



# City of Palo Alto

## City Council Staff Report

(ID # 8742)

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**Report Type:** Informational Report      **Meeting Date:** 4/16/2018

**Summary Title:** 2017 Traffic Safety and Operations Report

**Title:** 2017 Traffic Safety and Operations Report

**From:** City Manager

**Lead Department:** Planning and Community Environment

### **Recommendation**

This is an informational report and no formal action is recommended.

### **Executive Summary**

The purpose of this report is to familiarize the City Council and the public with the summary of current traffic safety projects, activities and initiatives. Attachment A is the 2017 Traffic Safety and Operations Report prepared by Transportation staff to summarize traffic safety, operations and system monitoring projects within City of Palo Alto during the 2017 calendar year. This report will be the subject of a study session with the Planning and Transportation Commission in the coming month.

### **Environmental Review**

As this is an informational report and no action will be taken, environmental review is not required.

### **Attachments:**

- Traffic Safety and Operations Report 2017

# TRAFFIC SAFETY & OPERATIONS

2017 Report





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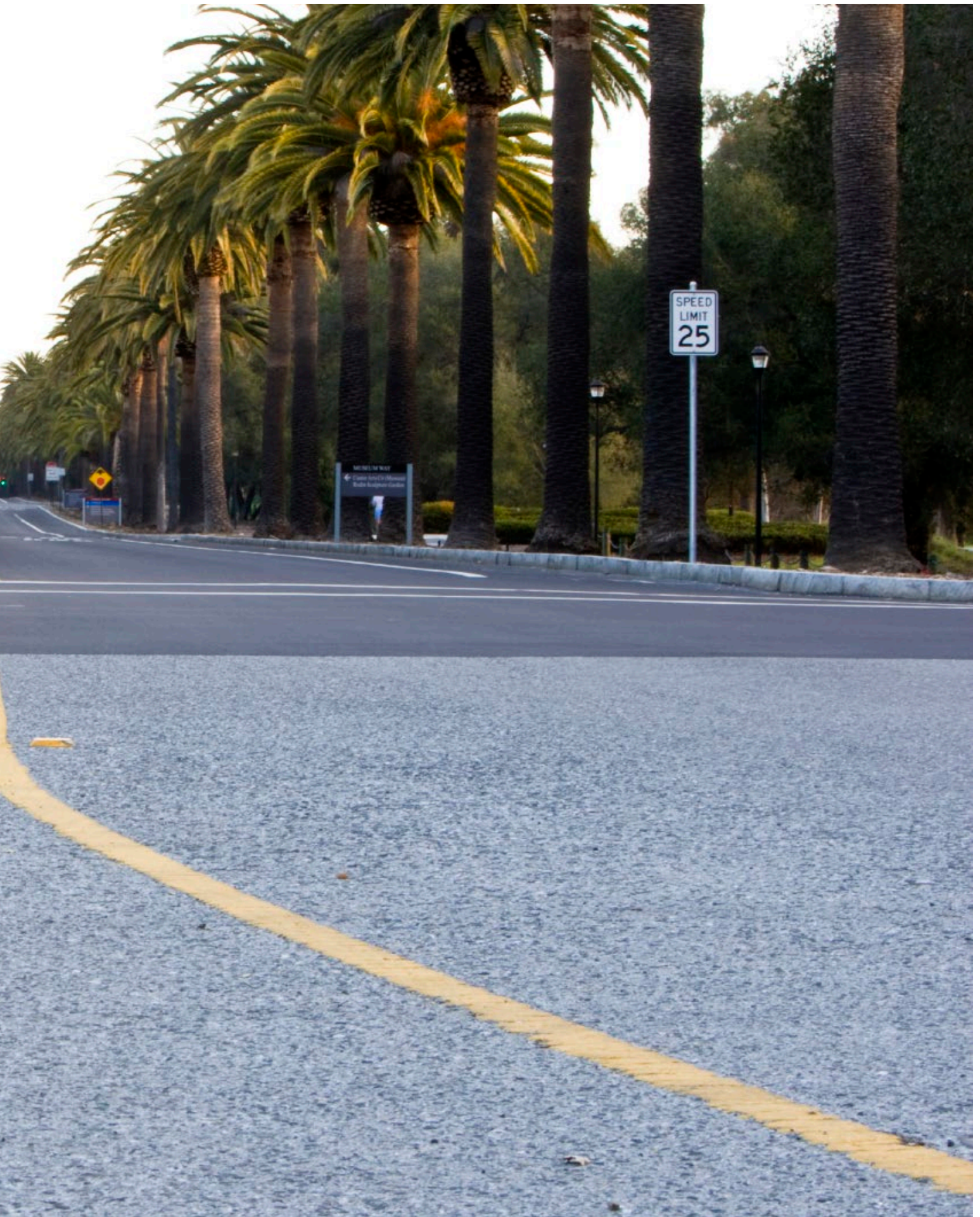
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# INTRODUCTION





## 1.1 POLICIES & GOALS

The purpose of the 2017 Traffic Safety and Operations Report is to provide an overview of traffic safety and operations and system monitoring projects within City of Palo Alto. The report is intended to be used as a benchmarking tool to track progress on efforts to reduce the number of collisions and collision severity, also track traffic operations and performance and identify traffic safety trends to help guide future engineering efforts.

This first of its kind report is a summary of current traffic safety projects, activities and initiatives undertaken in 2017. While some of these projects and programs are intended to serve large citywide efforts, some are focused on local neighborhoods and residents.

The report contents can help the city focus its funding, enforcement and road improvements and also assist the city in applying for state and federal grants, which often rely on statistics to determine awards. Overall, it can support projects and programs that help to improve traffic operations and reduce crashes, fatalities, and injuries.

Projects and programs listed in this report are consistent with existing City goals and policies from the 2030 Comprehensive Plan:

**Policy T-1.19** Provide facilities that encourage and support bicycling and walking.

**Policy T-1.22** Continue to measure the effectiveness of the City's transportation network to make better decisions on transportation issues.

**Policy T-1.23** Monitor VMT per capita and citywide GHG emissions from mobile sources as a measure of progress toward the City's goal of reducing GHG 80 percent below 1990 levels by 2030.

**Policy T-1.24** Monitor and publicly report on the level of service at critical intersections on a regular basis and consider additional intersections to add to this list to monitor the effectiveness of the City's growth management policies. Also monitor multi-modal level of service for arterials and residential arterials.

**GOAL T-2** Decrease delay, congestion and VMT with a priority on our worst intersections and our peak commute times, including school traffic.

**Policy T-2.1** Working with congestion management authorities including the VTA and the City/County Association of Governments of San Mateo County (C/CAG), implement traffic management strategies and technologies, such as



signal coordination, centralized traffic control and real-time travel information, to reduce traffic congestion in and around Palo Alto.

**Policy T-2.3** Use motor vehicle LOS at signalized intersections to evaluate the potential impact of proposed projects, including contributions to cumulative congestion. Use signal warrants and other metrics to evaluate impacts at unsignalized intersections.

**Policy T-2.4** Consistent with the principles of Complete Streets adopted by the City, work to achieve and maintain acceptable levels of service for transit vehicles, bicyclists, pedestrians and automobiles on roads in Palo Alto, while maintaining the ability to customize to the Palo Alto context.

**GOAL T-3** Maintain an efficient roadway network for all users.

**Policy T-3.3** Avoid major increases in single-occupant vehicle capacity when constructing or modifying roadways unless needed to remedy severe congestion or critical neighborhood traffic problems. Where capacity is increased, balance the needs of motor vehicles with those of pedestrians and bicyclists.

**Policy T-3.5** When constructing or modifying roadways, plan for use of the roadway by all users.

**Policy T-3.6** Consider pedestrians, bicyclists, e-bikes and motorcycles when designing road surfaces, curbs, crossings, signage, landscaping and sight lines.

**Policy T-3.7** Encourage pedestrian-friendly design features such as sidewalks, street trees, on-street parking, gathering spaces, gardens, outdoor furniture, art and interesting architectural details.

**Policy T-3.8** Add planting pockets with street trees to provide shade, calm traffic and enhance the pedestrian realm

**Policy T-3.14** Continue to prioritize the safety of school children in street modification projects that affect school travel routes, including during construction.

**GOAL T-4** Protect streets and adopted school commute corridors that contribute to neighborhood character and provide a range of local transportation options.

**Policy T-4.2** Continue to construct traffic calming measures to slow traffic on local and collector residential streets, and prioritize traffic calming measures for safety over congestion management.

**Policy T-4.4** Maintain the following roadways as residential arterials, treated with landscaping, medians and other visual improvements to distinguish them as residential streets, in order to improve safety:

- Middlefield Road (between San Francisquito Creek and San Antonio Road)
- University Avenue (between San Francisquito Creek and Middlefield Road)
- Embarcadero Road (between Alma Street and West Bayshore Road)
- East and West Charleston Road/Arastradero Road (between Miranda Avenue and Fabian Way)

**GOAL T-6** Provide a safe environment for motorists, pedestrians and bicyclists on Palo Alto streets.

**Policy T-6.1** Continue to make safety the first priority of citywide transportation planning. Prioritize pedestrian, bicycle and automobile safety over motor vehicle level of service at intersections and motor vehicle parking

**Policy T-6.2** Pursue the goal of zero severe injuries and roadway fatalities on Palo Alto city streets.

**Policy T-6.6** Use engineering, enforcement and educational tools to improve safety for all users on City roadways.

**Policy T-6.7** Use appropriate technology to monitor and improve circulation safety throughout the City.

**Policy T-6.8** Vigorously and consistently enforce speed limits and other traffic laws for both motor vehicle and bicycle traffic.





TRAFFIC OPERATIONS  
PROJECTS





## 2.1 TRAFFIC SIGNAL TIMING

Staff has been updating signal timing parameters throughout the city on a bi-annual basis since 2016. Prior to that, signal timing updates were not consistent and typically done on an as-needed basis.

As part of the Citywide traffic signal system update project in 2015, connectivity and communication upgrades allowed for more efficient control of the traffic signal system.

In 2016 and 2017, new coordinated timing programs were implemented on various arterial streets, including Embarcadero Road, San Antonio Road, various segments of Middlefield Road, and all streets within the downtown area. In addition to the new coordination plans, signal timing updates have continued on an as-needed basis or in response to changing traffic patterns and concerns.

In 2017, much of the signal timing efforts focused around:

- New peak period coordination of Middlefield Road between Lytton Avenue and University Avenue, and from Hamilton Avenue to Melville Avenue, (note: some intersections are currently under construction and awaiting detection upgrades)
- Updated coordination in the downtown area, including bicycle speed coordination (i.e. Green Wave) along Bryant Street,

- On-going adjustments to the San Antonio Road adaptive traffic control system
- Updated timing and Caltrain pre-emption phase sequencing at signalized intersections along Alma Street.







## 2.2 SYNCHROGREEN ADAPTIVE TRAFFIC CONTROL SYSTEM

As part of the City's 2015 traffic signal system upgrade project, a centralized management system and signal controller upgrades made most of the City's traffic signals compatible for future traffic control systems such as adaptive signal timing.

Adaptive signal timing is a form of traffic signal coordination that incorporates real-time collection of traffic data and adjustments to base signal timing settings.

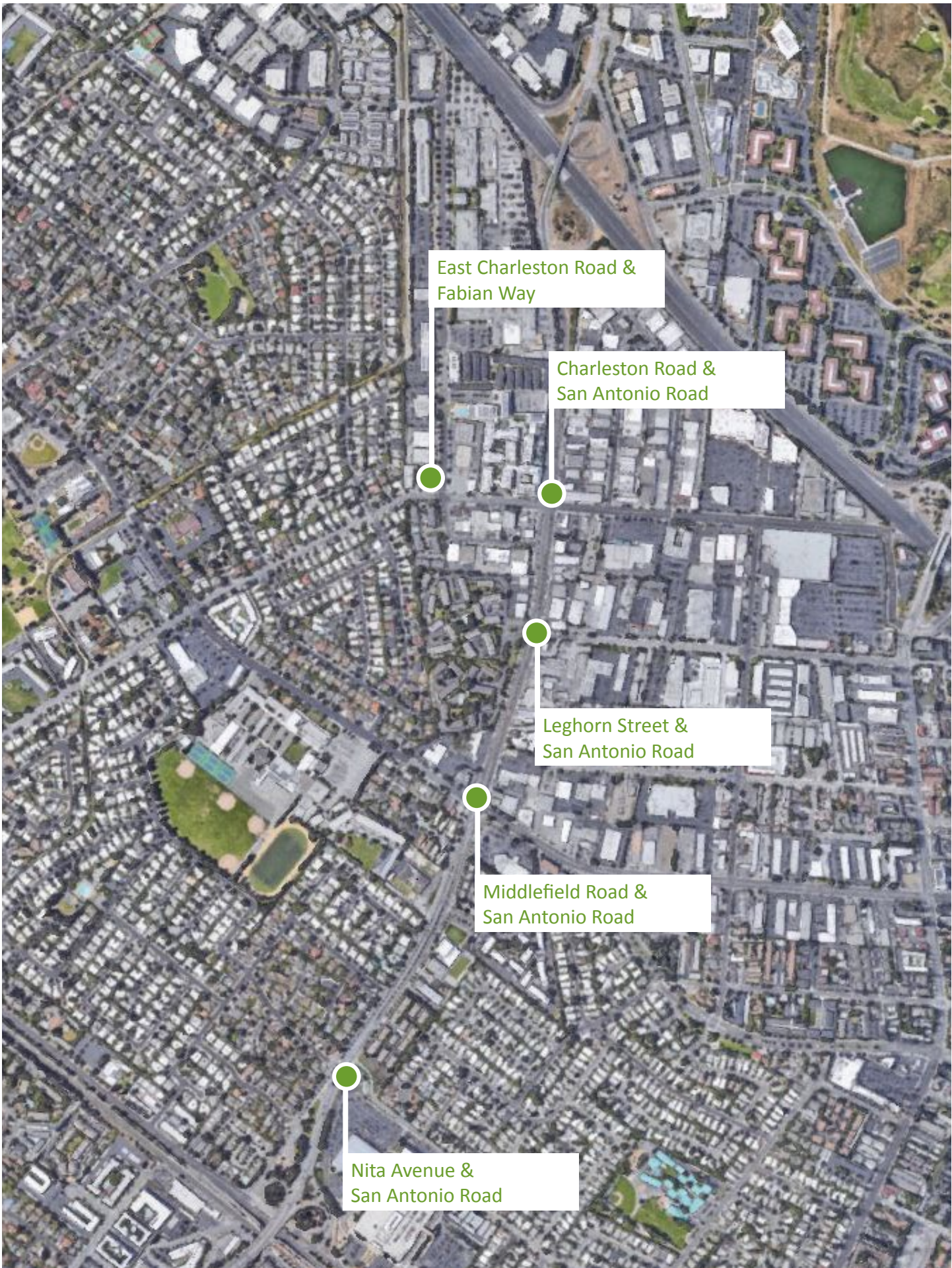
SynchroGreen is an adaptive traffic signal control program that has been running along Sand Hill Road in Palo Alto since the signal system upgrades in 2015.

In early 2017, the same adaptive program (SynchroGreen) was implemented at four intersections along San Antonio Road and at the intersection of East Charleston Road/Fabian Way.

Staff has generally observed improved operations along the main route (i.e. San Antonio Road), with minor increases in delay to some of the side-street movements. Staff believes the overall traffic congestion and delays have generally been reduced by the adaptive traffic control system.

In 2017, Staff has:

- Implemented, fine-tuned, and adjusted the SynchroGreen adaptive traffic control system along San Antonio Road
- Monitored and made minor adjustments along Sand Hill Road
- Secured grant funding for signal detection upgrades and SynchroGreen implementation for the Charleston Road and Arastradero Road corridor (to be implemented in Spring 2018).





## 2.3 VELOCITY BLUETOOTH TECHNOLOGY

Staff is in the process of implementing a series of Bluetooth monitors to provide data on travel times, average motor vehicle speeds and patterns at various intersections in the street network. Bluetooth-based data collection systems provide a cost effective means of gathering the large amount of raw data needed to characterize real-time traffic congestion.

This new performance monitoring tool takes advantage of the City's traffic signal communications network that was upgraded in 2015, and will help identify areas to work on improving coordinated signal timing to balance out delays.

This technology takes advantage of the large number of vehicles that are driving with Bluetooth enabled devices such as smart phones. Staff has completed the procurement process and the selected vendor is Iteris. Iteris product Velocity system uses unique MAC identifiers, and maintains anonymous user data to provide travel information data.

Proposed preliminary locations for installation in Palo Alto are:

- University Avenue/Middlefield Road
- University Avenue/ El Camino Real Ramps
- Alma Street /Lytton Avenue
- Embarcadero Road/ Saint Francis Drive

- Embarcadero Road/Middlefield Road
- San Antonio Avenue/Middlefield Road
- San Antonio Road/East Charleston Road
- East Charleston Road/Middlefield Road
- Alma Street/ East Charleston Road
- Arastradero Road/Gunn High School Driveway

Santa Clara County has also installed these monitors at the following nearby County locations:

- West Bayshore Road/Oregon Expressway
- Middlefield Road/ Oregon Expressway
- Central Expressway/Mayfield Avenue
- Page Mill Road/Foothill Expressway

Deploying several monitors along arterial corridors at various intersections in the road network will provide an efficient means to collect arterial travel times and speeds. All data collected will comply with the City's Privacy Policy.



Middlefield Road & University Avenue

Embarcadero Road & Saint Francis Drive

Alma Street & Lytton Avenue

University Avenue & El Camino Real

Embarcadero Road & Middlefield Road

East Charleston Road & San Antonio Road

East Charleston Road & Middlefield Road

East Charleston Road & Alma Street

Middlefield Road & San Antonio Avenue

Arastradero Road & Gunn High School



## 2.4 TRAFFIC SIGNAL UPGRADES

In 2016 and 2017, Staff implemented various signal upgrades on existing traffic signals. Two of these were focused around school access at the intersections of:

- Middlefield Road and North California Avenue – Implementation of separated bikeways with dedicated bicycle and pedestrian phase.
- Arastradero Road and Donald/Terman Drive – Implementation of split phasing to complement a new bicycle box and improve shared roadway bicycle traffic demand.

Traffic signal upgrades conducted at other intersections include:

- Welch Road and Lucile Packard Children’s Hospital – with the opening of the hospital, the full implementation of the traffic signal at the access driveway has been completed.
- Middlefield Road and Embarcadero Road – Addition of dedicated left-turn lanes for both approaches of Middlefield Road and implementation of protected left turn phasing. Current “split” phasing will be removed. (In progress, completion anticipated early 2018). In addition to the traffic signal modifications, each corner will receive protected intersection features that improve bicycle and pedestrian connections between Rinconada

Park and Coleridge Avenue (designated Safe Route to Schools and Enhanced Bikeway)

- Middlefield Road and Addison Avenue – Addition of fourth pedestrian crosswalk (In progress, completion anticipated early 2018)

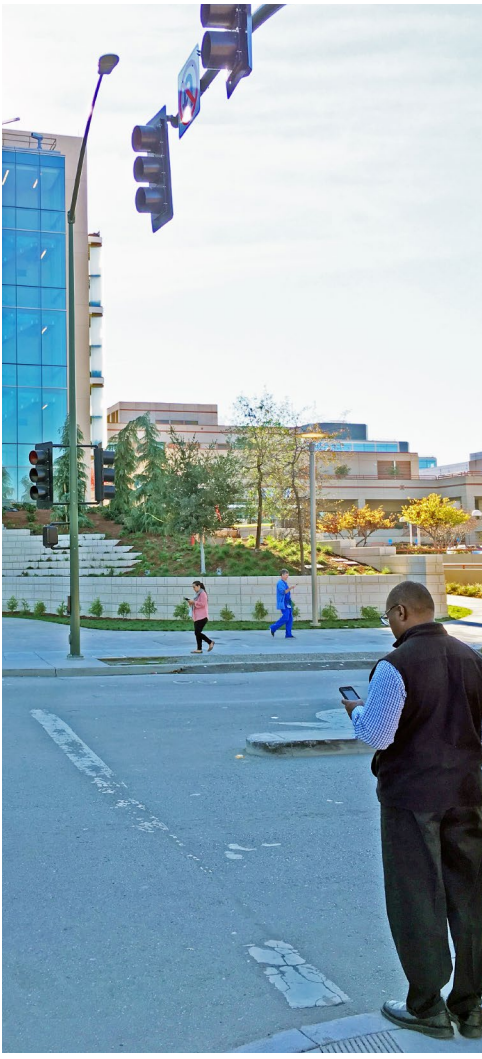
In 2018, existing traffic signals that are anticipated to undergo signal modification include:

- East Charleston Road and Fabian Way
- East Charleston Road and Middlefield Road
- East Charleston Road and Nelson Drive
- East Charleston Road and Carlson Court
- West Charleston Road and Wilkie Way
- Arastradero Road and Coulombe Drive
- Arastradero Road and Gunn High School Driveway

In 2018, installation of new traffic signals are proposed at the following locations:

- Park Boulevard and Page Mill Road (on and off-ramp, currently under construction)
- East Charleston Road and Louis Road/Montrose Avenue









TRAFFIC SAFETY  
PROJECTS







## 3.1 COWPER STREET/ COLERIDGE AVENUE

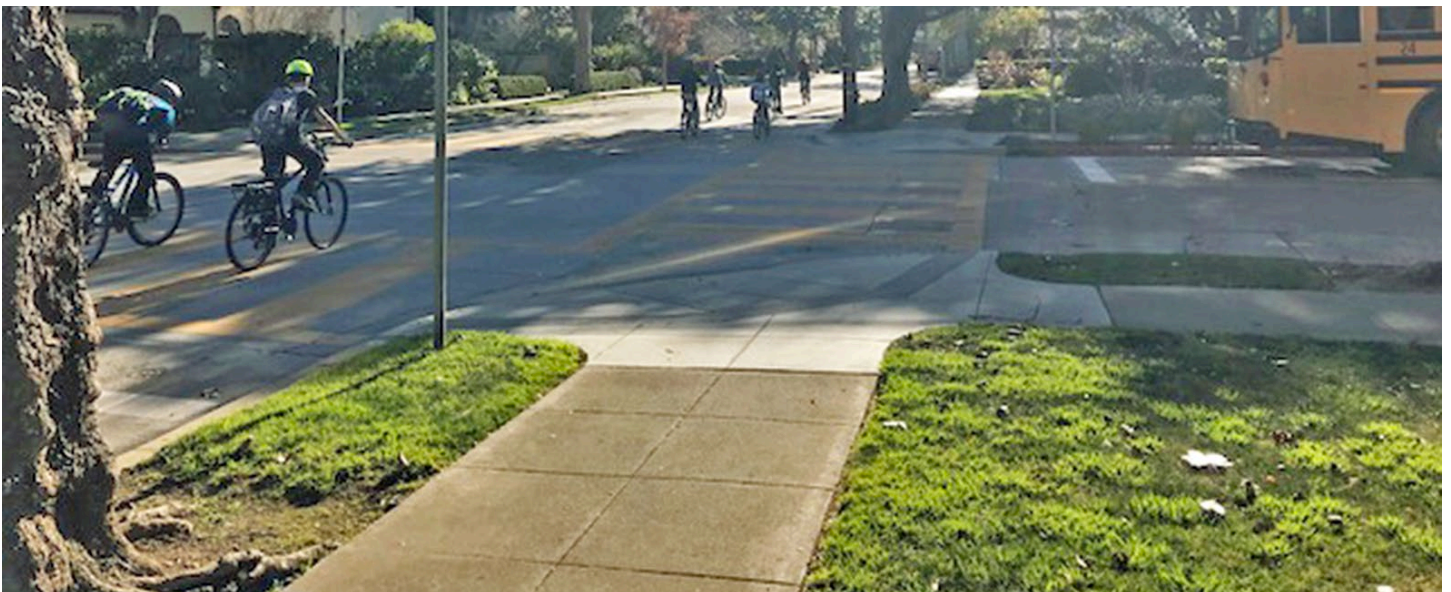
As part of Safe Routes to School programs, Cowper Street/Coleridge Avenue intersection was identified to improve safety for children bicycling or walking to school. Coleridge Avenue is a designated Safe Routes to School route for Walter Hays Elementary School and Cowper Street is a designated bicycle route.

Prior to the pilot, Cowper Street/Coleridge Avenue was a two-way stop controlled intersection with stop signs on Coleridge Avenue.

Community members raised concerns about traffic safety and unsafe vehicle speeds. In April 2016, a six-month pilot was implemented consisting of a temporary traffic circle, yellow high-visibility crosswalks and advanced yield lines. Results from the survey conducted at the end of pilot were evenly split and inconclusive.

The pilot was continued until April 2017 for another six months after being converted to an all-way YIELD controlled intersection. The second survey conducted in May 2017 showed that opinion remained divided, with regard to retaining or removing the traffic circle.

On June 28, 2017 the Planning and Transportation Commission recommended that the traffic circle and all-way YIELD control signs be removed and a larger neighborhood safety project be initiated. In the interim while a larger study is undertaken, this intersection has been converted to an all-way STOP control. Changes have been made to this intersection and staff has not received any negative feedback since the conversion to all-way STOP.





## 3.2 MIDDLEFIELD ROAD NORTH

Middlefield Road North Traffic Safety project attempts to enhance traffic and pedestrian safety and preserve neighborhood character and livability. Residents corresponded with the City regarding traffic conditions along Middlefield Road from Forest Avenue to the Menlo Park city limits.

Primary concerns cited were traffic congestion, safety, high travel speeds, collisions, and noise.

In response, the City initiated the Middlefield Road North Traffic Safety Pilot Project in July 2016 and staff worked with the neighborhood group to identify potential improvement options.

Council approved Concept Plan 7A on January 23, 2017 to implement as a one-year pilot project and construction was completed in June 2017. The approved concept Plan includes a traditional road diet that removed one travel lane in each direction, two five feet wide paved shoulders and a two-way left-turn lane. At the intersections with Hawthorne Avenue and Everett Avenue, all cars approaching Middlefield Road are required to make a right-turn, while left-turns and through movements are restricted by raised medians and signage.

This plan addresses concerns related to turning traffic to and from Everett Avenue, Hawthorne Avenue, and residen-

tial driveways and also includes changes that address safety for motor vehicle traffic.

Staff is continuing extensive ongoing monitoring of the corridor and immediate project area. Staff will return to City Council in August 2018 for direction on whether to make the improvements permanent or modify the alternative and complete additional monitoring.

### **Summary of Observed Motor Vehicle Speed**

The 85th percentile motor vehicle speed at three locations on Middlefield Road show a 3.0 percent and 12.5 percent decrease from the pre-pilot period. On the parallel routes, compared to the pre-pilot period, the 85th percentile motor vehicle speeds decreased on Fulton Street between Lytton Avenue and Everett Avenue (-4.0 percent), Webster Street (-4.0 percent), and Guinda Street (-5.3 percent), stayed the same on Byron Street (0.0 percent), and increased on Fulton Street between Lytton Avenue and University Avenue (8.7 percent).

### **Summary of Motor Vehicle Traffic Volumes and Classifications**

There was an average daily volume of 63,152 motor vehicles during the mid-pilot period. Compared to the pre-pilot period, there was a 6.8 percent decrease in overall motor vehicle volumes. Compared to the pre-pilot period, there



was a 5.8 percent decrease in overall motor vehicle volumes at the three locations observed along Middlefield Road. Compared to the pre-pilot period, there was a 30.6 percent increase in overall motor vehicle along the five parallel routes to Middlefield Road. Compared to the pre-pilot period, there was a 29.5 percent decrease in overall motor vehicle volumes along the four cross street locations.

#### Summary of Observed Near-miss Collisions

Compared to the pre-pilot period, the intersection of Middlefield Road and Everett Avenue saw an uptick in near-miss collisions with five observed during the mid-pilot period. This increase in near-miss collisions was representative of an increase in hazardous driving behavior observed during review of traffic camera video and reported by residents through the mid-pilot survey.

#### Reported Collisions on Project Corridor

Staff is in the process of analyzing collision data on the selected corridor of Middlefield Road from Palo Alto Avenue to Lytton Avenue during the mid-pilot period (fall 2017) to the average number of collisions during the same period in the five preceding years (fall 2012 through fall 2016) and focusing on the two intersections of Middlefield Road/Hawthorne Avenue and Middlefield Road/ Everett Avenue. However, the mid-pilot period (July 1st to December 31st, 2017) represent a small sample size.

In addition to reported collisions, some collisions go unreported, and while near-miss collisions can be a strong indicator of potential collision risk, information on near-misses is not always available for comparison.



## 3.3 MIDDLEFIELD ROAD/ NORTH CALIFORNIA AVENUE COMPLETE STREETS

In conjunction with Public Works' paving maintenance program, the following traffic calming features were introduced along Middlefield Road between Forest Avenue and Oregon Expressway; and on North California Avenue between Alma Street and Newell Avenue.

### **New Traffic Signal Equipment at Embarcadero Road and Middlefield Road**

This new signal was installed in conjunction with reconfigured lane approaches that reflect motor vehicle turning demand. The new signal will improve traffic operations with dedicated left turn phases on all approaches.

### **Reintroduced Pedestrian Crossing at Addison Avenue and Middlefield Road**

The fourth crosswalk leg was reintroduced at Addison Avenue and Middlefield Road intersection and the traffic signal was modified to include new vibra-tactile push buttons for people with impaired vision.

### **Speed Control Measures**

Along Middlefield Road, travel lanes were visually narrowed with striping to discourage speeding. Selected intersections received soft-hit bollards to discourage motorists from unsafe high-speed passing maneuvers within an intersection.

### **Protected Bikeway**

A new two-way protected cycletrack was installed to connect the two offset legs of North California Avenue and Jordan Middle School with the surrounding bike network.

### **Results**

85<sup>th</sup> Percentile Speed

- Before: 33-34MPH (4/2016)
- After: 29-32MPH (9/2016)

### **Average Daily Traffic (ADT)**

- Before: 11,000 (4/2016)
- After: 9,300 (9/2016)



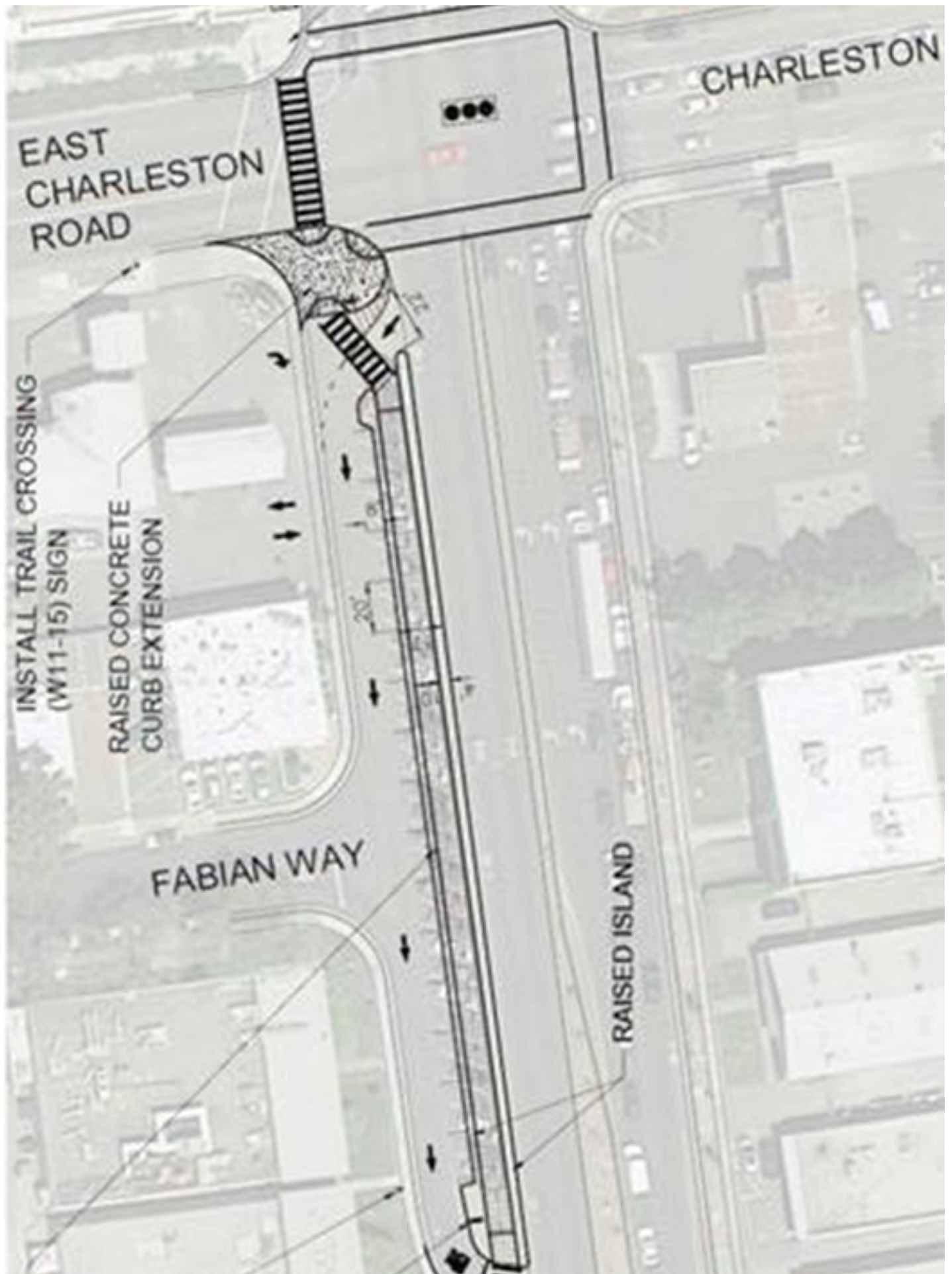




### 3.4 SAN ANTONIO ROAD/ EAST CHARLESTON ROAD INTERSECTION IMPROVEMENTS

This ongoing project aims to improve pedestrian safety—mainly crossing west leg of East Charleston Road with two conflicting southbound right-turn lanes on San Antonio Road. During field observations it was noted that vehicles in the second right-turn lane do not always yield to pedestrians. This project would also address existing intersection capacity and poor motor vehicle level of service (LOS).

Staff is currently developing three conceptual layouts of potential improvements for this intersection and will share with stakeholder’s group in early 2018. A preliminary stakeholder meeting is scheduled for April 2018.





### 3.5 SAINT FRANCIS DRIVE BETWEEN CHANNING AVENUE & EMBARCADERO ROAD

This upcoming project was initiated by residents and aims to improve pedestrian and bicycle safety while reducing motor vehicle speeds. Pedestrians are crossing midblock on Saint Francis Drive and vehicles not yielding to bicycles at the intersection of Saint Francis Drive and Channing Avenue. It is also observed that motor vehicles are not abiding by stop signs located at Channing Avenue and Saint Francis Drive.

Staff is currently collecting and summarizing traffic counts, collision data, and observing traffic operations along this corridor. Based on the findings of data collection, potential traffic calming treatments and/or traffic safety countermeasures will be developed. Two final conceptual layouts will be presented to neighborhood stakeholders and other members of the public at a public meeting in Spring 2018.



Channing Avenue

Saint Francis Drive

Embarcadero Road



## 3.5 ELECTRONIC SPEED FEEDBACK SIGNS

Electronic speed feedback signs also known as radar speed signs are interactive signs that displays vehicle speed as motorists approach. The purpose of radar speed signs is to slow cars down by making drivers aware when they are driving at speeds above the posted speed limits. They are used as a traffic calming device.

Over the last four months, staff updated, repaired and reprogrammed all 15 existing signs and installed two new ones along Arterial, Residential Arterial and Collector Streets within Palo Alto. Six out of the existing 15 signs were inoperable and had not been replaced since its installation in 2003.

Staff purchased additional signs that were of same brand as already in use within the City to ensure consistency with existing equipment and for ease of maintenance. These signs are also equipped with a traffic analyzer feature that collects day, time, and speed of vehicles and generates charts and speed compliance reports.

Signs operate from 7:00am until 9:00pm every day of the week and have been programmed as follows:

Posted Speed Limit	25mph	35mph
Starts flashing at	26-30mph	36-40mph
Flashes "SLOW DOWN"	31+ mph	41+ mph



Street	Location	Direction of Travel
Alma Street	North of Ferne Avenue	Northbound
Alma Street	North of Loma Verde Avenue	Northbound
Arastradero Road	At Hubbart Drive	Eastbound
Arastradero Road	At Hubbart Drive	Westbound
Channing Avenue	West of Addison Avenue	Westbound
East Charleston Road	West of Louis Road	Westbound
Embarcadero Road	East of Wildwood Lane	Westbound
Embarcadero Road	West of Newell Road	Westbound
Embarcadero Road	West of Bryant Street	Eastbound
Embarcadero Road	Between Louis Road and Greer Road	Eastbound
Middlefield Road	South of Moreno Avenue	Northbound
Middlefield Road	South of Marion Avenue	Southbound
Middlefield Road	North of Layne Court	Northbound
Middlefield Road	South of Towle Way	Southbound
Middlefield Road	South of Palo Alto Avenue	Southbound
University Avenue	West of Crescent Drive	Westbound
West Bayshore Road	South of Loma Verde Avenue	Southbound



## 3.6 ENHANCED CROSSWALK TREATMENTS

Staff has made a concerted effort to repair and/or update midblock pedestrian crosswalks throughout the city. The city's current standard for mid-block enhanced crossings includes the use of rectangular rapid flashing beacons (RRFB).

In 2017, Staff:

- Repaired flashing beacons at three crossings on Fabian Way between East Meadow Drive and Charleston Road
- Repaired RRFB crossings at El Camino Way and James Way, and at Charleston/Louis/Montrose (recently knocked down and waiting foundation repair)
- Updated pedestrian crossings to use RRFB at Arastradero Road and Clemo Avenue
- Implemented new RRFBs at existing crosswalk at 3305 Hillview Avenue

In 2018, Staff will implement new enhanced midblock crosswalks at 3251 Hanover St and 3251 Hillview Avenue, and other locations to be determined.









SYSTEMS MONITORING





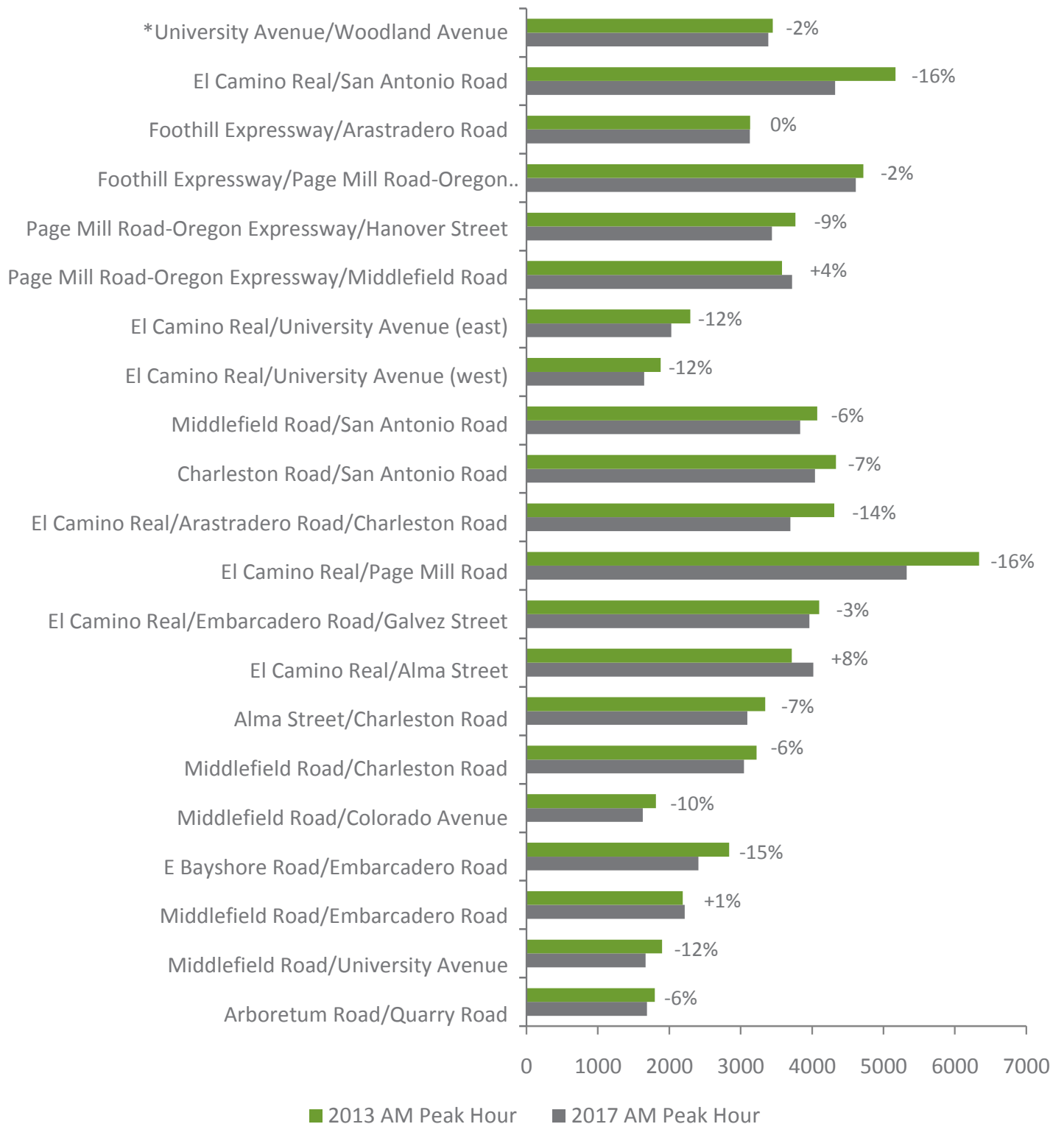
## 4.1 MORNING & EVENING INTERSECTION COUNTS

In previous years, Staff collected peak period turning movement counts at select intersections. The frequency and amount of data collected varied and has not been consistent throughout the years ranging from eight to 50 intersections.

Beginning in 2017, Staff plans to collect and report the traffic counts at 21 intersections on an annual basis. Chart 1 shows motor vehicle approach volumes at each of these intersections collected during morning peak hour in 2013 and 2017. Chart 2 shows motor vehicle approach volumes at each of these intersections collected during evening peak hour in 2013 and 2017.

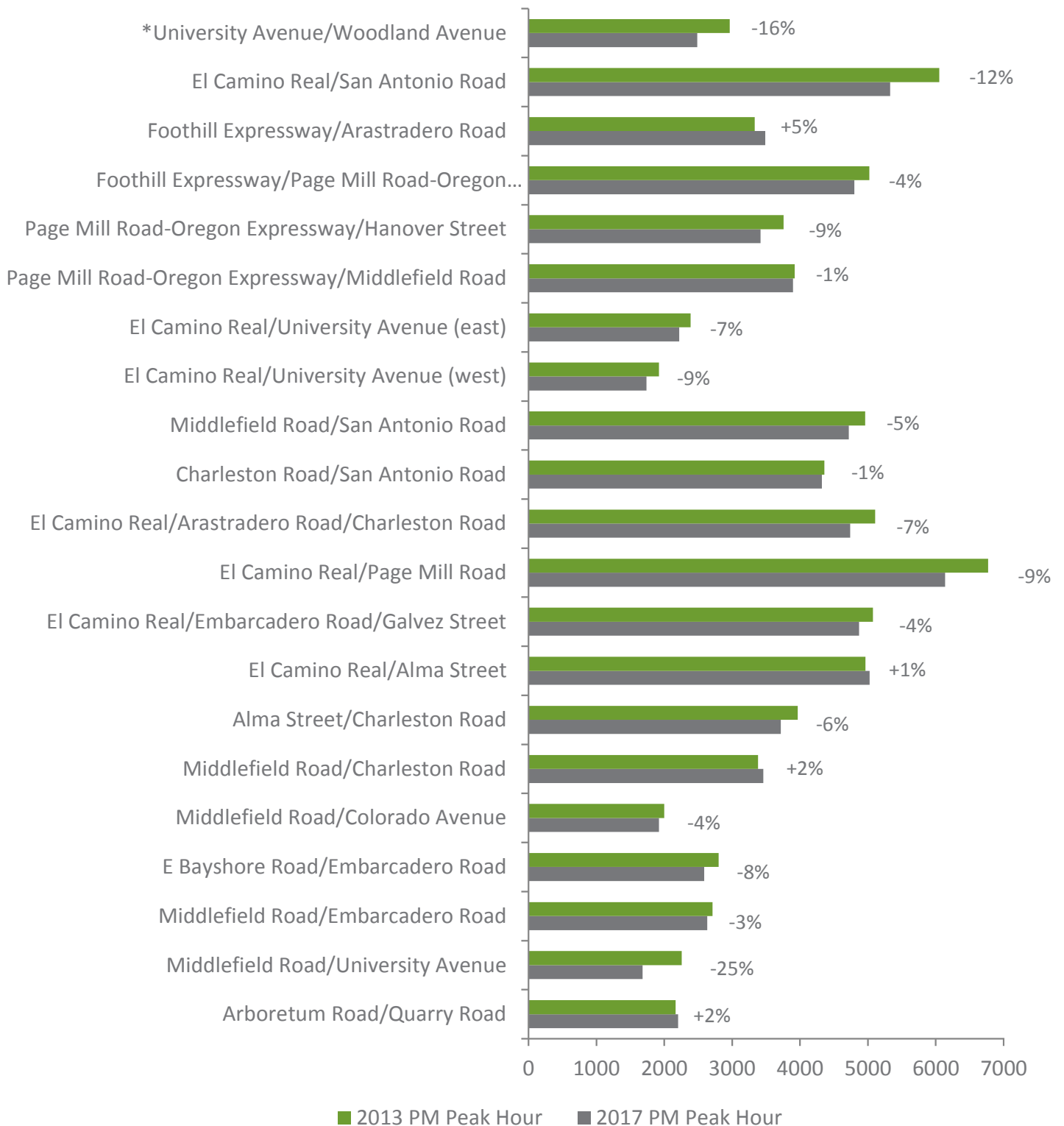






**CHART 1: PERCENT CHANGES IN MORNING TRAFFIC PEAKS 2013 TO 2017**

\*Peak Hour volumes for University Avenue/Woodland Avenue intersection may be reduced due to restricted capacity and downstream congestion.



**CHART 2: PERCENT CHANGES IN EVENING TRAFFIC PEAKS 2013 TO 2017**

\*Peak Hour volumes for University Avenue/Woodland Avenue intersection may be reduced due to restricted capacity and downstream congestion.



## 4.2 INTERSECTION LEVEL OF SERVICE & DELAY

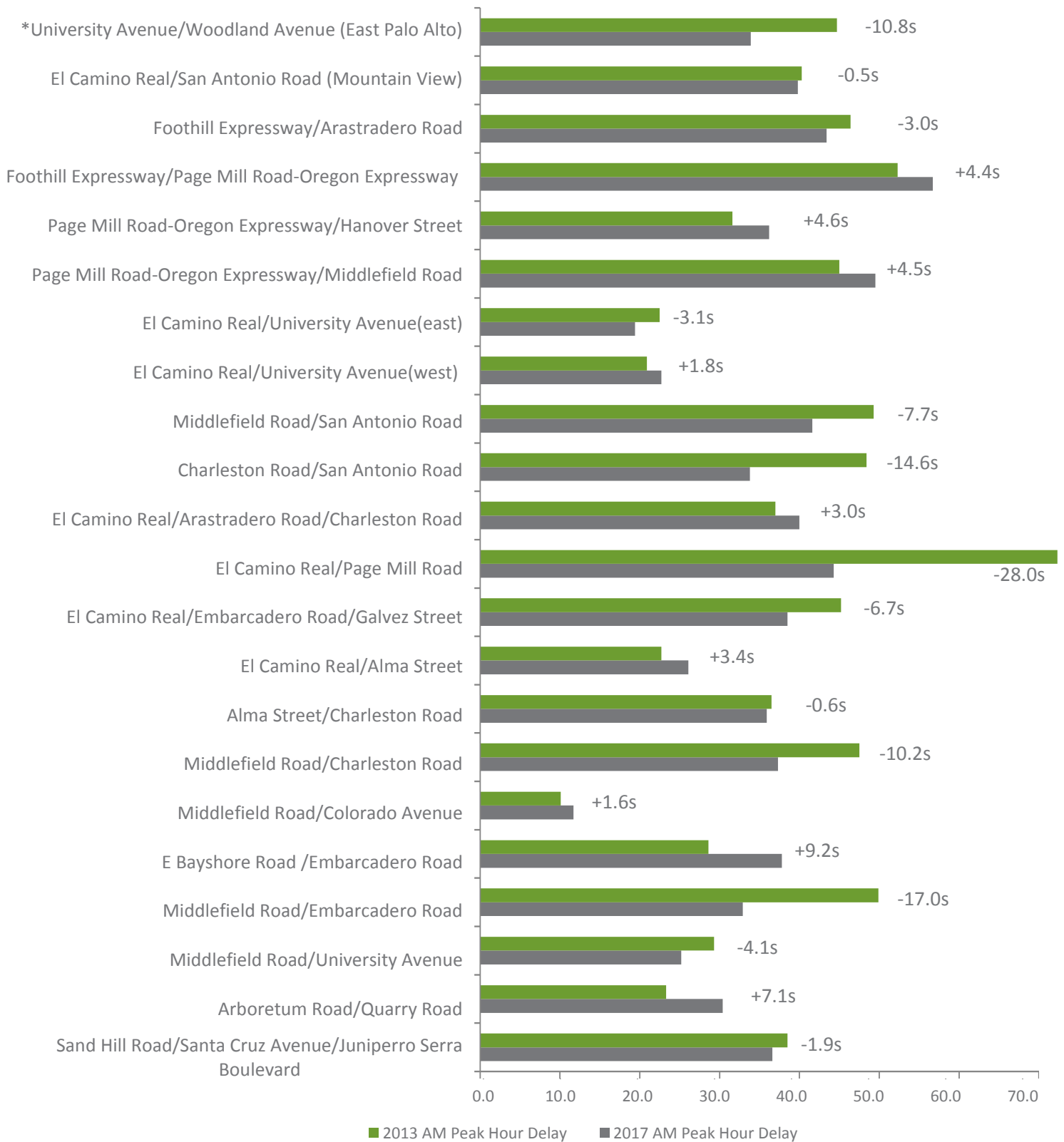
In October 2017, City Staff collected turning movement counts at 21 intersections and evaluated intersection Level of Service (LOS) for these intersections. The level of service is based on the highest peak hour during each of the AM and PM peak periods.

The table to the right summarizes the LOS and delay (in seconds) for years 2013 and 2017. Chart 3 shows delay (in seconds) during the morning peak hour at each of these intersections in 2013 and 2017. Chart 4 shows delay (in seconds) during the evening peak hour at each of these intersections in 2013 and 2017.



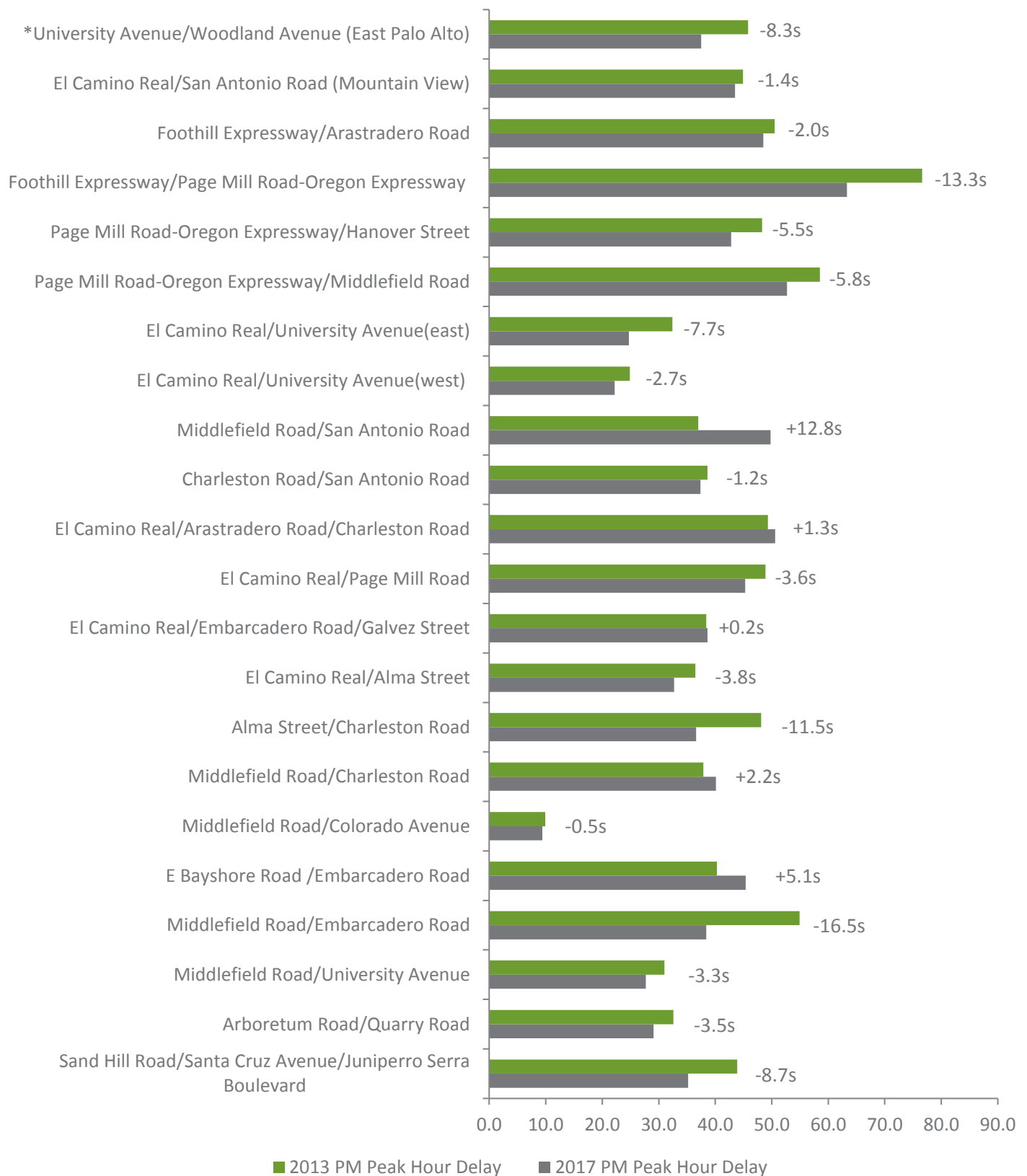
Intersection	2013				2017			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Sand Hill Road/Santa Cruz Avenue/Junipero Serra Boulevard	D	38.5	D	43.9	D	36.6	D	35.2
Arboretum Road/Quarry Road	C	23.3	C	32.6	C	30.4	C	29.1
Middlefield Road/University Avenue	C	29.3	C	31.0	C	25.2	C	27.7
Middlefield Road/Embarcadero Road	D	49.9	D	54.9	C	32.9	D	38.4
E Bayshore Road /Embarcadero Road	C	28.6	D	40.3	D	37.8	D	45.4
Middlefield Road/Colorado Avenue	B	10.1	A	9.9	B	11.7	A	9.4
Middlefield Road/Charleston Road	D	47.5	D	37.9	D	37.3	D	40.1
Alma Street/Charleston Road	D	36.5	D	48.1	D	35.9	D	36.6
El Camino Real/Alma Street	C	22.7	D	36.5	C	26.1	C	32.7
El Camino Real/Embarcadero Road/Galvez Street	D	45.2	D	38.4	D	38.5	D	38.6
El Camino Real/Page Mill Road	E	72.3	D	48.9	D	44.3	D	45.3
El Camino Real/Arastradero Road/Charleston Road	D	37.0	D	49.3	D	40.0	D	50.6
Charleston Road/San Antonio Road	D	48.4	D	38.6	C	33.8	D	37.4
Middlefield Road/San Antonio Road	D	49.3	D	37.0	D	41.6	D	49.8
El Camino Real/University Avenue (west)	C	20.9	C	24.9	C	22.7	C	22.2
El Camino Real/University Avenue (east)	C	22.5	C	32.4	B	19.4	C	24.7
Page Mill Road-Oregon Expressway/Middlefield Road	D	45.0	E	58.5	D	49.5	D	52.7
Page Mill Road-Oregon Expressway/Hanover Street	C	31.6	D	48.3	D	36.2	D	42.8
Foothill Expressway/Page Mill Road-Oregon Expressway	D	52.3	E	76.6	E	56.7	E	63.3
Foothill Expressway/Arastradero Road	D	46.4	D	50.5	D	43.4	D	48.5
El Camino Real/San Antonio Road (Mountain View)	D	40.3	D	44.9	D	39.8	D	43.5
University Avenue/Woodland Avenue (East Palo Alto)	D	44.7	E	45.8	C	33.9	D	37.5





**CHART 3: CHANGES IN DELAYS (IN SECONDS) DURING THE MORNING PEAK HOUR FROM 2013 TO 2017**

\*Delay may not be representative of actual conditions since demand is greater than traffic counts at University Avenue/Woodland Avenue due to downstream congestion



**CHART 4: CHANGES IN DELAYS (IN SECONDS) DURING THE EVENING PEAK HOUR FROM 2013 TO 2017**

\*Delay may not be representative of actual conditions since demand is greater than traffic counts at University Avenue/Woodland Avenue due to downstream congestion



## 4.3 TRAVEL TIME STUDIES

Travel time runs were conducted in August 2016 to determine the average speed, free flow speed and signal delay along the three study corridors listed below. These were measured by “floating car” technique using Geographic Positioning System (GPS) that consist of a vehicle that is specifically dispatched to drive with the traffic stream for the express purpose of data collection. A floating car run covers a one-way trip of the defined length of a study corridor. These runs capture travel time, speed, stopping time, number of stops, and other delays on a unidirectional roadway segment. The floating car survey data was analyzed to obtain overall averages of travel time, delay and speed for the entire length of each corridor. Another set of travel time runs will be conducted in Spring 2018.

- San Antonio Road, between US 101 and Alma Street Overcrossing (1.88 miles): During the a.m. peak period, an average number of three stops were observed and an average delay of 2 minutes was observed in both northbound and southbound direction. During the p.m. peak period, an average number of four stops were observed and an average delay of 3:30 minutes was observed in both northbound and southbound directions.
- Middlefield Road between Menlo Park City limits to Oregon Expressway (1.98 miles): During the a.m. peak period, an average number of five stops were observed and an average delay of 3:30 minutes was observed in both northbound and southbound direction. During the p.m. peak period, an average number of seven stops were observed and an average delay of 6 minutes was observed in both northbound and southbound directions.
- Embarcadero Road between El Camino Real and US 101 (2.48 miles): During the a.m. peak period, an average number of five stops were observed and an average delay of 3:50 minutes was observed in both northbound and southbound direction. During the p.m. peak period, an average number of seven stops were observed and an average delay of 4:30 minutes was observed in both northbound and southbound directions.

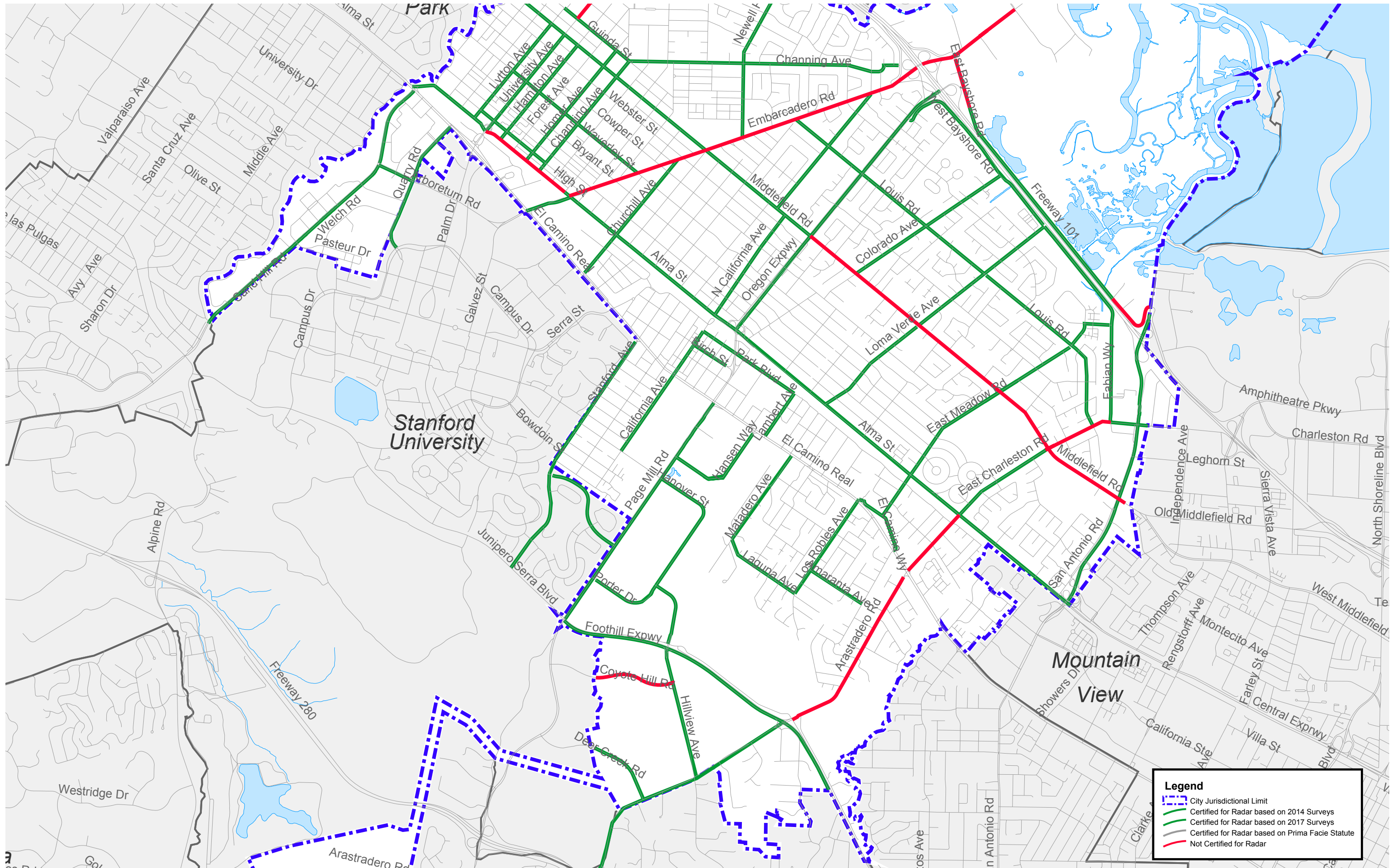


Roadway	Approach	Peak Hour	Average Stop Delay (min:sec)	Average Travel Time (min:sec)	Average Number of Stops	Average Speed (mph)
San Antonio Rd 101 to Alma Overcrossing	Northbound	A.M.	2:14	6:12	3	18
		P.M.	3:57	6:57	4	16
	Southbound	A.M.	2:01	5:56	3	20
		P.M.	3:13	7:05	4	17
Middlefield Rd MP City Limit to Oregon Expressway	Eastbound	A.M.	3:13	7:52	5	16
		P.M.	7:36	12:45	8	10
	Westbound	A.M.	3:53	8:27	5	15
		P.M.	4:23	9:23	7	13
Embarcadero Rd El Camino to 101	Eastbound	A.M.	2:53	7:36	5	19
		P.M.	10:41	16:34	9	9
	Westbound	A.M.	4:43	9:48	6	16
		P.M.	4:27	9:51	6	15



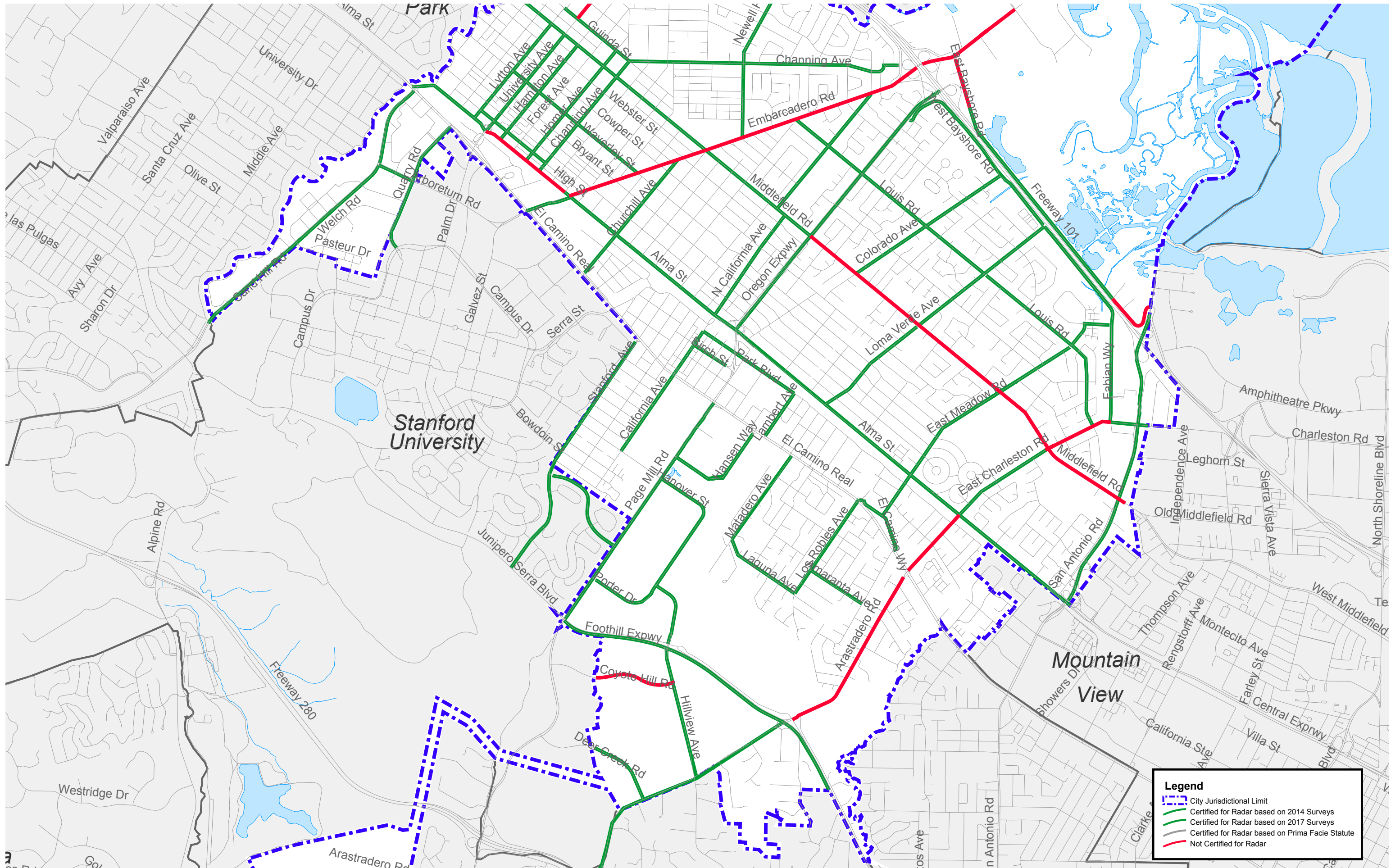
## 4.4 ENGINEERING & TRAFFIC SPEED SURVEYS

Staff completed Engineering and Traffic Speed Surveys in 2017 for all Arterials, Residential Arterials and Collector Streets, a total of 70 street segments. 2017 surveys validated the Posted Speed Limits for 58 street segments and previous 2014 surveys validated Posted Speed Limits for 15 street segments. Thus, a total of 73 street segments in Palo Alto are currently certified for use of radar for speed enforcement.



Stanford University

Mountain View

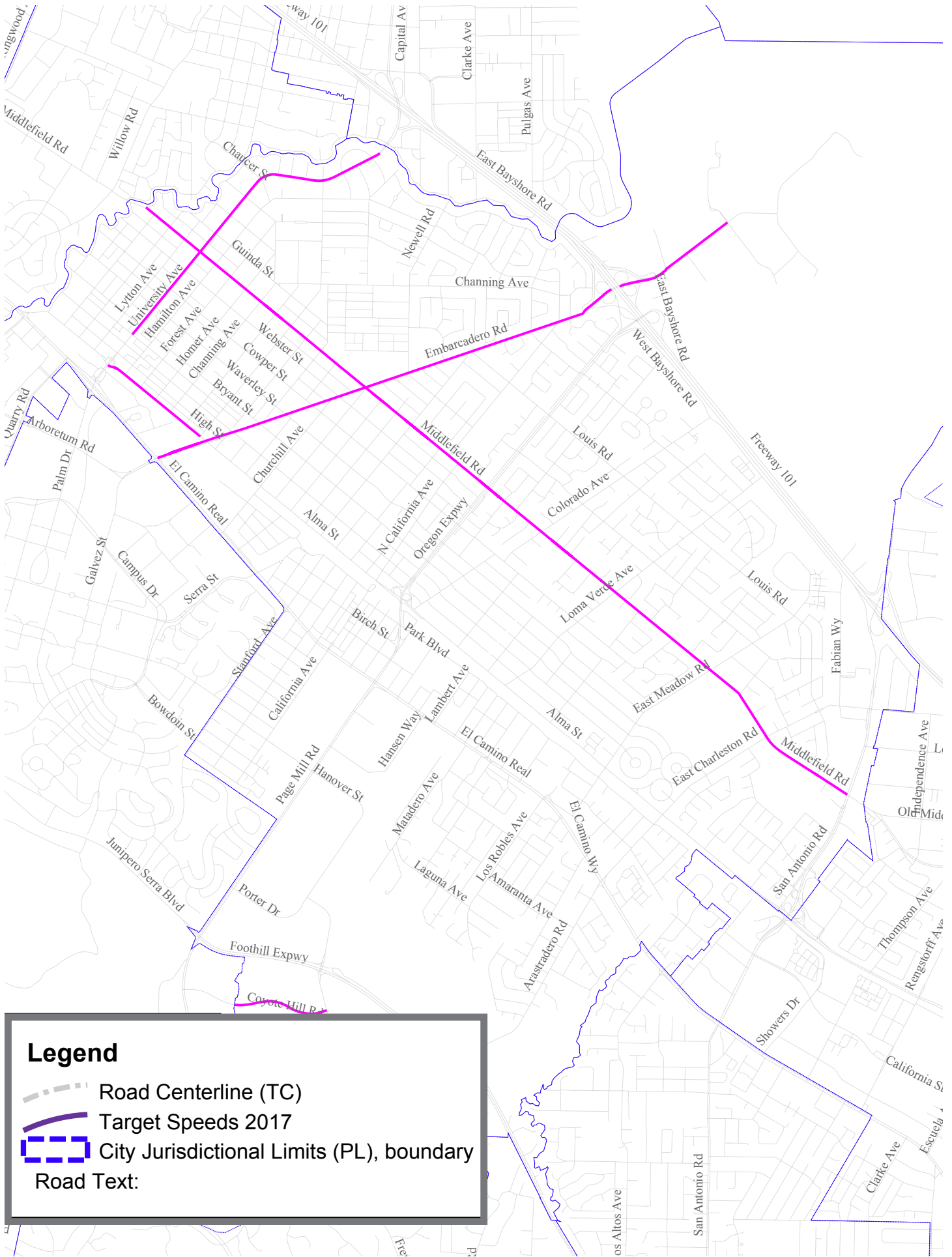




## 4.5 TARGET SPEEDS

On November 7, 2017 City Council adopted a resolution establishing Target Speeds for some roadway segments where the Engineering and Traffic Speed Surveys indicated that the current posted speed limit cannot be enforced by radar. These segments include portions of Alma Street, Coyote Hill Road, Embarcadero Road, Middlefield Road, and University Avenue. Staff intends to use the Target Speed to implement roadway design elements aimed at reducing the Operating Speed, potentially enabling radar enforcement in the future.

Such designs are already underway as part of the Charleston-Arastradero Corridor Project, which is scheduled to begin construction in 2018. In 2016, minor low-cost signing and striping changes were introduced along Middlefield Road between Lowell Avenue and Oregon Expressway. These roadway features, designed at 25 miles per hour, reduced the Operating Speed by two to four miles per hour, depending on the segment. Prior to the implementation of these changes, the Operating Speed exceeded the Posted Speed Limit by four to 11 miles per hour, depending on the segment.





## 4.6 HIGH INCIDENCE INTERSECTIONS

Based on the Statewide Integrated Traffic Records System (SWITRS), a high incidence intersection report was generated for Palo Alto over a period of five years from January 1, 2012 to December 31, 2016. It is a standard practice to analyze collision data from most recent complete five years in order to identify trends.

Table shows the highest number of reported collisions at intersections and collision rate which is expressed in collisions per million vehicles entering the intersection.



**COLLISION DATA/RATE JANUARY 2012 THROUGH DECEMBER 2016 (5 YEARS)**

Rank	Intersection	Total Number of Collisions	Collision Rate
1	Middlefield Rd at Forest Ave	9	Data unavailable
2	El Camino Real at Page Mill Rd	8	0.06
3	Middlefield Rd at Channing Ave*	6	0.26
4	El Camino Real at Arastradero Rd*	6	0.06
5	Middlefield Rd at Montrose Ave*	6	0.17
6	Middlefield Rd at University Ave	6	0.11
7	Alma St at Charleston Rd*	5	0.07
8	El Camino Real at Quarry Rd*	5	0.07
9	El Camino Real at Embarcadero Rd	5	0.05
10	Embarcadero Rd at Cowper St	5	0.10
10	University Ave at High St*	5	0.11
10	Middlefield Rd at Everett Ave*	5	0.14
10	Middlefield Rd at Hawthorne Ave*	5	0.13
10	Palo Alto Ave at El Camino Real	5	0.05

\* Project programmed/completed in 2017-2018



## 4.7 AUTOMATED TRAFFIC SIGNAL PERFORMANCE MEASURES

A relatively new form of intelligent transportation systems (ITS) is to monitor, evaluate, and modify intersection signal timing parameters using a very detailed data collection and evaluation of detailed metrics referred to as automated traffic signal performance measures (ATSPM).

ATSPMs consist of a high-resolution data-logging capability added to existing traffic signal infrastructure and data analysis techniques to provide signal timing recommendations based on actual performance versus the traditional method of using traffic simulation models.

As part of the City-wide signal system upgrade project in 2015, the City's ATMS central management system, network communications, and server system was also made compatible and ready to incorporate ATSPM programs.

Staff is in the process of implementing various ATSPM platforms which are directly compatible with City's existing traffic signal system and hardware; and will be comparing the platforms to determine the most appropriate as a City standard.

