authorized Clipper retail centers. Figure 2-14 displays fare payment methods of Caltrain passengers, by proportion of passengers who used each fare type. The Monthly Pass is the most frequently purchased form of fare payment, with 43 percent of passengers using this method. One-way tickets are the second most frequently purchased form of fare payment (San Mateo County Transit District, "Commute Fleets" 2013).



**Figure 2-14 Distribution of Caltrain Fare Types (2010)**



Source: "October 2010 Caltrain Onboard Survey Summary Report." (2010) Corey, Canapary and Galanis Research.

### 2.3.4 CALTRAIN ON-TIME PERFORMANCE AND TRAVEL TIMES

Caltrain's on-time performance in FY 2012 was 91.5 percent. Table 2-5 displays average travel times by service type and direction in the Study Area. Northbound times are calculated between the Tamien or San Jose Diridon Stations and the 4th and King Station in San Francisco. Southbound times are between the 4th and King Station and the Tamien or San Jose Diridon Stations.

Because Baby Bullet trains and Limited trains only stop at select stations, travel times on these trains are shorter than Local train travel times. Compared to Local trains, a passenger on a Baby Bullet can cut his/her travel time by about one-third. When making travel choices, passengers often weigh factors such as the time- and cost-competitiveness of the modes available to them. ~~The following section compares the time- and cost-competitiveness of riding Caltrain versus driving in a single-occupancy vehicle along a parallel automobile route in the Study Area.~~





**TABLE 2-5  
 AVERAGE CALTRAIN TRAVEL TIMES IN STUDY AREA (2013)**

Service Type	Average Travel Time in Minutes	
	Northbound	Southbound
Local	92	92
Limited	84	82
Baby Bullet	60	63

Note: Travel Times expressed from platform to platform between San Jose Diridon and 4<sup>th</sup> and King Station.

### 2.3.5 REGIONAL TRANSIT NETWORK CONNECTIVITY

The greater San Francisco Bay Area is served by an extensive public transit network of rail, buses, and ferries. In general, Caltrain is well connected with the regional transit network, offering public transit connecting service to other service providers or public shuttles at all stations within the Study Area. Caltrain is connected to the following rail transit systems: Bay Area Rapid Transit (BART), the ~~MUNI Light Rail~~ MUNI Metro system operated by San Francisco Municipal Transportation Agency (SFMTA), Altamont Commuter Express (ACE) commuter rail, VTA light rail, and Amtrak. The Caltrain system is also connected to the following bus transit systems: SamTrans, MUNI, VTA, Alameda-Contra Costa (AC) Transit, Santa Cruz Metro Transit District, Monterey-Salinas Transit (MST), and a number of public shuttles. Table 2-6 summarizes the service areas of all transit systems that currently connects to a Caltrain station within the Study Area. Figure 2-15 displays all regional rail transit systems connected to Caltrain within the Study Area. Figure 2-16 shows all bus and rail systems connected to Caltrain within Zone 1. Figure 2-17 shows all bus and rail systems connected to Caltrain within Zone 2. Figure 2-18 shows all bus and rail systems connected to Caltrain within Zone 3. Figure 2-19 shows all bus and rail systems connected to Caltrain within Zone 4.



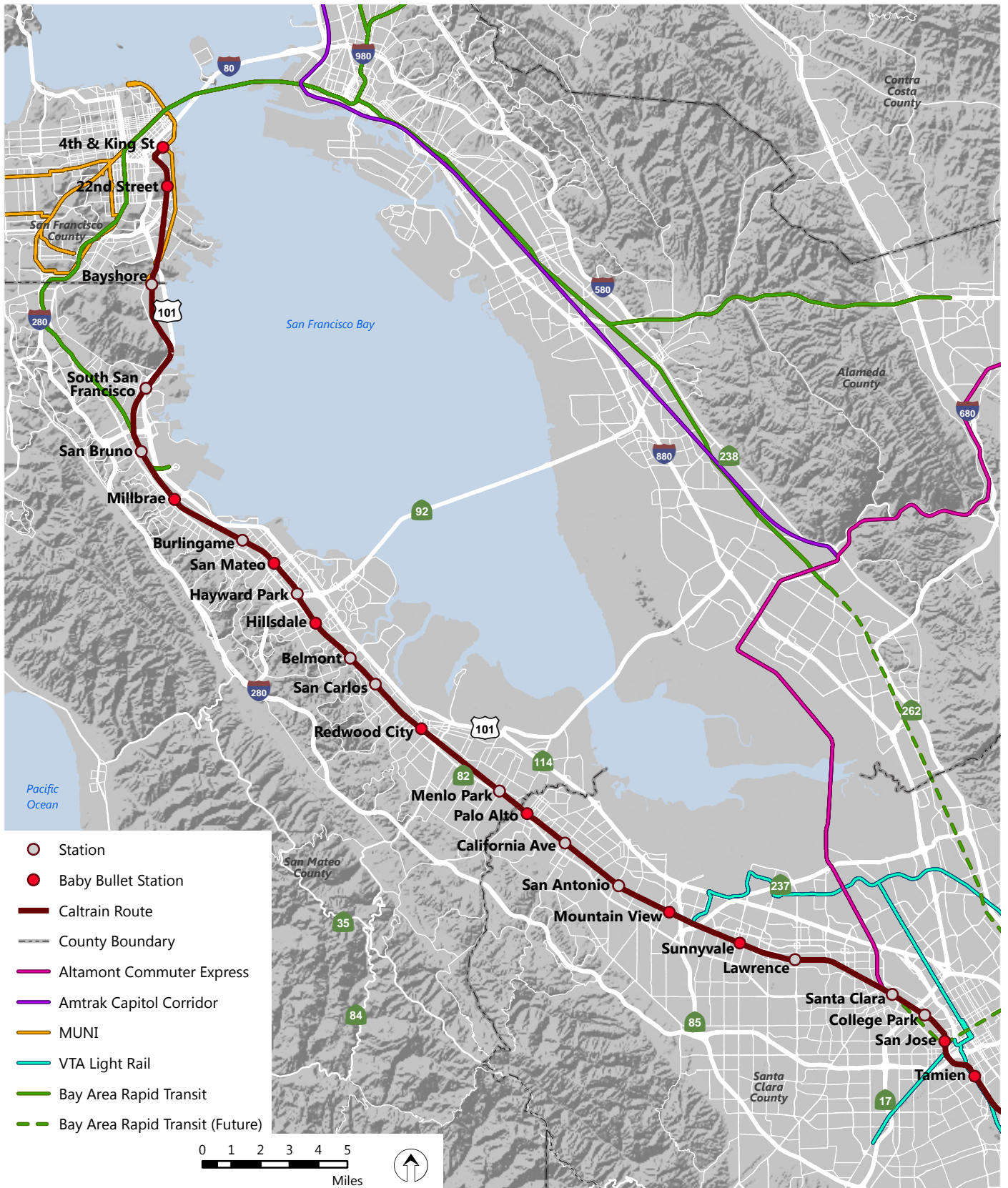


Figure 2-15

### Existing Regional Rail Transit Connections in Study Area (2013)

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